GIS Tutorial Series III

Using GIS, DFIRM, and Other Data for Sample Community Applications

Learning Objectives

This tutorial was designed to help users:

- Understand the uses of Geographical Information System (GIS) for community-based applications within the context of FEMA's flood hazard mapping and mitigation efforts.

- Learn how communities may benefit from using FEMA flood hazard data to determine where disasters may occur and how they may affect a community.

- Learn how communities may use FEMA flood hazard data to create plans to mitigate such hazards and/or respond to flood events.

- Understand how GIS technology is used for disaster preparedness and hazard mitigation efforts.

Introduction

In the previous modules of the GIS Tutorial Series, we provided an overview of Geographic Information Systems (GIS) technology (I. Introduction to GIS) and how it is used to create Digital Flood Insurance Rate Maps (DFIRMs) (II. Using GIS to Create DFIRMs).

This tutorial provides an overview of the use of DFIRM, GIS, and other data to produce sample community applications that take into account flood hazards in a community.

Included in this tutorial are examples that show how the data may be layered to create the maps required to accomplish this task. A GIS also allows FEMA to quickly create visual aids that enhance the understanding of any event. For instance, in the case of a major flood, GIS data may be used to determine the impact of flooding on citizens of an affected area. The GIS can accurately display critically damaged areas, potential transportation and evacuation problems, and estimate the number of people affected.

Using GIS maps, FEMA may also determine the population density in each affected area, how many people have applied for assistance, and the resources needed. These analyses also help FEMA anticipate potential problems.

The GIS is an invaluable tool in all stages of a disaster event. It provides broad and precise geographical views of the magnitude and consequences of any event.

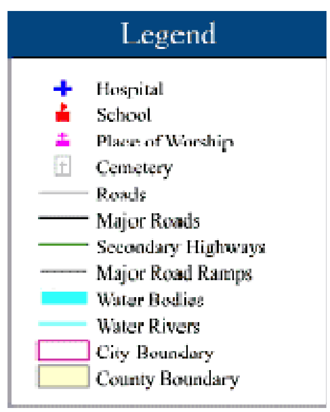
Step 1: Laying the Foundation

As stated previously, FEMA uses GIS technology to analyze data and quickly create visuals to enhance the understanding of any event.

To illustrate how GIS technology may be applied in the event of a flood disaster, we will walk you through the creation of a map for a medium-sized city in the United States that incorporates DFIRM and other data. This example focuses on the community's population density and areas subject to inundation by the base (1-percent-annual-chance) flood. The 100-year flood zones are also known as Special Flood Hazard Areas (SFHAs), the areas subject to inundation by the base (1-percent-annual chance) flood.

The base map typically shows road, surface water, political boundaries, and other physical features. Below is the base map for our case study.

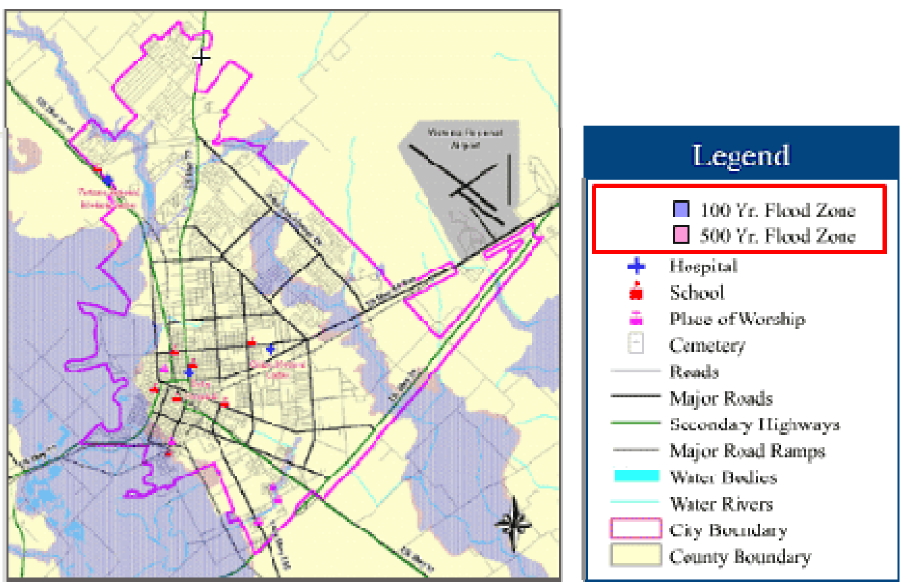
As shown on the map legend, the pink lines represent the city boundaries, and the black and green lines show major roads and secondary highways, respectively. Areas shaded in cyan represent water bodies. Cyan lines designate rivers. Critical facilities, such as hospitals and schools, are shown in royal blue and red, respectively.



Step 2: Adding DFIRM Data

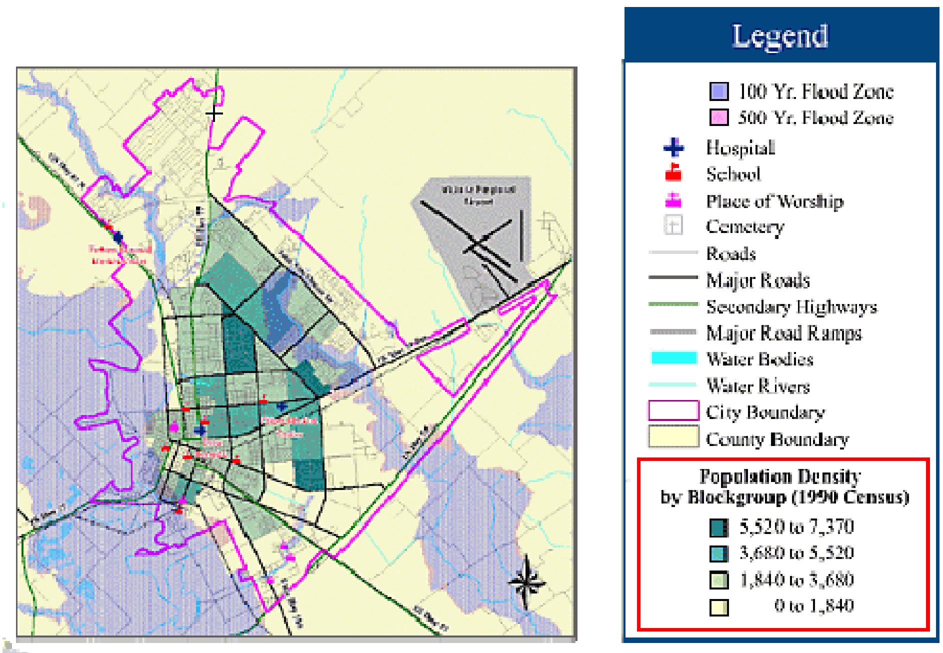
This screen shows the addition of the flood hazard data layer, including boundaries for both the 100-year (1-percent-annual-chance), and the 500-year (0.2-percent-annual-chance) floods. The 100-year flood is also known as the base flood. The SFHAs (the areas subject to inundation by the base flood) are shaded in blue-gray tones; areas subject to inundation by the 500-year flood are shaded in rose. Federal law requires flood insurance for all structures located in SFHAs that carry a mortgage loan backed by a federally regulated lender or servicer. Additional information about this requirement is available at www.fema.gov/plan/prevent/fhm/in_main

As shown in this example, several areas within the city boundaries could be affected by the base flood, including neighborhoods, roads, and some community facilities. This information can assist planners in determining where the damage is most likely to occur and the facilities and services that could be affected by flooding.



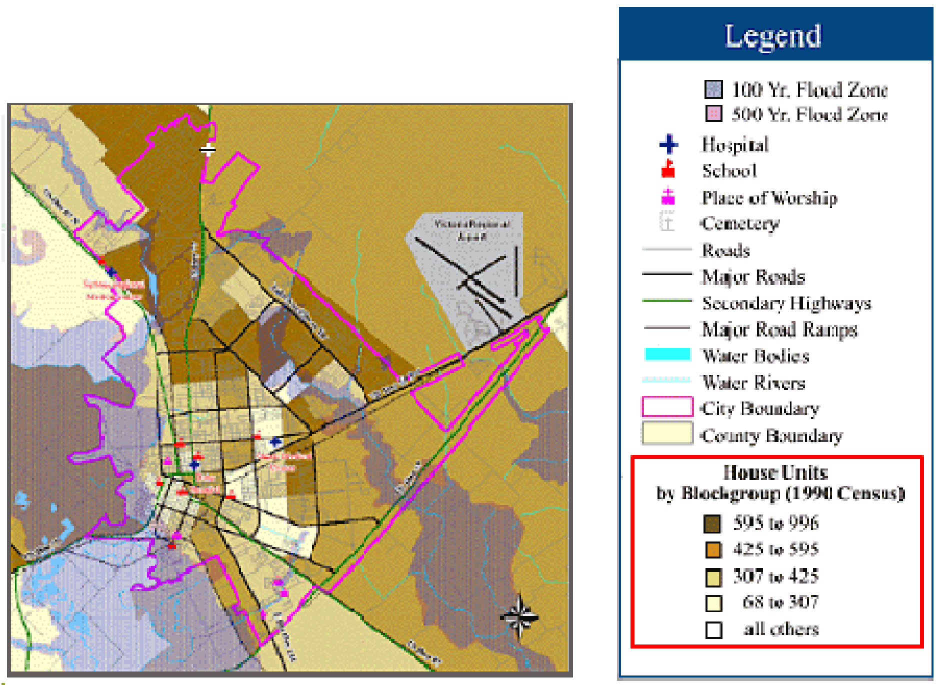
Step 3: Adding Population Data

The third step involves the addition of population density data by block group. This information is helpful when assessing the level of flooding risk in densely populated neighborhoods. Planners, emergency managers, and other officials may use this data to estimate the impact of any future disaster event and develop mitigation plans to reduce a community's vulnerability. Such information is also useful to estimate where post-disaster assistance will be needed the most.



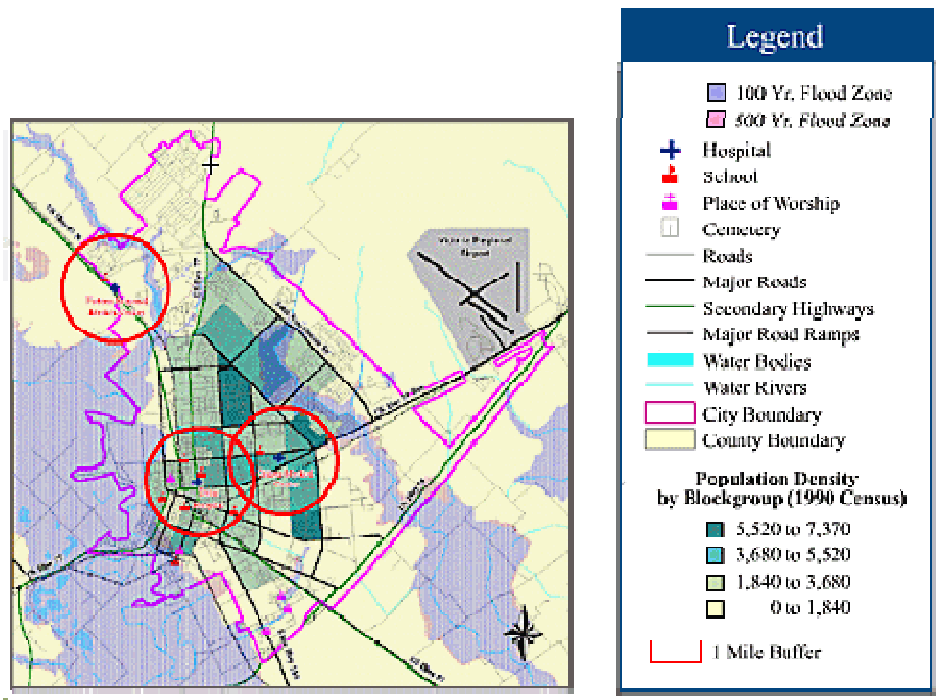
Step 4: Adding Housing Units Information

In this example, we have replaced the population density data with house units data by block group. City planners and other officials may use this information to analyze the risks to the community's built environment and possible economic losses. If it appears that there is a high degree of vulnerability, community officials and citizens may use this information to develop a plan for new development and/or storm water management systems to help them minimize the vulnerability factor identified in their analysis.



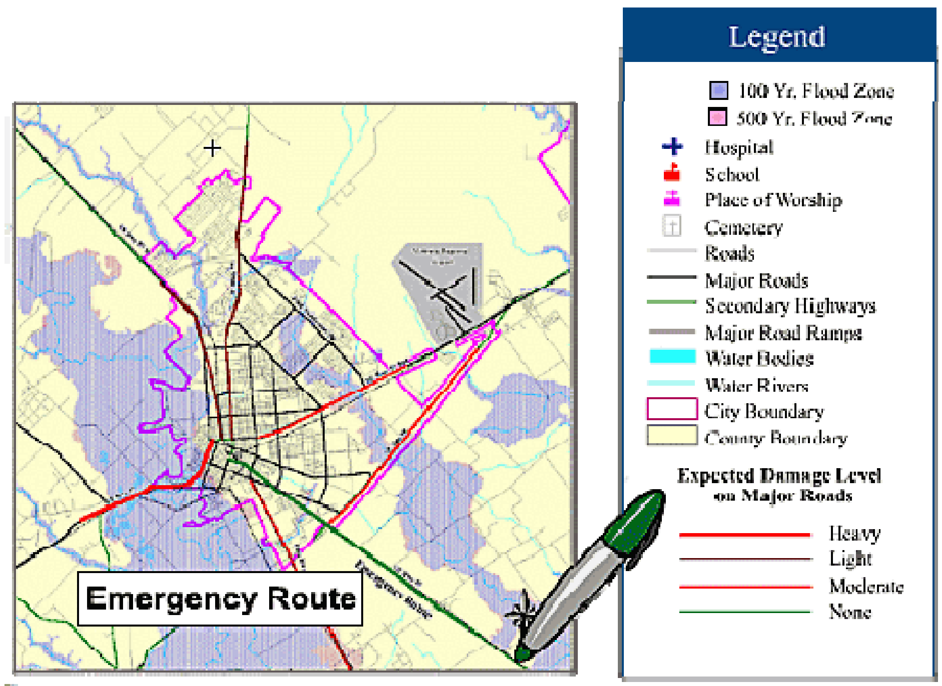
Step 5: Emergency Facilities

This example shows the addition of 1-mile buffers to the hospitals. This information helps emergency planners determine the access that at-risk populations might have to critical facilities, such as hospitals. This is a visual aid, and not intended to express "real" access and coverage. The location of schools and places of worship has been included to show the location of possible temporary shelters in case of a disaster. This information also helps identify where temporary medical facilities and shelters may be necessary.



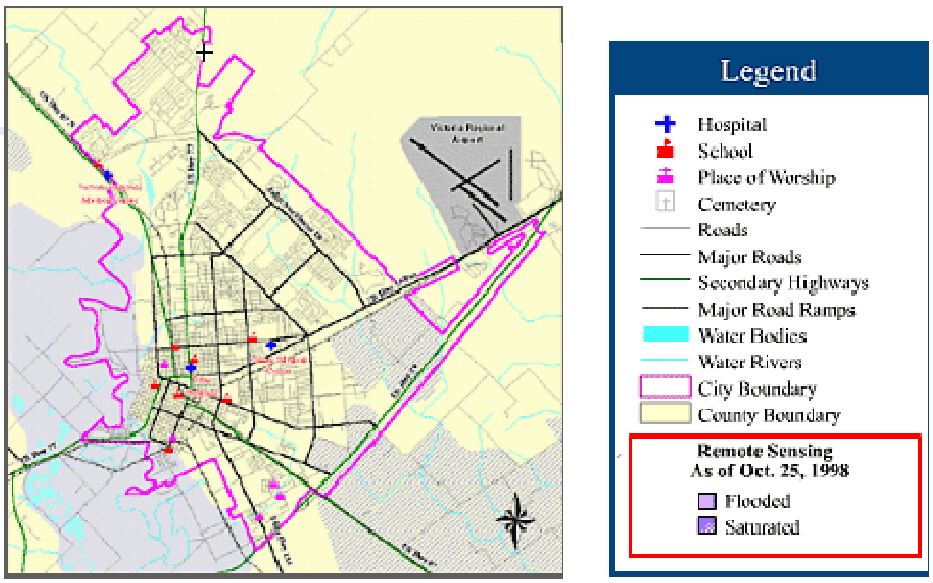
Step 6: Planning an Emergency Route

This example shows a potential emergency route, determined by considering the expected level of exposure to flooding on major roads and highways. This information would help emergency planners and city authorities propose an evacuation plan that takes into account various levels of risk. In addition, it also provides better information about what to expect in the event of a flood. Finally, it provides a comparison tool to evaluate real and planned actions to improve a community's response to future events. (In a real event, this plan could be calibrated with the use of routing software and real flood elevation data on each major road.)



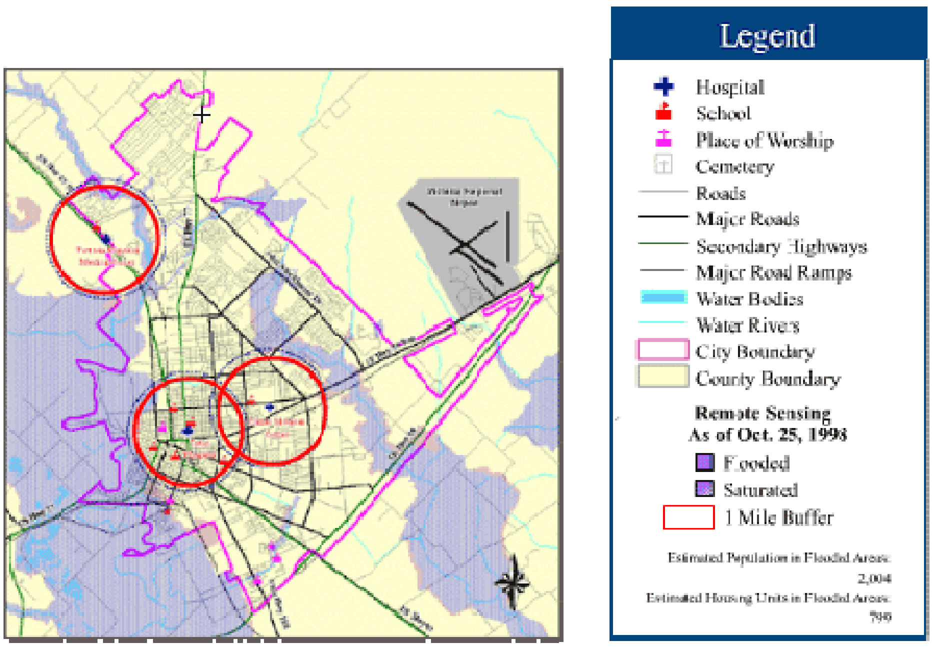
Step 7: Viewing Remote Sensing Data

This example shows the addition of historic information gathered from remote sensing data of an actual flood event. This example shows flooded and saturated areas, as well as areas about to be flooded. Remote sensing imagery enables FEMA and community officials to follow the course of disaster events, such as major floods, as they are occurring. In addition, both historical and real-time data provide emergency managers and city authorities with the information they need to plan and respond accordingly.



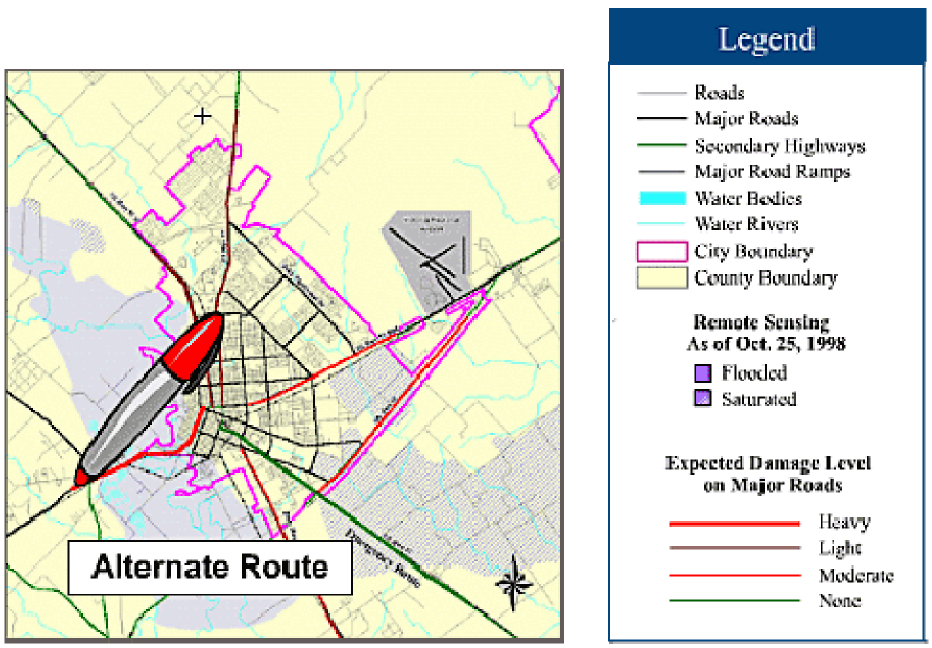
Step 8: Response and Recovery Preparation

This example shows the remote sensing analysis of the flood overlaid with the 1-mile buffer. The estimated number of people and housing units affected by the flooding are also provided. This image was created by analyzing the flooding in conjunction with block group data. As shown in this and previous examples, the city's critical roads and facilities are located near (but not in) the flooded areas. As a result, access to medical assistance and possible temporary shelters is maintained. Information about the population and housing units affected allow emergency managers to estimate the amount of supplies to be provided to those in temporary shelters. It also helps them to estimate the level of funding needed to rebuild and/or repair the affected housing units.



Step 9: Planning Alternate Routes

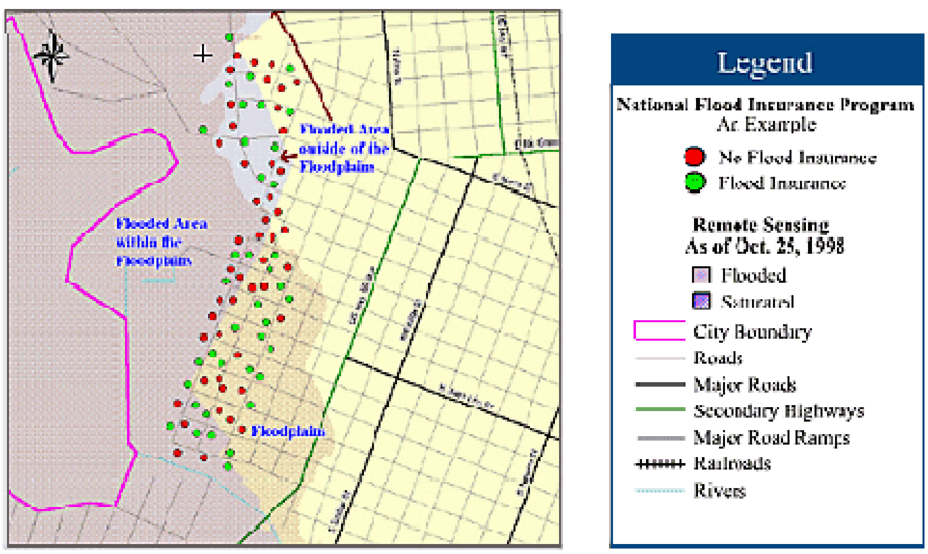
A previous example in the tutorial shows an emergency route planned according to expected levels of damage on major roads. This example shows that flooding did affect some of the major roads, as expected (U.S. Highway 77). This example also shows that the road suggested by our initial analysis as the best emergency route, U.S. Highway 87 South, became saturated. Other highways in the area, U.S. Highway 87 North, U.S. Highway 77 North, and State Highway 185 South were not flooded. If necessary, these (major roads) could be used as alternate emergency routes.



Step 10: Flood Insurance

Finally, let's take a look at a combination of information showing us where the community's SFHA is located in relation to the actual flooding. This example uses hypothetical data to show properties within a community's floodplain, as well as properties just outside the floodplain, with and without flood insurance. *Structures in designated SFHAs have at least a one-in-four chance of suffering flood damage during the term of a 30-year mortgage.

This information provides insurance companies and emergency planners with some of the data they need to determine the economic impacts of flood disasters at the local level. Additional information such as property values, level of damage, and population per house unit may be cross-referenced with information about the number of insured structures to provide a more precise picture of the event's losses. This quantification information also provides the pertinent authorities with the information they need to respond in accordance with the real needs identified.



Summary

This tutorial has provided you with an overview of how a GIS may be used to provide public officials with the data and analyses necessary to plan for and respond to a major flood. The examples also underscore the importance of GIS to flood hazard mitigation and response.

The examples also demonstrate the importance of DFIRM data to mitigate, and respond to, flood hazards in any community. For additional information on DFIRMs and the type of information included in a DFIRM, please review the second tutorial in this series, Using GIS to Create DFIRMs. The first tutorial in the series, Introduction to GIS, provides an overview of basic GIS concepts, which may be of assistance in understanding some of the material in this tutorial.

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