

## Lesson 3. Assessing Risks

### Introduction

This lesson describes a methodology that can be used by communities to determine what hazards potentially threaten a community and how vulnerable the community is to those risks. Once completed, a community has valuable data to use as the basis for the hazard mitigation plan, emergency plans, and other long-term community planning mechanisms.

### A Systematic Approach to Assessing Risks

Risk Assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process is accomplished by completing four steps, which are described in FEMA's planning guide entitled, "Understanding Your Risks: Identifying and Estimating Hazard Losses."

- Step 1: Identify hazards.
- Step 2: Profile hazard events.
- Step 3: Inventory assets.
- Step 4: Estimate losses.

### Risk Assessment Terms

Before we proceed, there are some important risk assessment terms that are sometimes misunderstood and therefore will be defined, namely *hazards*, *vulnerability*, *exposure*, and *risk*.

Hazard	A <b>hazard</b> is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Hazards exist with or without the presence of people and land development. Earthquakes, hurricanes, tornadoes, and other geological and meteorological events have been occurring for a very long time, and the natural environment adapted to their impacts. Hazard identification is the process of identifying hazards that threaten a given area.
Vulnerability	<b>Vulnerability</b> is susceptibility to physical injury, harm, damage, or economic loss. It depends on an asset's construction, contents, and economic value of its functions. Vulnerability assessment provides the extent of injury and damages that may result from a hazard event of a given intensity in a given area.
Exposure	<b>Exposure</b> is the people, property, systems, or functions that could be lost to a hazard. Generally exposure includes what lies in the area the hazard could affect.
Risk	<b>Risk</b> depends on all three factors: hazard, vulnerability, and exposure. Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. It refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.

## Lesson 3. Assessing Risks

### Step 1: Identify Hazards

This step answers the question: What kind of hazards can affect your community?

There are many ways to find hazard information. Review existing plans, such as emergency operations plans. Hazards may be described there. Search old newspapers and other historical records. Talk to the experts in the community, State, or region. Gather information such as hazard maps on Internet websites of agencies such as FEMA, Department of Homeland Security, U.S. Geological Survey (USGS), the National Oceanographic and Atmospheric Agency (NOAA), and the U.S. Forest Service.

If preliminary research reveals that your community or State has been directly affected by a specific hazard, or that your area is threatened by one, address it in greater detail later in the process. If the area has not been affected by a hazard event in several years, but it is identified as a possible threat, confirm that the hazard type is relevant by going to the websites of the agencies listed above.

Completion of this step will produce a list of hazards that could affect the community. Another benefit of this research is to begin to foster relationships with experts at the State and community levels.

### Step 2: Profile Hazard Events

This step answers the question: “How bad can it get?”

Profiling hazards is necessary because each hazard type has unique characteristics that can cause different types of damage. In addition, the same hazard events may affect communities in different ways because of various community characteristics, such as geography, development trends, population distribution, and age and type of buildings.

A hazard profile includes:

- The location or geographical areas that would be affected.
- The hazard extent (magnitude or severity). For hazards not geographically determined, like tornadoes, recorded intensities of previous events are used.
- The probability, likelihood, or frequency of the event occurring.
- Any past occurrences of the hazard events in or near the community.

The best way to show areas affected by hazards is to record the data on a base map. A base map should be as complete, accurate, and current as possible. Depending on community resources, it can be as sophisticated as a digital display or as simple as a paper map of the community.

## Lesson 3. Assessing Risks

### Step 2: Profile Hazard Events (Continued)

For example, transfer flood boundaries and base flood elevations (BFEs) from a FEMA Flood Insurance Rate Map (FIRM) onto the base map. If there is an earthquake risk, transfer the Peak Ground Acceleration (PGA) zones from a USGS map onto the base map. Completion of this step will produce a map showing the area impacted by each hazard type.

### Step 3: Inventory Assets

Step 3 answers the question: “What assets will be affected by the hazard event?”

Assets are the people, property, and activities in a community. The product of this step is a list of the assets in the community. This enables hazard mitigation planning teams to understand what can be affected by different hazard events. The level of detail in this step will determine the quality of the loss estimate in the final risk assessment step.

Incorporate in the asset inventory an overview, or summary, of the impact on the community's vulnerable structures. Include, by type of hazard, a general description of the types of structures (e.g., buildings, infrastructure, and critical facilities) affected by the hazard. For example, flooding will affect all structures whose lowest floors are built below the base flood elevation. Include a general description of the extent of the hazard's impact to vulnerable structures. This description can be presented in terms of dollar values or percentage of damages.

Among the most urgent and important assets within the community are critical facilities. The community will be able to make better decisions about how to expend resources to protect critical facilities as a result of this type of assessment. Critical facilities include the following:

- **Essential facilities** for the health and welfare of the whole population (e.g., hospitals, police and fire stations, emergency operations centers, evacuation shelters, and schools).
- **Transportation systems**, including airways, highways, railways, and waterways.
- **Lifeline utility systems**, such as potable water, wastewater, oil, natural gas, electric power, and communication systems.
- **High potential loss facilities**, such as nuclear power plants, dams, and military installations.
- **Hazardous material facilities**, producing industrial/hazardous materials (e.g., corrosives, explosives, flammable materials, radioactive materials, and toxins).

## Lesson 3. Assessing Risks

### Step 3: Inventory Assets (Continued)

If the community has the resources to take the inventory to a greater level of detail, it is possible to determine the proportion of buildings, the value of buildings, and the population of hazard areas. Keep track of the inventory data gathered for each hazard being assessed.

This step should also include a look at the location(s) of expected growth in the community. This information can be found by referring to the local comprehensive plan, or talking with community officials to determine where future growth is expected to take place. Are those areas located within hazard areas?

The FEMA criteria for approval of a local hazard mitigation plan do not require any greater detail in the risk assessment. However, the asset inventory at this point includes only the total estimated population, number of buildings, and value of buildings in the hazard area. Ending the inventory now provides only a very broad picture of potential damage from a hazard event. It will not allow you to specify the structures at greatest risk of damage, making objective determination of mitigation priorities difficult in the next phase of the planning process.

The following questions will help you determine how much more information to collect, if any.

Do you have enough data to determine:

- Where greatest damages may occur?
- Where critical facilities will be operational after an event?
- Which assets are subject to greatest potential damages?
- If historic, environmental, or cultural resources are vulnerable?
- Severity, repetitiveness, or likelihood of particular hazard?
- Benefit of mitigation actions?

If the planning team decides to proceed, it will gather information on the assets that can be damaged by a hazard event. Characteristics of different hazards create the need for different types of data. For example, for flooding the following data are needed:

- Building type/type of foundation.
- Building code design level/date of construction (i.e., before or after the floodplain ordinance?).
- Topography.
- Distance from hazard zone (flood zone).

## Lesson 3. Assessing Risks

### Step 4: Estimate Losses

Step 4 answers the question: “How will the community’s assets be affected by the hazard event?” This step provides the community and the State with a common framework in which to measure the effects of hazards on vulnerable structures. Steps 1 to 3 of the risk assessment phase involve gathering data on the hazards that may affect the community and the assets that can be damaged by the hazard event. All that information will be put to use in the fourth and final step, Estimate Losses.

This step is not required for approval of a local hazard mitigation plan by FEMA. If it is completed, it does provide a greater degree of dependability upon which to base the hazard mitigation strategy. The following list of activities provides only a brief synopsis of how to complete a loss estimate:

- Estimate the losses to structures.
- Estimate the losses to contents.
- Estimate the losses to structure use and function.
- Calculate the loss from each hazard event.
- Calculate the losses to each asset.
- Calculate the estimated damages for each hazard event.

Create a composite map of the risk assessment data that have been collected and mapped, and create a composite loss map. A composite map overlays the results of individual hazard maps to determine areas with relatively more assets at risk than others.

FEMA has developed a loss estimation model that is useful in estimating losses from earthquakes, floods and hurricane winds. HAZUS-MH is a geographic information system (GIS) software package that uses census data and other existing databases to estimate damage and losses, including:

- Physical damage: damage to residential and commercial buildings, schools, critical facilities, and infrastructure;
- Economic loss: lost jobs, business interruptions, repair and reconstruction costs; and
- Social impacts: impacts to people, including requirements for shelters and medical aid.

During the past decade, HAZUS-MH has evolved into a powerful tool for mitigation and recovery planning and analysis. An increasing number of states and localities are using HAZUS-MH in the preparation of risk assessments and mitigation plans under the Disaster Mitigation Act of 2000. HAZUS-MH is also being used to support post-disaster planning for recovery from hurricanes, earthquakes, and floods.

## Lesson 3. Assessing Risks

### Step 4: Estimate Losses

States and communities may obtain free HAZUS-MH software and training from FEMA. Information is available at [www.FEMA.gov/hazus](http://www.FEMA.gov/hazus).

HAZUS-MH can be used by individuals and organizations with limited knowledge of hazard analysis, as well as by those with extensive expertise in the earth, building, and GIS sciences due to its diverse range of options. FEMA has developed a free on-line seminar that provides an overview of the capabilities of HAZUS-MH and how it can support mitigation, response, and recovery efforts. You can find this seminar at

[http://campus.esri.com/acb2000/showdetl.cfm?did=6&Product\\_id=851&CFID=1679765&CFTOKEN=55742665](http://campus.esri.com/acb2000/showdetl.cfm?did=6&Product_id=851&CFID=1679765&CFTOKEN=55742665)

or

go to <http://campus.esri.com/campus/home/workshoplist.cfm> and look for Hazus.

### Summary

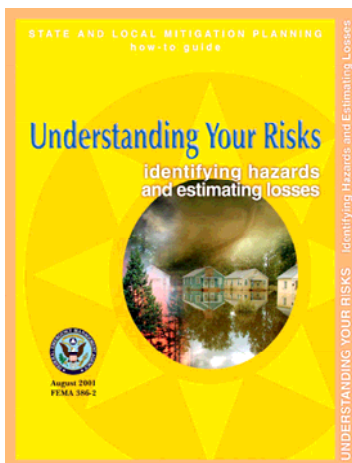


Photo: Cover of FEMA publication 386-2, "Understanding Your Risks: Identifying Hazards and Estimating Losses"

Note that each community will determine for itself what constitutes "moderate," "high," and "extreme" vulnerability criteria.

The risk assessment steps taken in this phase of the mitigation planning process provide the basis for developing a multi-hazard mitigation plan.

This unit has included methods for answering the following questions:

- What kinds of hazards can affect the community?
- How bad can it get?
- What will be affected by these hazards?
- How will these hazards affect the community?

For more detailed instructions on how to complete each step of the risk assessment process, refer to the FEMA publication 386-2, "Understanding Your Risks: Identifying Hazards and Estimating Losses."

### Lesson 3. Assessing Risks

#### Hazard Mitigation in Your Community

Based on your knowledge of your community, complete the following table to determine what hazards you might be considering in your risk assessment.

Type of Hazard	Frequency: Times in the last			Population Impact			Property Impact		
	5 yrs.	10 yrs.	20 yrs.	High	Med	Low	High	Med	Low
Aircraft Accident									
Avalanche									
Civil Disorder									
Coastal Storm									
Communication (disruption)									
Dam Failure									
Drought									
Earthquake									
Extreme Heat									
Flood (rapid snow melt, ice jam, heavy rain)									
Hail									
HAZMAT (fixed facility, transportation)									
Hurricane									
Landslide (earthquake included, rain-induced)									
Lightning									
National Emergency									
Utility Interruption (communication, electricity, natural gas)									
Radiological (fixed facility, transportation)									
Subsidence (sinkhole)									
Thunderstorm (microburst)									

### Lesson 3. Assessing Risks

#### Hazard Mitigation in Your Community (Continued)

Type of Hazard	Frequency: Times in the last			Population Impact			Property Impact		
	5 yrs.	10 yrs.	20 yrs.	High	Med	Low	High	Med	Low
Tornado (microburst)									
Transportation (air, rail, interstate, primary highway, county/city roads, military missile)									
Urban Fire (conflagration)									
Volcanic Ash									
Volcanic Explosion									
Wildland Fire (urban interface, public land, private land)									
Winter Storm (snow, ice, extreme cold)									
Chemical									
Biological									
Explosion									
Arson									
Release									



### Lesson 3. Assessing Risks

#### Test Yourself

1. Match the terms with their definitions.

Hazard  
Risk

Vulnerability  
Risk assessment

Exposure

\_\_\_\_\_ is the estimated impact that a hazard would have on people, services, facilities, and structures in a community.

\_\_\_\_\_ is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing.

\_\_\_\_\_ is the people, property, systems, or functions that could be lost to a hazard.

\_\_\_\_\_ is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

\_\_\_\_\_ is the susceptibility to physical injury, harm, damage, or economic loss.

2. The four major steps of a risk assessment are:

3. Three ways to find hazard information are:

4. A hazard profile includes: (*select all that apply*)

- Location or geographical areas not affected by the hazard event.
- Hazard magnitude or severity.
- Probability, likelihood, or frequency of the hazard event occurring.
- Any past occurrences of the hazard events in or near the community.
- Benefit-cost analysis of the community's sustainability quotient.

5. Among the most urgent and important assets within the community are \_\_\_\_\_ facilities.

### Lesson 3. Assessing Risks

#### Test Yourself (Continued)

6. **True or False.** Loss estimation is not required for approval of a local hazard mitigation plan by FEMA, but provides valuable information to the selection of the mitigation strategy.
  
7. \_\_\_\_\_ is the loss estimation software program that is useful in predicting the physical, economic, and social impacts of various hazard events.