

Fire Service/HazMat GIS Data Model Implementation Guide



Prepared in cooperation with the National Association of State Fire Marshals

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Fire Service/Haz Mat GIS Data Model

Introduction

This document provides information about the Fire Service GIS Data Model purpose and content. The intended audience includes local fire department GIS Managers and Implementation Teams with a special focus on Haz Mat Incident Data.

The Fire Service GIS Data model was developed with collaboration from several national organizations including the National Association of State Fire Marshals, the Metropolitan Fire Chiefs Association, the Volunteer and Combination Fire Officers Section of the International Association of Fire Chiefs, under a cooperative agreement with the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA). As the model was being developed in collaboration with input from many local fire departments around the U.S., it became apparent that more than just the feature classes, tables, and data relationships were needed.

The US fire service responds to thousands of emergency calls every day, the vast majority of which result in positive outcomes. Occasionally one of these emergencies escalates into an incident of significance beyond the initial responding agency's borders. When this happens, it is critically important that the information created in the initial stages of the incident become available to share with other resources assisting in response, mitigation and management of the incident.

In developing the data model template, it became increasingly clear that the fire and emergency service requirements for mapping demands task focused map products that are readily available upon demand. Because many of the requirements for map products at an emergency are consistent across department types and sizes, developing standard map templates and data exchange formats soon became an important focus of this data model project. Therefore, in addition to the basic guidelines for developing a geodatabase using the data model schema, this Implementation Guide includes information on the use of those map template components of the data model project.

The content for this document is largely based on input from the data model leadership team and initial implementation pilot projects.

Credits

Many key people and organizations supported the development of the initial data model template.

Foremost, the National Association of State Fire Marshals and its partners in this project are grateful to the leadership and resources provided by US DOT's Pipeline and Hazardous Materials Administration.

A special thanks goes to the leadership team who supported the concept through the early stages of the project and guided the development of the initial data model template:

Peter O'Rourke from the National Association of State Fire Marshals

David Blankinship from Colorado Springs, CO

Ashley Lesh from the Center for GIS, Towson, MD

Chief Keith Richter from Contra Costa County Fire Protection District, CA

Chief Fred Windisch from the Ponderosa Volunteer Fire Department, Houston, TX

Rand Napoli, Florida State Fire Marshal (ret.), from Tallahassee FL

The pilot implementation sites are making good progress and continue to provide great input and feedback

Colorado Springs Fire Department, CO

Contra Costa County FPD, CA

Harris County Fire Marshals Office, Houston, TX

Los Angeles City Fire Department, CA

Charlottesville Fire Department, VA

South Central PA Counter Terrorism Task Force

And throughout the process many others have contributed feedback and ideas. Particularly significant among these are

Chris Rogers, FireMapping Inc., Kirkland, WA

Phil Beilin from the City of Walnut Creek, CA

Seth Rubenstein from the CA Department of HLS

Steve Pollackov from the New York City Fire Department

Purpose

The purpose of this data model is to provide a practical starting point for fire and emergency service organizations that are just getting started with ArcGIS, and also to provide a reasonable data model target for more mature organizations moving to the Geodatabase from shapefiles and other formats/data models. The goal is to make it easier for local Fire Departments to build a useful Geographic Information System.

Beyond the basic datasets, there are a number of applications/business functions in the fire service that are not completely addressed by this data model. Typical examples are Wildland Fire, emergency management and other related public safety functions such as law enforcement, health and transportation. Several related data models already exist and many examples of applications in these are accessible from peer organizations, conferences and in online materials/data models. Proceedings from ESRI User Conferences are also useful sources, as are general Google searches for examples. Plain-old-networking still might be the best way to grow your program into new application areas.

This data model provides a Geodatabase structure for typical fire department datasets. Most of the content has been derived from other data model templates and tailored to fire service best practices. The goal is to have a solid foundation to support a number of business applications, and also to facilitate regional and national information sharing by building a level of consistency in the way these common datasets are managed.

The model also will serve as a foundation for NASFM and its partners to pilot test both the model's implementation and as a platform for hazardous materials incident data reporting to US DOT's PHMSA. Within months of commencing the pilot test, NASFM intends to begin reporting electronic hazmat incident data to PHMSA.

Business Functions

GIS has proven to be an important capability for fire departments to improve safety and provide effective services. Managing and mitigating risk in increasingly complex situations is key, and geographic information and maps provide a means to visualize incidents and enhance situational awareness. Quite simply, using geography to integrate information from multiple sources is efficient, practical, and useful.

Fire Departments spend a significant amount of time inspecting property, drafting incident reports and assessing risk. Rather than burying that data in filing cabinets, the promise of GIS is providing that information to first responders and incident command – in a way that does not encumber firefighters with complex technology/training. The potential of the technology is significant, yet there is a considerable amount of work to be done to operationalize assessments, hazards, and risks in a way that is useful in real time.

From the outside looking in, it is probably not easy to understand how a GIS Data Model can play a role in this leap forward. GIS Professionals recognize that the Data Model is one of the most important decisions made for any GIS program: the Data Model defines the limits of the system capabilities, and it also drives the cost and complexity of the data management problem. GIS data is always used by multiple applications in different ways, and this means that GIS Professionals are always working collaboratively on best practices for data models to make sure they are prepared to support current and future needs. In that context, the GIS Data Model may not be visible or directly meaningful to firefighters, but the data model is a key part of every map, application, and report that the system generates.

To support the business of fire departments, GIS can ideally be used to support the following functions:

First Response

Locate an Incident

Route to location

Provide Resource/Responder information

Access Tactical information

Preplan

Floor plan

Pictures

Aerial Imagery

Facility Sensor and Video feeds

Incident Management

Support Incident Command Systems (ICS) and National Incident Management Systems (NIMS) processes and procedures

Expand to operate across boundaries

Understand resources: what and where

Access information related to the facility: tactical reference materials and dynamic feeds

Display other data (imagery, hazmat, streets, schools, churches, etc.) for purposes of staging or triage, exposures, evacuations, etc.

Drag and drop resources onto the map (resource assignments and status management)

Track resources through GPS data

Print a map – plan

Archive info for hotwash/training

Other tools

Chief and Staff

Department Situational Awareness

Help determine Program Emphasis and Direction

Support everyday operations / scale for complex emergency support

Accountability

Measure Performance

Identify Trends

Rapid capability to support:

Budget preparation

Communication of issues to constituents

Specialist Applications

Fire Prevention

Inspectors

Fire Educators

Simple to use applications that support electronic data collection and data presentation to meet their program requirements

To support these functions, Technology Specialists are key to successful implementation. GIS is heavy lifting, producing products that can be assimilated and easily used by non-technical department personnel whenever needed.

Their role includes:

Understand the Mission

Support applications for tactical response, incident command and emergency management.

Maintain the department technology infrastructure

Communicate with all department members to understand needs and determine how technology can support them

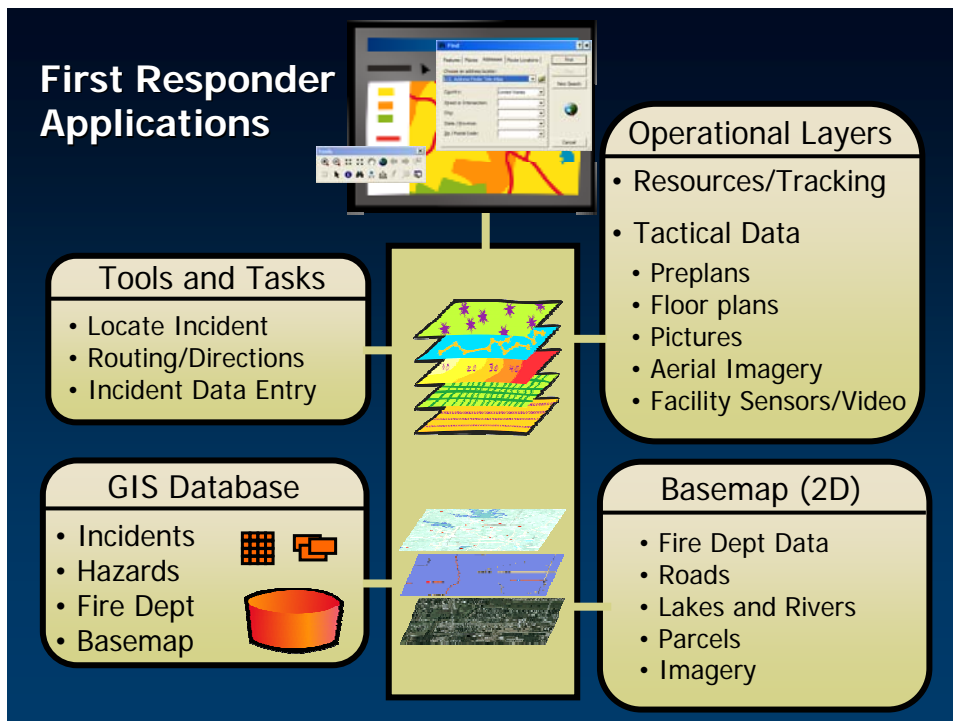
Actively participate in risk and hazard assessments

Actively support and model potential mitigation plans

Develop methods to operationalize planning results

Develop information products to support mission needs

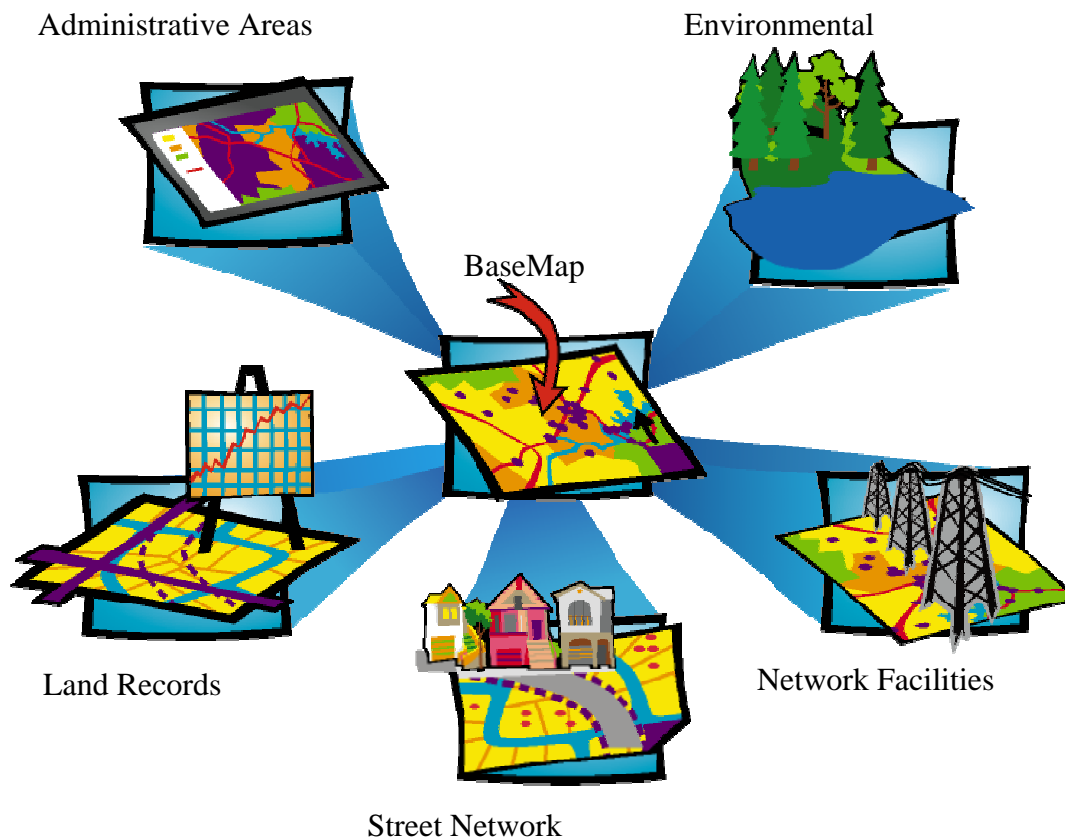
From an end user perspective, the GIS database is a supporting piece of infrastructure that enables applications. In the following diagram this is shown for the First Response business functions.



Data Model Content

Fire Departments face a number of challenges building a comprehensive GIS database because they tend to be primarily consumers of data rather than producers of data. In most communities there is at least one local government GIS program that will be a primary source of data. Developing the right partnerships and relationships is key to the success and sustainability of GIS for Fire Departments.

In the Fire Service Data Model, there is a Shopping List for Base GIS Data, and it is expected that the design of the datasets will largely be imported from existing local sources. The main categories (aka Data Themes) of information at the local government level are summarized in the diagram below.



In the fire service template model, this is referred to as base map content. Developing a strategy for these datasets will be a critical success factor for GIS for Fire Departments. An important goal of this data model initiative is to establish best practices for managing base data. Some of the main datasets and partnering challenges include:

Addresses and Street Centerlines

Structures/Buildings

Hydrants

Water

Imagery

At a summary level, the content of the data model includes:

2 Feature Datasets

33 Feature Classes

No Topology Datasets

No Geometric Networks

No Rasters

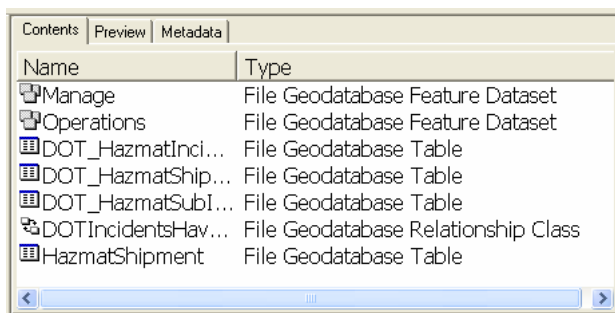
4 Tables

4 Relationship Classes

97 Domains

If you are just getting started you will likely choose a subset of the content – some recommendations for priorities are provided later in this document.

The following picture shows the top-level view of the data model in ArcCatalog:



The model is organized into 2 feature datasets. Feature datasets are used to group feature classes with a common spatial reference and editing permissions. The “Manage” feature dataset includes feature classes that are typically managed by fire service organizations.

Arson	File Geodatabase Feature Class
Building	File Geodatabase Feature Class
CommunicationN...	File Geodatabase Feature Class
Density	File Geodatabase Feature Class
EMSPostingLocation	File Geodatabase Feature Class
FacilitySite	File Geodatabase Feature Class
FacilitySitePoint	File Geodatabase Feature Class
FireAdminBoundary	File Geodatabase Feature Class
FireAreaHazard	File Geodatabase Feature Class
FireFacility	File Geodatabase Feature Class
FireRiskAssessment	File Geodatabase Feature Class
FireStation	File Geodatabase Feature Class
Hazmat_Location	File Geodatabase Feature Class
HistoricalCall	File Geodatabase Feature Class
SafetySpot	File Geodatabase Feature Class
Sensor	File Geodatabase Feature Class
WaterSource	File Geodatabase Feature Class

The “Operations” Feature Dataset contains datasets that support emergency management operations, with a focus on data that is managed and shared during an incident:

Fire_DamageAsse...	File Geodatabase Feature Class
IncidentAreaHasH...	File Geodatabase Relationship Class
IncidentLineHasH...	File Geodatabase Relationship Class
IncidentPointHas...	File Geodatabase Relationship Class
Ops_AccessArea	File Geodatabase Feature Class
Ops_AccessLine	File Geodatabase Feature Class
Ops_AccessPoint	File Geodatabase Feature Class
Ops_AlertArea	File Geodatabase Feature Class
Ops_DamageAsse...	File Geodatabase Feature Class
Ops_DamageZone	File Geodatabase Feature Class
Ops_EmergencyF...	File Geodatabase Feature Class
Ops_IncidentArea	File Geodatabase Feature Class
Ops_IncidentLine	File Geodatabase Feature Class
Ops_IncidentPoint	File Geodatabase Feature Class
Ops_MapGrid	File Geodatabase Feature Class
Ops_ResourceAss...	File Geodatabase Feature Class
Ops_SearchRescu...	File Geodatabase Feature Class
Ops_SearchRescu...	File Geodatabase Feature Class
Ops_SearchRescu...	File Geodatabase Feature Class

Of course there is a lot more detail in the model than what you see here. When you download the [Fire/HazMat GIS data model](#) you will find detailed documentation in Visio and Html formats. One example of each of those documentation styles is included here.

Ops_EmergencyFacility

- Permanent_Identifier
- Source_DataDesc
- Source_Originator
- Data_Security
- Distribution_Policy
- LifecycleStatus
- EffectiveStartDate
- EffectiveEndDate
- Name
- FType
- FCode
- Organization
- Jurisdiction
- Contact_Name
- Contact_Email
- Contact_Phone
- Capacity
- Hours_Operation
- Days_Operation
- Access_Restrictions
- Open_Date_Time
- Closed_Date_Time

Other topics to investigate and define in project work:

- Historical Data, ie HazMat over time
- Prevention and Mitigation needs to be considered
- Wildland-Urban Interface and related data
- Staff and responder "home" locations – people to/from work
- Pre-plans and map pages
- Resource assignments and situation status – ties to resource systems with visual display of locations
- Access/Barriers
- Hazards – special hazards and mitigation
- Risk Data – risk mgmt
- Inspections
- Public Education
- Engineering
- Compliance/Code Enforcement
- Flood Plain
- Indicate prevention or mitigation efforts such as defensible space in VHFSZ
- Temporal data for HazMat inventory, construction
- Fire Stations need: YearBuilt, flood plain, seismic protection, wind event protection, emergency power, fuel on site attributes
- Datasets for critical facilities and public safety
- Mutual Aid
- Access/BZPP Gates/moveable barriers
- Check lightweight construction features for buildings
- Preplans

Ops_EmergencyFacility - FeatureClass					
Name	Ops_EmergencyFacility				
ShapeType	Point				
FeatureType	Simple				
AliasName	Ops_EmergencyFacility				
HasM	false				
HasZ	false				
Description	An Emergency Facility location along with basic information about the facility				
DataTheme	EmergencyOperations				
Field	Data Type	Length	AliasName	Description	Domain
Permanent_Identifier	GlobalID	38	Permanent Identifier	Permanent Public Identifier for a Feature	
Source_DataDesc	String	100	Source DataDesc	Description of the Source Dataset for a feature	
Source_Originator	String	130	Source Originator	Originator of the source information	
Data_Security	SmallInteger	2	Data Security	Security or Sensitivity of Data according to DISA/Federal security levels	Sec. Classification Domain
Distribution_Policy	String	4	Distribution Policy	Distribution Policy for features as defined by producers or licensors	Distribution Policy Domain
LifecycleStatus	Integer	4	Lifecycle Status	Lifecycle Status of the information from planned to historical	LifecycleStatus Domain
EffectiveStartDate	Date	8	Effective Start Date	The date and time when the data came into effect	
EffectiveEndDate	Date	8	Effective End Date	The date and time when the data is no longer active	
Name	String	255		Name	
FType	Integer	4	FType	FTypes are descriptive attributes that provide a general classification of things	EmergencyFacility Domain
FCode	Integer	4		FCodes are descriptive attributes that provide a general classification of things	

A discussion about tools and documentation for your model is included in the [Implementation Guide](#).

Implementation Guide

While a lot of thought and experience went into the content of the data model, user feedback indicated that people are more interested in practical implementation advice than discussing design patterns and technical details. This section provides a high-level discussion of the steps involved in implementing your Geodatabase project.

3.1 Inventory Current Data and Data Needs

Even if you are just getting started, there will be GIS data available in your community. This section provides some advice on how to discover what data is already available in your community.

What do you have?

Within your own organization you should talk to people in different departments about existing data and who has it. Some of the groups doing GIS work will likely be in:

Planning

Assessment/Land Records

Emergency Management, and

Water Utilities

What do others have for you?

If you are in a City, talk to the County/Region. If you are in a County/Region, talk to the Cities. You'll probably be surprised by the gaps and overlaps in datasets.

You should also investigate the data available from Regional, State and Federal sources in your jurisdiction. Talk to people in multiple departments at multiple levels of government. Get out and network with your peers to see what they are doing and learn from their experience.

What do you need?

You can use the list of datasets in the data model as a shopping list. If you are just getting started, we recommend that you start with the following datasets:

Parcels

Point or polygon representation based on data availability and long term plans. Points can be generated by geocoding the assessor database and moving the points to parcels/rooftops of buildings.

Assessor database. Develop a plan to link spatial and tabular records for applications.

Utility and telephone records. A Good source of address and land records information – usually these are reasonably accurate since billing/revenue depends on these records. The correlation between these records and parcel datasets can be complex, but they are one good source of information.

Street Centerlines

Existing dispatch datasets, existing centerline dataset, commercial sources, Census Bureau, Departments of Transportation

You may have a challenge in sifting through geometry and attribute content in multiple datasets. An accurate, up-to-date centerline dataset has many benefits to a wide variety of applications.

Address Points are also desirable, even in the early stages of a GIS Program. Many advanced GIS programs, however, do not have address points, and they accomplish a lot with a good street centerline dataset.

Hydrography

National Hydrography Dataset (NHD) and/or local sources

Water resource data is in high demand – not just for mapping purposes but for everything from transportation to environmental to recreation.

OrthoImagery

Local/regional/state purchases, National Digital Orthophoto Program, National Agriculture Imagery Program, Imagery for the Nation.

Develop a plan to have high-resolution imagery updated every few years. The costs can be shared with other organizations, and the value in terms of perception and visualization is significant.

Derived products such as Digital Elevation Models can be developed as part of the image capture program, and there are options for multi-band products as well as color orthophotography.

Administrative Boundaries

Local, Census Bureau, or Commercial data

Buildings/Structures/Facilities

Sources for Facilities are high on the priority list. You should consider the FacilitySitePoint and FacilitySite datasets early in the project. This is relatively new on the list of fire department datasets, but a number of emergency and daily business

functions can be supported with data that provides the location and name of key infrastructure along with point of contact information.

Other datasets

As available from local, state, and federal government sources

ArcGIS Online

ESRI Maps and Data

StreetMap USA

Other commercial data providers

PLSS for PLSS States

Address Points from Dispatch applications, licensing, etc.

Existing Business applications

Beyond this basic set of priorities, you should consider the business drivers/business functions that your system will need to support to develop your own list of priorities for data collection.

Appendix A: “Standard Map Product Templates” provides samples of maps which many fire departments find particularly useful.

Appendix B: “US DOT Guidelines For Reporting of Hazardous Materials Incidents” provides information on the guidance documents for accurate and timely reporting of Hazardous Materials Incidents.

Spatial Reference

As you inventory available datasets, collect information about the spatial reference for the datasets. One of the early decisions you need to make is which spatial reference to use. There is a lot of information about Spatial References in the ArcGIS Desktop Help system (<http://webhelp.esri.com>); you can use that as a guide along with advice from peer organizations if you are just getting started.

3.2 Hardware/Software Setup

If your GIS team is small, you can get started with some basic hardware and software. An outline is shown in the diagram below.



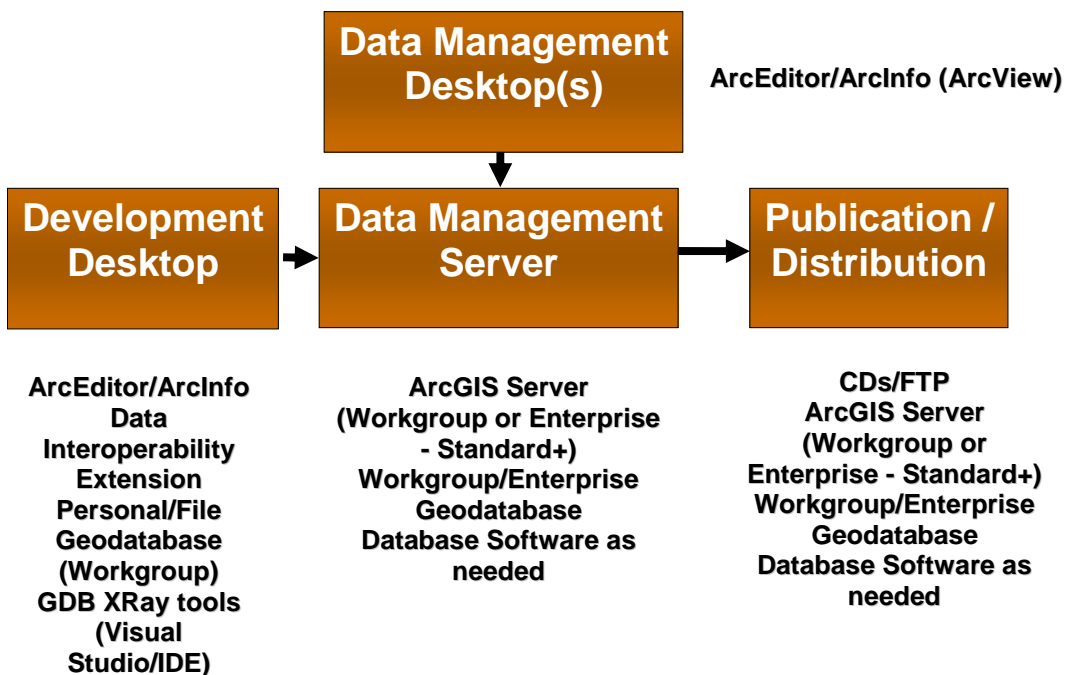
Your starting point could be as simple as a single Mapping and Data Management computer (a Desktop or high-end Laptop). Some people even use ArcView for this, but you won't be able to edit Workgroup or Enterprise Geodatabases, or use more sophisticated data types in the Geodatabase such as Topologies if you use ArcView. ArcEditor or ArcInfo licenses are recommended for data management users. As the system grows you will want to have at least one ArcInfo license. In general, floating licenses are the best approach for multi-user environments. You should also consider that ArcGIS extensions will be required for different applications.

To distribute or publish the information, the starting point can be as simple as creating CDs or managing an FTP site for data exchange. Beyond the basic datasets, you can publish maps, layers, and finished products such as .pdf's for casual users. One practical approach here is to distribute a Compressed File Geodatabase – this will really shrink the database size and you'll be pleased with the performance.

The next step for publication will be to consider how to use ArcGIS Server to publish maps and related content. You can get started with a relatively inexpensive Server here and expand the system as user demand and budgets permit.

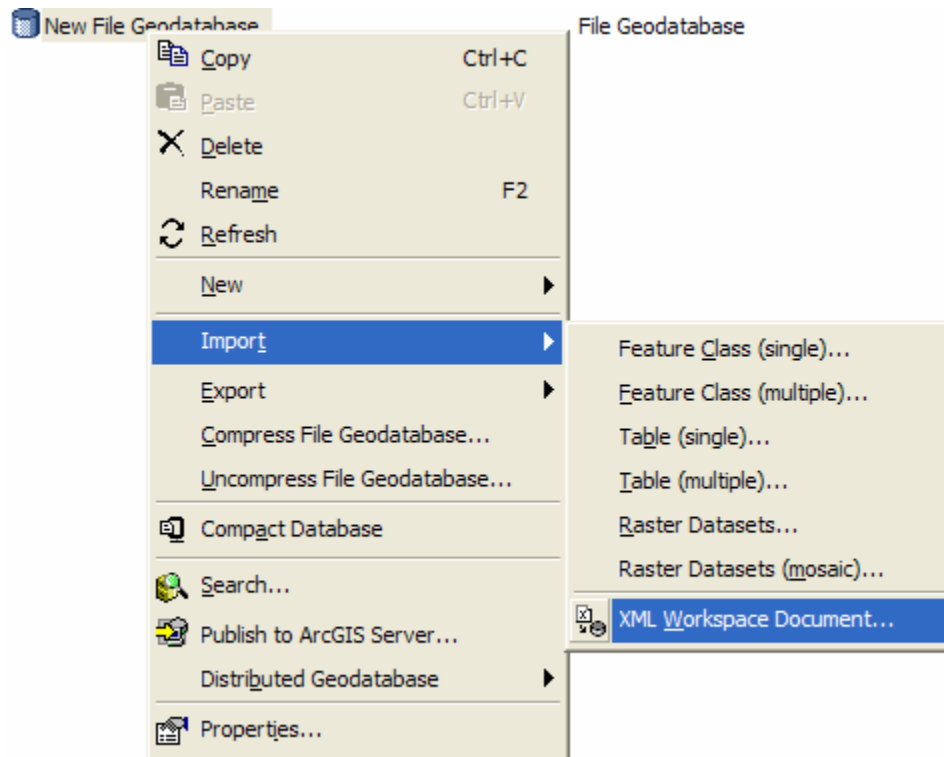
Overall, it is relatively easy to grow the hardware and software over time, but you should have a long-term plan in mind for how your data management processes and the use of ArcGIS technology will evolve.

The diagram below provides a list of hardware and software that is typical for larger GIS teams and more advanced implementations.



Create Geodatabase from Template Model

The template data model is provided in Geodatabase XML Workspace format. To use the XML Workspace document, create an empty Geodatabase, right-click on it, and select “Import->Xml Workspace Document”.



Follow the steps in the wizard and you should see the content of the Geodatabase after selecting “Refresh” or “F5” after the wizard finishes.

Tool Tips

ArcCatalog is the best tool for modifying the design if you are just getting started, but there are tools such as GDB XRay, ArcGIS Diagrammer, GeoProcessing tools/scripts/models, and ArcObjects that can be used to manage your design content

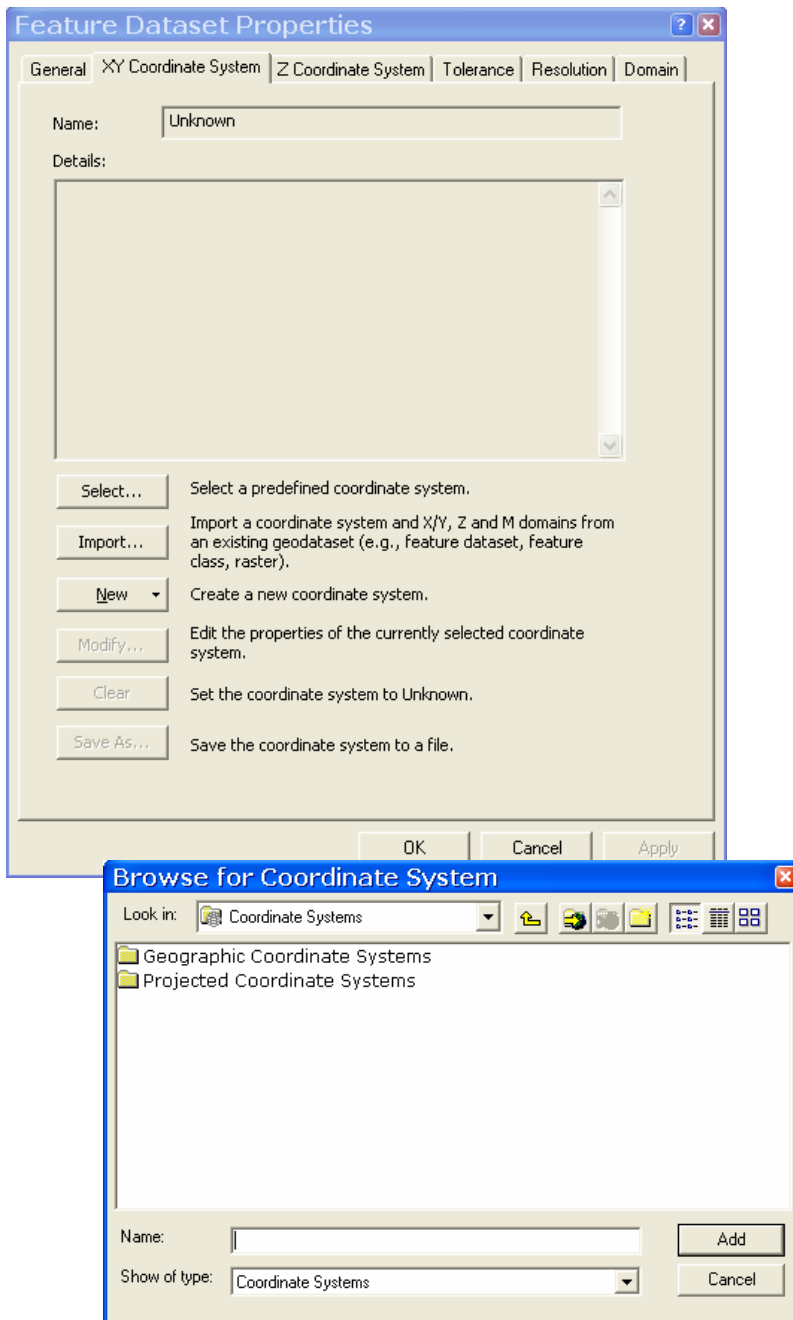
You can use GDB XRay to examine the contents of the Geodatabase in detail and do some design (spreadsheets) and documentation (Html).

3.3 Configure Data Model

The data model contains a number of feature classes, attributes, and domains. The steps involved in configuring the data model are described in this section.

Set Spatial Reference

Once you have selected a spatial reference(s), you will need to modify the spatial reference in the template Geodatabase. You can right-click and select “Properties...” on feature datasets and workspace-level feature classes to change the spatial reference.



Once the spatial reference is set and you load data, it is relatively difficult to change it, so you need to spend some time on this decision early in the process to avoid rework later.

At an elementary level, spatial references manage the complex math required to represent the surface of the earth. Many common spatial references for local government attempt to flatten the “orange peel” into smaller pieces – UTM coordinate systems are good examples of this. ArcGIS can do projection on the fly to display information stored using different spatial references, so it is acceptable to have data stored in more than one spatial reference. At the same time, you should consider managing data in one spatial reference so that you can take advantage of datasets such as topologies, networks, and also improve interoperability with other tools that may not handle multiple spatial references at an application level.

While it would be easy to recommend that everyone should use UTM, some cities/counties are unfortunately located in awkward places along the dividing lines between pieces of the orange peel (New Orleans is one example of this).

Before ArcGIS 9.2 there was a need to be careful about the precision of the Geodatabase coordinate system, but that consideration was removed with High Precision geometry storage in 9.2.

Tool Tips

Once you have data loaded, you can still use the GeoProcessing “Project Data” tool to re-project your data

Configure Domains

You will need to populate some domain values for your jurisdiction. The purpose of the domains is to ensure consistent data entry in the system. You can also make changes to other domains as required.

Tool Tips

You can import contents of database tables using the Geoprocessing Task `TableToDomain`.

You can use GDB XRay tools to type/paste domain lists into Excel spreadsheets to import into your Geodatabase.

You can also perform minor edits of the domains using ArcCatalog.

Some organizations prefer not to use domains and they write simple applications that read this information from database tables.

For countries outside of the US, you will need to make some changes – zip codes to postal codes, FIPS codes to some other national/regional identification scheme. Once you make those changes you should not have to make significant changes to the content unless you want the domain values to be presented/stored in a different language. If you need some help to create a model for a different language, please contact sgrise@esri.com since there are tools and methods that will help to make this easier. Also, your ESRI Distributor will likely be interested to support this effort.

Organize into Feature Datasets

If you have a single data management team that does all of the editing, you can use the `ManagedData` and `ReferenceData` structure from the template model. You will need to grant permissions on Workgroup/Enterprise Geodatabases to those users.

If you have editing performed by multiple workgroups, you should consider granting privileges to the groups according to the data they are responsible for managing. Separating those feature classes into workgroup-based feature datasets and granting common permissions to all feature classes within a feature dataset is recommended. For instance, if you have a group that will manage the Police and Fire Boundaries and Structure/Facility data, you should create a separate Feature Dataset

Tool Tips

You may need to drop the topology to move some feature classes to different Feature Datasets. You can recreate the topology using the topology `.rul` file included with the design template materials. The wizard will skip over rules that correspond to feature classes that are no longer in that Feature Dataset.

You may need to do occasional rule validation to check topological relationships between datasets that are managed by different departments. You should develop a plan to monitor this aspect of data quality as part of data update procedures.

While you are doing this housecleaning, you could also re-arrange, delete, or rename feature classes you have no plan to implement. One simple way to do this is just rename everything you are not using to start with “zzz” or to move the feature classes to a feature dataset called “zzz” or “unused”. There is a minor performance impact incurred by keeping the feature classes in the same feature dataset as features you are editing – they are opened/checked when users Start Editing, and also in some editing operations (i.e., the first time feature classes in a topology/feature dataset are edited).

Review Documentation and Descriptions

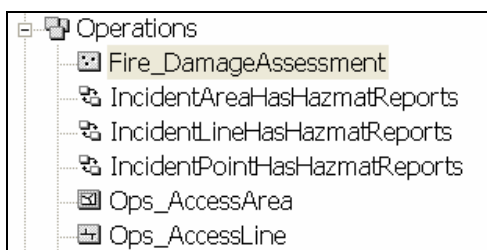
Basic documentation, especially for Descriptions of the datasets and attributes is provided with the data model. Again, the html data dictionary report included with the design template includes this information. You can also browse the information in ArcCatalog.

You should review the detailed properties of the datasets:

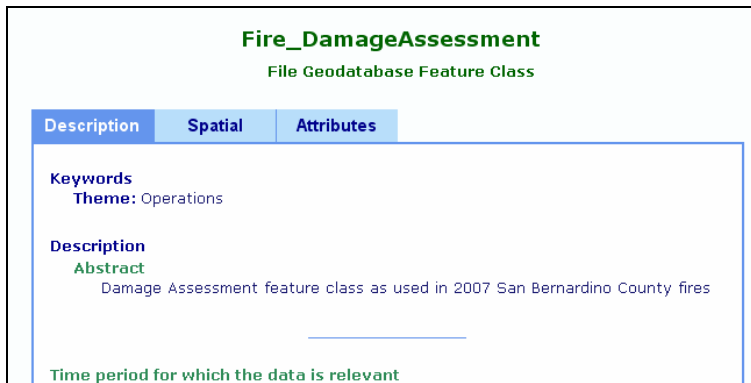
Descriptions (stored in Metadata in the Geodatabase)

Data Themes (stored in Metadata Keyword)

Field Names, Types, Alias Names, Length, Precision, Scale, Domains, etc



FieldName	Description	AliasName	DomainName
Permanent_Identifier	GlobalID	GlobalID	null
IncidentName	Name/ID for Incident	Incident Name	Fire_Name
InspectionDate	Date of Damage Inspe	Date	null
Address	Address of inspected	null	null
Damage	Extent of Damage	Extent of Damage	Damage
Material	Exterior Material	Exterior Material	Material
Roof	Roof Type	Roof Type	Roof
WindowsFrame	Windows Frame	Windows Frame	Windows
WindowsGlazing	Windows Glazing	Windows Glazing	WindowG



While these details are reasonable for most implementations, it is difficult to rename columns, change data types, or even change field lengths once the Geodatabase is created. It's even more difficult to make changes once you load data. Spend some time before loading your data getting the details right.

Tool Tips

The GDB XRay tools were developed as part of this data model effort to simplify the process of examining Geodatabases and managing the properties and associated documentation.

Most changes can be made using either ArcCatalog Geodatabase tools a variety of GeoProcessing, ArcObjects, ArcGIS Diagrammer, and GDB XRay tools.

3.4 Implementation

The next section provides information about implementing the data model – loading data, system administration, and strategies for growing the system over time.

Set up Enterprise/Workgroup Geodatabase Environment

At an early stage, even small workgroups should consider moving to a Workgroup Geodatabase. It is possible to implement a data management system without a single Geodatabase repository, but as your work progresses you will keep bumping into reasons to do it. There is a lot of information in the ArcGIS Help system related to setting up Geodatabase environments for both Workgroup and Enterprise implementations.

Small teams can get started with a Workgroup Geodatabase. If an Enterprise Geodatabase is in your future you should consider setting up the software and infrastructure to support your needs early in the project. This work can go on in parallel while you prepare and load data.

If you are not familiar with setting up Geodatabases, it will take a bit of time to install and configure the environment. Do spend some time understanding configuration settings such as dbtune, topology defaults, and other configuration options specific to your database platform. In general, the larger the deployment environment, the more time you should spend on these details.

For more information on this topic refer to the ArcSDE Configuration and Tuning Guide for your database platform. There are also a number of useful Whitepapers and Technical Articles at <http://support.esri.com>.

Load Data

Before you load data, you will first need to develop a source-target matrix: this is typically a spreadsheet that describes the source dataset name and the target dataset name.

Next, you will need to develop routines to load the data. There are some simple tools to support this, and some more complex tools. In general, you should find a way to keep this as simple as possible, but you should consider automating the loading tasks since you will likely do this a number of times.

It is a good idea to do most of the initial data loading work on your development Desktop/Laptop system. File Geodatabases are fast for data loading and manipulation. To get the data to the production Workgroup or Enterprise Geodatabase, you can copy and paste from the File Geodatabase. Another approach is to set up the target Geodatabase and use the GeoProcessing “Append” Tool to append data to the target Geodatabase.

Tool Tips

To load data into the target model, you can use GeoProcessing Tools, Scripts, and Models to store some of the parameters for data loading. A sample Javascript file is provided in the design template to demonstrate how to script the data loading task (LoadData.js).

For more advanced data loading activities, the ArcGIS Data Interoperability Extension provides a number of additional capabilities to tailor and automate data loading processes. Data Interop is also a good tool for distributing data in different formats and data models from your data management system, so there are a number of reasons to consider using this extension beyond initial data loading.

You will likely end up loading your data multiple times before you get it right. Spend some time automating the process at the beginning and you can concentrate on getting the data right rather than wrestling the tools.

Setting up and loading raster data requires another level of planning and implementation. The ArcGIS Desktop Help system is a good reference for the steps involved in setting up raster data.

Maps and Layers

In most cases the best way to develop a map design is to do some work in ArcMap and get feedback from end users/decision makers. You should be able to do a lot of mapping work with the basic data model, but you should also understand that your mapping work may have some impact on the data model. It's a good idea to think about the types of maps and try to understand any data model/data impacts early in the process.

Some sample maps are included in the appendix of this document. In the next phase of the data model development, design templates will be included in the data model materials.

Data Management and Administration Plans

An important step is to define data maintenance processes and responsibilities. This should include detailed definitions of the processes for updating the data. In addition, it is useful to have some initial project work focused on data quality in the following areas:

Basic data quality and integrity checking. It is likely that after setting up domains and topology for the database you will have a number of cleanup activities.

Addresses, Parcels, and Street Centerlines are typically a challenge, especially if you are just getting started. Concentrate on these datasets in the initial stages of improving data quality. See "Special Topics" for additional discussion of this subject.

Plan your workflow and data management tasks in sufficient detail that operators/users understand what to do when they sit down at the computer. You may find specific challenges related to multi-user editing and versioning that could be new to you and your organization – develop a plan and test the workflows before making final decisions.

You should also consider activities related to system administration and management at this point. Develop a plan that includes day-to-day administrative tasks, assigning permissions, and backup/recovery strategies. Test your backups by doing a restore onto a different system.

Tool Tips

Consider developing simple tools for data editing that streamline the data maintenance activities. Small investments in tools can lead to significant productivity and quality gains. Focus on practical needs like reducing the number of mouse clicks and putting commonly-used tasks into simple toolbars at first. Drive additional activities based on feedback from the users of the tools.

To build additional rules for data integrity and quality into your Geodatabase, you should understand Class Extensions and Validation in ArcGIS. There is significant documentation on these topics at <http://edn.esri.com>.

Setting up the Publication System

In many cases a separate publication is required for use by external and/or internal users. Many organizations strive to have a single Geodatabase instance, but others prefer to separate the Publication system for various reasons:

Architecture (performance, scalability, high availability),

Security (filtered data content to remove sensitive data from public systems, different permissions on the publication database),

Data Model (structure to support business applications vs. data maintenance, generally de-normalized/simplified).

The big design question for the publication system is whether to use the same data model as the maintenance system or not. For maintenance it is desirable to normalize data (split out into multiple tables and reduce redundancy in the database). At the same time, casual/web users will want to access all of the information with a single mouse click – typically these users will struggle with relationships and other complexities in the database.

For this data model template, a number of attributes and datasets have already been simplified or de-normalized. In the data maintenance environment you may need to normalize tables or drop attributes because the data is maintained in other Enterprise systems.

For the publication model, you may need or want to pull additional attribute information from other Enterprise systems, or you may want to simplify the publication data model in other ways.

One interesting opportunity starting at ArcGIS 9.2 is to use Geodatabase replication between the maintenance database and the publication database. The data model presented here is well-suited to using Geodatabase replication, but if you have additional needs then you will need to understand your options.

Tool Tips

Geodatabase replication provides out of the box tools for distributing data to a publication system.

The Data Interoperability Extension provides ETL tools that can be used to automate data distribution to the publication system in the case that the target data model is different from the source data model

In some organizations, there is just one GIS Server and the distinction between maintenance and publication environments is just the applications that work from a single Geodatabase.

Growing the System Time

Once you have the basic system in production, you are not done. One thing you'll notice is that a lot of good things start to happen – requests from users and departments for additional support, and some funding and projects to help expand from the basic system outlined here.

User needs will dictate your department's application and mapping priorities. The Application/Data Matrix in Appendix C is a useful tool for planning and prioritizing. There is no magic formula for prioritizing business applications. But there is s are available in the Appendix to this document. As the team working to grow the system, you should develop a strategy for growth based on best practices. Here are some basic activities you should consider as part of a strategy:

Find peers and success stories for different application areas

Share solutions and data

Internal

Gov2Gov

Talk to business managers in your organization

About how to leverage GIS data in government business functions

About Spatially enabling existing business applications/workflows

Expand Data and Map Publishing

Build Web Services

Multiple hosting and access options

Add new datasets as time allows and the need arises

Find your consumers/customers and listen to them

Overall, you should develop a long-term strategy for growing the program, and look for opportunities to achieve your goals incrementally through funded projects and collaboration in your community.

Special Topics

The following are some other topics of particular importance to Fire Service GIS. Some are handled in other places and some need to be fleshed out through use of the model and addressed in future iterations of this document.

3.5 Addressing and Data Maintenance

An up-to-date accurate address model can be used by many agencies to support many of their business functions. Successful data model implementations should include a plan and process to have contributing agencies regularly use and update the data.

These common business functions include: issuing permits, business licenses; owner notifications; as well as many first responder applications. The current Fire data model has a limited (2) fields for address information. Expanding the data model to have points for sub-addresses (secondary) or access points is important in many urban environments. For example, in a simple case, a multi-story building could have many addresses (suites or apartments), there could be several buildings on a parcel. A point for each address inside a building footprint tied to a parcel, can provide more locational information for the responder's ability to locate this site.

Addresses

HazMat locations

Structures / Sites

Pre-plans

Hydrants

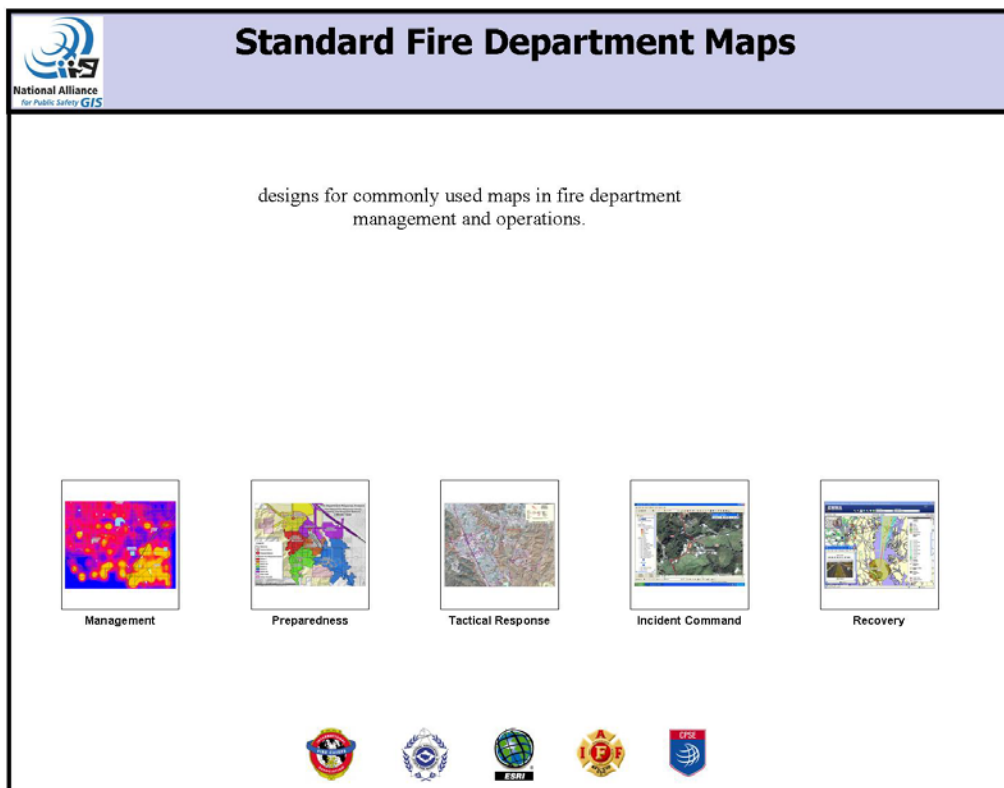
Water


Imagery

Events, Historical, floorplans/structures

Appendix A: Standard Map Product Templates

The following are sample designs for commonly used maps in fire department management and operations.







Standard Fire Department Map Products

Preparedness


(Set Two of Five)



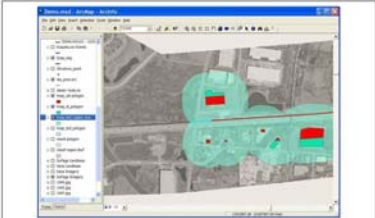
Service Delivery Capability
Standards of Cover




What's My Demand
How much wet stuff and people do I need?



What our community is
Stations, districts, zoning, community



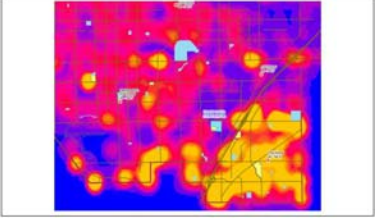
Critical infrastructure; values and hazards;
Natural and technological hazards
Community risk—oh shit stuff




Standard Fire Department Map Products

Management


(Set One of Five)




Budget
Resource needs




Public Information





Accountability
Measure how you are doing





Situational Awareness
What's happening now


 **Standard Fire Department Map Products**
Tactical Response
(Set Three of Five)



Station Wall Maps



Map Book Series

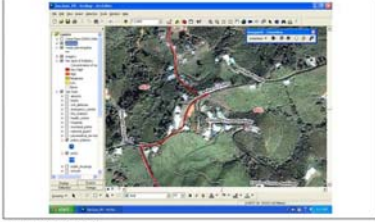

Water Sources and Hydrants



Hazards Map


 **Standard Fire Department Map Products**
Incident Command
(Set Four of Five)


ICS Incident Operations Area
(ICS 201)


Logistics Map


Transportation Map

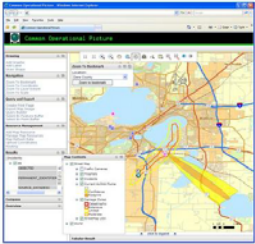

Public Information Map



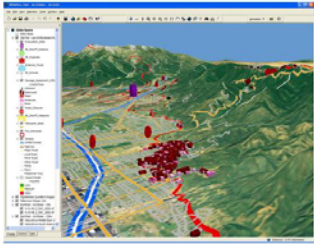
Standard Fire Department Map Products

Recovery


(Set Five of Five)




Damage Assessment: Areas that have been damaged by a tornado. Displays a chemical plume from a facility that was damaged by the tornado.
Source: PS Screenshots



Critical Community Infrastructure Affected:



Evacuation and Shelters



Sources of Supplies

Fire Data Model Implementation Guide

Appendix B: US DOT Guidelines for Reporting of Hazardous Materials

Title 49: Transportation

PART 171—GENERAL INFORMATION, REGULATIONS, AND DEFINITIONS

Subpart B—XXX

§ 171.15 Immediate notice of certain hazardous materials incidents.

(a) General. As soon as practical but no later than 12 hours after the occurrence of any incident described in paragraph (b) of this section, each person in physical possession of the hazardous material must provide notice by telephone to the National Response Center (NRC) on 800-424-8802 (toll free) or 202-267-2675 (toll call). Notice involving an infectious substance (etiologic agent) may be given to the Director, Centers for Disease Control and Prevention, U.S. Public Health Service, Atlanta, GA, 800-232-0124 (toll free), in place of notice to the NRC. Each notice must include the following information:

- (1) Name of reporter;
 - (2) Name and address of person represented by reporter;
 - (3) Phone number where reporter can be contacted;
 - (4) Date, time, and location of incident;
 - (5) The extent of injury, if any;
 - (6) Class or division, proper shipping name, and quantity of hazardous materials involved, if such information is available; and
 - (7) Type of incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene.
- (b) Reportable incident. A telephone report is required whenever any of the following occurs during the course of transportation in commerce (including loading, unloading, and temporary storage):
- (1) As a direct result of a hazardous material—
 - (i) A person is killed;
 - (ii) A person receives an injury requiring admittance to a hospital;
 - (iii) The general public is evacuated for one hour or more;
 - (iv) A major transportation artery or facility is closed or shut down for one hour or more; or

(v) The operational flight pattern or routine of an aircraft is altered;

(2) Fire, breakage, spillage, or suspected radioactive contamination occurs involving a radioactive material (see also §176.48 of this subchapter);

(3) Fire, breakage, spillage, or suspected contamination occurs involving an infectious substance other than a diagnostic specimen or regulated medical waste;

(4) A release of a marine pollutant occurs in a quantity exceeding 450 L (119 gallons) for a liquid or 400 kg (882 pounds) for a solid; or

(5) A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident) that, in the judgment of the person in possession of the hazardous material, it should be reported to the NRC even though it does not meet the criteria of paragraph (b) (1), (2), (3) or (4) of this section.

(c) Written report. Each person making a report under this section must also make the report required by §171.16 of this subpart.

Note to §171.15: Under 40 CFR 302.6, EPA requires persons in charge of facilities (including transport vehicles, vessels, and aircraft) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release, to DOT's National Response Center at (toll free) 800-424-8802 or (toll) 202-267-2675

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Title 49: Transportation

PART 171—GENERAL INFORMATION, REGULATIONS, AND DEFINITIONS

Subpart B—XXX

§ 171.16 Detailed hazardous materials incident reports.

(a) General. Each person in physical possession of a hazardous material at the time that any of the following incidents occurs during transportation (including loading, unloading, and temporary storage) must submit a Hazardous Materials Incident Report on DOT Form F 5800.1 (01/2004) within 30 days of discovery of the incident:

(1) Any of the circumstances set forth in §171.15(b);

(2) An unintentional release of a hazardous material or the discharge of any quantity of hazardous waste;

(3) A specification cargo tank with a capacity of 1,000 gallons or greater containing any hazardous material suffers structural damage to the lading retention system or damage that requires repair to a system intended to protect the lading retention system, even if there is no release of hazardous material; or

(4) An undeclared hazardous material is discovered.

(b) Providing and retaining copies of the report. Each person reporting under this section must—

(1) Submit a written Hazardous Materials Incident Report to the Information Systems Manager, PHH-63, Pipeline and Hazardous Materials Safety Administration, Department of Transportation, Washington, DC 20590-0001, or an electronic Hazardous Material Incident Report to the Information System Manager, DHM-63, Research and Special Programs Administration, Department of Transportation, Washington, DC 20590-0001 at <http://hazmat.dot.gov>;

(2) For an incident involving transportation by aircraft, submit a written or electronic copy of the Hazardous Materials Incident Report to the FAA Security Field Office nearest the location of the incident; and

(3) Retain a written or electronic copy of the Hazardous Materials Incident Report for a period of two years at the reporting person's principal place of business. If the written or electronic Hazardous Materials Incident Report is maintained at other than the reporting person's principal place of business, the report must be made available at the reporting person's principal place of business within 24 hours of a request for the report by an authorized representative or special agent of the Department of Transportation.

(c) Updating the incident report. A Hazardous Materials Incident Report must be updated within one year of the date of occurrence of the incident whenever:

(1) A death results from injury caused by a hazardous material;

(2) There was a misidentification of the hazardous material or package information on a prior incident report;

(3) Damage, loss or related cost that was not known when the initial incident report was filed becomes known; or

(4) Damage, loss, or related cost changes by \$25,000 or more, or 10% of the prior total estimate, whichever is greater.

(d) Exceptions. Unless a telephone report is required under the provisions of §171.15 of this part, the requirements of paragraphs (a), (b), and (c) of this section do not apply to the following incidents:

(1) A release of a minimal amount of material from—

(i) A vent, for materials for which venting is authorized;

(ii) The routine operation of a seal, pump, compressor, or valve; or

(iii) Connection or disconnection of loading or unloading lines, provided that the release does not result in property damage.

- (2) An unintentional release of hazardous material when:
- (i) The material is properly classed as—
 - (A) ORM-D; or
 - (B) a Packing Group III material in Class or Division 3, 4, 5, 6.1, 8, or 9;
 - (ii) Each package has a capacity of less than 20 liters (5.2 gallons) for liquids or less than 30 kg (66 pounds) for solids;
 - (iii) The total aggregate release is less than 20 liters (5.2 gallons) for liquids or less than 30 kg (66 pounds) for solids; and
 - (iv) The material is not—
 - (A) Offered for transportation or transported by aircraft,
 - (B) A hazardous waste, or
 - (C) An undeclared hazardous material.
- (3) An undeclared hazardous material discovered in an air passenger's checked or carry-on baggage during the airport screening process. (For discrepancy reporting by carriers, see §175.31 of this subchapter.)