UNIT 3: NFIP FLOOD STUDIES AND MAPS

In this unit

This unit describes the flood data, studies, and maps that the National Flood Insurance Program provides to communities to assist them in carrying out their floodplain management program. It reviews:

- Flood study and map terminology,
- How flood studies are prepared along riverine floodplains,
- How flood studies are prepared on coastal floodplains, and
- How the NFIP maps display the study data.

Materials needed for this unit

- Flood Insurance Study, Flood County, USA and Incorporated Areas
- Flood Insurance Rate Map, Flood County, USA and Incorporated Areas

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A. NFIP FLOOD STUDIES

FLOOD STUDY TERMINOLOGY

Before describing how flood studies are developed, we first need to introduce some of the common terms used in floodplain analysis and in the National Flood Insurance Program (NFIP). The following terms are integral for understanding the basis for flood studies and flood maps:

- The base flood,
- The 100-year flood,
- Special Flood Hazard Area, and
- Base Flood Elevation.

The base flood

Floods come in many sizes — with varying degrees of magnitude and frequency.

Rivers and coastlines are expected to flood, as all bodies of water have floodplains. But rivers and coastlines are different, as well; each has its own probability of flooding. Probability is a statistical term having to do with the size of a flood and the odds of that size of flood occurring in any year.

For each river, engineers assign statistical probabilities to different size floods. This is done to understand what might be a common or ordinary flood for a particular river versus a less likely or a severe flood for that same river.

In order to have common standards, the NFIP adopted a baseline probability called the base flood. The base flood is the one-percent annual chance flood. The one-percent annual chance flood is the flood that has a one-percent (one out of 100) chance of occurring in any given year. The base flood, which is also informally referred to as the 100-year flood, is the national standard used by the NFIP and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development

The one-percent annual chance flood was chosen as a compromise between a more frequent flood (such as a 10-percent chance flood), which would permit excessive exposure to flood risk, and a more infrequent flood (say, a 0.1-percent chance flood), which would be considered an excessive and unreasonable standard.

The 100-year flood

The one-percent annual chance flood is also called the 100-year flood because the inverse of one percent (one divided by one percent or 0.01) equals 100. This calculation gives us the flood's recurrence interval, in terms of probability, which is 100 years.

The term "100-year flood" is often misconstrued. Commonly, people interpret the 100-year flood definition to mean "once every 100 years." This is wrong. You could experience a 100-year flood two times in the same year, two years in a row, or four times over the course of 100 years. You could also not experience a 100-year flood over the course of 200 or more years.

To avoid confusion (and because probabilities and statistics can be confusing), the NFIP uses the term "base flood." A 100-year base flood is defined as having a one-percent chance of being reached or exceeded in any single year. Thus, the 100-year flood also is called the "one-percent annual chance flood."

To restate, "100-year flood" and "base flood" both refer to a flood that has a one-percent chance of occurring in any given year. The terms "base flood," "100-year flood," and "one-percent annual chance flood" are often used interchangeably.

Special flood hazard area and base flood elevation

The land area covered by the floodwaters of the base flood is the base floodplain. On NFIP maps, the base floodplain is called the Special Flood Hazard Area (SFHA). The SFHA is designated as Zone A, AE, A1-30, AO, AH, V, VE or V1-30 depending on the amount of flood data available, the severity of the flood hazard, or the age of the flood map (see the discussion of zones in this Unit for more information.).

The SFHA is the area where the NFIP's floodplain management regulations must be enforced by the community as a condition of participation in the NFIP and the area where the mandatory flood insurance purchase requirement applies.

The computed elevation to which floodwater is anticipated to rise during the base flood is the Base Flood Elevation **(**BFE).

WHAT ARE THE ODDS OF BEING FLOODED?

The term "100-year flood" has caused much confusion for people not familiar with statistics. Another way to look at flood risk is to think of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage—a 26% chance for a structure located in the SFHA.

Chance of Flooding over a Period of Years

Time Period	Flood Size 10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During a 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 1-2% chance that the house will catch fire during the same 30-year mortgage.

IDENTIFYING FLOODPRONE AREAS

The National Flood Insurance Act of 1968 directed the Federal Insurance Administration (FIA) to:

- Identify all floodprone areas within the United States.
- Establish flood-risk zones within floodprone areas.

Today, the Federal Emergency Management Agency's (FEMA) Mitigation Division is responsible for implementing this directive. FEMA has conducted flood studies and produced various forms of maps. The flood studies analyze the terrain and the factors that affect flood hazards. This information is used to draw the maps that delineate floodplain boundaries.

The maps and flood studies also show projected flood elevations, flood velocities, floodway dimensions, insurance rating zones, and descriptions of how the study was conducted and how the maps were prepared. This information is needed for flood insurance and floodplain management purposes.

All of this information is referred to as a community's Flood Insurance Study (FIS), which is conducted under standards set by FEMA for the NFIP. FEMA has prepared flood insurance studies for more than 19,000 communities.

In keeping with the directive of the National Flood Insurance Act of 1968, initial flood study and mapping efforts of the NFIP were focused on identifying all floodprone areas within the United States. Flood data and floodplain information from many sources — such as soils mapping, actual high water profiles, aerial photographs of previous floods, topographic maps, etc. — were used to overlay the *approximate* outline of the base (100-year) floodplain for specific stream reaches on available community maps, usually U. S. Geological Survey topographic quadrangle maps.

These documents were referred to as Flood Hazard Boundary Maps and were based on approximate studies. Most communities used a Flood Hazard Boundary Map when they first joined the NFIP.

As money was appropriated by Congress, FEMA performed more detailed studies for many communities, resulting in the publication of Flood Insurance Study reports and Flood Insurance Rate Maps (FIRMs). These studies provide communities with data needed to adopt and implement more comprehensive floodplain management measures and to enter the Regular Phase of the NFIP.

FISs, also referred to as detailed studies, were carried out for developed communities and for those areas experiencing rapid growth. FISs contain guidance on understanding the FIRM as well as information needed for new construction allowed in developing and developed areas.

Today, almost every community in the NFIP has a FIRM, which may contain approximate and/or detailed flood hazard analyses. The areas mapped with approximate studies are areas where, originally, there was little or no development or expectation of development. However, recent development may have created a need for future detailed studies in these areas.

Flood maps are one of the most vital parts of a floodplain management program, so it is important to understand how the maps were created and to be familiar with the information that is available within the accompanying flood study.

Flood Insurance Study

When a flood study is completed for the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). A FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community.

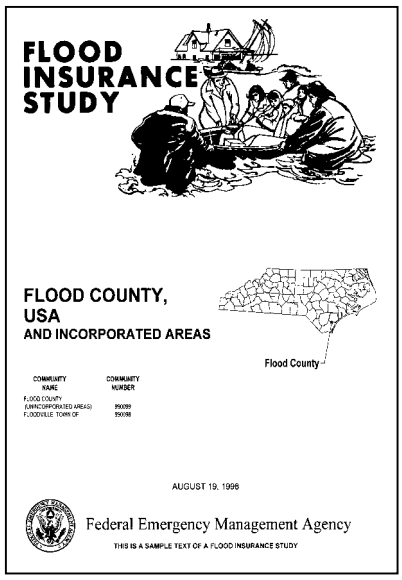
The FIS report and associated maps delineate the SFHA, designate flood risk zones and establish base flood elevations. They serve as the basis for rating flood insurance and for regulating floodplain development and carrying out other floodplain management measures.

The study has three components:

- The FIS — Flood Insurance Study report
- The FIRM — Flood Insurance Rate Map
- Prior to 1986, a separate Flood Boundary and Floodway Map (FBFM) was issued as a component of the FIS for each community studied.

The FIS report includes:

- An appraisal of the community's flood problems in a narrative that describes:
  - -- the purpose of the study,
  - -- historic floods,
  - -- the area and flooding sources studied, and
  - -- the engineering methods employed.
- A vicinity map of the community and, occasionally, photographs of historic floods.
- Tables summarizing various flood hazard data.
- Computed flood profiles for various recurrence probabilities, usually the 10-, 50-, 100-, and/or 500-year floods.



Flood County, USA and Incorporated Areas

Included in the reference guide materials are the FIS report and maps for Flood County, USA and Incorporated Areas. This fictitious community was developed to illustrate examples of both riverine and coastal flood hazards.

This unit uses these documents for Flood County, USA and Incorporated Areas:

- The FIS report, and
- The FIRM, accompanying Map Index, and panels 25, 38, and 40.

Flood County is subject to flooding from several flooding sources; however, this unit concentrates on the following three sources:

- The Rocky River, which drains from the west, and flows through the Town of Floodville to the Atlantic Ocean.
- Cobb Brook, which flows from the west to the Rocky River.
- The Atlantic Ocean.

As you look at Flood County, you may find that some street names do not appear on the FIRM. This is because flood hazard maps are created to show details related to identified floodplains. If your community flood maps lack street names, use a supplementary street map to assist you in locating properties accurately.

As you work through this unit, we recommend that you locate similar sections in your community's FIS and see how this information pertains to your situation. The outline is similar for all FISs, so you should be able to locate the same tables and exhibits in the table of contents.

B. RIVERINE STUDIES

Detailed flood studies are conducted differently for different types of flooding, which are:

- Riverine flooding of rivers, streams or other waterways,
- Lacustrine flooding of lakes and ponds,
- Coastal flooding caused by hurricanes or severe storms, and
- Shallow flooding, ponding, and sheet flow.

As you recall from Unit 1, there are other types of flooding, such as alluvial fans, ice jams, and mudflows. This unit does not cover how these areas are studied because each situation is unique. If your community has these unique hazards, Appendix C lists some reference materials that may be of assistance.

Riverine flooding occurs in rivers, streams, ditches or other waterways that are subject to overbank flooding, flash floods, and urban drainage system flooding. Riverine studies involve, among other factors, the collection and analysis of information about the river's watershed, the topography or the lay of the land along the river, precipitation, and the characteristics of the river itself.

HYDROLOGY

In order to determine the depth of flood waters and to determine the size or width of floodplains, engineers must first examine the watershed to determine the amount of water that will reach a stream and be carried by the stream during a flood event.

Hydrology, a science dealing with the distribution and circulation of water in the atmosphere, on land surfaces, and underground, is used to determine flood flow frequencies. The study of a watershed's behavior during and after a rainstorm is, therefore, hydrology. A hydrologic analysis determines the amount of rainfall that will stay within a watershed — absorbed by the soil, trapped in puddles, *etc.* — and the rate at which the remaining amount of rainfall will reach the stream.

The rainfall that reaches the stream is called runoff. Increased runoff will, in turn, increase flood discharge. Discharge is the amount of water flowing down a stream channel. Discharges are measured in cubic feet per second or cfs. (A cubic foot of water is about 7.5 gallons.) Data for this measurement is taken by stream gauges at specified locations along a given stream also known as gaging stations.

Significant development or other changes in the watershed (both within a community and any upstream communities) can significantly change the flood discharges. Often, the increase in impervious areas associated with urbanization

causes increase in stream discharges. In addition, new technical data such as new regional equations, new design storms, and in some circumstance, increase in the length of gage records, might significantly affect the base discharge estimation.

Runoff amounts and discharge rates vary depending on soil type, ground slope, land use, and the presence of storm sewers. In general, more runoff occurs on non-vegetated land, on paved and built-on urban land, and on steeper slopes.

Discharges are estimated by using rainfall and snowmelt data and historical stream records or by using regional equations that represent such data. Computer models allow engineers to incorporate numerous watershed characteristics into the hydrologic analyses. Discharge rates also generally increase as the size of a watershed increases.

Upon completion of the hydrologic analysis, engineers have flood discharges for various size rainstorms that are measured at different points along a stream, such as at the confluence with another stream and at the mouth of a tributary stream.

CROSS SECTIONS

All detailed flood studies examine the areas through which floodwater will flow. This requires a determination of ground elevations and obstructions to flow (such as vegetation, buildings, bridges, and other development) for these areas. Accurate data on the channel geometry and changes in the floodplain are obtained from ground surveys, aerial photography, or topographic maps.

To locate the true elevations at a site, surveyors have established elevation reference marks or bench marks that are referenced to a common vertical elevation reference called a datum. The use of a datum ensures uniformity of references to land elevations and avoids misinterpretation of flood elevations.

Established reference marks and bench marks with a recorded elevation allow surveyors to describe the changes in the ground levels or stream characteristics as elevations relative to the referenced datum. They are also used by surveyors to determine the elevations of buildings that are at risk of flooding.

A cross section is a graphical depiction of the stream and the floodplain at a particular point along the stream. It is taken at right angles to the flow of the stream. At each cross section, the engineer has accurate information on the size and geometry of the channel, the shape of the floodplain, and the changes in the elevation of the ground. A typical surveyed cross section is shown in Figure 3-1.

Cross sections are taken of the floodplain at locations along the stream that are representative of local conditions. Cross sections are taken at each bridge or other major obstruction and at other locations, depending on how much the stream or adjacent floodplain conditions change (Figure 3-2). The more changes there are in

topography (perhaps steep riverbanks changing to large flat overbank areas), the more cross sections are needed to define the floodplain accurately.

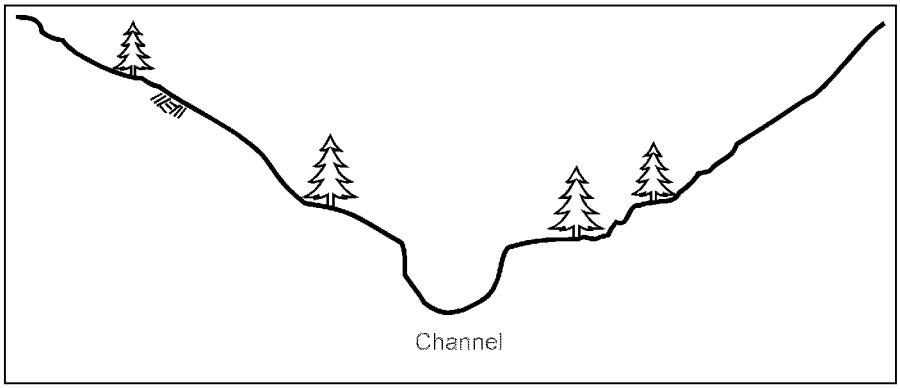


Figure 3-1: Surveyed cross section

About Datums and Elevations

During the 1920s, the U.S. government created a network of 21 tidal gages in the U.S. and five in Canada to provide a fixed continental datum that would bring a consistent relationship to all vertical elevation determinations in the U.S. This new datum was known as the Mean Sea Level (MSL) Datum of 1929 and is the base elevation to which all relief features and elevation data are referenced in the contiguous United States. In 1973, to avoid confusion in many communities that used a local mean sea level datum, the name was changed to the National Geodetic Vertical Datum (NGVD) of 1929. NGVD is also the datum of reference for the vast majority of FISs.

Most permanent elevation reference marks (or bench marks) are referenced to the NGVD (see example). Reference marks are not always brass caps; they can be chiseled squares or other designated markers left by surveyors. The city or county surveyor or engineer's office should have a list of bench marks in the community. An ultimate goal of the NFIP is to convert all FISs to a newer standard called the North American Vertical Datum (NAVD) of 1988. This latest standard will eliminate inconsistencies caused when the NGVD is not consistent at all 26 tidal stations.

When reporting elevations for structures, cross sections, or topographic mapping, it is very important to note the datum to which the survey is referenced. Differences between NAVD 88 and NGVD 29 vary by as much as –1.5 feet along the east coast of southern Florida to + 4.9 feet in the Rocky Mountains of Colorado. Software for converting between NAVD 88 and NGVD 29 is available from the National Geodetic Survey.

There are now 600,000 permanent benchmarks associated with the NAVD of 1988. See *Flood Insurance Study: Guidelines and Specifications for Study Contractors*, FEMA-37 (1995), for further information.

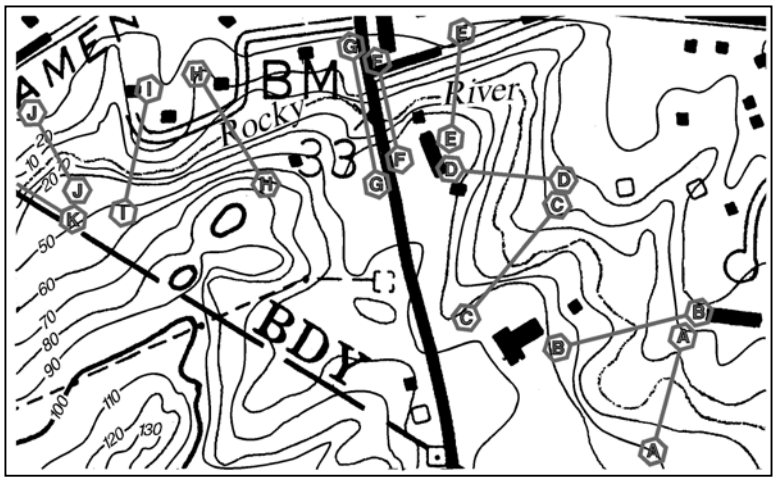


Figure 3-2: Typical cross section locations

The surveyors and engineers also estimate the roughness factor along the floodplain to determine how fast floodwater will flow through the area. Roughness factors are related to ground surface conditions, and they reflect changes in floodwater velocity due to ground friction. For example, water will flow faster over mowed grass and pavement than it will over an area covered in bushes and trees, or planted in tall crops.

A portion of the collected survey information is used in the hydrologic analysis, but the surveyed cross sections and other survey information are the building blocks of the hydraulic analysis and mapping efforts.

HYDRAULICS

Hydraulics, a science that deals with fluids in motion, is used to determine how a quantity of water will flow through a channel or floodplain. For purposes of floodplain analysis, hydraulics is the study of floodwaters moving through the stream and the floodplain. Hydraulic analysis combines:

- Flood hydrology, or discharges,
- The cross section data on how much area there is to carry the flood, and
- Stream characteristics — roughness, slope, locations and sizes of structures.

The data are usually processed using a computer model, most commonly HEC-2 or HEC-RAS, which were developed by the U.S. Army Corps of Engineers' Hydrologic Engineering Center.

Changes in hydraulic conditions of a stream usually occur when new bridges, culverts and road crossings are constructed, and when there are changes in the physical characteristics of the stream. If a bridge or culvert is not properly sized, it can cause flood waters to back-up, which increases flood levels upstream.

Although most bridge openings and culverts are designed to allow stream flows associated with frequent storm events to pass without such backwater effects, they may still cause increase in the base flood elevation. Therefore, any bridges, culverts, or other road crossings that have been constructed since the analyses for the effective FIS and FIRM were completed should be evaluated for their potential effect on the base flood and the associated floodway. In addition, any significant changes in the stream channel or floodplain geometry could affect the floodplain and floodway. One should always ask the questions: 1) has any portion of the floodplain been filled? 2) has the stream channel migrated or changed location because of significant erosion and/or depositions? 3) have any portions of the stream been channelized, widened, or dredged? 4) have there been significant changes in the vegetation in the floodplain? Aerial photographs are useful tools in evaluating changes in stream channels and floodplains.

The hydraulic study produces determinations of flood elevations, velocities, and floodplain widths at each cross section for a range of flood flow frequencies (Figure 3-3). These elevations are the primary source of data used by engineers to map the floodplain.

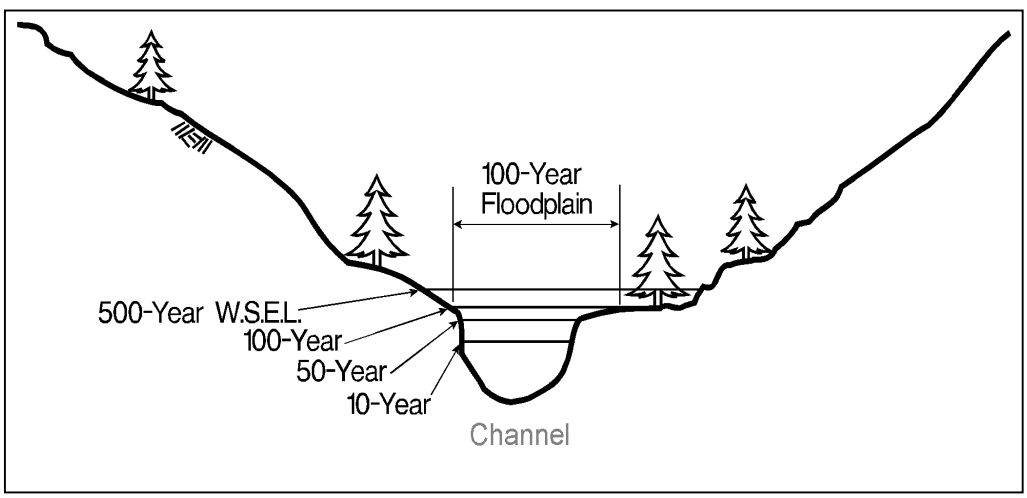


Figure 3-3: Cross section with flood elevations

A FIS typically produces elevations for the 10-, 50-, 100-, and 500-year floods. Water-Surface Elevations (WSEL) for the 10-, 50-, and 500-year floods are typically used for other floodplain management purposes. For example, the 10-year flood data may be used for locating septic systems, the 50-year flood for placing bridges and culverts, and the 500-year for siting critical facilities, such as hospitals or emergency operation facilities.

FLOOD PROFILE

The hydraulic computer program generates potential flood elevations at each cross section, but flood elevations at locations between the cross sections need to be determined as well. This is done by plotting the elevations at the cross sections

on a graph and connecting the plotted points. Such a graph is called a flood profile.

Figure 3-4 shows a portion of the flood profile for the Rocky River. The entire profile is found in the back of the Flood County FIS report.

The bottom of the graph (the horizontal axis or x-axis) shows the distance along the stream, which is commonly called stationing. For stationing, you start at the mouth of a stream (its point of discharge into a larger body of water) and look upstream. Generally, when profiles are plotted, the slope of the streambed will rise as you read the graph from left to right.

River distances are measured in either feet or miles (1mile=5280 feet), or meters and kilometers (1 kilometer=1000 meters). For most profiles, the distance is measured above the mouth of the stream or above its confluence (where it meets with another stream). In the case of Flood County, the stream distances for the Rocky River are measured above the County Boundary.

The left and right sides of the graph (the vertical axis or y-axis) show elevations in feet (NGVD). The legend at the bottom right corner shows the symbol for each flood profile plotted. Bridges are indicated with an “I” shaped symbol. The bottom of the “I” represents the bridge’s low chord (lowest beam) and the top of the “I” represents the top of the roadway or the top of a solid bridge railing.

Additional information is provided on the profiles, such as corporate limits and confluences of smaller streams. Profiles also provide a picture of stream characteristics, such as steep sections of the streambed and where restrictive bridge openings cause floodwaters to back up (see the footbridge in Figure 3-4).

By reading a profile, you can determine the flood elevation at any point along the stream. Reading profiles is covered in Unit 4.

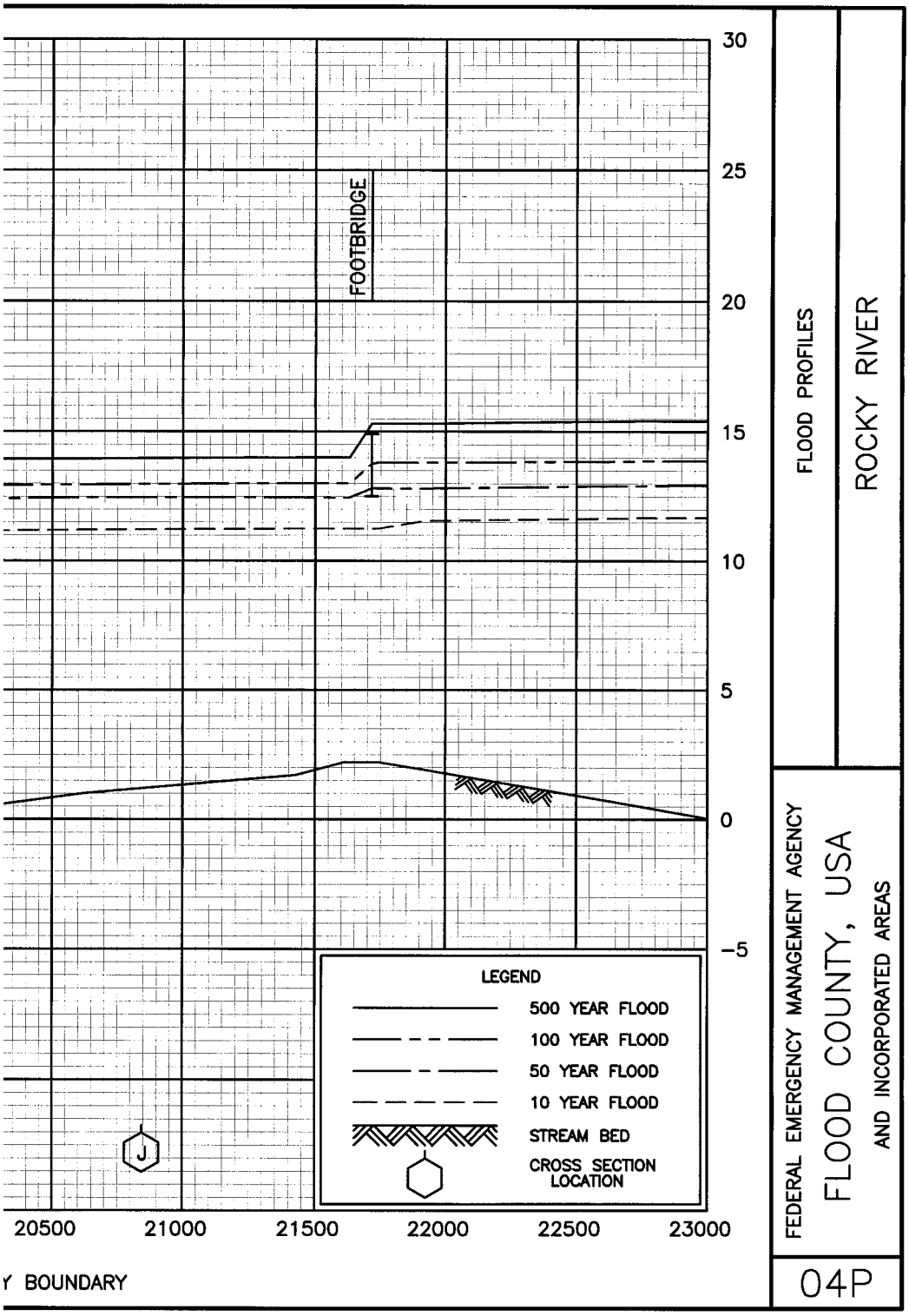


Figure 3-4: Rocky River flood profile

FLOODPLAIN MAP

The next step in the mapping process is to transfer the flood elevation data onto a map showing ground elevation data. This is called a topographic map or contour map because points with the same elevation are connected by a contour line. The topographic or contour map is often referred to as the base map.

The most common topographic maps used are produced by the U.S. Geological Survey. Some communities have prepared their own topographic maps and provided them to FEMA during the study process to improve the accuracy of their floodplain maps.

The base flood elevations from the cross sections and profiles are plotted on the topographic map. Floodplain boundary lines are drawn connecting these plotted points using the contour lines as a guide. The completed map illustrates the SFHA (Figure 3-5).

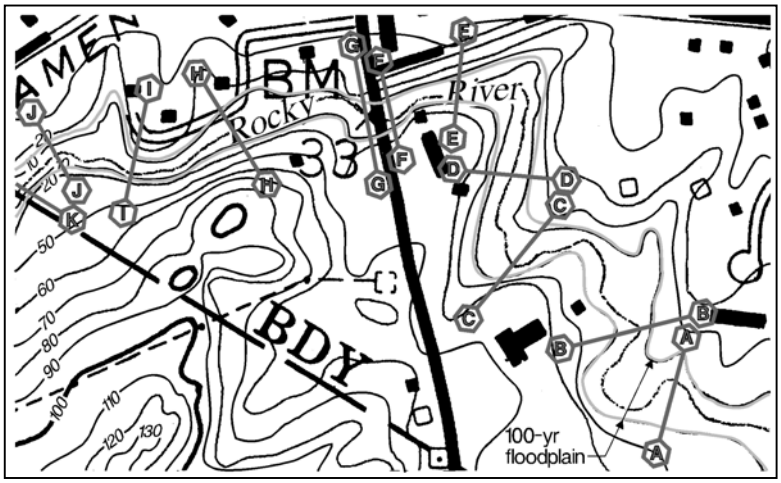


Figure 3-5: The BFEs at the cross sections from the Rocky River profile are used to plot the BFEs on the contour map.

Lines are connected to show the floodplain boundary on a map.

It is important to remember that floodplain map boundaries are only as accurate as the topographic map on which they are drawn. Since the U.S. Geological Survey topographic quadrangle maps have so small a scale, the SFHA boundaries cannot be precisely mapped. This is important to remember when determining if a building is in or out of the floodplain, and, therefore, the use of other relevant measurements may be required and is recommended.

Correlating map features with ground features requires care, because maps do not always represent exact conditions on the ground. Where there is an apparent discrepancy between floodplain boundaries shown on a map and actual ground conditions, as the local administrator, you can use elevation data to resolve the

matter by locating the flood elevation on the ground via an elevation survey. This elevation represents the actual extent of flooding for that particular flood.

Note: Banks, lending institutions and others who must read the FIRM to determine if flood insurance is required must go by the map. They cannot make on-site interpretations based on data other than the FIRM. However, they may recommend that the property owner submit a request for a map revision or map amendment so the map can be officially changed to reflect the more accurate data (see Unit 4, Section D).

FLOODWAY ANALYSIS

The final step in preparing most riverine flood studies is to produce the floodway analysis, which identifies where encroachment by development will increase flood elevations significantly and worsen flood conditions.

The floodway is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. FEMA has mapped designated floodways in more than 8,000 communities.

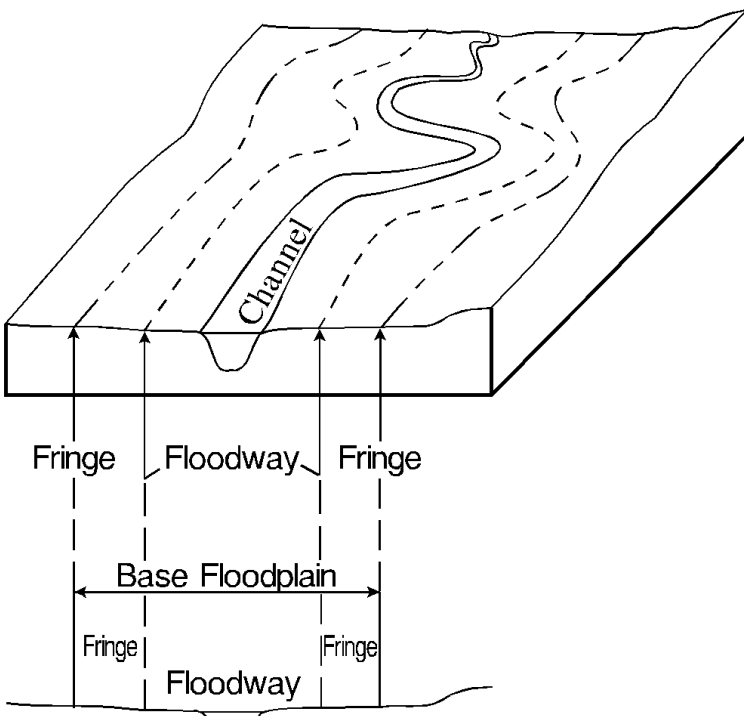


Figure 3-6: Floodway cross section and map

The remainder of the floodplain is called the flood fringe (Figure 3-6), where water may be shallower and slower. The floodway and the flood fringe together comprise the base floodplain or special flood hazard area. On the flood map these areas will be designated as Zone A1-30 or AE. NFIP minimum standards provide that other areas outside the boundaries of the floodway can be developed without further analysis. Consequently, most communities permit development in the flood fringe if the development is elevated or otherwise protected to the base flood level (or any higher state or local standards). Development in the floodway is allowed if it can be demonstrated that no rise in the base flood elevation will occur. It is recommended, however, that

floodway development be discouraged or even prohibited because of the hazardous nature of this area.

A floodway analysis determines the boundaries of the floodway using these floodplain management concepts:

- Continued development in the floodplain will likely further obstruct flood flows, which will back water up or divert it to other properties.
- Properties on both sides of a river or stream should be treated equitably. The degree of obstruction permitted now for one should be permitted in the future for the other.
- Property owners should be allowed to develop their land, provided they do not obstruct flood flows, cause damage or create a nuisance to others. (A community may allow development in the flood fringe that cumulatively increases the BFE, but NFIP regulations specify that such total increases cannot exceed one foot at any point along the stream. Some states or communities have more restrictive standards that must be met.)

A floodway analysis is done with a computer program that can make the necessary calculations of the effects of further development. Beginning at both edges of the floodplain, the computer model starts "filling" the floodplain. This "squeezes" the floodwater toward the channel and causes the flood level to rise. At the point where this process reaches a one foot rise, the floodway boundaries are drawn (Figure 3-7).

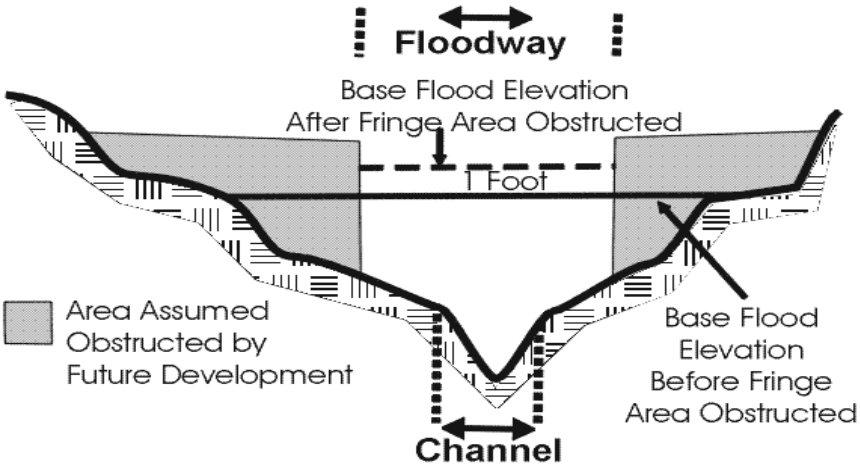


Figure 3-7: Computer floodway analysis

The floodway boundaries at each cross section are transferred to the topographic or contour map that shows the SFHA boundaries. The plotted points are connected to show the floodway and flood fringe on the floodplain map.

Not every cross section will show an exact one-foot rise. Topographic conditions and the need to "smooth out" the floodway line will result in some cross sections having increases of less than one foot.

Allowing flood heights to rise up to one foot is a compromise standard. Prohibiting any rise in flood heights would prohibit most types of new development or redevelopment. On the other hand, allowing development to cause significant increases in flood heights can cause great problems for others.

States and communities may use a more restrictive standard for delineating a floodway. Some may allow only a 0.5-foot or 0.1-foot rise in the base flood elevation in the floodway analysis. This results in wider floodways and less area in the flood fringe.

A floodway analysis should be prepared with close coordination between the modeling engineer and those who are responsible for community planning and floodplain management.

The number of possible floodway configurations is almost limitless. Therefore, in choosing a regulatory configuration, the interests of individual property owners and the community as a whole must be weighed.

C. COASTAL FLOOD STUDIES

Coastal flood studies are conducted for communities along the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and the Caribbean Sea. Coastal studies are used to establish a base flood and an SFHA, but they may also designate a coastal high hazard area (V Zone).

Note that coastal communities, particularly counties, may also have riverine floodplains with designated floodways.

STORM SURGE

Most coastal floods are caused by coastal storms, usually hurricanes and northeasters. Such storms bring air pressure changes and strong winds that "pile" water up against the shore in what is called a storm surge.

A computer simulation of a coastal storm is developed based on data from past storms. Such data include wind speeds, wind direction, and air pressure from historical hurricanes and northeasters. The resulting surge elevations are then calibrated using historical information so the probabilities for each event can be determined.

The coastal storm surge computer program produces stillwater flood elevations — the elevations of various coastal floods, not including waves. The computer model is calibrated by reproducing the observed historical stillwater elevations. The program determines the stillwater elevation from these historical data.

WAVES

In addition to storm surge, wave action is an important aspect of coastal storms. Wind-driven waves produce velocities and impacts that may cause significant structural damage. The coastal flood study analyzes how high the wave crest elevation will be above the stillwater elevation as water is driven onshore.

When waves hit the shore, water is moving with such force that it keeps traveling inland. This is called wave runup, when land areas that are higher than the stillwater elevation are flooded (Figure 3-8). Wave setup is defined as the additional elevation of the water surface over normal surge elevation caused by onshore mass transport of the water by wave action. Wave set-up is a function of deepwater wave height and duration.

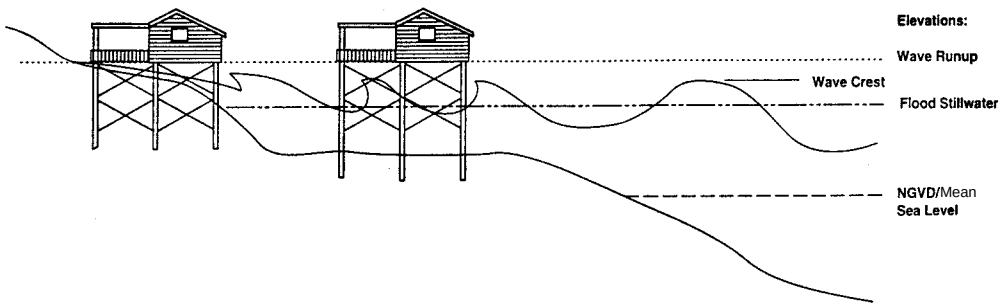


Figure 3-8: Wave runup

HYDRAULIC ANALYSIS

As with riverine studies, a coastal hydraulic analysis determines where moving water goes. Using similar surveying techniques as in a riverine study, the coastal flood engineer surveys transects instead of cross sections.

A transect shows the elevation of the ground both onshore and offshore. The ground elevation data are used by computer programs to determine the expected height of the wave crests and runup above the storm surge.

A transect schematic is shown in Figure 3-9. A transect location map appears on page 11 of Flood County's FIS report. This map shows where the transects were measured.

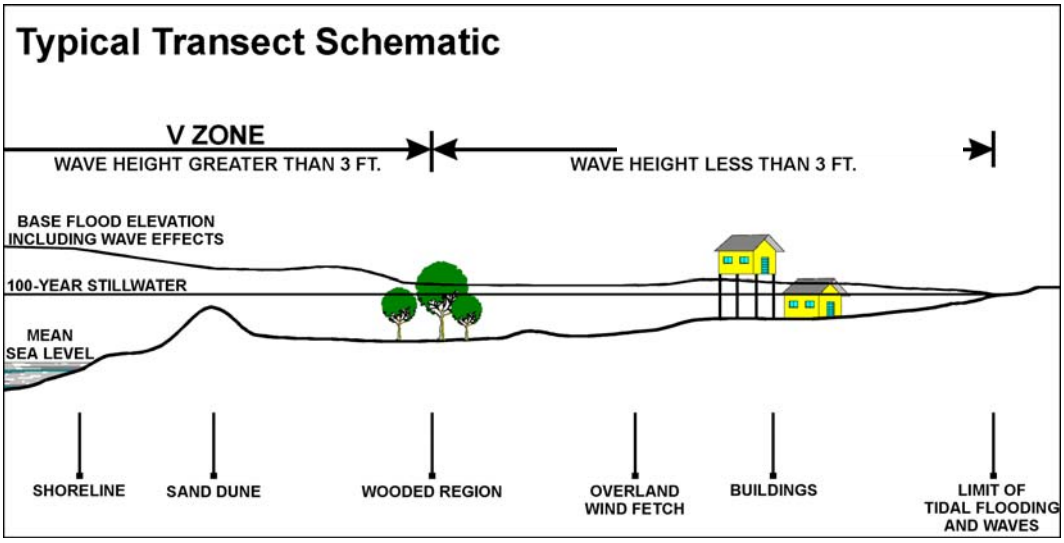


Figure 3-9. Transect schematic

Underwater topography, called bathymetry, and the shapes and locations of coastal islands, headlands, estuaries, harbors, and other coastal features are also taken into consideration in determining flood elevations.

The official BFE is the stillwater elevation plus wave runup, or the wave crest elevation, whichever is greater. The resulting BFE can be many feet higher than the stillwater elevation.

Obstructions such as dunes or buildings break the waves, dissipating wave energy so that wave height and BFEs are reduced as you go inland. Figure 3-9 shows that as water moves inland, the waves break and the base flood elevation (including wave effects) is reduced while the stillwater elevation stays the same.

COASTAL HIGH HAZARD AREA

Waves pack a lot of power. Much more destructive than standing or slow-moving water, their power increases dramatically with their height. For the purposes of the NFIP, the flood study identifies the coastal high hazard area as that most hazardous part of the coastal floodplain, due to its exposure to wave effects. This is typically the area between the shoreline and the most landward of the following points:

- where the computed wave heights for the base flood are three feet or more,
- the inland limit of the primary frontal dune, or
- where the eroded ground profile is three feet below the computed runup elevation.

The three-foot wave height threshold was selected because a three-foot wave generally carries enough energy to break a wall panel away from a floor to which it has been nailed.

These areas are designated as V Zones, where the “V” stands for “velocity wave action.” V Zones are subject to more stringent regulatory requirements and a different flood insurance rate structure because they are exposed to an increased degree of risk. Coastal flood areas not within the coastal high hazard area are mapped as A Zones *(*see Figure 3-9*)*.

COASTAL FLOODPLAIN MAP

After gathering stillwater elevation and wave height data at the transects, the coastal flood engineer then transfers the elevation data to the best available topographic map. Flood elevations between transects are interpolated, taking local topography into consideration.

Flood County FIRM number 99009C, Panel 0040 D, shows a coastal floodplain for the Atlantic Ocean coastline. Note that south of Flower Street, the

V Zone boundaries meander along the shoreline, and the BFEs decrease over a relatively wide space from 14 feet to 12 feet (above NGVD, or roughly sea level). Landward of the Zone VE (EL 12) boundary, the zones change to Zone AE, with BFEs decreasing from 11 feet to 10 feet NGVD. These wider flood zones are typical of gradually varying topography on barrier island beaches or marshland.

In contrast, the V Zone boundaries between Flower Street and Public Way are narrower and roughly parallel to the shoreline, with BFEs decreasing rapidly from 14 feet to 13 feet NGVD. Note also that the area directly landward of the Zone VE (EL 13) is designated Zone AO (Depth 2’), signifying shallow flooding of 2 feet NGVD or less. This situation often occurs when a substantial dune line or flood protection structure exists along the shoreline.

D. SHALLOW FLOODING STUDIES

For the NFIP, shallow flooding is defined as flooding with an average depth of one to three feet in areas where a clearly defined channel does not exist. Shallow flooding can exist in any of the following situations:

- *Ponding:* In flat areas, water collects or "ponds" in depressions.
- *Sheet flow:* In steeper areas where there are no defined channels or on flat plains, water will spread out over the land surface.
- *Urban drainage:* Local drainage problems can be caused where runoff collects in yards or swales or when storm sewers back up.
- *Coastal flooding:* Wave runup will send water inland over flat areas or over dunes. Often it may collect or pond behind an obstruction which keeps it from draining back into the ocean.

For the purposes of the NFIP, shallow flooding is distinguishable from riverine or coastal flooding because it occurs in areas where there is no channel or identifiable flow path.

Shallow flooding is mapped based on historic flood experiences and a study of the topography. In some areas, the techniques used for riverine studies are used. The result will either be a BFE or a base flood depth (in feet above the ground). A shallow flooding study usually produces data for the base flood, but not for the 10-year or other floods.

On Flood County's FIRM, there is a small area upstream of Argyle Way, on Panel 0038, that is shown as "Zone AO (Depth 2')," indicating that the base flood depth is two feet above the ground. Therefore, it is a sheet flow area. Sheet flow areas (which usually have depths established) are AO Zones, and ponding areas (which have BFEs established) are usually designated AH Zones on a FIRM.

E. APPROXIMATE STUDIES

Detailed studies are expensive — a riverine study typically costs $5,000 to $10,000 per mile of stream that is to be mapped — so it is not cost effective to perform a detailed study in watersheds where there is little or no development and none is anticipated, such as in rural areas.

Therefore, some NFIP maps show floodplains that were mapped using approximate study methods. Flood data and floodplain information from a variety of sources — such as soils mapping, actual high water profiles, aerial photographs of previous floods, and topographic maps — were used to overlay the approximate outline of the base floodplain for specific stream reaches on available community maps, usually U.S. Geological Survey topographic quadrangle maps.

In addition, many flooding sources have been studied by other Federal, State, or local agencies. Some of these studies do not meet the NFIP standards for a FIS, but often contain valuable flood hazard information, which may be incorporated into the NFIP maps as approximate studies. Those types of studies typically cover developed or developing areas. They often contain flood elevation profiles that can be used as “best available data” for floodplain management purposes.

F. NFIP MAPS

This section will explain how flood hazards and flood insurance zones are depicted on NFIP maps. The Flood County, USA and Incorporated Areas maps will be referenced wherever possible. As this information is presented, look for similar types of maps or map features on your community's maps.

Maps published with an FIS are:

- The Flood Insurance Rate Map (the FIRM), which is published in an old format in studies prepared before 1986 and a new format in studies prepared after 1986.
- The Flood Boundary and Floodway Map (the FBFM or Floodway Map), which was included in studies prepared before 1986.
- Again, since 1986, the Flood Boundary and Floodway Map information has been incorporated into the Flood Insurance Rate Map.

The maps allow you to identify SFHAs, determine the location of a specific property in relation to the SFHA, determine the BFE at a specific site, locate regulatory floodways, and identify undeveloped coastal barriers where flood insurance is not available.

The flood maps, particularly the FIRMs, come in many formats because of the mapping of additional hazards, the need for more regional flood maps, and the increased use of computer generated maps. Several general features are included on all maps.

Originally, the FIRMs were designed for use by insurance agents and lenders. The Floodway Maps were created for use by local floodplain managers and administrators. For all studies conducted since 1986, the FIRM contains both the flood insurance rate zones and floodways.

GENERAL MAP FEATURES

Flood maps are either flat or Z-fold. Flat maps are on 11-inch-by-17-inch "ledger" size paper. Z-fold maps are on larger pages and get their name from the way they are folded. The current flood maps for most communities are now Z-fold.

Your packet includes the FIRM panels for Flood County, USA and Incorporated Areas, which are Z-fold maps.

All flood maps are prepared with general features or elements that may include an index, a legend (or key to map), a title block, community name and number information, panel or map number information, an arrow pointing north on the map, and effective date or revision date information.

Many communities, especially counties, are geographically too large to fit on one map or panel at a usable scale. Maps for these communities are divided into two or more panels with unique panel numbers. Whenever a community requires more than one panel, a Map Index for both the FIRM and Floodway Map is prepared.

In this section, we will discuss the Map Index, elevation reference marks, and map scales and direction. Other map features will be presented as we discuss FIRMs and Floodway Maps.

MAP INDEX

The Map Index shows the community's boundaries, highlighting prominent features such as major highways, railroads, and streams. The map index shows how the community is displayed on the various panels.

Flood County's Map Index shows that the county's FIRM has three panels, 0025, 0038, and 0040. In cases where panels have no identified flood hazard areas (or no floodways on a Floodway Map), they are not printed. Note that panel 0030 D was not printed, as is indicated on the index by an asterisk (*).

The number of panels that have been printed for a particular community appears in the title block ("Panels Printed: 25, 38, 40).

Title block

The title block is the lower right portion of the opened map for both the Map Index and the FIRM panels. The FIRM panel title block includes:

- the community's name -- Flood County, USA and Incorporated Areas,
- the six-digit community identification number or map number -- 99009C,
- the panel number, such as "0025," "0038," or "0040,"
- a map panel suffix – "D," which indicates the number of revisions that have been made (e.g., "D" is the fourth publishing of that panel), and
- a map effective or revision date – "August 19, 1998."

Map revision date

The date in the title block shows the map's most recent revision. As changes occur within a community that results in a change in flood elevations or floodplain delineations, FEMA republishes *only the Map Index and the changed map panels*. Any revised panels are given a new map revision date and a new suffix letter.

Once the panels are issued to the community, the date on the panel is referred to as the *effective date*. Some communities have map panels with different

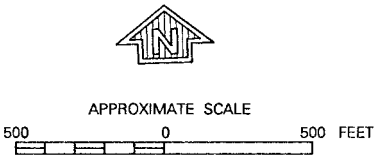
effective dates. The Map Index lists the current effective date for the most recently revised panel of a FIRM or of the FIRM itself, if all panels were revised.

With each revision comes a new panel suffix. Note that Flood County's panels were last revised in 1998 and have the suffix "D."

Map scales and north direction

Different scales may be used for a single community with more than one panel. As an example, the map scale on the Flood County FIRM Panel 0038 is 1 inch = 500 feet (one inch equals 500 feet), and the scale of panel 40 is 1 inch = 1,000 feet.

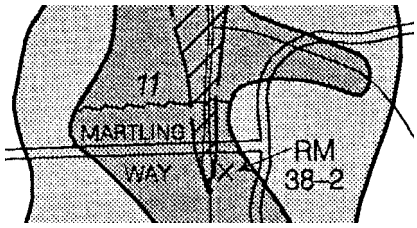
Different scales are used on FIRM and Floodway Maps, depending on the size of the mapped area for a community and the base map that is used.



An arrow pointing north is shown on all maps, including the map index. For FIRMs and Floodway Maps, the north direction arrow is located near the map scale. The north direction on the maps may be "turned" to maximize the mapped area that can be shown on a panel and to minimize the number of panels. To ensure correct orientation and accurate use of the FIRM, it is very important to pay attention to the direction of the north arrow on the panel.

Elevation reference marks

Elevation reference marks are located on FIRMs and Floodway Maps. For these two types of maps, locations are identified with a small "x" and the designation "ERM" or "RM" simply followed by a reference mark number. For the newer Digital FIRMs (DFIRMs), locations are identified with a small "x" and the designation "ERM" or "RM" followed by the panel number and the number of the reference mark. Descriptions of the marks, including their elevations, appear either on FIRM panels, on Floodway Maps, or in the FIS text. Note that some ERM and RM descriptions may appear on a different map panel than the mark itself due to space limitations.



ERMs and RMs are important sites. They provide a ground elevation reference for surveyors to start from when they determine the elevation of a building, a cross, section, or topography for a site. Occasionally, an ERM cannot be found as described on the FIRM or Floodway Map because new construction or some other change in the area has obliterated the monument. In these instances, the next closest ERM may be used. Alternatively, USGS, USC&GS, or NGS bench marks, which are marked on most USGS 7.5 minute series topographic maps, may be used.

FIRM Zones

FIRMs show different floodplains with different zone designations. These are primarily for insurance rating purposes, but the zone differentiation can be very helpful for other floodplain management purposes. The more common zones are listed in Figure 3-10.

Zone A	The 100-year or base floodplain. There are six types of A Zones: **A** The base floodplain mapped by approximate methods, *i.e.*, BFEs are not determined. This is often called an unnumbered A Zone or an approximate A Zone. **A1-30** These are known as numbered A Zones (*e.g.*, A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). **AE** The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones. **AO** The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided. **AH** Shallow flooding base floodplain. BFEs are provided. **A99** Area to be protected from base flood by levees or Federal Flood Protection Systems under construction. BFEs are not determined. **AR** The base floodplain that results from the decertification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	**V** The coastal area subject to a velocity hazard (wave action) where BFEs are not determined on the FIRM. **VE** The coastal area subject to a velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
Zone D	Area of undetermined but possible flood hazards.

Figure 3-10: Flood Insurance Rate Map Zones

Note that the special Flood Hazard Area (SFHA) includes only A and V Zones.

FLOOD HAZARD BOUNDARY MAP (FHBM)

FHBMs (Figure 3-18) were initially prepared to provide flood maps to many communities in a short period of time. They were made in the 1970s and early 1980s without benefit of detailed studies or hydraulic analyses for nearly all floodprone communities in the nation (over 21,000). They were intended for interim use in most communities until more detailed studies could be carried out.

FHBMs are still being used where detailed Flood Insurance Studies have not been prepared or cannot be justified. They are to be used for floodplain management, in conjunction with other local studies and other available data.

On the FHBM, the SFHA is designated as a shaded area labeled "Zone A," and no base flood elevations are given (see Figure 3-18).

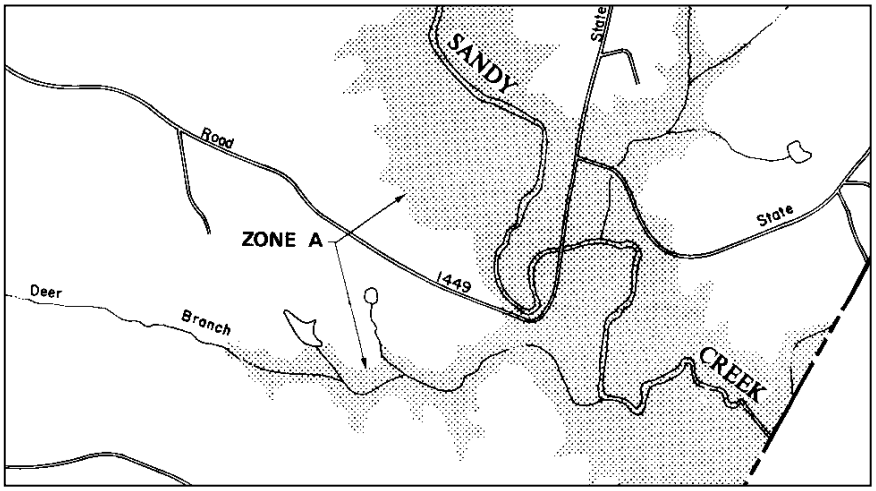


Figure 3-18: Flood Hazard Boundary Map

In some cases, FEMA simply converted the FHBM to a FIRM by issuing a letter to the community stating that the FHBM shall be considered a FIRM. In those cases, the community was instructed to line out FHBM on the map's title box and write in FIRM.

FLOOD INSURANCE RATE MAP (FIRM) — OLD FORMAT (PRE 1986)

The FIRM is used to generally determine:

- Whether a property is in the floodplain.
- The flood insurance zone that applies to the property.
- The approximate base flood elevation (BFE) at the site.

Date: Several dates may be listed in the FIRM legend, including:

- Initial Identification — date of the first Flood Hazard Boundary Map (FHBM).
- Any dates of revisions to the FHBM that have occurred since the initial identification.
- Flood Insurance Rate Map Effective — the date of the initial or first FIRM. This is the date used to determine whether a building is "pre-FIRM" or "post-FIRM."
- Flood Insurance Rate Map Revisions — dates of subsequent revisions to the FIRM.

The FIRM also will show:

Base (100-year) floodplain or SFHA: Designated by the dark-shaded areas (Insurance Zones A, A1–A30, A99, AO, AH, AR, V, V1–V30).

500-year floodplain: Designated by the lighter-shaded areas (Insurance Zone B).

Base Flood Elevation (BFE): The water surface elevation of the base flood at that point of the stream is denoted in whole numbers by wavy lines running across the floodplain. Coastal Zones within the area of 100-year tidal flooding, as well as some AH Zones, may have BFE lines, and some lake AE Zones have the base flood elevation noted in parentheses beneath the zone designations.

Zone break line (Gutter line): The thin white line separates flood insurance rate zones within the 100-year floodplain.

Approximate floodplain areas: The 100-year floodplain areas are delineated using approximate methods. No BFEs are shown in approximate floodplain areas; these areas are classified as (unnumbered) A Zones.

An example of an approximate floodplain may be found in the upper left corner of Flood County FIRM Panel 0040, on Rocky River. The detailed study does not extend upstream of cross section K. Note that there are no cross sections or BFEs shown in this A Zone, which extends onto Panel 0025.

Flood Boundary and Floodway Map (Floodway Map) – Old format (Pre 1986)

The Flood Boundary and Floodway Map is also known as the FBFM or, simply, the Floodway Map. The Floodway Map shows how the floodplain is divided into the floodway and flood fringe where streams are studied in detail. They also show general floodplain areas where floodplains have been studied by approximate methods.

Floodway Maps have these features:

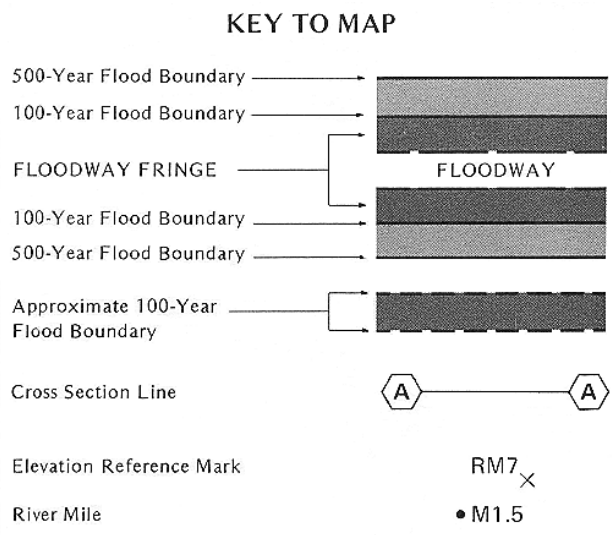
Title block: Includes the community name, county name, panel number, community number, and the map date. The panel numbers may be different from the FIRM panel numbers.

Map scale: The Floodway Map may have the same or a different scale than the FIRM for the same community.

Cross section line: These lines represent the location of some of the surveyed cross sections used in the computer model of the stream for calculating 100-year flood elevations. These cross sections can be used to relate a specific point on the Floodway Map to the flood profile and floodway data table.

Floodway: The 100-year floodplain has been divided into two areas, the floodway and the flood fringe. The white area adjacent to and including the channel is the floodway. The shaded area is the fringe.

One problem with this method of delineating floodways is that sometimes people confuse the white floodway with the white area representing land that is free from flooding. Also, because the floodway is mapped separately, often property owners, lenders, real estate agents, and others do not have easy access to the Floodway Maps and do not know of the severe flood hazard associated with the floodway.



FISs published since 1986 have corrected this problem — they do not have separate FIRM and Floodway Maps. Floodways are delineated on the newer FIRMs as a diagonally hatched area (see Figures 3-11 and 3-12).

Note that no BFEs or flood zone names are shown on the Floodway Map.

The floodway is usually wider in flatter, wider floodplains and narrower in steeper areas where floodplains are narrower.

If a map panel area does not include any detailed study streams or floodways, a Floodway Map will not be printed; only a FIRM panel will be printed. Because coastal studies do not have floodways, all of the data needed are shown in the FIS report and on the FIRM.

Flood fringe: The fringe is shown as a shaded area outside of the floodway but still within the 100-year floodplain. The flood fringe and the floodway together comprise the special flood hazard area.

500-year floodplain: More lightly shaded areas adjacent to, but outside of, the 100-year floodplain delineate the 500-year floodplain for streams studied in detail.

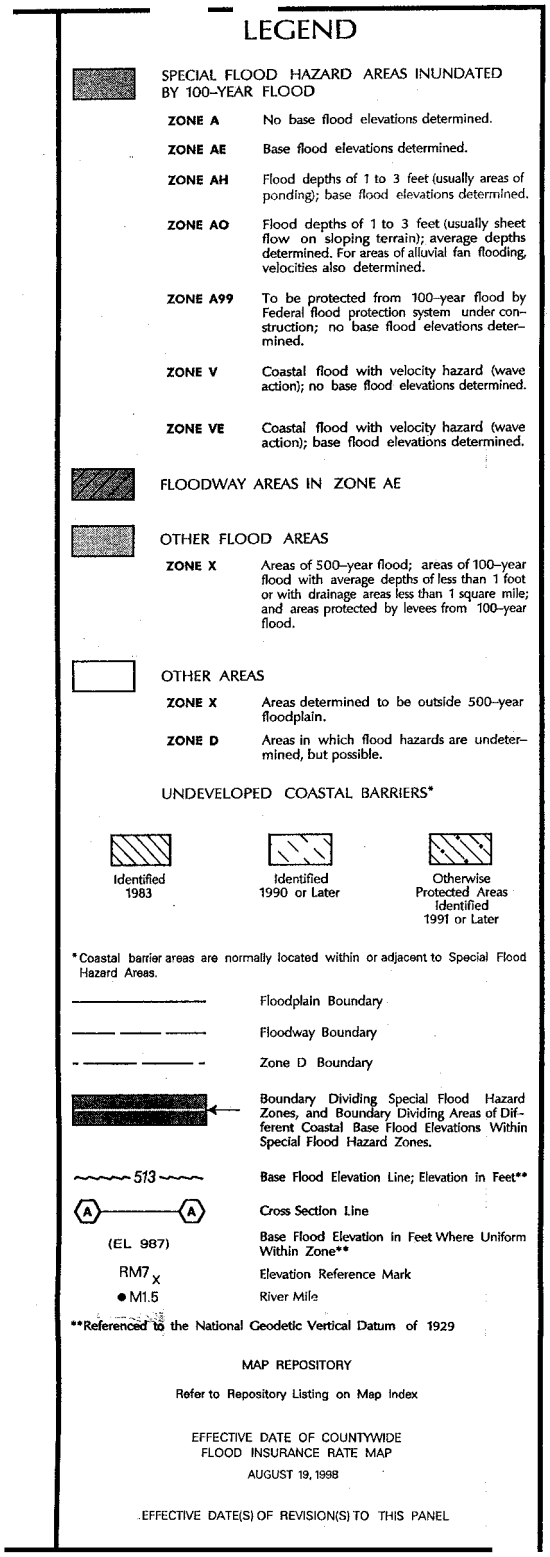
Approximate floodplain areas: The 100-year floodplain areas are determined using approximate methods. The boundaries of the approximate floodplain on the Floodway Map are shown as dashed lines.

FLOOD INSURANCE RATE MAP — NEW FORMAT (SINCE 1986)

Flood maps have been redesigned over the years since the first FISs were prepared in the late 1960s, making them easier to use. A new format for FIRMs was introduced in 1986 that includes:

- Floodways and other floodplain management information, such as cross sections, that were previously provided on separate Flood Boundary and Floodway Maps (Floodway Maps). (Except in a few instances, Floodway Maps are no longer being prepared.)
- Simplified flood insurance zone designations. The previous Zones A1-A30 and V1-V30 were replaced by the designations AE and VE; Zones B and C were replaced by Zone X. The 500-year floodplain is still shown as “shaded” portions of Zone X.

Figure 3-11 shows the legend for the new FIRM format. Figure 3-12 is an example of a new format FIRM with a floodway. With these changes, the FIRMs are more easily used by community officials for floodplain management, by lenders to determine the need for flood insurance, by insurance agents to rate policy applications, and by land surveyors, engineers, property owners and others to determine flood hazards in a given location. The Flood County, USA and Incorporated Areas map uses the newer format.



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

UNDEVELOPED COASTAL BARRIERS*

Identified 1983

Identified 1990 or Later

Otherwise Protected Areas Identified 1991 or Later

*Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet**

A — A — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone**

RM7 x — Elevation Reference Mark

● M1.5 — River Mile

**Referenced to the National Geodetic Vertical Datum of 1929

MAP REPOSITORY

Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

AUGUST 19, 1998

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

Figure 3-11: New format FIRM legend

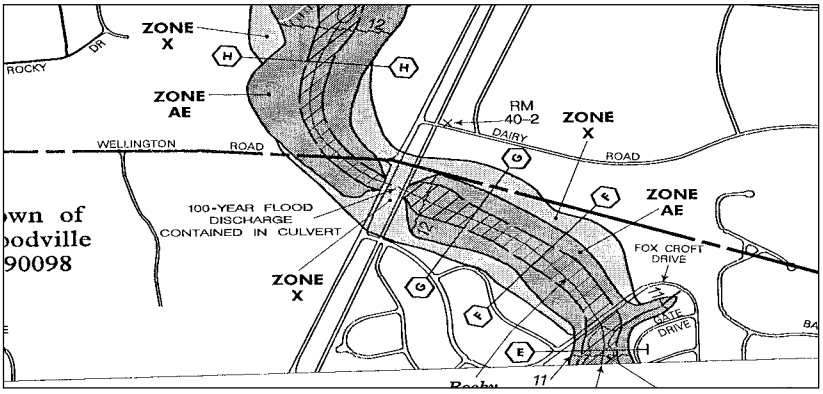


Figure 3-12: Floodway in new FIRM format

PARTIAL MAP INITIATIVES FIRM

In some cases, it is more cost efficient for FEMA to update and print only a portion of the total FIRM and FBFM panels for a community in the new format. This is referred to as Partial Map Initiatives FIRM. Here, instead of printing the entire set of separate FIRM and FBFM panels for the community, only those panels affected by the revision elements are combined into the new format FIRM panel. To clarify this for the community, the FBFM index would show that those FBFM panels were no longer printed and that the floodway mapping information would appear on the new format FIRM showing that same area. The FIS report would also indicate on the Notice to User Page the combination of FIRM and FBFM panels and the differentiation between the old and new format zone labeling.

FIRMS WITH COASTAL AND LAKE FLOODPLAINS

Coastal FIRMs

Coastal areas include the shores of the Atlantic and Pacific Oceans, the Gulf of Mexico and the Caribbean Sea, and inlets subject to tides. They also include the shorelines of the Great Lakes.

Coastal high hazard areas subject to flooding *and* wave action of three feet or more are designated as V Zones. The number in parentheses after or below the V Zone designation is the BFE. There are several V Zones on Panel 0040 of Flood County FIRM.

Coastal Barrier Resources System

Undeveloped portions of coastal barrier islands and similar land forms in the Coastal Barrier Resources System (CBRS) — such as coastal mainland along the shore of the Great Lakes, along bays, inlets, or estuaries — have been identified and included on applicable map panels. They are called CBRA areas, established by the Coastal Barrier Resources Act of 1982 and the Coastal Barrier Improvement Act of 1990.

The Acts provide protection to CBRA areas by prohibiting most expenditures of federal funds including the provision of flood insurance for new and substantially improved buildings in the mapped area. The restrictions are covered in more detail in Unit 9, Section D.

The designations for these undeveloped coastal barriers depend on when they were designated by the acts; therefore, not all CBRA areas have the same date of designation. Examples of the three different screens used on the FIRM are shown in the legend for Flood County FIRM Panel 0040. The prohibition date is indicated for each CBRA zone on the FIRM. It should be noted that although FEMA shows CBRA areas on its FIRMs, only Congress can authorize a revision to their boundaries.

Flood County has an extensive CBRA area, which appears on FIRM Panels 0038 and 0040. Note that the designation and delineation of CBRS units are not directly related to the floodplain.

Lakes

Most lakes have a BFE, shown in parentheses below the flood zone that has been rounded off to the nearest whole number (see Figure 3-13). The actual BFE, to the nearest tenth of a foot, can be obtained from the FIS report. However, many long lakes, especially reservoirs, have a higher BFE at the upstream end than at the outfall. These types of lakes and reservoirs have BFEs shown with wavy lines, the same as riverine BFEs. They also appear on the stream profiles in the FIS report.

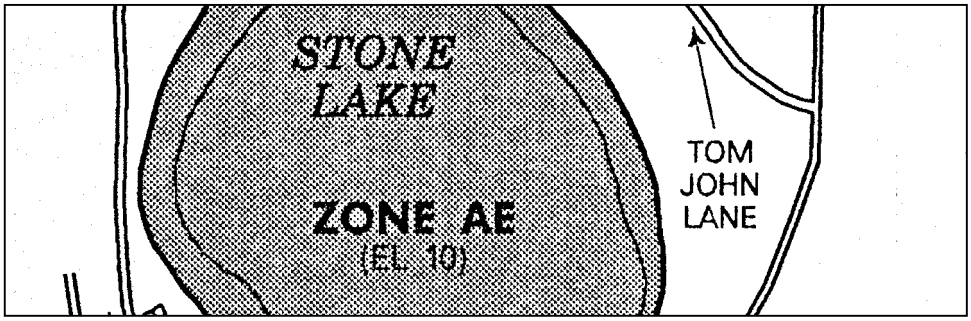


Figure 3-13: FIRM with lake floodplain

Where studies have been carried out for lakes and reservoirs, information on BFEs is contained in Section 3.0 of the FIS report. A *Summary of Stillwater Elevations* table is provided in the FIS report (Figure 3-14). Note that the actual BFEs to the nearest one-tenth of a foot appear in the table, but the BFE on the FIRM is shown in parentheses rounded to the nearest whole number. For the most accurate BFE, use the “100-year flood elevation” from the table, not the FIRM. For a shortcut method, you can add 0.4 foot to the elevation shown on the FIRM. This will get you an elevation at least as high as the number shown in the table.

FLOODING SOURCE AND LOCATION	ELEVATION (ft. NGVD)			
	10-YEAR	50-YEAR	100-YEAR	500-YEAR
STONE LAKE				
Entire shoreline within Flood County	7.0	9.0	10.2	12.8

Figure 3-14: Summary of stillwater elevations for a lake

SHALLOW FLOODING FIRMS

Under the NFIP, ponding or sheet flow constitutes shallow flooding, which is mapped based on historic flood experiences and study of the topography.

An example of a shallow flooding area is on the Flood County FIRM, panel 0038, upstream of Argyle Way, in an area marked "Zone AO (Depth 2')." Also, Panel 0040 shows an area where wave runup overtops and ponds behind a seawall, berm, or other feature that keeps the water from flowing back to the ocean.

We don't know how high the base flood is in relation to sea level in Flood County "Zone AO (Depth 2')." However, we do know that the base flood should be no deeper than two feet above the ground.

FIRMS WITH FLOOD PROTECTION PROJECTS

Some FIRMs may show areas protected from flooding by the 100-year flood because of the presence of a levee, concrete dike, floodwall, seawall, or other structure. These areas are usually designated as shaded Zone X and marked with the following note:

- This area protected from the 100-year flood from (Flooding Source Name) by LEVEE, DIKE, or other structure subject to failure or overtopping during larger floods.
- This is an indication that the flood protection structure has either been evaluated and found to meet all of the NFIP requirements for flood control structures, or has been certified by a Federal agency with levee design responsibility as having been adequately designed and constructed to provide protection from the 100-year flood.
- Floodways will be delineated at the landside toe of a levee that is recognized as providing 100-year flood protection.
- A levee that provides a lower level of protection, and that is not certified or does not meet the requirements for levees, may be shown on the FIRM, and flood elevations are computed as if the levee did not exist.

COUNTYWIDE FIRMS

The Flood County FIS report and FIRM covers the unincorporated areas of Flood County and all incorporated areas within Flood County. Therefore, it is referred to as a *countywide FIRM*. Countywide FIRMs show flood hazard information for all geographic areas of the county, including other jurisdictions such as villages, towns, and cities.

Previously, FHBM, FIRM and FBFM maps were prepared separately for each jurisdiction. County FIRMs, for example, showed the flood hazards identified only in the unincorporated areas of the county and did not show any flood information inside the corporate limits of a municipality. In countywide mapping, once the countywide map is produced, all of the identified flood hazard areas within the boundaries of the county are shown on one set of maps along with all floodway information maps (see section titled Flood Insurance Rate Map—New Format).

The countywide FIRM format has a number of advantages, and one in particular is that the user can see the relationship and simultaneous effect of each floodplain on a number of communities. In addition, FIRMs do not need to be updated when municipal boundaries change. Although boundaries might change, communities will continue to find the flood hazard information they need on the same countywide FIRM.

Figure 3-15 shows the title block of a countywide FIRM panel. The title block lists the communities mapped on that panel and their six-digit NFIP community ID numbers. The FIRM panel has a map number with five digits consisting of the NFIP-assigned state number as the first two digits and the NFIP-assigned county number as the next three digits followed by the letter “C,” which stands for “countywide,” and then the four digit panel number and suffix. Do not confuse the map panel number with the community number.

All previous map dates for each floodprone community in a countywide FIS are located on the community map history Table (Figure).The initial FIRM date for each community is shown on the FIRM index. These are the “post-FIRM” dates for insurance rating. Don’t confuse them with the effective date of the latest FIRM panel, which is shown in the title block.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, ALABAMA AND INCORPORATED AREAS

PANEL 344 OF 660

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BIRMINGHAM, CITY OF	010116	0344	E
UNINCORPORATED AREAS	010217	0344	E

Notice To User: The MAP NUMBER shown below should be used when placing map orders; the COMMUNITY NUMBER shown above should be used on insurance applications for the subject community.

MAP NUMBER
01073C0344 E

EFFECTIVE DATE:
JANUARY 20, 1999

Federal Emergency Management Agency

Figure 3-15: Title block of countywide FIRM panel

DIGITAL FIRMS

The conversion of FIRMs to a digital format has many benefits. For example, they can be revised and updated easily with just a few keystrokes, and they can be incorporated in the community's mapping system and tied in with other geographic information systems, such as the zoning map.

Users must bear in mind that the simple conversion of FIRMs to a digital format does not inherently improve the engineering quality of the product. Many of the same difficulties with interpretation of flood risk data — and the requirement that users apply sound judgment in methods selected for decision making and map interpretation — remain unchanged.

FEMA charges a fee for all digital FIRM data products. Any questions regarding these products may be directed to:

Federal Emergency Management Agency
Map Service Center
P.O. Box 1038
Jessup, Maryland 20794-1038

Phone: 800/358-9616
Fax: 800/358-9620
Internet: http://www.fema.gov

Digital Flood Insurance Rate Map (DFIRM)

The FIRM for Flood County, USA and Incorporated Areas is actually a Digital Flood Insurance Rate Map, or DFIRM. This is because it is a more recent publication, created with new digital methods; however, whether the maps are new DFIRMs or conventional FIRMs, they are still generally referred to as FIRMs. The DFIRM is comprised of all digital data required to create the hardcopy FIRM. These data include base map information, graphics, text, shading, and other geographic and graphic data. An example of a hardcopy paper DFIRM is shown in Figure 3-16.

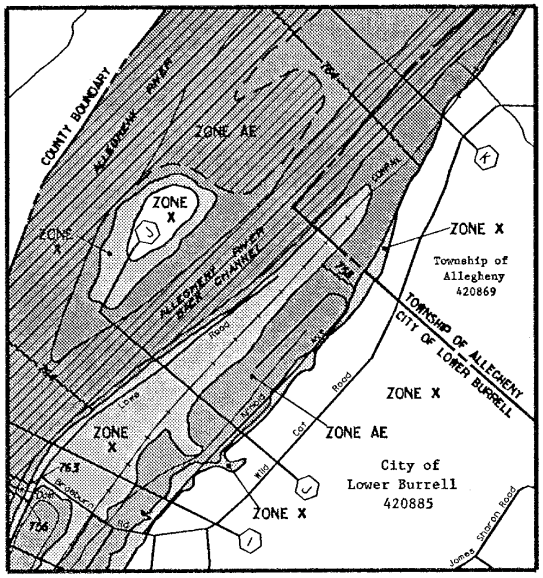


Figure 3-16: Hardcopy DFIRM

The majority of DFIRMs are produced in a countywide format, where all flood hazards for the county and incorporated communities are shown on one set of maps. It can be used for floodplain management purposes in a manner similar to other flood maps, but it can also be combined with other digital map information to create new information for planning purposes. DFIRMs are also produced for single jurisdictions when producing a countywide map would not be cost effective.

Digital Flood Insurance Rate Map – Digital Line Graph

The Digital Flood Insurance Rate Map - Digital Line Graph (DFIRM-DLG) is intended to be the primary means of transferring flood-risk data depicted on FIRMs to Geographic Information Systems (GIS). GISs are computer-based map systems that allow the user to keep a map updated easily and to correlate geographic information with other data, such as tax records on properties.

The Digital Flood Insurance Rate Map - Digital Line Graph (DFIRM-DLG) is a database created by extracting certain flood risk data from the DFIRM. The DFIRM-DLG does not include base map information, nor does it include graphic data required to create a hardcopy FIRM.

Communities whose digital base mapping files were used as the base map for the DFIRM will find that they may easily use the DFIRM-DLG files for determination of flood zones and for enforcement of regulations. A graphic image of a DFIRM-DLG is shown in Figure 3-17.

The digital data captured from the hardcopy DFIRM consists of FEMA hydrography (location of water bodies), flood hazard zones, BFEs, cross-section locations, and elevation reference marks.

All lines and area features in DLG files are encoded with one or more seven-digit attribute codes that provide the user with detailed information about the features. FEMA intends to make the DFIRM-DLG available on CD-ROM compatible with Insurance Services Office (ISO) 9660 standards.

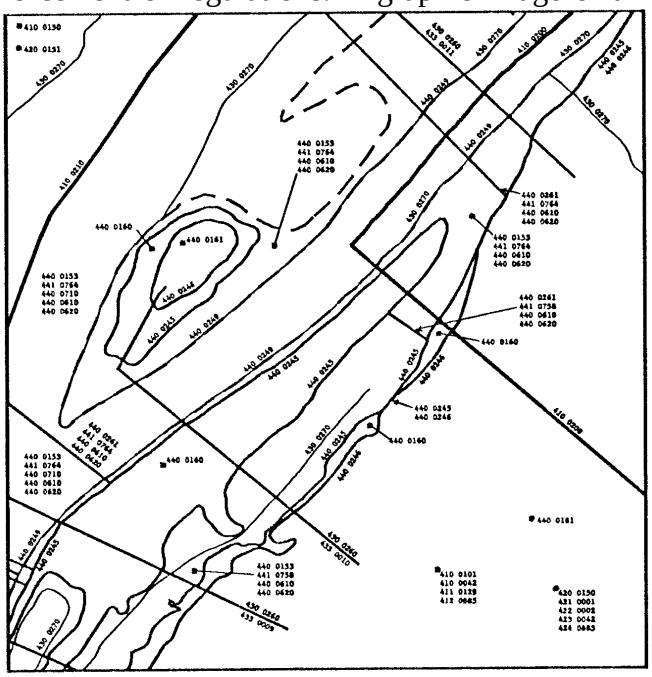


Figure 3-17: Graphic image of a DFIRM-DLG

With many commercially available GIS software packages, DLG data can be directly converted into vector data usable within the GIS environment. Third-party conversion software is also available that will convert DLG data to other proprietary GIS formats.

The DFIRM-DLG, when coupled with digital base map files or the local community digital base, can be used in a GIS to determine whether a structure is located within an SFHA. It should be noted that if a GIS is used to determine that a structure is within or near an SFHA, and a different base map source was used to generate the hardcopy DFIRM, the determination should be confirmed by referencing the printed hardcopy DFIRM.

Q3 Flood Data

In the Q3 Flood Data Product, FEMA has developed a graphical representation of certain features of the FIRM. The Q3 Flood Data are in three formats that are usable with desktop mapping and GIS software packages. These formats are:

- Digital Line Graph
- ARC/INFO
- MapInfo

Q3 Flood Data are created by digitally capturing certain key features from the current effective paper FIRMs. These features are converted into area features in one countywide data layer. The following vectorized (lines and areas) data features are included:

- SFHA and 500-year floodplain,
- Flood insurance zone designations,
- Floodway boundaries (if available),
- COBRA zones,
- Political boundaries,
- Community/map panel identification numbers,
- Boundaries between FIRM panels, and
- U.S. Geological Survey 7.5 minute (1:24,000 scale) quadrangle neatlines.

Several features are *not* included. They are:

- Hydrographic features,
- Base flood elevations,

- Cross section lines,
- Roads, road names or address ranges, and
- Elevation reference mark locations and elevations.

Q3s were developed to support insurance-related activities and are designed to provide guidance and a general proximity of the location of SFHAs. Q3s do not replace paper FIRMs as the legal document.

The data are not suitable for applications such as detailed site design and development plans or flood risk determinations. They cannot be used to determine absolute delineations of floodplain boundaries, but instead should be seen as portraying zones of uncertainty and possible risks associated with flooding.

Q3 Flood Data incorporate map revisions and letters of map revision and amendment. However, they do not correct for edge-matching errors, overlaps, etc., that were in the original paper FIRMs.

FEMA has produced Q3s for almost 900 counties nationwide. They are organized by county and contain data from all existing paper FIRM panels for the incorporated and unincorporated areas of the county.

Q3 Flood Data are available on CD-ROM from the FEMA Map Service Center. You can access the list of Q3 counties on the Internet and download sample data, data standards, and other Q3 information (http://www.fema.gov).