

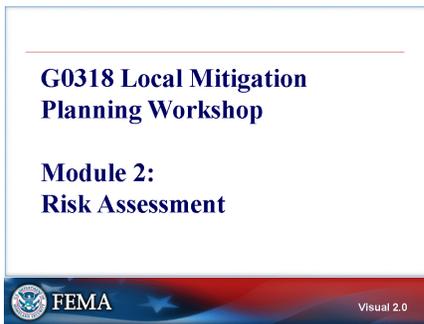
MODULE 2: RISK ASSESSMENT

OBJECTIVES

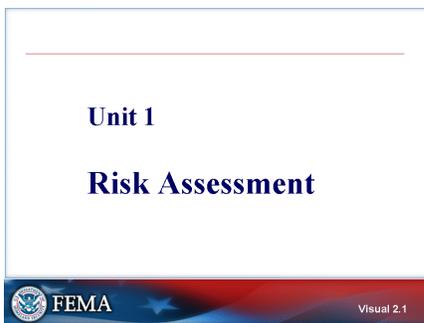
Participants will understand how to assess risk.

METHODOLOGY

This section includes lecture, discussion question, and a tabletop activity, and provides an opportunity for participants to ask questions.



Visual 2.0



Visual 2.1

Module 2: Risk Assessment

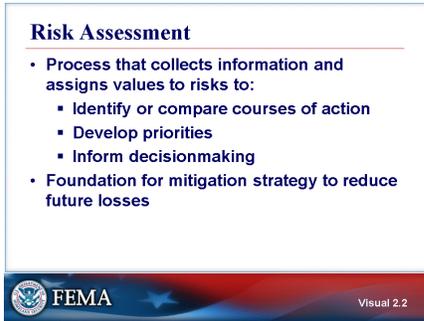
By the end of this module, participants will be able to develop a hazard risk assessment that forms a factual basis for mitigation actions appropriate for their community.

At the end of Module 2, participants will:

- Understand risk assessment terminology
- Recognize hazards and community assets
- Determine potential losses to vulnerable community assets
- Be able to summarize their community's vulnerability to the identified hazards

Unit 1: Risk Assessment

Unit 1 presents an approach for conducting a local risk assessment. At the end of this unit, participants will understand risk assessment terminology.



Visual 2.2

Risk Assessment

- Process that collects information and assigns values to risks to:
 - Identify or compare courses of action
 - Develop priorities
 - Inform decisionmaking
- Foundation for mitigation strategy to reduce future losses

The planning team conducts a risk assessment to determine the potential impacts of natural hazards on the community. The risk assessment provides the foundation for the rest of the mitigation planning process, which is focused on identifying and prioritizing actions the community can take to reduce risk to natural hazards.

In addition to informing the mitigation strategy, the risk assessment can be used to establish emergency preparedness and response priorities, for land use and comprehensive planning, and for decisionmaking by elected officials, city and county departments, businesses, and organizations in the community.

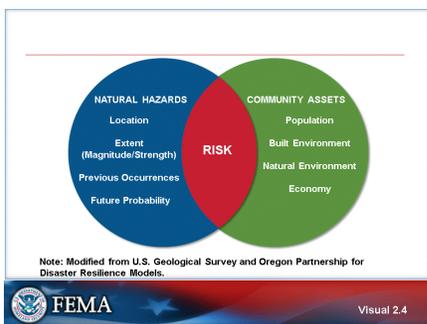
There are many approaches to risk assessments depending on available data, technology, and resources. Local risk assessments do not need to be created using sophisticated technology, but do need to be accurate, current, and relevant.



Visual 2.3

Risk Assessment Terms

- Natural Hazard
 - Source of harm or difficulty created by a meteorological, environmental, or geological event
- Community Assets
 - The people, structures, facilities, and systems that have value to the community
- Vulnerability
 - Characteristics of community assets that make them more or less susceptible to damage from a given hazard
 - Vulnerability depends on factors such as construction materials, building techniques, and location
- Impact
 - The consequence or effect of a hazard on the community and its assets
- Risk
 - The potential for damage or loss created by the interaction of natural hazards with community assets



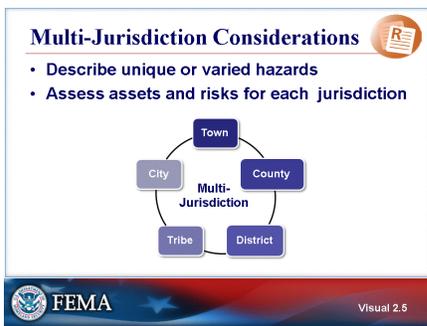
Visual 2.4

Natural Hazards, Community Assets, and Risk

Risk, for the purposes of hazard mitigation planning, is the potential for damage or loss created by the interaction of natural hazards with community assets.

Hazards are natural processes, such as tornados and earthquakes, that people and communities have little control over. However, the exposure of people, property, and other community assets to natural hazards can result in disasters depending on the impacts.

Impacts are the consequences or effects of the hazard on the community and its assets. The type and severity of impacts are based on the vulnerability of the asset, as well as the community capabilities in place to mitigate prepare, respond, and recover from events.

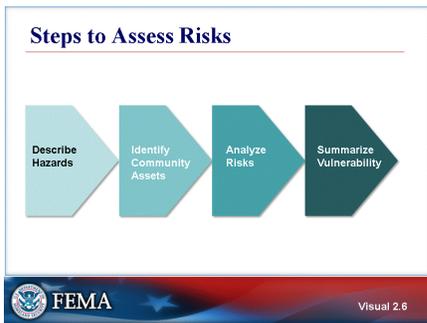


Multi-Jurisdiction Considerations

- Describe unique or varied hazards
- Assess assets and risks for each jurisdiction

Assets, vulnerabilities, and overall risk are unique to each community. For multi-jurisdictional planning efforts, the risk assessment must result in an evaluation of potential impacts and issues of concern for each participating jurisdiction to use in developing mitigation actions specific to each jurisdiction. Although hazards may be described for the entire planning area, the plan also must explain any hazards that are unique or varied within communities.

Reference: 44 CFR §201.6(c)(2)(iii)



Steps to Assess Risk

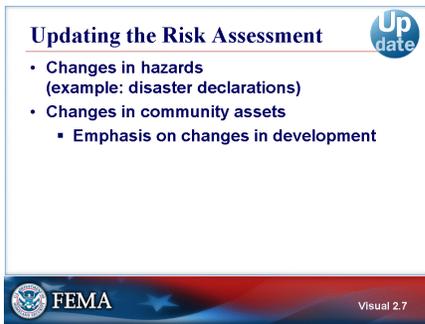
There are four basic steps to a risk assessment:

1. Describe Hazards
2. Identify Community Assets
3. Analyze Risks
4. Summarize Vulnerability

The desired outcomes of these steps are:

- An evaluation of the potential impacts of each hazard on the assets, the people, economy, and built and natural environments in the planning area
- An understanding of each community’s most significant risks and issues of concern

These potential impacts and issues of concern will be used to create problem statements and identify mitigation actions to reduce risk.



Visual 2.7

Updating the Risk Assessment

- Changes in hazards (example: disaster declarations)
- Changes in community assets
 - Emphasis on changes in development

A mitigation plan update focuses on how risk has changed since the previous plan was completed, particularly changes related to land use development and new hazard information.

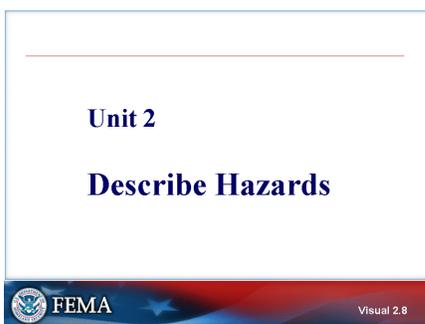
Changes in development, population shifts, areas affected by recent disasters, and new data and reports must be incorporated into the plan to analyze the current risk and update problem statements.

Changes in development means recent development (for example, construction completed since the last plan was approved), potential development (for example, development planned or under consideration by the jurisdiction), or conditions that may affect the risks and vulnerabilities of the jurisdictions (for example, climate variability, declining populations or projected increases in population, or foreclosures). Not all development will affect a jurisdiction's vulnerability. The plan should focus on development that may occur in hazard-prone areas given current zoning codes.

Unit 2: Describe Hazards

At the end of this unit, participants will be able to recognize

- Hazard description requirements
- Community assets



Visual 2.8



Visual 2.9



Visual 2.10

Step 1: Describe Hazards

- Describe Hazards
- Identify Community Assets
- Analyze Risks
- Summarize Vulnerability

Describing hazards is step one of the risk assessment. The plan must include a description of the natural hazards that can affect the jurisdiction(s) in the planning area.

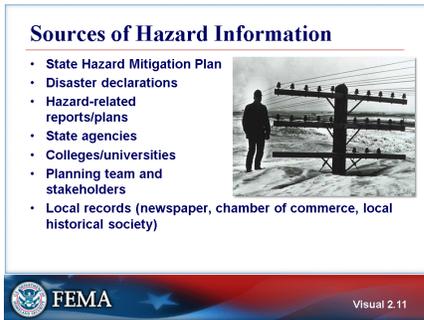
Types of Hazards

- **Natural hazards** must be addressed in a local mitigation plan; this is required by Federal regulation.

However, some communities may choose to assess other hazards in their planning process, and the mitigation plan may be the most appropriate tool for that community.

- **Technological hazards** result from accidents or the failure of systems and structures, such as hazardous materials spills, dam failure, or airplane accidents.
- **Human-caused hazards**, also known as threats, result from intentional actions of an adversary, such as a chemical or cyber-attack.
- **Climate change** in and of itself may not be a hazard, but it may change the characteristics of the hazards that currently affect the planning area, and climate adaptation strategies may complement other hazard mitigation strategies.

Federal mitigation planning regulations do not require technological and human-caused hazards to be included in the plan, but a community may choose to do so. See *Integrating Manmade Hazards into Mitigation Planning* (FEMA 386-7) for suggestions and information on including these types of hazards in the mitigation plan.



Visual 2.11

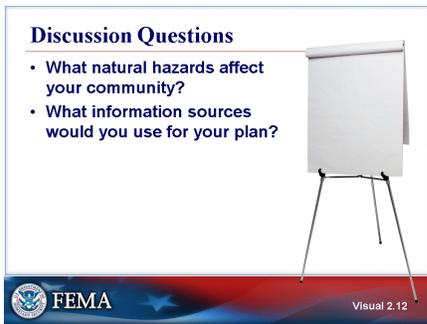
These photographs depict a natural hazard (blizzard in Colorado); a technological hazard (oil spill in Gulf of Mexico); a human-caused hazard (bombing of Federal building in Oklahoma City); and an impact of climate change hazard (drought in Marshall Islands).

Sources of Hazard Information

- State Hazard Mitigation Plan
- Disaster declarations
- Hazard-related reports/plans
- State agencies
- Colleges/universities
- Planning team and stakeholders
- Local records (newspaper, chamber of commerce, local historical society)

Review State Hazard Mitigation Plan for information on hazards affecting your planning area.

- Document the disaster declaration history of the planning area.
- Review existing studies, reports, and plans related to flooding, wildfire, geological, and other hazards in the planning area. State agencies are also good sources for hazard-related information.
- Contact colleges or universities that have hazard-related academic programs or extension services.
- Interview your planning team and stakeholders about which hazards pose risks to the planning area and should be described in the mitigation plan.
- Consult local resources such as the newspaper, chamber of commerce, local historical society, or other resources with records of past occurrences.
- For plan updates, reference hazards previously identified and determine if they are still fitting.



Visual 2.12



Visual 2.13

Discussion Questions

- What natural hazards affect your community?
- What information sources would you use for your plan?

Hazard Descriptions

- Location
- Extent
- Previous Occurrences
- Probability of Future Events

For each hazard affecting the planning area, the risk assessment must include a description of location, extent, previous occurrences, and probability of future events. Hazard descriptions explain which hazards are most significant and which locations of the planning area are most likely to be affected.

Plan updates will incorporate any additional hazards that have been identified and any new data that has become available, such as new flood studies. Plan updates must include hazard events that have occurred since the last plan was developed.



Visual 2.14



Visual 2.15

Location

Location is the geographic areas within the planning area that are affected by the hazard, such as a floodplain. Hazard areas may be further defined, such as high wildfire hazard areas versus low wildfire hazard areas.

Maps are the best way to illustrate location for many hazards. The locations that could be affected by a hazard may be described in a narrative or shown on maps in the plan.

The entire planning area may be uniformly affected by some hazards, such as drought or winter storm.

This map is part of a Flood Insurance Rate Map showing the location of the 1-percent-annual-chance floodplain in Moab, Utah

Extent

Extent is the strength or magnitude of the hazard, and it can range from nuisance to catastrophic levels. Extent is a characteristic of the hazard regardless of its effect or impact. Extent can be described different ways depending on the hazard, such as:

- An established scientific scale or measurement system, such as the Enhanced Fujita Scale for tornadoes
- The speed of onset
- The duration of hazard events

Describing the *extent* of a hazard is not the same as describing its potential impacts on a community. Extent defines the characteristics of the hazard regardless of the people and built environment it affects, while *impacts* refers to the effect of a hazard on the people and property in the community.

This map shows the potential depth of water during a flood in Moab, Utah.

Previous Occurrences

Date of Flood	Property Damage	Date of Flood	Property Damage
August 19, 2010	\$2,500,000	September 12, 2002	\$25,000
August 28, 2007	\$1,000	July 30, 1999	\$2,000
July 23, 2007	\$1,000	July 14, 1999	\$60,000
October 14, 2006	\$15,000	September 6, 1997	\$175,000
October 9, 2006	\$20,000	July 31, 1976	\$50,000
October 6, 2006	\$500,000	September 18, 1972	\$385
October 3, 2006	\$25,000	July 29, 1969	\$1,250
July 10, 2006	\$25,000	August 2, 1963	\$5,000
September 9, 2005	\$3,000		

Source of data: <http://webra.cas.sc.edu/hvri/products/sheldus.aspx>



Visual 2.16

Visual 2.16

Previous Occurrences

The plan must include the history of previous hazard events for each identified hazard. This information helps estimate the likelihood of future events and predict potential impacts. When data are available, describe the extent of the event and the impacts that occurred, such as fatalities and injuries, building and infrastructure damage, and loss of services.

Visual illustrates information on previous occurrences of flooding from the Colorado River in Grand County, Utah, and the estimated property damages for each occurrence.

Previous Occurrences

Date of Flood	Property Damage
August 19, 2010	\$2,500,000
August 28, 2007	\$1,000
July 23, 2007	\$1,000
October 14, 2006	\$15,000
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Probability of Future Events

- The previous slide shows:
 - There were 17 occurrences of flooding in Grand County, UT
 - Over 48 years from 1962 through 2010

With 17 occurrences in 48 years, probability of future occurrence is $17/48 = 0.3542$ or about a 35% chance of flooding in any year



Visual 2.17

Probability of Future Events

- The previous visual shows:
 - There have been 17 occurrences of flooding in Grand County, UT
 - Over 48 years from 1962 through 2010

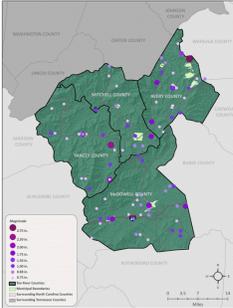
With 17 occurrences in 48 years, probability of future occurrence is $17/48 = 0.3542$ or about a 35 percent chance of flooding in any year

Probability of Future Events is the likelihood of the hazard occurring in the future. Probability may be defined using historical frequencies or statistical probabilities. For example, the likelihood of a flood event of a given size is defined by the percent chance of occurrence in a single year, such as the 1-percent-annual-chance flood, also known as a 100-year flood. Hazard likelihood can also be compared using general descriptions or rankings. If general descriptors are used, then they must be defined in the plan. For example, “highly likely” could be defined as occurring less than every 10 years, “likely” as occurring every 10-50 years, and “unlikely” as occurring at intervals greater than 50 years.

Hazard Map

- Location
- Extent
- Previous occurrences

Reference: *Toe River Region, NC Hazard Mitigation Plan*




Visual 2.18

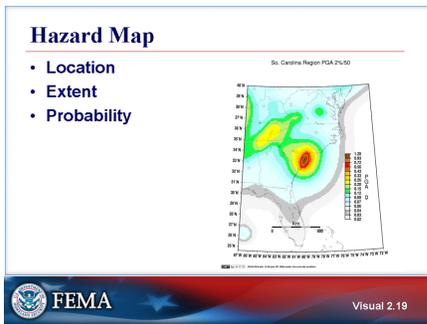
Hazard Map

- Location
- Extent
- Previous occurrences

Reference: *Toe River Region, NC, Hazard Mitigation Plan*

Hazards can be described in narrative, paragraph form, or visually through tables, maps, charts, or photographs. Some maps can be used to illustrate multiple elements, such as location and probability.

This map of the Toe River watershed in North Carolina shows the location of previous hail events, indicates the extent or size of the hail, and shows the number of previous occurrences.



Visual 2.19

Hazard Map

- Location
- Extent
- Probability

This map shows the potential Peak Ground Acceleration (PGA) for South Carolina. It identifies the locations with the greatest earthquake risk, the extent of the risk based on a scientific scale, and the probability of damage based on location.

Hazard	Location	Extent	Probability
Tornado	Entire planning area	EF2	2% chance per year
Hail	Entire planning area	1" diameter	10% chance per year
Flood	Along 0.2 mile of stream in Town A only	6" to 12" depth	25% chance per year

Visual 2.20

Summarize Hazard Information

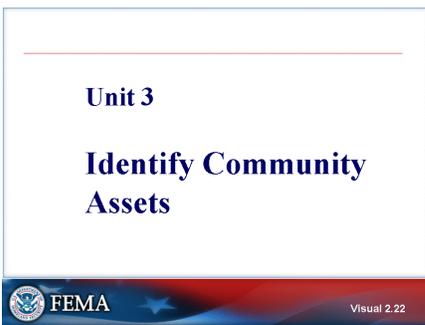
A table or matrix can be a good way to summarize information from the hazard descriptions and portray which hazards have the greatest significance to jurisdictions in the planning area.

Summarize Hazard Information

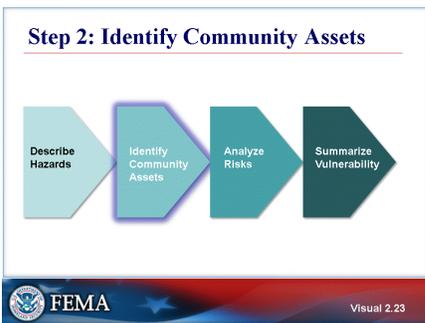
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Visual 2.21



Visual 2.22



Visual 2.23

Are there any questions?

Unit 3: Identify Community Assets

At the end of this unit, participants will be able to identify the community assets that are vulnerable to identified hazards.

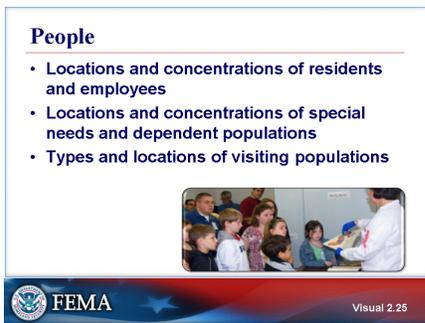
Step 2: Identify Community Assets

- Describe Hazards
- Identify Community Assets
- Analyze Risks
- Summarize Vulnerability

Each participating jurisdiction needs to inventory local assets at risk to hazards. Assets are defined broadly to include anything that is important to the character and function of a community.



Visual 2.24



Visual 2.25

Community Assets

Assets can be described in the following categories:

- People
- Economy
- Structures (Existing and Future Development)
- Critical Facilities and Infrastructure
- Natural Environment

When updating a mitigation plan, the planning team will need to update the asset inventory to reflect current conditions and analyze how changes in vulnerable populations, new or renovated critical facilities, infrastructure expansion, economic shifts, and new development in hazard-prone areas affect risk.

People

- Locations and concentrations of residents and employees
- Locations and concentrations of special needs and dependent populations
- Types and locations of visiting populations

An asset inventory should identify areas of higher population density of residents and workers, as well as the types of populations that may have unique vulnerabilities or be less able to respond and recover in a disaster. Consider the following populations in the community:

- **Concentrations of residents and employees during day, night, and commute hours.** Populations shift throughout the day, typically based on a work commute schedule, seasonal tourist events, and school calendars.

- **Types of visiting populations and locations where they are likely to congregate.** Visiting populations include students, second home owners, migrant farm workers, or visitors for special events that may be less familiar with the local environment and hazards and are not prepared to protect themselves in an event.
- **Locations and concentrations of special needs and dependent populations.** The very young, the elderly, the disabled, and non-English speakers are just some of the special needs and dependent populations that may require more assistance during and following hazard events. Locations of facilities that provide necessary services (e.g., hospitals, shelters, oxygen delivery, and accessible transportation, etc.) also need to be considered in terms of their vulnerability to risks.
- **Demographics of projected population growth.** This information may also be considered to avoid potential development subject to hazards.



Visual 2.26

Economy

- Major employers
- Primary economic sectors
- Commercial centers
- Dependencies between economy and infrastructure

Identify the economic assets whose losses or inoperability would have severe impacts on the community and its ability to recover from a disaster. These may include primary economic sectors in the community, major employers, and commercial centers. The planning team should also assess the dependencies between major economic assets and infrastructure.



Visual 2.27

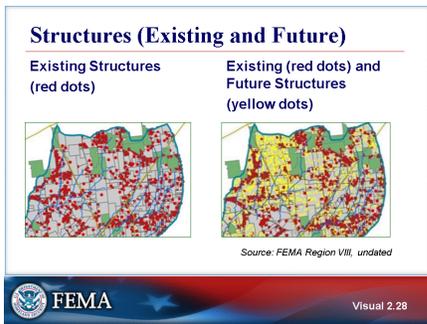
Structures (Existing and Future)

- Locations, types, and values of structures
- Cultural and historic resources
- Locations and types of planned new development / redevelopment
- Infrastructure for new development
- Planned critical facilities and capital improvements

FEMA regulation requires that the asset inventory consider not only the existing built environment, but also future development. Each participating jurisdiction should consider the following:

- Types of buildings by occupancy type, including commercial, industrial, and single- and multi-family residential
- Age and construction type of existing buildings to understand inventory
- Current building code and subdivision standards to determine whether the minimum requirements reflect the community's acceptable level of risk
- Museums, unique geological sites, concert halls, parks, stadiums, or any asset that is important to the community can be considered a cultural resource
- Existing land uses, as well as future land uses permitted by zoning and development trends
- Location, numbers, and types of structures of planned new development and redevelopment
- Existing stormwater management infrastructure and upgrades that will be necessary with any future development
- New facilities, infrastructure, annexations, and other planned capital improvements

The community can determine how much detail about community assets to provide in the plan.



Visual 2.28



Visual 2.29

Structures (Existing and Future)

Illustration shows a map of the location of:

- Existing Structures (on the left; location of existing structures shown as red dots)
- Existing and Future Structures (on the right; location of existing structures shown as red dots and of future structures as yellow dots)

Maps such as these show where structures will be located in the future should the area be built out as allowed by zoning or development codes.

Reference: *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan (New Jersey)*

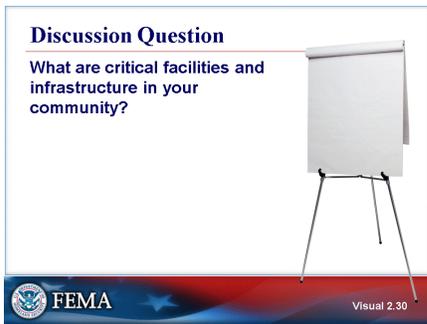
Critical Facilities and Infrastructure

- Location, age, and value of critical facilities and infrastructure
- Dependencies that exist among critical facilities and infrastructure

Critical facilities are specific assets of the built environment that provide services that are essential for life safety and economic viability. The continued operations of critical facilities during and following a disaster are key factors in the speed of recovery.

Consider not only their structural integrity and content value, but also the ways in which one critical facility depends on another and the effects of an interruption of the service they provide to the community to identify vulnerabilities.

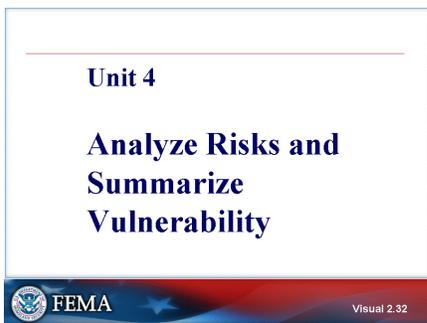
Infrastructure systems are also essential for life safety and economic viability. Many critical facilities are dependent upon infrastructure to function. For example, hospitals need electricity, water, and sewer to continue helping patients. As with critical facilities, the continued operations of infrastructure systems during and following a disaster are key factors in the severity of impacts and the speed of recovery.



Visual 2.30



Visual 2.31



Visual 2.32

Discussion Question

- What are critical facilities and infrastructure in your community?

Natural Environment

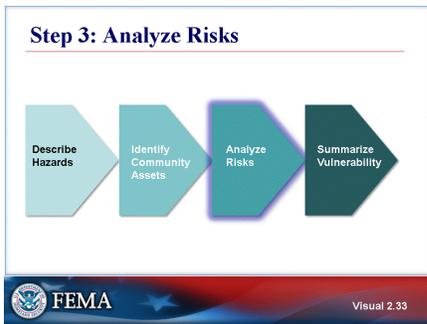
- Environmental functions that reduce magnitude of hazards
- Critical habitat areas to protect
- Areas where conservation reduces risk and achieves other community objectives (example: trails and parks)

Environmental assets and natural resources are important to community identity and quality of life and support the economy through agriculture, tourism, and recreation, and a variety of other ecosystem services, such as clean air and water. The natural environment also provides protective functions that reduce the impacts of hazards and contribute to resilience. For instance, wetlands and riparian areas help absorb and attenuate flood waters, soils and landscaping contribute to stormwater management, and vegetation in the upper watershed provides erosion control and reduces runoff.

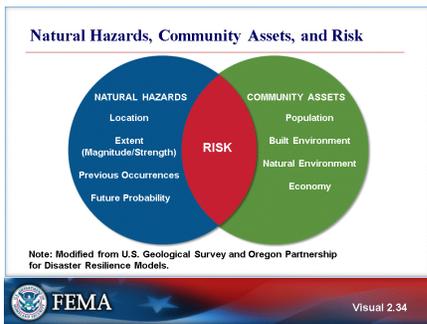
Unit 4: Analyze Risks And Summarize Vulnerability

At the end of this unit, participants will be able to:

- Determine potential impacts to vulnerable community assets
- Summarize community’s overall vulnerability to the identified hazards



Visual 2.33



Visual 2.34

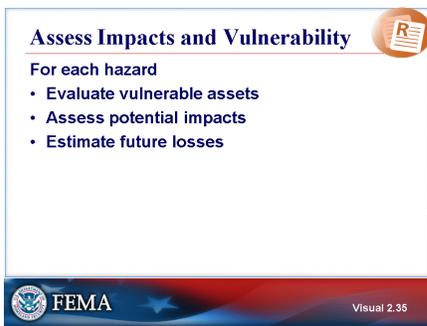
Step 3: Analyze Risks

- Describe Hazards
- Identify Community Assets
- Analyze Risks
- Summarize Vulnerability

The risk analysis step involves evaluating vulnerable assets and estimating potential impacts and losses for each hazard.

Natural Hazards, Community Assets, and Risk

The purpose of this analysis is to help the community understand the greatest risks facing the planning area. It occurs after hazards and assets have been identified.



Visual 2.35

Assess Impacts and Vulnerability

For each hazard:

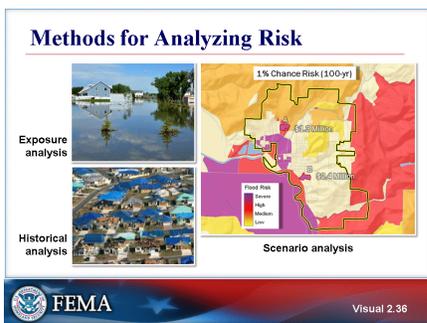
- Evaluate vulnerable assets
- Assess potential impacts
- Estimate future losses

There are a variety of methods for analyzing risk, and impacts can be expressed qualitatively or quantitatively.

Qualitative evaluations describe the types of impacts that might occur in a hazard event and can be developed by using the planning team, subject matter experts, stakeholders, and community members to brainstorm and discuss potential impacts.

Quantitative evaluations quantify the assets at risk to hazards and potential losses. Loss estimations quantify potential fatalities, injuries, direct property loss and damage, and indirect economic loss for a certain event scenario or over time (annualized loss).

Regardless of how the results are expressed or the methods of analysis used, this step must result in a description of the potential impacts of each hazard for each participating jurisdiction in the plan.



Visual 2.36

Methods for Analyzing Risk

There are a variety of methods to analyze vulnerable assets and potential impacts and estimate losses depending on the hazard and the available time, data, staff, and technical resources.

Exposure Analysis

What assets are located in hazard-prone areas?

- Quantify number, type, value of assets
- Estimate future development in hazard-prone areas based on planning and zoning
- Consider magnitude of hazard or event (high vs. moderate wildfire hazard areas)
- Use maps and GIS for analysis



Visual 2.37

Exposure Analysis

What assets are located in hazard-prone areas?

- Quantify number, type, value of assets
- Estimate future development in hazard-prone areas based on planning and zoning
- Consider magnitude of hazard or event (high vs. moderate wildfire hazard areas)
- Use maps and GIS for analysis

An exposure analysis identifies the existing and future assets located in identified hazard areas.

Exposure analysis may also take into account the magnitude of the hazard. For instance, the assets located in high, medium, or low wildfire hazard areas or the assets located in different flood frequency areas (1- percent-annual-chance flood and 0.2-percent-annual chance flood risk).

Exposure analysis can be used to quantify the number, type, and value of structures, critical facilities, and infrastructure in hazard areas and to estimate potential dollar losses of vulnerable structures. It also can be used to identify assets at risk to multiple hazards.

Exposure analysis can also be used to estimate the number of future structures and infrastructure in hazard- prone areas based on current zoning and building codes. Maps and GIS analysis are helpful tools for identifying assets located in hazard-prone areas.

Exposure Analysis

Jurisdiction	1% Annual Chance		0.2% Annual Chance*		≥ Zone (a) Flood	
	Parcel Count	Structure Value	Parcel Count	Structure Value	Parcel Count	Structure Value
Citrus Heights	157	\$30,239,260	276	\$53,562,243	23,170	\$3,719,877,361
Elk Grove	626	\$336,224,864	3,967	\$910,840,315	41,437	\$9,426,151,072
Folsom	8	\$2,519,866	124	\$389,740,000	19,787	\$6,912,627,854
Gaik	1	\$315,000	-	-	8,712	\$1,021,026,732
Isleton	324	\$29,743,866	-	-	9	\$1,833,479
Rancho Cordova	21	\$9,394,821	946	\$153,706,861	18,207	\$4,262,568,026
Sacramento	38,792	\$6,781,946,735	8,420	\$1,236,840,331	64,263	\$16,389,596,446
Unincorporated County	4,403	\$1,444,881,125	21,435	\$3,883,279,739	121,169	\$24,219,439,215
Total	33,971	\$8,265,362,735	35,118	\$6,285,199,833	322,244	\$67,269,677,981

Source: Sacramento County 2010 parcel roll database & parcel data. Sacramento County DPRA, January 2011. The parcel count for the 0.2% Annual Chance only includes those parcels in the 0.2% annual chance floodplain. The 0.2 annual chance flood also includes all parcels in the 1% annual chance floodplain.



Visual 2.38

Exposure Analysis

This visual shows an example of an exposure analysis.

Note that while this table summarizes exposure by providing the full value of structures in flood zones, it does not estimate potential loss; damage will not typically equal 100 percent of the value of a structure.

	1% Annual Chance		0.2% Annual Chance*		X Zone (no flood)	
Jurisdiction	Parcel Count	Structure Value	Parcel Count	Structure Value	Parcel Count	Structure Value
Citrus Heights	157	\$30,238,980	276	\$50,562,943	23,170	\$3,718,817,361
Elk Grove	525	\$206,224,864	3,967	\$812,840,315	41,437	\$9,429,151,072
Folsom	8	\$2,519,665	124	\$168,740,000	19,787	\$6,912,827,854
Galt	1	\$315,000	-	-	6,712	\$1,0210,595,732
Isleton	324	\$29,743,865	-	-	9	\$1,633,479
Rancho Cordova	21	\$9,394,521	946	\$153,705,651	16,207	\$4,262,908,025
Sacramento	28,192	\$6,781,945,735	8,420	\$1,736,860,331	94,263	\$18,389,505,445
Unincorporated County	4,483	\$1,444,981,125	21,415	\$3,583,079,793	131,159	\$24,219,438,215
Total	33,711	\$8,505,363,755	35,178	\$6,505,789,033	332,744	\$67,955,877,183

Historical Analysis

Based on past events, what are potential future impacts and losses?

- Use for higher frequency events with available data on past impacts and losses (e.g., winter storms, stormwater flooding)
- Consider vulnerability of new development



Visual 2.39

Hazards Suitable for Historical Analysis



Drought Flooding Severe Winter Weather



Visual 2.40

Historical Analysis

Based on past events, what are potential future impacts and losses?

- Use for higher frequency events with available data on past impacts and losses (e.g., winter storms, stormwater flooding)
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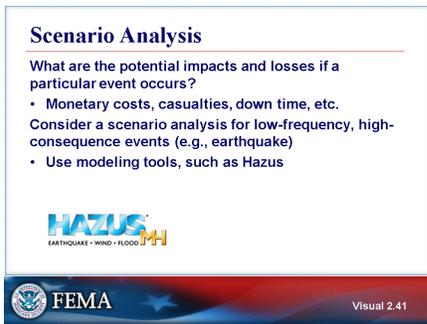
Historical analysis uses information on impacts and losses from previous hazard events to predict potential impacts and losses in a similar type of future event.

This can be especially useful for hazards that are weather-related. Because of the frequency of these events, communities are more likely to have experience with and data on impacts and losses. For recent events, consider not only what was damaged, but what might have been damaged if the event had been of greater magnitude. For hazard events that have not occurred recently, consider new development and infrastructure that would now be vulnerable in a similar event.

Hazards Suitable for Historical Analysis

- Drought
- Floods
- Severe winter weather

Historical analysis may be appropriate for events that occur relatively frequently in the planning area, such as drought, floods, and severe winter weather.



Visual 2.41

Scenario Analysis

What are the potential impacts and losses if a particular event occurs?

- Monetary costs, casualties, down time, etc.

Consider impacts for low-frequency, high-consequence events (e.g., earthquake).

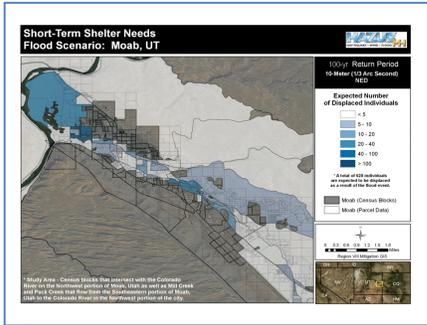
- Use modeling tools, such as Hazus

Scenario analysis asks “what if” a particular event occurred and predicts potential impacts and losses in terms of monetary costs, casualties, infrastructure down time, and other elements of risk. Scenarios are a good tool for assessing low-frequency, high-consequence events, such as earthquakes, for which historical information is not available. This type of analysis can also be used to describe possible impacts if different growth and development scenarios were to take place.

Hazus software uses a risk assessment methodology for analyzing potential losses from floods, hurricane wind, and earthquakes. In Hazus, current scientific and engineering knowledge is coupled with the GIS technology to produce estimates of hazard-related damage before, or after, a disaster occurs. Hazus analyses rely on hazard and asset data inputs to create accurate loss estimations.

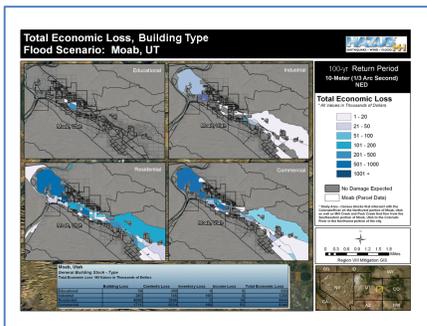
If using Hazus, the planning team should consider the following:

- Update hazard data with flood boundary, flood depth grid, earthquake shake maps, and/or hurricane wind data
- Update asset inventory with population, building stock, and critical facility data
- Edit flood depth damage functions and stream discharges



Visual 2.42

This visual shows the population along the Colorado River in Moab, Utah. This information can be used to estimate the number of displaced individuals and the short-term shelter needs for a flood scenario.



Visual 2.43

This visual shows the relative amount of estimated damages or economic losses due to flooding along the Colorado River in Moab, Utah. Maps depict losses for educational, industrial, residential, and commercial buildings.

Risk Index					
Hazard	Location	Probability	Extent	Impact	Rank
Tornado	Entire planning area	5% chance per year	EF2	Damage > \$35 million	1
Hail	Entire planning area	75% chance per year	Up to 1" diameter	Damage \$50,000 to \$100,000	2
Subsidence	Northwest corner of planning area	Very low, there is no history of subsidence	Minimal	Damage <\$500	3

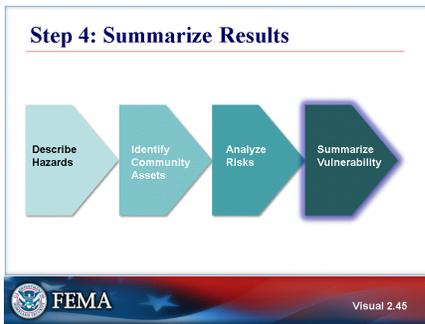
Visual 2.44

Risk Index

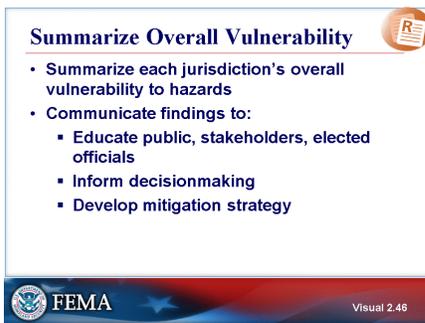
The results of these analyses could be incorporated into a risk index or matrix, such as a calculated priority risk index. The purpose of a risk index is to compare hazards to each other and rank which ones pose the greatest threat. Each hazard is given a rank based on probability, magnitude, impact, and other community identified considerations. While a risk index is not a complete risk assessment, it is a useful way to compare the results for multiple hazards. In a multi-jurisdictional plan, a risk index should be completed for each jurisdiction to reflect their unique vulnerabilities.

Risk Index

Hazard	Location	Probability	Extent	Impact	Rank
Tornado	Entire planning area	5% chance per year	EF2	Damage > \$35 million	1
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Subsidence	Northwest corner of planning area	Very low, there is no history of subsidence	Minimal	Damage < \$500	3



Visual 2.45



Visual 2.46

Step 4: Summarize Results

- Describe Hazards
- Identify Community Assets
- Analyze Risks
- Summarize Vulnerability

The risk analysis step involves evaluating vulnerable assets and estimating potential impacts and losses for each hazard.

The purpose of this analysis is to help the community understand the greatest risks facing the planning area and it occurs after hazards and assets have been identified.

Summarize Overall Vulnerability

- Summarize each jurisdiction's overall vulnerability to hazards
- Communicate findings to:
 - Educate public, stakeholders, elected officials
 - Inform decisionmaking
 - Develop mitigation strategy
 - The plan must include a summary of each jurisdiction's vulnerability to the identified hazards.

The previous three steps in the risk assessment process generate large amounts of information about hazards, vulnerable assets, and potential impacts and losses. This information needs to be summarized so the community can understand the most significant risks and vulnerabilities, not only to inform the mitigation strategy, but also to communicate findings to elected officials, and other stakeholders to inform decisionmaking.

Develop Problem Statements

To communicate vulnerabilities, develop problem statements

- Clear, concise
- Not overly technical
- Identify key issues or problems
- Based on results of the risk assessment
- Pertain to individual jurisdictions or to the entire planning area



Visual 2.47

Example Problem Statements

- Newberg City recently annexed the South Woods area located in the wildland-urban interface. The City's land use and building codes do not address wildfire hazard areas. Future development in South Woods will increase vulnerability to wildfires.
- The North Creek Sewage Treatment Plant is located in the 100-year floodplain and has been damaged in past events.



Visual 2.48

Develop Problem Statements

To communicate vulnerabilities, develop problem statements

- Clear, concise
- Not overly technical
- Identify key issues or problems
- Based on results of the risk assessment
- Pertain to individual jurisdictions or to the entire planning area

Each problem statement summarizes a particular vulnerability or problem that is supported by the findings of the risk assessment. A problem statement does not include a lot of technical information but clearly communicates one issue.

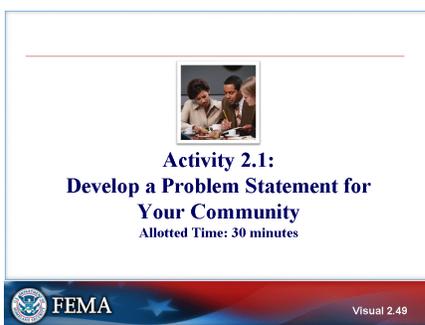
Example Problem Statements

- Newberg City recently annexed the South Woods area located in the wildland-urban interface. The City's land use and building codes do not address wildfire hazard areas. Future development in South Woods will increase vulnerability to wildfires.
- The North Creek Sewage Treatment Plant is located in the 100-year floodplain and has been damaged in past events.

One recommended approach to summarizing vulnerability is to develop problem statements. For instance, your analysis of impacts and losses allows you to identify which critical facilities are located in identified hazard areas, the neighborhood that has experienced the most flood damage in the past, or which hazard-prone areas are zoned for future development. This type of information about the issues of greatest concern can be summarized as problem statements.

The problem statement should answer:

- Location of problem
- Cause and contributing factors creating the problem
- Significance of impacts
- Who is impacted, if applicable Examples of problem statements are:
 1. The lighthouse, of significant historic value, is threatened by erosion from coastal flooding. The rate of erosion is 5 feet per year.
 2. Hazus predicts a 6.0 magnitude earthquake event in Greenville would result in \$10.5 million in structural losses and \$40 million in non-structural losses. Damage will be greatest to the 700 unreinforced masonry buildings (pre- building code) located in the downtown business district.
 3. The schools are a central focus of the community and offer opportunities to educate the public about hazards, risk, and mitigation. In addition, many school facilities are vulnerable to one or more hazards, including flooding, earthquake, tornado, and severe winter storms.



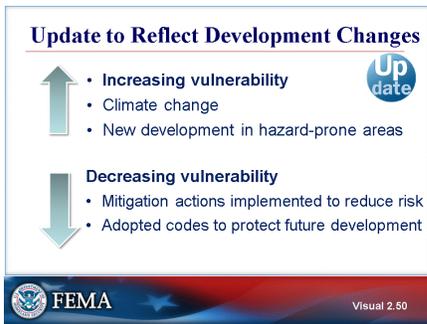
Visual 2.49

Activity 2.1: Develop a Problem Statement for Your Community

- Allotted Time: 30 minutes

Instructions

In small groups, identify a risk that exists in one of your communities and write a problem statement on the easel or paper. The problem statement should describe the specific risk to the community.



Visual 2.50

Increasing Vulnerability

- Climate change
- New development in hazard-prone areas

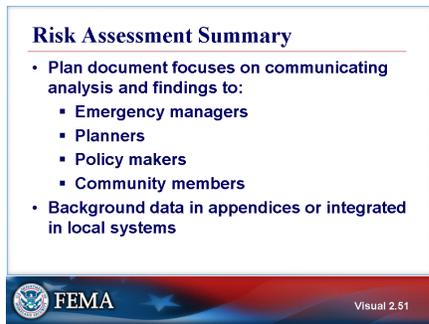
Decreasing Vulnerability

- Mitigation actions implemented to reduce risk
- Adopted codes to protect future development

Plan updates must describe changes in development that have occurred since the last plan was approved.

The planning team will need to gather information from planning and building departments on recent and planned development to evaluate how vulnerability may have increased or decreased. Development in identified hazard areas and construction not built to updated building codes increases the vulnerability of your community to future hazards and disasters. The planning team may also consider conditions that could affect the risks and vulnerabilities, such as climate variability, declining populations or projected increases in population, or foreclosures.

If no changes in development occurred or did not affect the jurisdiction's overall vulnerability, plan updates may validate the information in the previously approved plan.



Visual 2.51

Risk Assessment Summary

- Plan document focuses on communicating analysis and findings to:
 - Emergency managers
 - Planners
 - Policy makers
 - Community members
- Background data in appendices or integrated in local systems

While the process for conducting the risk assessment needs to be described as part of the planning process, there will likely be data inputs and outputs that do not need to be included in the main body of the plan document. Some of this information may be included in appendices, and some may be integrated and updated as part of your community's GIS program, recordkeeping, and other systems. Information in the plan document should focus on communicating the analysis and findings to a non-scientific audience that includes planners, policy makers, and community members.

Review of the Risk Assessment

For each hazard, the plan must provide

- Description of:
 - Hazards (location, extent, previous occurrences, and future probability)
 - Potential impacts for each participating jurisdiction
 - Repetitively damaged NFIP-insured structures
 - Changes in development since previous plan was developed if plan is an update
- Summary of vulnerability

FEMA Visual 2.52

Visual 2.52

Review of the Risk Assessment

To meet mitigation planning regulations, the plan must provide the following risk assessment information at a minimum:

- A description of the hazards that can affect jurisdictions in the planning area; the description includes information on location, extent, previous occurrences, and future probability for each hazard
- A description of the potential impacts of each identified hazard on each participation jurisdiction
- A description of NFIP-insured structures that have been repetitively damaged by floods
- A summary of each jurisdiction's vulnerability to the identified hazards

Plan updates must include a description of changes in development since the previously approved plan

Are there any questions?

Questions?



FEMA Visual 2.53

Visual 2.53