



**PDHonline Course L145 (5 PDH)**

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## **GIS – Introduction and Sample Uses**

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

**2020**

**PDH Online | PDH Center**

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**Welcome to:**

# **FEMAs GIS Tutorial Series (Tutorials I, II and III)**

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

**GIS**  
**(Geographic Information Systems)**  
**TUTORIAL 2 OF 3**

**The tutorial series presents an introduction to  
GIS  
illustrated with FEMA's application of GIS in  
their  
MAP MODERNIZATION OBJECTIVES**

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## IMPORTANT:

The **blue-text** links in the course material and the **GLOSSARY** entries accessed through the pull-down menu provide significant benefits to those studying the “live,” on-line tutorial.

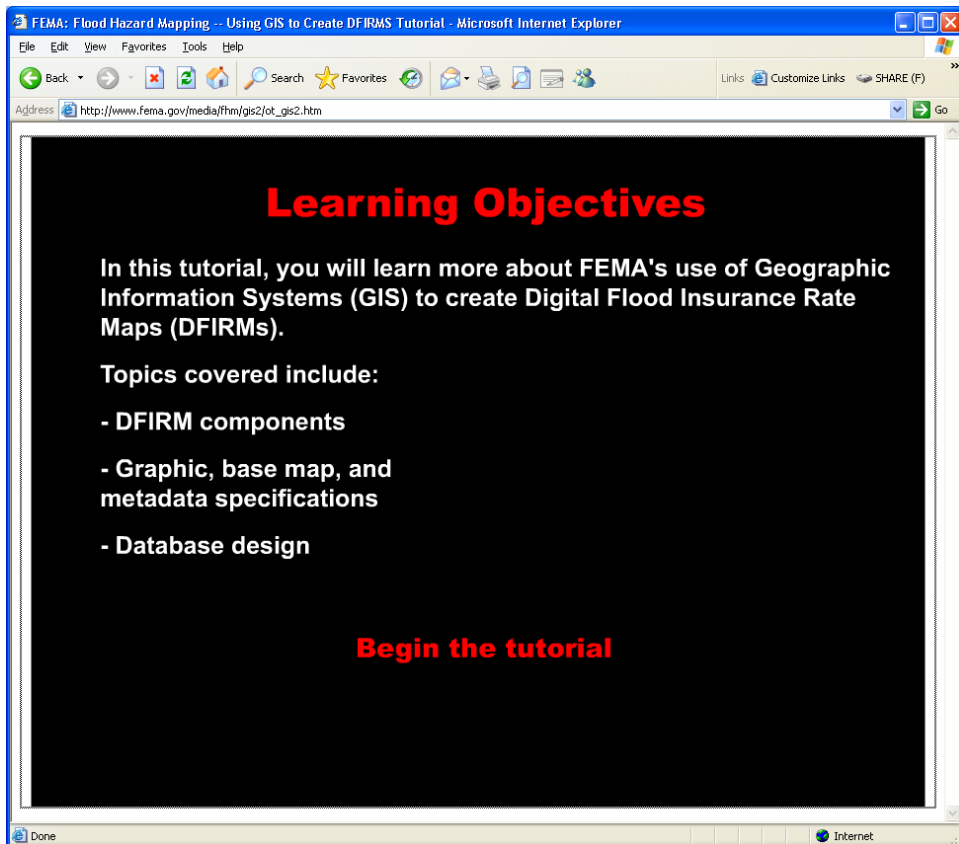
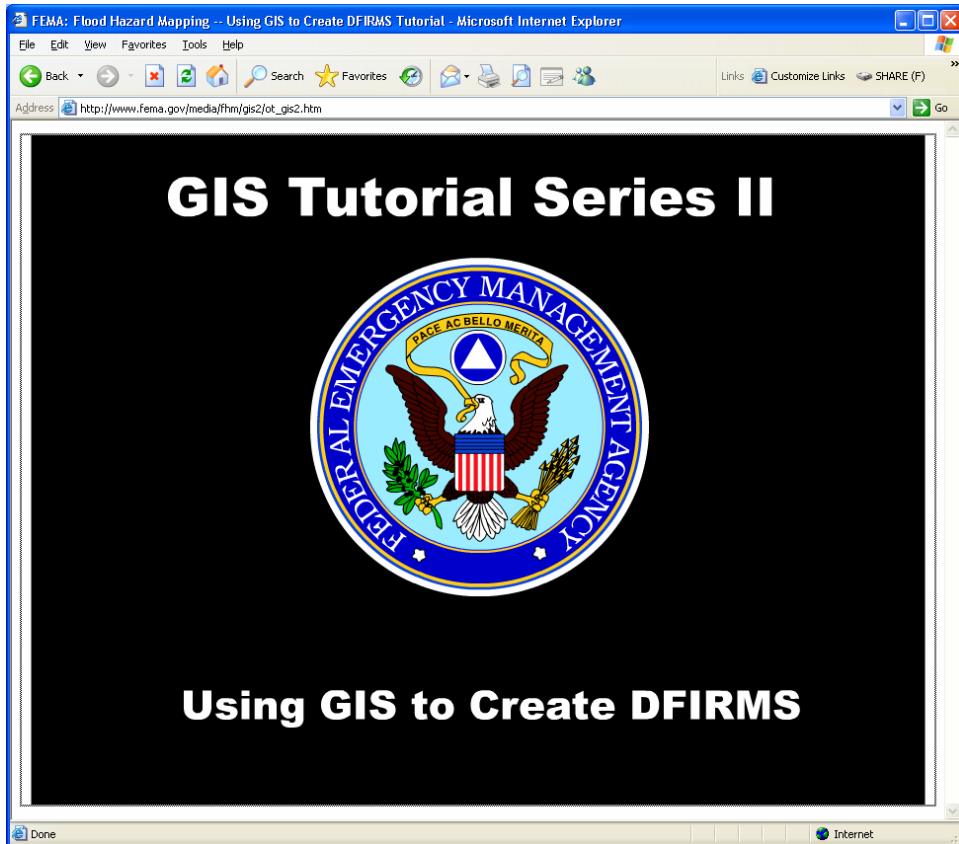
For this reason, it is suggested that those using this hard-copy version of FEMA’s GIS tutorial series make frequent reference to the **GLOSSARY** section at the end of each portion of the tutorial.

For your convenience and ease of study, each of these three hard-copy files (a separate file covering each session of FEMA’s 3-part GIS tutorial series) contains **GLOSSARY** entries from all three “live” tutorials.

Both the course material and the quiz rely on frequent reference to these **GLOSSARY** entries.

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Three image transitions begin the tutorial as below:

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FEMA: Flood Hazard Mapping -- Using GIS to Create DFIRMs Tutorial - Microsoft Internet Explorer

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**Introduction**

As GIS technology advances, it enhances FEMA's ability to reduce the loss of life and property while providing protection from all hazards. GIS technology has proven useful to FEMA in various areas, including flood hazard mapping.

The **first tutorial** in this series provided you with an introduction to GIS technology. This tutorial will provide you with an overview of FEMA's use of GIS for the creation of **Digital Flood Insurance Rate Maps (DFIRMs)**.

**Tropical Storm Floyd**

**Hurricane**

Wind S  
 By (Sh)  
 74 MPH  
 50 MPH  
 30 MPH  
 Storm  
 Storm  
 Storm  
 Storm  
 Storm  
 Storm

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**ZONE A**

WEST BELL DRIVE  
 ARVILLE  
 RENO AVE  
 SCHIRLIS STREET  
 LIMIT OF DETAILED STUDY  
 Branch  
 Central  
 PACIFIC  
 LIMIT OF DETAILED S

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**Introduction**

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For any terms presented in **blue text** on these screen captured images, refer to the **GLOSSARY** entries at the end of this file for the information that the on-line, "live" tutorial presents when its **blue text** is clicked with your mouse.

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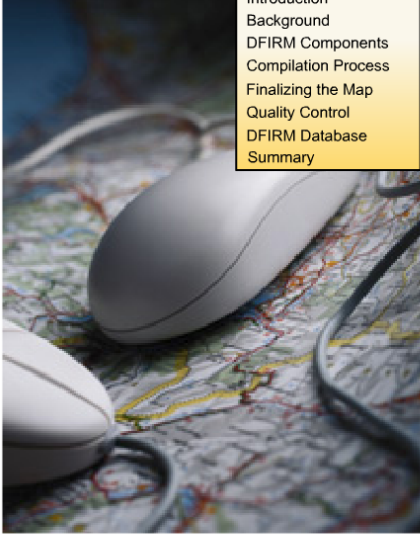
Introduction  
 Background  
 DFIRM Components  
 Compilation Process  
 Finalizing the Map  
 Quality Control  
 DFIRM Database  
 Summary

**Introduction**

Digital Flood Insurance Rate Maps (DFIRMs) are produced using digital methods, instead of the traditional **manual cartographic methods** used to produce Flood Insurance Rate Maps (FIRMs).

Below are some of the biggest advantages of using digital methods to produce DFIRMs.

- Standard technology
- Easier updates
- Spatial analysis
- Data management
- Distribution options
- Different viewing scales
- Ability to combine with other data
- Sources (multi-hazard mapping)

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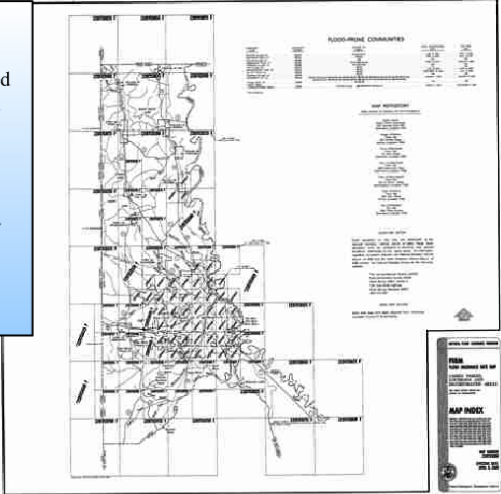
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**Background: FIRM Product**

Traditionally, older **FIRMs** were distributed as paper maps and produced using **manual cartographic methods**. The maps were produced in five different paper sizes and were printed in blue and white tones.

Manual cartographic products do not allow for easy **spatial analysis**. These methods are generally not cost effective for map revisions and updates.



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**Background: Modernizing DFIRMS**

In order to modernize FEMA's mapping products, several workgroups were formed to redesign the **DFIRM** product.

**Graphic specifications**

**Database design**

**Metadata specifications**

**Distribution plan**

**User applications**


**Use policy**

**Implementation strategy \***

**Cost quantification \***

**Multi-hazard mapping \***

Learn about the workgroups by clicking on the topics shown below. An asterisk by a group name indicates that the group's work is on hold pending finalization of the graphic and database specifications.



**Graphic specifications**

This workgroup has been tasked with developing the graphic specifications for the new DFIRM product, including colors, patterns, linewidths, and text fonts. Additional information about the graphic specifications is available at [www.fema.gov](http://www.fema.gov).

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**Database design**

This workgroup has been tasked with developing the database architecture for the items that will be attached to the map graphics, including the structure for linking features to each other and to all the underlying engineering and back-up data. Additional information is available at FEMA's Web site.

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**Metadata specifications**

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**User applications**

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**Implementation strategy \***

**Cost quantification \***

**Multi-hazard mapping \***

**Metadata specifications**

This workgroup has been tasked with finalizing the new DFIRM product metadata specifications once the database design is complete. The draft DFIRM database contains many items that will be used in the creation of metadata.

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**Multi-hazard mapping \***

**Distribution plan**

This workgroup has been tasked with addressing how the digital product(s) will be distributed.


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- [Database design](#)
- [Metadata specifications](#)
- [Distribution plan](#)
- [User applications](#)
- [Use policy](#)
- [Implementation strategy \\*](#)
- [Cost quantification \\*](#)
- [Multi-hazard mapping \\*](#)

#### User applications

This workgroup has been tasked with exploring database prototypes. A wide user base is expected to contribute ideas to the workgroup.


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- [Distribution plan](#)
- [User applications](#)
- [Use policy](#)
- [Implementation strategy \\*](#)
- [Cost quantification \\*](#)
- [Multi-hazard mapping \\*](#)

#### Use policy

This workgroup has been tasked with creating a recommended use policy to help clarify issues for users as they migrate from a paper environment to a digital one.


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- [Implementation strategy \\*](#)
- [Cost quantification \\*](#)
- [Multi-hazard mapping \\*](#)

#### Implementation strategy

This workgroup will be activated after the product design is complete. Its work is also dependent on funding levels. The group's efforts will require coordination with other Mitigation Directorate activities and other Federal agencies.


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- [Cost quantification \\*](#)
- [Multi-hazard mapping \\*](#)

#### Cost quantification

The scope and focus of this workgroup's tasks are under development.

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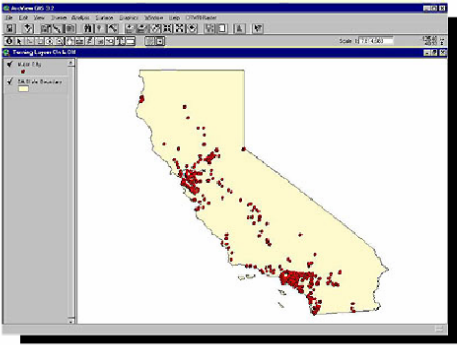

**DFIRM Components**

FEMA combines **base map** data (**vector** and/or **raster**) and flood hazard data to produce **DFIRMS**. This is the same information used to create **FIRMS**. However, the data behind the DFIRMS is digital GIS data, instead of hardcopy maps.

Using **GIS** to create DFIRMS enables users to turn various **layers** on or off as needed. The layers have attributes in the database that describe the features within each layer.

Use the button provided to turn the "major cities" layer on and off.

click here to turn off the major cities layer

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**Base Map Specifications**

As part of FEMA's **Map Modernization Plan**, new **base map** specifications for **DFIRMs** were developed. Some key items in the new base map standards include **accuracy**, currency (less than 7 years), and ease of distribution (FEMA must be able to distribute the base map).

For details on the base map specifications, go to [www.fema.gov](http://www.fema.gov).

Additional information about the Map Modernization Plan is available at [www.fema.gov](http://www.fema.gov).



Base Map



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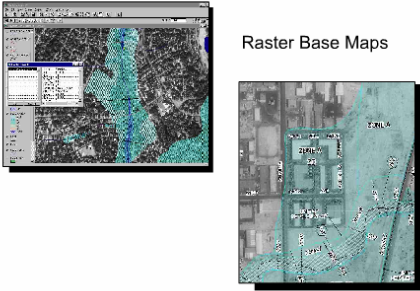
**Base Map Specifications (continued)**

A locally developed **base map**, typically a **vector** base map, may be used to produce the **DFIRM**, provided it meets FEMA's minimum base map standards.

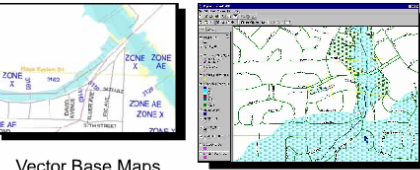
If a locally developed base map is not available or does not meet FEMA's standards, a USGS **Digital Orthophoto Quarter Quadrangle (DOQ)** will be used as the default base map (**raster**).

If complete coverage of neither is available, a combination of a raster and vector base map may be used for the DFIRM. This combination option is known as a "quilt" map.

**Raster Base Maps**



**Vector Base Maps**



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**Base Map Data**

**Base map** data includes roads, railroads, hydrography (e.g., streams), and community boundaries.

The base map may be in **vector** format, as shown here.

Road Railroad

Hydrography (stream) Community Boundary

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**Base Map Data (continued)**

The **base map** may also be in **raster** format, as shown in this example. Raster base maps will also require some **vector** information such as community boundaries along with annotation **layers** for items such as street names.

Community Boundary

Road Hydrography (stream)

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**Flood Hazard Data**

DFIRMs also include **flood hazard data**. This data normally contains **Base Flood Elevations (BFEs)**, cross sections, and zone designations with boundaries and **floodway** locations.

Base Flood Elevation

Cross Section

Zone Designation

Boundary

Done Internet

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**The Compilation Process: Introduction**

The ease with which FEMA will be able to combine the two main data components, base maps and flood hazard data, often depends on the format and **map projection** of the data received.

FEMA may receive data in a variety of **GIS** or **CAD** formats and map projections. Technicians must put the data in a standard map projection and a standard GIS format for use in FEMA's GIS.

For more information on map projections, see the first tutorial in this series: [Introduction to GIS](#).

To conform to FEMA standards, data must be in a standard map projection.

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**The Compilation Process:  
Introduction (continued)**

FEMA must standardize the data in order to produce **DFIRMs**. This process is known as **map compilation**. The first step in the process is to review the data received to ensure it is complete. The second step is to put the **base map** and **flood hazard data** into a standard **GIS** format, **map projection**, and **coordinate system**.



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**The Compilation Process:  
Data Format**

FEMA receives data in a variety of formats, depending on the software packages being used by a community or contractor.

The **GIS** software companies and programs listed here are examples of the file formats received by FEMA for the creation of **DFIRMs**.

**Selection of GIS Software Companies and Programs**

- ESRI (ArcView, Arc/INFO)**
- MapInfo (MapInfo)**
- Caliper (Maptitude)**
- Intergraph (GeoMedia)**
- Tactician (Tactician)**

*\*Note: This is not a comprehensive list of the types of GIS software packages available and does not constitute FEMA's endorsement of any of these companies and/or their products.*

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### The Compilation Process: Map Projection and Coordinate System

The data must be transferred into a common **map projection**. The **base map** data and **flood hazard data** must be in the same map projection and **coordinate system** in order to match up with each other.

These examples show the importance of using the appropriate projection and coordinate system.

Non-matching

Matching

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### Finalizing the Map

Once the data has gone through the compilation process, the maps are annotated with text, symbols are selected and assigned for specific features, and the final look of the map is developed.


Please note that the colors shown on the image to the right are used during production but are not the colors used for the final **DFIRM**.

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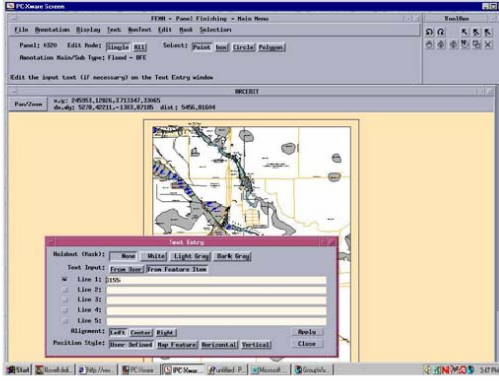
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#### Finalizing the Map (continued)

Cartographers use a special **GIS** application to label and finish the **DFIRMS**. This results in faster production times and easier updates than traditional **cartographic methods**.

The image on the right is a sample of the functions available to the cartographers.






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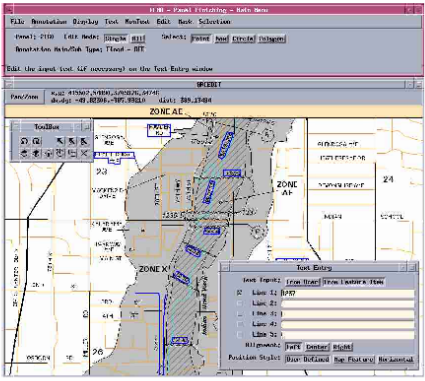
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#### Finalizing the Map (continued)

The example shown on the right depicts a custom application built using ESRI's ArcInfo\* software. It automates many of the cartographic steps such as **labeling** and **symbolology**.

This custom application was developed to incorporate FEMA **DFIRM** graphic specifications.

*\*Note: This is not a comprehensive list of the types of GIS software packages available and does not constitute FEMA's endorsement of any of these companies and/or their products.*



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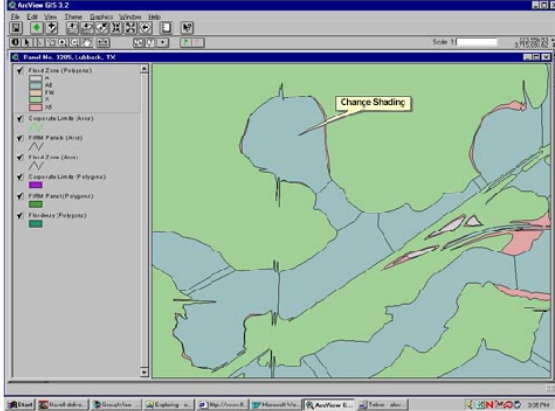
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**Quality Control Phase**

In the quality control (QC) phase, another custom GIS application is used. The QC phase may involve checking the hardcopy FIRM. This application takes advantage of the data behind the map to create maps for on-screen review.

For example, **Special Flood Hazard Areas (SFHAs)** are colored in different shades to check for errors in the image to the right. This allows QC staff to check for **topology** and **attribute** errors quickly and easily.



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**DFIRM Database**

The **Standard DFIRM Spatial Database** contains information from the engineering models along with information about the map features.

This allows users to perform automated analyses using GIS that were nearly impossible to perform with hard-copy **FIRMs**.

For more information on the DFIRM Spatial Database go to [www.fema.gov](http://www.fema.gov).



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- Database with supporting information



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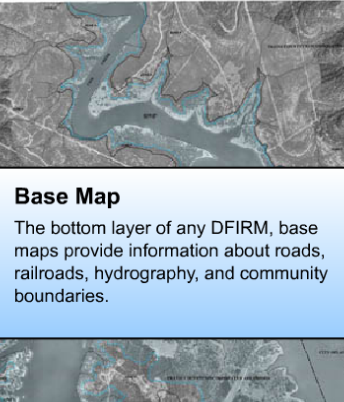
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**Base Map**

The bottom layer of any DFIRM, base maps provide information about roads, railroads, hydrography, and community boundaries.



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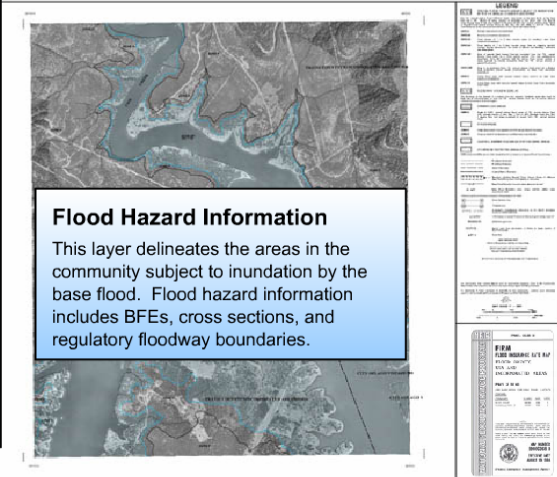
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**Flood Hazard Information**

This layer delineates the areas in the community subject to inundation by the base flood. Flood hazard information includes BFEs, cross sections, and regulatory floodway boundaries.



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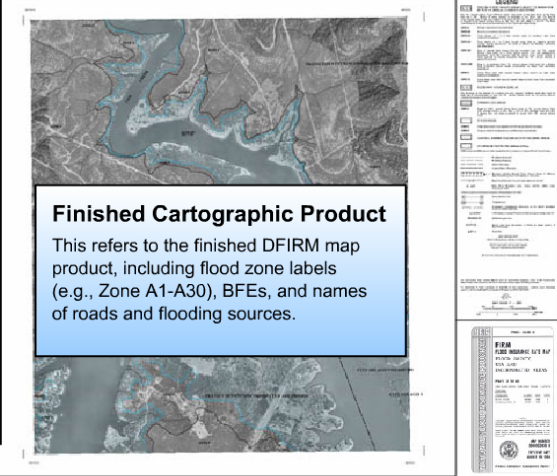
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**Finished Cartographic Product**

This refers to the finished DFIRM map product, including flood zone labels (e.g., Zone A1-A30), BFEs, and names of roads and flooding sources.



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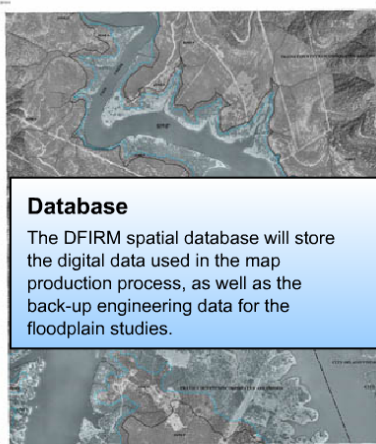


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**Database**

The DFIRM spatial database will store the digital data used in the map production process, as well as the back-up engineering data for the floodplain studies.

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**Congratulations!**  
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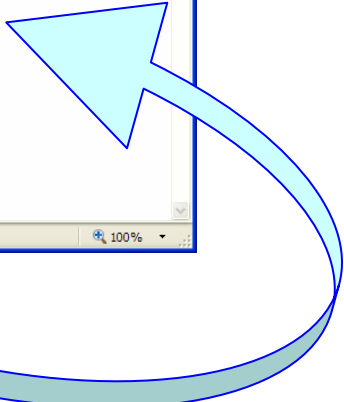
Enter your name in the box below and press the "Create Certificate" button for your own, personalized, Certificate of Completion.

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Enter Name

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**A CERTIFICATE OF COMPLETION is available**

# GLOSSARY

(Terms found in FEMA's three GIS tutorials)

## **100-Year Flood**

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

## **1-percent annual chance floodplain**

This is the boundary of the flood that has a 1-percent chance of being equaled or exceeded in any given year. Also known as, "the 100-year floodplain."

## **500-Year Floodplain**

This is the boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year. Officially termed "the 0.2-percent annual chance floodplain."

## **Accuracy**

This term refers to the conformance to a reasonable standard. The statistical meaning of accuracy is the degree with which an estimated mean differs from the true mean.

Different projects require different levels of data accuracy than others. The National Standard for Spatial Data Accuracy (NSSDA) has implemented a well-defined statistical and testing methodology for the positional accuracy of maps and geospatial data derived from sources such as aerial photographs, satellite imagery, or maps. Accuracy specifications for data collection during a FEMA Flood Insurance Study are outlined in several FEMA-authored guidance documents.

## **Area Data**

A fundamental unit of geographic information; it is a measure of a particular extent of the earth's surface.

## **Automated Floodplain Mapping**

The use of digital elevation models (DEMs) or digital terrain models with digital water surface elevation data in the GIS environment to define the limits of the floodplain.



**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.

**Block Group (data)**

A geographical area bounded on all sides by visible or nonvisible features shown on Census maps. A block group is the third smallest geographic entity for which the Census Bureau collects and tabulates decennial Census information.

**Buffers**

A zone of a specified distance around spatial features. Both constant- and variable-width buffers can be generated for a set of spatial features based on each feature's attribute values. The resulting buffer zones form polygons-areas that are either inside or outside the specified buffer distance from each feature. Buffers are useful for proximity analysis (e.g., find all stream segments within 300 feet of a proposed logging area).

**Coordinate System**

A reference system used to measure horizontal and vertical distances on a planimetric map. A coordinate system is usually defined by a map projection, a spheroid of reference, a datum, one or more standard parallels, a central meridian, and possible shifts in the x- and y-directions to locate x,y positions of point, line, and area features. In some software packages, it is used to refer to a system with units and characteristics defined by a map projection. A common coordinate system is used to spatially register geographic data for the same area.

**Data Sets**

A collection of related records.

**Datum**

A fixed starting point of a scale.

**Density (Population Density Data)**

The number of inhabitants per unit in a geographic region.

### **Digital Flood Insurance Rate Map (DFIRM)**

A FIRM is a map produced by FEMA that shows flood hazard information and is used to rate flood insurance. A DFIRM is a FIRM that was produced using digital technology.

As part of FEMA's Map Modernization Objectives, a new Digital Flood Insurance Rate Map (DFIRM) product is being developed. The new DFIRM product will include a spatial database with options that can be invoked depending on the available data. The DFIRM spatial database will include certain standard features and meet minimum mapping requirements. Additional enhancements will be included depending on community needs, available data, and funding. A review of needs and available data will lead to recommendations concerning which options to exercise.

### **Digitizing**

The process of converting map data from their original visual form (i.e., a paper map) to a digital format that can be handled by a computer.

### **Discrete (cells)**

Self-contained, distinct units.

### **Flood (also Flooding)**

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

### **Flood Hazard Data**

Information about a community's flooding hazards used to prepare Flood Insurance Rate Maps and Flood Insurance Study reports. It may include information such as statistical analyses of records of river-flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses.

### **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 Initiative 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.

### **Floodplain or Flood-Prone Area**

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

### **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.

### **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).

### **Geocoding**

Assigning locational coordinates, such as longitude/latitude, to map features (i.e., assigning a point location on the earth for a mailing address).

### **Georeference**

To establish the relationship between page coordinates on a planar map and known real-world coordinates.

### **GIS (Geographic Information System)**

A Geographic Information System (GIS) is a computer-based system to capture, store, retrieve, manipulate, analyze and display spatial information and its associated attributes. It combines spatial and tabular information to produce maps and to perform spatial analyses.

### **GPS**

The Global Positioning System (GPS) is a satellite-based radio navigation system developed and operated by the U.S. Department of Defense (DOD). It allows land, sea, and airborne users to determine their three-dimensional position, velocity and time precisely and accurately, 24 hours a day, in all weather, anywhere in the world. Each GPS satellite transmits an accurate position and time signal. GPS receivers collect signals from satellites and display the user's position, velocity, and time is needed for their marine, terrestrial, or aeronautical applications.

### **HAZUZ**

PC-based GIS software used to implement a standardized, nationally applicable earthquake loss estimation method. The HAZUZ software is being expanded to perform similar loss evaluations for wind (hurricanes, thunderstorms, tornadoes, extra tropical cyclones and hail) and flood (riverine and coastal) hazards. HAZUZ Development Is Being Funded by FEMA through a Cooperative Agreement with the National Institute of Building Sciences.

**Housing Unit (Data)**

A house, an apartment or other group of rooms, or a single room, is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters; that is, when the occupants do not live and eat with any other persons in the structure and there is direct access from the outside or through a common hall.

**IFSAR**

InterFerometric Synthetic Aperture Radar. It uses airborne or space-born radar antennae to obtain highly accurate terrain data over a larger geographical areas.

**LIDAR**

Light Detection And Ranging. Airborne laser system that combines a pulsing laser with a positioning system consisting of a Global Positioning System (GPS) receiver and an Inertial Measuring Unit (IMU) to measure the elevation of ground points on the earth's surface.

**Labeling**

The process of attaching identification codes to map features (i.e., attaching city names to city point locations).

**Layer**

A layer is a logical separation of mapped information according to theme. Many Geographic Information Systems and CAD/CAM systems allow the user to choose and work on a single layer or any combination of layers at a time.

**Line Data**

One of the basic geographical primitives. It is defined by at least two pairs of XY coordinates.

**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.

**Point Data**

A position, place or locality.

**Polygon**

A multi-sided figure representing an area on a map; a geographic primitive.

**Projection**

A mathematical model that transforms the locations of features on the Earth's surface to locations on a two-dimensional surface. Because the Earth is three-dimensional, some methods must be used to depict a map in two dimensions. Some projections preserve shape; others preserve accuracy of area, distance, or direction. See also coordinates or coordinate system.

Map projections project the earth's surface onto a flat plane. However, any such representation distorts some parameter of the earth's surface be it distance, area, shape, or direction.

**Q3 Data**

A digital representation of certain features of FEMA's Flood Insurance Rate Map (FIRM) product, intended for use with desktop mapping and GIS technology. Because of the scale of the digital Q3 Flood Data, it cannot be used to determine absolute delineations of flood risk boundaries.

**Raster**

A regular grid of cells covering an area.

**Raster Spatial Data**

A discrete set of uniform cells are coded to represent spatial information.

**Remote Sensing**

Acquiring information about an object without contacting it physically. Methods include aerial photography, radar, and satellite imaging. For example, when responding to a disaster, FEMA's Mapping and Analysis Center (MAC) may receive remote sensing data that indicates areas affected by the disaster, as derived from various imagery products. Typical examples include flooded, saturated and/or damaged areas.

**Special Flood Hazard Area (SFHA)**

Area inundated by the base (1-percent annual chance) flood, identified on the Flood Insurance Rate Map as Zones A, AE, AH, AO, AR, V, VE, or A99.

**Saturated**

Soaked with moisture.

**Spatial Data (or Spatial Information)**

Includes the geographic information of boundaries that make up a map; also known as georeferenced data.

**Tabular Data (or Tabular Information)**

Data organized in a table format.

### **Thematic Map**

A map showing information about a particular topic, often statistical in nature (i.e., population per state).

### **Vector**

The representation of spatial data by points, lines and polygons.

-----

### **Below are Zones found on Flood Insurance Rate Maps (FIRMs):**

#### **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.

**Zone V**

The flood insurance rates zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no Base Flood Elevations are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone VE**

The flood insurance rates zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zones B, C and X**

The flood insurance rates zone that corresponds to areas outside the 100-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-years stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No Based Flood Elevations or depths are shown within this zone.