FIRECARES

User and Implementation Guide

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Analyze how fire department resources
are deployed to match a community's risks.

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FIRECARES

List of Acronyms

DHS   Department of Homeland Security

ERF   Effective Response Force

FDID   Fire Department ID

FEMA   Federal Emergency Management Agency

IAFC   International Association of Fire Chiefs

IAFF   International Association of Fire Fighters

UL FSRI   UL Firefighter Safety Research Institute

NIST   National Institute of Standards and Technology

NFIRS   National Fire Incident Reporting System

1. Introduction to FireCARES

A fire department's relationship with data and performance should be seen as a continuum. Statements regarding a department's need to have good data and good performance are numerous. However, these statements are not the same. The beginning of the quality performance continuum is for a department to have good data. Good data is defined as data that are based on factual incidents, reported accurately, and can be accessed and manipulated easily. It can take a department a long time to work on its data, but it is important to recognize its ability to quantify impact before instituting change. Without good data there is no assurance that improvement efforts actually work.

Once a department has improved its data quality, it can begin working on having good performance. Good performance is the end of the quality improvement continuum. For example, improving fire station layouts to reduce turnout time, working with the communications center to streamline call processing, conducting targeted staff training, investing in community risk reduction efforts, and deploying additional/alternate resources within a jurisdiction are all ways to improve performance. A knee-jerk reaction to observing a given performance metric for a department may be to say that "the metric is wrong." However, in determining the root cause, it is important to distinguish whether the data used in the calculations are wrong or the performance itself is poor.

FireCARES is designed to analyze how fire department resources are deployed to match community risks. Local government decision makers often alter fire department resources faster than fire service leaders can evaluate the potential impact. These decisions can leave a community without sufficient resources to respond to emergency calls safely, efficiently, and effectively. These decisions can have even greater impact on vulnerable populations, including the elderly, young children, and people with disabilities. FireCARES — Community Assessment, Response Evaluation System — is an analytical system designed to evaluate community risk and fire department operational performance using national data layers in a geographic-based system. The FireCARES project provides fire departments the ability to add a technical basis to what has historically been an anecdotal discussion regarding community hazards and risks, as well as the impact of changes to fire department resource levels. FireCARES includes more than a decade of research on structure fires and related injuries and deaths, as well as building footprints, housing and mobile home units, public health and census data, and locations of vulnerable populations.

The goal of the project, which is funded by DHS/FEMA's Assistance to Firefighters Grant program is to aggregate national and local data to provide answers that both public and fire service leaders have not previously had. To accomplish this task, FireCARES provides three scores for each community dependent on the available data: the Community Risk Score, the Fire Department Performance Score, and

2. FireCARES Scores

To assess risk and fire department performance, it was important to establish filters that define comparisons between departments. A small rural department does not face the same risks or have the same resources as a major metropolitan department. Therefore, it would be unfair to both departments for that comparison to occur. Currently, department comparison groups are determined by NFPA geographical region (Northeast, South, Midwest, and West) and population protected class (there are 10 NFPA population protected classes).

2.1 Community Risk

The community risk score was developed as a function of the socio-demographic and geographic characteristics of the locations (census tracts) of reported structure fires over a seven-year period (2008-2014), according to available National Fire Incident Reporting System (NFIRS) data. The community risk score is determined by assessing variables that are known to contribute to fire, such as building materials, population demographics, and smokers. The socio-demographic attributes include:

• Population characteristics (e.g., size category of the department, population, number of males, age group counts, race counts)

• Housing characteristics (e.g., total housing units, total vacancies, size of home, number of renters, age of units)

• Household characteristics (e.g., median household income, social vulnerability index)

• Geographic region

Community risk assessment scores are calculated for the community as a whole. The community risk scores actually contain three separate scores:

• Risk of Fire

• Risk of Fire Spread

• Risk of Death and Injury

Once scores are determined for each jurisdiction, the jurisdictions are grouped with similar areas and populations. The grouping then allows a comparison of community risk scores between each jurisdiction. The jurisdictions in the like group are then ranked into the top 25%, the medium 50%, and the lower 25% in their group. Figure 2.1 shows how the community risk scores are displayed. For this example department, the community risk would read, "the community this department protects is at a high risk for the occurrence of fire." That means the community falls into the bottom quartile (riskiest 25%) compared to similar jurisdictions.

Figure 2.1: Community Risk Scores

2.2 Fire Department Performance Score

The goal of the fire department performance score is to assess how well a fire department performs compared to the standardized version of itself. One component of this metric is the structure fire spread category from NFIRS. This category provides information that quantifies the fire spread in a structure from confined to object of origin through spread beyond structure of origin. There are five categories defined in NFIRS, but for this analysis the data are collapsed into three categories:
room of origin (lumping object and room together); floor of origin (lumping floor and structure together); and beyond structure of origin. The resulting distribution (count of fires in each of the three bins) of fire spread is the basis for comparison for developing the performance score.

The second component of this score is the model that defines how the fire department would perform if it was acting as a standard, idealized version of itself. The concept is that there exists a theoretical version of every fire department where all responses meet or exceed the national standards governing department performance. Essentially, a fire department responding to a fire must complete a series of tasks before it can put water on the fire. For purposes of this model these tasks are broken up as follows:

- Time to alarm - Time required before the fire is noticed, and some form of action is taken [NIST TN 1661 [1], NIST TN 1797 [2]]

- Time to dispatch - Time required for dispatch operator to obtain enough information regarding the fire and location to issue a dispatch [NFPA 1710/1720 [3, 4]]

- Time to turnout - Time required for fire fighter turnout [NFPA 1710/1720 [3, 4]]

- Time to arrival - Transit time required for engine between station and fire location [NFPA 1710/1720 [3, 4], GIS]

- Time to ascend - Transit time required for fire fighters to ascend to the staging floor for fires in buildings. Data for ascent was gathered from timed 27-story climb experiments with 35 fire fighters of varying age, height, weight, and gender. Note this parameter is only enacted when staging would occur above ground level.

- Time to suppress - Time required for fire fighters on scene to put water onto fire (includes size-up, hose connection, etc.) [NIST TN 1661 [1], NIST TN 1797 [2]]

When water is put onto a fire, the idealized fire is assumed to have reached the peak size. The growth time for the fire is equivalent to the sum of the tasks the fire department must perform to suppress the fire. This time to suppression is coupled to a simple exponential area damage growth model previously is consistent with fire statistics literature. A distribution of fire spread is generated using the same three NFIRS bins discussed above, based on the modeled area of fire damage at the suppression time. Distributions of the room and building sizes are estimated from the American Housing Survey's (AHS) national survey of residential homes. Where available, it is possible to use the AHS metropolitan statistical areas to refine room and building distributions for larger metropolitan areas.

The concept is that there exists an average time correction for all fire department structure fire responses routed through the idealized fire department model that "corrects" the fire damage outcomes expected from national standards to the particular outcomes observed by a given fire department. This average correction time is known as the fire department performance score. Figure 2.2 shows the performance score for an example department. The number in the center of the dial is performance, or average time in seconds the department is over its idealized performance. The numbers on the left and right side of the dial are the minimum and maximum performance scores for the departments in the same grouping (location and size).

The gauge indicates whether the performance score is good, fair, or poor. The colors green, yellow, and red indicate good (top 25%), fair (middle 50%) and poor (bottom 25%) quartiles. This gauge compares the department to other similar departments and, as you can see, this department falls in the green quartile.

Figure 2.2: Performance Score

Performance Score
This department is 26 seconds over the industry standard. Learn more.

2. FireCARES Scores (continued)

2.3 Safe Grade

A community's set of safe grades represent an assessment of the number of fires, of fire spread, and of civilian and fire fighter injury or death based on how well the fire department resources (performance score) match the level of risks within the community (risk score). Therefore, given your community risk assessment score and given your fire department's historic response capabilities and performance, the safe grade is either good, fair, or poor, depending on how well you match resources deployed to the risks in the community. There are three safe grade comparison categories:

• Performance based on number of fires

• Performance based on fire spread

• Performance based on injury and death

For each category, your department is compared against similar departments and based on the risk group (low, medium, high) the community falls within for the respective category (see above). Based on your performance score relative to those other departments, your safe grade is either good, fair, or poor. A good, safe grade represents the top 25%, a fair safe grade represents the median 50%, and a poor safe grade represents the bottom 25%.

Note that all three scores can be filtered by the hazard level of structures: low, medium, and high as defined by NFPA. This is filterable on the department landing page by clicking on the the hazard level bar above the performance score.

3. Using FireCARES.org

Go to FireCARES.org and begin by typing a fire department name or municipality in the search bar (Figure 3.1).

If you know the department you are looking for, enter it in the search bar and click the dialog box. If you leave the bar blank, results will be returned for all of the departments in FireCARES. There are 27,000+ fire departments in FireCARES. The goal is to have a landing page for every fire department, anywhere in the United States. On the left hand side of Figure 3.2, you can see that search results can be filtered by department name, FDID, state, geographical region, performance score or protected population. You can also search through all of the fields by entering your query in the top box.
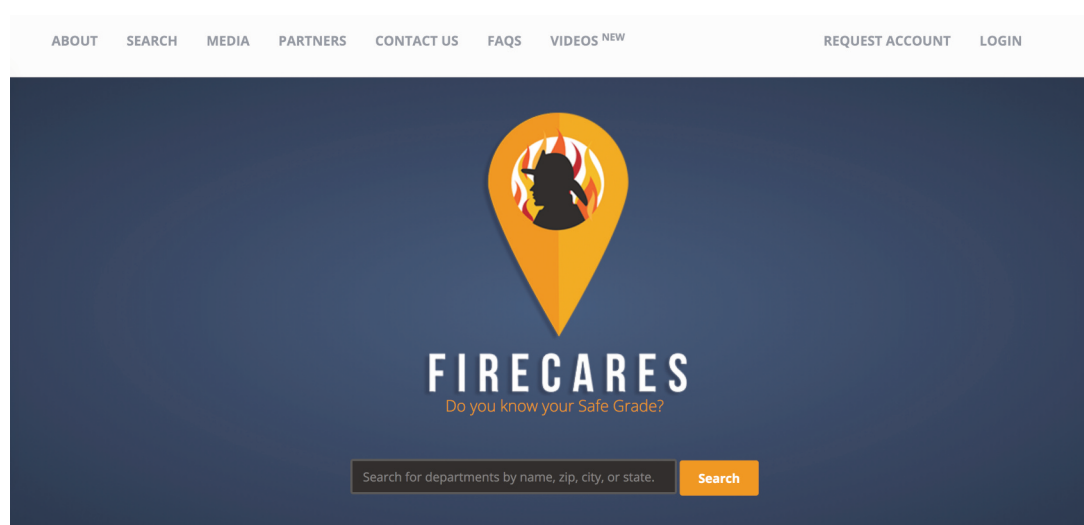
Figure 3.1: FireCARES Homepage

Figure 3.2: FireCARES Search Results

Clicking on a department's map image or name will take you to that department's landing page. Note that if you are not logged in, the department page will look like Figure 3.3. Note that of the three scores generated by FireCARES, only the community risk scores are available without login. The fire department performance score and safe grades are only available upon login.

3.1 Logging In

Login credentials are granted to the fire chief, the local union president (when applicable) and/or their designees. If you are an IAFF president or an IAFF officer, you can login using your iMIS credentials. If you are an IAFC member, you can login using your Helix credentials. Figure 3.4 shows the FireCARES login dialog box.

If you do not have an account, are not sure if you have an account, or iMIS/Helix do not apply, click on the request account box. Enter your email and click the check registration box. If you don't have an account, a request for an account from that email address will be made. If an account associated with that email exists, then you will be redirected back to the login page.

Figure 3.3: FireCARES department landing page without login

Figure 3.4: FireCARES Login Dialog

3. Using FireCARES.org (continued)

Once an email has been approved, the user will be directed to the registration screen. This dialog box will require you to enter your name, email address, login username and password. Following entry of these attributes, the user will click the Register icon (cf. Figure 3.5). Users will then be able to log into FireCARES.

An authenticated user can provide login authority to others in their department as they deem necessary and appropriate, but must keep a record of those authorized. To provide login authority, the chief and/or local union president will provide a list of eligible emails to FireCARES administration. Upon receipt, logins will be created for each email provided.

To minimize shared logins, a robust password should be implemented upon registration. Changing passwords on 90 day cycles is strongly encouraged but will not initially be required.

3.2 Department Details

Once logged in, users will now see the two additional scores (performance score and safe grades), as well as other features for the department. From Figure 3.6, you can see that the performance score and safe grades are also active along with the publicly available community risk score.
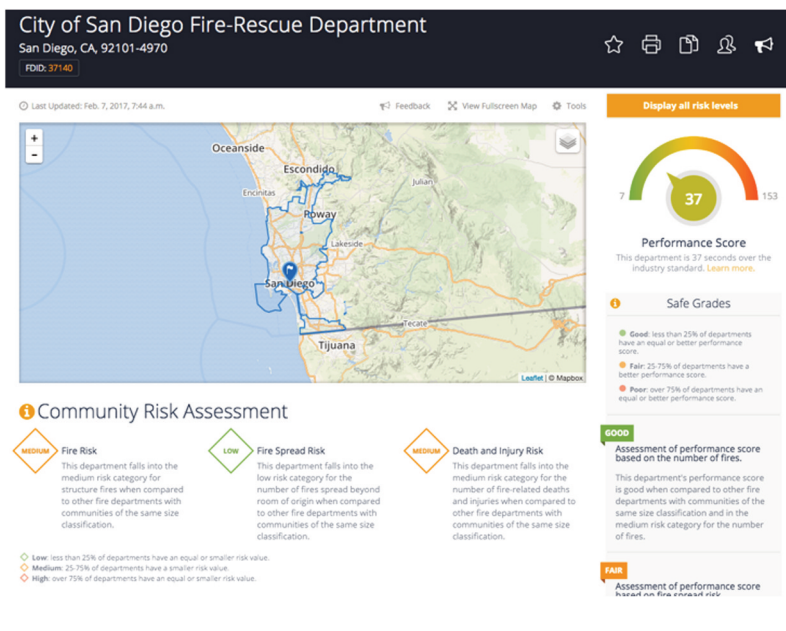

Figure 3.5: FireCARES Register Dialog

Figure 3.6: FireCARES department landing page

When viewing your department's page, the first item to check is to ensure that your department's jurisdictional boundary (the blue outline in Figure 3.6) is present and correct. From your boundary, both your protected area and protected population are calculated (cf. Figure 3.7). The protected population is determined using U.S. Census data. If you notice differences in your population, your protected area, or if your boundary has changed, send an email to: Contact Us: Boundaries. Be sure to include your fire department name and FDID as it is specified on FireCARES.org. If you send an updated GIS shapefile for your jurisdictional boundary, the preferred projection is WGS84, however, FireCARES can convert if the existing projection is specified.

Additional descriptive features about your department are:
• Department Type [USFA]
• NFPA Region [NFPA]
• FDID [USFA/NFIRS]
• State
• Phone/Fax [USFA Census]
• Website Link
(as shown in figure 3.8)

Description

The Los Angeles Fire Department is a career department located in the West NFPA region and headquartered in Los Angeles, CA.

3,792,621
Protected Population

502.82mi²
Community Size

Annual Structure Fires

Annual structure fire counts for the Omaha Fire & Rescue based on the National Fire Incident Reporting System (NFIRS).
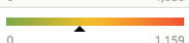
Year	Structure Fires	Total Fire Calls
2014	483	0 — 1,015
2013	495	0 — 1,031
2012	525	0 — 1,146
2011	444	0 — 979
2010	456	0 — 1,080
2009	452	0 — 1,159
2008	415	0 — 1,130
2007	445	0 — 1,270
2006	324	0 — 959
2005	418	0 — 957
2004	345	0 — 875
2003	380	0 — 982
2002	439	0 — 1,197

Summary

Department Type	Career
NFPA Region	West
FDID	19105
State	CA
Phone	(213) 485-6003
Fax	(213) 485-9884
IAFF	112
Official Website ⤴	

3.3 Annual Structure Fires

The annual structure fire counts are determined by the data sent by each department to the National Fire Incident Reporting System (NFIRS). In Figure 3.9, when available, NFIRS data is shown from 2002 to 2014. The middle column represents fires coded as structure fires within the NFIRS system. The right column shows a color bar where the maximum value is the total number of fire calls in NFIRS for that specific calendar year, and the black triangle indicates the number of structure fires. This allows users to visualize consistency in data from year to year in both number of fire calls and percentage of structure fires. Note that data is based on the publicly available NFIRS data. If your department would like to send newer NFIRS data, FireCARES can directly ingest NFIRS exchange files. This can be done using the paper icon in the upper right of your department landing page.

3. Using FireCARES.org (continued)

3.4 Station Detail Page

On each department page, the department's list of stations is included by station name and address. If there are missing stations, stations that are no longer active, or if the station list is wrong, either the station name or station address, please send an email to: Contact Us: Stations.

Users can also select a particular station from the station list and that station will open into its own landing page. If first due areas have been provided, the stations first due area will also appear. In this view, users can click the GIS layer box (stack of paper icon in the upper right corner of the map) to turn on Service Area to see GIS mapping from that station for 4-minute, 6-minute, and 8-minute travel time. All maps are printable using the printer icon at the top of the page. Figure 3.10 shows an example service area calculation.

In addition to the service area calculations, apparatus and staffing tables can be completed on each station detail page. Departments are requested to complete station tables so that additional GIS features such as effective response force (ERF) assembly times by hazard levels — which is coming soon — can be completed. The ERF is calculated by hazard levels. Figure 3.11 shows an example of the form for entering your staffing data. Users can select an apparatus type, the number of personnel, and whether advanced life support is provided, when applicable. After entering the data, remember to click Save before clicking on the Add Apparatus tab.

Figure 3.10: GIS based response polygons for 0-4 minute travel times, 4-6 minute travel times, and 6-8 minute travel times.
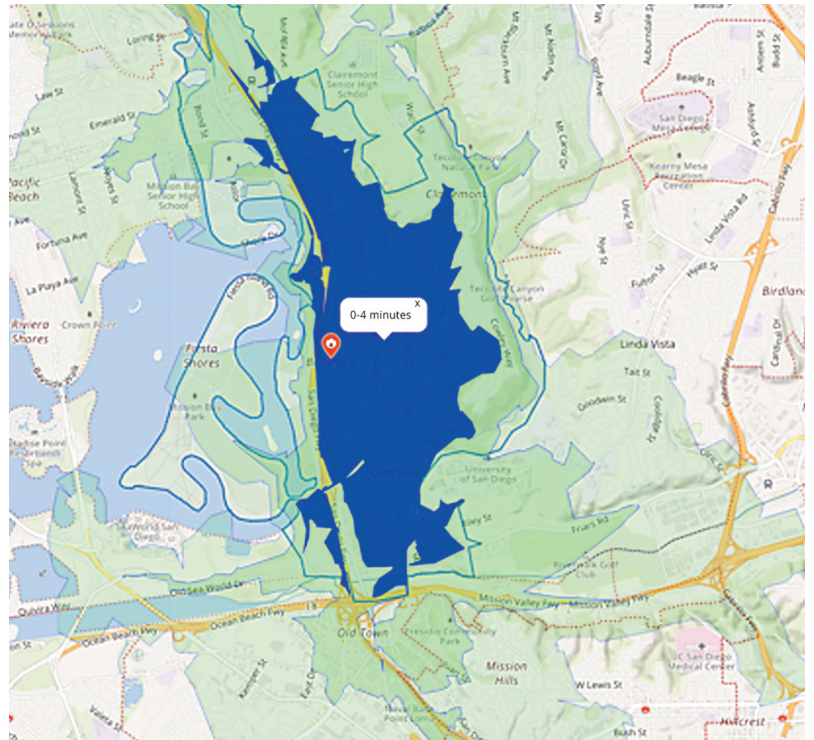

Figure 3.11: Apparatus and Staffing Table

3.5 Interactive Fires Heat Map

Click the heat map to view more than 12 years of fires that occur in the community. The feature is turned on by hovering over the stack of paper icon in the upper right corner of the map and clicking on the Fires Heatmap radio button. Call volume is indicated by green, yellow, and red areas. High call volume is indicated by red areas and low call volume by green. If you zoom in on the map, the coloring will dynamically adjust based on the calls that occurred within the boundaries of the map window. When this feature is turned on, a dashboard will appear below the map (cf. Figure 3.12)

Clicking on any of the features on the dashboard will filter the heat map data accordingly. Users can filter the data by time (month, year, hour) or by structure hazard level (low, medium, high, or unknown). Any of these filters can be applied at the same time. To remove a filter, click the respective x icon nearest the applied filter. The filters include history, month, day, hour, and hazard.
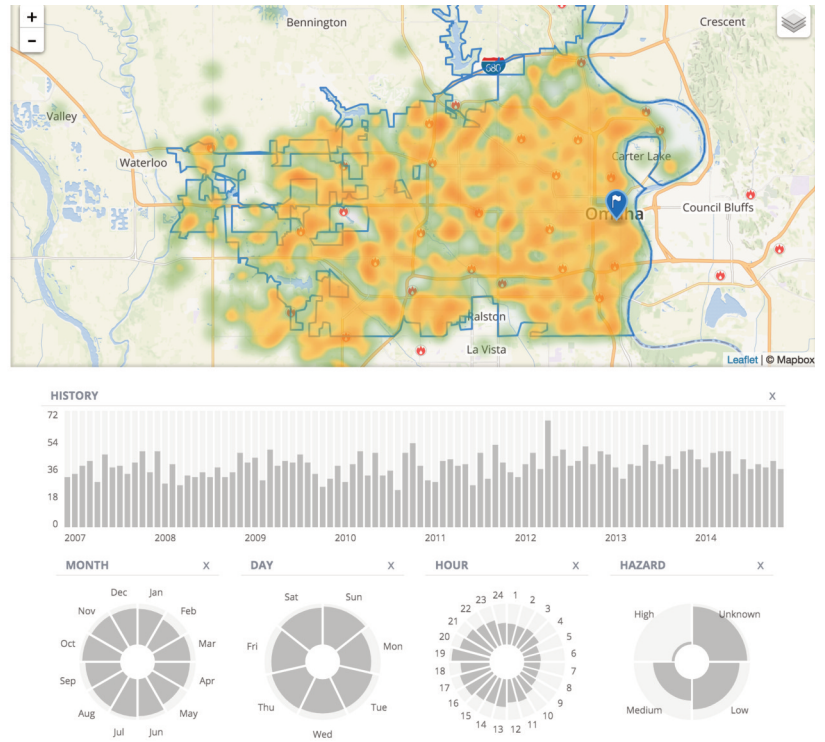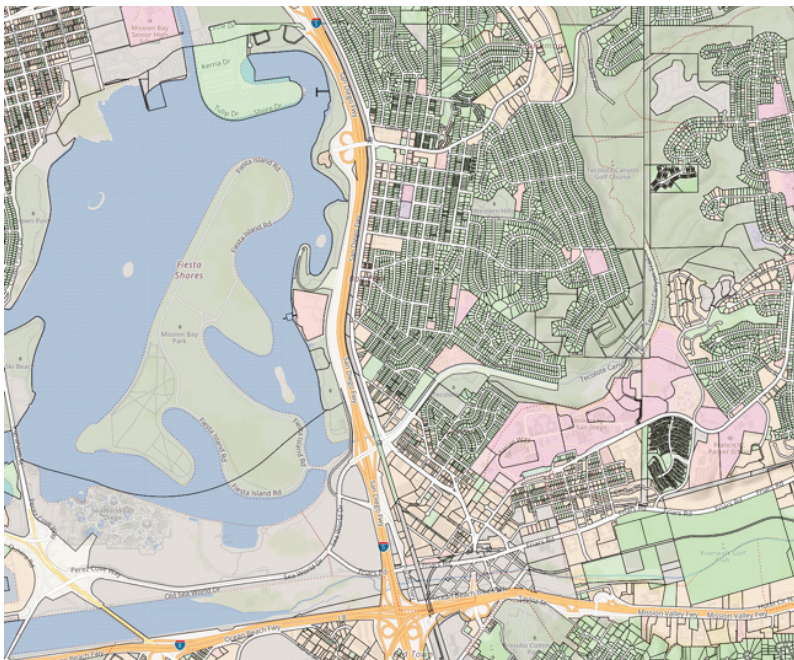
3.6 Interactive Parcel Data

Data specific to each parcel within the community are provided by hovering over the stack of paper icon in the upper right corner of the map and clicking on the Parcels radio button. To view the parcels, please zoom in on the map 4 levels. If the parcels do not show up right away, allow a moment for the data to load. Parcels are color coded by hazard level: green = low, orange = medium, and red= high. If you uncheck the Jurisdiction Boundary radio button, then you can click on any parcel and any of the known parcel attributes will appear. Figure 3.13 shows an example of a department map with the parcel data loaded.

3. Using FireCARES.org (continued)

3.7 Predicted Fire Estimates

Using historical fire data (NFIRS) and characteristics about your community (community risk), estimates can be made regarding the number of fires, how big those fires may be, and the number of casualties. Figure 3.14 shows an example dialog box of these predictions.

Figure 3.14: Estimated prediction of number of fires, fire size, and number of casualities.

Number of fires per year	
Average since 2010	481
Predicted	432
Beyond room/floor	139
Beyond structure	14
Deaths & injuries per year	
Average since 2010	25
Predicted	41

4. Checking Your Department's Data

Ensure that your department has the most accurate data.

1. **Check the jurisdiction border.** Please send an email to: Contact Us: Boundaries. Be sure to include your fire department name and FDID as it is specified on FireCARES.org. The map will be used to update your border.

2. **Check your fire station list and corresponding addresses.** If the station list on your department's page is incorrect, please send an email to: Contact Us: Stations. Be sure to include your fire department name and FDID as it is specified on FireCARES.org.

3. **Station Apparatus and Staffing Tables.** Department Administrators/Users have necessary permissions to add data in the station apparatus and staffing tables to assure that your data are available for new GIS calculation features being implemented.

4. **Fire Data as a source of information.** NFIRS data were used as the national source of fire incidents. For each department, the available NFIRS data were loaded and analyzed in the system. As you can see, the most recent data available at the national level are two years old. Departments may send NFIRS transaction files directly to FireCARES for loading to assure that all scores using attributes from this data are up to date.

Connect FireCARES to your NFORS data. As departments link to NFORS data modules, their data are not only real time for NFORS analytics, but can also be used to populate the FireCARES system for real time feature updates. Go to NFORS.org for more information on how to access the NFORS module at no costs.

5. Project Partners

This work has been funded by DHS/FEMA's Assistance to Firefighters grant program. The work is a collaboration among several organizations to make FireCARES a tool for the fire service.

• Commission on Fire Accreditation International (CFAI-Risk)

• International Association of Fire Fighters (IAFF)

• Metropolitan Fire Chiefs Association

• International Association of Fire Chiefs (IAFC)

• Underwriters Laboratories Firefighter Safety Research Institute (ULFSRI)

• National Institute of Standards and Technology (NIST)

• Urban Institute

• The University of Texas at Austin

Other organizations that have helped with this project include the International Association of Fire Chiefs (IAFC), Metropolitan Fire Chiefs, and Worcester Polytechnic University (WPI).

References

[1] J. Averill, L. Moore-Merrell, A. Barowy, R. Santos, R. Peacock, K. Notarianni, and D. Wissoker. Report on Residential Fireground Field Experiments. NIST Technical Note 1661, National Institute of Standards and Technology, Gaithersburg, Maryland, 2010.

[2] J. Averill, L. Moore-Merrell, R. Ranellone, C. Weinschenk, N. Taylor, R. Goldstein, Wissoker D. Santos, R., and K. Notarianni. Report on High-Rise Fireground Field Experiments. NIST Technical Note 1797, National Institute of Standards and Technology, Gaithersburg, Maryland, 2013.

[3] National Fire Protection Association, Quincy, Massachusetts. NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, 2016.

[4] National Fire Protection Association, Quincy, Massachusetts. NFPA 1720, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments, 2014.

FIRECARES