



**PDHonline Course L130J (2.5 PDH)**

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# **FEMA's Flood Insurance Study Report (FIS) - Understanding and Utilizing This Resource**

*Instructor: Jonathan Terry, P.L.S.*

**2020**

**PDH Online | PDH Center**

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**Welcome to:**

## **FEMA's FIS Tutorial**

**Screen-captures of FEMA's  
well-thought-out and carefully  
presented tutorial on the:**

## **Flood Insurance Study**

FEMA FIS TUTORIAL IS FOUND ON THE WEB AT: [http://www.fema.gov/media/fhm/fis/ot\\_fis.htm](http://www.fema.gov/media/fhm/fis/ot_fis.htm)

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**Welcome to the FEMA Flood Insurance Study Tutorial**

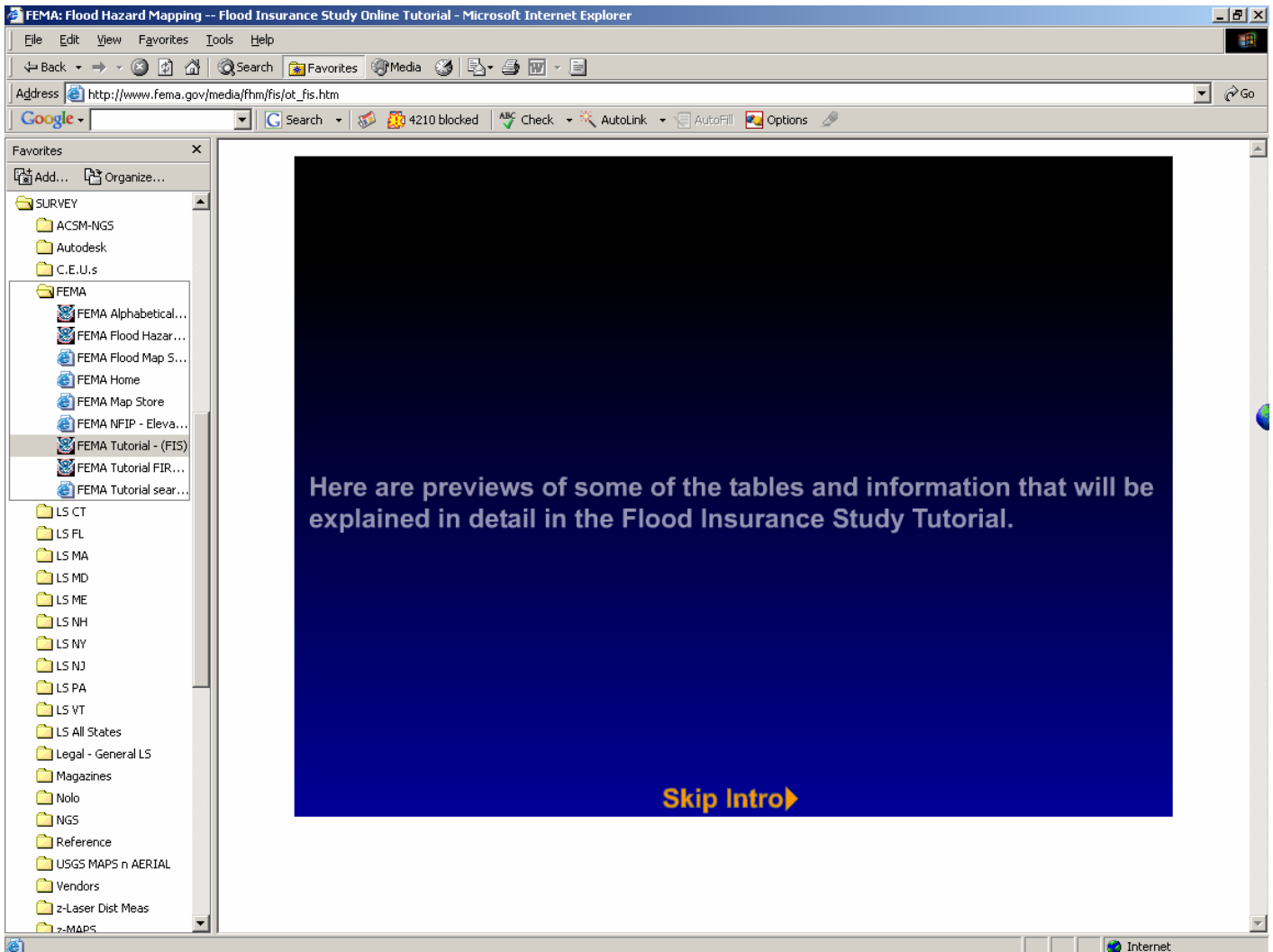
**The objectives of the tutorial are:**

- 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.**

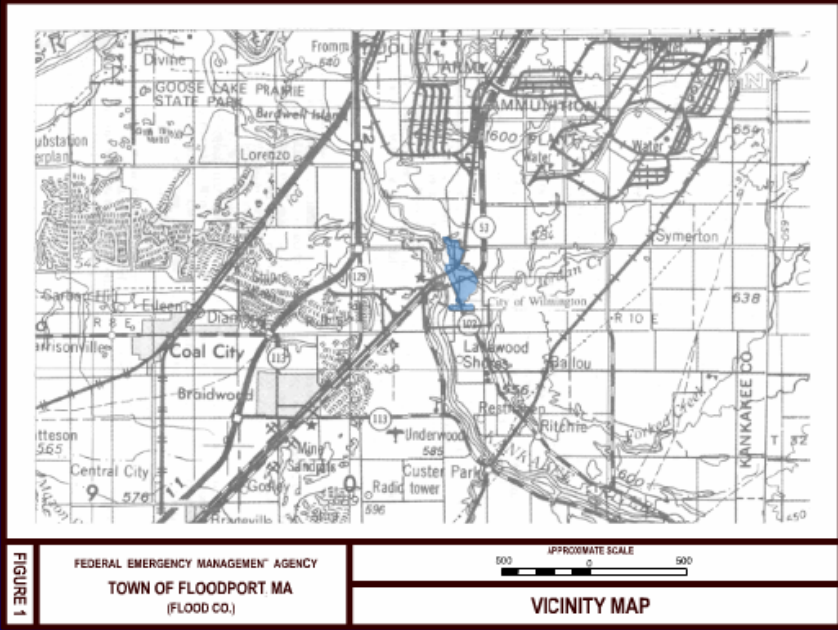
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### Vicinity Map



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## Summary of Stillwater Elevations Table

Flooding Source and Location	Elevation (Feet)			
	10-Year	50-Year	100-Year	500-Year
Atlantic Ocean				
Entire Shoreline Within Floodport	8.2	8.9	9.2	9.8
Merrimack River				
Entire Shoreline Within Floodport	5.9	7.2	8.2	8.9

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## Transect Description Table

Transect	Location	100 Year Flood Elevation (Feet)	
		Stillwater	Maximum Wave
1	From Plum Island Point south to Plum Island Turnpike, extended east	9.2-8.2	14 <sup>1</sup>
2	From Plum Island Turnpike, extended east, to Perry Road, extended east	9.2	18 <sup>2</sup>
3	From Perry Road, extended east, to Mason Street, extended east	9.3	14 <sup>1</sup>
4	From Mason Street, extended east, to 8th Street, extended east	9.3	14 <sup>1</sup>
5	From 8th Street extended east, to approximately 3,000 feet south of 1st Street	9.3	17 <sup>3</sup>

<sup>1</sup>

<sup>2</sup>

<sup>3</sup>

Due to Map Scale Limitations, Maximum Wave Elevation Not Shown on FIRM

Maximum Wave Height Elevation

Maximum Wave Runup Elevation

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# Floodway Width

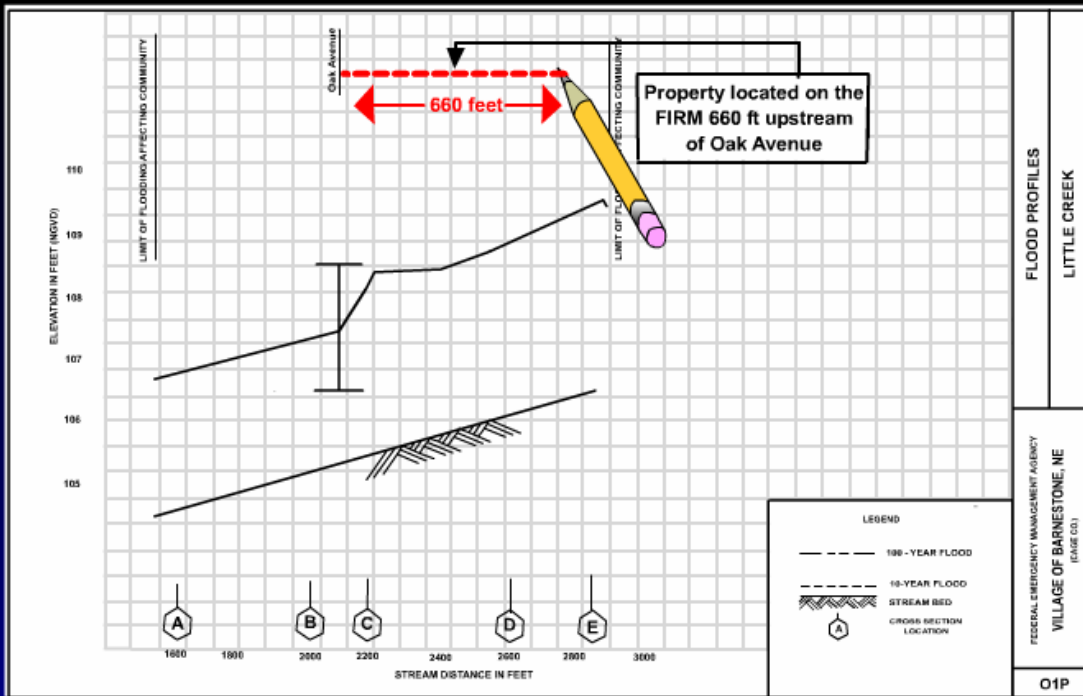
The map displays a street grid with labels for '106', '107', '108', '109', '110', '111', '112', '113', '114', '115', '116', '117', '118', '119', '120', '121', '122', '123', '124', '125', '126', '127', '128', '129', '130', '131', '132', '133', '134', '135', '136', '137', '138', '139', '140', '141', '142', '143', '144', '145', '146', '147', '148', '149', '150'. A red box highlights a specific area on the map, and a red arrow points to the width of a structure within that area. The map also shows 'ZONE AE', 'ZONE A', 'LIMIT OF DETAILED STUDY', 'CORPORATE LIMITS', 'HIGHLAND DRIVE', 'HILLSIDE DRIVE', 'STREET', 'WATER ST', and 'B'. A legend is visible on the right side of the map.

**FLOODWAY WIDTH**

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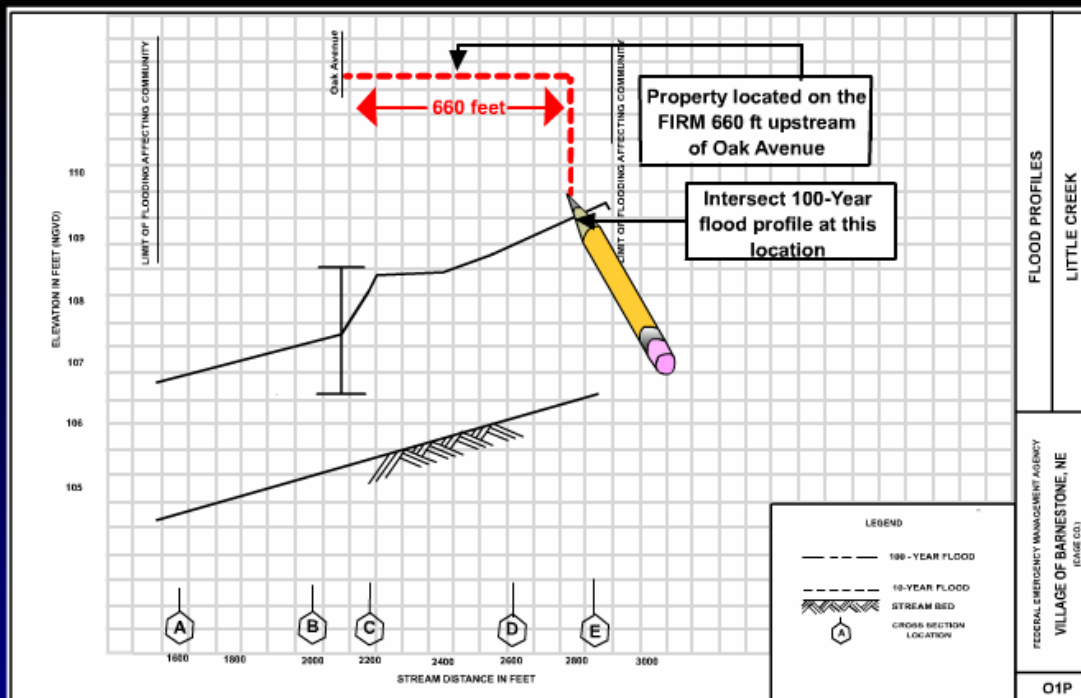
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## Flood Profiles



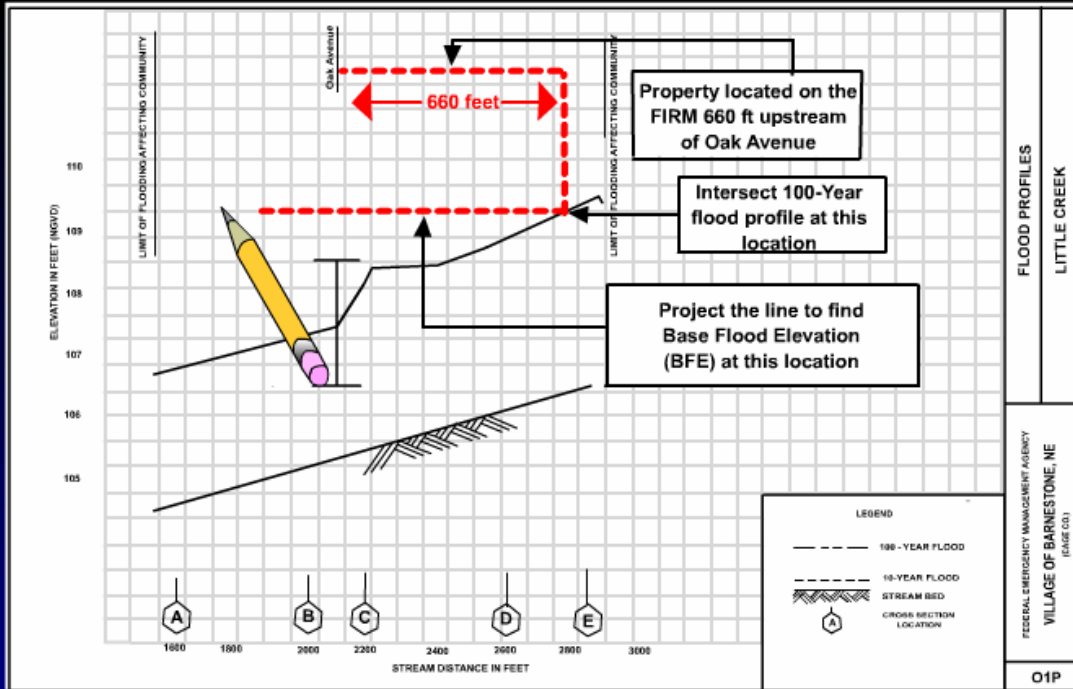
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## Flood Profiles



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### Flood Profiles



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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**.



Hi! I'll be here throughout the tutorial. Just click me to view important tips.  
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### How to Use a Flood Insurance Study




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What is a Flood Insurance Study?

A **Flood Insurance Study (FIS)** is a report prepared by the **Federal Emergency Management Agency (FEMA)** that summarizes the analyses of flood hazards in a community. The analyses used to prepare the FIS are also used to prepare the **Flood Insurance Rate Map (FIRM)**, which is a map that shows the flood hazard 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.

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### 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 (FIS)** 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 [www.msc.fema.gov](http://www.msc.fema.gov).



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FIS

What is found in this tutorial?

The remainder of this tutorial explains the eight sections and supporting information found in a **Flood Insurance Study (FIS)**.

- Section 1: Introduction
- Section 2: Area Studied
- Section 3: Engineering Methods
- Section 4: **Floodplain 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

- Vicinity Map
- Summary of **Discharges** Table
- Floodway** Data Table
- Summary of Stillwater Elevations Table
- Flood Profiles**
- Flood Insurance Rate Map**

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**FIS**

Section 1.0 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 determining 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 **National Flood Insurance Program (NFIP)** requirements.

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## 1.2 Authority and Acknowledgements

**Authority for the National Flood Insurance Program (NFIP)**

Identifies the National Flood Insurance Act (1968), the Flood Disaster Protection Act (1973) and National Flood Insurance Reform Act (1994).

**Identification of study contractor(s)**

Identifies the companies or government agencies that did the work that was incorporated into the **Flood Insurance Study** report and **Flood Insurance Rate Map**.

**Contract Numbers**

Identifies the Contract or Inter-Agency Agreement Numbers under which the work was accomplished.

**Date work completed for each contract or Inter-Agency Agreement**

Provides the date that the Study Contractor or other Federal agency completed its work.

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## 1.3 Coordination

### Initial Consultation Coordination Officer's (CCO) Meeting

Identifies dates during which representatives of **FEMA** met with community officials to discuss the scope of the study. Identifies which **flooding** sources were to be studied by detailed or approximate methods. Identifies which companies, 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 **Flood Insurance Study** and **Flood Insurance Rate Map**, 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.

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## Section 2.0 Area Studied

### 2.1 Scope of Study

**Identification of flooding sources studied by detailed methods of analysis and the geographical limits of the study**



Names the streams studied by detailed methods of analysis and the upstream and downstream limits.

**Identification of flooding sources studied by approximate methods of analysis**

Names the streams studied by approximate methods of analysis.

### Vicinity Map

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..

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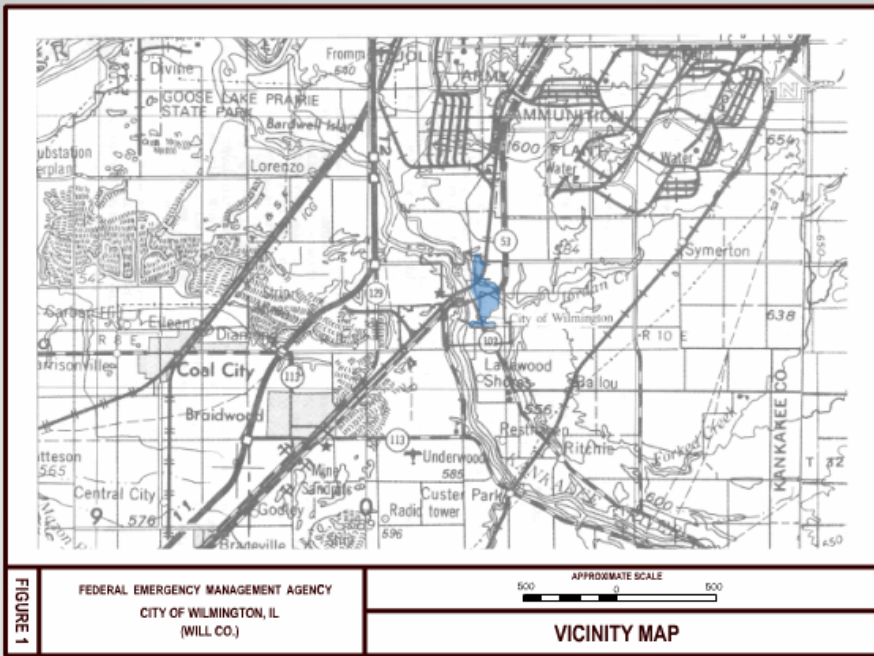


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## 2.2 Community Description

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.

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### 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**  
Details include the magnitude of the storm; the number of casualties; and the amount of damage caused to personal property, real property, and infrastructure. This information can be very 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.

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## 2.4 Flood Protection Measures

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- [Levees](#)
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- [Non-structural flood control measures](#)
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## 2.4 Flood Protection Measures

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### 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 (e.g., 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 the channel. Also, the section indicates whether the **base flood** is contained in the channel and, if not, the extent of **flooding** outside the channel.

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## 2.4 Flood Protection Measures

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- [Projects not recognized by the National Flood Insurance Program](#)



### Levees

**Levees** are man-made structures or fill along a river that extend above the **flood** elevation to prevent lower areas from being inundated by the flood. The information in this section includes the type of levee (e.g., 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 for which the levee provides protection) and the historical performance of the levee.

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## 2.4 Flood Protection Measures

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- Dams**
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**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 (e.g., 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.

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## 2.4 Flood Protection Measures

- [Channelization projects](#)
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- Non-structural flood control measures**
  - [Projects not recognized by the National Flood Insurance Program](#)

**Non-structural flood control measures**

Non-structural **lood** control measures include **floodplain** ordinances that are more restrictive than the **NFIP** minimum, ordinances that reduce runoff potential by restricting watershed development, or easements that designate open space in the floodplain.

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## 2.4 Flood Protection Measures

- [Channelization projects](#)
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- [Non-structural flood control measures](#)

**Projects not recognized by the National Flood Insurance Program**

**Projects not recognized by the National Flood Insurance Program**

Explains why any of the projects detailed within this section were not recognized by **FEMA** as providing protection from the **base flood**.




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### 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 flood** can occur more than once over a short time interval.

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### 3.1 Hydrologic Analyses

Hydrologic analyses are studies of the amount of water flowing in a stream during flood events. Generally, **Flood Insurance Studies** 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](#)
- [Methods of Analysis \(Riverine\)](#)
- [Summary of Discharges Table](#)
- [Coastal Analysis](#)

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## 3.1 Hydrologic Analyses

- [Sources of Data](#)
- [Methods of Analysis \(Riverine\)](#)
- [Summary of Discharges Table](#)
- [Coastal Analysis](#)

### 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.

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## 3.1 Hydrologic Analyses

- [Sources of Data](#)
- [Methods of Analysis \(Riverine\)](#)
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**Methods of Analysis (Riverine)**

Detailed explanation of the methods used to determine the **peak discharges** for streams and why that methodology is appropriate for the watershed. Typical methodologies are:

- [Regression Equations](#)
- [Gage Data Analysis](#)
- [Drainage Area-Discharge curves](#)
- [Rainfall-Runoff Modeling](#)

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### 3.1 Hydrologic Analyses

- Sources of Data
- Methods of Analysis (Riverine) — ● **Regression Equations**
- Summary of Discharges Table
- Coastal Analysis
- Gage Data Analysis
- Drainage Area-Discharge curves
- Rainfall-Runoff Modeling

#### 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 the variables 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.

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#### Gage Data Analysis

Gage data analysis involves statistical computations performed on a historical record of stream gage data to determine the **peak discharge** of the stream for a given probability **flood** event (e.g., a flood that has a 1-percent annual chance of occurrence). This section provides information about the location of the gage, the name of the agency or organization that operates the gage, and the length of historical record used in the analysis. Also, any changes in the watershed that could influence the peak discharges recorded at the gage are discussed in this section.

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#### Drainage Area-Discharge Curves

Drainage area – discharge curves are graphs developed from known **peak discharges** and drainage areas for other streams in the vicinity relating peak discharges to the drainage areas. Using the curves, the analyst can determine the peak discharges at any point on the stream based on the drainage area to that point. A separate curve is used for each frequency storm.

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#### Rainfall-runoff Models

Rainfall-runoff models are computer programs that calculate the **peak discharge** by using watershed characteristics to determine the amount of runoff during a given storm event. 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.

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## 3.1 Hydrologic Analyses

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TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (SQ MILES)</u>	<u>PEAK DISCHARGE (CFS)</u>			
		<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
LITTLE CREEK at mouth	5.7	4,480	5,775	6,480	7,975
Oak Ave	2.25	3,185	4,395	4,950	6,005

### Summary of Discharges Table

The Summary of **Discharges** Table briefly summarizes 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.

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**Coastal Analysis**

- [Explanation of Storm Surge Analysis](#)
- [Summary of Stillwater Elevations Table](#)


**Coastal Analyses**

- 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 storm occurrence
- Astronomic tide effects
- Joint probability analysis
- Determination of stillwater elevation
- Wave setup analysis

All the above 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.

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
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  - [Explanation of Storm Surge Analysis](#)
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#### **Explanation of Storm Surge Analysis**

Brief explanation of coastal **flooding** in general and tropical and extratropical 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 surge 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.

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**Coastal Analysis**

[Explanation of Storm Surge Analysis](#)

**[Summary of Stillwater Elevations Table](#)**

Flooding Source and Location	Elevation (Feet)			
	10-Year	50-Year	100-Year	500-Year
Atlantic Ocean				
Entire Shoreline Within Floodport	8.2	8.9	9.2	9.8
Merrimack River				
Entire Shoreline Within Floodport	5.9	7.2	8.2	8.9

### Summary of Stillwater Elevations Table

Identification of Shoreline

Lists stillwater elevations for selected recurrence intervals at each location along shoreline.

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### 3.2 Hydraulic Analyses

Hydraulic analyses are studies that determine the **water-surface elevations** on streams. **Flood Insurance Studies** are primarily concerned with the 100-year water-surface elevations, which are known as **Base Flood Elevations**; 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
- Methodologies
- Datum

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### 3.2 Hydraulic Analyses

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**Sources of Data**  
Typical information used in a hydraulic analyses may include:

- [Cross Sections](#)
- [Roughness Coefficients](#)
- [Starting Water-Surface Elevation \(SWSEL\)](#)

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## 3.2 Hydraulic Analyses

- [Sources of Data](#)
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### 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.

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### 3.2 Hydraulic Analyses

[Sources of Data](#)

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**Datum**

**Datum**

This section indicates the vertical **datum** to which all elevations are referenced. Vertical datum is important to ensure that like values are being used when the information in the **Flood Insurance Study** is being compared to other vertical data. **FEMA** had primarily used the **National Geodetic Vertical Datum of 1929 (NGVD)**, but is using the North American Vertical Datum of 1988 (NAVD) for new studies.

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### 3.3 Wave Height Analyses

- Wave Height Analysis Methodology and Criteria
- Concept of the Transect
- Wave Height Elevation vs. Actual Wave Height
- Storm Erosion and Effects on Beach Profiles
- Wave Height Analysis Computer Program Used
- Wave Runup Analysis Computer Program Used
- Field Surveys and Topographic Mapping Used
- Primary Frontal Dune

- Transect Location Map
- Transect Description Table
- Transect Data Table

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### 3.3 Wave Height Analyses

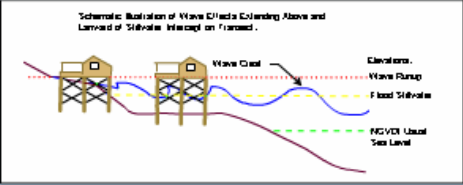
**Wave Height Analysis Methodology and Criteria**

- Concept of the Transect
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**Transect Location Map**

**Transect Description Table**

**Transect Data Table**



**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.

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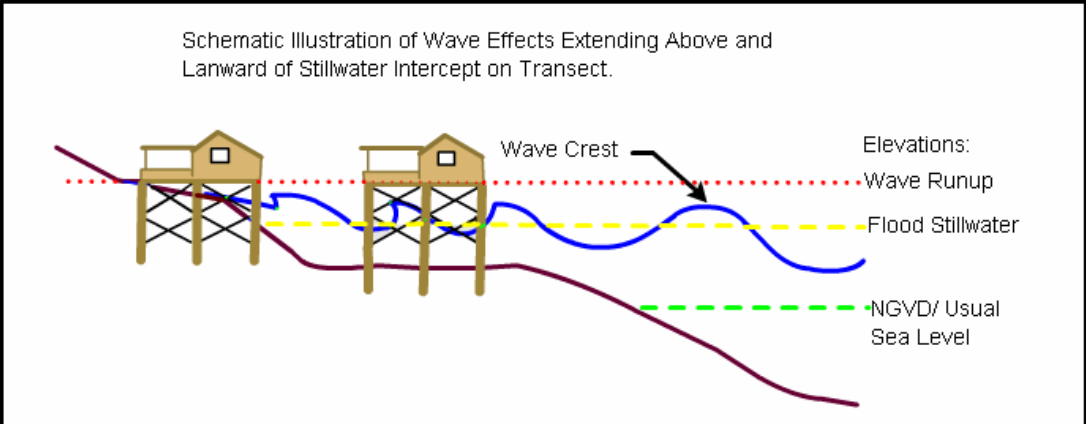
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Schematic Illustration of Wave Effects Extending Above and Lanward of Stillwater Intercept on Transect.



Elevations:

- Wave Runup
- Flood Stillwater
- NGVD/ Usual Sea Level

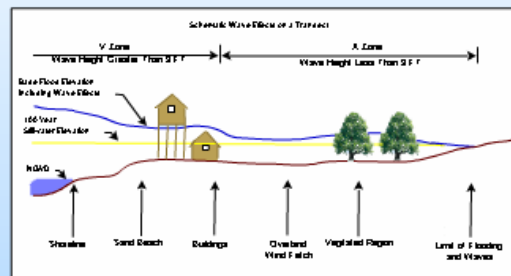
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#### Concept of the Transect

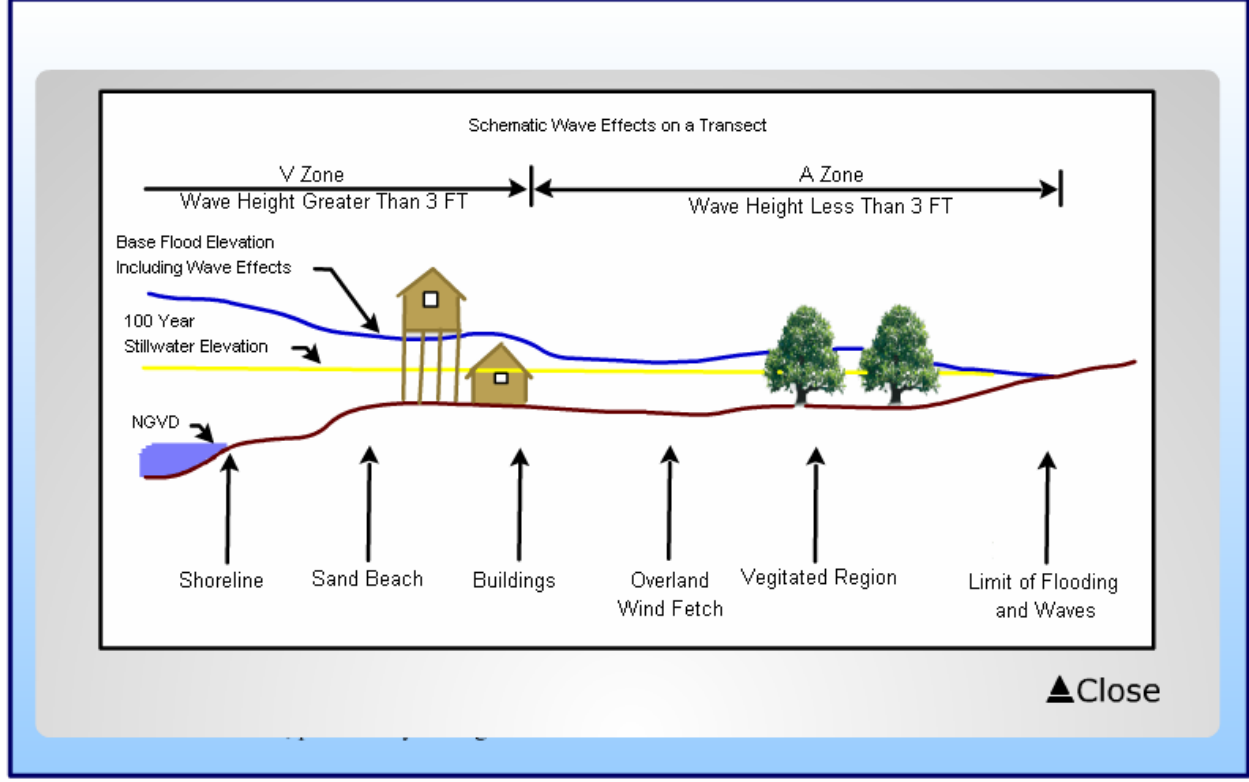
Explains that the transect is a line perpendicular to the shoreline, similar to a **cross section**, that depicts beach elevations and obstructions. A transect represents a portion of a beach in which ground cover and ground elevations are similar, particularly during a storm event.



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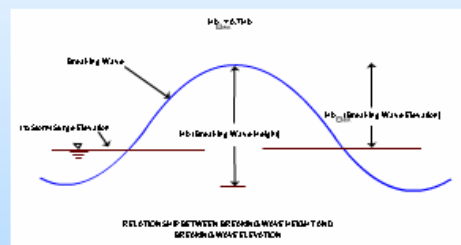
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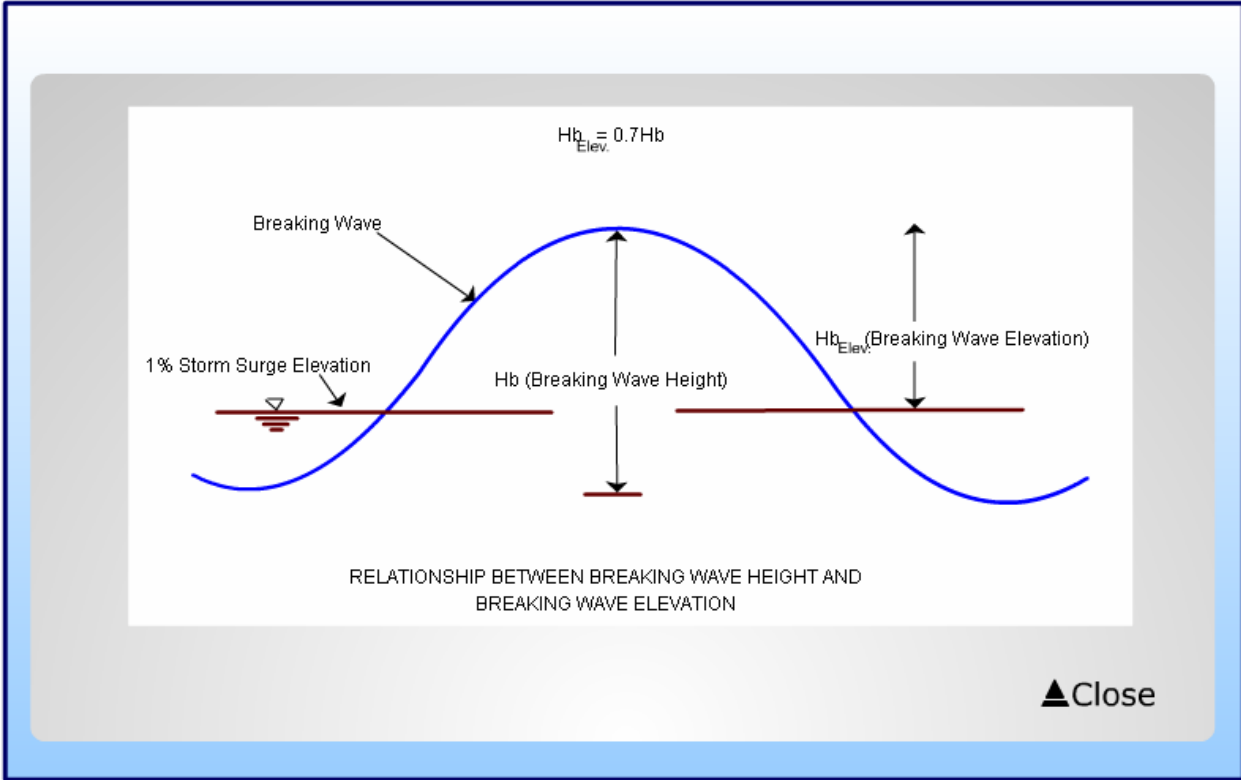
#### Wave Height Elevation vs. Actual Wave Height

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.



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### 3.3 Wave Height Analyses

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Concept of the Transect

Wave Height Elevation vs. Actual Wave Height

**Storm Erosion and Effects on Beach Profiles**

Wave Height Analysis Computer Program Used

Wave Runup Analysis Computer Program Used

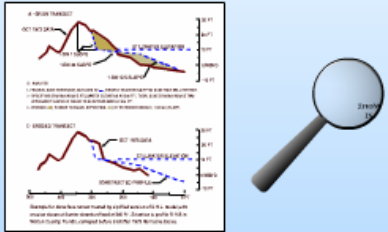
Field Surveys and Topographic Mapping Used

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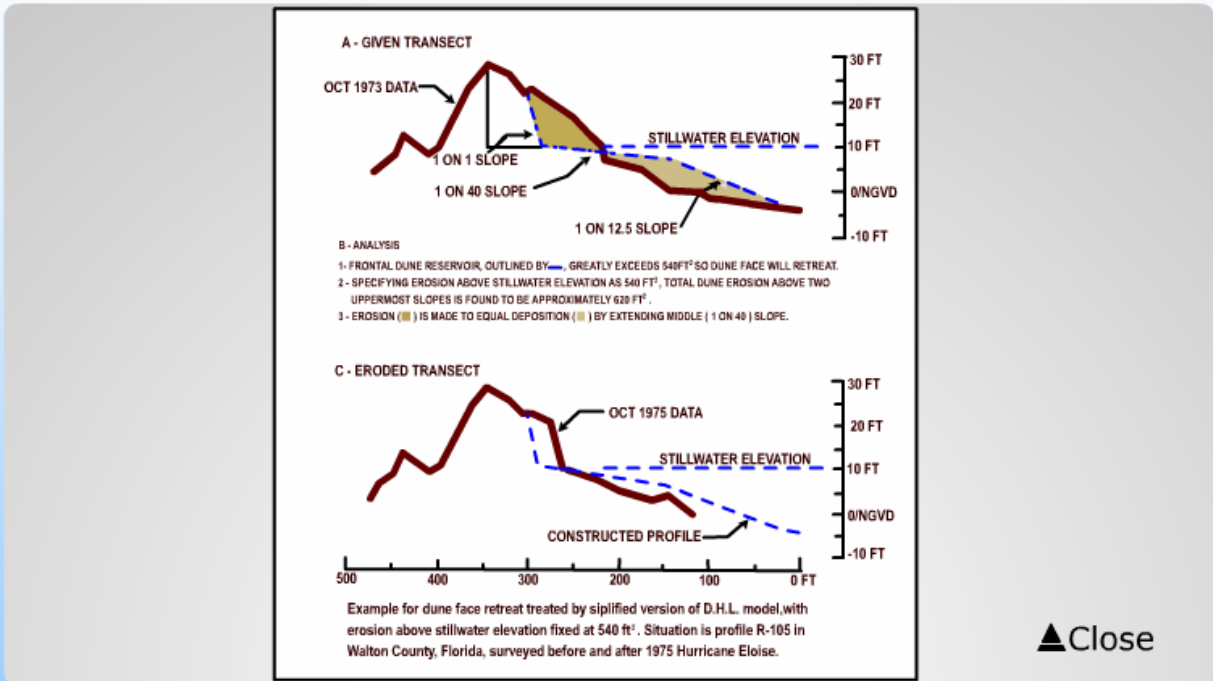


**Storm Erosion and Effects on Beach Profiles**

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 a national average.

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**Wave Height Analysis for Flood Insurance Studies (WHAFIS)**  
Wave Height Analysis for Flood Insurance Studies (WHAFIS), Version 3.0, is a DOS-based program that uses representative transects to compute wave crest elevations in a given study area. Transects are selected considering major topographic, vegetative, and cultural features. WHAFIS uses this and other input information to compute an appropriate depth-limited wave height at the seaward end of each transect.

**Wave Height Analysis Computer Program Used**

References 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, for example, the **USACE Automated Coastal Engineering System (ACES)**, discusses parameters used and how coastal areas are mapped.

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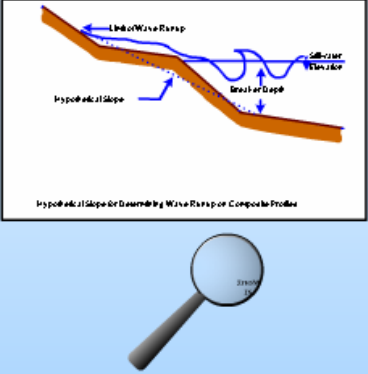


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Hypothetical Slope Determined by Wave Runup or Composite Profile

**Wave Runup Analysis Computer Program Used**

Concept of wave runup and conditions (e.g., abrupt beach slope or bluff) where wave runup can occur. Identifies and describes wave runup program used and how results were incorporated into the **base flood elevations**.

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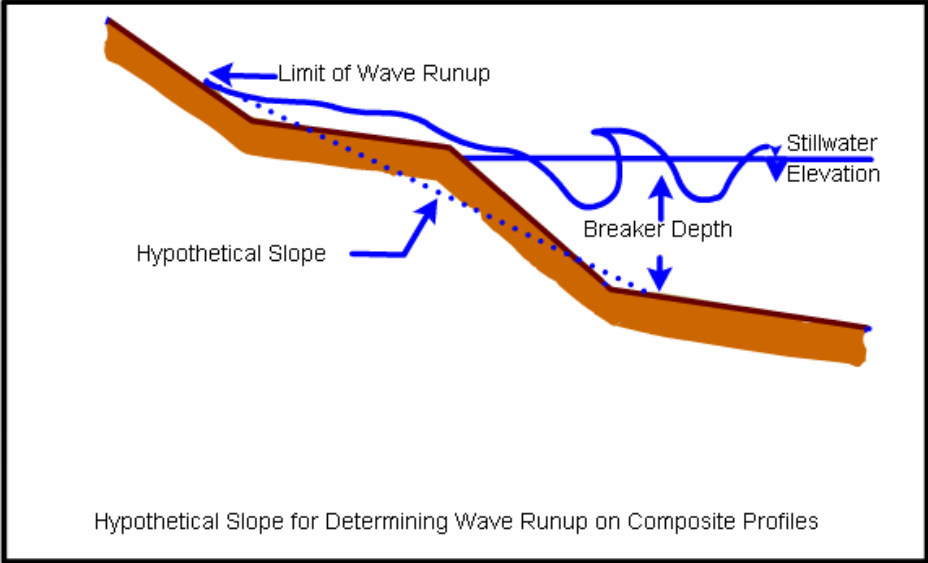


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Limit of Wave Runup

Stillwater Elevation

Breaker Depth

Hypothetical Slope

Hypothetical Slope for Determining Wave Runup on Composite Profiles

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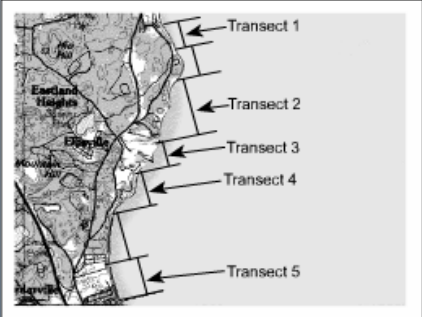
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#### Field Surveys and Topographic Mapping Used

Identifies maps used to delineate the **flood zones** and the date transects were surveyed.

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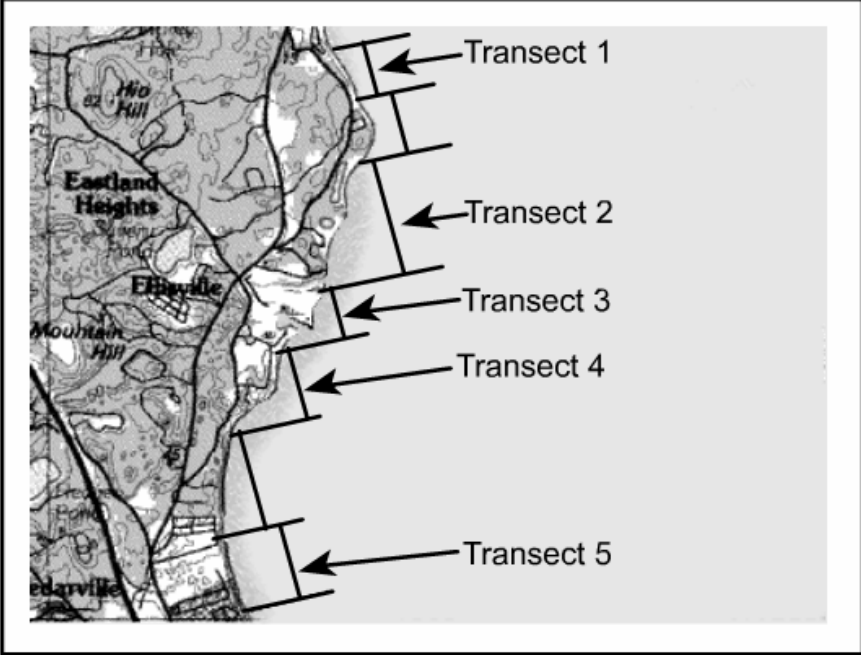
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<a href="#">Primary Frontal Dune</a>	

**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 dune profile is then included into the wave height and wave run up analysis as an existing dune.


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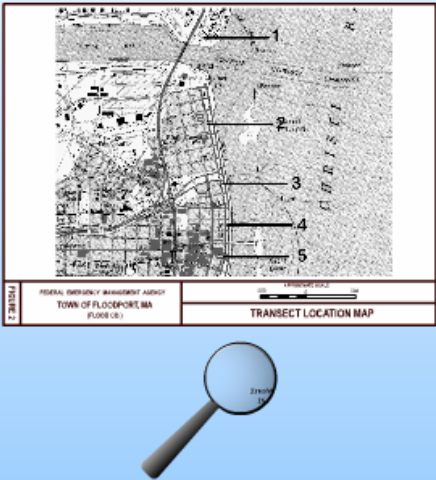
### 3.3 Wave Height Analyses

- [Wave Height Analysis Methodology and Criteria](#)
- [Concept of the Transect](#)
- [Wave Height Elevation vs. Actual Wave Height](#)
- [Storm Erosion and Effects on Beach Profiles](#)
- [Wave Height Analysis Computer Program Used](#)
- [Wave Runup Analysis Computer Program Used](#)
- [Field Surveys and Topographic Mapping Used](#)
- [Primary Frontal Dune](#)

**Transect Location Map**

[Transect Description Table](#)

[Transect Data Table](#)

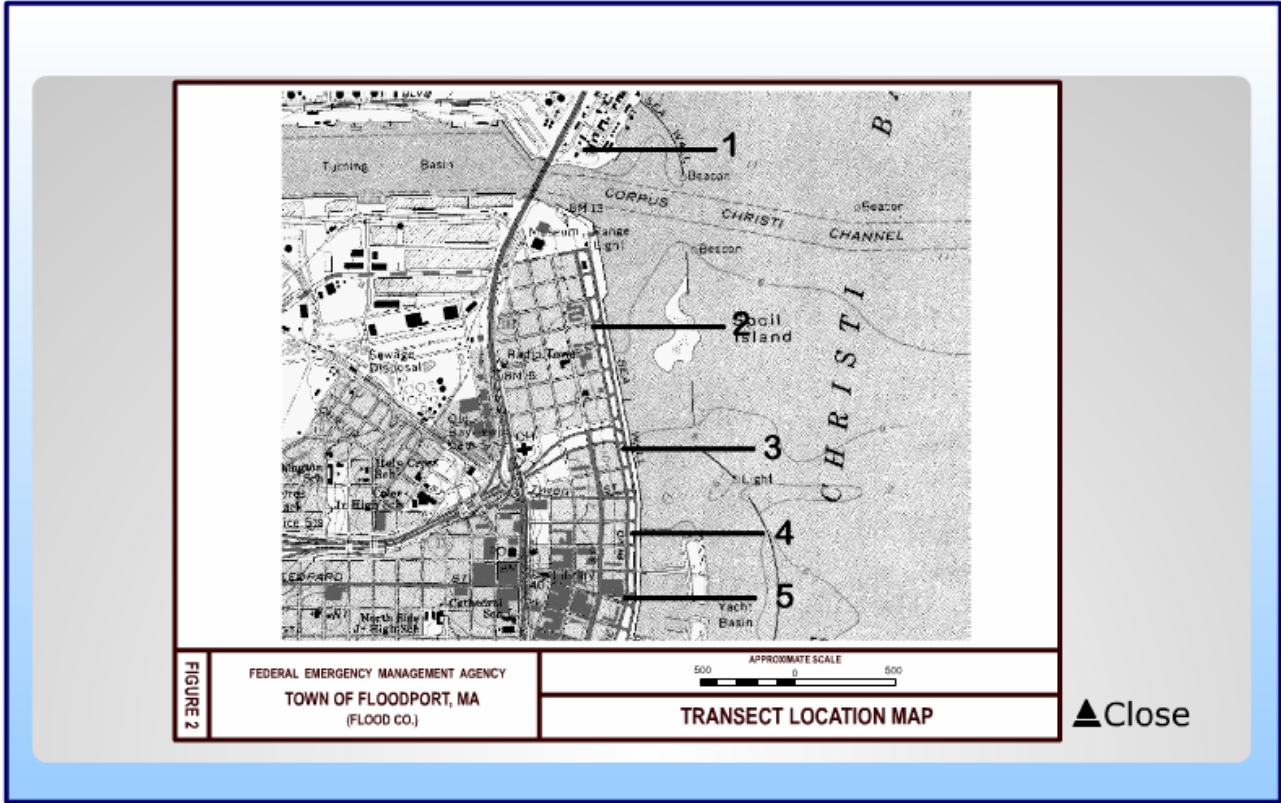


**Transect Location Map**

- Location of Transects
- Numbering of Transects

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### 3.3 Wave Height Analyses

- Wave Height Analysis Methodology and Criteria
- Concept of the Transect
- Wave Height Elevation vs. Actual Wave Height
- Storm Erosion and Effects on Beach Profiles
- Wave Height Analysis Computer Program Used
- Wave Runup Analysis Computer Program Used
- Field Surveys and Topographic Mapping Used
- Primary Frontal Dune

- Transect Location Map
- Transect Description Table**
- Transect Data Table

#### Transect Description Table

- Transect Number
- Description of Transect
- Stillwater Elevation at each Transect
- Maximum Wave or Runup Elevation at each Transect

Transect	Location	100 Year Flood Elevation (Foot)	
		Stillwater	Maximum Wave
1	From Plum Island Pier south to Plum Island Furrows, extended east	9.2-9.2	14
2	From Plum Island Furrows, extended east, to Perry Road, extended east	9.2	13
3	From Perry Road, extended east, to Kwaan Street, extended east	9.2	14
4	From Kwaan Street, extended east, to 8th Street, extended east	9.2	14
5	From 8th Street, extended east, to approximately 2,000 feet south of 1st Street	9.2	14
Due to Map Scale Limitations, Maximum Wave Elevation Not Shown on FIS Maximum Wave Height Elevation Maximum Wave Runup Elevation			2




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Transect	Location	100 Year Flood Elevation (Feet)	
		Stillwater	Maximum Wave
1	From Plum Island Point south to Plum Island Turnpike, extended east	9.2-8.2	14 <sup>1</sup>
2	From Plum Island Turnpike, extended east, to Perry Road, extended east	9.2	18 <sup>2</sup>
3	From Perry Road, extended east, to Mason Street, extended east	9.3	14 <sup>1</sup>
4	From Mason Street, extended east, to 8th Street, extended east	9.3	14 <sup>1</sup>
5	From 8th Street extended east, to approximately 3,000 feet south of 1st Street	9.3	17 <sup>3</sup>

<sup>1</sup> Due to Map Scale Limitations, Maximum Wave Elevation Not Shown on FIRM

<sup>2</sup> Maximum Wave Height Elevation

<sup>3</sup> Maximum Wave Runup Elevation




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### 3.3 Wave Height Analyses

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[Wave Height Elevation vs. Actual Wave Height](#)

[Storm Erosion and Effects on Beach Profiles](#)

[Wave Height Analysis Computer Program Used](#)

[Wave Runup Analysis Computer Program Used](#)

[Field Surveys and Topographic Mapping Used](#)

[Primary Frontal Dune](#)

[Transect Location Map](#)

[Transect Description Table](#)

[Transect Data Table](#)

**Transect Data Table**

**Flooding Source**

Transect Number

Stillwater Elevations for All Recurrence Intervals

Range of Wave Height and Runup Elevations

Transect Data

Flooding Source	Stillwater Flood Elevation (F feet)				Dune Flood Elevation (F feet)	1
	10-Year	50-Year	100-Year	500-Year		
Atlantic Ocean and Merrimack River						
Transect 1	3.2	3.9	9.2	9.3	9-	
14	14					
Atlantic Ocean						
Transect 2	3.9	7.2	3.2	3.9	3-	
Transect 3	11					
Transect 4	3.2	3.9	9.2	9.3	9-	
Transect 5	13					
13	3.9	9.0	9.9	10.0	9-	
14	14					
14	3.9	9.0	9.9	10.0	9-	
14	14					
14	3.9	9.0	9.9	10.0	9-	
14	14					
14	3.9	9.0	9.9	10.0	9-	

Due to Map Scale Limitations, Dune Flood Elevations Shown on F-824 Represent Average Elevations for the Zones Depicted.




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### Transect Data

Flooding Source	Stillwater Flood Elevation (Feet)				Base Flood Elevation (Feet) 1
	10-Year	50-Year	100-Year	500-Year	
Atlantic Ocean and Merrimack River					
Transect 1	8.2	8.9	9.2	9.8	9 -
	14				
Atlantic Ocean	5.9	7.2	8.2	8.9	8 -
Transect 2	11				
Transect 3					
Transect 4	8.2	8.9	9.2	9.8	9 -
Transect 5	18				
	8.3	9.0	9.3	10.0	9 -
	14				
1 Due to Map Scale Limitations, Base Flood Elevations are shown on FIRMs Represent Average Elevations for the Zones Depicted.	6.3	8.0	8.3	10.0	9 -
	17				

▲ Close


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## Section 4.0 Floodplain Management Applications

### 4.1 Floodplain Boundaries

**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.

**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 of occurring (**100-year flood**) and in some areas the flood having a 0.2-percent annual chance of occurring (500-year flood). This section indicates the **scales**, contour intervals, and dates of the topographic maps used to delineate the floodplains. The floodplains are delineated using flood elevations at **cross sections** or transects and by interpolating between cross sections or transects using topographic maps.




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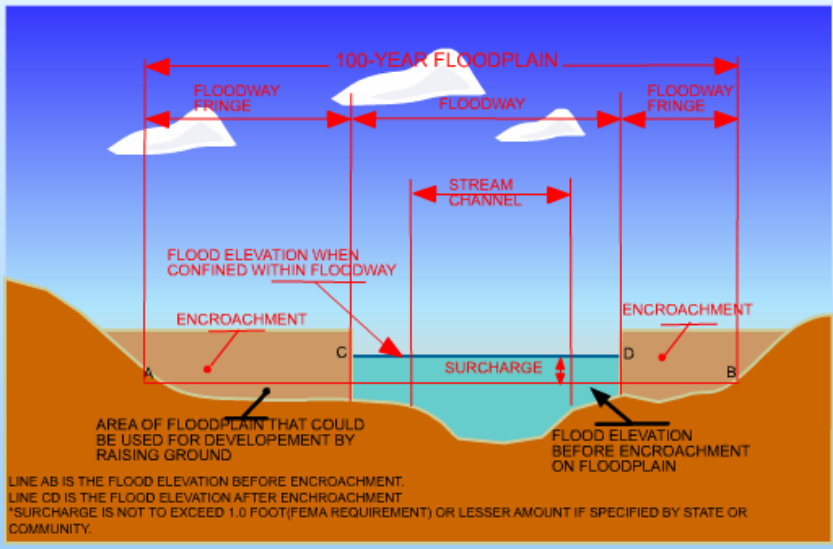


**Floodway**

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).

### 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 the floodways were determined.



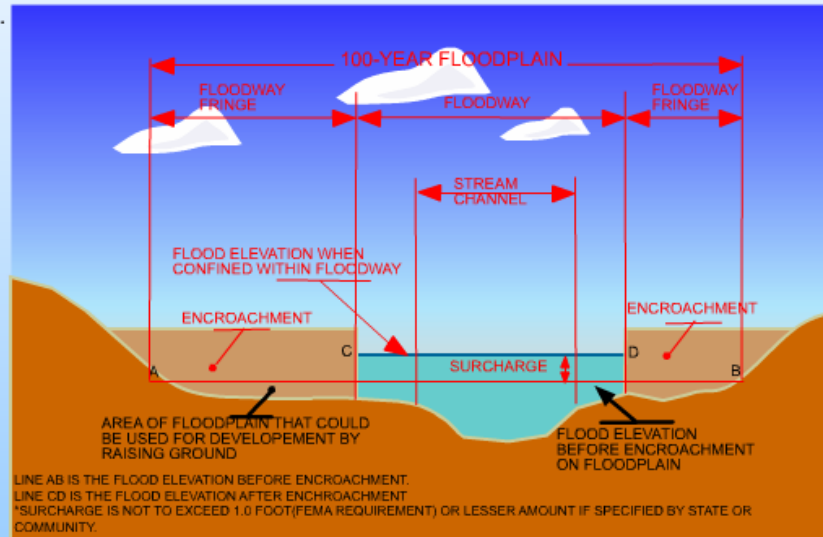
The diagram illustrates a cross-section of a stream and its floodplain. Key features include:

- 100-YEAR FLOODPLAIN:** The total width of the area that would be flooded by a 100-year flood.
- FLOODWAY:** The channel of the stream plus adjacent floodplain areas that must remain free of encroachment.
- FLOODWAY FRINGE:** The areas on either side of the floodway.
- STREAM CHANNEL:** The central waterway.
- ENCROACHMENT:** Areas where the floodway boundaries have been narrowed.
- SURCHARGE:** The increase in flood elevation due to encroachment.
- FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY:** The higher water level caused by the narrower channel.
- FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN:** The lower water level when the floodway is wider.

LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.  
 LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.  
 \*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE OR COMMUNITY.

## 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 the floodways were determined.



## 4.2 Floodways

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



FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
FLOODING CREEK								
A	415'	257	2,168	1.0	426.7	425.8'	426.2	0.4
B	716'	106	722	2.8	426.7	425.8'	426.2	0.3
C	1,522'	86	468	4.4	428.3	428.3	426.1	0.8
D	2,121'	50	288	6.9	433.5	433.5	424.3	0.2
E	2,880'	41	180	6.6	442.1	442.1	442.3	0.2

<sup>1</sup> Feet Above Mean Sea Level  
<sup>2</sup> Elevation Without Considering Backwater From Big River

B STEMS	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	FLOOD COUNTY, USA	
	(UNINCORPORATED AREAS)	
		FLOODING CREEK

CLICKING ON THE **MOVIE CAMERA** ICON ON THE ABOVE SLIDE BRINGS UP THIS SLIDE:

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Flooding Creek								
A	415 <sup>1</sup>	257	2,168	1.0	426.7	425.8 <sup>2</sup>	426.2	0.4
B	715 <sup>1</sup>	100	722	2.8	426.7	425.9 <sup>2</sup>	426.2	0.3
C	1,525 <sup>1</sup>	90	468	4.4	428.3	428.3	429.1	0.8
D	2,121 <sup>1</sup>	50	298	6.9	433.5	433.5	434.3	0.2
E	2,985 <sup>1</sup>	41	190	6.6	442.1	442.1	442.3	0.2

Just click on any of the highlighted columns for examples.

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CLICKING ON CROSS SECTION HEADING BRINGS UP THIS SLIDE:

The screenshot displays a Microsoft Internet Explorer browser window with the address [http://www.fema.gov/media/fhm/fis/ot\\_fis.htm](http://www.fema.gov/media/fhm/fis/ot_fis.htm). The page content includes the FEMA logo and the title "Federal Emergency Management Agency Flood Insurance Study Tutorial". Navigation links for "Help", "Glossary", and "Contents" are present. The main content area shows a diagram with two views of "Section A":

- Plan View Section "A"**: Shows a top-down view of a stream and floodplain. A red arrow points to the "Stream Centerline". A green arrow points to the "Limit of Floodplain". Flood zones are labeled "ZONE AE" and "ZONE A".
- Cross Section View Section "A"**: Shows a side view of the stream and floodplain. A red arrow points to the "Stream Centerline". A blue arrow points to the "100 Year Flood Elevation". A green arrow points to the "Limit of Floodplain".

A "Close" button is located in the bottom right corner of the diagram area.

CLICKING ON **DISTANCE** HEADING BRINGS UP THIS SLIDE:

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CLICKING ON **WIDTH - (FEET)** HEADING BRINGS UP THIS SLIDE:

The screenshot shows a Microsoft Internet Explorer browser window titled "FEMA: Flood Hazard Mapping -- Flood Insurance Study Online Tutorial". The address bar displays "http://www.fema.gov/media/fhm/fis/ot\_fis.htm". The browser interface includes a menu bar (File, Edit, View, Favorites, Tools, Help), a toolbar with navigation buttons, and a search bar. The main content area displays the FEMA Flood Insurance Study Tutorial interface. At the top, there is a blue header with the FEMA logo, the text "Federal Emergency Management Agency Flood Insurance Study Tutorial", and navigation buttons for "Help", "Glossary", and "Contents". Below the header is a large map of a floodway area. The map shows a network of streets and a floodway. A red box highlights a specific section of the floodway, and a red label "FLOODWAY WIDTH" with a double-headed arrow indicates the width of this section. The map includes labels for "ZONE AE", "ZONE A LIMIT OF DETAILED STUDY", "CORPORATE LIMITS", and various street names like "HIGHLAND DRIVE", "HILLSIDE DRIVE", "STREET", "AVE 108", "107", "108", "106", "WATER ST", and "B". At the bottom of the map area, there are "NEXT" and "Close" buttons. The browser's taskbar at the bottom shows the "Internet" icon.



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FLOODWAY WIDTH

FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY

ENCROACHMENT

ENCROACHMENT

AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPEMENT BY RAISING GROUND

FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN

Close

Internet



CLICKING ON SECTION AREA (SQUARE FEET) HEADING BRINGS UP THIS SLIDE:

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**FLOODWAY SECTION AREA**

FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY

ENCROACHMENT

ENCROACHMENT

AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPEMENT BY RAISING GROUND

FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN

Close

Internet

CLICKING ON MEAN VELOCITY (FEET PER SECOND) HEADING BRINGS UP THIS SLIDE:

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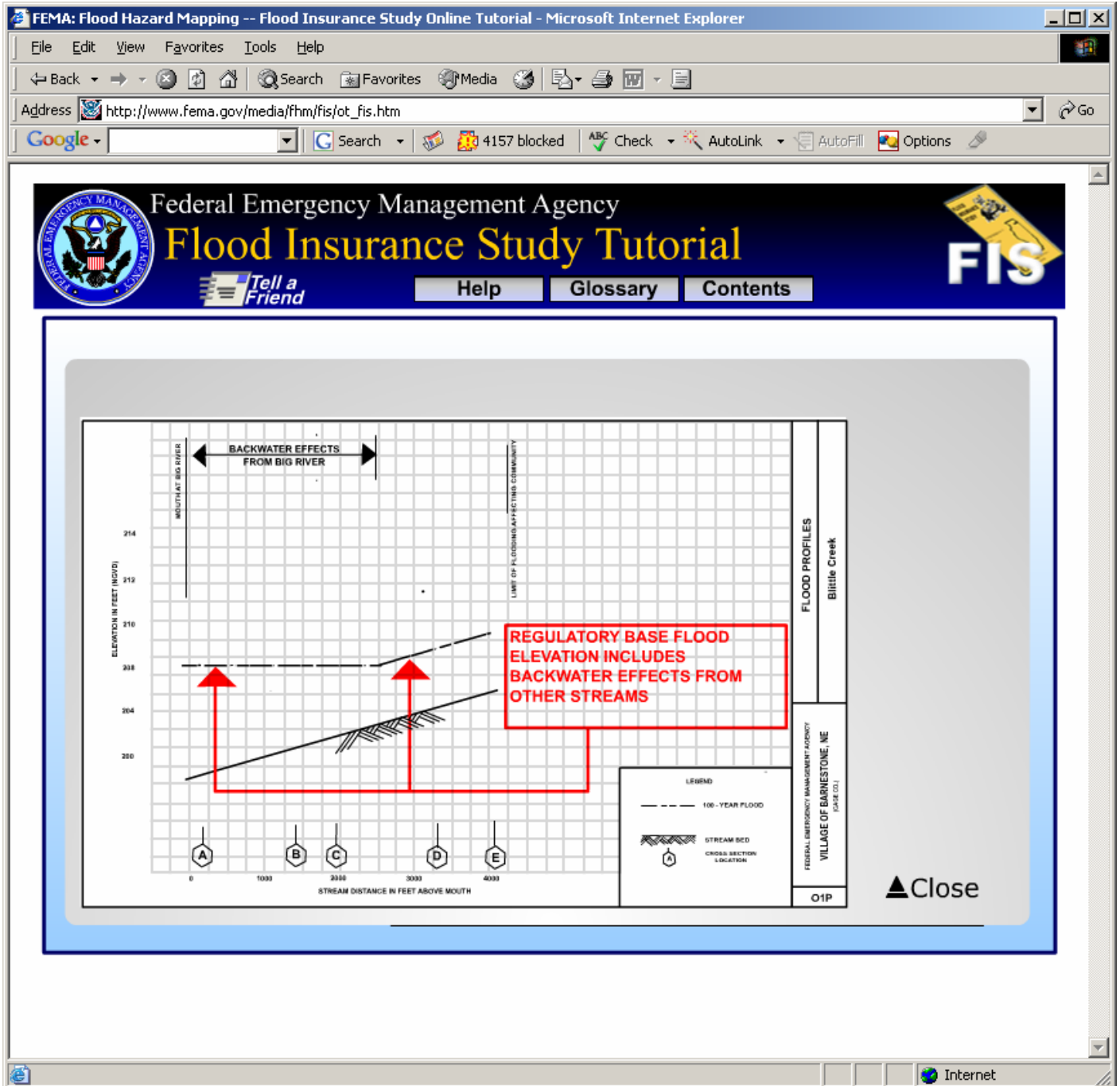
- $q = \text{Discharges}$
- $a = \text{Area}$
- $v = \text{Mean Velocity}$

Below the diagram, the formula  $\frac{q}{a} = v$  is shown. An example calculation is provided: "for example:  $\frac{2,000 \text{ cfs}}{500 \text{ feet flow area}} = 4 \text{ feet per second}$ ".

**MEAN VELOCITY**  
Is the 100-year flow divided by the cross-sectional area of the floodway.  
The velocity is measured in feet per second.

Close

CLICKING ON **REGULATORY** HEADING BRINGS UP THIS SLIDE:



CLICKING ON **WITHOUT FLOODWAY** HEADING BRINGS UP THIS SLIDE:

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BACKWATER EFFECTS FROM BIG RIVER

WITHOUT FLOODWAY BASE FLOOD ELEVATION DOES NOT ACCOUNT FOR BACKWATER EFFECTS FROM OTHER STREAMS

ELEVATION IN FEET (MOVD)

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND  
--- 100-YEAR FLOOD  
--- STREAM BED  
○ CROSS SECTION LOCATION

FLOOD PROFILES  
Blittle Creek

FEDERAL EMERGENCY MANAGEMENT AGENCY  
VILLAGE OF BARNESSTONE, NE  
12.14.02.1

Close

Internet

CLICKING ON **WITH FLOODWAY** HEADING BRINGS UP THIS SLIDE:

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- Address Bar:** http://www.fema.gov/media/fhm/fis/ot\_fis.htm
- Navigation:** Back, Forward, Home, Search, Favorites, Media, Print, Stop, Refresh, Go
- Search:** Google search bar with a search button.
- Page Header:** Federal Emergency Management Agency logo, "Flood Insurance Study Tutorial" title, "Tell a Friend" button, and "FIS" logo.
- Navigation Buttons:** Help, Glossary, Contents
- Slide Content:** A cross-section diagram of a floodway. The diagram shows a central water body (floodway) flanked by land. Two areas of land are labeled "ENCROACHMENT". A red arrow points from the text "WITH FLOODWAY BASE FLOOD ELEVATION" to the water level. Below the water level, a red line indicates the "FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN". A blue line indicates the "AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPEMENT BY RAISING GROUND".
- Slide Footer:** A "Close" button with an upward-pointing triangle icon.
- Taskbar:** Shows the Internet Explorer icon and the word "Internet".

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FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY

ENCROACHMENT

ENCROACHMENT

AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPEMENT BY RAISING GROUND

INCREASE

FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN

Close

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## 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 analyses. This section identifies and defines all zones shown on the effective FIRM. Older **Flood Insurance Studies (FISs)** 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**.

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## Section 7.0 Other Studies

This section identifies other studies of **flooding** in the area and indicates if these studies agree or disagree with the **Flood Insurance Study (FIS)**. 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.

Internet




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## Section 10.0 Revisions

This section is included in some **Flood Insurance Studies (FISs)** 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 performed the analyses, descriptions of the hydrologic and hydraulic analyses, and identification of the maps used to determine the **floodplain** boundaries.


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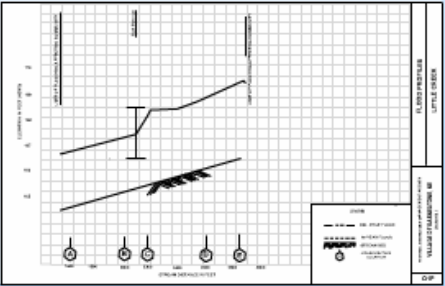
**Flood Profiles:**

A **flood profile** is a graph of the **flood** elevations along the centerline of a stream. The flood profiles in the **Flood Insurance Study (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 **FIRM** which the base flood elevations are rounded to the nearest whole foot.




**FIRM**





**FIS Flood Profile**



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1. Locate the property (■) on the Flood Insurance Rate Map (FIRM).

▲NEXT

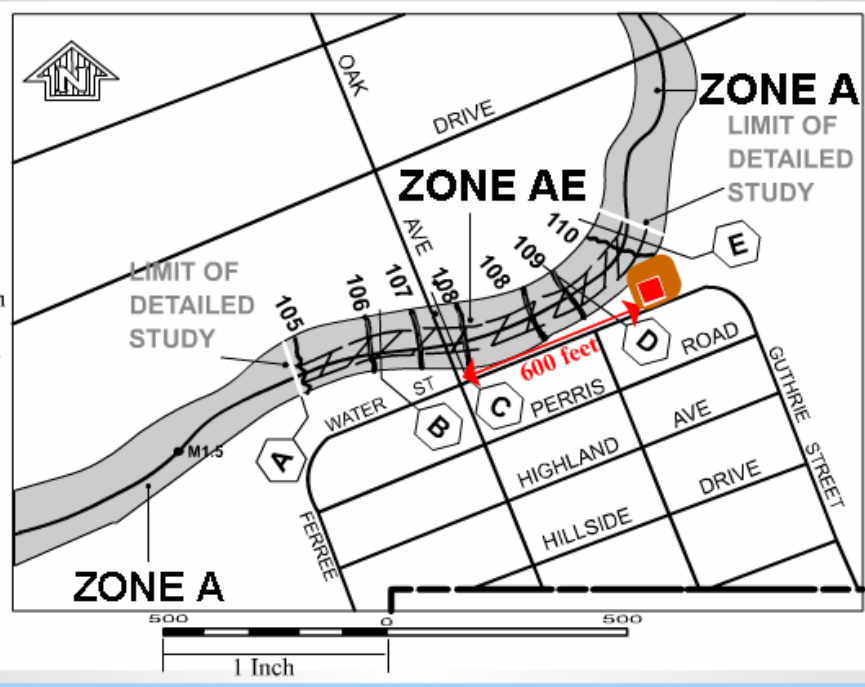
The map displays a residential area with several streets: Oak Drive, Water St, Ferris Ave, Highland Ave, Hillside Drive, and Guthrie Street. A river or waterway flows through the area. Flood zones are labeled: Zone A (bottom left), Zone AE (center), and Zone A (top right). The 'LIMIT OF DETAILED STUDY' is indicated by a dashed line. A red square (■) marks a property on the map. A scale bar at the bottom shows 500 feet increments, with a total length of 1000 feet (1 Inch). A north arrow is in the top left. A 'Close' button is in the bottom right.

▲Close

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2. Locate the boundary of the property (■). This information might come from a property plat.

▲NEXT



▲Close

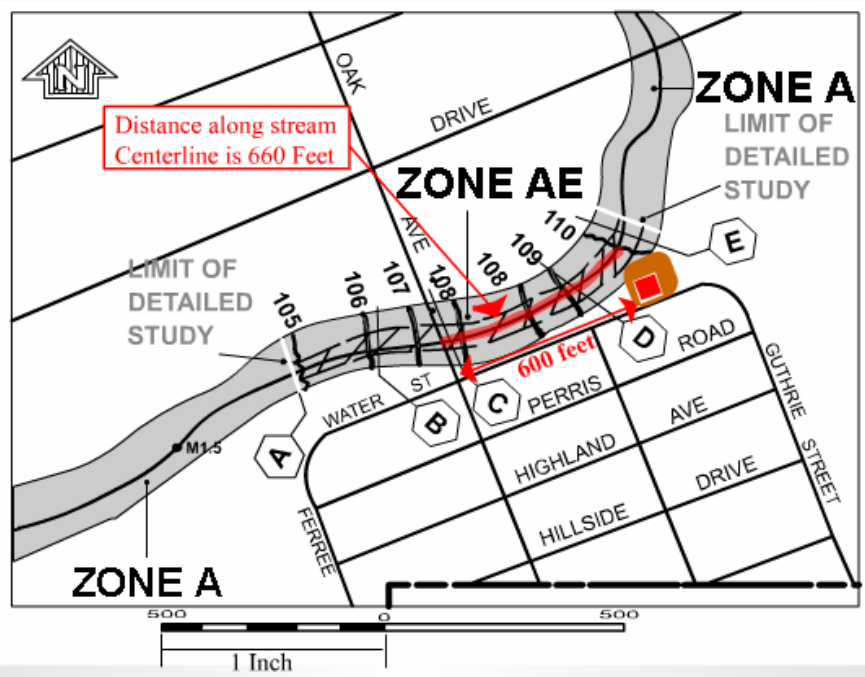
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3. Measure the distance along stream centerline from known point (Oak Avenue).

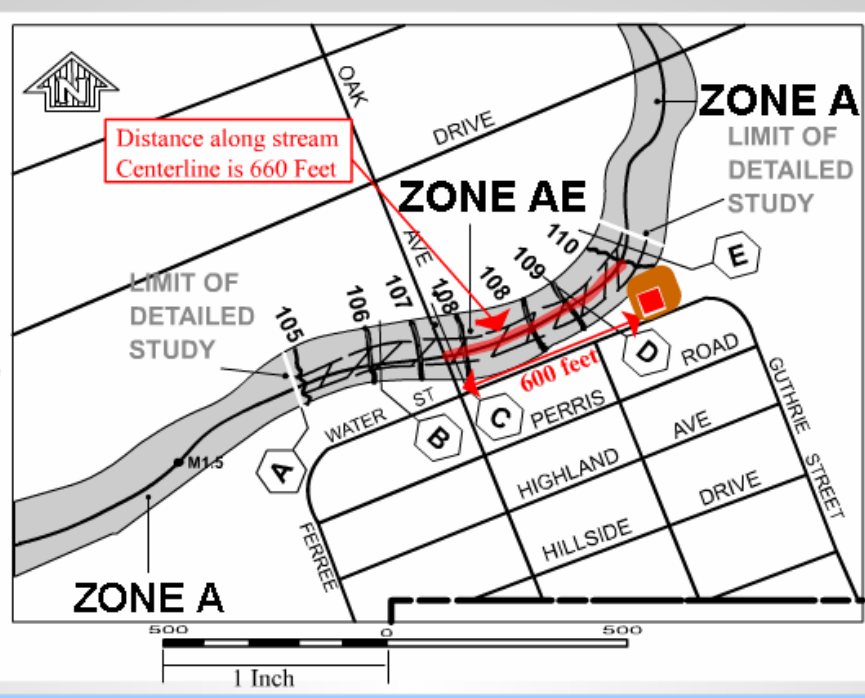
**▲NEXT**



**▲Close**

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4. Close this window and go to the Flood Insurance Study (FIS) profile to determine the Base Flood Elevation.





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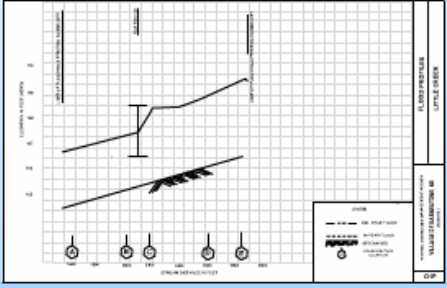
**Flood Profiles:**

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**FIRM**





**FIS Flood Profile**



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**CLICKING THE MOVIE CAMERA IN THE ELLIPSE BRINGS UP THE FOLLOWING SERIES OF SLIDES**

THE ANIMATION DRAWS THE RED LINES ON THE FOLLOWING 3 SLIDES

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**FLOOD PROFILES**  
LITTLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY  
VILLAGE OF BARNESTONE, NE  
(PAGE 001)

ELEVATION IN FEET (NOVD)

110  
109  
108  
107  
106  
105

1600 1800 2000 2200 2400 2600 2800 3000

STREAM DISTANCE IN FEET

Legend

- 100-YEAR FLOOD
- 10-YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

Property located on the FIRM 660 ft upstream of Oak Avenue

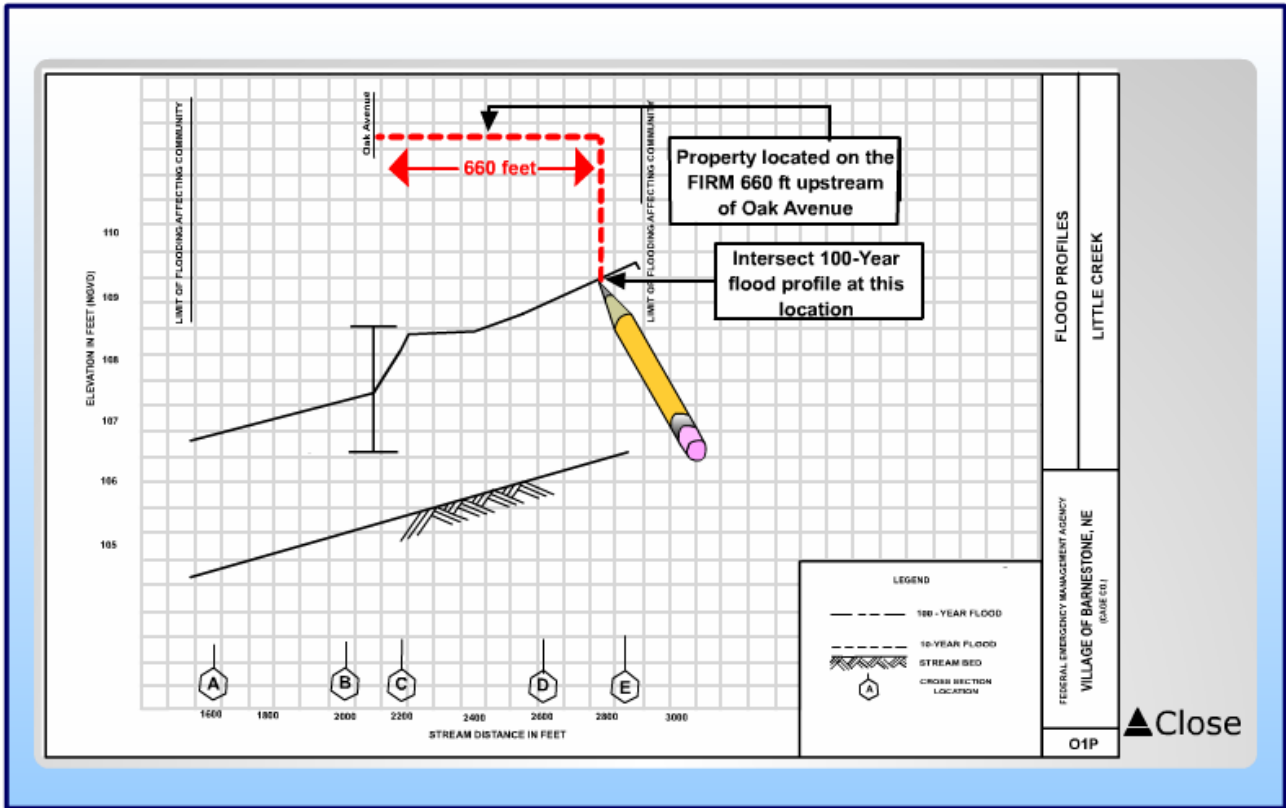
Close



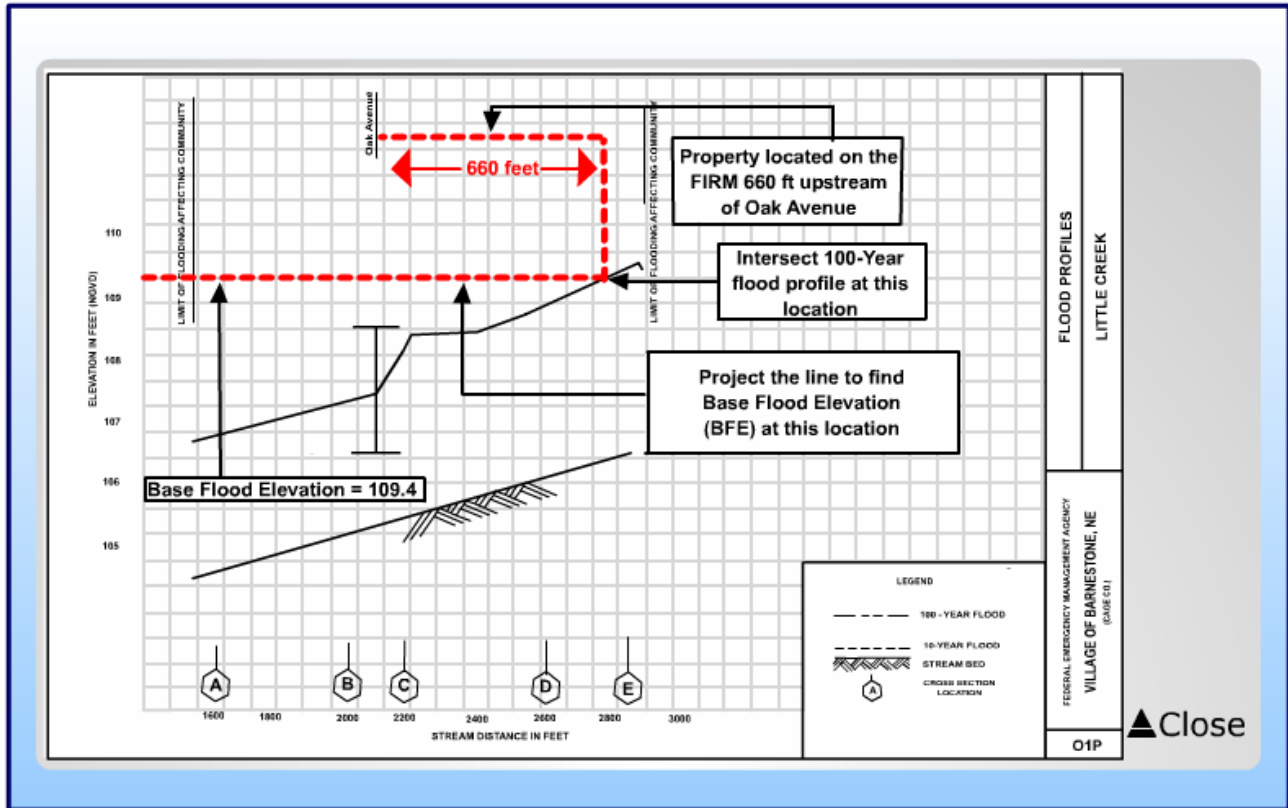
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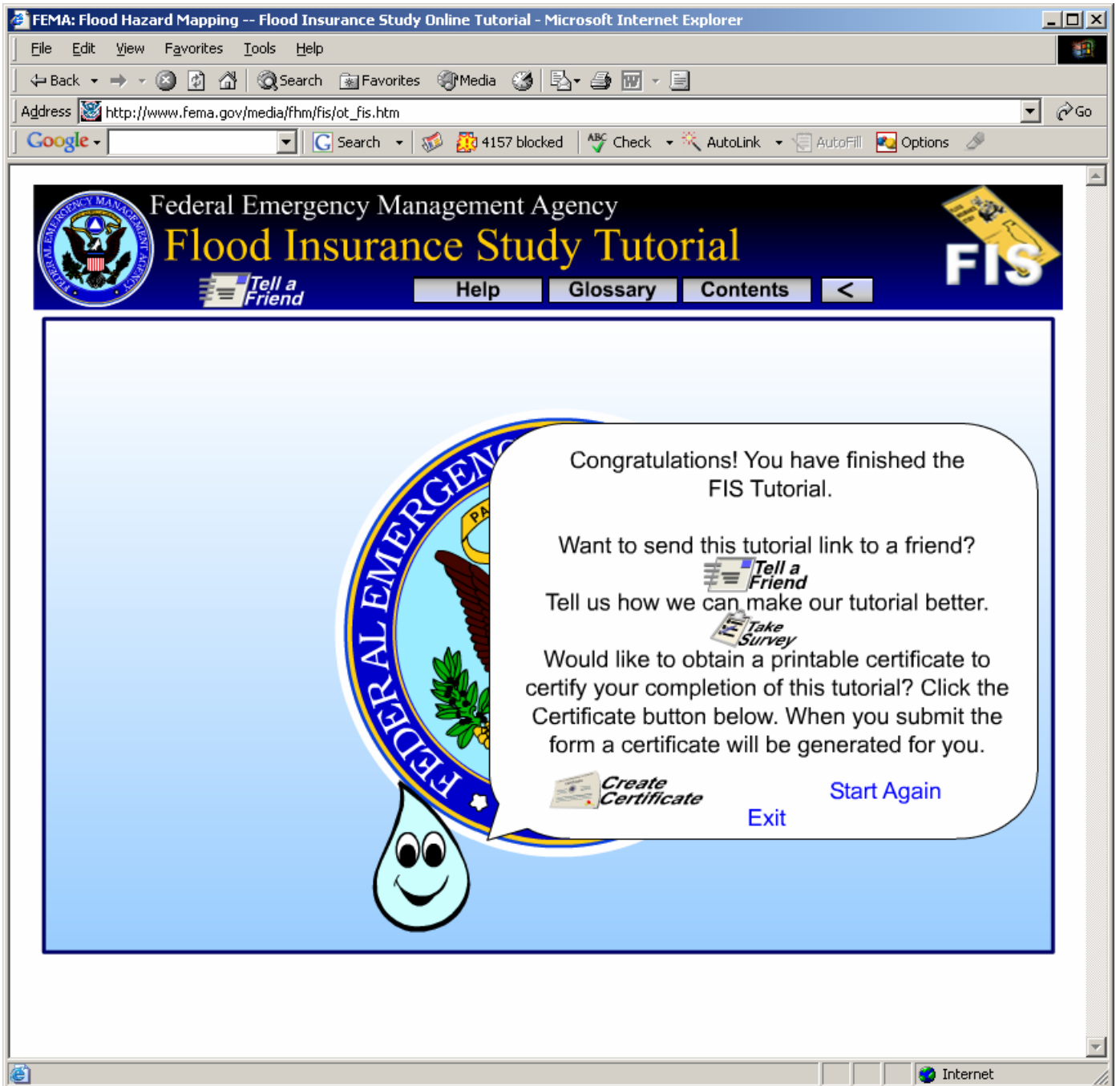
# Flood Insurance Study Tutorial

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## Conclusion

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

Internet



THE FEMA FIS TUTORIAL PROVIDES A VERY PROFESSIONAL LOOKING CERTIFICATE THAT YOU CAN PRINT OUT AT THE CONCLUSION OF YOUR SESSION.

TO OBTAIN YOUR CONTINUING EDUCATION CREDIT FROM PDH ONLINE, YOU MUST COMPLETE AND PASS THE QUIZ ON THE PDH ONLINE SITE.

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Search Web Y!

# Certificate of Completion


This is to certify that

***Jonathan Terry, P.L.S.***

has successfully completed FEMA's

***Flood Insurance Study Tutorial***

On this 9th day of April, 2007



1 of 1

Done Unknown Zone

## **GLOSSARY ENTRIES PROVIDED ON THE TUTORIAL'S "GLOSSARY" PULL-DOWN MENU:**

### **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 on a NFIP map has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage.

### **Base Flood Elevation (BFE)**

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 cf is approximately equal to 7.5 gallons per second.

### **Datum**

A fixed starting point of a scale.

### **Discharge**

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

### **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 Boundary Floodway Map (FBFM)**

A pre-Map Initiatives floodplain management map that delineates the 100-year (1 percent annual chance) and 500-year (0.2 percent annual chance) floodplains, floodway, and cross sections.

**Flood Insurance Rate Map (FIRM)**

A map on which the 100-year (1% annual chance) and the 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 an accurate flood insurance policies to homeowners in communities participating in the National Flood Insurance Program.

**Flood Insurance Study (FIS)**

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 known 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 Management**

The operation of the program of corrective and preventive measures for mitigating flood damage, including, but not limited to, emergency preparedness plans, flood-control works, and floodplain management regulations.

Floodplain or Flood Hazard Area

**Floodplain, Flood Hazard Area or Flood-Prone Area**

Any land area susceptible to inundation by water from any source.

**Floodway**

Channel of the stream plus any adjacent floodplain areas that must be kept free of encroachment so that a 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 US 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**

A man-made structure, usually an earthen embankment, designed to contain, control or divert the flow of water in order to provide flood protection.

**Manning's "n" Roughness Coefficient**

Coefficient used to account for the friction caused by friction, 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 and 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  $n$  values is available from t;H; 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.

**Maps Service Center (MSC)**

The Maps Service Center (MSC) distributes National Flood Insurance Program (NFIP) products including: Digital Flood Insurance Rate Maps (DFIRM), Flood Insurance Rate Maps (FIRM), Flood Insurance Studies (FIS), Digital Q3 flood data, Community Status Book, Flood Map Status Information Service (FMSIS), and Letters of Map Change (LOMC).

**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 the 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 (cfs).



**Perpendicular to Flow Path**

Cross section 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 map distance equal to a given number or 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 a 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.

**Zone**

A geographical area shown on Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

The following are not given in the FIS tutorial but are included here for your information:

**Zone A**

The flood insurance rate zone that corresponds to the 100-year floodplains that is determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone A99**

The flood insurance rate zone that corresponds to areas of the 100-year floodplains that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No Base Flood Elevations or depths are shown within the zone. Mandatory flood insurance purchase requirements apply.

**Zone AE**

[Note: In the tutorial, the following definition for Zone AE is accessed through clicking a link titled, "Zone AE and A1-A30.]

The flood insurance rate zone that corresponds to the 100-year floodplains that is determined in the Flood Insurance Study by detailed methods. In most instances, Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AH**

The flood insurance rate zone that corresponds to the areas of the 100-year shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. The Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AO**

The flood insurance rate zone that corresponds to the area of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. The depth should be averaged along the cross-section and then along the direction of flow to determine the extent of the zone. Average flood depths derived from the detailed hydraulic analyses are shown within this zone. In addition, alluvial fan flood hazards are shown as Zone AO on the Flood Insurance Rate Map. Mandatory flood insurance purchase requirements apply.

**Zone AR**

The flood insurance rate zone that results from the decertification of a previously accepted flood protection system that is being restored to provide protection from the 100-year or greater flood event.

**Zone D**

Designation on National Flood Insurance Program maps used for areas where there are possible, but undetermined, flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk.