FEMA Flood Insurance Study Tutorial

Developed December 2000

Updated June 2003

Flood Insurance Study Tutorial Learning Objectives

The Objectives of the tutorial are:

1. To show what information is contained in the Flood Insurance Study (FIS),
2. To explain what the information in the FIS means, and
3. To describe how to use the information in the FIS.

Welcome

We are pleased to present this guide to the Flood Insurance Study (FIS). This tutorial will describe the various information found in the FIS and explain how to use it. The sections of the tutorial are explained in detail for you to fully understand the information in the FIS. Using the information in the FIS in conjunction with the Flood Insurance Rate Map (FIRM) will enable you to determine the flood risk for a property, and allow you to take actions that may prevent flood disasters or insure against losses caused by floods.

The glossary terms used in this tutorial will be listed at the end.

What is a Flood Insurance Study?

A FIS is a report prepared by the Federal Emergency Management Agency (FEMA) that summarizes an analysis of the flood hazards in a community. The analysis used to prepare a FIS is also used to prepare a FIRM, which is a map that shows the flood hazards areas in a community. The FIRM is the basis for floodplain management, mitigation, and insurance activities in the National Flood Insurance Program. The FIS provides information to supplement the FIRM.

Obtaining Flood Insurance Studies

All requests for printed copies of effective Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Insurance Study Reports should be submitted to FEMA's Map Service Center. You may contact the Map Service Center toll free, either by telephone at (800) 358-9616 or by facsimile at (800) 358-9620. For more information on the publications available at the Map Service Center, you should contact the Center's web site at http://www.msc.fema.gov/.

Federal Emergency Management Agency
Map Service Center
P.O. Box 1038
Jessup, Maryland 20794-1038
Telephone: (800) 358-9616
Fax: (800) 358-9620
http://www.msc.fema.gov/.

What is in this tutorial?

The remainder of this tutorial explains the seven sections and supporting Information found in a Flood Insurance Study.

- Section 1: Introduction
- Section 2: Area Studied
- Section 3: Engineering Methods
- Section 4: Flood Plain Management Applications
- Section 5: Insurance Application
- Section 6: Flood Insurance Rate Map
- Section 7: Other Studies
- Section 8: Location of Data
- Section 9: Bibliography
- Section 10: Revisions (not in all FISs)

Supporting Data includes:

- Vicinity Map
- Summary of Discharges Table
- Floodway Data Table
- Flood Insurance Zone Data Table
- Flood Profiles
- Flood Insurance Rate Map

Section 1 - Introduction

1.1 – Purpose of Study

- Overview
  This section tells which communities are included in the FIS and explains that the study developed flood risk data to be used for flood insurance rates and assisting the communities in providing floodplain management.

- States and Communities may enforce stricter criteria.
  Explains that the Federal criteria are the minimum, and that states or localities may enact and enforce stricter floodplain and land use criteria than the minimum NFIP requirements.

1.2 – Authority and Acknowledgements

- Authority for the NFIP, National Flood Insurance Act.
  Identifies the National Flood Insurance Act (1968) and the Flood Disaster Protection Act (1973).

- Identification of study contractor(s)
  Identifies the companies or government agencies that did the work that was incorporated into the FIS report and FIRM.

- Contract Numbers
  Identifies the contract Numbers under which the work was accomplished.

- Date work completed for each contract
  Provides the date that the Study Contractor completed his work.

1.3 – Coordination

- Initial Consultation & Coordination (CCO) Meeting
  Identifies dates during which representatives of FEMA met with community officials to discuss the scope of the study. Identifies which flood sources were to be studied by detailed or approximate methods. Identifies which corporations, communities and Federal Agencies were represented at the meeting.

- Sources of Additional Information
  Identifies sources of additional information that may have been incorporated into the FIS and FIRM but were not contracted or paid for by FEMA.

- Final CCO Meeting
  Provides date at which the results of the study were presented to representatives of the community and other interested parties. Also identifies the communities and agencies present at the meeting.

Section 2.0 – Area Studied

2.1 – Scope of Study

- Identification of flood sources studied by detailed methods and the geographical limits of the study
  Names the streams studied by detailed methods and the upstream and downstream limits.

- Identification of flood sources studied by approximate methods.
  Names the streams studied by approximate methods.

- Vicinity Map
  Shows the location of community in reference to County and/or State. Usually a portion of a USGS map shows the community by corporate limits or a star.

2.2 – Community Description

- Describes the location, climate, and many of the physical characteristics of the community. The types of information that may be included in this section are size and population of the community, the average rainfall and temperature, soil types, and the names of the adjacent communities.

2.3 – Principal Flood Problems

This section may include some of the following information:

- Causes of Major Floods
  Identifies the causes of flooding within the community or region and identifies natural or man-made features that aggravate flooding within the community.

- Past Major Floods
  Provides the dates of the past major floods within the community.

- Historical Flood Data
  Provides brief historical accounts, usually from local newspapers of the floods that have affected the community. Details should include the strength of the storm, the amount of damage caused to personal property, real property and infrastructure and casualties. Most helpful if the events are associated with a recurrence interval.

- Gage Station Locations
  Provides location of stream or tide gages, dates of operation, intervals of continuous operation and name of Agency that owns, operates or maintains the gage. The type of gage might also be included.

2.4 – Flood Protection Measures

- Channelization projects
  Channelization projects are man-made channels or waterways that are designed to increase the flow carrying capacity of the channels and, thereby, reduce the flood elevations. For a channelization project, the information in this section includes the type of channel (i.e., grass, concrete, gabion lined, etc.), the name of the agency or organization that constructed the channel, the date of construction, and the name of the agency or organization that maintains channel. Also, the section describes if the base flood is contained in the channel, and if not, the extent of flooding outside the channel.

- Levees
  Levees are man-made structures or fill that extend above the flood elevation to prevent lower areas from being inundated by the flood. For a levee, the information in this section includes the type of levee (i.e., earthen, concrete floodwall, agricultural, etc.), the name of the agency or organization that constructed the levee, the date of construction, the name of the agency or organization that maintains levee, the level of protection provided by the levee (i.e., the frequency of the floods that do not overtop the levee) and the historical performance of the levee.

- Dams
  Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream. Dams are often used to create retention basins, reservoirs, and ponds. For a dam, the information in this section includes the type of dam (i.e., earthen, concrete, etc.), the name of the agency or organization that constructed the dam, the date of construction, the name of the agency or organization that maintains dam, the purpose of the dam, and the historical performance of the dam. Also, included in this section are key dimensions and elevations of the dam; width, height, top elevation, spillway crest elevation, normal pool elevation, and emergency spillway elevation. In addition, details on operation or emergency plans may be included in this section.

- Non-structural flood control measures
  Non-structural flood control projects or ordinances are items such as floodplain ordinances that are more restrictive than the NFIP minimum, ordinances that reduce runoff potential by restricting watershed development, or designing easements or open space in the floodplain.

- Projects not recognized by the National Flood Insurance Program
  Describes the details on why any of the projects detailed within this section were not recognized by FEMA as providing protection from the base flood.

Section 3.0 – Engineering Methods

- Identification and explanation of flood frequencies
  Provides brief explanation of probability and recurrence intervals for floods. Explains how a 100-year, or other rare flood, can occur more than once over a short time interval.

3.1 – Hydrologic Analyses

Hydrologic analyses are studies of the amount of water flowing in a stream during flood events. Generally, FISs are concerned with the peak rates of flow or discharges in streams for the 10-, 50-, 100-, and 500- year flood events. The peak discharges are typically measured in cubic feet per second (cfs). The major items addressed in this section are:

- Sources of Data
  Identifies the data used to determine the peak discharges or the agency from which the discharges were obtained. The data used to determine the discharges may include topographical maps, gage data, land use or zoning maps, and soil information.

- Methods of Analysis
  Detailed explanation on the methods used to determine the peak discharges, and why that methodology is appropriate for the watershed. Typical methodologies are:

  - Regression Equations
    Regression equations are mathematical equations based on statistical analysis that calculate the peak discharge based on watershed characteristics. This section indicates from what publication the equation was obtained, who developed the equation, and what variable are required for the equation. Typical variables used in regression equations include drainage area, rainfall, and watershed slope. Any limitations on the use of the equation, such as size of watershed or region, are also included in this section.

  - Gage Data Analysis
    Gage data analysis is statistical computations perform on a historical record of flood data at a stream gage to determine the peak discharge on the stream for a given probability flood event (e.g. a flood that has a 1-percent annual chance). For gage data analysis this section provides information about the stream gage, which includes the location of the gage, the name of the agency or organization that owns and operates the gage, and the length of historical record used in the analysis. Also, any changes in the watershed, which could influence the peak discharges recorded at the gage, will be discussed in this section.

- Drainage Areas-Discharge Curves
  Drainage area – discharge curves are graphs relating peak discharges to the drainage areas developed from known peak discharges and drainage areas for other streams in the area. Using the curves the peak discharges at any point on the stream can be determined by simply knowing the drainage area to that point. A separate curve is used for each frequency storm.

- Rainfall-runoff Models
  Rainfall-runoff models are computer models are programs that calculate the peak discharges for given storm events and watershed characteristics. For a computer model, the information in this section includes the name of the computer program, the name of the agency that created the program, and major parameters of the program. Also, any storms that may have been used to calibrate the model are identified in this section.

- Summary of Discharges Table
  Summary of Discharge Tables briefly summarize the peak discharges and drainage areas at locations along the streams. Not all discharges used in the analyses are shown on the table. The locations chosen for the table are generally at physical features shown on the maps. Typically peak discharges for the 10-, 50-, 100-, and 500-year floods are shown in the tables.

- Coastal Analysis
  All of the below factors are included in the final determination of the coastal flood hazard area and are explained in this section of the FIS. The FIS typically includes the Parameter Values for Surge Elevations table and the Summary of Stillwater Elevations table.

    - Explanation of Storm Surge Analysis
      Brief explanation of coastal flooding in general and tropical and extra-tropical cyclones in particular (Hurricanes and Northeasters). Explanation of how these storms generate storm surges along the coast and the "forcing functions" of the storms (wind speed, central pressure depression, radius to maximum winds, forward speed, and direction of approach to the shoreline). Identification of the type of computer model and name of computer model used to establish the storm elevation. Identification of the sources of data used in the storm surge program to generate the model. Explanation of how the storm surge model was calibrated and identification of the storm(s) used.

      - Storm surge analyses and parameters
        - Storm intensity (central pressure depression)
        - Radius from storm center to maximum winds
        - Forward speed of storm
        - Direction of storm path
        - Frequency of the storm occurrence
      - Astronomic tide effects
      - Joint probability analysis
      - Determination of stillwater elevation
      - Wave setup analysis

- Summary of Stillwater Elevations Table
    - Identification of Shoreline
    - Lists stillwater elevations for selected recurrence intervals at each location along shoreline.

3.2 – Hydraulic Analyses

Hydraulic analyses are studies that determine the water surface elevations on streams or rivers. FISs are primarily concerned with the 100-year floods water surface elevations, which are known as base flood elevations (BFEs), however the water surface elevations for the 10-, 50-, and 500-year floods are also often determined. The major items addressed in this section are:

- Sources of Data
  This section identifies the sources of the data used in the analysis to calculate the flood elevations.

  - Cross Sections
    A cross section is an elevation view of the floodplain taken perpendicular to the flow at a given point. Cross sections are typically determined using field survey information, topographic maps, or some combination of the two. This section will contain pertinent information about the cross sections, such as how they were determined; the date of any field survey; and the scale, contour interval, and date of topographic maps that may have been used. Some of the locations of the cross sections used in the analyses may be shown on the FIRM.

- Roughness Coefficients
  Roughness coefficients, commonly referred to as Manning's "n" values, are values used in the hydraulic calculations that reflect the resistance to flow in the channel and overbanks. The resistance to flow in the channel and overbanks is primarily due to the vegetation that is present in these areas. This section lists or gives a range of the Manning's "n" values used for the channel and overbanks.

- Starting Water Surface Elevation (SWSEL)
  Starting Water Surface Elevations are the flood elevations at the first cross sections used in the step-backwater computations. For Starting Water Surface Elevations, FEMA generally uses normal depths, which are computed using the channel slopes and cross sectional areas (also known as slope-area method). This section describes how the starting water surface elevations were determined.

- Methodologies
  This section describes the methodologies used to compute the flood elevations and the various components used in the calculations. The most common methodology used to calculate flood elevations for a stream is a step-backwater computer program, such as HEC-2 or HECRAS. For more complex flooding situations, a computer program that models two-dimensional flow may be used.

- Datum
  This section indicates the vertical datum used for the information used in the hydraulic analysis and presented in the FIS. Vertical datum is important to ensure that like values are being used when the information in the FIS is being compared to other vertical data. FEMA had primarily used the National Geodetic Vertical Datum (NGVD), but is using the North American Vertical Datum (NAVD) for new studies.

3.3 – Wave Height Analyses

- Wave Height Analysis Methodology and Criteria
  Brief discussion of wave height elevations. Brief discussion of how obstructions, such as vegetation, buildings, etc., can absorb wave energy and thereby reduce wave heights and elevations. Describes how waves can regenerate inland due to wind over low, flat areas and inland bays.

- Concept of the Transect
  Explain that the transect is a line, similar to a cross section that represents a portion of a beach in which ground cover and ground elevations are similar, particularly during a storm event.

- Wave Height Elevation versus Actual Wave Height
  Concept of the wave elevation being 70% of the wave total height. The total height of the wave is not added to the stillwater elevation, only the wave elevation.

- Storm Erosion and Effects on Beach Profiles
  Discussion of the FEMA approach to storm-induced beach erosion. FEMA's approach is to remove 540 square feet of the dune area above the stillwater elevation and adjust the transect profile accordingly. The 540 square-foot criteria is based on the national average.

- Wave Height Analysis Computer Program Used
  Reference the FEMA Wave Height Analysis for Flood Insurance Studies (WHAFIS) computer program and how it combines all the items discussed previously. If another program is used ie USACE Automated Coastal Engineering System (ACES) discuss parameters used and how coastal areas mapped.

- Wave Runup Analysis Computer Program Used
  Concept of wave runup and conditions (ie abrupt beach slope or bluff) where wave runup can occur. Identify and describe wave runup program used and how results were incorporated into the base flood elevations.

- Field Surveys and Topographic Mapping Used
  Identifies maps used to delineate the flood zones and the date transects were surveyed.

- Primary frontal dune analysis and its ability to remain as a topographic feature during the base flood.
  In order to be considered as remaining intact during the base flood, the primary frontal dune must have at least 540 square feet of area in cross section above the stillwater elevation. If the dune is intact, the eroded profile is then included into the wave height and wave runup analysis as an existing dune.

- Transect Location Map
  - Location of Transects
  - Numbering of Transects

- Transect Description Table
  - Transect Number
  - Description of Transect
  - Stillwater Elevation at each Transect
  - Maximum Wave or Run up Elevation at each Transect

- Transect Data Table
  - Flood Source
  - Transect Number
  - Stillwater Elevations For All Recurrence Intervals
  - Range of Wave Height and Runup Elevations

Section 4.0 – Floodplain Management Applications

Section 4.1 – Floodplain Boundaries

Floodplain boundaries show the areas that would be inundated by a flood of a given frequency. The FIRM shows the floodplain boundaries for the flood having a 1-percent annual chance (100-year flood) and in some areas the flood having a 0.2-percent annual chance (500-year flood). This section indicates the scales, contour intervals, and dates of the topographic maps used to delineate the floodplain boundaries. The floodplains are delineated using flood elevations at cross sections or transects and by interpolating between cross sections or transects using topographic maps.

Section 4.2 – Floodways

- This section defines the floodway and explains how it is used for floodplain management. Also, this section lists which streams have floodways and describes how floodways were determined.

- The Floodway Data Table presents the results of the floodway analyses at the cross sections shown on the flood maps.

Section 5.0 – Insurance Applications

For insurance applications, areas on the FIRM are designated by zones based on the flood risk potential computed in the analysis. This section identifies and defines all zones shown on the effective FIRM. Older Flood Insurance Study may include a Flood Insurance Zone Data Table. This table presents information that was used for insurance applications, but is not used any longer.

Section 6.0 – Flood Insurance Rate Map (FIRM)

This section briefly describes the purpose of the FIRM for flood insurance and floodplain management.

Section 7.0 – Other Studies

This section identifies other studies of flooding in the area and indicates if these studies agree or disagrees with the Flood Insurance Study. Also, included in this section is a list of previous FISs that are superseded by the publication of the new FIS.

Section 8.0 – Location of Data

This section identifies the FEMA Regional Office and the Community Map Repository (i.e., the local community office that keeps a copy of the FIS) and gives their addresses.

Section 9.0 – Bibliography

This section lists References.

Section 10.0 – Revisions

This section is included in some Flood Insurance Studies and provides brief information on revisions to the FIS. The information provided may include the development or project that necessitated the revision, the name of the agency or engineering firm that preformed the analyses, descriptions of the hydrologic and hydraulic analyses, and identification of the maps used to determine the floodplain boundaries.

Flood Profiles

A flood profile is a graph of the flood elevations along the centerline of a stream. The flood profiles in the FIS show the profiles for the 100-year flood event, and also often show the profiles for the 10-, 50-, and 500-year flood events. Other information shown on the flood profiles include the cross sections shown on the flood maps, the location of the streets crossing the streams, the elevation of the streambed, and other hydraulic structures. The flood profiles should be used to determine the precise base flood elevation for an area in the floodplain, rather than the Flood Insurance Rate Map, which the base flood elevations are rounded to the nearest whole foot.

Conclusion

Upon concluding this tutorial, you should have learned what information is included in the Flood Insurance Study, and how to use the information in conjunction with the Flood Insurance Rate Map to determine flood risks. Knowing this will enable you to make wise decisions to reduce the risk from potential flood hazards.

Glossary Terms

100-year flood
The flood having a 1-percent chance of being equaled or exceeded in any given year; also known as the base flood. The 1-percent annual chance flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a special flood hazard area shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage.

Base Flood
The flood having a 1-percent chance of being equaled or exceeded in any given year; also known as the 100-year flood. The base flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a special flood hazard area shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage.

Base Flood Elevation
The height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or depth of the base flood, usually in feet, above the ground surface.

Cross Section
A line developed from topographic information, across a floodplain at which a computation of flood flow has been made to establish a potential flood elevation. Cross sections are shown on the Flood Boundary Floodway Map, Flood Insurance Rate Map, and/or Flood Profiles of a Flood Insurance Study.

Cubic feet per second (cfs)
Typical units used to express the rate of flow of surface water in open channels. One "cfs" is approximately equal to 7.5 gallons per second.

Datum
FEMA's Flood Insurance Rate Maps (FIRMs) reference the elevation datum used to compute flood elevations. In completing elevation certificates, the same elevation datum as that shown on the FIRM must be used to compute lot and/or structure elevations and to compute flood elevations that are not given on the FIRM. The National Geodetic Vertical Datum (NGVD) is the national standard reference datum for elevations, formerly referred to as Mean Sea Level (MSL) of 1929. NGVD is used as the reference datum on most FIRMs.

Discharge
The volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Federal Emergency Management Agency (FEMA)
An independent agency of the Federal government, founded in 1979, which reports directly to the President. FEMA is responsible for identifying and mitigating natural and man-made hazards. The agency's mission is:
to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.

Flood (also Flooding)
A general and temporary condition of partial or complete inundation of normally dry land areas. For flood insurance claim purposes, two or more structures must be inundated before flood damage will be covered.

Flood Hazard Boundary Map (FHBM)
Initial map issued by FEMA to identify approximate Special Flood Hazard Areas (SFHAs) within a community.

Flood Insurance Rate Map (FIRM)
A map on which the 100-year (1% annual chance) and 500-year (0.2% annual chance) floodplains, Base Flood Elevations, and risk premium zones (and floodway information on Map Initiatives FIRMs) are delineated to enable insurance agents to issue accurate flood insurance policies to homeowners in communities participating in the National Flood Insurance Program.

Flood Insurance Study
An examination, evaluation, and determination of flood hazards and, if appropriate corresponding water-surface elevations. The resulting reports are used to develop Flood Insurance Rate Maps. Also know as a flood elevation study.

Flood Profile
A cross-sectional drawing showing the contiguous cross sections along a stream, with ground elevations and potential flood elevations plotted.

Floodplain or Flood-Prone Area
Any land area susceptible to inundation by water from any source.

Floodway
Channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood discharge can be conveyed without increasing the elevation of the 100-year flood by more than a specified amount (1 foot in most states).

HEC-2
A step-backwater program developed by the U.S Army Corps of Engineers Hydrologic Engineering Center for use in calculating water-surface profiles for steady, gradually varied flow in natural or man-made channels.

Levee
Levees are man-made structures or fill that extend above the flood elevation to prevent lower areas from being inundated by the flood.

Mannings “n” Roughness Coefficient
Coefficient used to account for the friction caused by earthen, vegetative, and/or man-made surfaces within a floodplain cross section. The coefficient, n, is commonly used to represent flow resistance for hydraulic computations of flow in open channels. The procedure for selecting n values is subjective and requires judgment and skill that is developed primarily through experience. The expertise necessary for proper selection of n values can be obtained in part by examining characteristics of channels that have known or verified roughness coefficients. A table of Manning's "n" values is available from the "Help" pull-down menu in the Quick-2 program.

Map Repository
The location where a community's flood maps are kept; usually the local zoning and planning office.

Map Service Center (MSC)
The Map Service Center distributes National Flood Insurance Program (NFIP) materials to a broad range of customers, including Federal, State, and local government officials; real estate professionals; insurance providers; appraisers; builders; land developers; design engineers; surveyors; lenders; and the public.

MSC products include: Digital Flood Insurance Rate Maps, Flood Insurance Rate Maps, Flood Insurance Study reports, Digital Q3 flood data, Community Status Book, Flood Map Status Information Service, Letters of Map Change, and NFIP Insurance Manuals.

National Flood Insurance Program (NFIP)
Federal insurance program under which flood-prone areas are identified and flood insurance is made available to residents of participating communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage.

Normal Depth
The depth expected for a stream when the flow is uniform, steady, one-dimensional, and is not affected by downstream obstructions or flow changes. This is the usual calculation that is utilized to determine Base Flood Elevations for property or structures in approximate (Zone A) areas.

Overbank
The area of a cross section that is found outside of the channel bank stations on either side of the stream channel.

Peak Discharge
The peak volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Perpendicular to Flow Path
Cross sections should be plotted so that they are oriented in a manner that is perpendicular to the flow path. Plotting cross sections in this manner requires that the user examine the topography to determine the direction in which the water is most likely to flow in relation to different points along the proposed cross section line. Typically, this can be achieved by ensuring that the cross section line crosses each contour on the topographic map at or near a 90° angle.

Scale
A representative fraction of map distance to ground distance. Example: 1:12,000 is the representative fraction in which one unit of measure on the map is equal to 12,000 of the same units of measure on the ground. Federal Emergency Management Agency map scales are expressed in a ratio of 1" of map distance equal to a given number of feet on the ground.

Step-Backwater Analysis
Method used in Quick-2 (and other modeling programs) to analyze multiple cross sections. Water-surface elevations are determined for all sections based on a given discharge. The initial water-surface elevation is automatically determined by the normal depth method or by direct input of a water-surface elevation or depth.

Water-Surface Elevation
The height, in relation to the National Geodetic Vertical Datum of 1929 (or other datum, where specified) of floods of various magnitudes and frequencies in the identified floodplains of coastal or riverine areas.