

# Modeling and Mapping Non-Accredited Levees: Freeboard Deficient Procedure

The Federal Emergency Management Agency (FEMA) has developed a new set of procedures for analyzing and mapping flood hazard on the landward side of non-accredited levee systems on Flood Insurance Rate Maps (FIRMs). Non-accredited levee systems are those that do not meet all the requirements outlined in Title 44 of the Code of Federal Regulations (CFR), Section 65.10.

This fact sheet summarizes the Freeboard Deficient procedure. This procedure applies to levee reaches that are above BFE but below the freeboard requirements outlined in Title 44 CFR 65.10. The Freeboard Deficient procedure can be used for levee reaches that meet all of the requirements of 44 CFR 65.10, except freeboard. The Freeboard Deficient procedure can be applied to one or more reaches in a levee system or to an entire system.

**Levee freeboard** refers to the vertical distance from the Base Flood Elevation (BFE; also known as the 1-percent-annual-chance flood elevation) up to the top of the levee.

## Updated Levee Analysis and Mapping Methodologies

FEMA has developed procedures for analyzing and mapping hazards associated with non-accredited levees shown on FIRMs. An overview is provided in Fact Sheets titled:

1. Dividing Levee Systems into Multiple Reaches
2. Natural Valley Procedure
3. Sound Reach Procedure
4. Freeboard Deficient Procedure
5. Overtopping Procedure
6. Structural-Based Inundation Procedure
7. Understanding the Zone D Designation

For more information, please visit: <https://www.fema.gov/flood-maps/living-levees/technical-partners-engineers>

The CFR can be accessed at: <https://www.ecfr.gov>

## When to Use Freeboard Deficient Procedure

Figure 1 illustrates a levee system with a freeboard deficient reach. To use the *Freeboard Deficient* approach, the levee system must meet the structural, operational, and maintenance standards of 44 CFR 65.10. Although the levee system may have reaches that are deficient in freeboard, the levee reaches must be higher than the Base Flood Elevation (BFE) for their entire length.

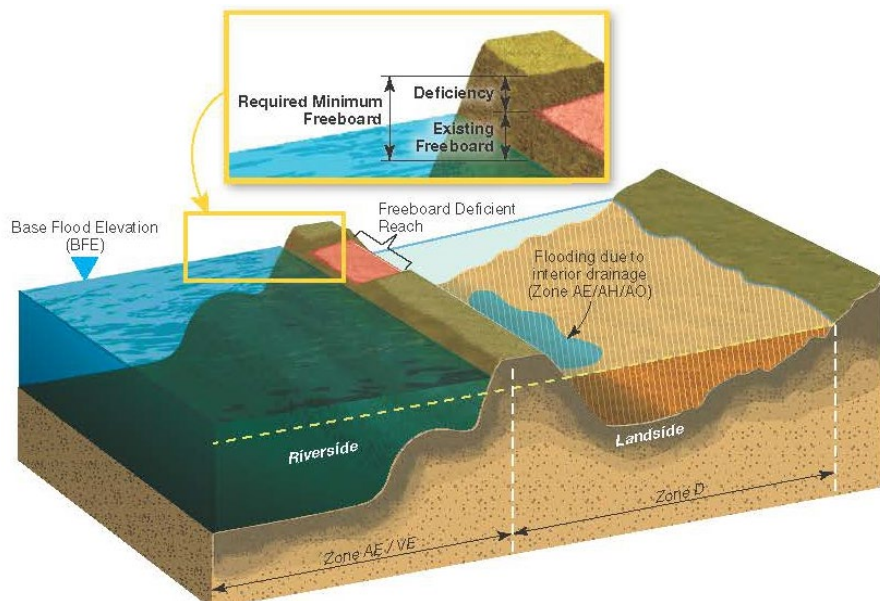


Figure 1: Cross-section of a freeboard-deficient reach



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If the BFE is higher than the levee at any point along the specified reach or system, the *Freeboard Deficient* approach is not applicable. In those situations, the *Overtopping, Structural-Based Inundation or Natural Valley* procedures (Fact Sheets 2, 5, 6) may apply, or consideration needs to be given to modify the reach destination.

## Minimum Levee Documentation Requirements

When using the *Freeboard Deficient* approach for levee analysis, documentation submitted to FEMA must identify where a levee system does not meet the freeboard requirements of 44CFR 65.10. In addition, the documentation should include information about all the other standards outlined in 44 CFR 65.10, including operations and maintenance information. FEMA will review levee documentation received (or currently on file and still applicable) and perform a completeness check.

## Freeboard Deficient Analysis and Mapping Procedures

There is no unique reach specific modeling for *Freeboard Deficient* reaches. These areas are not shown as Special Flood Hazard Areas (SFHAs), but analyzed using the Natural Valley procedure (see Fact Sheet 2) to establish the extent of the Zone D. Figure 2 shows how flood zones may be mapped for a non-accredited levee system with freeboard deficient reaches.

The analysis must also examine the potential for flood water resulting from upstream or downstream levee systems or reaches that do not meet all standards of 44 CFR 65.10. Additionally, interior drainage must be assessed and mapped appropriately.

## Why Freeboard is Necessary

Flood risk is dynamic because of physical and climatological changes. Levee systems are designed to reduce the risk of up to specific level of flooding at the time they are designed. Although flood risk may be reduced by a levee system, it cannot be completely eliminated. Freeboard requirements compensate for the uncertainty associated with the magnitude of future flood events and the possibility that flood waters may exceed the levee system design. Even if the top of a levee is slightly above the BFE, flood waters can overtop or breach the levee and result in catastrophic failure. Given the potentially catastrophic consequences of a levee system failure, including freeboard in levee design is important.

For the purposes of the National Flood Insurance Program, levee freeboard standards are as follows:

Riverine levees normally require a minimum freeboard of 3 feet above the water-surface level of the base flood. In some situations only 2 feet is required.

Coastal levees must provide freeboard of 1 foot above the height of the 1-percent wave height, or the maximum wave run-up (whichever is greater).

Exceptions and further details are defined in 44 CFR 65.10.



**Figure 1. Example of new Zone D flood hazard areas behind a freeboard deficient reach**