Tips and Tricks for Using ArcGIS for Fire Pre-Incident Planning Version III

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Abstract:

The Kirkland Fire Department has been using GIS software to produce and maintain pre-incident plans for several years. After some years of work, we've found several tips that make ArcGIS a useful program including –

- Standardization of plans and symbols

- Implementation with the Fire Service Data Model

- Avoiding duplication of other map work (e.g., hydrant maintenance)

- Using a customized version of ArcGIS called PITMapper

- 3D modeling of a potential hazard

- Community risk assessment

- Ability to see an incident location in several views

- Integration of GIS data that isn't readily available in standard CAD programs

- Several other advantages

ArcGIS has proven to be a labor-saving tool.

*This is an update of UC Paper 2026 from the 2006 ESRI users' conference. It is important to note the history and procedures of the current process as well as show how to make ArcGIS more "firefighter friendly".

The KFD uses ArcGIS 9.3 to create their pre-incident plans. Pre-incident plans are documents that contain diagrams of buildings and features that could be hazardous to fire fighters and civilians. Most fire departments create there pre-incident plans using a CAD package like AutoCAD or some of the industry specific packages like Fire Zone or FireCAD.

Background: Kirkland Washington is located on the east side of Lake Washington across from the City of Seattle. Kirkland is mixed urban suburban community with approximately 80,000 people living within a 20 square mile service area. The Kirkland Fire Department (KFD) is a multi service fire department providing EMS, Fire Suppression and Prevention, Hazardous Material, and Specialized Rescue Response for the City of Kirkland, King County Fire District #41 and automatic aid agreements with surrounding departments. We have 6 fire stations.

History: The use of GIS in creating pre-incident plans was born out of necessity to reduce duplicate work. KFD was already using ArcView 3.2 and eventually ArcGIS 9.3.1 to create the map books and wall maps for the fire stations. The pre-incident planning program languished for years without any real progress from hand drawn site plan diagrams. Many attempts were made to use software like Visio and AutoCAD but the learning curve for on duty firefighters was steep and the production time consuming.

For all intents and purpose a pre-fire or pre-incident diagram is a map. Much of the required data that is required for a pre-incident diagram include
- Building shape
- Hydrant
- Streets
- Edge of Pavement
- Aerial Photos
- Utilities

Kirkland and the surrounding area has excellent GIS data (street edge of pavement, centerline data, and building data) and the fire department maintains accurate hydrant, and address information. This caused us to explore using GIS for most of our source data for the diagrams.

First attempts involved using these layers in conjunction with AutoCAD where we had most of the building symbols.   This was convenient considering that if anything like hydrant location changed is would be reflected on the pre-fire. It was still time consuming considering that you had to maintain the drawing in AutoCAD and then add the data as a theme in ArcView. Plus it was a challenge to format the wording and turn of the "Live Link" on each individual pre-fire page layout.

After converting over to ArcGIS 9.3.1 there was still the desire for the multiple layout features in ArcView 3.2. Then we started using the DS map page extension from the ESRI website.

How it usually is done

Most fire departments use a graphics program like Visio, AutoCAD, or specialty programs like Fire Zone. They also usually maintain data in a database like Access, dBase, or a SQL Server type database. A graphic and database, sounds like GIS!

Data Requirements

Each building or hazard feature has an associated feature class that is stored in a Personal Geodatabase. The feature classes in the Preplan Geodatabase includes

- Buildings
    - Can calculate fire flow based on the area create and in the building feature class!
- Access features
    - Doors
    - Knox Box
    - Attic and roof access
- Fire Suppression features
    - Sprinkler Connections
    - Standpipe Connection
    - Water Supply features
- Alarms
- Utility shutoffs
- Label points
- Safety Hazards
- Elevators and Stairs
- Index grids See Annex A for Table Sample

Procedure:

1. Base data has to be established. A polygon index layer is created similar to a map page grid with the exception that the grid needs to encompass any features that responders would find pertinent to that occupancy. This may include grids overlapping when pre-incident plans are close together. It may even include other buildings or features from other buildings

2. The Map Book samples allows for field values to be included on the layout. So in the index layer we've included several fields that relate to pre-incident planning. This is basically our pre-fire database we use to maintain building information. Currently we've been experimenting with using Access to edit the table value in a form for consistent data entry.
3. To put together the base data for the document you need to add the following layers
    a. Buildings
    b. Edge of pavement

       c. Street centerline network
       d. Hydrant
       e. Utility data
       f. Aerial photo if available

4. The building, fire protection, and hazardous features need to be represented. In most pre-fire plans a rough representation of what the building looks like is drawn and then drawing symbols showing things like sprinkler connections, standpipe discharges, Knox box locations, and fire alarm panel location are put on the data frame. We've decided to outline what symbols we would like to show and then create a separate feature class for each feature. Most things are represented by a point file but things like fences and fire wall are represented by lines and hazardous areas are a polygon. KFD decided to use the pre-fire symbols outlined in NFPA 170.

5. *Labeling* is the biggest challenge.   Many of the feature classes have label attribute data and invariably you want to include information on the drawing that can be only represented by text. We approached this with creating separate point feature class for certain categories of labels. Our categories included
       a. Building labels
       b. Address labels
       c. Hazardous information
       d. Other

6. Another option for labeling option is to *annotation*. This is a better option for paper since it stays fixed. From there, you can convert it to a point file
       a. The same categories are used to label

Layout Setup using the DS Map Book Sample

Before with static templates in Microsoft Visio you were stuck with one template and if you wanted to change that template you would have to go to each individual file. With ArcGIS and the Map Book extension you can create a book based on any layout design you desire. For instruction purpose we'll go through some key steps to make this as easy as possible.

1. Add the following layers to your document
       a. Edge of Pavement
       b. Buildings
       c. Street centerline network. Make the layer invisible and auto label the street names
       d. Hydrants, use any desire symbol
   e. Water features

2. Next add the layers that have been developed
   a. Index Grid, set the display so that the outline and fill have no color
   b. Pre-fire symbol layers, you can use either your own symbols or the NFPA symbols that are included in the symbols palette.
3. Go to your layout view and position the data frame in the position you want. In this example we'll place it top and centered
4. At the bottom we'll include the page number we want to use. REMEMBER, YOU MUST HAVE AN UNIQUE ID FIELDS IN YOUR INDEX TABLE.
5. Usually pre-fire diagrams include a name, address and specific building information like occupancy type. Add some text at the bottom of the layout
6. Create the map series using the index grid to create your "pre-fire book".
7. Right click on the map series tree in the map book tab and you'll come up with this menu on the right. Highlight the text label you identified with the page number and highlight Tag as Page Number. Use Tag with Index Layer Field for adding the other field values
8. Next you can add a local grid indicator to your layout to show surrounding information like closest hydrants. Add the layers that you feel may be appropriate for this

Symbols

Preplan symbols are available in the "Hazmat" style palette.
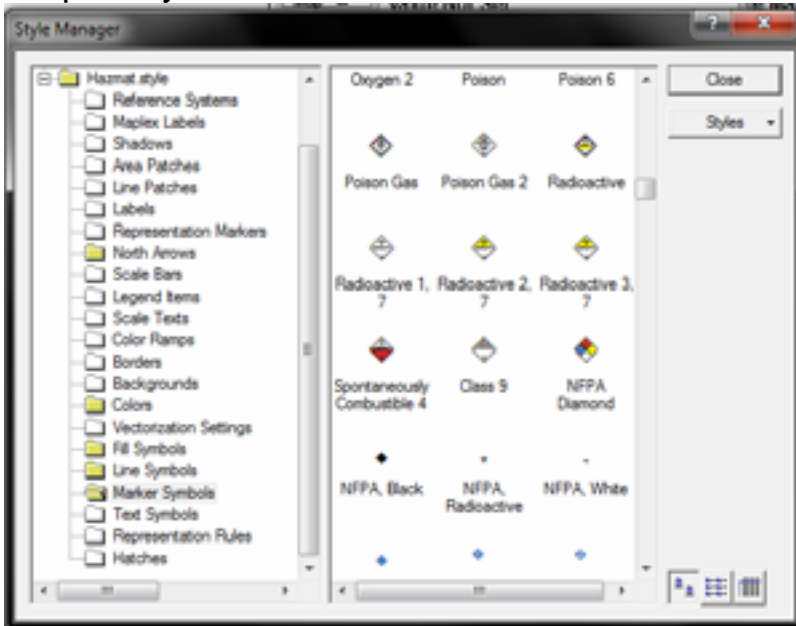
Making ArcGIS a "firefighter friendly" tool to create preplans

For the past 4 years we've been working on a program called PITMapper. PITMapper (Pre-Incident Tactical Mapper) is a customized version of ArcGIS 9.3.1. It is designed in a way that eliminates some of the "extra" features of ArcGIS and enhanced the work flow with pop-up forms. It includes some of the following features
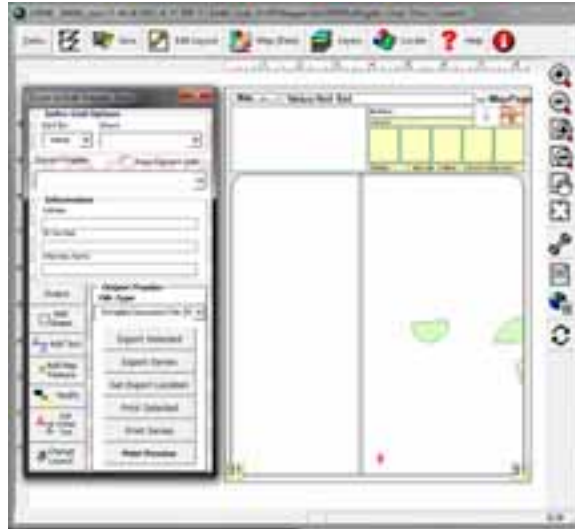- Form based editing of a geodatabase
- Options to manage an index grid
- Ways to manage layouts
- Workflow manager
- Removes features that will mess up the map of somebody not familiar with ArcGIS were to use

Edit Screen

Floating Tool

Layout Editor

Workflow of Preplans

Firefighters have many tasks in their day to day operations that need to be completed. To make collecting data easier we have categorized the level of information that needs to be collected into 3 levels

1. Level 1 or Quick Action Plans are preplans that are a quick summary of hazards. These are essentially a one page preplans with a building footprint with general hazards of a building. Approximately 80% of hazards in our community are mapped this way.
2. Level 2 or Command and Control plans are preplans with the same information as the Level 1 preplans but also includes floor plans, aerial photos, pictures of the building, and detailed data about hazards that may exist
3. Level 3 or Unified Command preplans are preplans that contain all of the information from the previous two levels plus information that may be helpful for law enforcement. These preplans are mainly the schools.
4. Level 4 or Other Maps

Categorizing preplans have helped us reduce unnecessary work that was done previously without any work flow.

3D Mapping using SketchUp and Google Earth

There are a few scripts that can be downloaded from the ArcScripts website that create KML files that can be read in Google Earth and ArcExplorer-ArcGIS. SketchUp is a 3d graphics program that can import building footprint information and then export into a Geodatabase or a KML file. With Sketchup you can modify the look of the building and add building features like doors and windows and some textures. This has increased the quality of information our preplans and ability to view information.

Community Risk Assessment

With mapping safety hazards you can globally zoom out and identify risks to your community.

The Pros and Cons

Pros	Cons
• Can be used in conjunction with departments mapping program • Allows a lot of flexibility in creating layouts • Symbols can be changed globally • Combines the functionality of a graphics program and database • Helps to conform to global standards like symbols and layout design • Can be used for limited text reporting • Increases interoperability between departments • Dynamic labeling with GIS layers • Reduced time in creating layouts • Community Risk Assessment • 3d modeling of hazards • Increased speed in creating diagrams (most of the work is already complete with the GIS layers!)	• Steep learning curve • Not out of the box • Expense of ArcGIS • Must have at least a minimum of GIS data (Ortho Photos)

Conclusions

Using ArcGIS for pre-incident planning is an interesting way to create pre-incident plan diagrams. By creating a strong set of base information, a fire department can manage their pre-incident information on the fly and with room to grow.

Acknowledgements

- City of Kirkland GIS
- Kirkland Fire Department

Biography: Chris Rogers is a career firefighter with the Kirkland Fire Department for the past 15 years. Chris has a Bachelor of Science degree in Cartography with a minor in computer science.

For more information look at http://www.firemapping.com

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Annex A Index Grid Table Schema

Name	Alias	Feature Type
SHAPE	**SHAPE**	**Geometry**
NAME1	**Name**	**String**
ALT_NAME	**Alernate Names**	**String**
ADDRESS1	**Address**	**String**
COMIDNUM	**Unique ID Number**	**String**
Name_ID	**Name + ID Number**	**String**
Level_	**Preplan Level**	**String**
MAPPAGE	**Map Page**	**String**
Rel_Size	**Relative Size**	**String**
Type	**Type**	**String**
Label	**Label**	**String**
Stories_Above	**Stories Above**	**Integer**
Stories_Beloe	**Stories Below**	**Integer**
UBCBldCode	**UBC Building Type**	**String**
Sprinkled	**Level of Sprinkler Protection**	**String**
Truss_Exists	**Truss Exists?**	**String**
safety1a	**Safety Information**	**String**
SAFETY1	**Safety Comments**	**String**
SAFETY2A	**Safety Information**	**String**
SAFETY2	**Safety Comments**	**String**
SAFETY3A	**Safety Information**	**String**
SAFETY3	**Safety Comments**	**String**
SAFETY4A	**Safety Information**	**String**
SAFETY4	**Safety Comments**	**String**
SAFETY5A	**Safety Information**	**String**
SAFETY5	**Safety Comments**	**String**
Flammabili	**NFPA 704 Flammability**	**String**
HealthHaz	**NFPA 704 Health Hazards**	**String**
Reactivity	**NFPA 704 Reactivity**	**String**
Special_Ha	**NFPA 704 Special Hazards**	**String**
Inv_25	**Fire Flow 25 % Involved**	**Integer**
inv_50	**Fire Flow 50 % Involved**	**Integer**
Inv_75	**Fire Flow 75 % Involved**	**Integer**
Inv_100	**Fire Flow 100 % Involved**	**Integer**
PROPUSE4	**Property Use**	**String**
accRoof	**Roof or Above Ground Access**	**String**
accBelow	**Below Grade or Underground Access**	**String**
accVehicle	**Vehicle, Boat, Air Access**	**String**
accAir	**Air Access**	**String**
accWater	**Water Access**	**String**
Elevator	**Elevator and Stair Locations**	**String**
Vent1	**Ventilation Hazards 1**	**String**
Vent2	**Ventilation Hazards 2**	**String**
Vent3	**Ventilation Hazards 3**	**String**
Vent4	**Ventilation Hazards 4**	**String**
Vent5	**Ventilation Hazards 5**	**String**
Angle1	**Angle**	**Integer**
Jurisdiction1	**Jurisdiction1**	**String**
COMPLEX	**COMPLEX**	**String**
COMMNUMI	**Number of Commercial Units**	**Integer**
RESNUMUNI	**Number of Residential Units**	**Integer**
CITY	**CITY**	**String**
STATE	**STATE**	**String**
POSTALCODE	**POSTALCODE**	**String**
X	**X or Latitude**	**Double**
Y	**Y or Longtitude**	**Double**
Area	**Area**	**Integer**
PROPVALUE	**Property Value**	**Double**
CONTVALUE	**Contents Value**	**Double**
OccLoadDay	**Occ Load Day**	**Integer**
OccLoadNight	**Occ Load Night**	**Integer**
ConName1	**Contact Name**	**String**
ConPhone1	**Contact Phone Number**	**String**
ConType1	**Contact Type**	**String**
Contact_Notes	**Contact_Notes**	**String**
Roof_mat1	**Roof Covering**	**String**
nRoofType	**Roof Type**	**String**
TrussType1	**Truss Type**	**String**
RoofConst1	**Roof Construction**	**String**
Other_Const_Notes	**Construction Notes**	**String**
Knox_Box	**Knox Box Locations**	**String**

Tips and Tricks for Using ArcGIS for Fire Pre-Incident Planning

FDC_Locations	**FDC Locations**	**String**
Sprinkler_Riser_Locations	**Sprinkler Riser Locations**	**String**
Standpipe_Discharge_Locations	**Standpipe Discharge Locations**	**String**
Alarm_Panel_Locations	**Alarm Panel Locations**	**String**
Alrm_Reset	**Alarm Reset**	**String**
Monitor_Agency_Phone	**Monitor Agency & Phone**	**String**
nDetTyp	**Dominant Detector**	**String**
nDetPower	**Detector Power**	**String**
Water_Shutoff	**Water Shutoff**	**String**
Gas_HVAC_Shutoff	**Gas & HVAC Shutoff**	**String**
Power_Shutoff	**Power Shutoff, EG**	**String**
Communication_Shutoff	**Communication Shutoff (Cable & Phone)**	**String**
Hazmat1	**Hazmat1**	**String**
HazClass1	**Haz Class1**	**String**
Hazmat2	**Hazmat2**	**String**
HazClass2	**Haz Class2**	**String**
Hazmat3	**Hazmat3**	**String**
HazClass3	**Haz Class3**	**String**
Hazmat4	**Hazmat4**	**String**
HazClass4	**Haz Class4**	**String**
Hazmat5	**Hazmat5**	**String**
HazClass5	**Haz Class5**	**String**
Other_Hazmat	**Other Hazmat Materials**	**String**
PredStrat	**Predicted Strategy**	**String**
FireBehav	**Possible Fire Behavior**	**String**
ProbAnt	**Problems Anticipated**	**String**
Radio_Problem	**Radio Problems**	**String**
Exposure_Highest_Level_A	**Exposure Highest Level Side A**	**String**
Exposure_Highest_Level_B	**Exposure Highest Level Side B**	**String**
Exposure_Highest_Level_C	**Exposure Highest Level Side C**	**String**
Exposure_Highest_Level_D	**Exposure Highest Level Side D**	**String**
Machine_Hazards	**Machine Hazards**	**String**
Special_Unusual_Hazards	**Special or Unusual Hazards**	**String**
High_Angle_Hazards	**High Angle Hazards**	**String**
Observation_Points	**Observation Points (Lookouts)**	**String**
LowestFloor	**Lowest Floor**	**Integer**
HighestFloor	**HighestFloor**	**Integer**
Special_Response_Instructions	**Special Response Instructions**	**String**
Arrival_Instructions	**Arrival Instructions**	**String**
More_Arrival_Instructions	**More Arrival Instructions**	**String**
Housenum	**Housenum**	**String**
StreetPrefix	**StreetPrefix**	**String**
StreetName	**StreetName**	**String**
StreetType	**StreetType**	**String**
StreetSuffix	**StreetSuffix**	**String**
HoursOpen	**Hour sOpen**	**String**
MSDS_Roster_Location	**MSDS Roster Location**	**String**
User_	**User_**	**String**
Fireload	**Fireload**	**String**
DateStamp	**DateStamp**	**String**
Division	**Division**	**String**
Battalion	**Battalion**	**String**
UC_CommandPost	**UC Command Post or Base**	**String**
acc_Primary_Access	**Primary Access**	**String**
UC_Operation_Area	**Operation Area**	**String**
UC_RoadBlock	**Road Block**	**String**
UC_TriageArea	**Triage Area**	**String**
UC_TreatmentArea	**Treatment Area**	**String**
UC_TransportArea	**Transport Area**	**String**
UC_PublicSafetyStaging	**Public Safety Staging (Police and Fire)**	**String**
UC_CivilianStaging	**Civilian Staging (Student, Family, Media)**	**String**
wat_Depth	**Water depth**	**String**
watCurrent	**Water Current**	**String**
watObstructionUnderwater	**Obstruction Underwater**	**String**
wildVeg_Fuel	**Wildland Fuel and Vegitation**	**String**
wildNaturalFeatures_Topograph_136	**Wildland Natural Features & Topography**	**String**
wildTypicalWeather	**Typical Weather**	**String**
SafetyZones	**Safety Zones**	**String**
Drafting_Sites	**Drafting Sites**	**String**
Escape_Routes	**Escape Routes**	**String**
Communication_Features	**Communication Features**	**String**
Notes1	**Notes1**	**String**
Notes2	**Notes2**	**String**
LastEdit	**LastEdit**	**String**

Sprinklered	**Sprinklered**	**String**
Size_	**Size_**	**String**
Size2	**Size2**	**Integer**
Floors	**Floors**	**String**
Angle	**Angle**	**Small Integer**
SizeUp	**SizeUp**	**String**
District	**District**	**String**
Links1	**Links1**	**String**
Links2	**Links2**	**String**
Links3	**Links3**	**String**
Links4	**Links4**	**String**
Links5	**Links5**	**String**
Links6	**Links6**	**String**
Path	**Path**	**String**