



Higher Standards in Floodplain Management

G282.1

Student Manual

June 2009



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Higher Standards in Floodplain Management




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1

Key Points

Introduce Yourself to Your Table Group



- Name
- Community
- Position in your community
- Floodplain management concerns/need for improvement



G282.1
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2

Key Points – Introduction

Introduce yourself to the members of your table group. Give them your:

- Name.
- Community.
- Floodplain Manager (FPM) position in your community.
- Floodplain management concerns/need for improvement.

Introduce Someone at Your Table to Us

Choose another person at your table, and tell us his/her:

- Name.
- Community.



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3

Key Points – Introduction

Introduce one person at your table to the rest of the group by presenting his or her:

- Name.
- Community.

Ground Rules

- **Participate.**
- **One person speaks at a time.**
- **All input is honored.**
- **This is a safe room—what’s said here stays here.**
- **Tell the course manager right away about problems he/she can fix.**



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4

Key Points – Introduction

The course ground rules are:

- Participate.
- One person speaks at a time.
- All input is honored.
- This is a safe room—what’s said here stays here.
- Tell the course manager right away about problems he/she can fix.

Your Expectations

What do you want to gain from attending this course?



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5

Key Points – Introduction

Answer the following discussion question:

What do you want to gain from attending this course?

Objectives

- **Advocate for higher standards through outreach.**
 - Explain how floodplains affect the environment.
 - Explain why to plan for future conditions.
- **Recommend provisions to build higher and farther back.**
- **Describe Community Rating System (CRS) participation advantages.**
- **Describe measures to promote higher standards.**



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6

Key Points – Introduction

The objectives of the Higher Standards course:

- Advocate for higher standards through outreach.
 - Explain how floodplains affect the environment.
 - Explain why to plan for future conditions.
- Recommend provisions to build higher and farther back.
- Describe Community Rating System (CRS) participation advantages.
- Describe measures to promote higher standards.

Higher Standards Basis

- National Flood Insurance Program (NFIP) minimum standards
- The 1% chance flood compromise
- Costs and benefits of higher standards
- The CRS concept
- Philosophy of No Adverse Impact (NAI)



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7

Key Points – Introduction

A variety of sources contribute to the advancement of higher standards in floodplain management.

- The National Flood Insurance Program (NFIP) sets minimum standards for development in mapped floodplains.
- The 1 percent chance flood standard, by delineating floodplain boundaries, provides a compromise between pressure for development and public policy to limit flood losses.
- Higher standards have demonstrated benefits in excess of costs. According to a 2005 report issued by the Multihazard Mitigation Council, every dollar spent on flood project grants saves almost \$5.
- The Community Rating System (CRS) rewards higher standards with reduced insurance premium costs.
- The philosophy of no adverse impact (NAI) encourages individuals and communities to avoid development that would cause flooding of neighbors or neighboring communities. NAI also is known as the good neighbor policy.

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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8

Key Points – Freeboard

This course includes the following major topics:

- Freeboard
- Critical Facilities
- Detailed BFE in A Zones
- Subdivision Requirements
- Prohibition of Fill: Coastal and Floodway
- Enclosure Limitations

This section of the course covers freeboard requirements and higher standards.

Freeboard Definition



Freeboard is a margin of safety added to the base flood elevation (BFE) to account for:

- Waves.
- Debris.
- Miscalculations, or lack of data.



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9

Key Points – Freeboard

The first section of this course examines freeboard as an important element in higher floodplain standards. Freeboard is a margin of safety added to the base flood elevation (BFE) to account for waves, debris, and miscalculations or lack of data.

While not required by the NFIP standards, communities are encouraged to adopt at least a 1-foot freeboard to account for the 1-foot rise built into the concept of designating a regulatory floodway and the encroachment requirements where floodways are not identified.

In some cases, freeboard is mandatory. For example:

- New York State building codes mandate freeboard.
- Oregon has a State floodplain management statute that mandates freeboard.
- Indiana has a restrictive floodway standard of .2 feet for encroachment.
- Montana requires 2 feet of freeboard in the SFHA.

Pennsylvania does not require freeboard, but recommends at least 18 inches of freeboard, because insurance tables round up the 18 inches to 2 feet.

Benefits of Freeboard

Library on Sanibel Island, FL

- **Local regulations: 10 feet above BFE**
- **Library: Additional 3 feet of freeboard**
- **Survived Hurricanes Charley and Wilma with no damage**



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10

Key Points – Freeboard

Read the following case study:

On August 12, 2004, in Sanibel, Florida, Library Director Pat Allen and her staff readied the 10,000-square-foot expansion of the library for an official opening. That morning, staff guided the delivery crew as they moved equipment and shelving into the new addition. By late afternoon of the next day, Hurricane Charley brought fierce winds to Sanibel Island that tested the engineering of both the new expansion and the original building.

Concrete pilings provided a secure foundation. The pilings raised the building above BFE, a requirement because Sanibel flood maps show all property on the island to be in a Special Flood Hazard Area (SFHA). Local regulations mandated a height of 10 feet above BFE, but the library added an additional 3 feet of freeboard to better counteract flooding and provide covered parking.

Before residents could return to normal after Hurricane Charley, Hurricane Wilma, another hurricane that was primarily a wind event, brought 100 mph winds to Sanibel on October 24, 2005. Again the library suffered no damage and stood ready to welcome residents back to the island.

Freeboard helps to mitigate the effects of climate variability such as higher storm surges and greater runoff by anticipating future conditions.

Benefiting From Freeboard

What are the benefits of freeboard?



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11

Key Points – Freeboard

Answer the following discussion question:

What are the benefits of freeboard?

Note that:

- Estimates of flood heights are subject to various errors, especially in areas without long-term flood and rainfall records.
- Buildings may be damaged by floods that exceed the predicted 100-year flood.
- Urbanization and other changes in the watershed can increase the flood hazard.
- Filling and other development in the fringe can reduce the floodplain storage capacity and increase overland flood flows.

Example: Katrina Elevation

- Ms. Charlotte Lamar bought beachfront property in Mississippi.
- Despite the lack of a freeboard requirement, Ms. Lamar chose to elevate her house above the BFE with 5 feet of freeboard.
- Ms. Lamar's house was one of the few to survive Hurricane Katrina's surge.



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12

Key Points – Freeboard

Read the following case study:

When a beachfront housing development opened in 1995 at Belle Fontaine in Ocean Springs, MS, Charlotte Lamar found her dream house. Ms. Lamar's home suffered little damage during Hurricane Katrina in August 2005, thanks to mitigation measures she employed during its construction.

Ms. Lamar learned that her new home would have to be elevated to protect it from flooding. She gathered information from Jackson County on residential elevations and damages incurred during previous hurricanes in her community. She credits her son, an engineer, for additional suggestions that prompted her to include an additional 5 feet of elevation (freeboard) into the construction of her home.

Eight pressure-treated wood pilings were positioned at the corners of the octagonal structure, embedded 15 feet in the ground, and connected to the roof. The design of the roof aids in its wind resistance; its pitch equalizes downward pressure from high winds. The entire house is tied together with metal brackets and hurricane straps that help distribute wind loads by providing a continuous load path from the roof to the foundation. The home, built of cedar, stands approximately 22 feet above sea level and is located in Zone C, where there is no regulation to elevate above the base flood elevation. Therefore, Ms. Lamar elevated her house by choice, basing her decision on historical events such as Hurricane Camille.

Ten years later, Hurricane Katrina threatened Ms. Lamar's house with a tidal surge estimated at 19 feet above sea level at Belle Fontaine. Thanks to hurricane mitigation planning, her home is one of the few houses in her community that did not surrender to the catastrophic storm.

The tidal surge rose 2 feet on Ms. Lamar's property, but missed her house by 3 feet because of the additional elevation incorporated into her home's construction. The force of the tidal surge destroyed the air conditioning and heating ductwork beneath the house; saltwater invaded the floor vents and left mud on the floors of the house; and the 102-mile-per-hour winds and rain damaged a window, allowing water into the house. However, compared to other beachfront homes, Ms. Lamar's house sustained minimal damage.

Activity: Selling the Concept



Instructions:

- Brainstorm ways to explain/sell freeboard to your assigned audience.
- List bullet points for a freeboard brochure.
- Draft code language for the implementation of freeboard.



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13

Key Points – Freeboard

Activity Instructions:

1. Note the following:
 - There are a number of reasons why different segments of the community may oppose the idea of freeboard.
 - Your group will suggest strategies for convincing different audiences to support the concept.
2. Your instructor will assign your group one of the following audiences:
 - Homeowners: What benefits does freeboard offer to individuals and families?
 - Elected officials: How will the community benefit?
 - Building and zoning officials: How will a margin of safety affect the built community?
 - Developers: How can freeboard enhance projects?
 - Emergency manager: How will freeboard affect emergency operations?
3. Your group should:
 - Brainstorm ways to explain/sell freeboard to their assigned audiences.
 - List bullet points for a freeboard brochure aimed for the assigned audience.
 - Draft code language for the implementation of freeboard.

Continued . . .

Activity Instructions (Continued)

4. You will be allowed to work for approximately 35 minutes.
5. Take notes on presentations by other groups. The information could be used to sell freeboard in your own community.
6. Ask a spokesperson from your group to present the freeboard brochure bullet points.
7. Select a volunteer to present your group's code language.

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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15

Key Points – Critical Facilities

This section of the course covers critical facilities.

Flooding in Critical Facilities

**What critical facilities
have flooded in your
communities?**



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16

Key Points – Critical Facilities

Answer the following discussion question:

What critical facilities have flooded in your communities?

Critical Facilities—Characteristics

Critical facilities, such as hospitals and police stations, need:

- To operate 24 hours a day, 7 days a week.
- Dry land access.



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17

Key Points – Critical Facilities

The following are examples of the types of critical facilities that should be given special attention:

- Hospitals, schools, nursing homes, and housing likely to have occupants who may not be sufficiently mobile to avoid injury or death during a flood.
- Police stations, fire stations, vehicle and equipment storage facilities, and Emergency Operations Centers that are needed for flood response activities before, during, and after a flood.
- Public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood.
- Structures or facilities that produce, use, or store hazardous materials that may be highly volatile, flammable, explosive, toxic, and/or water-reactive.
- Facilities that store essential and irreplaceable records.

These facilities should be in operation 24 hours a day, 7 days a week. They also should have dry land access.

FEMA-543: Design Guide for Improving Critical Facility Safety from Flooding and High Winds, provides examples of critical facilities. This document can be found or downloaded from the FEMA Web site <http://www.fema.gov/library/viewRecord.do?id=2441>.

Critical Facilities Challenges

- Unmapped community
- Community entirely in the floodplain



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18

Key Points – Critical Facilities

Note that for communities that aren't mapped, the 500-year floodplain is not delineated.

Other communities may be entirely in the floodplain, which poses a challenge for protecting preexisting facilities and planning new facilities.

EO 11988: Floodplain Management

Executive Order (EO) 11988:

- **Stipulates that “critical actions” should not be undertaken in any area subject to the 500-year flood.**
- **Guidance definition of critical actions: Those actions for which even a slight chance of flooding would be too great.**
- **NFIP regulations in 44 CFR 60.3 do not require a higher standard than the 100-year flood for critical facilities.**



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19

Key Points – Critical Facilities

While providing additional protection to critical facilities is not explicitly referenced in Executive Order (EO) 11988, Floodplain Management, the Water Resources Council's 1978 Floodplain Management Guidelines for Implementing EO 11988 introduced the concept of using the 500-year flood and 500-year floodplain as the standard for determining when to implement “critical actions.” This was done in recognition of the fact that the impacts of floods on human health, safety, and welfare for many activities could not be minimized unless a higher degree of protection was provided. Many Federal agencies have adopted the 500-year flood as the standard for their critical actions.

For the purposes of implementing EO 11988 by Federal agencies, the Floodplain Management Guidelines define critical action (or critical facilities) as any activity for which even a slight chance of flooding would be too great. Actions or facilities that are typically considered critical:

- Include facilities such as hospitals, schools, and nursing homes where, given the flood warning lead-time available, the occupants of the facilities may not be sufficiently mobile to avoid loss of life or injury; and
- Include facilities that house essential and irreplaceable records, utilities, and/or emergency services.
- Are those that would create an added dimension to the disaster, such as liquefied natural gas terminals and facilities that produce and store highly volatile, toxic, or water-reactive materials.

Under the Water Resources Council's Floodplain Management Guidelines for Implementing EO 11988, “critical actions” are to be located outside of the 500-year floodplain or, if there is no practical alternative to locating in the 500-year floodplain, must be elevated or floodproofed to the elevation of the 500-year flood.

FEMA defines “critical action” in 44 CFR Part 9, which implements EO 11988 for agency programs, and applies the 500-year standard to those actions. While presumably FEMA is applying “critical action” to Public Assistance and to FEMA facilities, it does not apply the concept to the NFIP and to actions regulated by NFIP communities. This can result in more restrictive standards being applied to the repair of critical facilities owned by State and local governments that receive disaster assistance than are applied to the construction of a new critical facility that is not subject to the Executive order.

Continued . . .

Critical Facilities and the NFIP

Note that, because the NFIP minimum requirements apply to structures and other development and not to “actions,” the term “critical facility” should be used. NFIP minimum requirements are currently silent on critical facilities. As a result, critical facilities are now considered nonresidential structures and must be elevated or floodproofed to only the base flood. As many critical facilities are built by State and local government and do not require Federal funds or permits, facilities such as police stations, fire departments, hospitals, emergency operations centers, and other important facilities are usually not subject to the Executive Order or to Federal agency implementing regulations. As a result, they are often built within the base floodplain and protected only to the base flood elevation in accordance with NFIP minimum requirements.

FEMA has encouraged, through guidance to States and communities, protection of critical facilities to the 500-year flood. The only official guidance in the regulations is 44 CFR 60.22, “Planning considerations for flood-prone areas,” which encourages, but does not require, communities to establish minimum floodproofing and access requirements for critical facilities.

In addition, the NFIP Community Rating System (CRS) encourages communities and local jurisdictions to enact ordinances that prohibit the construction of critical facilities within the 500-year floodplain, or at least protect them to this standard. Only 61 CRS communities receive credit under CRS for either prohibiting critical facilities from the 500-year floodplain or requiring their protection to the 500-year flood.

States and individual communities may opt to specify in their floodplain ordinance the location or level of protection required for such facilities. Some States have provided language in model floodplain ordinances that discourages development of critical facilities within the 500-year floodplain if there is a feasible alternative. There are also a few States that require by regulation that critical facilities be protected to the 500-year flood.

Critical Facilities and Flood Disasters

The Mitigation Assessment Team (MAT) has studied the wind and flood building performance and functionality impacts of critical facilities from several recent and past disasters. As the MAT report for Hurricane Katrina pointed out, critical facilities did not perform any better than commercial buildings, despite the importance attached to these buildings. A number of critical facilities were damaged by flood, including emergency operations centers, fire stations, and hospitals.

Several other post-disaster assessments—including the ones for the 1993 Midwest flood disaster; 1997 upper Midwest disaster in North Dakota, South Dakota, and Minnesota; 1994 Tropical Storm Alberto; and 2001 Tropical Storm Allison—also cited similar damages to medical facilities, schools, public utilities, nursing homes, hospitals, and facilities that stored hazardous materials. Critical facilities were evaluated closely by the MAT following Hurricane Ivan. While critical facilities suffered extensive wind damage, the MAT did not observe any critical or essential facilities located in areas affected by flooding. By being located outside floodprone areas, the critical and essential facilities in Alabama and Florida that were not severely damaged by wind were able to provide community services without interruption due to flooding.

The lessons learned from these events and their resulting recommendations have been captured in a new publication, *FEMA 543 – Design Guide for Improving Critical Facility Performance from Flooding and High Winds*. This and other MAT reports illustrate that the 100-year flood elevation has not been adequate for purposes of protecting critical facilities. While this recently published manual provides building professionals and decisionmakers with information and guidelines for implementing a variety of mitigation measures to reduce the vulnerability to damage and disruption of operations during flood events, there is nothing in the regulations that would require communities to protect critical facilities to a higher standard than the BFE.

Activity: Critical Facilities



Instructions:

- Note the facility category assigned to your group.
- List facilities within your assigned category.



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21

Key Points – Critical Facilities

Activity Instructions:

1. Your group will be assigned a critical facility category:
 - Law enforcement
 - Fire and safety
 - Infrastructure
 - Health
 - Communications
 - Other, as needed
2. Your group should list the critical facilities in your category.
3. Select spokesperson from your group to present your group's list.

Critical Facilities

Why are critical facilities important?

What are the consequences of damage?



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22

Key Points – Critical Facilities

Answer the following discussion questions:

Why are critical facilities important?

What are the consequences of damage?

Activity: Higher Standards



Instructions:

- Use your group's facility category from the previous activity.
- List ideas for achieving higher standards in:
 - Preexisting facilities
 - Planned facilities



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23

Key Points – Critical Facilities

Activity Instructions:

1. Continue with your assigned facility categories from the previous activity.
2. Your group will list ideas for achieving higher standards in:
 - Preexisting facilities
 - Planned facilities

Protecting Critical Facilities

What are
challenges to protecting
critical facilities?



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24

Key Points – Critical Facilities

Answer the following discussion question:

What are challenges to protecting critical facilities?

Burying Electrical Lines

Should electrical lines
be buried in the
floodplain?



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25

Key Points – Critical Facilities

Answer the following discussion question:

Should electrical lines in the floodplain be buried?

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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26

Key Points – Detailed BFE in A Zones

This section of the course covers detailed BFE in A Zones.

Detailed BFE in A Zones

Topics:

- NFIP Minimum Requirements
- Community Practices
- Costs and Benefits of BFE Development
- Outreach to Builders and Developers



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27

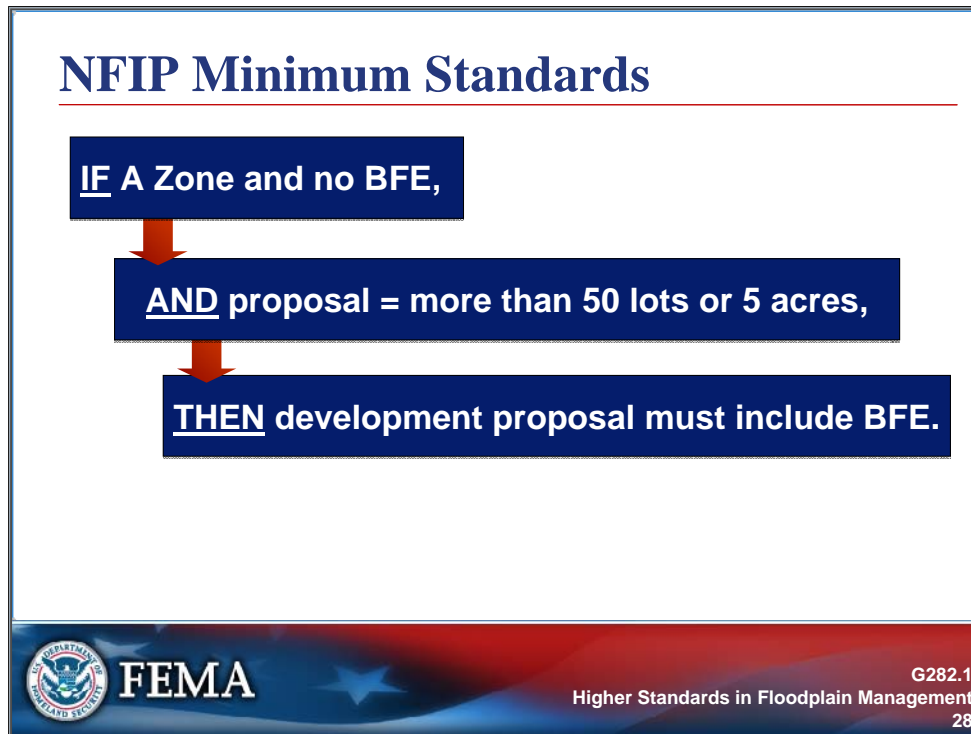
Key Points – Detailed BFE in A Zones

The next portion of this course will discuss Detailed BFE in A Zones as a higher standard. Topics are:

- NFIP Minimum Requirements.
- Community Practices.
- Costs and Benefits of BFE Development.
- Outreach to Builders and Developers.

Answer the following discussion question:

What different names are used for A zones?



Key Points – Detailed BFE in A Zones

Note that, under 44 CFR 60.3(b), if the Administrator has designated areas of special flood hazards (A Zones) by the publication of a community's Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM), but has neither produced water surface elevation data nor identified a floodway or coastal high-hazard area, the community shall:

- Require that all new subdivision proposals and other proposed developments (including proposals for manufactured home parks) that are for more than 50 lots or 5 acres, whichever is the lesser, be included within such proposals BFE data.
- Require developers to obtain, review, and reasonably utilize any BFE and floodway data available from a Federal, State, or other source as criteria for new construction, substantial improvements, or other development in Zone A on the community's FHBM or FIRM.

BFEs: Higher Standard

Require detailed BFEs for thresholds below 50 lots or 5 acres.



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29

Key Points – Detailed BFE in A Zones

For developments that exceed the thresholds of 50 lots or 5 acres identified in NFIP regulations at 60.3(b)(3), Base Flood Elevations must be either obtained from other sources or developed using detailed methodologies comparable to those contained in a Flood Insurance Study (FIS).

A higher standard for BFE development is to require the property owner or developer to develop detailed BFEs for thresholds below 50 lots or 5 acres.

Costs and Benefits of BFE Development

Costs	Benefits
<ul style="list-style-type: none">▪ The cost of a study to develop BFE▪ The cost to establish benchmarks in remote areas▪ The cost to develop to a higher standard	<ul style="list-style-type: none">▪ Reduce damages▪ Obtain an accurate flood insurance rating▪ Potentially lower insurance costs▪ Potentially reduce Special Flood Hazard Area (SFHA)



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30

Key Points – Detailed BFE in A Zones

The costs to develop an engineered Base Flood Elevation (BFE) include:

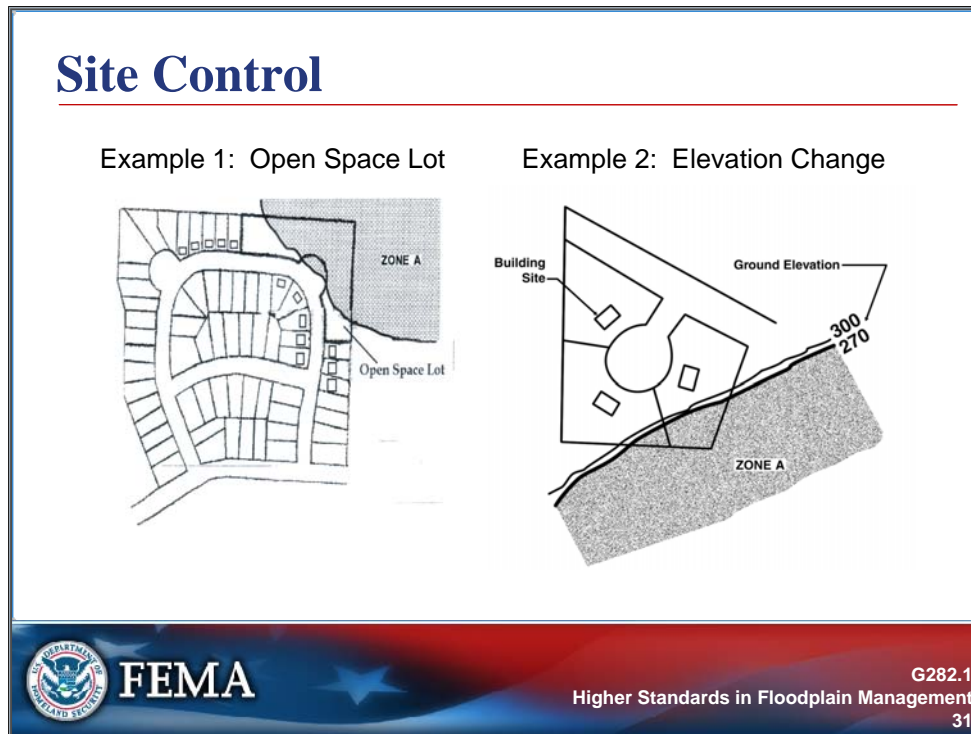
- The cost to hire an engineer to perform a study for a new development and provide a report.
- The cost to conduct a limited data survey in remote areas to establish benchmarks.
- The cost to develop to a higher standard.

A rule-of-thumb cost to develop an engineered BFE is \$10,000 per mile. Costs to develop BFEs may range between \$4,000 and \$50,000. In some Regions, the U.S. Army Corps of Engineers (USACE) will do a BFE, if requested.

The costs can be balanced with the benefits of obtaining an engineered BFE, which are:

- Reductions in damages.
- Accurate flood insurance rating.
- Potential lower insurance costs. (Rates could be higher if existing structures were built at or below BFE.)
- Reduction in the area of the SFHA (a letter of map change, or LOMC, may be possible).

If a developer obtains a BFE, the Floodplain Manager (FPM) should require the developer to apply for a Letter of Map Revision (LOMR) or Conditional Letter of Map Revision (CLOMR). If FEMA's review verifies the data, a LOMR or CLOMR will be issued. Studies in A zones often refine the floodplain.



Key Points – Detailed BFE in A Zones

Site Control:

- In Example 1 in the visual, the corner of the tract that includes Zone A is left undeveloped as open space.
- In Example 2, note that there is a 30-foot elevation change. The building sites are on land elevated well above Zone A, even though portions of two lots are in the floodplain.

By setting BFE requirements in A Zones, the community can control new development. Undeveloped land, still in large tracts, offers the best opportunity to limit where certain types of development will be located. When a developer wants to subdivide the land, communities have many tools to arrange the development so that buildings are kept out of the floodplain, or at least are located in the least hazardous areas of the floodplain.

Controlling the site has two advantages over simply requiring the buildings to be protected from flooding:

- Buildings aren't isolated by floodwaters, putting a strain on local emergency services to guard them, evacuate, or rescue their occupants.
- The neighborhood will have waterfront open space and recreation areas—a valuable amenity in most communities.

A housing development can be clustered so the developer can sell the same number of home sites as in a conventional subdivision. Note that:

- You can check your State laws to determine whether cluster development can be mandated or just encouraged during the subdivision review process.
- Cluster developments that incorporate open space get CRS credit both for open space and floodplain insurance benefits.

Your Experiences

How have you persuaded property owners to get engineered BFEs?

If your community doesn't have a regulation, what is your approach?



The slide footer features the FEMA logo on the left, which includes the text 'U.S. DEPARTMENT OF HOMELAND SECURITY' and 'FEMA'. To the right of the logo is a red and blue decorative banner with a white star. Further right, the text 'G282.1 Higher Standards in Floodplain Management' and the page number '32' are displayed.

Key Points – Detailed BFE in A Zones

Answer the following discussion questions:

How have you persuaded property owners to get engineered BFEs?

If your community doesn't have a regulation, what is your approach?

Community Practices

What message does
“Approximate A Zone”
send to your
community?



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33

Key Points – Detailed BFE in A Zones

Answer the following discussion question:

What message does “Approximate A Zone” send to your community?

Unnumbered A Zones in Your Community

How do you regulate
unnumbered A Zones in
your community?



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34

Key Points – Detailed BFE in A Zones

Answer the following discussion question:

How do you regulate unnumbered A Zones in your community?

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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35

Key Points – Subdivision Requirements

This section of the course covers subdivision requirements.

Higher Standards: Subdivisions

To get **higher** standards, add any of the following strategies to the NFIP minimum standards:

- Minimum-sized open space
- Low-density zoning
- Stormwater management
- Setbacks



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36

Key Points – Subdivision Requirements

Examples of higher flood standards for subdivisions that supplement NFIP minimum standards include the following:

- Minimum-sized open space, which requires that a portion of a development be reserved for open space.
- Low-density zoning, in which a lot may not be below a given size, and the size and number of structures are limited.
- Stormwater management, such as controlling or reducing runoff.
- Setbacks, meaning development must be built a given distance from the shore.

Local stormwater management may be regulated through a comprehensive land development ordinance, zoning ordinance, or freestanding ordinance.

Density may be in a zoning or subdivision ordinance. One provision is a limit on the percent of impervious surfaces on individual lots.

Non-degradation of State waterways statutes may regulate setbacks and elevations for septic systems. NFIP regulations require locations to protect septic systems from infiltration.

Stormwater Management

- Detention
- Retention
- Water gardens
- Green roofs
- Compensatory storage



Retention Pond



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37

Key Points – Subdivision Requirements

There is a disconnect between stormwater management and floodplain management. Stormwater management usually protects from a 2-year storm, or more rarely from a 20 or 50-year storm.

Zoning can promote stormwater management by requiring replacement of impervious surfaces such as concrete with more pervious surfaces, such as stones.

Methods of stormwater management, include:

- Detention by curbs, gutters, and channels.
- Retention in ponds.
- Water gardens that capture runoff.
- Green roofs that reduce runoff.
- Compensatory storage to provide storage for runoff resulting from fill.

A green roof consists of a waterproof membrane, a growing medium, and plants, typically low-growing, low maintenance, and drought-tolerant, installed as the top layer of a roof. Among other benefits, green roofs absorb and filter stormwater to reduce runoff.

- In the U.S., most green roofs are on skyscrapers to help mitigate urban “heat islands” and to save energy. However, solar home competitions on the National Mall have featured green roofs on single-family homes.
- In Europe, especially in Germany, green roofs are becoming increasingly common.

Compensatory storage relates to cut and fill land grading: If you remove material here and put it there, the removal area in theory will provide storage for lost capacity in the fill area.

Setback Requirements

- Wells
- Septic tanks
- Accessory buildings
- Above-ground fuel tanks



Well



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38

Key Points – Subdivision Requirements

Setbacks are established in a zoning ordinance to delineate the required distance between a building and a lot line. The setback concept can be further applied in floodplain or sensitive land ordinances to separate urban development from wetlands, coastal areas, riverbanks, or floodplains.

Communities can impose setback requirements for:

- Wells.
- Septic tanks.
- Accessory buildings.
- Above-ground fuel tanks.

In some communities, there is no alternative to locating wells and septic tanks in the SFHA. NFIP compliance consists of protection from infiltration. The wellhead should be above the BFE.

In some States, there is no zoning. Individual communities address their own hazards. Floodplain management may be the only land use regulation in such communities.

Case Study: 10,000 Rain Gardens



Garden outside drainpipe



Curb garden to collect runoff



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Higher Standards in Floodplain Management
39

Key Points – Subdivision Requirements

Read the following case study:

Since mid-2005, Kansas City, MO, metropolitan area residents have built 86 rain gardens and are working their way up to 10,000, the number of rain gardens they want to build to reduce the amount of runoff that pollutes their waterways.

10,000 Rain Gardens is a public-private initiative, involving citizens, corporations, educators, and nonprofit organizations and government agencies such as the Kansas City Metropolitan Area (KCMO) Water Services Department. Even though it is not a government program, the initiative has attracted the support of elected officials. Kansas City Mayor Kay Barnes, Johnson County Board of Commissioners Chairwoman Annabeth Surbaugh, and Jackson County Executive Katheryn Shields last summer joined in a call for regional participation in the environmental initiative. Volunteers planted a rain garden in front of a Kansas City drain pipe to capture runoff and rain. "Protecting our streams and rivers from pollution and our homes and businesses from flooding requires a regional approach to be truly effective upstream and downstream," said Mayor Barnes.

A rain garden is a shallow basin filled with native plants that holds and filters rain. Stormwater runoff is captured in a small bowl-like garden that is planted and maintained with attractive, thirsty native plants whose roots grow deep into clay soils common to the Kansas City area.

In part, 10,000 Rain Gardens is a public education initiative, and it appears to be working. In 2003, the Mid-America Regional Council conducted a first, benchmark water quality survey of residents in the metropolitan Kansas City area. The survey is part of an ongoing effort to measure the impact that water quality education efforts in the region are having on the public's overall awareness and behavior. In that first survey, less than half those questioned thought they could do something to help improve water quality.

Continued . . .

Case Study (Continued)

In 2004 and 2005, consultants for the KCMO Water Services Department conducted interviews throughout the region to determine how stakeholders, including neighborhood activists, elected officials, government employees, developers, economic development officials, educators, corporate citizens, and civic leaders, viewed the issues of stormwater runoff and sewage overflowing into rivers and streams.

There was consensus on the importance of these issues to the community's quality of life, and stakeholders wanted a regional approach. They suggested more green solutions to the problems of flooding and runoff polluting streams and rivers, and stressed the importance of a comprehensive public education plan to help citizens become part of the solution.

A Web site address for further information is <http://www.rainkc.com/>.

Key Points

Case Study: Harris County, TX

A joint task force is promoting public education via:

- A speaker's bureau.
- Community events and outreach.
- City/county employee training.
- School education.
- Guidance documents for stormwater projects, including:
 - Construction.
 - New development.
 - Significant redevelopment.



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41

Key Points – Subdivision Requirements

Read the following case study:

Public education and awareness are considered critical tools for achieving changes in behavior necessary for stormwater pollution reductions and minimizing the contaminants in stormwater runoff. The City of Houston, Harris County, the Harris County Flood Control District, and the Texas Department of Transportation, formed a joint task force (JTF) to prepare and submit a two-part joint application to the Environmental Protection Agency (EPA). The JTF is taking a positive, community-oriented approach to education and outreach. The public education component of the program includes and/or will include the following activities and/or programs: speakers bureau, community events and outreach, city and county employee training, and school education.

The city and county have developed several guidance documents to help students in construction, new development, and significant redevelopment stormwater projects. The following documents are available:

- Storm Water Management Handbook for Construction Activities
- Storm Water Quality Management Guidance Manual
- Minimum Design Criteria for Implementation of Certain Best Management Practices for Storm Water Runoff Treatment Options

The Web site for the Harris County program is: <http://cleanwaterways.org/>.

Case Study: Huntsville, AL



Huntsville's Division of Natural Resources is responsible for:

- A comprehensive municipal stormwater management system.
- Stormwater quality monitoring.
- Industrial inspections/ investigations: pollutant discharges.
- Surface water quality investigations.



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42

Key Points – Subdivision Requirements

Read the following case study:

The Division of Natural Resources in Huntsville, Alabama, coordinates activities by the City of Huntsville designed to ensure compliance with State and Federal stormwater quality requirements for medium-sized municipalities. These requirements include implementation of a comprehensive municipal stormwater management program, as well as requirements for monitoring stormwater quality.

In addition to assembling information gathered by other city departments to satisfy reporting requirements, the Division conducts industrial inspections and investigates discharges of pollutants to the storm sewer system. Surface water quality investigations also are performed in support of the stormwater quality program.

Available information on urban stream water quality and information on preventing surface water pollution is available to the public through the Division's office. Copies of the Stormwater Quality Control Ordinance and the related Fact Sheet are available at the Division's office.

The Web site for the Huntsville's program is:
<http://www.hsvcity.com/NatRes/program.php#blank>.

Subdivision Requirements

What subdivision requirements protect the floodplain?



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43

Key Points – Subdivision Requirements

Answer the following discussion question:

What subdivision requirements protect the floodplain?

Activity: “Bad” Subdivision



Instructions:

- Design a “bad” subdivision in the floodplain.
- Describe the features of a “bad” subdivision.



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44

Key Points – Subdivision Requirements

Activity Instructions:

1. You are going to design a “bad” subdivision in the floodplain.
2. Describe the features of a “bad” subdivision.

Activity: Subdivision Improvement



Instructions:

- Suggest measures to improve the “bad” subdivision.



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45

Key Points – Subdivision Requirements

Activity Instructions:

You will suggest measures to improve the “bad” subdivision.

Winning Support

In preceding activities:

- We outlined ideas for higher subdivision standards.
- The next challenge is to get the ideas enacted.
- Different stakeholders in the community will need convincing.



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46

Key Points – Subdivision Requirements


In the preceding activities:

- We just outlined ideas for higher subdivision standards.
- The next challenge is to get the ideas enacted.
- Different stakeholders in the community will need convincing.

Obstacles to Higher Standards

What obstacles block higher subdivision standards?

What is your plan to overcome obstacles?



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47

Key Points – Subdivision Requirements

Answer the following discussion questions:

What obstacles block higher subdivision standards?

What is your plan to overcome obstacles?

Why haven't these ideas been implemented in your community?

Note that:

- Having identified a plan, you need to share the plan with stakeholders and win support.
- The next step is to develop outreach strategies.

Activity: Developer Workshop



Instructions:

- Plan a workshop as a vehicle to sell higher subdivision standards to the development community.
- Suggest possible topics and speakers for the workshop.



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48

Key Points – Subdivision Requirements

Activity Instructions:

1. Plan a workshop as a vehicle to sell higher subdivision standards to the development community of private-sector developers and realtors.
2. Suggest possible topics and speakers for the workshop.

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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49

Key Points – Prohibition of Fill

This section of the module covers prohibition of fill.

Prohibition of Fill



Topics:

- NFIP requirements
- Effects of fill
- Results of prohibiting fill
- Justifying fill prohibition



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50

Key Points – Prohibition of Fill

The next section of this course discusses prohibition of fill. Topics are:

- NFIP requirements.
- Effects of fill.
- Results of prohibiting fill.
- Justifying fill prohibition.

NFIP Requirements



Requirements for fill:

- 44 CFR 60.3(e)(6)
- For coastal fill requirements, refer to Technical Bulletin 5-93.
- In addition to a floodplain development permit, fill in the floodway requires a “no rise” certificate.



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51

Key Points – Prohibition of Fill

NFIP requirements for fill can be found in the following documents:

- 44 CFR 60.3(e)(6) prohibits use of fill for structural support of buildings in V and VE zones.
- Coastal: FEMA Technical Bulletin 5-93 sets requirements. To obtain the bulletin go to the following web site: <http://www.fema.gov/library/viewRecord.do?id=1718>
- Floodway: Fill placed in the floodway requires a permit for fill from the FPM plus a “no rise” certificate certifying that the fill will not cause a rise in the base flood elevation. The certification should be signed and sealed by a professional engineer.

Effects of Fill

- Fill in the fringe can increase impervious surfaces.
- Nonstructural fill can create obstructions and alter the contour of coastal environments.
- In the floodway, fill can raise flood levels.



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52

Key Points – Prohibition of Fill

Effects of Fill:

- Fill in the floodway fringe can increase impervious surfaces and possibly raise flood levels.
- In a coastal environment, nonstructural use of fill can create obstructions, alter the coastline contour, and increase risk of flooding nearby structures.
- In the floodway, fill is an encroachment that potentially raises flood levels.

Fill is an option to elevate. However, fill erodes and settles, and after a flood, people often perceive that fill increased the flood risk. Ask developers to explore other elevation options.

Results of Prohibiting Fill

What benefits and challenges result when fill is prohibited?



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53

Key Points – Prohibition of Fill

Answer the following discussion question:

What benefits and challenges result when fill is prohibited?

“Selling” Prohibition of Fill

The following arguments can help convince people to prohibit fill:

- **Fill in the floodplain reduces floodwater storage, increasing peak flows downstream.**
- **Coastal fill puts nearby structures at risk of damage.**
- **Fill can be displaced and redeposited, creating hazards.**
- **Prohibition of fill earns CRS credits.**



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54

Key Points – Prohibition of Fill

Floodplain managers face challenges when convincing elected officials and the public to prohibit fill.

Reasons to support such efforts include:

- Although a building built on fill and elevated above the BFE meets the NFIP rules, filling a substantial portion of the floodplain reduces storage for floodwater and tends to increase peak flows downstream. Prohibiting fill will reduce this problem, as will requiring the provision of a similar volume of compensatory storage if fill is placed in the floodplains.
- Coastal fill puts nearby structures at risk of damage.
- In coastal and riverine situations, fill can be displaced and redeposited elsewhere during a storm, creating more work for the community and property owners. Displaced fill also may create new hazards when redeposited in access areas, roadways, or other critical locations.
- CRS credits that result in lower flood insurance premium costs.

Examples

Communities that prohibit fill:

- Snoqualmie, WA
- Santa Rosa Island, Pensacola, FL



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55

Key Points – Prohibition of Fill

Communities that successfully prohibited fill include:

- Snoqualmie, Washington.
- Santa Rosa Island, Pensacola, Florida.

The following excerpt is from Snoqualmie Flood Hazard Regulations, 15.12.160, Specific Standards.

F. Fill

1. Subject to the provisions of subsection (F)(2) of this section, no fill shall be permitted except where provision has been made on the subject property to balance the capacity to store floodwaters and accommodate potential surface flow in an amount equal to the amount of floodwater likely to be displaced by the fill; provided, provision may be made subject to SMC 15.12.180 to balance the capacity to store floodwaters off the subject property, when it can be demonstrated that the property upon which the balancing capacity is being created is located such that no increase in the base flood discharge will result. Care shall be taken to prevent erosion and surface runoff to adjacent properties. All fill shall be compacted at the time of placement.
2. Any person may place not more than five yards of material used solely for landscape maintenance or gardening at a residence or business in any one calendar year; provided, written notification shall be given to the building official within five business days after the placement of such fill. Such right shall not be assignable, nor shall it carry over from year to year or otherwise be cumulative.

Activity: Prohibiting Fill



Instructions:

- Draft ordinance language prohibiting fill.
- Include V Zones and the floodway.



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56

Key Points – Prohibition of Fill

Activity Instructions:

Your table group will draft ordinance language prohibiting fill. The ordinance should include V Zones and the floodway.

Course Content Map

Freeboard

Critical Facilities

Detailed BFE in A Zones

Subdivision Requirements

Prohibition of
Fill

Enclosure Limitations



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57

Key Points – Enclosure Limitations

The final section of this course covers enclosure limitations.

Enclosure Limitations

Topics:

- NFIP minimum requirements
- Limitation objectives



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58

Key Points – Enclosure Limitations

The next section of this course discusses enclosure limitations. Topics are:

- NFIP minimum requirements.
- Limitation objectives.

Requirements for an enclosure for an A zone are openings in at least two walls and operation requiring no human intervention.

Requirements for an enclosure in a V zone are a pile or column foundation that is free of obstruction or has breakaway walls.

NFIP Minimum Requirements

Enclosures below BFE are limited to:

- Storage.
- Parking.
- Access.

[Acronym: SPA]



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59

Key Points – Enclosure Limitations

The NFIP limits enclosures below the BFE to:

- Storage.
- Parking.
- Access.

Note that the acronym for the allowable uses is SPA.

Impact of Enclosures on Insurance

A Zone	V Zone
An enclosure without proper openings = higher insurance costs	An enclosure that's ≥ 300 sq ft = higher insurance costs



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60

Key Points – Enclosure Limitations

Impact of Enclosures:

- V-Zone buildings with lower-area enclosures (constructed with breakaway walls) that exceed 299 square feet may be subject to higher insurance premiums.
- A-Zone enclosures without proper openings receive higher insurance rates than enclosures with proper openings. A minimal amount of insurance coverage is provided for the enclosed area.

Enclosure Restrictions

What benefits result when enclosure size is limited?

In what zones might no enclosures be allowed?



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61

Key Points – Enclosure Limitations

Answer the following discussion questions:

What benefits result when enclosure size is limited?

In what zones might no enclosures be allowed?

Non-Conversion of Enclosures

- **Common problem: Enclosures converted to living areas.**
- **Enforcement: Difficult due to private property rights.**
- **Community options:**
 - **Non-conversion agreements filed with the deed.**
 - **Covenant or deed restrictions.**
 - **Inclusion of language allowing inspection to confirm compliance.**



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62

Key Points – Enclosure Limitations

Local officials should be aware that after issuance of the certificate of occupancy for a home with an enclosure, some property owners will attempt to convert enclosures to living areas.

Non-conversion is difficult to enforce because of private property rights.

The community has several options to prevent conversion.

- Require the property owner to sign a non-conversion agreement that is filed with the deed.
- Impose covenant or deed restrictions.
- In relevant documents, include language allowing public officials to inspect the structure to confirm compliance with the agreement or restriction.

Non-Conversion Agreements

- A non-conversion agreement is:
 - A legal document that is filed with the deed, and
 - Makes future owners aware of the agreement.
- The following require non-conversion agreements:
 - Lincoln, NE
 - State of Maryland



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63

Key Points – Enclosure Limitations

A non-conversion agreement is a legal document that is filed with the deed so that future owners are aware of the requirement.

Lincoln, Nebraska and the State of Maryland are examples of jurisdictions that require non-conversion agreements.

Refer to the Maryland Declaration of Land Restriction for Certain Structures in the Floodplain, in the Resource Booklet.

Activity: Higher Standards

- **Develop a plan for your community. Describe:**
 - **Which higher standards would have priority.**
 - **A strategy for convincing stakeholders to support those standards.**
- **After 20 minutes, share plans within your table group.**
- **Chose one of the plans to share with the entire class.**



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64

Key Points – Summary

Activity Instructions:

1. You have learned about many examples of higher standards that could be implemented in communities to make people and property safer from flooding. You now need to develop a plan to bring higher standards back to your community.
2. Individual plans should address:
 - Priorities you would set among higher standards to select those that are most beneficial and achievable in your community.
 - Strategies to convince stakeholders to support specific higher standards.
3. Develop your individual plan for 20 minutes, and then share your plan with others at your table.
4. Ask a spokesperson from your group to present your plan.

Benefits of Higher Standards

- Reduction in flood damages
- Reduction in flood insurance rates
- A safer community
- CRS credits



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65

Key Points – Summary

Higher floodplain management standards result in many benefits to your community, including reductions in:

- Flood damages
- Flood insurance rates
- Human suffering
- Loss of use
- Loss of tax revenue
- Loss of productivity

Other benefits include:

- A safer community
- CRS credits

Implementation of higher standards can be sensitive because citizens, public officials, and pro-development interests may perceive the standards as threats to property rights and economic expansion.

Remember citizens may blame politicians if no steps were taken to protect the community.

Summary

Are you now able to:

- Advocate for higher standards through outreach?
 - Explain how floodplains affect the environment?
 - Explain why to plan for future conditions?
- Recommend provisions to build higher and farther back?
- Describe CRS participation advantages?
- Describe measures to promote higher standards?



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66

Key Points – Summary

You should now able to:

- Advocate for higher standards through outreach.
 - Explain how floodplains affect the environment.
 - Explain why to plan for future conditions.
- Recommend provisions to build higher and farther back.
- Describe CRS participation advantages.
- Describe measures to promote higher standards.

Refer to your course expectations posted at the beginning of the course. Answer the following discussion question:

Were your expectations met?