# Appendix B: Mitigation Strategies

The following items illustrate many of the broad mitigation strategies that communities, tribes, counties, and other entities can implement to help protect lives, property and the environment in their jurisdictions. The following grid lists the six basic mitigation categories outlined by FEMA (introduced in Chapter 2), the strategies that fall in those categories, and the hazards those strategies may be effective for.

Many of the strategies, while listed in one category, may have elements that include other categories as well. For example, almost all strategies have a Public Information & Education component, where homeowners and business owners are educated about possible measures they may take on their own.

**Table B–1: List of Mitigation Strategies**

| Category | Mitigation Strategy | | Hazards Impacted |
|---|---|---|---|
| **Public Information & Education** | B.1.1 | Public Information Program Strategy | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.2 | Educational Programs | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.3 | Outreach Projects | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.4 | Technical Assistance | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.5 | Map Information | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.6 | Library | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |

| Category | Mitigation Strategy | | Hazards Impacted |
|---|---|---|---|
| | B.1.7 | Websites | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.1.8 | Real Estate Disclosure | Flood, Expansive Soils |
| | B.1.9 | FireWise Communities | Wildfire |
| | B.1.10 | Business Continuity Planning & Mitigation | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| **Preventive Measures** | B.2.1 | Planning | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.2.2 | Zoning | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.2.3 | Floodplain Development Regulations | Flood, Dam Failure |
| | B.2.4 | Stormwater Management | Flood, Dam Failure |
| | B.2.5 | Building Codes | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Expansive Soil, Urban Fire, Wildfire, Earthquake |
| | B.2.6 | IBHS Fortified Home Program | Flood, Tornado, High Wind, Lightning, Hail, Urban Fire, Wildfire, Earthquake |
| | B.2.7 | Smoke Detectors | Urban Fire |
| | B.2.8 | Hurricane Fasteners | Tornado, High Wind, Earthquake |
| | B.2.9 | Mobile Home Tie-Downs | Tornado, High Wind |
| | B.2.10 | Lightning Warning Systems | Lightning |
| | B.2.11 | Power Outages from Winter Storms | Winter Storm, Lightning |
| | B.2.12 | Standby Electric Generators | Tornado, High Wind, Lightning, Winter Storm |
| | B.2.13 | Critical Facility Protection | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.2.14 | Extreme Heat Protection | Extreme Heat |
| | B.2.15 | Proper Storage & Disposal of Hazardous Materials | Hazardous Material |
| | B.2.16 | Water Conservation | Drought |
| | B.2.17 | Open Space Preservation | Flood, Drought, Dam Failure |
| **Structural Projects** | B.3.1 | Safe Rooms | Tornado, High Wind |
| | B.3.2 | School Safe Rooms | Tornado, High Wind |
| | B.3.3 | Reservoirs and Detention | Flood |

| Category | Mitigation Strategy | | Hazards Impacted |
|---|---|---|---|
| | B.3.4 | Levees & Floodwalls | Flood, Dam Failure |
| | B.3.5 | Channel Improvements | Flood, Dam Failure |
| | B.3.6 | Crossings and Roadways | Flood, Dam Failure |
| | B.3.7 | Drainage and Storm Sewer Improvements | Flood, Dam Failure |
| | B.3.8 | Drainage System Maintenance | Flood, Dam Failure |
| **Property Protection** | B.4.1 | The Community's Role | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.4.2 | Insurance | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Dam Failure, Transportation |
| | B.4.3 | Acquisition and Relocation | Flood |
| | B.4.4 | Building Elevation | Flood, Dam Failure |
| | B.4.5 | Barriers | Flood, Dam Failure |
| | B.4.6 | Retrofitting | Flood, Tornado, High Wind, Lightning, Hail, Expansive Soil, Wildfire, Earthquake |
| | B.4.7 | Impact Resistant Windows & Doors | Tornado, High Wind, Hail |
| | B.4.8 | Impact Resistant Roofing | Tornado, High Wind, Hail |
| | B.4.9 | Lightning Protection Systems | Lightning |
| | B.4.10 | Surge and Spike Protection | Lightning |
| | B.4.11 | Landscaping for Wildfire Prevention | Wildfire |
| **Emergency Services** | B.5.1 | Threat Recognition | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.2 | Warning | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.3 | 9-1-1 and 2-1-1 | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.4 | Emergency Telephone Notification Systems (ETNS) | Flood, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Hazardous Material |
| | B.5.5 | Response | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.6 | Emergency Operations Plan (EOP) | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |

| Category | Mitigation Strategy | | Hazards Impacted |
|---|---|---|---|
| | B.5.7 | Incident Command System (ICS) | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.8 | Mutual Aid / Interagency Agreements | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.9 | CERT (Community Emergency Response Teams) | Flood, Tornado, High Wind, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.10 | Debris Management | Flood, Tornado, High Wind, Winter Storm, Wildfire, Earthquake |
| | B.5.11 | Critical Facilities Protection | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.12 | Site Emergency Plans | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.13 | Post-Disaster Recovery & Mitigation | Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation |
| | B.5.14 | StormReady Communities | Flood, Tornado, High Wind, Hail, Winter Storm |
| **Natural Resource Protection** | B.6.1 | Wetland Protection | Flood, Wildfire |
| | B.6.2 | Erosion and Sedimentation Control | Flood, Wildfire |
| | B.6.3 | River Restoration | Flood, Wildfire, Hazardous Material |
| | B.6.4 | Best Management Practices | Flood, Hazardous Material |
| | B.6.5 | Dumping Regulations | Flood, Tornado, High Winds, Winter Storm, Hazardous Material |

# B.1 Public Information and Education

A successful public information and education program involves both the public and private sectors. Public information and education activities advise and educate residents, property owners, renters, businesses, and local officials about hazards and ways to protect people and property from them. Public information activities are among the least expensive mitigation measures, and at the same time are often the most effective thing a community can do to save lives and property. All mitigation activities – preventive, structural, property protection, emergency services, and natural resource protection – begin with public information and education.

## B.1.1 Public Information Program Strategy

*Getting Your Message Out*

Professional advertising agencies may be willing to help get the message out regarding disaster preparedness and mitigation at little or no cost. They have a vested interest in their community and want to keep it safe. The same holds true for the media. The local newspaper, radio or television will contribute to keeping a safe and prepared community. Invite them to, and let them participate in special events, meetings, practice exercises, etc.

Education alliance partners, such as restaurants, convenience stores or the library, can put preparedness tips on tray liners or sacks, distribute brochures or allow you to erect a display with disaster information of local interest.

Many other options are available such as including brochures with utility bills, presentations at local gatherings, billboards, direct mailing and websites. See an example of a sample Flood Safety flyer at the end of this section, Figure B-1.

**Summer camps, and other educational programs for children, can teach a new generation about nature, natural hazards, and preservation.**

*General*

Numerous publications on tornadoes, thunderstorms, lightning, winter storms and flooding are available through NOAA. Up to 300 copies of most publications can be ordered from your local National Weather Service, NOAA Outreach Unit or American Red Cross. Many of the brochures can be downloaded from www.nws.noaa.gov/om/brochures.shtml.

For a nominal fee the American Red Cross offers videos on general preparedness, winter storms, chemical emergencies, hurricanes and earthquakes.

The National Weather Service issues watches and warnings for tornadoes, severe thunderstorms, floods, winter storms and extreme heat that may include "Call to Action" statements. The messages appear on the NWS telephone line, the local weather service office website and on television stations carrying Emergency Alert System messages.

Communities can encourage residents to prepare themselves by stocking up with necessary items and planning for how family members should respond if any of a number of possible emergency or disaster events strike.

***Hazard Brochures***

Area agencies or the American Red Cross have available the book *Repairing Your Flooded Home* and fliers *Are You Ready for a Flood?* and *Avoiding Flood Damage.* For a summary of what to do after a tornado see www.redcross.org/services/disaster/0,1082,0_502_,00.html. The brochure *Taking Shelter From the Storm: Building a Safe Room for your Home or Small Business* is available from FEMA. A copy of the brochure can be requested from the FEMA website www.fema.gov/library/viewRecord.do?id=1536. *Are You Ready for a Tornado?* is available from the American Red Cross, FEMA and the National Oceanic and Atmospheric Administration. Area agencies or the American Red Cross have available the fliers *Are You Ready For a Heat Wave? Are You Ready For a Winter Storm?* and *Are You Ready For a Thunderstorm?*

After reviewing possible and locally implemented public information activities covered in the previous sections, a community may develop a strategy based on the Community Rating System format, including the following components:

a. The local hazards, discussed in Chapter 4 of this plan

b. The safety and property protection measures appropriate for the hazards, discussed in Chapter 5 and this Appendix.

c. Hazard-related public information activities currently being implemented in the community or Tribe, including those by non-government agencies (discussed in Chapter 2)

d. Goals and Objectives for the community's public information program (covered in Chapter 5)

e. Outreach projects that will reach the goals (see Chapter 6, Action Items and Table 6-2.)

f. A process for monitoring and evaluating the projects (see Chapter 7)

## B.1.2 Educational Programs

A community's most important natural resource is its children. They will inherit the resources, infrastructure and development built by earlier generations at great cost and effort. They will also face the same natural forces that bring floods, tornadoes, storms and other hazards.

Environmental education programs can teach children about natural hazards, the forces that cause them, and the importance of protecting people, property and nature, such as watersheds and floodplains. Educational programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps. An activity can be complex enough as to require course curriculum development, or as simple as an explanatory sign near a river.

Educational programs designed for children often reach adults as well. Parents often learn innovative concepts or new ideas from their children. If a child comes home from school with an assignment in natural hazard safety, the parents will normally become interested in finding out about it as well.

There are many programs that provide information and curriculum materials on nature and natural hazards. On FEMA website www.fema.gov/kids/ children can learn about having a family disaster plan, what they might feel in and following a disaster, what the different disasters are, what to do during a disaster, take quizzes and play games. There is also information on how to get a free video, brochures and other fun stuff.

Another site, for students and educators on water resources, is the USGS "Water Science for Schools" http://ga.usgs.gov/edu/. The American Red Cross has a 24-page *Disaster Preparedness Coloring Book* for kids age 3-10. The coloring book is available online and can be printed from www.redcross.org/pubs/dspubs/genprep.html.

Youth programs and activities often include posters, coloring books, games, and references. Hands-on models that allow students to see the effects of different land use practices are also available through local natural resources conservation districts.

### B.1.3 Outreach Projects

Mapping and library activities are of little use if no one knows they exist. An outreach project can remedy this. Sending notices to property owners can help introduce the idea of property protection and identify sources of assistance.

Outreach projects are the first step in the process of orienting property owners to property protection and assisting them in designing and implementing a project. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

The most effective types of outreach projects are mailed or otherwise distributed to flood-prone property owners or to everyone in the community. Other approaches may include the following:

- articles and special sections in newspapers;
- radio and TV news releases and interview shows;
- hazard protection video for cable TV programs or to loan to organizations;
- presentations at meetings of neighborhood, civic or business/professional groups;
- displays in public buildings or shopping malls;

- open houses about floodproofing.

Research has proven that outreach projects work. However, awareness of the hazard is not enough. People need to be told what they can do about the hazard, so projects should include information on safety, health, and property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns.

## B.1.4 Technical Assistance

While general information helps, most property owners do not feel ready to take major steps, like retrofitting their buildings, without help or guidance. Check with your local community government, Tribal resource or Chamber of Commerce to see what expert guidance, such as a Home Builders Association or Remodelers Council, may be available in your area. Experienced construction specialists can provide advice, not necessarily to design a protection measure, but to steer the owner onto the right track.

Local building, public works, or engineering staff members may be available to visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an important resource for owners who are unsure of the project or the contractor.

Other new construction or retrofitting guidance and resources, such as the National Storm Shelter Association or the Institute for Business and Home Safety's *Fortified...for Safer Living* program, are available on the websites listed in Table B-2.

## B.1.5 Map Information

Many benefits stem from providing map information to inquirers. Residents and businesses that are aware of the potential hazards can take steps to avoid problems and reduce their exposure to flooding, dam failure or releases, expansive soils, hazardous materials events, and other hazards that have a geographical distribution. Real estate agents and house hunters can find out if a property is flood-prone and whether flood insurance may be required.

Maps provide a wealth of information about past and potential hazards. Geographic Information Systems, sometimes called smart maps, provide efficiency and add to capabilities of many government services. Assessors, public works, parks and recreation, and 911 services are all typical departments capable of applying GIS applications to improve their services. GIS allows trained users to complete comprehensive queries, extract statistical information, and completely manage all relevant spatial information and the associated attribute information that pertain to those departments.

### *Flood maps*

Several legal requirements are tied to FEMA's Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study Maps. These include building regulations and the mandatory purchase of flood insurance. FEMA provides floodplain and FIRM information as a mitigation service. Local government can help residents submit requests for map amendments and revisions when these are needed to show that a building is outside the mapped floodplain.

Although FEMA maps are accurate, users and inquirers must remember that maps are not perfect. They display only the larger flood-prone areas that have been studied. In some areas, watershed developments make even recent maps outdated. Those inquiring about flood maps must be reminded that being outside the mapped floodplain is no guarantee that a property will never flood. In fact, many properties that flood are not located in a designated floodplain.

By taking the initiative locally to accurately map problem areas with information not already on FEMA maps, a community can warn residents about potential risks that may not have been anticipated. Upgrading maps provides a truer measure of risks to a community.

*Other Hazard Data*

Other data that can be shown on maps include those hazards that are distributed geographically. These include:

- dam breach inundation areas;
- levee failure inundation areas;
- expansive soils;
- wildfire risk zones;
- earthquake risk zones;
- hazardous materials sites;
- wetlands.

General location maps for many of these natural and man-made hazards have been developed by U. S. Army Corps of Engineers, Association of South Central Governments (ASCOG), Oklahoma Geological Survey, and Flanagan & Associates, LLC, several of which are included in this Multi-Hazard Disaster Mitigation Plan study.

Flood zone determinations are usually available, possibly free of charge, to any resident through a local Floodplain Administrator or other local government office. If the determination is for a building permit, local ordinances must be followed.

## B.1.6 Library

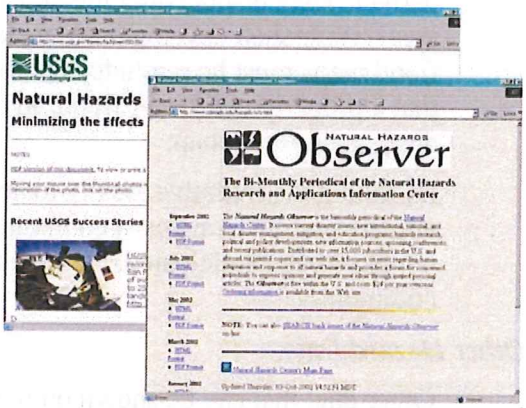
The local Public Library is a place for residents to seek information on hazards, hazard protection, and protecting natural resources. Historically, libraries have been the first place people turn to when they want to research a topic. Interested property owners can read or check out handbooks or other publications that cover their situation. The libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government.

The local public library System may maintain flood related documents, available to library patrons, required under the NFIP and CRS.

## B.1.7 Websites

Today, Websites are becoming more popular as research tools. They provide quick access to a wealth of public and private sites and sources of information. Through links to other Websites, there is almost no limit to the amount of up to date information that can be accessed by the user.

Most communities, counties or Tribes have a local website where safety information can be made available to local residents. FEMA's Mapping Website is at http://msc.fema.gov. Additional websites related to specific hazards are listed in the following table.




**Websites have become one of the more popular research tools**

**Table B–2: Disaster Safety and Mitigation Websites**

| *Agency* | *Web Address* |
|---|---|
| | ***General*** |
| American Red Cross | www.redcross.org/services/prepare/0,1082,0_239_,00.html |
| Federal Alliance for Safe Homes (FLASH) | www.flash.org |
| Federal Emergency Management Agency | www.fema.gov |
| Oklahoma Dept. of Emergency Management | www.odcem.state.ok.us |
| Institute for Business and Home Safety (IBHS) | www.ibhs.org/ |
| National Clearinghouse for Educational Facilities | www.edfacilities.org |
| USGS - Hazards Page | www.usgs.gov/themes/hazard.html |
| | ***Floods*** |
| CDC – Floods | http://emergency.cdc.gov/disasters/floods/ |
| FLASH – Floods | www.flash.org/activity.cfm?currentPeril=2 |
| Oklahoma Water Resources Board | www.owrb.state.ok.us/ |
| Oklahoma Floodplain Managers Association | www.okflood.org/ |
| U.S. Army Corps of Engineers | www.usace.army.mil/ |
| National Flood Insurance Program | www.fema.gov/nfip/whonfip.shtm |
| Stormwater Manager's Resource Center | www.stormwatercenter.net/ |
| USGS – Floods | www.usgs.gov/hazards/ |
| | ***High Winds / Tornadoes*** |
| CDC – Tornadoes | http://emergency.cdc.gov/disasters/tornadoes/ |
| FLASH – Tornadoes | www.flash.org/activity.cfm?currentPeril=3 |
| National Climatic Data Center | www.ncdc.noaa.gov/oa/ncdc.html |
| The Tornado Project Online | www.tornadoproject.com/ |
| | ***Lightning*** |
| FLASH – Lightning | www.flash.org/activity.cfm?currentPeril=4 |
| National Lightning Safety Institute | www.lightningsafety.com/nlsi_lls.html |
| | ***Hailstorms*** |
| FLASH – Hail | www.flash.org/activity.cfm?currentPeril=5 |
| | ***Winter Storms*** |

| Agency | Web Address |
|---|---|
| American Red Cross – Power Outage | www.redcross.org/services/prepare/0,1082 |
| American Red Cross – Winter Storms | www.redcross.org/services/prepare/0,1082,0_252_,00.html |
| CDC – Winter Weather | http://emergency.cdc.gov/disasters/winter/ |
| FLASH – Power Outages | www.flash.org/activity.cfm?currentPeril=13 |
| FLASH – Winter Storms | www.flash.org/activity.cfm?currentPeril=15 |
| ***Extreme Heat*** | |
| American Red Cross – Heatwaves | www.redcross.org/services/prepare/0,1082,0_243_,00.html |
| Centers for Disease Control & Prevention (CDC) | http://emergency.cdc.gov/disasters/extremeheat/ |
| National Weather Service – Heat Index | www.hpc.ncep.noaa.gov/heat_index.shtml |
| ***Drought*** | |
| American Red Cross – Drought | www.redcross.org/services/prepare/0,1082,0_95_,00.html |
| OWRB - Drought Monitoring Page | www.owrb.state.ok.us/supply/drought/drought_index.php |
| ***Expansive Soils*** | |
| US Department of Agriculture | www.usda.gov/ |
| Natural Resource Conservation Service | www.nrcs.usda.gov/ |
| ***Urban Fires*** | |
| Oklahoma State Fire Marshal's Office | www.oklaosf.state.ok.us/~firemar/ |
| National Fire protection Association | www.nfpa.org |
| ***Wildfires*** | |
| CDC – Wildfires | http://www.bt.cdc.gov/disasters/wildfires/ |
| FireWise Communities | www.firewise.org |
| FLASH – Wildfire | www.flash.org/activity.cfm?currentPeril=8 |
| USGS Wildfires | www.usgs.gov/themes/wildfire.html |
| ***Earthquakes*** | |
| CDC – Earthquakes | http://emergency.cdc.gov/disasters/earthquakes/ |
| FLASH – Earthquake | www.flash.org/activity.cfm?currentPeril=7 |
| U.S. Geological Survey | www.usgs.gov/hazards/earthquakes/ |
| Oklahoma Geological Survey | www.okgeosurvey1.gov/home.html |
| National Geophysical Data Center | www.ngdc.noaa.gov/ |
| ***Hazardous Materials Events*** | |
| National Response Center | www.nrc.uscg.mil |
| National Transportation Safety Board | www.ntsb.gov/ |
| Oklahoma Department of Environmental Quality | www.deq.state.ok.us/ |
| Environmental Protection Agency | www.epa.gov |
| ***Dam Failures*** | |
| Oklahoma Water Resources Board | www.owrb.state.ok.us/ |
| US Army Corps of Engineers | www.usace.army.mil/ |
| Grand River Dam Authority | www.grda.com/ |

## B.1.8 Real Estate Disclosure

After a flood or other natural disaster, people often say they would have taken steps to protect themselves if they had known their property was exposed to a hazard.

Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only ten days before closing, applicants are often already committed to purchasing a property when they first learn of the flood hazard.

**Flooding and other hazards are sometimes not disclosed until it is too late. Hazard maps can help homebuyers avoid surprises like this.**

The "Residential Property Condition Disclosure Act" requires sellers to provide potential buyers with a completed, signed and dated "Residential Property Condition Disclosure Statement". Included in the statement are disclosures regarding flooding and flood insurance. For a copy of the "Residential Property Condition Disclosure Statement" see www.orec.state.ok.us/pdf/disclose3.pdf.

## B.1.9 Firewise Communities

While incorporating components from several of the different mitigation strategies, The Firewise program primarily depends on homeowners taking actions to protect their own property. Therefore Public Education and Information is a key factor to its success. While it is not possible, or in many cases even desirable, to prevent wildfires, it is certainly possible, by interrupting the natural flow of the fire, to assure that wildfires will not produce catastrophic home or crop losses. In the words of Judith Cook, Project Manager for Firewise Communities/USA, "We can modify our home ignition zones. We're basically saying to the fire, 'there's nothing for you here!'"

Firewise Community USA is a project of the National Wildfire Coordinating Group. It recognizes communities that have gone through a process to reduce the dangers of wildfires along what is referred to as the Wildland-Urban Interface (WUI). Additional information on the Firewise Community program can be found at www.firewise.org/usa.

In order to become a Firewise Community, a community will:

1. Contact a Firewise Specialist. In Oklahoma, the Firewise Specialist may be reached through the Oklahoma Department of Agriculture, Forestry Services, at (405) 521-3864. The Specialist will coordinate with local fire officials to schedule a site visit and assess the community.

2. The community will create a Firewise Board that includes homeowners, fire professionals, and other stakeholders.
3. The Firewise Specialist will schedule a meeting with the Board to present the assessment report for review and acceptance.
4. The Board will use the report to create agreed-upon, area-specific solutions to the fire issues, which the Specialist will review and, if acceptable, will work with the community to seek project implementation funds, if necessary.

**A home in the WUI surrounded by a "defensible" zone that helped protect it from damage during a wildfire outbreak.**

5. Local solutions will be implemented following a schedule designed by the local Board and the Specialist, A permanent Firewise task force or committee is created that will maintain the program into the future.
6. A completed plan and registration form will be submitted to Firewise Communities/USA for formal recognition of the Community.
7. An important consideration to remember is that if a community or Tribe covers a larger jurisdiction, it may be appropriate to identify smaller areas, such as a homeowner's addition, that can be developed independently of the community at large. The smaller project can then serve as a model program for other homeowner's associations or planning groups to develop programs in their at-risk area.

## B.1.10 Business Continuity Planning and Mitigation

While Business Continuity Planning (BCP) can include portions from many of the categories listed in this chapter, an integrated program for small and medium businesses and non-profits is a frequently neglected component in a community's mitigation strategy. It has been demonstrated repeatedly that many businesses and non-profits that close their doors following a disaster either fail to re-open, or struggle to remain open following the event. This is especially true of smaller businesses that may rely on a limited number of locations and a


**Insurance is a start, but won't cover the cost of lost sales, lost jobs and lost customers if a business is affected.**

narrow customer base, or may not have the economic reserves to recover from financial losses. The lack of ability to recover may be for several reasons:

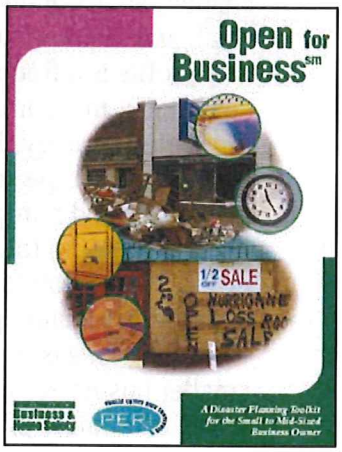
- absenteeism from employees who are affected or who have affected family members;
- psychological trauma from losing co-workers;
- loss of an irreplaceable executive or manager;
- economic stress on the business from having to make repairs and replenish stock over and above what may be covered by insurance;
- loss of revenue from having the doors closed for even a short period of time;
- loss of the customer base, either from people who are forced to evacuate the area or who may not have immediate disposable income for the company's products;
- loss of a critical customer or the vendor of a critical inventory item ("upstream" and "downstream" issues);
- loss of critical data, either paper or electronic records;
- an interruption in community or Tribal infrastructure (utilities, road access, media losses, etc.).

In addition, the loss of a business, even for a short period of time, may adversely affect the community or Tribe in many ways, some of which may include:

- loss of tax revenue for community services;
- loss of jobs for community residents;
- loss of access to the company's products (especially significant if the company supplies an essential service or product, such as construction equipment, medications, transportation, or groceries);

Effective Business Continuity Planning (BCP) may include such activities as:

- making regular back-ups of critical data and keeping it in an off-site location;
- maintaining accurate contact information (phone, e-mail, pager, etc.) on critical employees;
- identifying potential off-site locations that can be used in case the primary location of the company is damaged or inaccessible;
- reviewing all activities of a company and identifying which activities are critical and must resume right away, which are less critical and may not need to resume for a short period of time, and which activities can be put on hold for a longer period of time;
- developing "canned" PR pieces that can be quickly disseminated in the event of an incident at the company;
- having an honest conversation with insurers to determine that policies are sufficiently inclusive and appropriate for the business;
- communicating with suppliers and critical customers on



what their emergency response and business resumption plans include.

Business continuity planning can be facilitated by the community in a number of ways, primarily in the area of Public Information.

- The Chamber of Commerce may sponsor programs such as the Institute for Business & Home Safety's (IBHS) *Open For Business* presentation. For more information, see www.ibhs.org/business_protection.
- The American Red Cross has also teamed with the Federal Emergency Management Agency to produce the *Emergency Management Guide for Business and Industry.* More information is available at www.redcross.org/services/disaster/0,1082,0_606_,00.html.

Several professional groups such as the Association of Contingency Planners (www.acp-international.com/okla/) or ARMA, a professional organization of Records & Information Management professionals (www.arma.org) may be available in your area to assist with developing disaster preparedness and mitigation plans or exploring ways to safeguard critical records and information.

In addition, if a community, Tribe or other entity (such as a University) is promoting Community Emergency Response Teams (CERT), business CERTs can be developed to respond to a disaster, not only within a neighborhood, but also within a business establishment. CERTs are trained in disaster organization, immediate disaster evaluation, immediate disaster first aid, light search and rescue, and light fire suppression. For more information on CERT, see www.citizencorps.gov/cert.

## B.1.11 Conclusions

1. There are many ways public information programs can be used so people and businesses will be more aware of hazards they face and how they can protect themselves.
2. Most public information activities can be used to advise people about all hazards, not just floods.
3. Other public information activities require coordination with other organizations, such as schools and real estate agents.
4. There are several area organizations that can provide support for public information and educational programs.
5. Developing effective strategies for small businesses and non-profits is as critical as for other elements of the communities.

## B.1.12 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

**Figure B–1: A Sample Public Service Notice for Flooding**

## Flood Safety

- Do not walk through flowing water. Drowning is the number one cause of flood deaths. Currents can be deceptive; six inches of moving water can knock you off your feet. Use a pole or stick to ensure that the ground is still there before you go through an area where the water is not flowing.
- Do not drive through a flooded area. More people drown in their cars than anywhere else. Don't drive around road barriers; the road or bridge may be washed out.
- Stay away from power lines and electrical wires. The number two flood killer after drowning is electrocution. Electrical current can travel through water. Immediately report downed power lines to your local fire department.
- Look out for animals that have been flooded out of their homes and who may seek shelter in yours. Use a pole or stick to poke and turn things over and scare away small animals.
- Look before you step. After a flood, the ground and floors are covered with debris including broken bottles and nails. Floors and stairs that have been covered with mud can be very slippery.
- Be alert for gas leaks. Use a flashlight to inspect for damage. Don't smoke or use candles, lanterns, or an open flame unless you know the gas has been turned off and the area has been ventilated.
- Carbon monoxide exhaust kills. Use a generator or other gasoline-powered machine outdoors. The same goes for camping stoves. Charcoal fumes are especially deadly -- cook with charcoal outdoors.
- Clean everything that got wet. Floodwaters have picked up sewage and chemicals from roads, farms, factories, and storage buildings. Spoiled food, flooded cosmetics, and medicine can be health hazards. When in doubt, throw them out.
- Take good care of yourself. Recovering from a flood is a big job. It is tough on both the body and the spirit and the effects a disaster has on you and your family may last a long time.

## B.2 Preventive Measures

Preventive activities are designed to keep matters from occurring or getting worse. Their objective is to ensure that future development does not increase damages or loss of life, and that new or remodeled construction is protected from those hazards. Preventive measures are often administered by building, zoning, planning, and code enforcement offices. They typically include planning, zoning, open space preservation, building codes, drainage criteria, a flood and drainage annex, and floodplain development regulations, and stormwater management. In addition, there are a number of other ways to make homes and commercial structures stronger and less vulnerable to the effects of disasters.

The first three measures (planning, zoning, and open space preservation) work to keep damage-prone development *out* of hazardous or sensitive areas.

The next two measures (building codes and floodplain development regulations) impose standards on what is allowed to be built *in* the floodplain. These protect buildings, roads, and other facilities from flood damage and prevent the new development from making any existing flood problem worse. Building codes are also critical to mitigating the impact of non-flood hazards on new buildings.

Stormwater management addresses the runoff of stormwater from new developments onto other properties and into floodplains.

**The mitigation planning process involves meetings with civic groups and local residents, as well as with decision-making councils and commissions**

### B.2.1 Planning

While plans generally have limited authority, they reflect what the community would like to see happen in the future. Plans guide other local measures such as capital improvements and the development of ordinances. Planning can include, but is not limited to:

- Capital Improvement Plans — Infrastructure planning decisions can affect flood hazard mitigation. For example, decisions to extend roads or utilities to an area may increase exposure. Communities may consider structural flood protections such as levees or floodwalls.
- Flood & Drainage Annex to the Hazard Mitigation Plan — A flood & drainage annex to the hazard mitigation plan (FDAHMP) addresses the current and future drainage needs of a given community. The boundary of the plan usually follows regional watershed limits. The proposed facilities may include channels, storm drains, levees, basins, dams, wetlands or any other conveyance capable of economically relieving flooding

problems within the plan area. The plan includes an estimate of facility capacity, sizes and costs.

FDAHMP's are prepared for a variety of purposes. First, the plans provide a guide for the orderly development of the community. Second, they provide an estimate of costs to resolve flooding issues within a community. Community or Tribal officials will use FDAHMP's to determine Capital expenditures for each budget year. Finally, the plans can be used to establish Area Drainage Plan fees for a given community, which prevent existing taxpayers from having to shoulder the burden of land development costs.

- Emergency Back-up Generator Hazard Mitigation Plan Annex

During power outages, public and private critical facilities are frequently unable to perform functions necessary for effective response and recovery. Social Service agencies cannot serve their clients, police/fire/EMS cannot refuel or replenish supplies, communications systems fail, financial and economic systems break down, and childcare and long term care facilities cannot care for their residents. Emergency management is not able to supply generators to all critical facilities in a timely manner.

With that in mind, just as a community needs to develop a plan before implementing floodplain improvements, a community-wide Emergency Back-up Generator Hazard Mitigation Plan Annex (EBGHMP) needs to be developed before spending time and money purchasing expensive equipment. This will ensure that the community has effectively determined needs and priorities and has a clear vision of what steps produce the most effective generator use for dollars spent.

A comprehensive community EBGHMP might include the following:

1. Inventory all critical facilities
2. Determine critical functions and the timeline
3. Determine generator size and whether a permanent vs. "generator-ready" installation is appropriate.
4. Determine the appropriate type of fuel for each location.
5. Develop a budget and operational timeline.
6. Provide for continual maintenance and ongoing testing.

- Zoning Ordinance Adoption or Amendments

Examples of zoning methods that affect flood hazard mitigation include:

1. adopting ordinances that limit development in the floodplain;
2. limiting the density of developments in the floodplain;
3. requiring floodplains be kept as open space.

- **Subdivision Ordinances or Amendments**

  Subdivision design standards can require elevation data collection during the platting process. Lots may be required to have buildable space above the base flood elevation.

- **Building Code Adoption or Amendments**

  Requirements for building design standards and enforcement include that:

  1. a residential structure be elevated;
  2. a non-residential structure be elevated or floodproofed.

- **Conservation Easements**

  Conservation easements may be used to protect environmentally significant portions of parcels from development. They do not restrict all use of the land. Rather, they direct development to areas of land not environmentally significant.

- **Transfer of Development Rights**

  In return for keeping floodplain areas in open space, a community may agree to allow a developer to increase densities on another parcel that is not at risk. This allows a developer to recoup losses from non-use of a floodplain site with gains from development of a non-floodplain site.

- **Purchase of Easement / Development Rights**

  Compensating an owner for partial rights, such as easement or development rights, can prevent a property from being developed contrary to a community's plan to maintain open space. This may apply to undeveloped land generally or to farmland in particular.

- **Stormwater Management Ordinances or Amendments**

  Stormwater ordinances may regulate development in upland areas in order to reduce stormwater run-off. Examples of erosion control techniques that may be employed within a watershed include proper bank stabilization with sloping or grading techniques, planting vegetation on slopes, terracing hillsides, or installing riprap boulders or geotextile fabric.

- **Multi-Jurisdiction Cooperation Within Watershed**

  Forming a regional watershed council helps bring together resources for comprehensive analysis, planning, decision-making, and cooperation.

- **Comprehensive Watershed Tax**

  A tax can be used as a mitigation action in several ways:

  1. Tax funds may be used to finance maintenance of drainage systems or to construct reservoirs.
  2. Tax assessments may discourage builders from constructing in a given area.
  3. Taxes may be used to support a regulatory system.

- **Post-Disaster Recovery Ordinance**

  A post-disaster recovery ordinance regulates repair activity, generally depending on property location. It prepares a community to respond to a disaster event in an orderly fashion by requiring homeowners to:

  1. obtain permits for repairs;
  2. refrain from making repairs;
  3. make repairs using standard methods.

  While many communities will attempt to build back rapidly just

as they were before, it is far preferable to build back stronger and more disaster resistant.

## B.2.2 Zoning

A community's zoning ordinances should regulate development by dividing the community into zones or districts and setting development criteria for each zone or district. Zoning ordinances are considered the primary tool to implement a comprehensive plan's guidelines for how land should be developed.

## B.2.3 Floodplain Development Regulations

Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for subdivision regulations and building codes. These are usually spelled out in a separate ordinance.

Experience shows that the National Flood Insurance Program's minimum standard is insufficient for developing urban communities. A community's regulations may exceed the NFIP's minimum national standards in several significant ways.

The Community Rating System (CRS) is a companion program to the NFIP. It rewards a community for taking actions over and above minimum NFIP requirements with the goal of further reducing flood damages in the jurisdiction. The more actions a community or Tribe takes, the lower the premiums for flood insurance within that community.

Subdivision regulations govern how land will be subdivided into individual lots, and set the construction and location standards for the infrastructure the developer builds to serve those lots, including roads, sidewalks, utility lines, storm sewers, and drainageways. They provide an additional vehicle for floodplain development rules. For example, some communities require that every subdivision in a floodplain provide a building site above the flood level for every lot and/or require streets to be at or no more than one foot below the base flood elevation.

Floodplains are only part of flood-management considerations. Water gathers and drains throughout entire watersheds, from uplands to lowlands. Each watershed is an interactive element of the whole. A change at one place can cause changes elsewhere, whether planned or inadvertent. The development of a comprehensive, basin-wide Flood and Drainage Annex to the Mitigation Plan that identifies existing and potential future drainage and flooding problems to public facilities and private property can be a vital tool in disaster mitigation planning.

## *Minimum National Flood Insurance Program Regulatory Requirements*

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in the area subject to inundation by the 100-year (base) flood.

There are four major floodplain regulatory requirements. State and local law may set additional floodplain regulatory requirements.

1. All development in the 100-year floodplain must have a permit from the community. The NFIP regulations define "development" as any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.
2. Development should not be allowed in the floodway. The NFIP regulations define the floodway as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. The floodway is usually the most hazardous area of a riverine floodplain and the most sensitive to development. At a minimum, no development in the floodway may cause an obstruction to flood flows. Generally an engineering study must be performed to determine whether an obstruction will be created.
3. New buildings may be built in the floodplain, but they must be protected from damage by the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.
4. Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.

Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the state or Federal criteria. This is especially important in areas with older Flood Insurance Rate Maps that may not reflect the current hazard. Such ordinances could include prohibiting certain types of highly damage-prone uses from the floodway or requiring that structures be elevated 1 or more feet above the BFE. The NFIP's Community Rating System provides insurance premium credits to recognize the additional flood protection benefit of higher regulatory standards.

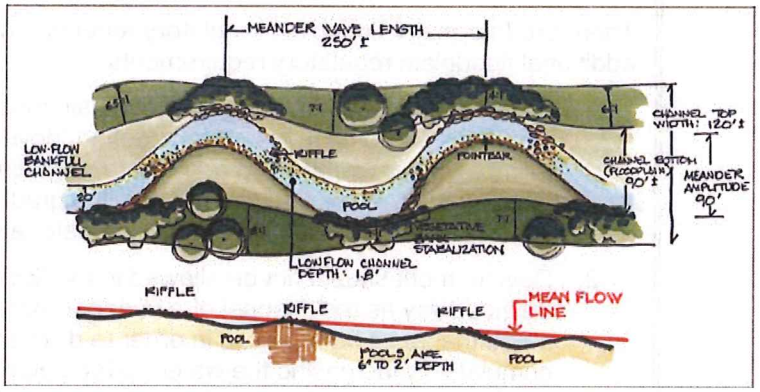
## B.2.4 Stormwater Management

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently.

As watersheds develop, runoff usually becomes deeper and faster and floods become more frequent. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

Insurance purposes require that NFIP floodplain maps must be based on existing watershed development, but unless plans and regulations are based on future watershed urbanization, development permitted today may flood tomorrow as uphill urbanization increases runoff.

This combination of increased runoff and more efficient stormwater channels leads to increases in downstream storm peaks and changes in the timing when storm peaks move downstream. Unconstrained watershed development often will overload a community's drainage system and aggravate downstream flooding.




**In addition to detention facilities, stormwater management plans can include restoring some channelized streams with meanders and native vegetation to slow runoff and prevent flash flooding.**

A second problem with stormwater is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams.

Oklahoma communities that participate in the NFIP are listed at www.fema.gov/cis/OK.pdf.

### *Retention / Detention*

Some communities with stormwater management regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a higher rate than under pre-development conditions. It is recommended that communities require a drainage plan from new developments.

The Community Rating System (CRS) uses three factors to measure the impact of stormwater management regulations on downstream flooding:

1. What developments have to account for their runoff? If only larger subdivisions have to detain the increased runoff, the cumulative effect of many small projects can still produce greater flows to downstream properties.
2. How much water is managed? Historically, local stormwater management programs address smaller storms, such as the 2- or 10-year storms. The CRS reflects the growing realization nationally that the runoff from larger storms must be managed. It provides full credit only for programs that address all storms up to the 100-year storm.
3. Who is responsible to ensure that the facility works over time? Roads and sewers are located on dedicated public rights-of-way and the community assumes the job of maintaining them in the future. Stormwater management detention basins have traditionally stayed on private property and maintenance has been left up to the owner. Often homeowners associations do not know how and do not have the capability to properly maintain these facilities. The community receives up to 110 points if the community assumes responsibility to ensure that the facilities are maintained.

**Stormwater Detention Ponds manage the increased runoff from new developments, temporarily store flood waters, and can be used for community parks, recreation, and open-space.**

### *Watershed Approaches*

The standard regulatory approach of requiring each development to manage stormwater to the same criteria has several shortcomings:

1. It does not account for differences in stream and watershed conditions (although the standards can be revised to reflect findings from watershed studies).
2. Municipalities within the same watershed may require different levels of control of stormwater.
3. There is no review of the downstream impacts from runoff or any determination of whether the usual standards compound existing flooding problems.
4. It results in many small basins on private property that may or may not be properly maintained.

The way to correct these deficiencies is to conduct a master study of the watershed to determine the appropriate standards for different areas and, sometimes, to identify where

a larger central basin would be more effective and efficient than many smaller ones. The CRS program provides up to 225 points if communities adopt such master plans.

### B.2.5 Building Codes

Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. These standards should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Building codes are also a prime mitigation measure for other natural hazards, especially earthquakes, tornadoes, windstorms and heat and cold. When properly designed and constructed according to code, the average building can withstand the impacts of most of these forces. The code could include provisions such as:

- requiring sprinkler systems for fire protection in larger or public buildings;
- regulating overhanging masonry elements that can fall during an earthquake;
- ensuring that foundations are strong enough for earth movement and that all structural elements are properly connected to the foundation;
- making sure roofing systems will handle high winds and expected snow loads.

Ideally, current codes should include elements from the most recent International Building Codes (IBC), which includes the International Residential Code, the Plumbing Code, Mechanical Code, Fire Code, and Residential and Fuel Gas Codes. For additional information on International Building Codes, see www.iccsafe.org.

### B.2.6 IBHS Fortified Home Program

**What is a Fortified Home**

The *Fortified...for Safer Living* home program gives builders and homeowners a set of criteria for upgrades that help reduce the risk of damage from natural disasters. The program raises a homes' overall safety above building code minimum requirements. During construction and upon completion a home is inspected and certified as a "Fortified...for Safer Living" home.

The combination of materials and techniques produces residences equipped to better resist hurricanes, tornadoes, fire and floods. The fortified home construction method produces homes that are comfortable while being resistant to natural disasters.

The following are features of a "Fortified...for Safer Living" home:

- The home and critical utilities are elevated by reinforced continuous piles a minimum of two feet above ground-level walls, stairs and Base Flood Elevation (BFE).
- The home is connected from the peak of the roof to the foot of the reinforced piles to form a continuous load path capable of withstanding 130 mph winds.
- Windows, doors and other openings are properly flashed and protected to withstand the impact of windborne debris without penetration of wind and water.

- The roof truss system has a 110 mph wind rated covering, a secondary moisture barrier, twice the required underlayment, thicker plywood deck sheathing and a stronger holding nail and nailing pattern.
- Other features include non-combustible roof materials, reinforced entry garage doors and landscaping techniques reducing wildfire and flooding vulnerability.
- A certified inspector verifies all required Fortified home products and materials are installed correctly in accordance with manufacturer's specifications for "Fortified…for Safer Living" program specifications.
- The home and property are also verified to be a low risk hazard for exposure to wildfire.

More information about Fortified Home guidelines is available at www.disastersafety.org/text.asp?id=fortified.

## *Economics of a Fortified Home*

### Cost (new home)

Depending on the quality of the material the buyer chooses, the cost to add fortified features could be as low as five percent of the total cost of a new home. See the following table, from the Institute of Business and Home Safety (IBHS) for a typical upgrade.

**Table B–3: Cost Differentials for Fortified Home vs. standard Construction**

As-built base home price: $151,500 (including lot and options, before "Fortified" upgrade).

| | Standard Home | "Fortified" Home | Incremental Cost to "Fortify" |
|---|---|---|---|
| Windows and doors | 5,450* | $15,500** ($7,700) | $10,050 ($2,250) |
| Garage doors | $650 | $1,250 | $600 |
| Roof decking | $650 | $1,750 | $1,100 |
| Sealing roof joints | $0 | $650 | $650 |
| Roof covering | $2,350 | $3,350 | $1,000 |
| Concrete/steel down pours | $0 | $500 | $500 |
| Fortified inspection costs | $0 | $1,000 | $1,000 |
| | | Total increment cost: | $14,900 ($7,100) |
| | | Percentage of base cost: | 9.8% (4.7%***) |

* Based on selection of PGT® window & door products.
** Fortified with PGT® WinGuard™ impact-resistant windows & doors.
*** Cost of panel shutters instead of impact-resistant windows.

### Cost (existing home)

Many of the fortification techniques used to build new homes are too expensive as retrofits. Fortifying is much more expensive when a home is already built. However, there are creative ways to reduce costs and still fortify an existing home. Improving roof decking on an existing structure would cost about $5,000. For $50 a certain type of glue

gun available in most hardware stores can retrofit a roof as effectively as if a new roof had been put on with wood screws.

**Savings**

In Florida, a fortified home can save homeowners over 20% in insurance premiums. A standard brick, stone, or masonry house in a coastal area, with a deductible of $500 and a 2% hurricane deductible, would generate an annual premium of $2,240. In contrast, the same home with the additional fortified construction features would pay an annual premium of $1,746, a savings of $504, or 22.5%. Also, underwriting guidelines may be relaxed for fortified homes. Insurers may make exceptions for fortified homes in areas where they wouldn't normally write policies.

Lower deductibles may be available. In Florida, policies covering wind damage typically have a deductible of 2% of the covered amount. On a $150,000 home the deductible would be $3,000. Fortified homeowners may be eligible for a flat deductible of $500.

As for intangible savings, personal photographs, important family documents and computer data are just a few of the items a fortified home may protect. Additionally there is the inconvenience and cost of other living arrangements while a home is being rebuilt.

For more information about one insurer's guidelines on insuring fortified homes see www.roughnotes.com/rnmagazine/search/general_articles/01_08p52.htm.

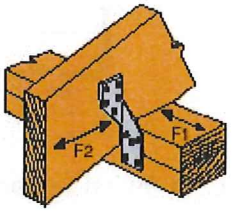
## B.2.7 Smoke Detectors

Smoke detectors save lives. Approximately two-thirds of fatal fires occur in the 10% of homes not protected with smoke detectors. You are twice as likely to die in a fire if you do not have a properly operating smoke detector.

There are two basic types of smoke detectors - photoelectric and ionization. Photoelectric smoke alarms generally are more effective at detecting slow-smoldering fires, fires that might smolder for hours before bursting into flames. Ionization smoke alarms are more effective at detecting fast-flaming fires, fires that consume materials rapidly and spread quickly.

Test smoke detectors every month, change the batteries twice per year, clean detectors at least once per year and replace smoke detectors every 10 years. For more facts about smoke detectors see www.firemar.state.ok.us/forms/lg-alarm.pdf.

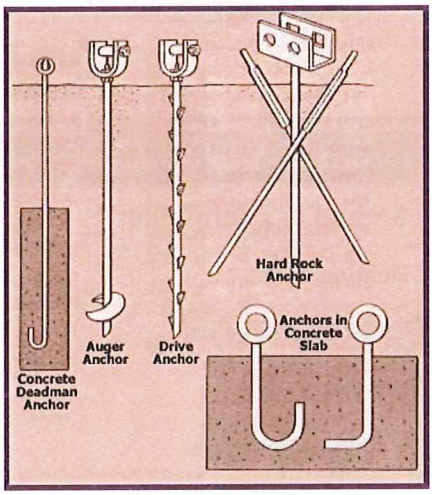
## B.2.8 Hurricane Fasteners




A home's roof system is its most vulnerable and expensive component. Hurricane roof-to-wall and additional straps are metal connectors designed to hold a roof to its walls in high winds. They make a home's roof-to-wall connection five-to-15 times stronger than traditional construction and can prevent damage in winds at least 75 mph. In many coastal communities, reinforcing connections are enforced as a code restriction for new homes. Although designed to protect roofs during the extended and violent winds of hurricanes, these fasteners have proven effective in preventing roof removal in tornado events. For more information on hurricane fasteners

and straps and protecting your roof, go to www.nhc.noaa.gov/HAW2/pdf/hurricane_retrofit.pdf.

## B.2.9 Mobile Home Tie-Downs



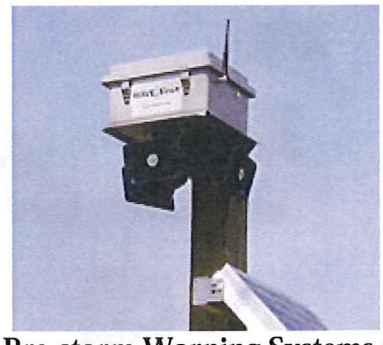

Tie-downs are devices that anchor or otherwise secure a mobile home to the ground in order to protect the mobile home and its surroundings from damage caused by wind and/or other natural forces. All tie-downs must comply with the specifications of the home manufacturer and, if applicable, with standards set by local government officials. Anchoring and tie-down systems vary greatly. It's important for a homeowner to contact the local building inspector for regulations regarding anchoring and blocking installation in each community. Regulations may vary considerably from one community to the next.

Anchors are available for different types of soil conditions, including concrete slab. Auger anchors have been designed for both hard soil and soft soil. Rock anchors or drive anchors allow attachment to a rock or coral base. This type of anchor is also pinned to the ground with crossing steel stakes.

To resist wind forces, a home may need two different types of tie-downs. In older homes, a vertical or over-the-top tie-down is needed to compensate for the uplift force. A diagonal or frame tie-down is needed to compensate for both lateral and uplift forces. Singlewide manufactured homes need both types of tie-downs. Doublewide homes only need the diagonal ties.

To be tied down safely, find out from a local manufactured home association or building inspector how many tie-downs and anchors are needed for local wind and soil conditions. The cost of installing additional tie-downs and anchors is small compared to the potential cost of wind damage to a manufactured home that was not properly tied down.

## B.2.10 Lightning Warning Systems



There are two basic types of warning systems:

**Strike Location and Identification Systems** sense the electromagnetic pulse or the electrostatic pulse that accompanies a lightning discharge. Sensors and processing equipment work from those pulses or transients. These systems are most useful for tracking storms, locating a lightning strike and producing density plots of lightning activity by geographical area. They do not provide early warning of an impending storm.

**Pre-storm Warning Systems** sense the conditions that precede a storm. All severe storms create a related electrostatic field. This field provides a reliable storm signature that is peculiar to severe storms and can be related to the severity of the storm. That signature is present prior to lightning activity and provides a measurable parameter for

pre-storm warning. The electrostatic field strength is directly related to the state of the storm and/or its proximity to the site. Therefore, an increase in the electrostatic field is an indicator of a storm moving into or building up over the area. The warning time is determined by the rate of buildup or the rate of movement of the storm.

**Table B–4: Lightning Detection Options**
**From the National Lightning Safety Institute**

| Lightning Detection Options - Accuracy vs. Cost vs. Complexity | | | |
|---|---|---|---|
| **Source of Information** | **Accuracy** | **Cost** | **Complexity** |
| Hearing thunder | Danger is near | None | Simple |
| TV weather channel | General info. | None | Simple |
| Weather radios | General info. | Up to $40 | Simple |
| Handheld detectors | 50-60% accurate | Up to $500 | Somewhat |
| Boltek system (www.boltek.com) | 70-80% accurate | Up to $1,500 | Somewhat |
| ThorGuard system (www.thorguard.com) | 85-90% | $1,000 - $6,500 | Somewhat |
| WXLine system (www.WXLine.com) | 90-95% accurate | Up to $7,000 | Somewhat |
| Subscription service | 95%+ accurate | Monthly fee | Simple |

Essential companions to any type of lightning warning system include:

- a written Lightning Safety Policy;
- designation of Primary Safety Person;
- determination of when to suspend activities;
- determination of Safe/Not Safe Shelters;
- notification to Persons at Risk;
- education – at a minimum consider posting information about lightning and the organization's safety program;
- determination of when to resume activities.

The above options can be developed with many variations, up to and including all-in-one units that include a lightning threat detector, strobe light and 360° warning horn, and fully-automated programmable computer to pre-set various options for different types of facilities, such as times of operation, degrees of sensitivity, and appropriate sounding of an "all clear" signal.

## B.2.11 Power Outages from Winter Storms

Power outages from winter storms can lead to an abundance of problems. Homeowners without power will resort to candles or open flames for heat and light. Generators are noisy, produce potentially deadly exhaust and can cause power spikes damaging equipment. Kerosene heaters burn oxygen and increase the potential of asphyxiation and production of carbon monoxide. With fuel burning equipment there is a constant danger of fire or explosion, burns and breathing poisonous exhaust. In addition, the inability to heat a home increases the risk of pipes freezing.

Power lines can be protected and power outages prevented by:

- Replacing existing power lines with heavier T-2 line, shorter spans, and heavier poles and crossbars. It is estimated this will increase the overall strength of power distribution lines by 66%.
- Burying utility lines. This removes the risk of power outages due to ice accumulation or tree limbs bringing down power lines.
- Pruning trees away from power lines and enforcing policies regarding tree limb clearances.
- Designed-failure allowing for lines to fall or fail in small sections rather than as a complete system.

For a success story on wind storm power outage mitigation, see www.fema.gov/regions/v/ss/r5_n09.shtm. Options for alternate power sources are described at www.currentsolutionspc.com/doc/distributed.pdf.

When power outages occur, the first imperative in emergency power planning is to equip essential facilities with permanent backup power, and to make sure existing backup sources are properly sized and maintained. Essential post-disaster services include:

- medical care;
- drinking water supply;
- police and fire protection;
- refrigeration;
- communications;
- pollution control (especially wastewater treatment);
- transportation (especially airports and seaports);
- weather forecasting;
- temporary relief shelters;
- emergency response command and control.

**Ice can add up to 500# of weight per line between power poles. (Picture from the Oklahoma 12/2007 ice storms)**

Backup systems should be sized

to meet the requirements of a facility's necessary public services. Some facilities, such as wastewater treatment plants and hospitals, are so important that backup systems should be sized to carry full loads. A complete and consistent planned maintenance program that includes regular inspection and operational testing should cover all backup power systems.

## B.2.12 Standby Electric Generators

Standby electric generators can provide an extra sense of security during unpredictable weather and resulting power outages. But even small, portable electric generators – if used improperly – can threaten resident safety and the safety of power company linemen working on the electrical system. For information on safely purchasing and using a residential generator, see www.redcross.org/services/disaster/0,1082,0_565_,00.html.

Before purchasing a generator, consider how it will be used. That will help ensure buying a generator that is correctly sized for the application in mind. Portable, gasoline-driven generators are designed to be used for appliances with cords connected to them. Typically, they are not designed to be connected to a home or building wiring. Residents should not attempt to install these devices to an electrical panel.

### *Fixed Generators*

Large, fixed generators generally are directly connected to building wiring to provide standby power during emergencies or power outages. However, the wiring needs to be properly installed by a qualified electrical contractor. Properly installing a "permanent" generator is extremely dangerous, and usually requires an electrical permit from the local electrical or building inspector's office. It is recommended that a community develop an Emergency Back-Up Generator Hazard Mitigation Plan Annex in order to set priorities for acquisition and budget development. Picking an appropriate fixed-site emergency generator involves a number of issues including:

- Type of fuel – Usually a choice between propane, natural gas or diesel, depending on the availability of either fuel in an emergency, and any possible regulations concerning on-site storage. Other considerations:
  - Natural gas or propane emit far fewer exhaust emissions, which may be a factor.
  - Natural gas generators usually have to be larger, since natural gas does not have the BTU output of gasoline or diesel, and NG generators tend to be more expensive.
  - Natural gas is frequently shut off in the event of a fire or some other disasters. This may not be an issue during winter storms or following lightning strikes (the two most common causes of major power outages), but should be considered during other events.
  - Diesel will require an onsite storage tank and a reliable source for refills during an extended outage. This is frequently an issue since so many commercial sources are dependent on electric pumps to deliver fuel. Also, diesel is seasonally-rated, since extreme cold can have a detrimental effect on standard diesel.
  - Propane will also require onsite storage, which could be a safety concern since propane tanks are traditionally above ground. But getting commercial propane tanks refilled may be easier during a power outage than getting diesel refills.

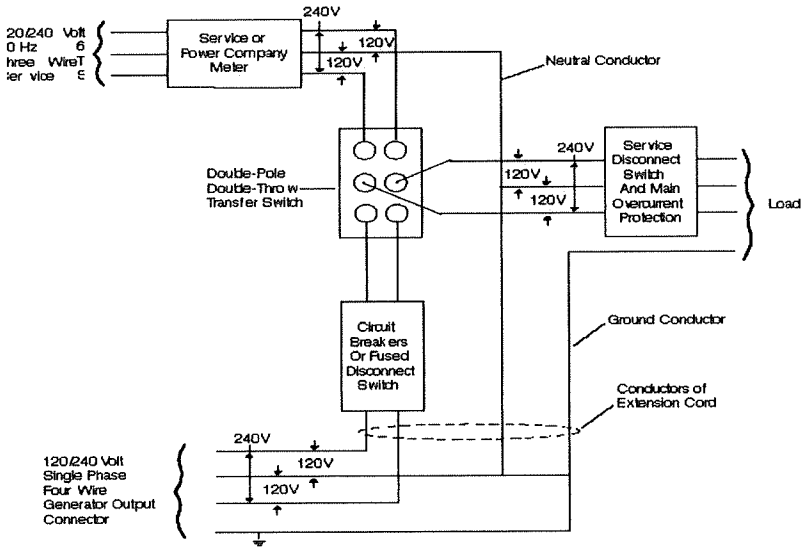
- Proper voltage – It's usually best for an emergency generator to match your standard incoming voltage, whether it's single-phase 120/240 or three-phase 277/480, which is the more common commercial application.
- Power requirements – this will entail (a) identifying your critical functions, and (b) having an electrical professional rate the running/start-up kilowatt (kW) requirements for those functions. (See Table B-5 for some basic power ratings for typical applications.)
- Cost – even a small (30-45 kW, 277/480 volt) natural gas standby generator can cost $10,000, plus expenses for installation and automatic transfer switches. Most emergency operations centers, 911 dispatch centers, and other critical facilities will need a generator with higher requirements.

### *"Back feeding" - a dangerous condition*

Improperly connecting a portable generator to electric wiring can produce "back feed" – a dangerous current that can electrocute or critically injure residents or others. Back feed into power lines from a generator could create "hot" power lines during an outage. Linemen who expected lines to be de-energized have been injured or killed.

One good way to avoid back feeding is to install a double-pole, double throw transfer-switch gear. A qualified electrical contractor can install this transfer switch so that dangerous back feed can be prevented. "In accordance with the National Electrical Code, paragraph 700-6; Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Automatic transfer switches shall be electrically operated and mechanically held." The transfer switch must be a break-before-make switch, which will "break" the electrical connection with commercial power lines before it "makes" the connection between the generator and wiring. The switch also will prevent utility power from damaging the generator when regular service is restored. An electrical diagram of an installation using a transfer switch appears in Figure B-2.

**Figure B–2: Standby power equipment and connections**




Since transfer switches can be expensive, another way to install a generator is to have a sub-panel with main breakers and power from the main panel or generator. Main panel breaker and generator breaker in sub-panel would have handles interlocked to prevent both from being opened and closed at the same time. This prevents back feed to commercial power when the generator is in use.

For commercial emergency installations, it is also critical that an electrical professional review what the standard and max loads will be on the system. An evaluation needs to be made as to what critical functions need to be operational – HVAC, communications, lighting, security, cooking capabilities, and so on. In health care facilities, assistive devices and water supply equipment can pull large quantities of power, which will need to be taken into account.

Typical wattage requirements are described in the following table:

**Table B–5: Typical Wattage Requirements for Generator Usage**

| Item | Running Watts | Item | Running Watts |
|---|---|---|---|
| Air conditioner (12,000 BTU) | 1,700 | Furnace Fan (1/3 HP) | 1,200 |
| Battery Charger (20 A) | 500 | Light Bulb | 100 |
| Chain Saw | 1,200 | Microwave Oven | 1,000 |
| Circular Saw | 1,000 | Oil Burner on Furnace | 300 |
| Coffee Maker | 1,000 | Radio | 50 |
| Compressor (1 HP) | 2,000 | Refrigerator | 600 |
| Deep Freeze | 500 | Submersible Pump (1 HP) | 2,000 |
| Electric heater (small) | 1,500 | Sump Pump | 600 |
| Electric Range (1 element) | 1,500 | Television | 300 |

***Source***: Above information adapted from American Electric Power, *A Word About Portable Electric Generators*, and Flathead Electric Cooperative, *Safely Installing Your Electric Generator, 2007.*

## B.2.13 Critical Facility Protection

Critical facilities require a higher level of protection because they are vital public facilities, pose a higher risk of pollution of floodwaters from hazardous materials, or are critical to the response and recovery effort during and after a disaster. The Community Rating System (CRS) provides credit for regulations protecting critical facilities from the 500-year flood.

Sample regulatory language can be found at the FEMA training website at http://training.fema.gov/EMIWeb/CRS/m6s4main.htm.

## B.2.14 Extreme Heat Protection

Outdoor workers or people who engage in strenuous yard work or recreational activities are extremely vulnerable to heat-related illness.

Elderly, children, low-income individuals and people with compromised immune systems are more vulnerable to health risks due to intense climate changes, especially extreme heat. Aging is often accompanied by chronic illnesses that may increase susceptibility to extreme environmental conditions. Poverty among elderly increases the risk.

Children are vulnerable due to their size, behavior and fact that they are growing and developing. Children living in poverty or without access to proper medical care are especially vulnerable.

Low-income individuals are less likely to be able to afford air-conditioning and have less access to health care.

Cancer, AIDS and diabetes compromise individual's immune systems. Afflicted individuals are more susceptible to physical stresses such as those during extreme heat.

Steps individuals and families can take to protect themselves from the heat include:

- install window air-conditioners snugly and insulate spaces for a tighter fit;
- hang shades, draperies, awnings or louvers on windows receiving morning or afternoon sun. Awnings or louvers can reduce heat entering the house by up to 80%.
- stay indoors as much as possible. If air conditioning is not available stay on the lowest floor out of the sunshine.
- drink plenty of water and limit alcoholic beverages;
- dress in light-colored, loose fitting clothes that cover as much skin as possible;
- take a cool bath.

Suggestions for a community heat emergency intervention plan include:

- Standardizing guidelines for providing warnings to the public, including not only the National Weather Service, but also Emergency Medical Services, the Health Department, Emergency Management, Tribal Community Health Representatives and other recognized agencies.
- The public must have access to steps to take to lessen the likelihood of heat problems, such as staying in air-conditioning, if possible, and drinking plenty of fluids.
- A room air conditioner loan program for bed-ridden/chair-ridden individuals can assist those individuals who cannot physically leave their homes to visit an air-conditioned location each day.
- "Buddy systems" can be established where an individual is assigned to check on people at risk. The "buddy" should be trained to deal with heat related emergencies.
- Utility companies should not be allowed to terminate service during a heat emergency, even if individuals have not paid their bill.

For more information on extreme heat, mitigation and protection from the heat see www.fema.gov/hazards/extremeheat/heatf.shtm.

## B.2.15 Proper Storage and Disposal of Hazardous Materials

Household chemicals and motor oil dumped down drains or directly onto the ground can work their way into the waterways and ground waters. Oil from a single oil change can ruin one million gallons of fresh water. Used crankcase oil has been reported to account for more than 40% of the oil pollution in waterways.

Most public and private vehicle maintenance facilities have well-developed systems to store their waste oil for recycling. However, "do-it-yourselfers" account for a large percentage of the oil changes in any community. Therefore, it is important for community recycling and solid waste management programs to include a system for waste oil collection and provide ways to collect and dispose of household chemicals.

Many counties and communities offer household pollutant collection events. Among the pollutants collected are oil-based paints, paint thinners, pesticides, fertilizers, cleansers,

acids, ammunition, batteries, motor oil, and antifreeze. Residents are not charged for items collected. Events are typically funded by participating communities.

Containers of hazardous materials should not be located in a flood hazard area. If such a location is necessary hazardous material containers need to be anchored. Contents can contaminate water and multiply the damaging effects of flooding by causing fires or explosions, or by otherwise making structures unusable. Buoyant materials should be anchored. If they float downstream they may cause additional damage to buildings or bridges or may plug a stream resulting in higher flood heights.

The link www.earth911.org/zip.asp provides a list of hazardous waste recycling centers and used oil collection facilities based on zip code.

## B.2.16 Water Conservation

97% of the earth's water is in the oceans and 2% is trapped in icecaps and glaciers. Only about 1% of the earth's water is available for human consumption. The water supply is taxed to supply all the competing interests: residential – including drinking and sanitation, manufacturing, environmental, agricultural, and recreational.

Conserving water conserves energy – gas, electric or both – reduces monthly water/ sewer bills and postpones the construction of or eliminates the need to build expensive capital projects such as wastewater or water treatment plants that need future maintenance.

Plumbing codes implemented in Phoenix Arizona in 1990 required low-flow faucets, shower heads, and toilets. Since then water consumption per capita has decreased 27 percent. Other cities, such as Wilsonville, Oregon, have implemented an inverted block water rate structure charging customers higher rates as water consumption increases.

Public education can have a significant impact. Household conservation tips include:

- updating plumbing fixtures with low-flow devices;
- keeping a pitcher of water in the refrigerator instead of running the tap;
- watering the yard and gardens in the morning or evening when temperatures are cooler to minimize evaporation;
- collecting water used for rinsing and reusing it to water plants;
- landscaping with drought-resistant, low water use plants;
- using a hose nozzle and turning off the water while washing cars.

## B.2.17 Open Space Preservation

Keeping the floodplain open and free from development is the best approach to preventing flood damage. Preserving open space is beneficial to the public in several ways. Preserving floodplains, wetlands, and natural water storage areas maintains the existing stormwater storage capacities of an area. These sites can also serve as recreational areas, greenway corridors and provide habitat for local flora and fauna. In addition to being preserved in its natural landscape, open space may also be maintained as a park, golf course, or in agricultural use.

## B.2.18 Conclusions

1. Planning and zoning will help the community or Tribe develop proactively so that the resulting infrastructure is laid out in a coherent and safe manner.
2. Building codes for foundations, sprinkler systems, masonry, and structural elements such as roofs are prime mitigation measures for occurrences of floods, tornadoes, high winds, extreme heat and cold, lightning strikes, and earthquakes.
3. Public education (see Section B.1) can demonstrate preventive measures individuals and businesses can use to protect their own lives and facilities.
4. Communities should participate in the NFIP and use subdivision regulations to control the direction of floodplain development.
5. Deficiencies in stormwater management can be identified by conducting a Flood and Drainage Annex for watersheds to determine appropriate standards for different areas.

## B.2.19 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures*, Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

## B.3 Structural Projects

Structural projects are usually designed by engineers or architects, constructed by the public sector, and maintained and managed by governmental entities. Structural projects traditionally include stormwater detention reservoirs, levees and floodwalls, channel modifications, drainage and storm sewer improvements, and community tornado safe-rooms.

### B.3.1 Safe Rooms

Safe rooms are specially constructed shelters intended to protect occupants from tornados and high winds. Constructed of concrete and steel, properly built safe rooms can provide protection against wind speeds of 250mph and airborne debris traveling as fast as 100mph.

A safe room can be incorporated into the construction of a new home, or can be retrofitted above or below ground into an existing home. The cost of constructing a safe room is between $2500 and $6000, depending on the room size, location and type of foundation on which the home is built. Safe rooms can function year-round as a usable area, such as a bathroom, closet or utility room.

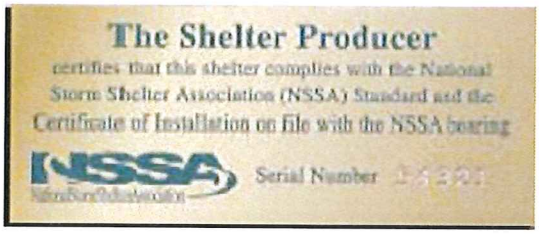
**Dr. Ernst Kiesling, Civil Engineering Professor at Texas Tech University, inspects a safe room in the aftermath of the May 8, 2003 tornadoes in Moore, Oklahoma.**

The State of Oklahoma, FEMA and communities may offer reimbursement grants for construction of certain categories of Safe Rooms through the Hazard Mitigation Grant Program (HMPG).

FEMA 320, *Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business* has specific designs for tornado and hurricane safe rooms. To obtain a copy of FEMA 320 refer to www.fema.gov/plan/prevent/saferoom/fema320.shtm.

#### *National Storm Shelter Association*

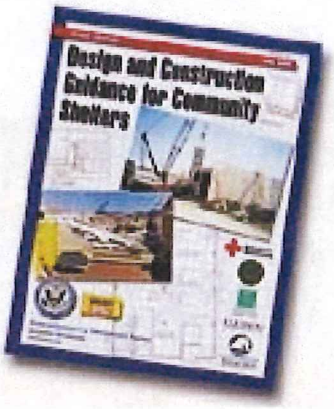
The National Storm Shelter Association (NSSA) is an industry organization developed to ensure the highest quality of manufactured and constructed storm shelters. The NSSA has developed a program to verify that design, construction, and installation of storm shelters are in compliance with the most comprehensive and extensive safety standards available. Without full compliance with the standard, vulnerabilities may exist and safety may be compromised. Shelter-producing members of the NSSA submit shelter designs to the



scrutiny of an independent third-party engineering company and have their shelters tested for debris impact resistance (FEMA 320 designs have been tested). In addition they will file a certificate of installation with NSSA for each shelter.

Upon building or installing a storm shelter, the member applies a seal to the shelter certifying that it is designed, built, and installed to meet the NSSA standard. Only the shelter producer or an agency that carefully inspects the shelter design, construction, and installation may certify compliance with an applicable standard. Claims of "FEMA Certified" or "Texas Tech Certified" are misleading since neither FEMA nor the Texas Tech Wind Science and Engineering Research Center (contributors to the FEMA standards for individual and community SafeRooms) certifies shelter quality. This program not only provides assurance to the user of a storm shelter that it has been built to a certain performance standard, but it shifts some responsibility from the community to provide verification from building inspectors for compliance and reduces building inspectors' training requirements. Additional information on the NSSA certification program can be obtained at www.nssa.cc.

## B.3.2 School Safe Rooms




In the past, a school's interior areas, especially hallways, have been designated as the best place to seek refuge from violent storms. However, in 1999 the hallways of two schools in Sedgwick County, Kansas received significant damage which could have resulted in student casualties had school been in session.

The FEMA 361 publication, *Design and Construction Guidance for Community Shelters*, provides guidelines for constructing school safe rooms. A community shelter strong enough to survive a violent storm can also be used as a

**Before and after photos of hallways in Wichita Kansas schools damaged by a tornado**

cafeteria, gymnasium or other common area.

Schools, administration buildings and institutions of higher learning are required to have written plans and procedures in place for protecting students, faculty, administrators and visitors from natural and man-made disasters and emergencies. The requirement, directed by Oklahoma House Bill HB1512, was enacted May 29, 2003.

For more information about Sedgwick County's new school safe rooms go to www.fema.gov/mit/saferoom/casestudies.shtm. To receive a copy of FEMA 361, see www.fema.gov/pdf/hazards/nhp_fema361.pdf. For more information on HB1512, see www.lsb.state.ok.us/2003-04HB/HB1512_int.rtf.

### B.3.3 Reservoirs and Detention

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought).

Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased.

**Reservoirs provide storage of rainwater without the hazards of maintaining a dam.**

In urban areas, some reservoirs are simply man-made holes dug to store floodwaters. When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open space uses.

### B.3.4 Levees and Floodwalls

Probably the best-known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

Failure to maintain levees can lead to significant loss of life and property if they are stressed and broken or breached during a flood event. An inspection, maintenance and enforcement program helps ensure structural integrity.

Levees placed along the river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties upstream or downstream. To reduce environmental impacts and provide multiple use benefits, a setback levee (set back from the floodway) is the best project design. The area inside a setback levee can provide open space for recreational purposes and provide access sites to the river or stream.

## B.3.5 Channel Improvements

By improving channel conveyance, more water is carried away at a faster rate. Improvements generally include making a channel wider, deeper, smoother or straighter. Some smaller channels in urban areas have been lined with concrete or put in underground pipes.

## B.3.6 Crossings and Roadways

In some cases buildings may be elevated above floodwaters, but access to the building is lost when floodwaters overtop local roadways, driveways, and culverts or ditches. Depending on the recurrence interval between floods, the availability of alternative access, and the level of need for access, it may be economically justifiable to elevate some roadways and improve crossing points.

**Culverts like this one can constrict flow and cause backwater flooding.**

For example, if there is sufficient downstream channel capacity, a small culvert that constricts flows and causes localized backwater flooding may be replaced with a larger culvert to eliminate flooding at the waterway crossing point. The potential for worsening adjacent or downstream flooding should be considered before implementing any crossing or roadway drainage improvements.

## B.3.7 Drainage and Storm Sewer Improvements

Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Storm sewer improvements include installing new sewers, enlarging small pipes, and preventing back flows. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer improvements usually are designed to carry the runoff from smaller, more frequent storms.

**Drainageways should be inspected regularly for blockage from debris**

Because drainage ditches and storm sewers convey water faster to other locations, improvements are only recommended for small local problems where the receiving stream or river has sufficient capacity to handle the additional volume and flow of water. To reduce the cumulative downstream flood impacts of numerous small drainage projects, additional detention or run-off reduction practices should be provided in conjunction with the drainage system improvements.

### B.3.8 Drainage System Maintenance

The drainage system may include detention ponds, stream channels, swales, ditches and culverts. Drainage system maintenance is an ongoing program to clean out blockages caused by an accumulation of sediment or overgrowth of weedy, non-native vegetation or debris, and remediation of stream bank erosion sites.

"Debris" refers to a wide range of blockage materials that may include tree limbs and branches that accumulate naturally, or large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales or detention basins. Maintenance of detention ponds may also require revegetation or repairs of a restrictor pipe, berms or overflow structure.

Maintenance activities normally do not alter the shape of a channel or pond, but they do affect how well a drainage system can do its job. Sometimes it is a very fine line that separates debris that should be removed from natural material that helps form habitat.

### B.3.9 Conclusions

1. Reservoirs can hold high flows of water that can later be released slowly or retained for recreational purposes or drought mitigation.
2. Levees and floodwalls are not as effective overall because of possible underground seepage, erosion, degradation of aquatic habitat and water quality, and ineffectiveness in large floods.
3. Channel improvements allow more water to be carried away faster.
4. The effectiveness of elevating buildings depends on the availability of alternative access when flooding occurs.
5. Crossing and roadway drainage improvements must take into account additional detention or run-off reduction.
6. Drainage and storm sewer improvements carry runoff from smaller, more frequent storms.
7. Drainage system maintenance is an ongoing project of removing debris that decreases the effectiveness of detention ponds, channels, ditches, and culverts.

### B.3.10 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures*, Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

# B.4 Property Protection

Property protection measures are used to modify buildings or property subject to damage from various hazardous events. The property owner normally implements property protection measures. However, in many cases technical and financial assistance can be provided by a governmental agency. Property protection measures typically include acquisition and relocation, flood-proofing, building elevation, barriers, retrofitting, safe rooms, hail resistant roofing, insurance, and the like.

## B.4.1 The Community's Role

Property protection measures are usually considered the responsibility of the property owner. However, local government should be involved in all strategies that can reduce losses from natural hazards, especially acquisition. There are various roles the community can play in encouraging and supporting implementation of these measures.

Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done. They need to see examples, preferably from nearby neighborhoods or communities.

*Financial Assistance*

Communities can help owners by helping to pay for a retrofitting project, just like they pay for flood control projects. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups and other flood problems that arise from an inadequate public sewer or drain system.

Less expensive community programs include low interest loans, forgivable low interest loans and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches do not fully fund the project but they cost the community treasury less and they increase the owner's commitment to the flood protection project.

Often, small amounts of money act as a catalyst to pique the owner's interest to get a self-protection project moving. Several Chicago suburbs have active rebate programs that fund only 20% or 25% of the total cost of a retrofitting project. These programs have helped install hundreds of projects that protect buildings from low flood hazards.

*Acquisition Agent*

Local Government can be a focal point for many acquisition projects. In most cases, when acquisition of a property is feasible, the local government is the ultimate owner of the property, but in other cases, the school district or other public agencies can assume ownership and the attendant maintenance responsibilities.

*Other Incentives: "Non-financial Incentives"*

Sometimes government actions can provide a financial incentive from another source, or other incentive options are available. A flood insurance premium reduction will result if a building is elevated above the flood level. This reduction is not enough to take much of a bite out of the cost of the project, but it reassures the owner that he or she is doing the

right thing. Other forms of floodproofing are not reflected in the flood insurance rates for residential properties, but they may help with the Community Rating System, which provides a premium reduction for all policies in the community.

Other incentives to consider are programs to help owners calculate the benefits and costs of a project and a "seal of approval" for retrofitted buildings. The latter would be given following an inspection that confirms that the building meets certain standards. There are many other personal but non-economic incentives to protect a property from flood damage, such as peace of mind and increased value at property resale.

## B.4.2 Insurance

Insurance has the advantage that, as long as the policy is in force, the property is protected and no human intervention is needed for the measure to work. There are three types of insurance coverage:

NFIP Coordinator Dianna Herrera presenting a class on flood insurance requirements

1. The standard homeowner's, dwelling, and commercial insurance policies cover against the perils of wildfire and the effects of severe weather, such as frozen water pipes.
2. Many companies sell earthquake insurance as an additional peril rider on homeowner's policies. Individual policies can be written for large commercial properties. Rates and deductibles vary depending on the potential risk and the nature of the insured properties.
3. Flood insurance is provided under the National Flood Insurance Program.

### *Flood Insurance*

Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the National Flood Insurance Program (NFIP). Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area.

Building coverage is for the structure. Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage.

Some people have purchased flood insurance because the bank required it when they got a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. People cannot wait for the river to rise before they buy their coverage.

## B.4.3 Acquisition and Relocation

Moving out of harm's way is the surest and safest way to protect a building from damage. Acquiring buildings and removing them is also a way to convert a problem area into a community asset and obtain environmental benefits.

The major difference between the two approaches is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park. Relocation can be either government or owner-financed.

**Moving a home out of the floodplain is sometimes the only way to protect it from flooding**

While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

### *Cost*

An acquisition budget should be based on the median price of similar properties in the community, plus $10,000 to $20,000 for appraisals, abstracts, title opinions, relocation benefits, and demolition. Costs may be lower after a flood or other disaster. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner.

One problem that sometimes results from an acquisition project is a "checkerboard" pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Relocation can be expensive, with costs ranging from $30,000 for a small wood frame building to over $60,000 for masonry and slab on grade buildings. Two story houses are more expensive to move because of the need to relocate wires and avoid overpasses. Additional costs may be necessary for acquiring a new lot on which to place the relocated building and for restoring the old site. Larger buildings may have to be cut and the parts moved separately. Because of all these complications, there are cases where acquisition is less expensive than relocation.

### *Where Appropriate*

Acquisition and relocation are appropriate in areas subject to:

- flash flooding;
- deep waters;
- dam break flooding;

- landslides;
- potential hazardous materials spills;
- other high hazard that affects a specific area.

Acquisition and relocation are not appropriate for hazards like tornadoes or winter storms because there are no areas safe from the hazard. Relocation is also preferred for large lots that include buildable areas outside the hazardous area or where the owner has a new lot in a safer area.

Acquisition (followed by demolition) is preferred over relocation for buildings that are difficult to move, such as larger, slab foundation, or masonry structures, and for dilapidated structures that are not worth protecting.

## B.4.4 Building Elevation

Raising a building above the flood level is the best on-site property protection method for flooding. 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 elevation on compacted earthen fill.

## B.4.5 Barriers

Barriers keep surface waters from reaching a building. A barrier can be built of dirt or soil ("berm") or concrete or steel ("floodwall"). In cases of shallow flooding, regrading a yard can provide the same protection as a separate barrier.

## B.4.6 Retrofitting

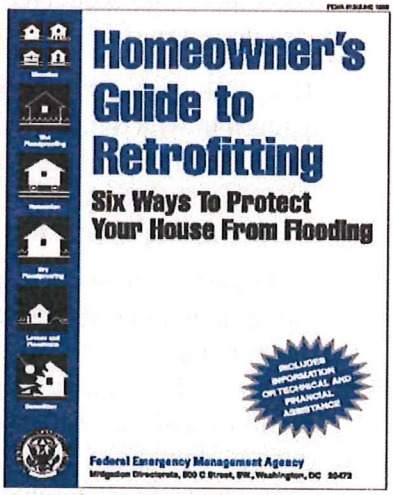
This term covers a variety of techniques for modifying a building to reduce its susceptibility to damage by one or more hazards.

*Where Appropriate*

Some of the more common approaches are:

**Floods and dam failures:**

- Dry floodproofing keeps the water out by strengthening walls, sealing openings, or using waterproof compounds or plastic sheeting on walls. Dry floodproofing is not recommended for residential construction.
- Wet floodproofing, using water resistant paints and elevating anything that could be damaged by a flood, allows for easy cleanup after floodwaters recede. Accessory structures or garages below the residential structure are potential candidates for wet floodproofing.
- Installing drain plugs, standpipes or backflow valves to stop sewer backup.




**FEMA guides are available to help homeowners retrofit their flood-prone properties**

**Tornado:**

- Constructing an underground shelter or in-building "safe room"
- Securing roofs, walls and foundations with adequate fasteners or tie downs
- Strengthening garage doors and other large openings

**High winds:**

- Installing storm shutters and storm windows
- Burying utility lines
- Using special roofing shingles designed to interlock and resist uplift forces
- Installing/incorporating backup power supplies

**Hailstorms:**

- Installing hail resistant roofing materials

**Lightning:**

- Installing lightning rods and lightning surge interrupters
- Burying utility lines
- Installing/incorporating backup power supplies

**Winter storms:**

- Adding insulation
- Relocating water lines from outside walls to interior spaces
- Sealing windows
- Burying utility lines
- Installing/incorporating backup power supplies

**Extreme heat and drought:**

- Adding insulation
- Installing water saver appliances, such as shower heads and toilets

**Urban and wild fires:**

- Replacing wood shingles with fire resistant roofing
- Adding spark arrestors on chimneys
- Landscaping to keep bushes and trees away from structures
- Installing sprinkler systems
- Installing smoke alarms

**Earthquake:**

- Retrofitting structures to better withstand shaking.

- Tying down appliances, water heaters, bookcases and fragile furniture so they won't fall over during a quake.

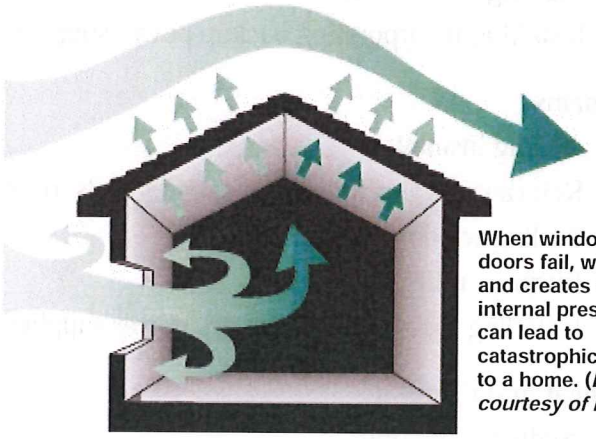
***Common Measures***

From the above lists, it can be seen that certain approaches can help protect from more than one hazard. These include:

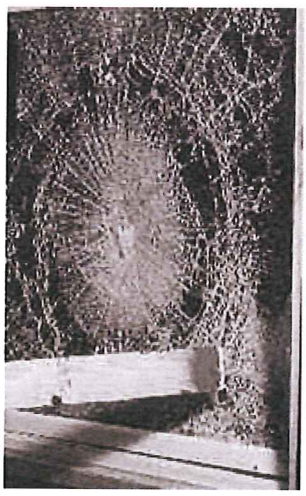
- strengthening roofs and walls to protect from wind and earthquake forces;
- bolting or tying walls to the foundation protect from wind and earthquake forces and the effects of buoyancy during a flood;
- adding insulation to protect for extreme heat and cold;
- anchoring water heaters and tanks to protect from ground shaking and flotation;
- burying utility lines to protect from wind, ice and snow;
- installing backup power systems for power losses during storms;
- installing roofing that is hail resistant and fireproof.

## B.4.7 Impact Resistant Windows and Doors

Doors and windows can be the most vulnerable components of your home. During high wind events, such as thunderstorms or tornadoes, wind-driven debris can easily penetrate unprotected or unreinforced windows and doors, breaching the secure envelope of the structure. The debris and rain may cause damage to interior furnishings or harm to residents, but the wind itself can create extreme pressures on the walls and ceiling, leading to catastrophic structural failure. This danger can be mitigated by the installation of impact-resistant windows and doors.



**When windows and doors fail, wind enters and creates an internal pressure that can lead to catastrophic damage to a home. (*Drawing courtesy of Flash.org*)**



***Windows***

Today's impact-resistant glass sandwiches a laminated inner layer made of polyvinyl butyral, a plastic, between two sheets of glass. Stronger than a car windshield, the glass might shatter if a heavy object crashes into it, but it won't break to bits. That makes wind less likely to penetrate the envelope of a home and create interior pressure severe enough to blow a roof off. Impact-resistant windows are only as strong, though, as the frame in which they rest. "An impact resistant window is tested

as a unit that includes the glass, the frame as well as the attachment hardware and the installation method." (*Federal Alliance for Safe Homes – FLASH*)

The second type of impact-resistant glass uses a film applied to the surface. Impact-resistant film is placed over the glass to keep windows from shattering into sharp particles if broken. Since these films are added to the glass, they may not be as effective as a standard impact-resistant system. Their durability depends on how well the glass and protective laminate stay in the frame and window assembly. They will be effective against smaller objects, but larger pieces of debris may still take the window out of the frame. For more information on protective window films and other technologies, visit the Protecting People First Initiative (www.protectingpeople.org/arenspage.shtm) or the International Window Film Association (www.iwfa.com/iwfa/Consumer_Info/safety.html).

While costs for replacing window glass or using impact-resistant glass in new construction can be expensive, there are additional benefits that may be gained. Impact-resistant glass has been used successfully to reduce burglaries, vandalism and break-ins with both homes and businesses. In addition, using an impact-resistant glazing that is also more energy efficient can produce substantial energy savings. According to the Partnership for Advancing Housing Technology (PATH), a public-private partnership between leaders in the homebuilding, product manufacturing, and insurance industries and several Federal agencies:

> Special glass "…can be used to both make windows impact resistant and more energy efficient. Low-E and solar control low-E (also called spectrally selective) coatings can be used to boost the energy efficiency of windows. Low-E double pane windows, most common in cold and moderate climates, are more energy efficient than clear windows because the low-E coating reduces heat loss through the window.
>
> Solar control glass, also called Low E2, is a good glass for hot climates because, in addition to improving the insulating ability of windows, it also limits solar heat gain by blocking passage of infrared and some ultraviolet rays. Solar control glass allows a higher level of visible light to pass through a window with less solar heat gain reduction than tinted window coatings."

PATH gives a tentative cost estimate for using impact resistant glass systems in a model 2,250 sq. ft. home at $14,850. (www.pathnet.org/sp.asp?id=18692). In addition, residential users may view a window and door protection cost estimate tool at the Federal Alliance for Safe Homes (FLASH) website www.blueprintforsafety.org/tools/shuttertoolhome.aspx.

One manufacturer provides the following pricing table for commercial applications:

## Table B–6: Impact Resistant Windows Cost Estimate Table

The following pricing table is for estimating purposes only. Changes in dimensions, glass types, finishes, hardware selection, volume discounts, and other variables could raise or lower prices.
(Provided by CGI Windows, www.cgiwindows.com.)

**APPROXIMATE IMPACT RESISTANT PRICING 2007 - COMMERCIAL GRADE ALUMINUM PRODUCTS**

| Product | W | x | H | Max. Design Pressure (PSF) | COST* |
|---|---|---|---|---|---|
| Series 238 - Casement Window | 24" | x | 48 | +110 / -120 | $400.12 |
| Series 238 - Casement Window | 30" | x | 60 | +110 / -120 | $526.63 |
| Series 238 - Casement Window | 36" | x | 60 | +110 / -120 | $593.31 |
| Series 238 - Casement Window | 32" | x | 72 | +85 / -85 | $625.18 |
| Series 360 - Single Hung Window | 36" | x | 72 | +100 / -167.2 | $593.80 |
| Series 360 - Single Hung Window | 54" | x | 96" | +100 / -120 | $1,274.27 |
| Series 450 - Pair of Door | 74 1/2" | x | 96 3/4 | +100 / -110 | $2,425.69 |

**Aluminum Finish:** White, Bronze, or Driftwood ESP
**Glass Type:** 7/16" Laminated Glass Typical (Ann/Ann) / 5/16" Lami Glass at Single Hungs (Ann/Ann)
**Glass Color:** Clear, Gray, Bronze, Dark Gray (Turtle Code)

** Note: Cost excludes special items, colonial muntins, HS/HS Glass, Temp/Temp Glass, aluminum tube mullions, shipping, shop drawings, installation, permits, special engineering, windload calculations, etc.*

### *Garage Doors*

Garage doors are particularly vulnerable, especially doublewide garage doors because of their long span and, frequently, lightweight materials. Reinforced garage door and track systems are available to help avoid that problem. Retrofit kits are also available to reinforce existing garage doors, but the retrofit kits do not provide the same level of protection as systems designed to be wind and impact-resistant. (*Source: Federal Alliance for Safe Homes – FLASH. www.flash.org.)*

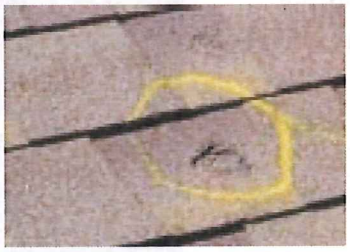
**Illustrating the dangers of unreinforced garage doors, in all but the house at upper left, these doors have been breached, leading to substantial roof damage – in some cases, completely removing a second floor. But in the home with an intact garage door, the roof is almost entirely undamaged.**

## B.4.8 Impact Resistant Roofing

Hail is a hazard that threatens most states, but it doesn't strike all areas equally. Since 1980, the country has averaged 3,000 hailstorms per year, with four states accounting for 42% of the total: Texas, 500 per year; Oklahoma, 400; Kansas, 225; Nebraska, 135. In these high risk states, hail strikes may occur up to 6 times a year, putting houses in repeated danger. (Source: State Farm Insurance)

In 1996, the Institute for Business & Home Safety (IBHS) and Underwriters Laboratory (UL) developed a protocol for testing and rating roofing systems against impact damage. The test uses four sizes of steel balls, ranging from 1¼ -2 inches in diameter, to replicate different sizes of hailstones. The balls are dropped from different heights to simulate various impact speeds. The materials are rated on a scale of 1 (least resistant) to 4 (most resistant).

New impact-resistant roofing will cost more, even in mass production. New shingles may also require more labor at installation. However, some impact-resistive, asphalt-based products will add as little as 10-15% up to 50% to the cost. Class 4 products made of aluminum, copper, plastic and resin shingles have been available for years, but they cost considerably more than standard roofing materials. With the introduction of modified asphalt materials, many more homeowners are able to achieve greater wind and hail resistance than ever before.



**Photos courtesy of State Farm Insurance**

However, in areas where storms and high winds can damage many roofs, these shingles offer additional protection to the structure and occupants. Depending on location and frequency of storms, the costs for this type of roofing could be less than the costs of replacing roofing due to impact or wind. With a 6-nail vs. 3-nail installation, Class 4 shingles frequently come with a limited warranty against 120-130 mph winds. (Source: National Association

**LET IT HAIL, LET IT HAIL!**

The March thunderstorm blew in without much warning during the Ft. Worth early evening rush hour. When softball-size hail smashed through the roof of a downtown restaurant, customer Mario Valverde headed for safety to escape falling debris and glass shards from exploding windows.

Valverde, a National Weather Service (NWS) veteran, knew this storm would make headlines.

"The hail punched right through the ceiling," Valverde said. "The hailstones knocked ceiling tiles loose and rainwater cascaded down from the electrical fixtures. I hid out in the restaurant's freezer room along with the other customers and employees. I found out later the storm killed two people." An experienced weatherman, Valverde knew that the fierce storm had passed directly over his home in Saginaw. "I called my insurer and the claim adjuster told me the roof had to be replaced. Afterwards, property insurance premiums went up ten percent in my area."

Fortunately, most storms aren't as violent as the one Valverde experienced, and hail larger than baseball size is rare. "Ninety percent of hail is golf ball size or less," said contractor Scott Hamilton, of Lon Smith Roofing in Fort Worth. However, while smaller hailstones may not fracture standard roof shingles, damage still remains.

***(Source: Insurance Journal – TX)***

of Home Builders). Additionally, insurance companies may offer a discount to homeowners on their homeowner's insurance policy for shingles meeting Class 4 rating from UL 2218. Also, Class 4 shingles frequently have a 30-50 year guarantee, vs. a 15-20 year guarantee for conventional Class 1 material, thus greatly extending the period between roof replacements.

**Class 4 Roofing materials Cost Effectiveness**

If the insurance carrier offers a premium discount, the total impact to the homeowner is reduced. Assuming an average annual premium for our sample home of $800, and further assuming our hail-resistant product qualifies for the maximum discount offered by the insurance carrier (25 percent), then our homeowner will be saving $200 per year in premiums, or $6,000 over 30 years. The total impact to the homeowner of $2,100 now becomes a savings of $3,900 or approximately $130 per year.

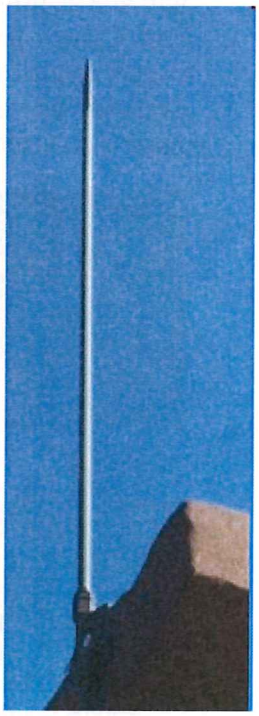
The selection of a hail-resistant shingle, in conjunction with an incentive from the insurance carrier, is a cost effective alternative for both the homeowner and the insurance company. To make this program a reality, however, the insurance company must educate the homeowner on the potential long-term cost savings that are associated with the installation of the preferred roofing system.

***Article originally published by: Professional Investigative Engineers, Inc.***

## B.4.9 Lightning Protection Systems

The purpose of a lightning protection system is to intercept lightning and safely direct its current to ground. If the system is properly designed, installed and maintained it can provide almost 100% protection to buildings.

The system for an ordinary structure includes at least air terminals (lightning rods), down conductors, and ground terminals. These three elements of the system must form a continuous conductive path for lightning current. Many systems of air terminals now may not even be connected to the building. They may be comprised of freestanding cables or towers above or next to the building. This is especially needed where the structure may house explosives or delicate electronics, since even with a lightning rod, some energy may be transferred to the structure through induction.



National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems* describes lightning protection system installation requirements. NFPA 780 is available through www.nfpa.org/Codes/NFPA_Codes_and_Standards/List_of_NFPA_documents/NFPA_780.asp. Additional information on design and construction of lightning protection systems is available on www.montana.edu/wwwpb/pubs/mt8529ag.pdf.

## B.4.10 Surge and Spike Protection

The average home has 2,200 or more power surges annually, 60% of which are generated within the home. Most surges are caused

by motors starting in air conditioners, garage doors, refrigerators and other major appliances. Electronic appliances can be damaged or destroyed by over-voltage surges or spikes.

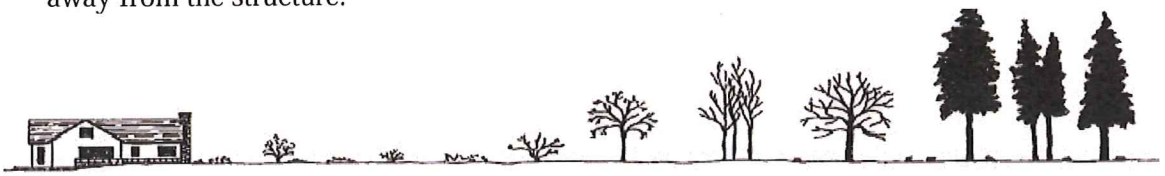
Whole house surge protectors offer the first line of defense against high-energy, high-voltage surges. These devices thwart the energy of the initial surge and reduce it before it reaches electrical appliances. In many cases this level of protection is enough to protect the home. Surge protectors should be sufficient to also provide "spike protection," which can defend against the extremely high spiking voltage created by lightning strikes. Many surge protectors, while effective against routine voltage fluctuations, may not defend against high level spikes.

Surge protection devices connected directly to appliances offer the second line of defense. They are the only defense against surges within the home as when, for example, a large appliance kicks in. The combination of whole house and point-of-use surge protection provides the best possible protection.

For more information on whole house and point-of-use surge protectors, refer to www.howstuffworks.com/surge-protector.htm.

## B.4.11 Landscaping for Wildfire Prevention

The chance of losing property due to wildfire can be reduced using fire prevention landscaping techniques. The amount of cleared space around a home improves its ability to survive a wildfire. A structure is more likely to survive when grasses, trees and other common fuels are removed, reduced or modified to reduce a fire's intensity and keep it away from the structure.



**Zone 1: Moist and trim.** Turf, perennials, groundcovers and annuals form a greenbelt that is regularly watered and maintained. Shrubs and trees are located at least 10 feet from the house.

**Zone 2: Low and sparse.** Slow growing, drought-tolerant shrubs and groundcovers keep fire near ground level. Native vegetation can be retained if it is low growing, does not accumulate dry, flammable material and is irrigated.

**Zone 3: High and clean.** Native trees and shrubs are thinned and dry debris on the ground is removed. Overgrowth is removed and trees are pruned every 3-5 years.

**Zone 4: Natural area.** Native plants are selectively thinned. Highly flammable vegetation is replaced with less fire-prone species.

For comprehensive lists of steps to protect your home before, during and after a wildfire, see www.fema.gov/pdf/library/98surst_wf.pdf or www.cnr.uidaho.edu/extforest/F3.pdf.

## B.4.12 Conclusions

1. Acquisition and relocation of property is the most effective for property protection in the case of hazards that are expected to occur repeatedly in the same locations. Acquisition followed by demolition is preferable.

2. Other methods of property protection for flooding include raising building elevations and building berms and floodwalls.
3. Building modifications are also appropriate for some hazards.
4. Property insurance has the advantage of protecting the property without human intervention.
5. Local government can help in reducing losses from natural hazards by providing financial assistance, having an acquisition program, and other incentives.

## B.4.13 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

# B.5 Emergency Services

Emergency services measures protect people during and after a hazard event. Measures include preparedness, threat recognition, warning, response, critical facilities protection, and post-disaster recovery and mitigation.

## B.5.1 Threat Recognition

Threat recognition is the key. The first step in responding to a flood, tornado, storm or other natural hazard is being aware that one is coming. Without a proper and timely threat recognition system, adequate warnings cannot be disseminated.

### *Emergency Alert System (EAS)*

Using digital technology to distribute messages to radio, television and cable systems, the EAS provides state and local officials with the ability to send out emergency information targeted to a specific area. The information can be sent electronically through broadcast stations and cable systems even if those facilities are unattended.

### *Floods*

A flood threat recognition system provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

**Areas subject to flooding should be clearly posted**

On larger rivers, including the Washita, the National Weather Service does the measuring and calculating, which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government to be the official source for weather information.

The National Weather Service issues notices to the public, using two levels of notification:

*Flood watch:* conditions are right for flooding;

*Flood warning:* a flood has started or is expected to occur.

On smaller rivers, local rainfall and river gages are needed to establish a flood threat recognition system. The National Weather Service may issue a "flash flood watch." This means the amount of rain expected will cause ponding and other flooding on small streams and depressions. These events are sometimes so localized and rapid that a "flash

flood warning" may not be issued, especially if no gauges or other remote threat recognition equipment is available.

*Meteorological Hazards*

The National Weather Service is the primary agency for detecting meteorological threats, such as tornadoes, thunderstorms, and winter storms. As with floods, the Federal agency can only look at the large scale, e.g., whether conditions are appropriate for formation of a tornado. For tornadoes and thunderstorms, the local government can provide more site-specific and timely recognition by sending out spotters to watch the skies when the Weather Service issues a watch or warning.

*NOAA Weather (All-Hazard) Radios*

The National Oceanographic and Atmospheric Administration (the parent agency for the National Weather Service) maintains a nationwide network of radio stations broadcasting continuous weather information direct from regional National Weather Service offices. The NWS broadcasts warnings, watches, and forecasts 24 hours a day. Post-event information is also broadcast for natural hazards (such as tornados and earthquakes) and environmental hazards (such as chemical releases or oil spills). In addition, many emergency management agencies have access to these radios to broadcast Amber Alerts and other hazard and safety information.

These broadcasts can be received by any radio capable of receiving the Weather Service frequency. NOAA All Hazard Radios have the additional advantage of being activated by a pre-broadcast signal transmitted by the NWS, coming off standby and sounding an alert tone loud enough to wake sleeping individuals before transmitting the warning message. NOAA Weather Radio receivers can be purchased at many retail stores that sell electronic merchandise. Typical cost of a residential grade NOAA Weather Radio is between $20 and $80.

For more information on NOAA Weather Radios, see www.nws.noaa.gov/nwr/.

## B.5.2 Warning

After the threat recognition system tells the Emergency Manager or other local government official that a flood or other hazard is coming, the next step is to notify the public and staff of other agencies and critical facilities. The earlier and the more specific the warning is given, the greater the number of people who can implement protection measures. The following are some of the more common warning methods:

| | |
|---|---|
| Broadcast announcements & EAS | Good tools for delivering an alert to a wide coverage area but not well suited for delivering "actionable" information to specific population segments. For an EAS to be effective, it is essential for the target audience to be tuned in to a regional station. Actual practice shows this is not always the case, particularly late at night when the general population is asleep. |

| | |
|---|---|
| Door-to-door Notification | Door-to-door notification would be an ideal way to communicate with specific individuals or neighborhoods. However, efficiency is impacted by the number of addresses to be contacted, the number of personnel available to "walk the streets", and the amount of time available prior to the event (i.e., evacuation). It is highly unlikely that sufficient public safety personnel would be available to effectively provide such door-to-door notification services. Door-to-door also has the potential of putting first responders in harm's way. |
| Other Communications Devices | There are many communication devices available that may be able to receive emergency notifications – faxes, pagers, PDAs and cell phones. However, as with Weather Alert Radio, their level of penetration throughout the population is too low to ensure effective delivery. Selecting distinct population segments based on geography with such devices is also a problem. |
| Outdoor warning sirens | Sirens can be effective in their ability to alert people within hearing distance that a crisis or emergency situation may exist. Outdoor warning sirens and public address systems are commonly located in densely populated urban settings, but are not as useful in rural areas. Sirens are intended to alert the public to implement some pre-determined action (i.e., tune to radio and television for specific information on a hazard). However the public generally has no awareness of the need to do so and often will ignore sirens thinking they are a "test" unless they see the hazard approaching, which is often then too late to take appropriate action.<br><br>In addition, in many areas, sirens are used only for specific emergencies, such as floods or tornadoes, and are of little use in helping public safety personnel alert residents to other events/crises. |
| NOAA Weather Radio | Weather Alert Radio, while an invaluable tool, has limited applicability. Lacking proper feedback, public safety and emergency management officials have no way of being sure that everyone in their jurisdiction can be reached with such announcements because, similar to broadcast announcements, the audience must have a NOAA radio, and be tuned in. |
| Sirens on public safety vehicles | These have many of the same drawbacks as both door-to-door notification and outdoor warning sirens. Emergency vehicle sirens do not provide "actionable" information on how to respond. In addition, crucial emergency service personnel may be tied up when their services are more urgently needed for response. |

**Adapted from *NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004***

Multiple or redundant systems are the most effective, since people do not hear one warning, they may still get the message from another part of the system. Each has advantages and disadvantages. Outdoor warning sirens can reach the most people quickly (except those around loud noise, such as at a factory or during a thunderstorm), but they do not explain what hazard is coming and cannot be sounded unless a timely means of threat recognition exists. Radio and TV provide a lot of information, but people have to know to turn them on. Telephone trees are fast, but can be expensive, do not work when phones lines are down, and can break down if some people in the chain are directly affected.

Just as important as issuing a warning is telling people what to do. A warning program should have a public information aspect. People need to know the difference between a

tornado warning (when they should seek shelter in a basement) and a flood warning (when they should stay out of basements).

### B.5.3 9-1-1 and 2-1-1

Some communities have expanded their basic 9-1-1 location identification telephone service to include features such as "enhanced 9-1-1" registering name, address, and a description of the building/site. Additionally, non-emergency 2-1-1 service can be used to have people call to get information, such as locations of cooling shelters during a heat wave. For information on coverage areas and contact information for area 2-1-1 systems, see www.211oklahoma.org.

### B.5.4 Emergency Telephone Notification Systems (ETNS)

It has become more common to use an "Emergency Telephone Notification System" (frequently referred to as "reverse 9-1-1") with which a community or Tribe can send out a mass telephone announcement to targeted numbers in the 9-1-1 system, effectively supplementing a community's other warning systems. An effective ETNS can offer certain advantages over other systems:

- ETNS systems provide the ability to precisely target populations in specific geographic locations better than existing alternatives, particularly when ETNS systems are integrated with geographic information systems (GIS) maps commonly used by 9-1-1 systems;
- The telephone, more than any other communications medium, allows officials to deliver specific actionable information that lets those in harm's way know exactly what to do, what to expect, or what to look for;
- The telephone is always on, providing the opportunity to reach nearly everyone in a target area either live or through voicemail.
- Many systems also offer the option of allowing people to call in and retrieve the same message or an updated one. This can reduce the subsequent number of calls to 9-1-1 from people who did not fully understand the message the first time. (*Source: NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004*).

### B.5.5 Response

The protection of life and property is the foremost important task of emergency responders. Concurrent with threat recognition and issuing warnings, government officials should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- activating the emergency operations room (emergency management);
- closing streets or bridges (police or public works);

- shutting off power to threatened areas (utility company);
- holding children at school/releasing children from school (school district);
- passing out sand and sandbags (public works);
- ordering an evacuation (mayor);
- opening evacuation shelters (Red Cross);
- monitoring water levels (engineering);
- providing security and other protection measures (police).

**In the event of an emergency, responders must make an organized effort to minimize the impacts of the incident.**

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner.

### B.5.6 Emergency Operations Plan (EOP)

An EOP develops a comprehensive (multi-use) emergency management program which seeks to mitigate the effects of a hazard, to prepare for measures to be taken which will preserve life and minimize damage, to respond during emergencies and provide necessary assistance and to establish a recovery system in order to return communities to their normal state of affairs. The plan defines who does what, when, where and how in order to mitigate, prepare for, respond to and recover from the effects of war, natural disasters, technological accidents and other major incidents / hazards.

Funding for creating or updating an EOP is available from FEMA. For information on how to obtain funding contact the Oklahoma Office of Homeland Security or go to www.dhs.gov/xopnbiz/grants/.

The State of Oklahoma's Emergency Operations Plan is published on www.ok.gov/OEM/Programs_&_Services/Planning/State_Emergency_Operations_Plan_(EOP)/.

Communities and Public School Districts should coordinate the local emergency response plans with the local school district's emergency operations plan.

## B.5.7 Incident Command System (ICS)

The Incident Command System is the model tool for the command, control and coordination of resources at the scene of an emergency. It is a management tool of procedures for organizing personnel, facilities, equipment and communications. ICS is based upon basic management skills managers and leaders already know: planning, directing, organizing, coordinating, communicating, delegating and evaluating.

Continuity of Operations (COOP) planning should be addressed in the EOP. COOP ensures the essential functions of an organization, including government, can continue to operate during and after an emergency incident. An incident may prevent access to normally operating systems, such as physical plant, data or communication networks, or transportation. Government, business, other organizations, and families should be encouraged to prepare by regularly backing up computer hard drives, copying essential files, and storing these items in a separate location.

ICS is not a means to wrestle control or authority away from agencies or departments, a way to subvert the normal chain of command within a department or agency, nor is it always managed by the fire department, too big for small everyday events or restricted to use by government agencies and departments. ICS is an adaptable methodology suitable for emergency management as well as many other categories. If leadership is essential for the success of an event or a response, ICS is the supporting foundation for successfully managing that event.

The Incident Command System is built around five major management activities. These activities are:

- Command – sets objectives and priorities and has overall responsibility at the incident or event.
- Operations – conducts tactical operations to carry out the plan and directs resources.
- Planning – develops the action plan to accomplish objectives and collects and evaluates information.
- Logistics – provides resources and services to support incident needs.
- Finance / Administration – monitors costs, provides accounting, reports time and cost analysis.

The system can grow or shrink to meet changing needs. This makes it very cost-effective and efficient. The system can be applied to a wide variety of situations such as fires, multi-jurisdiction and multi-agency disasters, hazardous material spills and recovery incidents, pest eradication programs and state or local natural hazards management.

For a detailed description of ICS, a diagram of ICS organization, or checklists of duties for each management activity and links to other resources see http://www.911dispatch.com/ics/ics_main.html.

## B.5.8 Mutual Aid / Interagency Agreements

Local governments should establish mutual aid agreements for utility and communications systems, including 9-1-1. Mutual aid or interagency agreements have

value for preventing or responding to other hazard or emergency situations, as fire and police departments often do.

## B.5.9 CERT (Community Emergency Response Team)

After a major disaster, local emergency teams quickly become overwhelmed. CERT is designed to have trained groups of people in every neighborhood and business ready to assist first responders (police, firefighters and EMS) during an emergency.

CERT programs train and equip residents in neighborhoods and businesses enabling them to "self-activate" immediately after a disaster. CERT teams are trained in:

- disaster preparedness;
- light fire suppression;
- Incident Command System;
- light search and rescue;
- basic disaster medical care;
- basic disaster psychology.

FEMA grants have been given to states for funding CERT programs or expanding existing teams. For information about the Oklahoma grant see www.fema.gov/news/newsrelease.fema?id=3155.

For more information on the CERT program talk to your local emergency management official or visit training.fema.gov/emiweb/CERT/.

## B.5.10 Debris Management

The tornados of May 3, 1999 left an estimated 500,000 cubic yards of debris. Debris in the aftermath of a disaster poses significant health and safety risks. Debris can include fuel containers, chemicals, appliances and explosives.

Two key considerations regarding debris management are the need for rapid removal and protection of the public health and environment. Before a disaster strikes, communities should set up staging area(s) where residents and cleanup crews can take debris prior to final disposal.

Community members can participate in debris control by securing debris, yard items, or stored objects that may otherwise be swept away, damaged, or pose a hazard if floodwaters would pick them up and carry them away. Additionally, a community can pass and enforce an ordinance regulating dumping.

For the Oklahoma Department of Environmental Quality's *Guidelines for Debris Management* see document: http://www.deq.state.ok.us/factsheets/local/debris.pdf.

## B.5.11 Critical Facilities Protection

"Critical facilities" were previously discussed in Section 2.3.5. Generally, they fall into three categories:

- buildings or locations vital to the response and recovery effort, such as police and fire stations and telephone exchanges;
- buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials or utility facilities, or water treatment plants;
- locations that would require extraordinary response or preparedness measures, such as hospitals, retirement homes, or childcare facilities.

In addition, since September 11th, FEMA has included financial institutions as possible critical facilities, because of the potential devastating effect on the community infrastructure upon their loss.

Protecting privately-owned critical facilities during a disaster is the responsibility of the facility owner or operator. However, if they are not prepared for an emergency, the rest of the Tribe or community could be impacted. If a critical facility is damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If the owner or operator adequately prepares such a facility, it will be better able to support the community's emergency response efforts.

Many critical facilities have full-time professional managers or staff who are responsible for the facility during a disaster. These people often have their own emergency response plans. Many facilities would benefit from early disaster warning, disaster response planning, and coordination with community disaster response efforts.

Schools are critical facilities not only because of the special population they accommodate, but because they are often identified as shelter sites for residents. Processes and procedures can be developed to determine mitigation priorities incorporated into capital improvement plans that will ensure these buildings function after an event.

Protocols should be in place to ensure there are adequate backup facilities for the Emergency Operations Centers and 9-1-1 Centers, both of which are critical facilities.

## B.5.12 Site Emergency Plans

Communities can encourage development and testing of internal emergency plans and procedures, including continuity planning, by businesses and other organizations.

Communities should develop and test site emergency plans for schools, factories, office buildings, shopping malls, Tribal casinos, hospitals, correctional facilities, stadiums, recreation areas, and other similar facilities.

## B.5.13 Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and help people and property for the next disaster. Throughout the recovery phase, everyone wants to get "back to normal." The problem is, "normal" means the way they were before the disaster. Measures needed include the following:

*Recovery Actions*

- patrolling evacuated areas to prevent looting;
- providing safe drinking water;

- monitoring for diseases;
- vaccinating residents for tetanus;
- clearing streets;
- cleaning up debris and garbage;
- regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations.

**A firefighter searches through the remains of a hotel in Midwest City.**
Oklahoman Staff Photo by Paul Hellstern

*Mitigation Actions*

- conducting a public information effort to advise residents about mitigation measures they can incorporate into their reconstruction work;
- evaluating damaged public facilities to identify mitigation measures that can be included during repairs;
- acquiring substantially or repeatedly damaged properties from willing sellers;
- planning for long term mitigation activities;
- applying for post-disaster mitigation funds.

Requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations can be very difficult for local, understaffed overworked offices after a disaster. If these activities are not carried out properly, not only does the municipality miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

## B.5.14 StormReady Communities

*StormReady*, a program started by the National Weather Service in Oklahoma in 1999, helps arm America's communities with the communication and safety skills needed to save lives and property before and during an event. *StormReady* communities are better prepared to save lives from the onslaught of severe weather through better planning, education, and awareness.

*StormReady* has different guidelines for different sized communities. To be StormReady a community must:

- establish a 24-hour warning point and emergency operations center;
- have more than one way to receive severe weather warnings and forecasts and to alert the public;
- create a system that monitors weather conditions locally;
- promote the importance of public readiness through community seminars;
- develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

The economic investment in *StormReady* will depend on current assets. There is currently no grant funding for becoming *StormReady*. However, the Insurance Services Organization (ISO) provides CRS credit to *StormReady* communities. This credit is used to determine the CRS rating, which can lower flood insurance rates.

For details on how to become *StormReady* and the requirements based on community size see http://www.stormready.noaa.gov/. For a list of currently certified Stormready communities and counties, see www.stormready.noaa.gov/com-maps/ok-com.htm.

## B.5.15 Conclusions

1. Using solid, dependable threat recognition systems is first and foremost in emergency services.
2. Following a threat recognition, multiple or redundant warning systems and instructions for action are most effective in protecting residents.
3. Good emergency response plans that are updated yearly ensure that well-trained and experienced people can quickly take the appropriate measures to protect residents and property.
4. To ensure effective emergency response, critical facilities protection must be part of the plan.
5. Post-disaster recovery activities include providing neighborhood security, safe drinking water, appropriate vaccinations, and cleanup and regulated reconstruction.

## B.5.16 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

# B.6 Natural Resource Protection

Natural resource protection activities are generally aimed at preserving and restoring the natural and beneficial uses of natural areas. In doing so, these activities enable the beneficial functions of floodplains and drainageways to be better realized. These natural functions include:

- storage of floodwaters;
- absorption of flood energy;
- reduction of flood scour;
- infiltration and aquifer/groundwater recharge;
- removal/filtration of excess nutrients, pollutants, and sediments from floodwaters;
- habitat for flora and fauna;
- recreation and aesthetic opportunities;
- opportunities for off-street hiking and biking trails.

**Wetlands are a valued resource to ecosystems and should be protected.**

This Section reviews natural resource protection activities that protect natural areas and mitigate damage from other hazards. Integrating these activities into the hazard mitigation program will not only reduce the community's susceptibility to flood damage, but will also improve the overall environment.

## B.6.1 Wetland Protection

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and provide habitat for many species of fish, wildlife, and plants.

Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits.

**Wetlands**

- Store large amounts of floodwaters.
- Reduce flood velocities and erosion.
- Filter water, making it cleaner for those downstream.
- Provide habitat for species that cannot live or breed elsewhere.

## B.6.2 Erosion and Sedimentation Control

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as when it enters a lake or a wetland.

Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging costs.

Construction projects, which can expose large areas to erosion, should be closely monitored.

Not only are the drainage channels less able to do their job, but also the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified as the nation's number one nonpoint source pollutant for aquatic life.

Practices to reduce erosion and sedimentation have two principal components:

1. minimize erosion with vegetation;
2. capture sediment before it leaves the site.

Lack of vegetation along drainage channels promotes erosion.

Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as terraces, contour strip farming, no-till farm practices, sediment fences, hay or straw bales (as illustrated), constructed wetlands, and impoundments (e.g., sediment basins and farm ponds).

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

One tried and true approach is to have the contractor design the detention basins with extra capacity. They are built first, so they detain runoff during construction and act as sediment catch basins. The extra capacity collects the sediment that comes with the runoff until the site is planted and erosion is reduced.

## B.6.3 River Restoration

There is a growing movement that has several names, such as "stream conservation," "bioengineering" or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration" which restores native indigenous plants and animals to an area.

A key component of these efforts is using appropriate native plantings along the banks that resist erosion. This may involve "retrofitting" the shoreline with willow cuttings, wetland plants, and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

**Retrofitting streambanks with willow cuttings and geotextiles can be more cost effective than riprap or concrete-lined floodways.**

Studies have shown that after establishing the right vegetation, long-term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten-year period, the combined costs of installation and maintenance of a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

## B.6.4 Best Management Practices

*Point source* pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. State and federal water quality laws have reduced the pollutants that come from these facilities.

*Non-point source* pollutants come from non-specific locations and are harder to regulate. Examples are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

Best management practices (BMPs) are measures that reduce nonpoint source pollutants that enter the waterways. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants.

There are three general categories of BMPs:

1. **Avoidance**—Setting construction projects back from the stream;
2. **Reduction**—Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage;
3. **Cleansing**—Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-purpose stormwater facilities.

Because of the need to clean up our rivers and lakes, there are several laws mandating the use of best management practices for new developments and various land uses. The furthest reaching one is the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) requirements.

### B.6.5 Dumping Regulations

NPDES addresses liquid pollutants. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of a property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

### B.6.6 Conclusions

1. Wetlands play an important role in the natural course of flood control, preservation of water quality, and wildlife habitation, making a strong case for their protection.
2. Erosion can be reduced by use of vegetation. Sedimentation should be captured before it leaves its original location with oversized detention basins.
3. Vegetation used along riverbanks works more effectively in river maintenance than using banks made of concrete.
4. Nonpoint source pollutants are best managed by keeping construction projects away from streams, reducing sediment runoff, and using grass drainageways and detention basins for filtration.
5. Dumping regulations need to be communicated to the public and enforced.

6. The establishment and maintenance of wildlife habitat and natural ecosystems should be an important aspect of any drainage system program the community may implement in regards to floodplain management. This can be developed in cooperation with the Oklahoma Department of Wildlife Conservation, allowing aquatic plants and wildlife to be established in stormwater detention ponds and floodways.

## B.6.7 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.