CITYGATE ASSOCIATES, LLC
PUBLIC SAFETY SERVICES

STANDARDS OF COVERAGE ASSESSMENT

VOLUME 1 OF 2: TECHNICAL REPORT

CITY OF FREMONT, CA

MARCH 23, 2020

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CITY OF Fremont

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EXECUTIVE SUMMARY

The City of Fremont (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a Standards of Coverage (SOC) assessment to provide an ongoing foundation for fire service planning. The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. Citygate has provided recommendations to improve Department field deployment operations.

This report is presented in several parts, including this Executive Summary outlining the most significant findings and recommendations and the fire station/crew deployment analysis supported by maps, response statistics, and a risk assessment. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this report. Overall, there are 11 findings and three recommendations.

POLICY CHOICES FRAMEWORK

There are no mandatory federal or state regulations directing the level of fire service staffing, response times, or outcomes. Thus, the level of fire protection services provided is a matter of *local policy decision*. Communities have the level of fire services they choose to "purchase" and can afford, which may not always be the level desired. However, if services are provided at all, local, state, and federal regulations relating to firefighter and citizen safety must be followed.

OVERALL SUMMARY OF FIRE CREW DEPLOYMENT

Citygate finds the Department is well organized to accomplish its mission to serve an urban population in a municipal land-use pattern. The Department is using best practices and is data driven, as necessary.

Simply summarized, fire service deployment is about the *speed* and *weight* of the response. *Speed* refers to initial response (first-due) of all-risk intervention resources (engines, trucks, and/or ambulances) strategically deployed across a jurisdiction for response to emergencies within a certain time to achieve desired outcomes. *Weight* refers to the multiple-unit Effective Response Force (ERF), also commonly called a First Alarm, deployed for more serious emergencies, such as building fires, multiple-patient medical emergencies, vehicle collisions with extrication required, or technical rescue incidents. In these situations, a sufficient number of firefighters must be assembled within a reasonable time to safely control the emergency and prevent it from escalating into a more serious event.

If desired outcomes include limiting building fire damage to only part of the inside of an effected building and/or minimizing permanent impairment resulting from a medical emergency, then initial units should arrive within 7:30 minutes from 9-1-1 notification, and a multiple-unit ERF should arrive within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability. Total response time to emergency incidents includes three distinct components: (1) 9-1-1 call processing/dispatch time; (2) crew turnout time; and (3) travel time. Citygate's recommendations for these response components are 1:30 minutes, 2:00 minutes, and 4:00/8:00 minutes respectively for first-due and multiple-unit ERF responses in the City.

The City's current fire station system provides the following first-due unit response times across a variety of population density/risk areas for emergency medical and fire incident types. As the following table shows, no station area receives service by 7:30 minutes, a best practice goal for an urban area with mostly flat terrain and no hills or features such as freeways and railroads bisecting the community with limited crossings.

Table 1—Call to Arrival Analysis

Station	RY 18/19
Department-wide	**08:38**
Station 1	07:47
Station 2	09:16
Station 3	07:45
Station 4	10:55
Station 5	09:47
Station 6	08:02
Station 7	09:00
Station 8	07:38
Station 9	08:42
Station 10	09:49
Station 11	10:30

The Alameda County Regional Emergency Communications Center's (ACRECC) call processing time to 90 percent of the fire/EMS incidents is 1:35 minutes, very close to a national best practice recommendation of 1:30 minutes. At 2:13 minutes, the fire crew turnout times are *just* over a Citygate recommendation of 2:00 minutes. However, the travel times in the following table are slower than a best practices recommendation of 4:00 minutes for 90 percent of the incidents in an urban population density.

Table 2—Travel Time Analysis

Station	RY 18/19
Department-wide	**05:59**
Station 1	05:24
Station 2	06:21
Station 3	05:12
Station 4	07:52
Station 5	06:56
Station 6	05:20
Station 7	06:22
Station 8	04:58
Station 9	05:55
Station 10	06:54
Station 11	07:33

The percent of emergency incidents reached within 4:00 minutes travel time by a Department first responder has degraded steadily since 2004, and the rate of decay is *accelerating*.

Table 3—Percent of Incidents Reached by Fourth Minute of Travel by Year

Department-wide	2004	RY 16/17	RY 17/18	RY 18/19
Incidents Reached by Fourth Minute of Travel	79%	69.4%	67.9%	62.7%

The 4:00-minute first-due goal as published in National Fire Protection Association (NFPA) 1710[1] was developed in an era before advanced geographic information systems (GIS) mapping and statistics could model the challenges of a community with some hills and a curvilinear street network. Also, in that era, dispatch processing was thought to only require 1:00 minute, and crew turnout was only expected to require 1:00 minute. It is now understood that the complexities of dispatching can take up to 1:30 minutes, and crew turnout can take up to 2:00 minutes.

The City has 11 fire stations in all its key neighborhoods. Reaching 90 percent of the calls in 4:00 minutes or less travel time would require additional stations, which is not fiscally prudent based on the number and severity of incidents at this time. EMS accounts for 65 percent of the incidents

[1] Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Career Fire Departments.

and, of those, typically less than 20 percent are critical emergencies with a stopped heart or breathing. The number of structure fires is modest, and the 11-station system can deliver four engines and a ladder truck to these fires within 13:29 minutes total response time, which is only 2:00 minutes longer than Citygate's recommendation; building fires are reached in the core of the City much faster.

A typical Citygate response performance recommendation for first-due arrival is within 7:30 minutes from 9-1-1 dispatch notification, and for ERF arrival within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability. A 7:30-minute total response time measure uses 4:00 minutes travel time. The 2019 Alameda County EMS contract calls for Fire Department responders to arrive within 8:30 minutes from a 9-1-1 call.

With concerted effort, the City should be able to improve or at least maintain its current travel times. As traffic congestion worsens and high incident demand areas, like District 1, draw in more resources from other areas, simultaneous incidents in those areas receive longer travel times as units must cross the City covering for each other. This can be a problem at peak traffic congestion hours. As unit workloads approach Citygate's recommended threshold, the City will need to consider how to increase the number of units to serve the increasing demand from the existing 11 fire stations and, longer term, could need to consider an infill fire station.

In terms of emergency incident workload per unit, only Engine 51 is approaching the Citygate-recommended 30 percent unit-hour utilization threshold. However, during peak hours of the day, from 8:00 am to 8:00 pm, there is a Citywide simultaneous incident rate of at least two incidents at once 50 percent of the time.

The two ladder trucks are located too close together and limit the northern City ERF coverage. District 1 is very busy, and the ladder truck must cover many of the simultaneous medical incidents in District 1. This serves to wear an expensive aerial apparatus and responding to medical incidents means it is less available for fires and technical rescue incidents.

Given these issues and the high unit workloads in and near District 1, several improvements could be gained with a two-part deployment change:

1. Relocate the ladder truck from Station 1 to Station 6.
2. Add a Paramedic fire company with three personnel to Station 1, increasing the Citywide coverage from 13 to 14 companies.

Use the second fire company in District 1 to not only respond to simultaneous incidents in the core of the City but to also support adjacent districts when those units attend mandatory training outside their district or are committed to long-duration incidents. The investment in another company would stabilize response times in many parts of the City.

FINDINGS AND RECOMMENDATIONS

The following are findings and recommendations regarding deployment presented throughout this report.

Finding #1: While the City Council has adopted a response time goal, it needs more specificity regarding the measure start time. The City does not have response time goals for all types of fire/EMS emergencies.

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Finding #3: The current fire station placement provides a first response unit for all the City's major neighborhoods.

Finding #4: Fire unit travel times are longer than a best practice and Department goal of 4:00 minutes due to the terrain, curvilinear road network in many parts of the City, traffic calming measures, lack of comprehensive or next generation traffic pre-emption, and traffic congestion.

Finding #5: The Department's service demand is consistent, indicating the need for a 24-hour-per-day, seven-day-per-week fire and EMS emergency response system.

Finding #6: The largest impact of simultaneous incidents is felt in Station 1's District. This further shifts workload to other companies at peak hours of the day.

Finding #7: Call processing performance, at 1:35 minutes for 90 percent of the fire/EMS incidents, is very close to a best practice recommendation of 1:30 minutes.

Finding #8: Crew turnout performance, at 2:13 minutes, is only slightly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of the fire/EMS incidents.

Finding #9: First-due unit travel time, at 5:59 minutes to 90 percent of the fire/EMS incidents Citywide, is slower than the Department's 2005 90 percent travel time goal of 5:15 minutes and a best practice urban area goal of 4:00 minutes.

Finding #10: The Department's call to arrival time to 90 percent of the fire/EMS incidents, at 8:38 minutes, is slower than Citygate's recommended goal of 7:30 minutes. This result is primarily due to longer travel times.

Finding #11: The Effective Response Force (First Alarm) *travel* times, at 12:06 minutes, are longer than the best practice and Citygate-recommended goal of 8:00 minutes, and as with first-due units, reflects Fremont's challenging road network and topography.

The following Citygate recommendations are not listed in a priority order of importance; they are numbered in the order in which they appear in the technical report.

Recommendation #1: Adopt Updated Deployment Policies: The City Council should adopt *updated*, complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients when possible and keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:

1.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 7:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at ACRECC. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 4:00-minute travel time.

1.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, extricate trapped victims within 30:00 minutes, and treat multiple medical patients at a single incident, a multiple-unit ERF should arrive within 11:30 minutes from the time of 9-1-1 call receipt at ACRECC 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

1.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impacts on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

Fremont has a California Office of Emergency Services (OES) Type 2 Hazardous Materials Team and should maintain that State certification given the risks of a hazardous materials release within the City.

1.4 Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility. Fremont has a California Office of Emergency Services (OES) Type 1 Urban Search and Rescue team and should maintain that certification given the proximity of the City to the Hayward fault.

Recommendation #2: The Department should consider moving the ladder truck from Station 1 to Station 6 and adding a second staffed company at Station 1. Doing so will stabilize response time performance during peak hours for simultaneous incidents.

Recommendation #3: Work in concert with other City departments, including the Information Technology Services Department and the Public Works Department, to develop a multifaceted plan to improve response times, to include but not be limited to traffic signal preemption, smart corridor technologies, and less impactful traffic calming measures on key response routes.

Next Steps

- Review the content, findings, and recommendations of this report.
- Adopt revised response performance goals as recommended.
- Direct staff to return with a travel time improvement plan within 180 days and, as needed, modify an upcoming budget to implement the first phase.

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SECTION 1—INTRODUCTION AND BACKGROUND

The City of Fremont (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a Standards of Coverage (SOC) assessment to provide an ongoing foundation for fire service planning. The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. Citygate has provided recommendations to improve Department field deployment operations. Citygate's scope of work and corresponding Work Plan were developed consistent with Citygate's Project Team members' experience in fire administration and deployment. Citygate utilizes various National Fire Protection Association (NFPA) and Insurance Services Office (ISO) publications as best practice guidelines, along with the self-assessment criteria of the Commission on Fire Accreditation International (CFAI).

1.1 REPORT ORGANIZATION

This report is organized into the following sections. **Volume 2** (Map Atlas) is separately bound.

Executive Summary	Summary of current services and significant future challenges.
Section 1	Introduction and Background: An introduction to the study and background facts about the City.
Section 2	Standards of Coverage Assessment: An overview of the SOC process and detailed analysis of existing deployment policies, outcome expectations, community risk, critical tasks, distribution and concentration effectiveness, reliability and historical response effectiveness, and overall deployment evaluation.
Appendix A	Risk Assessment

In this report, the term "Department" will be used when referring to the fire agency itself, and the term "City" will be used when referring to the City of Fremont.

1.1.1 Goals of the Report

This report cites findings and makes recommendations, as appropriate, related to each finding. Findings and recommendations throughout this report are sequentially numbered. A complete list of these findings and recommendations is provided in the Executive Summary.

This document provides technical information about how fire services are provided, legally regulated, and how the Department currently operates. This information is presented in the form of recommendations and policy choices for consideration by the Department and City.

The result is a sound technical foundation upon which to understand the advantages and disadvantages of the choices facing Department and City leadership regarding the best way to provide fire services and, more specifically, at what level of desired outcome and expense.

1.1.2 Limitations of the Report

In the United States, there are no federal or state regulations requiring a specific minimum level of fire services. Each community, through the public policy process, is expected to understand the local fire and non-fire risks and its ability to pay for services, and then choose its level of fire services. *If* fire services are provided at all, federal and state regulations specify how to safely provide them for the public and for the personnel providing the services.

While this report and technical explanation can provide a framework for the discussion of Department services, neither this report nor the Citygate team can make the final decisions nor assess the cost of every alternative in detail. Once final strategic choices receive policy approval, City staff can conduct final costing and fiscal analyses as typically completed in its normal operating and capital budget preparation cycle.

1.2 PROJECT APPROACH AND SCOPE OF WORK

1.2.1 Project Approach and Research Methods

Citygate utilized multiple sources to gather, understand, and model information about the City and the Department. Citygate requested a large amount of background data and information to better understand current costs, service levels, history of service level decisions, and other prior studies.

In subsequent site visits, Citygate performed focused interviews of the Department's project team members and other project stakeholders. Citygate reviewed demographic information about the City and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected fire service deployment with the goal of identifying the location(s) of stations and crew quantities required to best serve the City and to facilitate deployment planning.

Once Citygate gained an understanding of the Department's service area and its fire and non-fire risks, the Citygate team developed a model of fire services that was tested against the travel time mapping and prior response data to ensure an appropriate fit. Citygate also evaluated future City growth and service demand by risk type and evaluated potential alternative emergency service delivery models. The result is a framework for enhancing Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Project Scope of Work

Citygate's approach to this SOC assessment involved:

- Reviewing information provided by the Department and City
- Utilizing FireView™, a geographic mapping program, to model fire station travel time coverage
- Using StatsFD™, an incident response time analysis program, to review the statistics of prior incident performance and plot the results on graphs and mapping exhibits
- Reviewing projected City population and related development growth
- Projecting future service demand by risk type
- Identifying and evaluating potential alternate service delivery models
- Recommending appropriate risk-specific response performance goals
- Identifying a long-term strategy, including incremental short- and mid-term goals, to achieve desired response performance objectives

1.3 City Overview[2]

Located in the southeast San Francisco Bay Area and bordering both the East Bay and South Bay regions, Fremont is the fourth largest city in the San Francisco Bay Area. In 1956, five individual townships—Mission San Jose, Centerville, Niles, Irvington, and Warm Springs—came together to form the City of Fremont. Since incorporation, Fremont has created six more districts, which it calls "community plan areas" for planning purposes. These include Central Fremont, North Fremont, South Fremont, and Bayside. The two other districts, Baylands and the Hill Areas, are primarily open space.

Fremont is one of the most ethnically and culturally diverse cities in the Bay Area. Fremont is astride multiple major transportation routes—Interstates 680 and 880, as well as rail transport lines including Altamont Commuter Express (ACE), Amtrak Capitol Corridor, and the Bay Area Rapid Transit (BART) system.

Fremont's 2011 population of 215,000 was projected to increase to approximately 256,000 by 2035. This projection anticipates a growing local economy, with employment gains leading to population increases. Fremont grew rapidly as a young City—by almost 600 percent between 1956

[2] Fremont website and 2030 General Update.

and 1990. Growth then slowed substantially. Fremont's population increased by approximately 17 percent between 1990 to 2000, and since 2000 it has grown by approximately five percent.

The Fremont Fire Department has a long and proud history of growing to meet the community's needs. The five volunteer fire companies of the original townships formed the core of the Fremont Fire Department upon incorporation in 1956. Soon afterward in 1959, a sixth station was added in South Irvington, then a seventh in 1963 in the growing central business district.

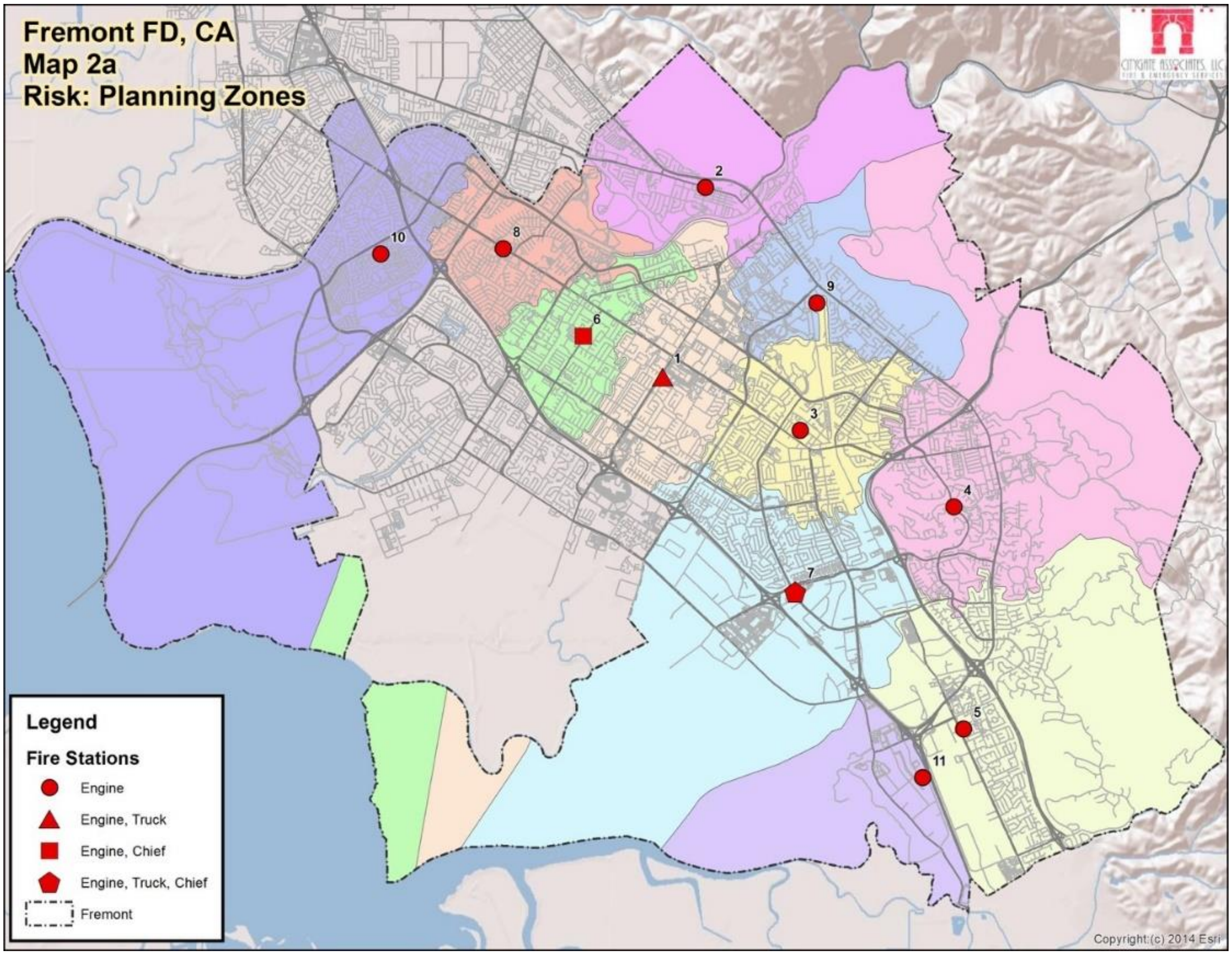
Station 8 was obtained in 1978 to accommodate the growth in the North Plain area. In 1985, the Council adopted a plan calling for expansion of the then eight stations to an 11-station model for fire and emergency medical services. The City began deploying Paramedics on fire engines and was the first in the Bay Area to do so. The City also adopted a more stringent fire sprinkler ordinance to allow a leaner staffing model than what would otherwise be necessary without built-in fire protection of buildings.

In 1990, Stations 9 and 10 were added to address long response times in Ardenwood and Mission Boulevard / Canyon Heights. Around the same time, Stations 4 and 5 were rebuilt into modern facilities from the original volunteer quarters. In 2003, on the heels of a discussion regarding fire engine staffing and a seismic study of fire station construction, the City created and adopted a Standard of Response Cover (SOC) policy into its General Plan Safety Element.

In 2001, a temporary Fire Station 11 opened in the Baylands area, and in 2010 a new permanent Station 11 was completed on Lakeview Boulevard. Since 2001, the Department has not opened any additional fire stations or added any additional suppression companies. During this timeframe, the Department's Citywide incident volume grew 25 percent from 12,867 in 2002 to 15,964 in RY 18/19.

This commitment to public service is evidenced by the insurance underwriting industry's fire department classifications rating reductions the Department has received. At present, the Department is part of a select group of statewide departments with an ISO Class 2 rating.

Figure 1—Fire Station Districts and General Geography



1.4 FIRE DEPARTMENT OVERVIEW

The Department operates out of 11 strategically located fire stations. All fire stations deliver fire suppression capabilities and Paramedic level EMS. The Department has a daily constant (minimum/maximum) staffing of 41 firefighting personnel on duty operating 11 fire engines (three firefighters each), two ladder trucks (three firefighters each), and two Battalion Chiefs. In addition, the Department also cross-staffs (using fire engine staff) specialty units for wildland, hazardous materials, and technical rescue responses.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or Paramedic level, capable of providing Advanced Life Support (ALS) pre-hospital emergency medical care. Ground Paramedic ambulance service is provided by a Countywide private company under contract with Alameda County.

Response personnel are also trained to the United States Department of Transportation Hazardous Material First Responder Operations level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. Six personnel per shift are further trained to the Hazardous Materials Technician or Specialist level for immediate response.

All types of technical rescues for the Department are conducted by the on-duty staff trained in confined space, trench rescue, and low-angle rescue. On-duty units are also trained to the operational level to assist the technicians.

1.4.1 Facilities and Resources

The Department provides services from 11 fire stations, as shown in the following table.

Table 4—Minimum Daily Staffing

Minimum Per Unit	Staff Type and Number		Total Personnel
11 Engines	3	Firefighters per Day	33
2 Ladder Trucks	3	Firefighters per Day	6
Battalion Chief	2	Per day for Command	2
Total 24-Hour Personnel			**41**

SECTION 2—STANDARDS OF COVERAGE ASSESSMENT

This section provides a detailed analysis of the Department's current ability to deploy and mitigate emergency risks within its service area. The response analysis uses prior response statistics and geographic mapping to help the Department and the community visualize what the current response system can and cannot deliver.

2.1 STANDARDS OF COVERAGE PROCESS OVERVIEW

The core methodology used by Citygate in the scope of its deployment analysis work is the *Standards of Cover*, 5th and 6th editions, which is a systems-based approach to fire department deployment published by the CFAI. This approach uses local risk and demographics to determine the level of protection best fitting a community's needs.

The SOC method evaluates deployment as part of a fire agency's self-assessment process. This approach uses risk and community expectations regarding outcomes to help elected officials make informed decisions regarding fire and EMS deployment. Citygate has adopted this multiple-part systems approach as a comprehensive tool to evaluate fire station locations. Depending on the needs of the study, the depth of the components may vary.

Such a systems approach to deployment, rather than a one-size-fits-all prescriptive formula, allows for local determination. In this comprehensive approach, each agency can match local needs (risks and expectations) with the costs of various levels of service. In an informed public policy debate, a governing board "purchases" the fire and emergency medical service levels the community needs and can afford.

While working with multiple components to conduct a deployment analysis is admittedly more work, it yields a much better result than using only a single component. For instance, if only travel time is considered, and frequency of multiple calls is not, the analysis could miss over-worked companies. If a risk assessment for deployment is not considered, and deployment is based only on travel time, a community could under-deploy to incidents.

The following table describes the eight elements of the SOC process.

Table 5—Standards of Coverage Process Elements

SOC Element		Description
1	Existing Deployment Policies	Reviewing the deployment goals the agency has in place today.
2	Community Outcome Expectations	Reviewing the expectations of the community for response to emergencies.
3	Community Risk Assessment	Reviewing the assets at risk in the community. (For this report, see Appendix A—Risk Assessment.)
4	Critical Task Analysis	Reviewing the tasks that must be performed and the personnel required to deliver the stated outcome expectation for the ERF.
5	Distribution Analysis	Reviewing the spacing of first-due resources (typically engines) to control routine emergencies.
6	Concentration Analysis	Reviewing the spacing of fire stations so that more complex emergencies can receive sufficient resources in a timely manner (First Alarm Assignment or the ERF).
7	Reliability and Historical Response Effectiveness Analysis	Using prior response statistics to determine the percent of compliance the existing system delivers.
8	Overall Evaluation	Proposing Standards of Coverage statements by risk type, as necessary.

Source: CFAI *Standards of Cover*, 5th Edition

Simply summarized, fire service deployment is about the *speed* and *weight* of the response. *Speed* refers to initial response (first-due) of all-risk intervention resources (engines, trucks, and/or ambulances) strategically deployed across a jurisdiction for response to emergencies within a certain time to achieve desired outcomes. *Weight* refers to the multiple-unit Effective Response Force (ERF), also commonly called a First Alarm, deployed for more serious emergencies, such as building fires, multiple-patient medical emergencies, vehicle collisions with extrication required, or technical rescue incidents. In these situations, a sufficient number of firefighters must be assembled within a reasonable amount of time to safely control the emergency and prevent it from escalating into a more serious event. The following table illustrates this deployment paradigm.

Table 6—Fire Service Deployment Paradigm

Element	Description	Purpose
Speed of Response	Travel time of initial response of all-risk intervention units strategically located across a jurisdiction.	Controlling routine to moderate emergencies to prevent the incident from escalating in size or complexity.
Weight of Response	Number of firefighters in a multiple-unit response for serious emergencies.	Assembling enough firefighters within a reasonable time frame to safely control a more complex emergency without escalation.

Thus, smaller fires and less complex emergencies require a single-unit or two-unit response (engine and/or specialty resource) within a relatively short response time. Larger or more complex incidents require more units and personnel to control. In either case, if the crews arrive too late or the total number of personnel is too few for the emergency, they are drawn into an escalating and more dangerous situation. The science of fire crew deployment is to spread crews out across a community or jurisdiction for quick response to keep emergencies small with positive outcomes, without spreading resources so far apart that they cannot assemble quickly enough to effectively control more serious emergencies.

2.2 Current Deployment

SOC Element 1 of 8
Existing Deployment Policies

Nationally recognized standards and best practices suggest using several incremental measurements to define response time. Ideally, the clock start time is when the 9-1-1 dispatcher receives the emergency call. In Fremont's case, when a 9-1-1 call is received by Fremont Police Dispatch, it is first screened to determine if fire or police resources are required. If the nature of the call is fire related, the call is transferred to ACRECC. Currently, the response time clock starts when ACRECC first enters the incident in its computer-aided dispatch (CAD) system. Response time increments include ACRECC call processing, crew alerting, response unit boarding (commonly called turnout time), and actual driving (travel) time.

The following are the City's current response time goals, adopted by the City Council in the 2011 General Plan, Safety Element:

Policy 10-4.4: Supplemental Fire Mitigation

Require supplemental fire mitigation measures in new development proposed above the Toe of the Hill (TOH) or other locations outside a 6:40 minute response-time area. Limit development in those areas where, despite fire mitigation measures, an acceptable level of protection is considered unattainable.

Implementation 10-4.4.A: Supplemental Mitigation

Require supplemental mitigation measures such as wetlands, fire resistant landscaping, defensible space, fire resistant construction, sprinkler systems, vegetation management and early warning fire detection systems for properties in the Very High Fire Hazard Severity Zone or as determined necessary by the Fire Department.

Goal 10-5: Emergency Response

A 6:40 minute response 90 percent of the time for emergencies in areas located below the TOH.

Policy 10-5.1: Standard of Cover

Provide an adequate level of fire equipment and personnel to protect the City in accordance with the adopted SOC.

Implementation 10-5.1.A: Fire Station Location Review

Periodically review existing and projected land uses within the City and implement plans for improving fire service through expansion and proper location of the City's fire stations, and appropriate equipment, personnel and other improvements in accordance with the adopted SOC.

Implementation 10-5.1.B: Fire Station Improvement

Continue to implement plans for improving service delivery through station expansion, relocation and/or other improvements as necessary.

Policy 10-5.2: 6:40 Minute Response Time

Strive to maintain a 6:40 minute response time for areas below the TOH.

Implementation 10-5.2.A: Response Time Evaluation

Continually evaluate response time and make improvements to equipment and personnel when necessary to ensure goals are met.

Implementation 10-5.2.B: Traffic Signal Override

Periodically evaluate the costs and benefits of equipping City emergency response vehicles with traffic signal override capabilities to speed responses and expand the program when appropriate.

The Department reports these measures of performance to the City Council; however, these goals do not address all types of response performance to other risks within the City, such as hazardous materials and technical rescue, as recommended by the CFAI. The response time goals do not define the "clock start" point of a measure as being 9-1-1 call receipt or the fire crew notification point.

NFPA 1710, the recommended deployment standard for career fire departments in urban/suburban areas, currently recommends the initial (first-due) intervention unit arrive within a 4:00-minute travel time and recommends arrival of all resources comprising the multiple-unit First Alarm within an 8:00-minute travel time at 90 percent or better reliability.[3]

The most recent published best practices by the NFPA for dispatching have increased the dispatch processing time to 90 seconds and, if there are language barriers, to 120 seconds. Further, for crew turnout time, 60 to 80 seconds is recommended depending on the type of protective clothing that must be donned.

If the travel time measures recommended by the NFPA (and Citygate) are added to dispatch processing and crew turnout times recommended by Citygate and best practices, then a realistic, 90 percent, first-due arrival goal is 7:30 minutes from the time of ACRECC receiving the 9-1-1 call transfer from the Fremont Police Department. This is comprised of 90 seconds dispatch, plus 2:00 minutes crew turnout, plus 4:00 minutes travel.

Finding #1:	While the City Council has adopted a response time goal, it needs more specificity regarding the measure start time. The City does not have response time goals for all types of fire/EMS emergencies.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of 11 engines and two ladder trucks, staffed with a minimum of three personnel each, and two Battalion Chiefs, for a total daily minimum year-round continuous staffing of at least 41 personnel operating from 11 fire stations. This deployment model meets the minimum staffing standards for building fires as recommended by NFPA 1710 and provides sufficient personnel for an Effective Response Force (ERF or First Alarm) to serious fire incidents. The Department has mutual-aid agreements with other fire agencies in Alameda and Santa Clara Counties, and is also a signatory to the County and State of California mutual-aid agreements.

[3] 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 Edition).

Response Plan

The Department is an all-risk fire agency providing the people it protects with services that include fire suppression; pre-hospital Paramedic (ALS) EMS; hazardous material and technical rescue response; and other non-emergency services including fire prevention, community safety education, and other related services.

Given these risks, the Department utilizes a tiered response plan calling for different types and numbers of resources depending on incident/risk type. ACRECC selects and dispatches the closest and most appropriate Department resource types pursuant to the Department's response plan, as shown in the following table.

Table 7—Response Plan by Incident Type

Incident Type	Resources Dispatched	Total Personnel
Single-Patient EMS	1 Engine or 1 Truck + 1 Private Ambulance	3+2
Vehicle Fire	1 Engine	3
Building Fire Residential	4 Engines, 1 Ladder Truck, 2 Battalion Chiefs	17
Wildland Fire	4 Wildland Engines, 2 Battalion Chiefs	14
Rescue	2 Engines, 1 Ladder Truck, 1 Rescue Unit, 2 Battalion Chiefs + 1 Private Ambulance	14+2
Hazardous Material	2 Engines, 1 Hazardous Materials Unit, 1 Ladder Truck, 2 Battalion Chiefs	14

Source: Fire Department

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

2.3 OUTCOME EXPECTATIONS

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The SOC process begins by reviewing existing emergency services outcome expectations. This includes determining the purpose of the response system and whether the governing body has adopted any response performance measures. If it has, the time measures used must be understood and reliable data must be available.

Current national best practice is to measure percent completion of a goal (e.g., 90 percent of responses) instead of an average measure. Mathematically, this is called a fractile measure.[4] This is because measuring the average only identifies the central or middle point of response time performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were far above or just above the average.

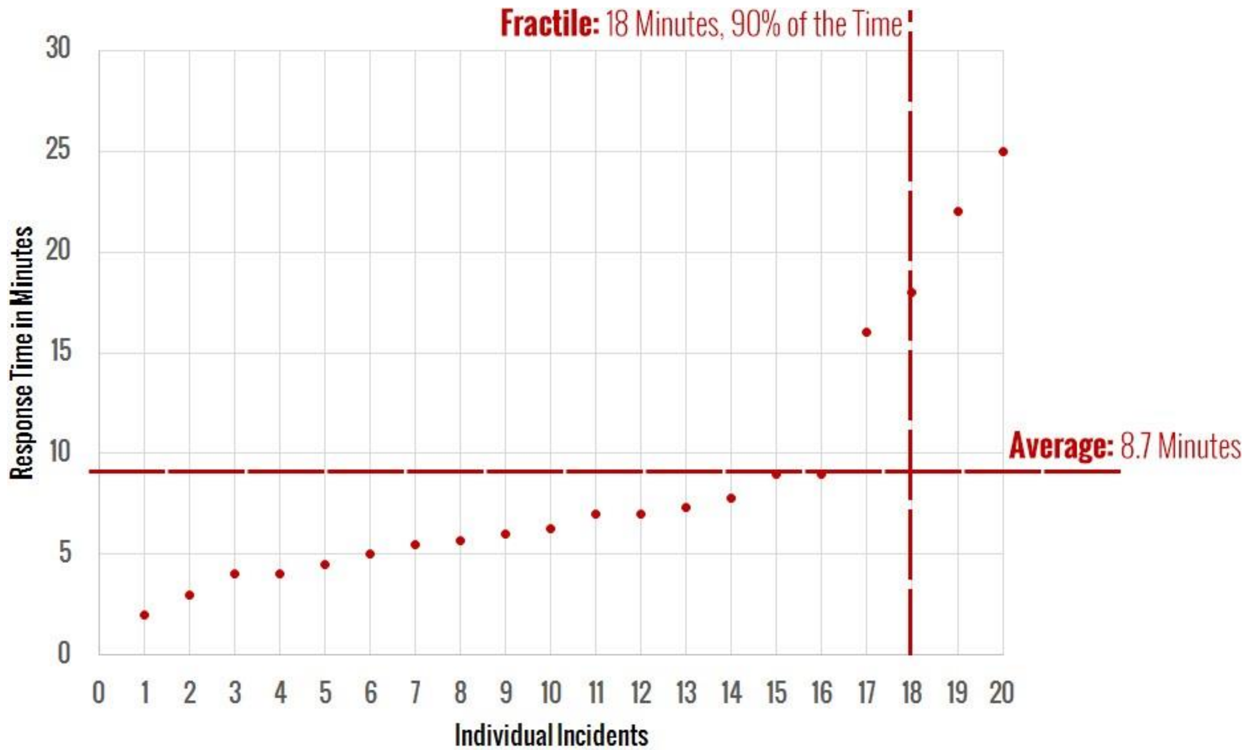
For example, Figure 2 shows response times for a fictitious fire department. This agency is small and receives 20 calls for service each month. Each response time has been plotted on the graph from shortest to longest response time.

Figure 2 shows that the average response time is 8.7 minutes. However, the average response time fails to properly account for four calls for service with response times far greater than a threshold in which positive outcomes could be expected. In fact, it is evident in Figure 2 that 20 percent of responses are far too slow and that this jurisdiction has a potential life-threatening service delivery problem. Average response time as a measurement tool for fire services is simply not sufficient. This is a significant issue in larger cities if hundreds or thousands of calls are answered far beyond the average.

By using the fractile measurement with 90 percent of responses in mind, this small jurisdiction has a response time of 18:00 minutes, 90 percent of the time. This fractile measurement is far more accurate at reflecting the service delivery situation of this small agency.

[4] A *fractile* is that point below which a stated fraction of the values lie. The fraction is often given in percent; the term percentile may then be used.

Figure 2—Fractile versus Average Response Time Measurements



More importantly, within the SOC process, positive outcomes are the goal. From that, crew size and response time can be calculated to allow appropriate fire station spacing (distribution and concentration). Emergency medical incidents include situations with the most severe time constraints. The brain can only survive 4:00 to 6:00 minutes without oxygen. Cardiac arrest, drowning, choking, trauma constrictions, or other similar events can cause oxygen deprivation to the brain. In a building fire, a small incipient fire can grow to involve the entire room in a 6:00- to 8:00-minute time frame. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, *all* responding crews must arrive, assess the situation, and deploy effective measures before brain death occurs or the fire spreads beyond the room of origin.

Thus, from the time of 9-1-1 receiving the call, an effective deployment system is *beginning* to manage the problem within a 7:00- to 8:00-minute total response time. This is right at the point that brain death is becoming irreversible and the fire has grown to the point of leaving the room of origin and becoming very serious. Thus, the City needs a <u>first-due</u> response goal that is within a range to give hope for a positive outcome. It is important to note that the fire or medical emergency continues to deteriorate from the time of inception, not from the time the fire engine starts to drive the response route. Ideally, the emergency is noticed immediately and the 9-1-1 system is activated promptly. This step of awareness—calling 9-1-1 and giving the dispatcher accurate information—

takes, in the best of circumstances, 1:30 minutes. Crew notification and travel time take up to an additional 2:00 minutes. After the unit travels across the road network, upon arrival, the crew must approach the patient or emergency, assess the situation, and appropriately deploy its skills and tools. Even in easy-to-access situations, this step can take 2:00 minutes or more. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multiple-story apartments or office complexes, or shopping center buildings.

Unfortunately, there are times when the emergency has become too severe, even before the 9-1-1 notification and/or fire department response, for the responding crew to reverse; however, when an appropriate response-time policy is combined with a well-designed deployment system, then only anomalies like bad weather, poor traffic conditions, or multiple emergencies slow down the response system. Consequently, a properly designed system will give citizens the hope of a positive outcome for their tax-dollar expenditure.

For this report, total response time is the sum of the ACRECC call processing, fire crew turnout, and road travel time steps. This is consistent with CFAI best practice recommendations. The 9-1-1 call transfer from the Fremont Police Department to ACRECC should be monitored and reported regularly to the Fremont Fire Department. Calls to 9-1-1 should be answered within 15 seconds 95 percent of the time. The call should then be transferred and picked up by ACRECC within 30 seconds 90 percent of the time.

2.4 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the SOC process is a community risk assessment. Within the context of an SOC study, the objectives of a community risk assessment are to:

- Identify the values at risk to be protected within the community or service area.
- Identify the specific hazards with the potential to adversely impact the community or service area.
- Quantify the overall risk associated with each hazard.
- Establish a foundation for current/future deployment decisions and risk-reduction / hazard mitigation planning and evaluation.

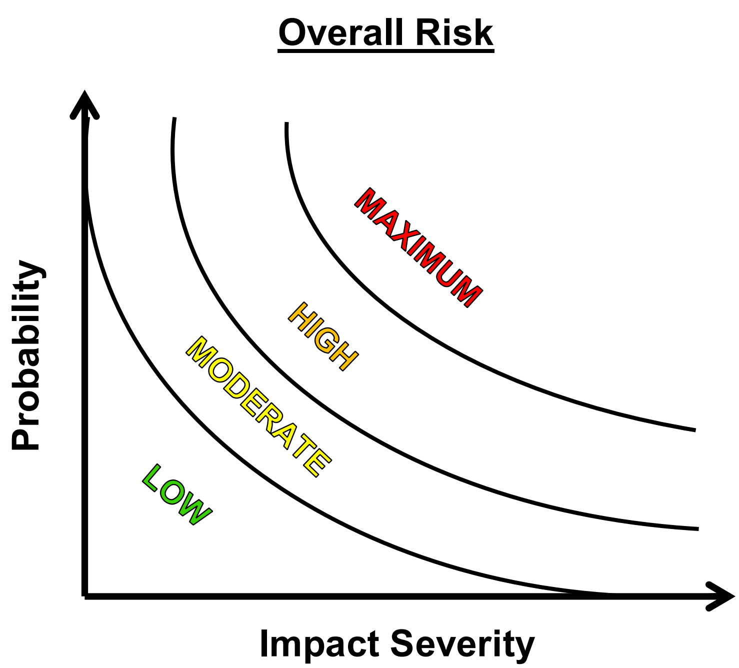
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the probability of hazard occurrence in combination with the likely severity of resultant impacts to people, property, and the community as a whole.

2.4.1 Risk Assessment Methodology

The methodology employed by Citygate to assess community risks as an integral element of an SOC study incorporates the following elements:

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification (to the extent data is available) of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Identification and evaluation of multiple, relevant impact severity factors for each hazard by planning zone using agency-/jurisdiction-specific data and information.
- Quantification of overall risk for each hazard based on probability of occurrence in combination with probable impact severity as shown in Figure 3.

Figure 3—Overall Risk



2.4.2 Values at Risk to Be Protected

Broadly defined, *values at risk* are those tangibles of significant importance or value to the community or jurisdiction that are potentially at risk of harm or damage from a hazard occurrence.

Values at risk typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, and/or natural resources.

People

Residents, employees, visitors, and travelers through a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than ten years of age, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:[5]

- Slightly more than 25 percent of the population is under ten years or over 65 years of age.
- The City's population is predominantly Asian (61 percent), followed by White (16 percent), Hispanic/Latino (13 percent), other ethnicities (6 percent), and Black / African American (4 percent).
- Of the population over 24 years of age, more than 93 percent has completed high school or equivalency.
- Of the population over 24 years of age, slightly more than 55 percent has an undergraduate, graduate, or professional degree.
- Nearly 67 percent of the population 15 years of age or older is in the workforce; of those, 4.57 percent are unemployed.
- The population below the federal poverty level is 4.9 percent.
- Only 3.42 percent of the population does not have health insurance coverage.

The Association of Bay Area Governments (ABAG) projects Fremont's population will grow to 275,440 (over the next 21 years). Housing units are projected to increase at a slower rate to 87,440 over the same period.

Critical Infrastructure / Key Resources

The U.S. Department of Homeland Security defines Critical Infrastructure / Key Resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. A hazard

[5] U.S. Census Bureau (2017).

occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Buildings

The City has more than 76,000 housing units, as well as a large inventory of non-residential occupancies, including office, research, professional services, and retail sales buildings; restaurants/bars; motels; churches; schools; government facilities; healthcare facilities; and other non-residential uses as described in **Appendix A**.

2.4.3 Hazard Identification

Citygate utilized prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and data and information specific to the agency/jurisdiction to identify the hazards to be evaluated for this report.

Following an evaluation of the fire and non-fire hazards as identified by the CFAI as they relate to services provided by the Department, Citygate evaluated the following five hazards for this risk assessment:

- Building Fire
- Wildland Fire
- Medical Emergency
- Hazardous Material Release/Spill
- Technical Rescue

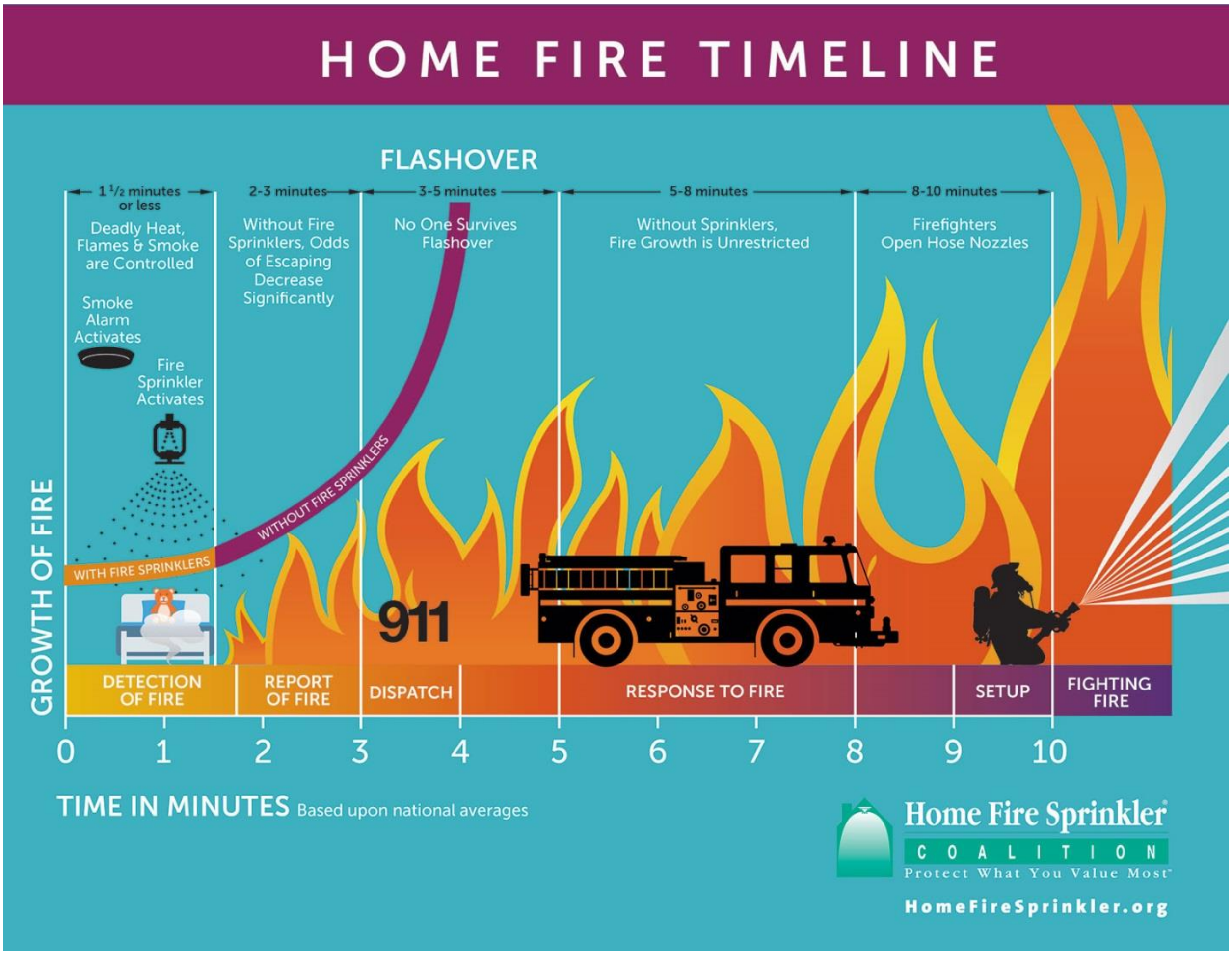
Because building fires and medical emergencies have the most severe time constraints if positive outcomes are to be achieved, the following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all five hazards.

Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building density, size, age, occupancy, and construction materials and methods, as well as the number of stories, the required fire flow, the proximity to other buildings, built-in fire protection/alarm systems, an available fire suppression water supply, building fire service capacity, fire suppression resource deployment (distribution/concentration), staffing, and response time.

Figure 4 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as 3:00 to 5:00 minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

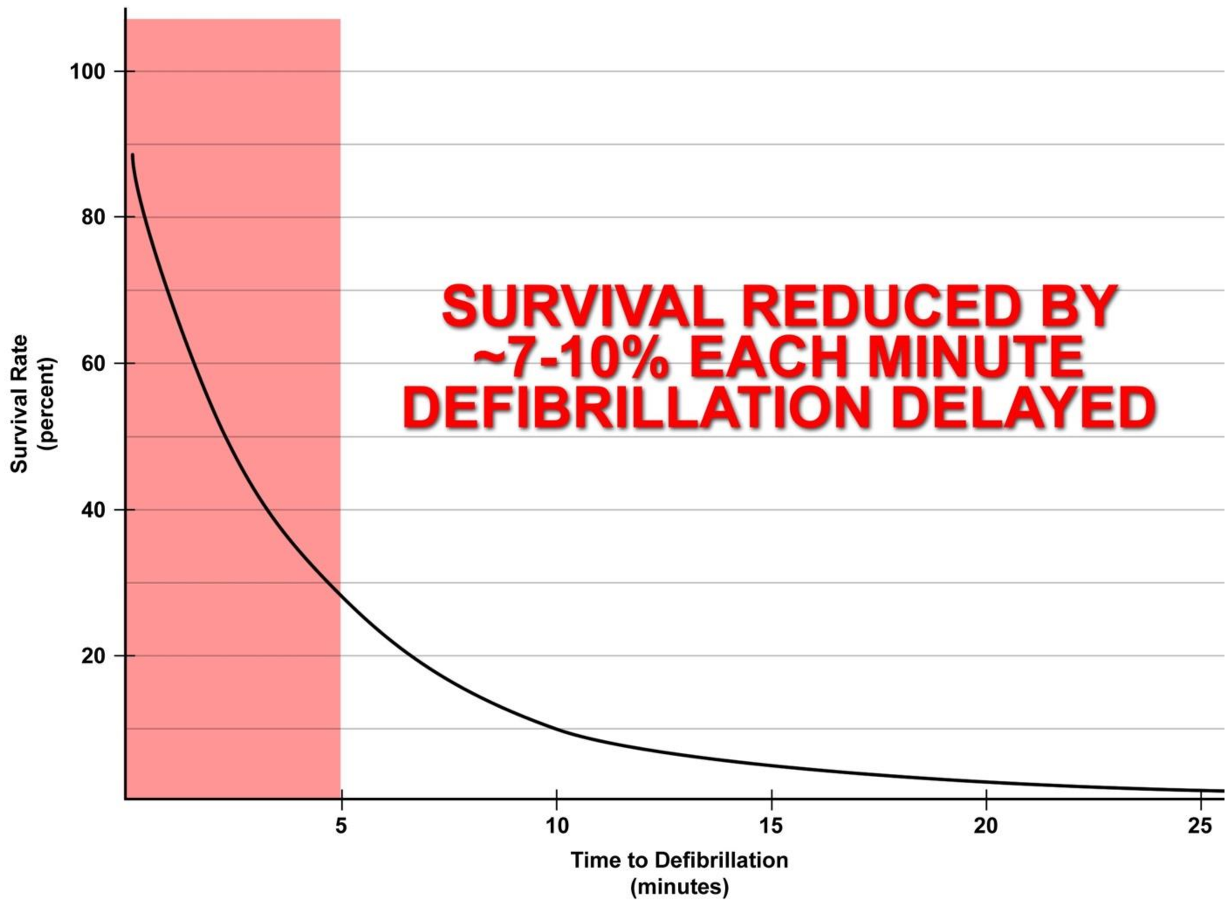
Figure 4—Building Fire Progression Timeline



Medical Emergency Risk

Fire agency service demand in most jurisdictions is predominantly for medical emergencies. Figure 5 illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases.

Figure 5—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org

The Department currently provides ALS pre-hospital emergency medical services, with operational personnel trained to the EMT or EMT-Paramedic level.

2.4.4 Risk Assessment Summary

The City's overall risk for the five hazards related to emergency services presented in this report range from **Low** to **High**, as summarized in the following table. See **Appendix A** for the full risk assessment.

Table 8—Overall Risk by Hazard

Planning Zone	Building Fire	Vegetation / Wildland Fire	Medical Emergency	Hazardous Materials	Technical Rescue
Station 1	*Moderate*	*Low*	*High*	*Low*	*Low*
Station 2	*Moderate*	*Moderate*	*High*	*Low*	*Low*
Station 3	*Moderate*	*Low*	*High*	*Low*	*Low*
Station 4	*Low*	*Moderate*	*High*	*Moderate*	*Low*
Station 5	*Moderate*	*Moderate*	*High*	*High*	*Low*
Station 6	*Moderate*	*Low*	*High*	*Low*	*Low*
Station 7	*Moderate*	*Low*	*High*	*High*	*Low*
Station 8	*Moderate*	*Low*	*High*	*Moderate*	*Low*
Station 9	*Moderate*	*Moderate*	*High*	*Moderate*	*Low*
Station 10	*Moderate*	*Low*	*High*	*Moderate*	*Low*
Station 11	*Low*	*Low*	*Moderate*	*Moderate*	*Low*

2.5 Critical Task Time Measures—What Must Be Done Over What Time Frame to Achieve the Stated Outcome Expectation?

SOC Element 4 of 8
Critical Task Time Study

SOC studies use critical task information to determine the number of firefighters needed within a time frame to achieve desired objectives on fire and emergency medical incidents. Table 9 and Table 10 illustrate critical tasks typical of building fire and medical emergency incidents, including the minimum number of personnel required to complete each task. These tables are composites from Citygate clients in urban/suburban departments similar to the City, with units staffed with three personnel per engine or ladder truck. It is important to understand the following relative to these tables:

- It can take a considerable amount of time after a task is ordered by command to complete the task and arrive at the desired outcome.
- Task completion time is usually a function of the number of personnel that are *simultaneously* available. The fewer firefighters available, the longer some tasks will take to complete. Conversely, with more firefighters available some tasks are completed concurrently.

- Many tasks must be conducted by a minimum of two firefighters to comply with safety regulations. For example, two firefighters are required to search for a victim in a smoke-filled room.

2.5.1 Critical Firefighting Tasks

Table 9 illustrates the critical tasks required to control a typical single-family dwelling fire with five response units (four engines, one truck, two chiefs) from the City, for a total ERF of 17 personnel. These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the SOC process. No conditions exist to override the Occupational Safety and Health Administration (OSHA) two-in/two-out safety policy, which requires that firefighters enter atmospheres that are immediately dangerous to life and health, such as building fires, in teams of two while two more firefighters are outside, immediately ready to rescue them should trouble arise.

Scenario: Simulated approximately 2,000 square foot, two-story, *residential* single-family house fire with unknown rescue situation. Responding companies receive dispatch information typical for a witnessed fire. Upon arrival, they find approximately 50 percent of the second floor involved in fire.

Table 9—First Alarm Residential Fire Critical Tasks – 17 Personnel

	Critical Task Description	Personnel Required
	First-Due Engine (3 personnel)	
1	Conditions report.	1
2	Establish supply line to hydrant.	2
3	Deploy initial fire attack line to point of building access.	1–2
4	Operate pump and charge attack line.	1
5	Establish incident command.	1
6	Conduct primary search if conditions dictate.	2
	Second-Due Engine (3 personnel)	
7	If necessary, establish supply line to hydrant.	1–2
8	Deploy a backup attack line.	1–2
9	Establish Initial Rapid Intervention Crew for OSHA 2-in-2-out.	2
	First-Due Truck (3 personnel)	
10	Deploy ground ladders to roof.	1–2
11	Establish horizontal or vertical building ventilation.	1–2
12	Open concealed spaces as required.	2
	Chief Officers	
13	Transfer of incident command.	1
14	Establish exterior command and scene safety.	1
	Third-Due Engine (3 personnel each)	
15	Conduct primary search.	3
	Fourth-Due Engine (3 personnel each)	
16	Establish Rapid Intervention Crew.	
17	Secure utilities.	1–2
18	Deploy additional attack line(s) as needed.	2
19	Conduct secondary search.	2

Grouped together, the duties in the previous table form an ERF, or First Alarm Assignment. These distinct tasks must be performed to effectively achieve the desired outcome; arriving on scene does not stop the emergency from escalating. While firefighters accomplish these tasks, the incident progression clock keeps running.

Fire in a building can double in size during its free-burn period before fire suppression is initiated. Many studies have shown that a small fire can spread to engulf an entire room in less than 4:00 to

5:00 minutes after free burning has started. Once the room is completely superheated and involved in fire (known as flashover), the fire will spread quickly throughout the structure and into the attic and walls. For this reason, it is imperative that fire suppression and search/rescue operations commence before the flashover point occurs if the outcome goal is to keep the fire damage in or near the room of origin. In addition, flashover presents a life-threatening situation to both firefighters and any occupants of the building.

2.5.2 Critical Medical Emergency Tasks

The Department responded to 10,323 EMS incidents in RY 18/19 including cardiac arrests, vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies.

For comparison, the following table summarizes the critical tasks required for a cardiac arrest patient. Many of these tasks require Paramedic intervention and, for that reason, the Department strives to maintain two Paramedics per company per day.

Table 10—Cardiac Arrest Critical Tasks – Three Engine Personnel + Ambulance

	Critical Task	Personnel Required	Critical Task Description
1	Chest compressions	1–2	Compression of chest to circulate blood
2	Ventilate/oxygenate	1–2	Bag-valve-mask, apply O_2
3	Airway control	1–2	Manual techniques/intubation/cricothyroidotomy
4	Defibrillate	1–2	Electrical defibrillation of dysrhythmia
5	Establish I.V.	1–2	Peripheral or central intravenous access
6	Interpret ECG	2	Identify type and treat dysrhythmia
7	Administer drugs	2	Administer appropriate pharmacological agents
8	Patient charting	1–2	Record vitals, treatments administered, etc.
9	Hospital communication	1–2	Receive treatment orders from physician
10	Treat en route to hospital	2–3	Continue to treat/monitor/transport patient

2.5.3 Critical Task Analysis and Effective Response Force Size

The time required to complete the critical tasks necessary to stop the escalation of an emergency must be compared to outcomes. As shown in nationally published fire service time versus temperature tables, after approximately 4:00 to 5:00 minutes of free burning in a room, fire will escalate to the point of flashover. At this point, the entire room is engulfed in fire, the entire building becomes threatened, and human survival near or in the room of fire origin becomes impossible. Additionally, brain death begins to occur within 4:00 to 6:00 minutes of the heart stopping. Thus, the ERF must arrive in time to prevent these emergency events from becoming worse.

The Department's daily staffing is sufficient to deliver two ERFs of 17 personnel (a minimum of four engines, one ladder truck, and one of two Battalion Chiefs) to a building fire, if they can arrive in time, which the statistical analysis of this report will discuss in depth. Mitigating an emergency event is a team effort once the units have arrived. This refers to the *weight* of response; if too few personnel arrive too slowly, the emergency will escalate instead of improving. The outcome times, of course, will be longer and yield less-desirable results if the arriving force is later or smaller.

The quantity of staffing and the arrival time frame can be critical in a serious fire. Fires in older and/or multiple-story buildings could well require the initial firefighters needing to rescue trapped or immobile occupants. If the ERF is too small, rescue and firefighting operations *cannot* be conducted simultaneously.

Fires and complex medical incidents require that additional units arrive in time to complete an effective intervention. Time is one factor that comes from *proper station placement*. Good performance also comes from *adequate staffing* and training. But when fire stations are spaced too far apart and one unit must cover another unit's area, or multiple units are needed, these other units can be too far away, and the emergency will escalate and/or result in less than desirable outcome.

Previous critical task studies conducted by Citygate, the NFPA and NIST[6] find that all units need to arrive with 15+ firefighters within 11:30 minutes (from the time of 9-1-1 call) at a building fire to be able to *simultaneously and effectively* perform the tasks of rescue, fire suppression, and ventilation.

If fewer firefighters arrive, *most* likely the search team would be delayed, as would ventilation. The attack lines would only consist of two firefighters, which does not allow for rapid movement of the hose line above the first floor in a multiple-story building. Rescue is conducted with at least two-person teams; thus, when rescue is essential, other tasks are not completed in a simultaneous, timely manner. Effective deployment is about the **speed** *(travel time)* and the **weight** *(number of firefighters)* of the response.

Seventeen initial personnel could handle a moderate risk, confined residential fire; however, even an ERF of 17 personnel will be seriously slowed if the fire is above the first floor in a low-rise apartment building or commercial/industrial building. This is where the capability to add additional personnel and resources to the standard response becomes critical.

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[6] Report on Residential Fireground Field Experiments, National Institute of Standards and Technology Technical Note #1661, April 2010.

Given that the Department's ERF plan delivers 17 personnel to a moderate-risk single family home fire, it reflects a goal to confine serious building fires to or near the room of origin and to prevent the spread of fire to adjoining buildings. This is a typical desired outcome in urban/suburban areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, rather than room, of origin.

The Department's current physical response to building fires is, in effect, its de-facto deployment measure to more densely populated urban areas, *if those areas are within a reasonable travel time from a fire station*. Thus, this becomes the baseline policy for the deployment of firefighters.

2.6 Distribution and Concentration Studies—How the Location of First-Due and First Alarm Resources Affects Emergency Incident Outcomes

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The City is served today by 11 fire stations deploying 11 engine companies, two aerial ladder trucks, and two Battalion Chiefs as the duty Incident Commander and Safety Officer. It is appropriate to understand, using geographic mapping tools, what the existing stations do and do not cover within travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

In brief, there are two geographic perspectives to fire station deployment:

Distribution – the spacing of first-due fire units to control routine emergencies before they escalate and require additional resources.

Concentration – the spacing of fire stations sufficiently close to each other so that more complex emergency incidents can quickly receive sufficient resources from multiple fire stations. As indicated, this is known as the **Effective Response Force** (ERF), or, more commonly, the First Alarm Assignment; the collection of a sufficient number of firefighters on scene, delivered within the concentration time goal to stop the escalation of the problem.

To analyze first-due fire unit travel time coverage, Citygate used FireView™, a geographic mapping tool that can measure theoretical travel time over a street network. For this calculation, Citygate used the base map and street travel speeds calibrated to actual fire apparatus travel times from previous responses to simulate real-world travel time coverage. Using these tools, Citygate ran several deployment tests and measured their impact on various parts of the City. A 4:00-minute first-due and 8:00-minute ERF *travel* time were used consistent with best practice response performance goals for positive outcomes in urban areas.

2.6.1 Deployment Baselines

Map #1 – General Geography, Station Locations, and Response Resource Types

Map #1 shows the City boundary and fire station locations. This is a reference map for other maps that follow. Station symbols denote the type of staffed fire apparatus at each station. All City engines and the ladder trucks are staffed with a minimum of three personnel daily.

Map #2a – Risk Assessment: Planning Zones

Map #2a shows the 11 risk planning zones, as recommended by the CFAI, used for this study, which are the same as each station's initial (first-due) response area.

Map #2b – Risk Assessment: Population Density

Map #2b shows the population density across the City for *resident* population. People drive EMS incident demand, and the highest population density areas are typically the locations with the highest EMS demand. It is therefore reasonable to expect the recent and proposed increases in residential density around transit hubs and places of employment will result, to some degree, in an increase in EMS call volume.

Map #2c – Critical Facilities

Map #2c displays the locations of the critical infrastructure sites in the City as reviewed in the risk assessment found in **Appendix A**. These sites support the functioning of a modern urban society.

Map #2d – Risk Assessment: High Risk Occupancies

Map #2d displays the locations of the higher-risk building occupancies within the City, as defined by the CFAI. These building occupancies typically require a larger initial ERF due to the higher risks associated with these specific occupancies. It is apparent that there are high- or maximum-risk occupancies in every planning zone.

Map #2e – Risk Assessment: High Needed Fire Flow Locations

Map #2e displays the locations of 378 of the buildings within the City with needed fire flow greater than 2,500 gallons per minute, as determined by the ISO. As the map illustrates, these buildings are predominantly located in the commercial and industrial zoned areas of the City.

Map #2f – Risk Assessment: Hazardous Materials Sites

Map #2f displays the locations of 1,162 sites within the City using hazardous materials regulated by the Department's Fire Prevention Bureau as determined by the County Health Department-managed, state-designated Certified Unified Program Agency (CUPA) program. As the map illustrates, these buildings are also predominantly located in the commercial and industrial zoned areas of the City.

Map #3 – Distribution: 4:00-Minute First-Due Travel Time Coverage

Map #3 shows the areas within a 4:00-minute travel time of one of the City's 11 fire stations. Green road segments indicate the City's current road network that a fire engine should be expected to reach within 4:00 minutes, assuming it is in station and encounters *no traffic congestion*. The modeling tool uses actual fire apparatus speed by roadway type.

The red street segments represent the reduced travel time coverage at peak morning/evening traffic congestion hours. As can be seen, severe traffic congestion can hamper fire unit travel time, even with traffic signal preemption technology. The impact is the largest in the more travelled, major road and commercial corridors. Also, the neighboring fire agency stations are too far away to be the primary provider to any of the Department's service area.

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against dispatch time data to reflect actual response times. There should be some overlap between station areas so that a second-due unit can have a chance of an acceptable response time when it responds to a call in a different station's first-due response area. As can be seen, coverage is fairly good for all but a few peripheral areas of the City. These small areas exist due to the street design or topography and thus are not large enough to warrant a fire station move or addition at this time.

As detailed later in this section, the *travel* time to 90 percent of fire and EMS incidents is 5:59 minutes Department-wide in RY 18/19. This is supported by the GIS model that shows 4:00-minute coverage does not extend out into some of the City's peripheral areas.

Map #4 – Insurance Services Office 1.5-Mile Coverage Areas

Map #4 displays the ISO recommendation that urban stations cover a 1.5-mile *distance* response area. Depending on a jurisdiction's road network, the 1.5-mile measure usually equates to a 3:30- to 4:00-minute travel time. However, a 1.5-mile measure is a reasonable indicator of station spacing and overlap. As can be seen, the 1.5-mile ISO coverage is smaller than the 4:00-minute first-due coverage in Map #3.

Map #5a – Concentration: Effective Response Force 8:00-Minute Travel Time Coverage

Map #5a shows, in green, the streets where the Department's current response plan *should* deliver the initial ERF of four engines, one ladder truck, and one of two Battalion Chiefs within 8:00 minutes travel time. Given there are two Battalion Chiefs in the City, showing both in this map would unduly lower the coverage area of the firefighting units and at least one chief officer. The ERF coverage is primarily in the core areas of the City during periods of traffic congestion. The coverage *without* traffic congestion is only slightly better. However, either coverage area does include the higher risk, more built up core sections of the City, which is the main goal, rather than less dense outer residential areas.

Map #5b – Scenario 1 – Recommended Deployment – Moving Truck 51 from Station 1 to Station 6

Map #5b is discussed in **Section 2.8.2**.

Map #6 – 8:00-Minute Ladder Truck Travel Time Coverage

Map #6 shows 8:00-minute travel time coverage for *either one* of the two ladder trucks with and without traffic congestion. As can be seen, much of the City can be reached by one ladder truck during normal traffic hours. During traffic congestion, a single ladder truck cannot reach the peripheral areas in 8:00 minutes or less.

Map #7 – Battalion Chief 8:00-Minute Travel Time Coverage

Map #8 displays 8:00-minute travel time coverage for *either one* of the two Battalion Chiefs with and without traffic congestion. It is apparent that the single Battalion Chief travel time coverage includes all areas of the City during normal traffic hours, and during congested periods one Battalion Chief can reach the core areas of the City in 8:00 minutes or less.

Map #8 – All Incident Locations

Map #8 shows the location of all incidents for three years from July 2016 through June 2019. It is apparent that incidents occur in all areas of the City.

Map #9 – Emergency Medical Services and Rescue Incident Locations

Map #9 illustrates only the emergency medical and rescue incident locations. With the majority of the calls for service being medical emergencies, virtually all areas of the City need pre-hospital emergency medical services.

Map #10 – All Fire Locations

Map #10 identifies the location of all fires within the City over the past three years. All fires include any type of fire call, from vehicle to dumpster to building. There are obviously fewer fires than medical or rescue calls. Even given this fact, it is evident that fires occur in all fire station areas, but also more frequently in some of the central and highest-population-density areas of the City.

Map #11 – Structure Fire Locations

Map #11 displays the location of the structure fire incidents over the past three years. While the number of structure fires is a smaller subset of total fires, there are two meaningful findings from this map. First, there are structure fires in every fire station area, and second, there are a relatively small number of building fires in the City overall. In Citygate's experience, this is consistent with other similar cities in the western United States.

As with the previous map of all fire types, there are more building fires in some of the central and highest-population-density areas of the City. These locations do receive a minimum Effective Response Force of four engines, one ladder truck, and one Battalion Chief in less than 8:00 minutes of travel time. This meets national best practice recommendations.

Map #12 – Emergency Medical Services and Rescue Incident Location Densities

Map #12 shows, by mathematical density, where clusters of emergency medical services incident activity occurred. In this set, the darker density color plots the highest concentration of EMS/rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS incidents, as shown in Map #9.

This perspective is important because the deployment system needs an overlap of units to ensure the delivery of multiple units when needed for more serious incidents or to handle simultaneous calls for service. Much of the density is in Station 1's area. This is fortunate, as Station 1 has both an engine and ladder truck Paramedic crew to respond when simultaneous incidents occur.

Map #13 – All Fire Location Densities

Map #13 is like Map #11 but shows the hot spots of activity for all types of fires during the last three years. Fire density is greater in the areas of the City with higher population density.

Map #14 – All Structure Fire Location Densities

Map #14 is like Map #13 but shows the hot spots for structure fire activity over the last three years. Given the location of the ladder truck and Battalion Chief in the center of Fremont, the multiple-unit coverage is closest to the greatest number of building fires in the five station areas in the core area of the City.

2.6.2 Road Mile Coverage Measures

In addition to the visual displays of coverage that maps provide, the GIS software allows the miles of public streets covered at 4:00 or 8:00 minutes to be measured. The following table provides these metrics for the coverage versus the impacts of traffic congestion.

Table 11—Service Area Road Mile Coverage Comparison (No Mutual Aid)

Measure	Total Road Miles (within City Limits)	Miles Reached by Open Fire Stations / % of Total Public Miles Covered	Difference in Miles Covered
4:00-Minute First-Due	1,199.5	597.6 *50% of total public miles*	**601.9**
4:00-Minute First-Due—Traffic Congestion	1,199.5	407.1 *34% of total public miles*	**792.4**
8:00-Minute ERF	1,199.5	270.7 *23% of total public miles*	**928.8**
8:00-Minute ERF—Traffic Congestion	1,199.5	95.9 *8% of total public miles*	**1,103.6**

The existing 4:00-minute first-due unit coverage is reduced by 16 percent during traffic congestion. The ERF with traffic congestion drops significantly to eight percent.

The City's shape and road network is difficult to serve efficiently from a few fire stations and this is why the City utilizes 11 fire stations. This is *a necessity* given the topography and roads. Traffic congestion travel time reductions do hurt the peripheral City areas. This means that when simultaneous incidents occur during peak hours of traffic congestion in the City's center, peripheral station areas cannot receive a second unit quickly if needed.

Finding #3: The current fire station placement provides a first response unit for all the City's major neighborhoods.

Finding #4: Fire unit travel times are longer than a best practice and Department goal of 4:00 minutes due to the terrain, curvilinear road network in many parts of the City, traffic calming measures, lack of comprehensive or next generation traffic pre-emption, and traffic congestion.

2.7 Statistical Analysis

SOC Element 7 of 8
Reliability & Historical Response Effectiveness Studies

The map sets described in **Section 2.6** and presented in **Volume 2** show the ideal situation for response times and the response effectiveness given perfect conditions with no units out of place or simultaneous calls for service. Examination of the actual response time data provides a picture of actual response performance with simultaneous calls, rush-hour traffic congestion, units out of position, and delayed travel time for events such as periods of severe weather.

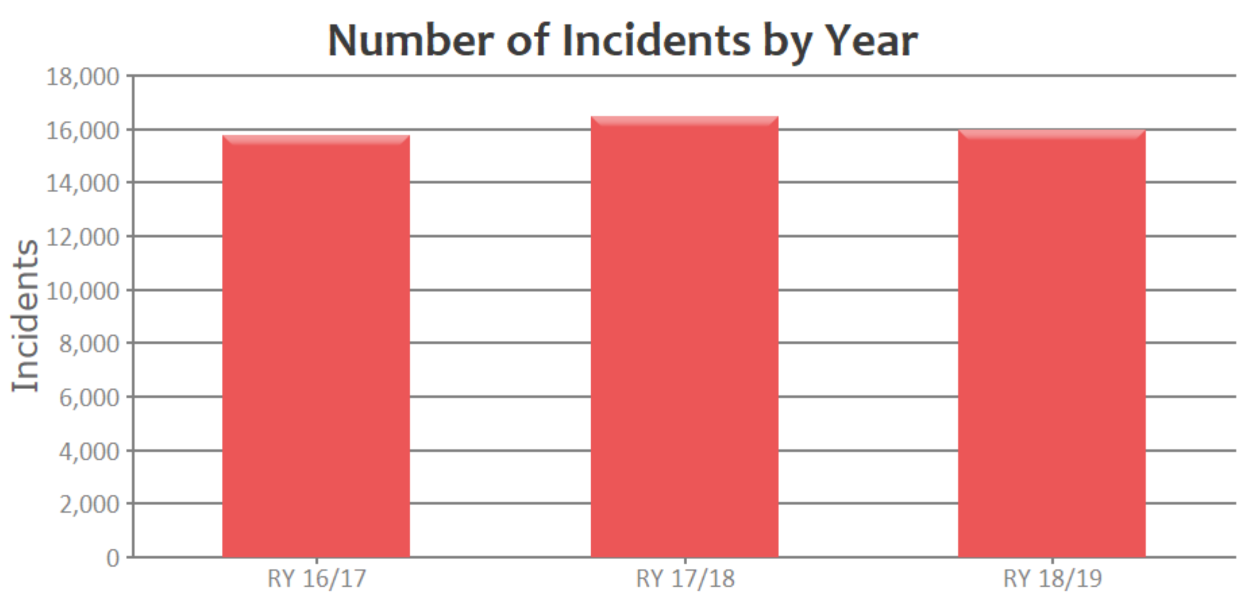
The following subsections provide summary statistical information regarding the Department and its services.

2.7.1 Demand for Service

The Department provided NFIRS 5 incident and records management system (RMS) apparatus response data for 1/1/2016 through 06/30/2019. These two data sets were merged, providing 56,044 incidents and 73,112 apparatus response records.

In RY 18/19 the Department responded to 15,964 incidents. During this period the Department had a daily demand of 43.74 incidents, 2.93 percent of which were to fire incidents, 65.48 percent were to EMS incidents, and 31.59 percent were to other incident types.

Figure 6—Annual Service Demand by Year



The following figure illustrates the number of incidents by incident type. The number of EMS incidents peaked in RY 17/18 while the number of fire incident types increased slightly year to year.

Figure 7—Number of Incidents by Year by Incident Type

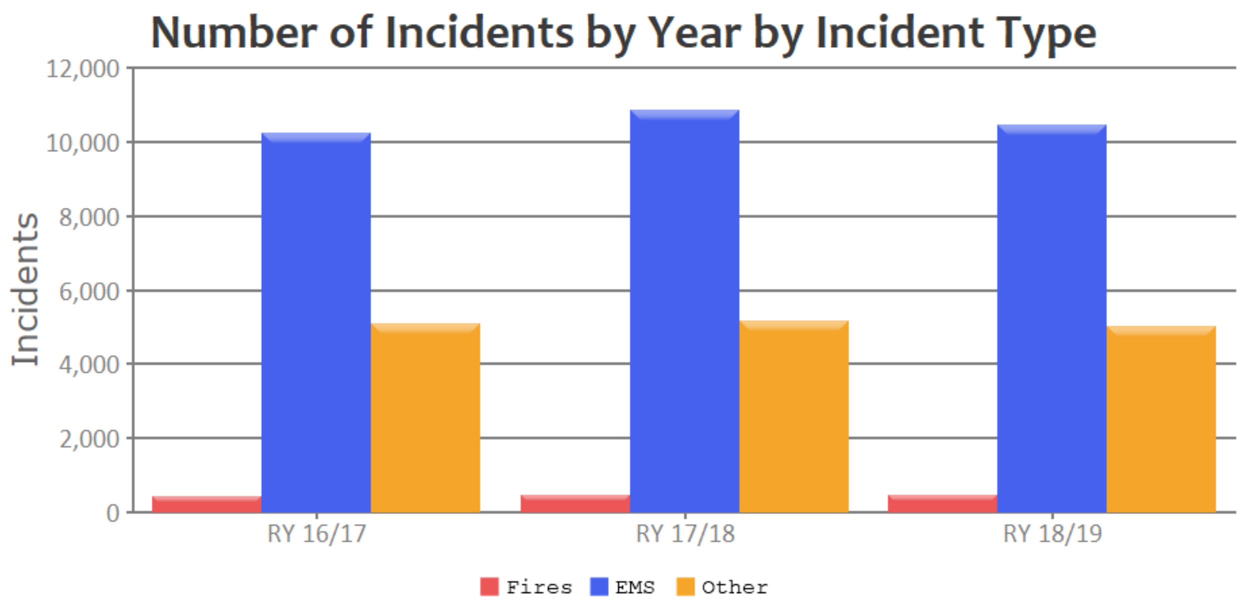
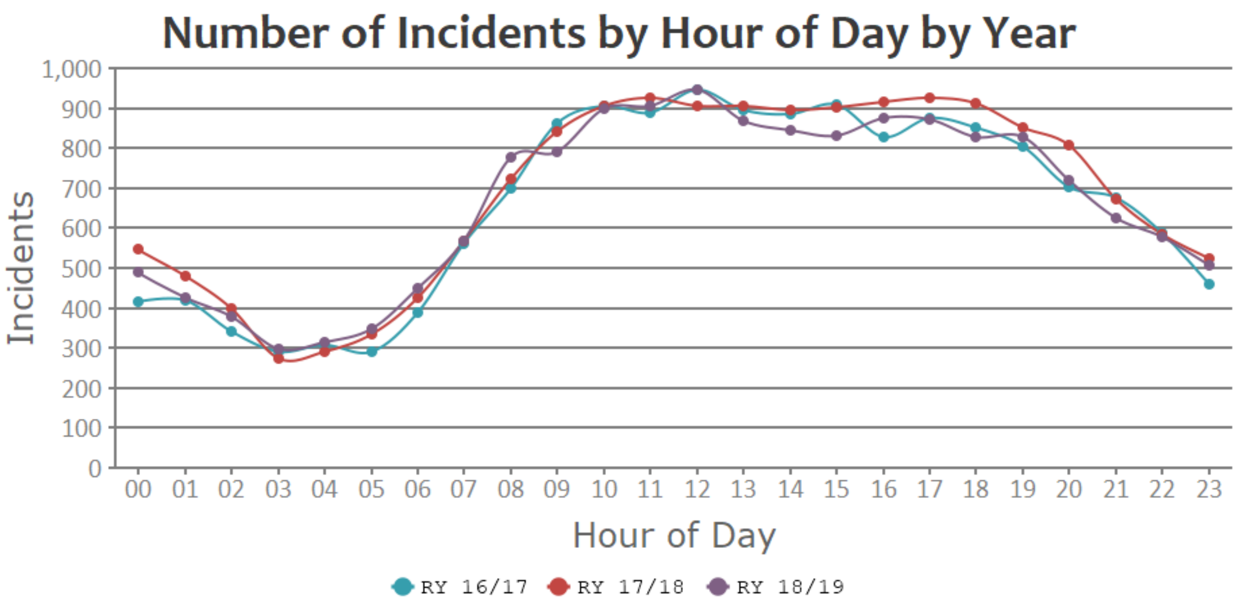


Figure 8 shows service demand by hour of day by year, illustrating that calls for service occur at every hour of the day and night, requiring fire suppression and EMS response capability 24 hours per day, every day of the year. There is a slight annual variance in hourly volume during the afternoon and early evening hours.

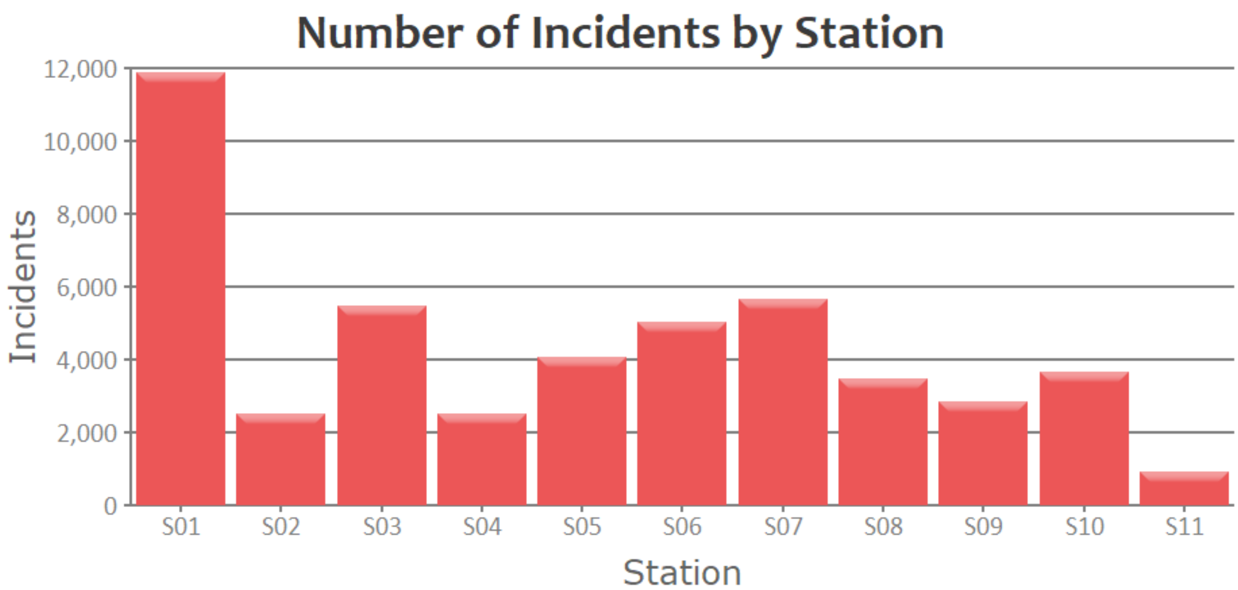
Figure 8—Service Demand by Hour of Day and Year



Finding #5:	The Department's service demand is consistent, indicating the need for a 24-hour-per-day, seven-day-per-week fire and EMS emergency response system.

The following figure illustrates the number of incidents by station during the three-year analysis period. Station 1 had the highest volume of activity. Station 11 had the lowest volume.

Figure 9—Number of Incidents by Station



The following table lists the more significant incidents by incident quantity in RY 18/19. Note that EMS incidents far outnumber all other incident types.

Table 12—Incidents: Quantity by Incident Type – RY 18/19

Federal NFIRS #/ Incident Type	RY 18/19
321 EMS call, excluding vehicle accident with injury	8,036
611 Dispatched and canceled en route	2,016
311 Medical assist, assist EMS crew	1,348
322 Vehicle accident with injuries	609
554 Assist invalid	454
735 Alarm system sounded due to malfunction	234
745 Alarm system sounded, no fire – unintentional	215
324 Motor vehicle accident no injuries	191
740 Unintentional transmission of alarm, other	156
300 Rescue, emergency medical call (EMS) call, other	139
743 Smoke detector activation, no fire – unintentional	112
553 Public service	111
552 Police matter	105
730 System malfunction, other	97
131 Passenger vehicle fire	49
111 Building fire	48
142 Brush, or brush and grass mixture fire	25

The following table illustrates the more significant types of incident property use in RY 18/19. The highest rankings for incidents by property use are residential dwellings.

Table 13—Incidents: Quantity by Property Use – RY 18/19

Federal NFIRS #/ Property Use	RY 18/19
419 1 or 2 family dwelling	4,689
429 Multi-family dwellings	1,861
960 Street, other	1,156
311 24-hour care nursing homes, 4 or more persons	844
961 Highway or divided highway	611
965 Vehicle parking area	398
700 Manufacturing, processing	337
400 Residential, other	277
962 Residential street, road or residential driveway	230
963 Street or road in commercial area	224
500 Mercantile, business, other	195
449 Hotel/motel, commercial	199
519 Food and beverage sales, grocery store	187
174 Rapid transit station	186
161 Restaurant or cafeteria	185
215 High school/junior high school/middle school	177
439 Boarding/rooming house, residential hotels	154
599 Business office	143
341 Clinic, clinic-type infirmary	138
459 Residential board and care	115
331 Hospital – medical or psychiatric	113
340 Clinics, doctors' offices, hemodialysis centers	104
213 Elementary school, including kindergarten	101
900 Outside or special property, other	88

2.7.2 Simultaneous Incident Activity

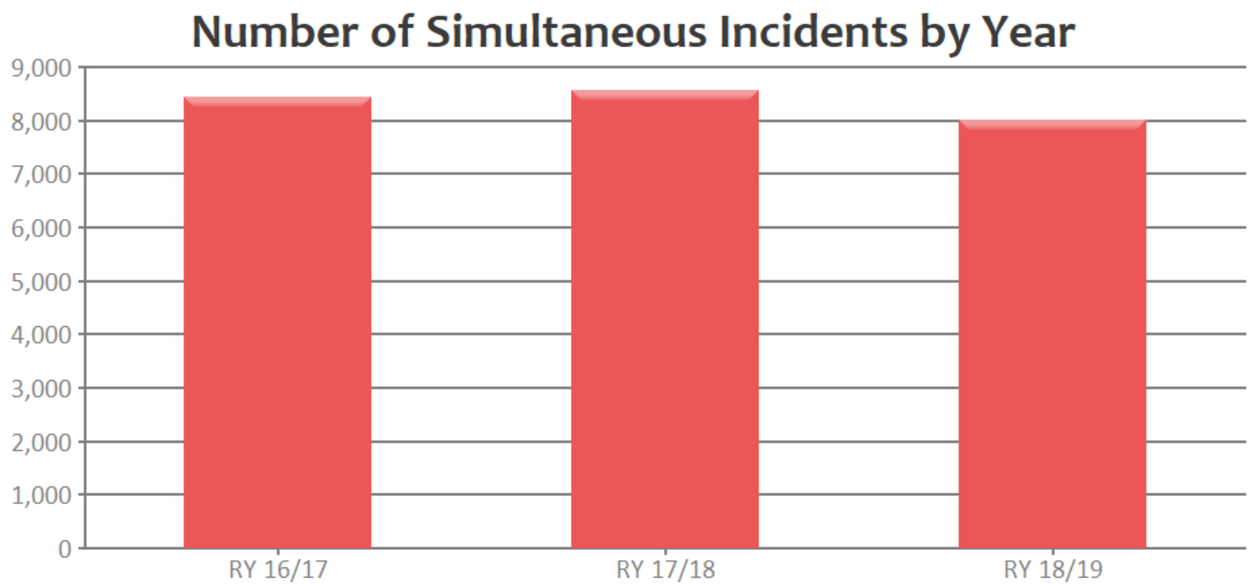
Simultaneous incidents occur when other incidents are underway at the time a new incident develops. During RY 18/19, 50.28 percent of incidents occurred while one or more other incidents were underway. The following is the percentage of simultaneous incidents broken down by the number of simultaneous incidents.

- 1 or more simultaneous incidents: 50.28 percent

- 2 or more simultaneous incidents: 16.96 percent
- 3 or more simultaneous incidents: 4.50 percent

The following figure shows that the number of simultaneous incidents peaked in RY 17/18.

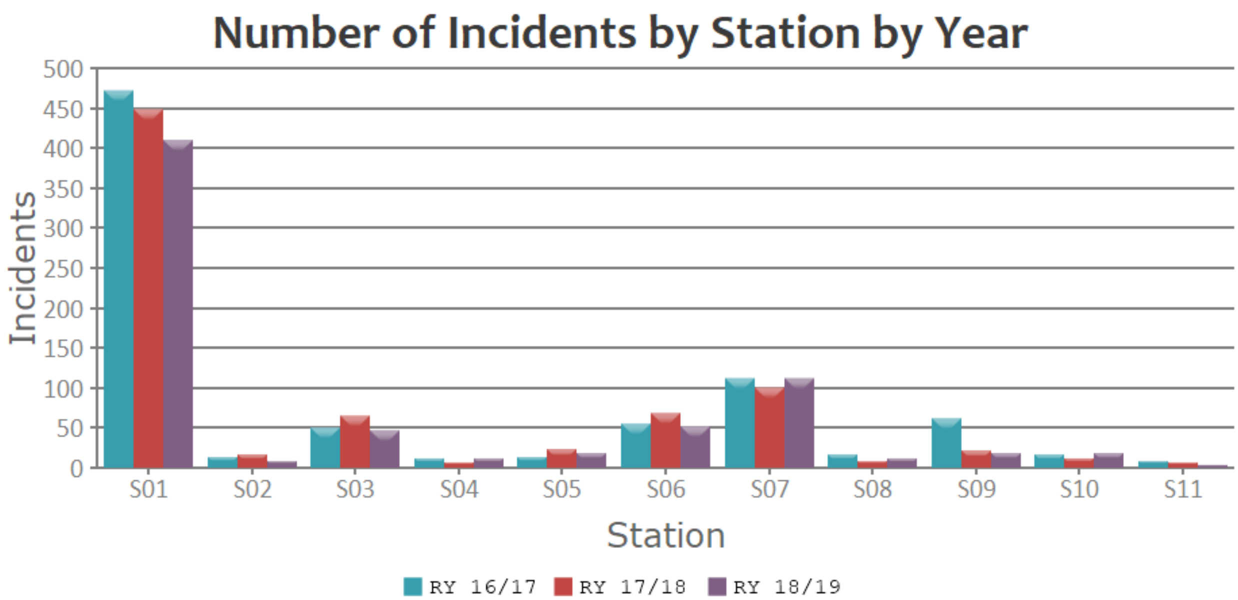
Figure 10—Number of Simultaneous Incidents by Year



In a larger city, simultaneous incidents in different station areas have very little operational consequence. However, when simultaneous incidents occur within a single station area, there can be significant delays in response times.

The following figure illustrates the number of single-station simultaneous incidents by station area by reporting year. Station 1 has the greatest number of single-station simultaneous incidents, with Station 7 in distant second place.

<u>Figure 11—Number of Single-Station Simultaneous Incidents by Station by Year</u>



Finding #6:	The largest impact of simultaneous incidents is felt in Station 1's District. This further shifts workload to other companies at peak hours of the day.

2.7.3 Workload by Unit-Hour Utilization (UHU)

Maintaining response time performance is a function of three interdependent issues—time over distance, rate of simultaneous incidents, and the workload per unit at peak demand hours of the day. The following tables show the percent of time per hour, across 12 months, that units are committed to 9-1-1 incidents. This time does <u>not</u> include returning to District, maintenance, training, inspections, public relations activities, refueling, etc.

The utilization percentage for apparatus is calculated by two primary factors, the number of responses and the duration of responses. The following table is a unit-hour utilization summary for Department engine companies. The busiest engines are listed in the farthest left column, while the least-busy engines are listed in the farthest right column. This report is based on 17,134 apparatus response records from 7/1/2018 through 6/30/2019.

Table 14—Unit-Hour Utilization – Engine Companies – RY 18/19

Hour	E51	E53	E58	E56	E57	E55	E60	E54	E59	E52	E61
00:00	7.75%	4.83%	3.26%	3.60%	5.08%	7.81%	3.47%	3.15%	3.29%	1.85%	0.87%
01:00	8.65%	5.06%	9.79%	4.47%	5.55%	5.25%	3.34%	2.74%	3.65%	2.11%	0.91%
02:00	6.76%	4.72%	4.25%	3.62%	3.98%	4.92%	3.09%	2.48%	2.88%	6.45%	0.64%
03:00	5.62%	3.89%	3.06%	3.05%	2.84%	2.85%	3.31%	1.43%	2.55%	2.78%	0.71%
04:00	4.98%	3.98%	3.37%	2.92%	2.36%	3.68%	3.46%	2.02%	1.94%	1.48%	1.12%
05:00	7.79%	4.21%	2.96%	4.08%	3.92%	3.85%	3.89%	2.92%	1.22%	2.92%	1.19%
06:00	7.36%	6.43%	2.87%	3.23%	4.40%	4.85%	3.57%	2.74%	3.14%	3.54%	1.40%
07:00	8.27%	5.95%	9.25%	6.18%	3.63%	5.52%	6.79%	4.26%	3.21%	4.34%	2.19%
08:00	13.03%	8.11%	8.08%	7.40%	6.82%	7.51%	6.36%	6.53%	3.91%	3.88%	2.49%
09:00	12.33%	9.22%	7.07%	5.87%	7.51%	5.99%	6.04%	5.53%	4.82%	4.46%	2.51%
10:00	14.66%	10.88%	8.20%	7.78%	7.44%	5.86%	6.12%	7.66%	7.81%	4.57%	2.60%
11:00	14.79%	9.58%	8.61%	7.10%	8.40%	5.52%	5.36%	6.04%	9.44%	6.03%	3.50%
12:00	14.70%	11.66%	8.55%	7.70%	10.78%	9.97%	6.61%	8.33%	5.54%	5.32%	3.87%
13:00	13.51%	8.76%	8.52%	7.55%	7.85%	8.30%	6.50%	8.21%	5.96%	4.36%	3.43%
14:00	25.79%	10.04%	12.86%	11.97%	9.57%	6.42%	6.39%	6.20%	5.99%	8.40%	1.97%
15:00	14.49%	9.14%	8.88%	7.79%	6.91%	5.63%	6.20%	4.36%	7.78%	4.83%	3.01%
16:00	14.27%	9.98%	9.19%	10.39%	10.93%	9.68%	7.72%	4.80%	5.37%	6.35%	2.68%
17:00	14.73%	11.99%	8.43%	10.61%	12.13%	8.23%	7.17%	9.93%	6.27%	6.70%	3.69%
18:00	13.05%	10.28%	7.90%	13.12%	7.79%	7.34%	7.70%	6.23%	5.47%	6.92%	1.84%
19:00	21.06%	11.40%	6.94%	7.61%	6.79%	8.09%	6.62%	7.30%	3.60%	4.28%	1.76%
20:00	12.85%	9.46%	6.97%	7.03%	8.79%	8.08%	8.93%	4.87%	4.24%	4.22%	2.13%
21:00	11.42%	8.30%	6.47%	6.29%	5.25%	7.02%	10.88%	6.56%	6.88%	5.53%	3.07%
22:00	12.23%	5.91%	5.45%	6.56%	6.60%	6.93%	5.94%	4.06%	3.09%	2.06%	2.26%
23:00	9.18%	7.00%	6.42%	6.42%	4.80%	7.61%	5.49%	4.06%	2.72%	3.16%	2.17%

The following table shows a unit-hour utilization summary for the Department's ladder companies. This report is based on 2,571 apparatus response records from 7/1/2018 through 6/30/2019.

Table 15—Unit-Hour Utilization – Ladder Companies – RY 18/19

Hour	T51	T57
00:00	2.71%	1.49%
01:00	1.82%	1.26%
02:00	2.79%	1.24%
03:00	2.29%	0.56%
04:00	2.27%	0.69%
05:00	3.50%	1.58%
06:00	3.16%	1.88%
07:00	3.90%	1.91%
08:00	4.74%	3.01%
09:00	5.75%	3.95%
10:00	8.02%	4.96%
11:00	8.08%	4.80%
12:00	8.74%	5.07%
13:00	6.39%	4.00%
14:00	5.58%	3.30%
15:00	7.19%	2.79%
16:00	6.23%	4.08%
17:00	9.13%	5.35%
18:00	8.21%	2.36%
19:00	6.40%	5.30%
20:00	5.16%	2.64%
21:00	4.31%	1.58%
22:00	3.36%	2.34%
23:00	3.51%	3.12%
Overall	**5.14%**	**2.89%**
Runs	**1,685**	**886**

During the nine-hour daytime work period, when crews on a 24-hour shift must also pay attention to apparatus checkout, station duties, training, fire prevention inspections, public education, and paperwork, plus required physical training and meal breaks, Citygate believes the maximum commitment unit-hour utilization (UHU) percentage per hour across the six- to nine-hour workday period should not exceed **30** percent. Beyond that, the most important duties to suffer will be training hours and fire prevention inspections.

While the City's engine and ladder unit UHU rates do not yet approach saturation levels of 30 percent *hour over hour*, the two Station 1 units—E51 and T51 combined—are at 23 percent over the late morning through early evening with occasional hours at 30 percent.

2.7.4 Operational Performance

Performance for the first apparatus to arrive on the scene of emergency incidents is measured by the time necessary for 90 percent completion of the following components:

- Call processing
- Turnout
- Travel
- Dispatch to arrival
- Call to arrival

2.7.5 Call Processing

Call processing measures the time from the first incident time stamp in ACRECC until apparatus are notified of the request for assistance.

The following table shows that call processing is 1:35 minutes for 90 percent compliance.

Table 16—Call Processing Analysis

Station	RY 18/19
Department-wide	**01:35**
Station 1	01:41
Station 2	01:30
Station 3	01:31
Station 4	01:35
Station 5	01:30
Station 6	01:30
Station 7	01:34
Station 8	01:27
Station 9	01:31
Station 10	01:43
Station 11	01:47

Finding #7:	Call processing performance, at 1:35 minutes for 90 percent of the fire/EMS incidents, is very close to a best practice recommendation of 1:30 minutes.

2.7.6 Turnout

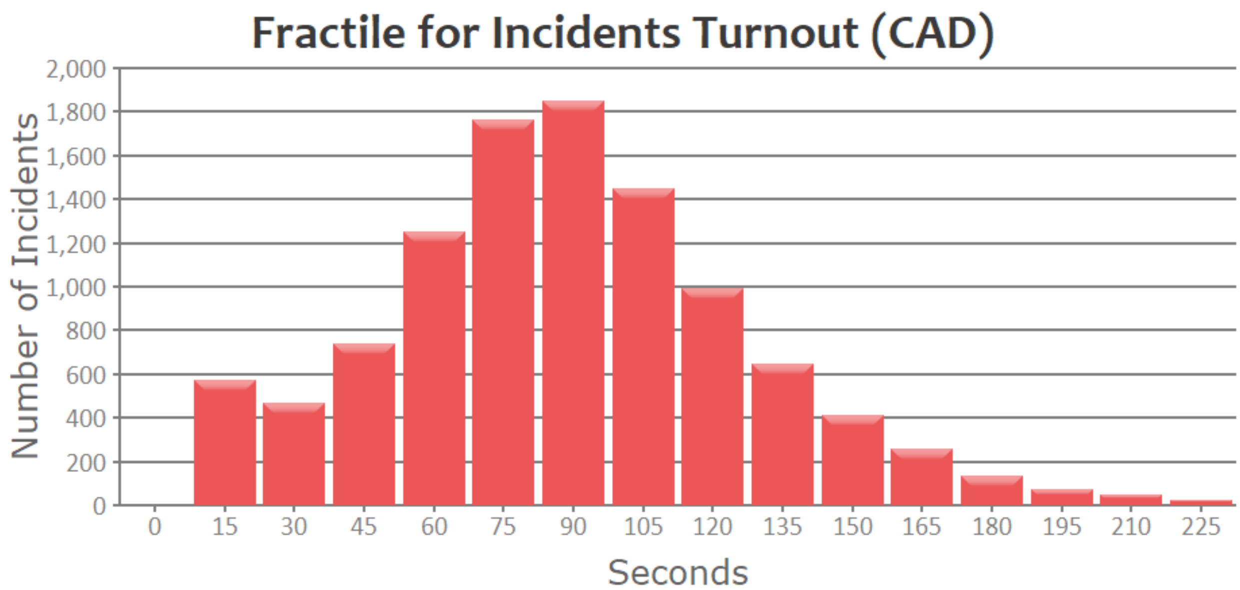
Turnout time measures the time from apparatus notification until the apparatus starts traveling to the scene. Citygate's goal for turnout time is 2:00 minutes. Fremont's fire crews slightly miss the 2:00-minute turnout time goal.

Table 17—Turnout Analysis

Station	RY 18/19
Department-wide	**02:13**
Station 1	02:02
Station 2	02:36
Station 3	02:04
Station 4	02:06
Station 5	02:27
Station 6	02:19
Station 7	02:12
Station 8	02:18
Station 9	02:13
Station 10	02:06
Station 11	02:28

The following figure illustrates fractile turnout performance, which shows that a majority of incident responses receive turnout performance within 2:00 minutes.

Figure 12—Fractile for Incidents Turnout (CAD)



Finding #8:	Crew turnout performance, at 2:13 minutes, is only slightly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of the fire/EMS incidents.

2.7.7 Travel

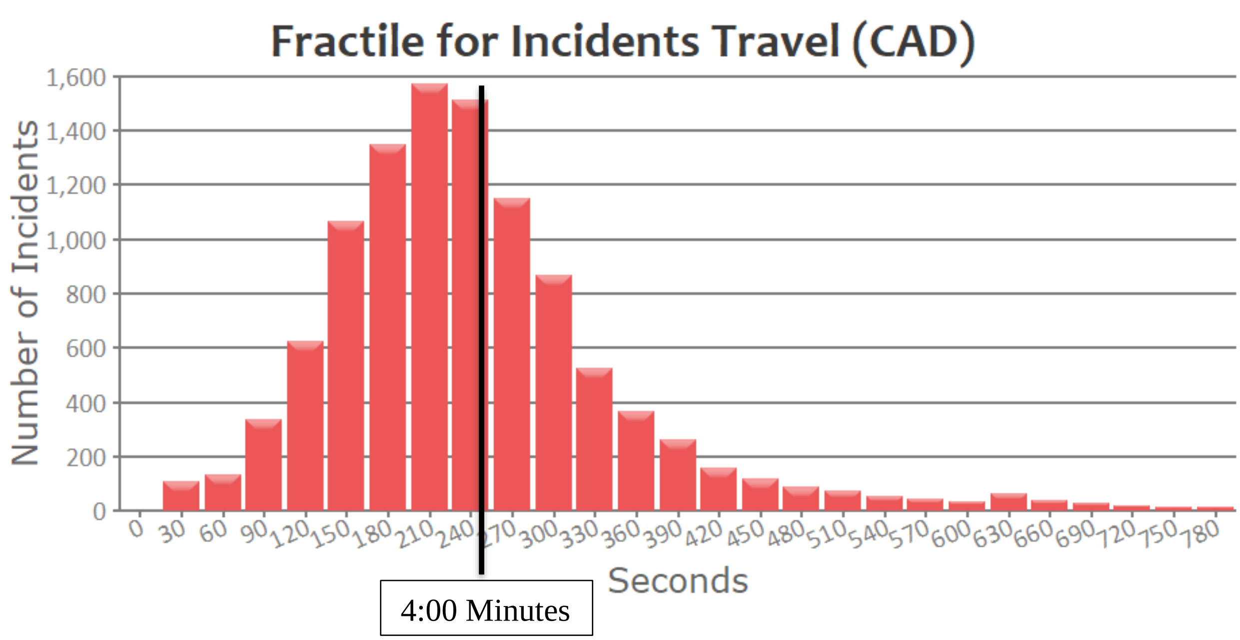
Travel time measures the time to travel to the scene of the emergency. In most urban and suburban fire departments, a 4:00-minute travel time 90 percent of the time would be considered highly desirable. Table 18 shows that no stations achieve that goal.

Table 18—Travel Performance to 90 Percent of Fire and EMS Incidents

Station	RY 18/19
Department-wide	**05:59**
Station 1	05:24
Station 2	06:21
Station 3	05:12
Station 4	07:52
Station 5	06:56
Station 6	05:20
Station 7	06:22
Station 8	04:58
Station 9	05:55
Station 10	06:54
Station 11	07:33

The following figure illustrates fractile travel performance. The peak segment for travel performance is 210 seconds, or 3:30 minutes. The volume decreases after the 210-second mark. This indicates that while many incidents can be reached within the first 4:00 minutes (240 seconds) there are still a number of incidents that require much longer travel times.

Figure 13—Fractile for *All* Incidents Travel (CAD)



Finding #9:	First-due unit travel time, at 5:59 minutes to 90 percent of the fire/EMS incidents Citywide, is slower than the Department's 2005 90 percent travel time goal of 5:15 minutes and a best practice urban area goal of 4:00 minutes.

2.7.8 Call to Arrival

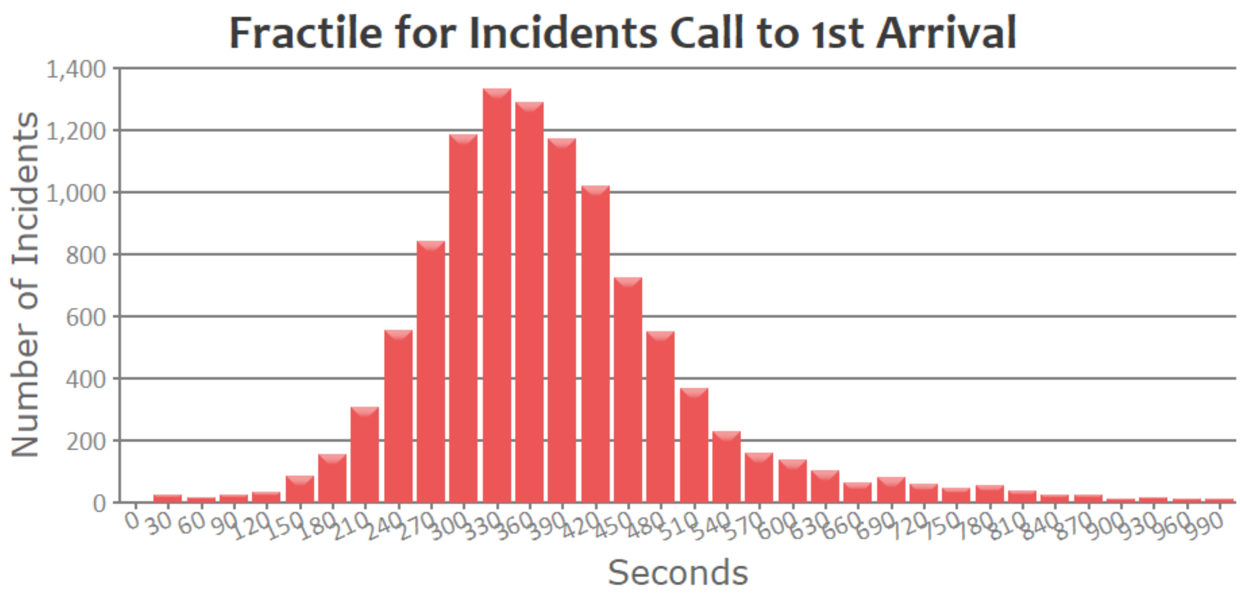
Call to arrival measures time from receipt of the request for assistance until the apparatus arrives on the scene. A best practice goal is 1:30 minutes for call processing, 2:00 minutes for turnout, and 4:00 minutes for travel. This equates to 7:30 minutes.

Table 19—Call to Arrival Performance to 90 Percent of Fire and EMS Incidents

Station	RY 18/19
Department-wide	**08:38**
Station 1	07:47
Station 2	09:16
Station 3	07:45
Station 4	10:55
Station 5	09:47
Station 6	08:02
Station 7	09:00
Station 8	07:38
Station 9	08:42
Station 10	09:49
Station 11	10:30

The following figure illustrates fractile call to arrival performance. The peak segment is 330 seconds, or 5:30 minutes. The slightly right shifted graph indicates a fairly high number of incidents with longer call to arrival times.

Figure 14—Fractile for Incidents Call to First Arrival



Finding #10:	The Department's call to arrival time to 90 percent of the fire/EMS incidents, at 8:38 minutes, is slower than Citygate's recommended goal of 7:30 minutes. This result is primarily due to longer travel times.

2.7.9 Effective Response Force (First Alarm) Concentration Measurements

The desired ERF for structure fires from the Department is four engines and one ladder truck. Additionally, two Battalion Chiefs are sent for a total of 17 personnel. Given only two chiefs Citywide, the following measure is only for the engines and ladder units.

A best practice goal for the ERF (First Alarm) is that the last arriving unit should take no longer than 8:00 minutes travel time. There are very few incidents in one year that need all the units to arrive within 8:00 minutes travel time. Thus, the following times also show the counts.

Table 20—Distribution – Effective Response Force (First Alarm) – Travel Time Performance to 90 Percent of Fire and EMS Incidents

Station	RY 18/19
Department-wide	**12:06 (20)**
Station 1	09:47 (2)
Station 2	09:14 (1)
Station 3	08:42 (5)
Station 4	11:59 (2)
Station 5	07:00 (1)
Station 6	12:15 (3)
Station 7	12:17 (1)
Station 8	12:06 (3)
Station 9	10:25 (2)
Station 10	none
Station 11	none

Finding #11: The Effective Response Force (First Alarm) travel times, at 12:06 minutes, are longer than the best practice and Citygate-recommended goal of 8:00 minutes, and as with first-due units, reflects Fremont's challenging road network and topography.

2.8 Overall Deployment Evaluation

SOC Element 8 of 8
Deployment Evaluation

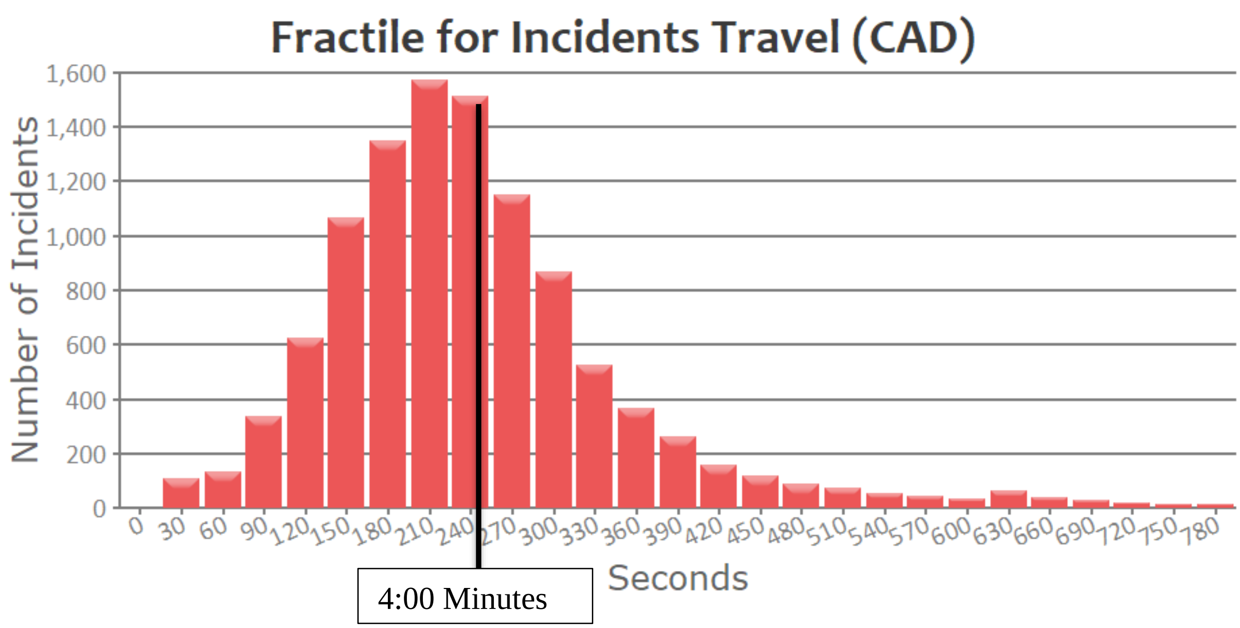
The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern typical of a city in Alameda County and the urban San Francisco Bay Area.

While the State fire code now requires fire sprinklers even in residential dwellings, it will be many more decades before enough homes are built or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an effected building and/or minimizing permanent impairment resulting from a medical emergency, the City will need both first-due unit and multiple-unit ERF coverage in all neighborhoods consistent with service goals to limit fire severity and to provide Paramedic level first responder care.

The challenge in Fremont is cost-effectively providing 4:00- and 8:00-minute travel time coverage due to a mostly non-grid road network design, geography with hills and open spaces combined with limited crossings at freeway and rail lines. The travel time performance at 90 percent seems worse than it really is. Many calls are answered closer to 4:00 minutes travel time for a first responder. The math challenge is to get to 90 percent of the calls. Two measures show this visually.

The following figure shows again the 4:00-minute travel time histogram showing calls on either side of 4:00 minutes travel for the neighborhood based first responder engine.

Figure 15—Fractile for *All* Incidents Travel (CAD)



2.8.1 Travel Time Challenges

The percent of emergency incidents reached within 4:00 minutes travel by a Department first responder has degraded steadily since 2004, and the rate of decay is accelerating.

Table 21—Percent of Incidents Reached by Fourth Minute of Travel by Year

Department-wide	2004	RY 16/17	RY 17/18	RY 18/19
Incidents Reached by Fourth Minute of Travel	79%	69.4%	67.9%	62.7%

- Traffic and road network design in Fremont has always been a multifaceted problem.

- The City has been and is currently attempting to reduce traffic congestion, as evidenced by the City's informational traffic congestion webpage[7] and the Fremont Vision Zero 2020.[8]

- Traffic calming in Fremont has a measurable impact on response times.

  - Fremont's 2004 SOC stated, "Extensive field testing has shown these devices slow response times by adding an additional 9.5 seconds for engines and 13.75 seconds for aerial ladder trucks for every speed bump encountered."

  - Fremont still has over 100 legacy speed bumps *without* emergency vehicle cutouts.

- Fremont has a lack of next generation signal pre-emption.

  - There are currently less than ten functioning pre-emption signals in Fremont.

  - The Fremont Smart Corridor initiative identifies "GPS Based Emergency Vehicle Pre-emption" as a key feature.[9]

The following table shows the travel time challenges a different way. Yellow highlights show the point at which 80 percent travel time compliance is reached. Green highlights show the point at which 90 percent travel time compliance is reached.

[7] https://fremont.gov/2818/Traffic-Congestion
[8] https://fremont.gov/2594/Fremont-Vision-Zero-2020
[9] https://fremontsmartcorridor.org/

Table 22—Time and Goal Percentage Changes

Travel Time / Station	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
4:00 Minutes	71%	59%	69%	39%	53%	74%	56%	75%	53%	49%	54%
4:15	77%	66%	76%	45%	57%	78%	63%	78%	61%	53%	59%
4:30	**81%**	72%	**81%**	51%	62%	**81%**	69%	**83%**	68%	59%	64%
4:45	85%	75%	85%	58%	67%	84%	74%	88%	74%	65%	67%
5:00 Minutes	88%	**80%**	87%	63%	73%	88%	78%	**90%**	**80%**	69%	74%
5:15	89%	82%	**91%**	68%	75%	**90%**	**81%**	92%	84%	75%	77%
5:30	**91%**	84%	92%	71%	**80%**	91%	83%	93%	87%	79%	79%
5:45	93%	86%	94%	74%	82%	93%	86%	95%	89%	**83%**	**81%**
6:00 Minutes	94%	88%	95%	77%	84%	94%	88%	96%	**91%**	84%	83%
6:15	94%	89%	96%	**81%**	86%	94%	**90%**	96%	93%	86%	83%
6:30	95%	**91%**	97%	82%	88%	95%	91%	97%	95%	88%	84%
6:45	95%	92%	97%	84%	89%	95%	92%	97%	95%	89%	85%
7:00 Minutes	96%	93%	97%	85%	**90%**	95%	93%	97%	96%	**90%**	85%
7:15	96%	93%	98%	87%	91%	96%	94%	98%	96%	91%	87%
7:30	97%	94%	98%	89%	93%	96%	94%	98%	96%	92%	89%
7:45	97%	95%	98%	89%	93%	97%	95%	98%	97%	93%	**91%**
8:00 Minutes	97%	95%	98%	**90%**	94%	97%	95%	98%	98%	94%	91%

- At an 80 percent measure, six of 11 station district incidents are met by the end of the fourth minute (4:59 or 5:00)
- By 5:15 minutes, another district reaches 81 percent and two move up to 90 percent
- By 5:30 minutes, an eighth district reaches 80 percent and another district moves to 90 percent
- By 5:45 minutes, two more districts reach 80 percent, for ten of 11, and four are at 90 percent

The 4:00-minute first-due unit goal as published in NFPA 1710 was developed in an era before advanced GIS mapping and statistics could model the challenges of a community with some hills and a curvilinear street network. Also, in that era, dispatch processing was thought to only require 1:00 minute, and crew turnout was only expected to require 1:00 minute. It is now understood that the complexities of dispatching can take up to 1:30 minutes, and crew turnout can take up to 2:00 minutes.

Fremont has 11 fire stations in all its key neighborhoods. Reaching 90 percent of the calls in 4:00 minutes or less travel time would require additional stations, which is not fiscally prudent based on the number and severity of incidents at this time. EMS accounts for 65 percent of the incidents and, of those, typically less than 20 percent are critical emergencies with a stopped heart or breathing. The number of structure fires is modest, and the 11-station system can deliver four engines and a ladder truck to these fires within 13:29 minutes total response time, which is only 2:00 minutes longer than Citygate's recommendation; building fires are reached in the core of the City much faster.

A typical Citygate response performance recommendation for first-due arrival is within 7:30 minutes from 9-1-1 dispatch notification, and for ERF arrival within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability. A 7:30-minute total response time measure uses 4:00 minutes travel time. The 2019 Alameda County EMS contract calls for Fire Department responders to arrive within 8:30 minutes from a 9-1-1 call.

2.8.2 Deployment Improvements

With concerted effort, Fremont should be able to improve or at least maintain its current travel times. As traffic congestion worsens and high incident demand areas, like District 1, draw in more resources from other areas, simultaneous incidents in those areas receive longer travel times as units must cross the City covering for each other. This can be a problem at peak traffic congestion hours. As unit workloads approach Citygate's recommended threshold, the City will need to consider how to increase the number of units to serve the increasing demand from the existing 11 fire stations and, longer term, could need to consider an infill fire station.

In terms of emergency incident workload per unit, only Engine 51 is approaching the Citygate-recommended 30 percent unit-hour utilization threshold. However, during peak hours of the day, from 8:00 am to 8:00 pm, there is a Citywide simultaneous incident rate of at least two incidents at once 50 percent of the time.

The two ladder trucks are located too close together and limit the northern City ERF coverage. District 1 is very busy, and the ladder truck must cover many of the simultaneous medical incidents in District 1. This serves to wear an expensive aerial apparatus and responding to medical incidents means it is less available for fires and technical rescue incidents.

Given these issues and the high unit workloads in and near District 1, several improvements could be gained with a two-part deployment change:

1. Relocate the ladder truck from Station 1 to Station 6.
2. Add a Paramedic fire company with three personnel to Station 1, increasing the Citywide coverage from 13 to 14 companies.

Use the second fire company in District 1 to not only respond to simultaneous incidents in the core of the City but to also support adjacent districts when those units attend mandatory training outside their district or are committed to long-duration incidents. The investment in another company would stabilize response times in many parts of the City.

Map #5b shows the effect of this move on ERF coverage in the northern City. Moving the truck and adding an engine increases ERF by 38.4 miles, a three percent improvement over the existing coverage.

2.8.3 Deployment Recommendations

Based on the technical analysis and findings contained in this SOC assessment, Citygate offers the following deployment recommendations:

Recommendation #1:	**Adopt Updated Deployment Policies:** The City Council should adopt *updated*, complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients when possible and keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:
1.1	Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 7:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at ACRECC. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 4:00-minute travel time.

1.2	Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, extricate trapped victims within 30:00 minutes, and treat multiple medical patients at a single incident, a multiple-unit ERF should arrive within 11:30 minutes from the time of 9-1-1 call receipt at ACRECC 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.
1.3	Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impacts on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team. Fremont has a California Office of Emergency Services (OES) Type 2 Hazardous Materials Team and should maintain that State certification given the risks of a hazardous materials release within the City.

1.4	Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility. Fremont has a California Office of Emergency Services (OES) Type 1 Urban Search and Rescue team and should maintain that certification given the proximity of the City to the Hayward fault.
Recommendation #2:	The Department should consider moving the ladder truck from Station 1 to Station 6 and adding a second staffed company at Station 1. Doing so will stabilize response time performance during peak hours for simultaneous incidents.
Recommendation #3:	Work in concert with other City departments, including the Information Technology Services Department and the Public Works Department, to develop a multifaceted plan to improve response times, to include but not be limited to traffic signal preemption, smart corridor technologies, and less impactful traffic calming measures on key response routes.

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APPENDIX A

RISK ASSESSMENT

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APPENDIX A—RISK ASSESSMENT

A.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the Standards of Coverage (SOC) process is a community risk assessment. Within the context of an SOC study, the objectives of a community risk assessment are to:

- Identify the values at risk to be protected within the community or service area.
- Identify the specific hazards with the potential to adversely impact the community or service area.
- Quantify the overall risk associated with each hazard.
- Establish a foundation for current/future deployment decisions and risk-reduction/hazard-mitigation planning and evaluation.

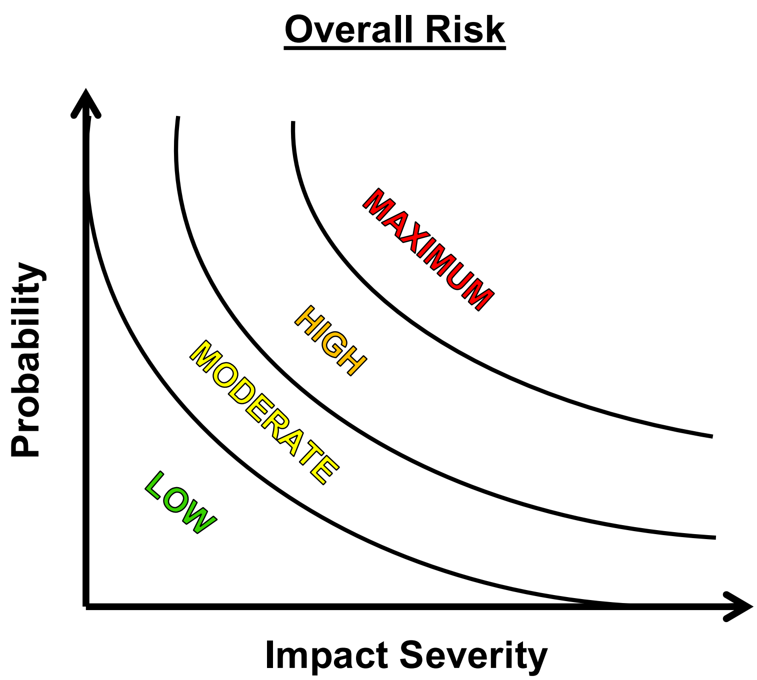
A hazard is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. Risk is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts* to people, property, and the community as a whole.

A.1.1 Risk Assessment Methodology

The methodology employed by Citygate to assess community risks as an integral element of an SOC study incorporates the following elements:

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification (to the extent data is available) of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Identification and evaluation of multiple relevant impact severity factors for each hazard by planning zone using agency/jurisdiction-specific data and information.
- Quantification of overall risk for each hazard based on probability of occurrence in combination with probable impact severity, as shown in Figure 1.

Figure 1—Overall Risk



Citygate used the following data sources for this study to understand the hazards and values to be protected in the City:

- U. S. Census Bureau population and demographic data
- Insurance Services Office (ISO) building fire flow and construction data
- City Geographical Information Systems (GIS) data
- City General Plan and Zoning information
- Alameda County Local Hazard Mitigation Plan
- City of Fremont Local Hazard Mitigation Plan
- Fire Department data and information.

A.1.2 Risk Assessment Summary

Citygate's evaluation of the values at risk and hazards likely to impact the City yields the following:

1. The Fire Department serves a diverse population, with densities ranging from less than 500 to more than 5,000 people per square mile, over a widely varied land use pattern.

2. The City's population is projected to grow by approximately 20 percent over the next 21 years.

3. The City has a large inventory of residential, commercial, office, industrial, research, educational, and other non-residential uses typical of other California communities of similar size and demographics.

4. The City has significant economic and other resource values to be protected, as identified in this assessment.

5. Alameda County has a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.

6. The City's overall risk for five hazards related to emergency services provided range from **Low** to **High**, as summarized in Table 1.

Table 1—Overall Risk by Hazard (Stations 1 through 6)

Hazard		Planning Zone					
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6
1	Building Fire	*Moderate*	*Moderate*	*Moderate*	*Low*	*Moderate*	*Moderate*
2	Vegetation/Wildland Fire	*Low*	*Moderate*	*Low*	*Moderate*	*Moderate*	*Low*
3	Medical Emergency	*High*	*High*	*High*	*High*	*High*	*High*
4	Hazardous Material	*Low*	*Low*	*Low*	*Moderate*	*High*	*Low*
5	Technical Rescue	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

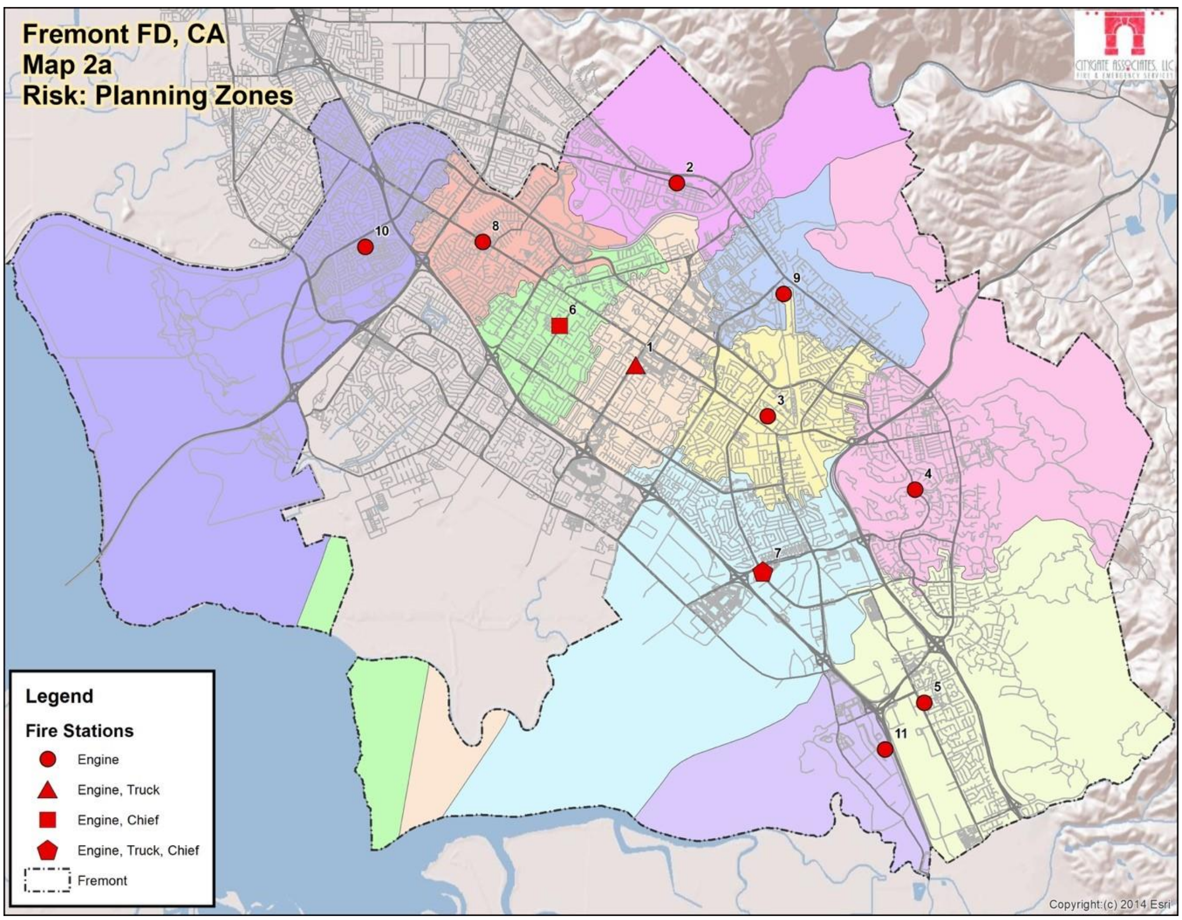
Table 2—Overall Risk by Hazard (Stations 7 through 11)

Hazard		Planning Zone				
		Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
1	Building Fire	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Low*
2	Vegetation/Wildland Fire	*Low*	*Low*	*Moderate*	*Low*	*Low*
3	Medical Emergency	*High*	*High*	*High*	*High*	*Moderate*
4	Hazardous Material	*High*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
5	Technical Rescue	*Low*	*Low*	*Low*	*Low*	*Low*

A.1.3 Planning Zones

The Commission on Fire Accreditation International (CFAI) recommends that jurisdictions establish geographic planning zones to better understand risk at a sub-jurisdictional level. For example, portions of a jurisdiction may contain predominantly moderate risk building occupancies, such as detached single-family residences, while other areas contain high- or maximum-risk occupancies, such as commercial and industrial buildings with a high hazard fire load. If risk was to be evaluated on a jurisdiction-wide basis, the predominant moderate risk could outweigh the high or maximum risk and may not be a significant factor in an overall assessment of risk. If, however, those high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, then it becomes a more significant risk factor. Another consideration in establishing planning zones is that the jurisdiction's record management system must also track the specific zone for each incident to be able to appropriately evaluate service demand and response performance relative to each specific zone. For this assessment, Citygate utilized 11 planning zones corresponding to each fire station's first-due response area, as shown in Figure 2.

Figure 2—Risk Planning Zones



A.1.4 Values at Risk to Be Protected

Values at risk, broadly defined, are tangibles of significant importance or value to the community or jurisdiction potentially at risk of harm or damage from a hazard occurrence. Values at risk typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, and/or natural resources.

People

Residents, employees, visitors, and travelers in a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, and people housed in institutional settings. Table 3 summarizes key demographic data for Fremont.

Table 3—Key Demographic Data – City of Fremont

Demographic	2017	Percentage
Population	**230,964**	
Under 10 years	31,640	**13.68%**
10 – 19 years	26,420	**11.44%**
20 – 64 years	145,695	**63.08%**
65 – 74 years	15,270	**6.61%**
75 years and older	11,939	**5.17%**
Median age	**37.7**	**N/A**
Housing Units	**76,550**	
Owner-Occupied	45,904	**59.97%**
Renter-Occupied	27,713	**36.20%**
Average Household Size	**3.10**	**N/A**
Ethnicity		
Asian	141,058	**61.07%**
White	36,784	**15.93%**
Hispanic/Latino	31,101	**13.47%**
Black/African American	8,709	**3.77%**
Other	13,312	**5.76%**
Education (population over 24 yrs. of age)	**161,887**	**70.09%**
High School Graduate	151,267	**93.44%**
Undergraduate Degree	46,883	**28.96%**
Graduate/Professional Degree	42,339	**26.15%**
Employment (population over 15 yrs. of age)	**182,370**	**78.96%**
In Labor Force	121,685	**66.72%**
Unemployed	5,555	**4.57%**
Population Below Poverty Level	11,317	**4.90%**
Population without Health Insurance Coverage	7,888	**3.42%**

Source: U.S. Census Bureau (2017)

Of note from Table 3 is the following:

- Slightly more than 25 percent of the population is under 10 years or over 65 years of age.

- The City's population is predominantly Asian (61 percent), followed by White (16 percent), Hispanic/Latino (13 percent), other ethnicities (6 percent), and Black / African American (4 percent).
- Of the population over 24 years of age, more than 93 percent has completed high school or equivalency.
- Of the population over 24 years of age, slightly more than 55 percent has an undergraduate, graduate, or professional degree.
- Nearly 67 percent of the population 15 years of age or older is in the workforce; of those, 4.57 percent are unemployed.
- The population below the federal poverty level is 4.9 percent.
- Only 3.42 percent of the population does not have health insurance coverage.

The Association of Bay Area Governments (ABAG) projects Fremont's population will grow to 275,440 (over the next 21 years) for an average annual growth rate of roughly 1 percent. Housing units are projected to increase at a slower rate to 87,440 over the same period.

Buildings

The City includes more than 76,000 housing units as well as a large inventory of non-residential occupancies, including industrial, manufacturing, research, technology, office, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other non-residential uses.

Building Occupancy Risk Categories

The CFAI identifies the following four risk categories that relate to building occupancy:

Low Risk – includes detached garages, storage sheds, outbuildings, and similar building occupancies that pose a relatively low risk of harm to humans or the community if damaged or destroyed by fire.

Moderate Risk – includes detached single-family or two-family dwellings; mobile homes; commercial and industrial buildings less than 10,000 square feet without a high hazard fire load; aircraft; railroad facilities; and similar building occupancies where loss of life or property damage is limited to the single building.

High Risk – includes apartment/condominium buildings; commercial and industrial buildings more than 10,000 square feet without a high hazard fire load; low-occupant load buildings with high fuel loading or hazardous materials; and similar occupancies with potential for substantial loss of life or unusual property damage or financial impact.

Maximum Risk – includes buildings or facilities with unusually high risk requiring an Effective Response Force (ERF) involving a significant augmentation of resources and personnel and where a fire would pose the potential for a catastrophic event involving large loss of life and/or significant economic impact to the community.

Evaluation of the City's building inventory reveals 408 high/maximum-risk building uses as they relate to the CFAI building fire risk categories as summarized in Table 4 and Map #2d (**Volume 2—Map Atlas**).

Table 4—Building Occupancy Inventory by Risk Category

Building Occupancy Classification		Number[1]	Risk Category[2]
A-1	Assembly	5	***High***
E	Education[3]	12	***High***
H	Hazardous	117	***High***
I	Institutional	20	***High***
R-1	Hotel/Motel	17	***High***
R-2	Multi-Family Residential	221	***High***
R-2.1	Residential Care Facilities	11	***High***
R-3.1	Assisted Living Facilities	5	***High***
Total		**408**	

[1] Source: City of Fremont Fire Department

[2] CFAI *Standards of Cover* (Fifth Edition)

[3] Middle and high schools, colleges, and specialized educational institutions

Critical Infrastructure / Key Resources

The U.S. Department of Homeland Security defines Critical Infrastructure / Key Resources (CIKR) as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The Department has identified 117 critical facilities and infrastructure as shown in Map #2c (**Volume 2—Map Atlas**). A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Economic Resources

Key economic drivers for the City include manufacturing, professional, scientific, technology, and information systems. Major employers include:

- Kaiser Hospital

- Lam Research
- Palo Alto Medical
- Seagate
- Synnex
- Tesla
- Thermo Fisher Scientific
- Washington Hospital
- Western Digital

Natural Resources

Natural resources within the City include:

- Alameda County Flood Control Channel (Niles Canyon)
- Central Park
- East Bay Regional Parks
  - Mission Peak
  - Vargas Plateau
  - Quarry Lakes
  - Coyote Hills
- Lake Elizabeth
- San Francisco Bay and Tidelands

Cultural/Historic Resources

- Mission San Jose

A.1.5 Hazard Identification

Citygate utilizes prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency/jurisdiction-specific data and information to identify the hazards to be evaluated for this study. The Alameda County Local Hazard Mitigation Plan[1] identifies the following hazards with potential to impact the County:

[1] County of Alameda 2016 Local Hazard Mitigation Plan, Section 4.3 (October 2016).

- Dam Failure Inundation
- Drought
- Earthquake
- Flood
- Landslide
- Liquefaction
- Tsunami
- Wildfire

The City of Fremont Local Hazard Mitigation Plan[2] identifies the following hazards with potential to impact the City:

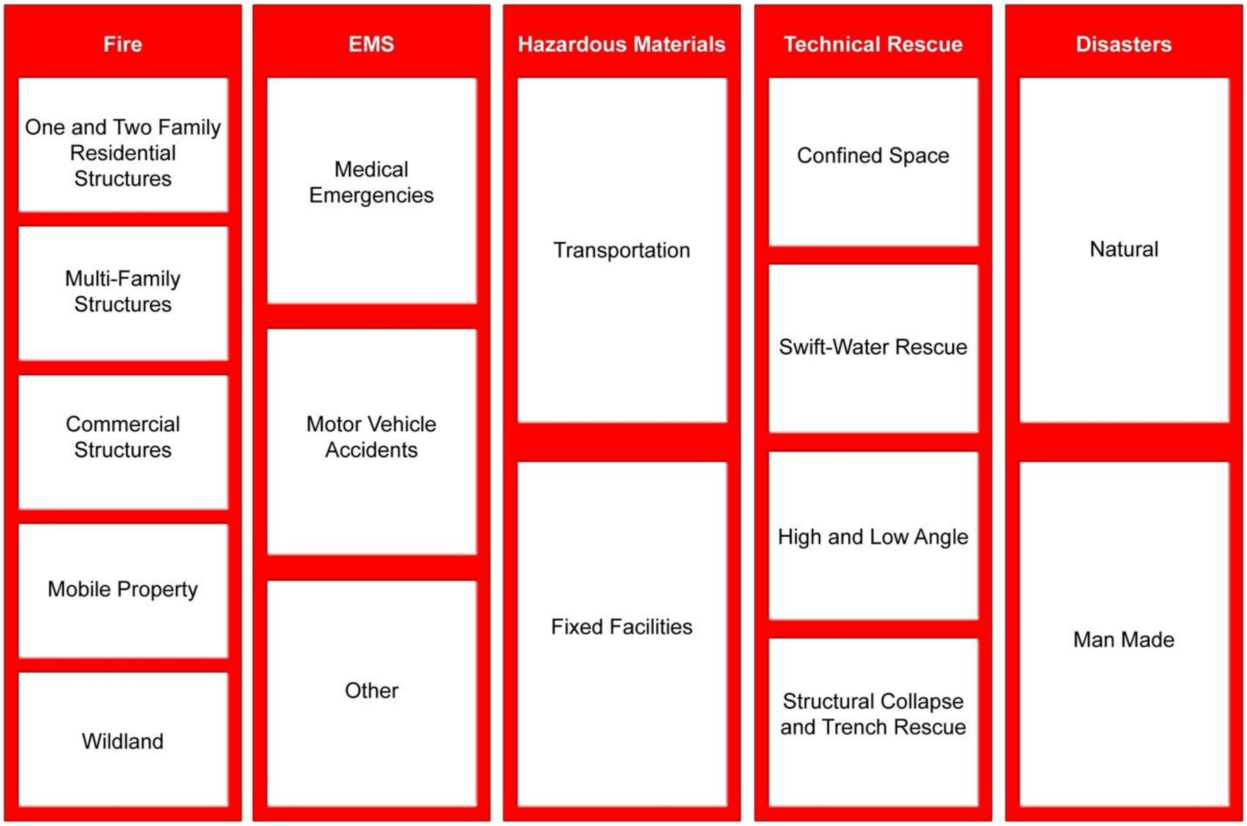
- Earthquake
- Landslide
- Flood
- Fire
- Climate Change

Although the Fire Department has no legal authority or responsibility to mitigate any of these hazards other than wildfire, it does provide services related to each hazard, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

The CFAI groups hazards into fire and non-fire categories, as shown in Figure 3. Identification, qualification, and quantification of the various fire and non-fire hazards are important factors in evaluating how resources are or can be deployed to mitigate those risks.

[2] City of Fremont 2016–2021 Local Hazard Mitigation Plan, Section 4.

Figure 3—Commission on Fire Accreditation International Hazard Categories



Source: CFAI *Standards of Cover* (Fifth Edition).

Subsequent to review and evaluation of the hazards identified in the Alameda County Local Hazard Mitigation Plan, the City of Fremont Local Hazard Mitigation Plan, and the fire and non-fire hazards as identified by the CFAI as they relate to services provided by the Department, Citygate evaluated the following five hazards for this risk assessment:

1. Building Fire
2. Vegetation/Wildland Fire
3. Medical Emergency
4. Hazardous Material Release/Spill
5. Technical Rescue

A.1.6 Service Capacity

Service capacity refers to the Department's available response force; the size, types, and condition of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic and/or mutual aid; and any other agency-specific factors influencing its ability to meet current and prospective future service demand relative to the risks to be protected.

The Department's service capacity for the five hazards evaluated consists of 41 personnel on duty daily staffing 11 Type-1 fire engines and two aerial ladder trucks, each staffed with at least one EMT-Paramedic, plus two Battalion Chiefs, all operating from the Department's 11 fire stations.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or EMT-Paramedic (Paramedic) level, capable of providing Advanced Life Support (ALS) pre-hospital emergency medical care. Ground paramedic ambulance service is provided by Falck Northern California, a private-sector ambulance provider operating under an exclusive operating area contract administered by the Alameda County Emergency Medical Services Agency. Air ambulance services, when needed, are provided by CalStar/REACH (Gilroy) and LifeFlight (Palo Alto). Kaiser Fremont and Washington Hospital are the primary receiving hospitals with emergency medical services. Valley Medical Center in San Jose and Eden Hospital in Castro Valley are the nearest trauma centers.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational (FRO) level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. Nine personnel (three per shift) are further trained to the Hazardous Materials Technician level as members of the Department's Special Operations Response Team that cross-staffs a Hazardous Materials Response unit at Station 11, and a Mass Casualty Incident (MCI) and Weapons of Mass Destruction (WMD) squad at Station 5.

Special Operations Response Team personnel are also trained to the Rescue Systems 2 and Confined Space/Trench Technician level, and cross-staff a Type-1 Heavy Rescue Unit at Station 10, while all other response personnel are trained to the Rescue Systems 1 and Confined Space Awareness level. The Department also operates a 21-foot Zodiac rigid hull rescue boat from Station 6, and a 16-foot Inflatable Rescue Boat (IRB) from Station 8.

A.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific period. Because the CFAI agency accreditation process requires annual review of an agency's risk assessment and baseline performance measures, Citygate recommends using the 12 months following completion of an SOC study as an appropriate period for the probability of occurrence evaluation. Table 5 describes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 5—Probability of Occurrence Scoring Criteria

Score	Probable Occurrence	Description	General Criteria
0–1.0	***Very Low***	Improbable	Hazard occurrence is *unlikely*
1.25–2.0	***Low***	Rare	Hazard *could occur*
2.25–3.0	***Moderate***	Infrequent	Hazard *should occur* infrequently
3.25–4.0	***High***	Likely	Hazard *likely to occur* regularly
4.25–5.0	***Very High***	Frequent	Hazard is *expected to occur* frequently

Citygate's SOC assessments use recent multiple-year hazard response data to determine the probability of hazard occurrence for the ensuing 12-month period.

A.1.8 Impact Severity

Impact severity refers to the extent a hazard occurrence impacts people, buildings, lifeline services, the environment, and the community as a whole. Table 6 describes the five impact severity categories and related scoring criteria used for this analysis.

Table 6—Impact Severity Scoring Criteria

Score	Impact Severity	General Criteria
0 – 1.0	Insignificant	• No serious injuries or fatalities • Few persons displaced for only a short duration • None or inconsequential damage • None or very minimal disruption to community • No measurable environmental impacts • Little or no financial loss
1.25 – 2.0	Minor	• Some minor injuries; no fatalities expected • Some persons displaced for less than 24 hours • Some minor damage • Minor community disruption; no loss of lifeline services • Minimal environmental impacts with no lasting effects • Minor financial loss
2.25 – 3.0	Moderate	• Some hospitalizations; some fatalities possible • Localized displacement of persons for up to 24 hours • Localized damage • Normal community functioning with some inconvenience • Minor loss of critical lifeline services • Some environmental impacts with no lasting effects, or small environmental impact with long-term effect • Moderate financial loss
3.25 – 4.0	Major	• Extensive serious injuries; significant number of persons hospitalized • Many fatalities possible • Significant displacement of many people for more than 24 hours • Significant damage requiring external resources • Community services disrupted; some lifeline services potentially unavailable • Some environmental impacts with long-term effects • Major financial loss
4.25 – 5.0	Catastrophic	• Large number of severe injuries and fatalities • Local/regional hospitals impacted • Large number of persons displaced for an extended duration • Extensive damage • Widespread loss of critical lifeline services • Community unable to function without significant support • Significant environmental impacts and/or permanent environmental damage • Catastrophic financial loss

A.1.9 Overall Risk

Overall hazard risk is determined by multiplying the *probability of occurrence score* by the *impact severity score*. The resultant total determines the overall *risk ranking* as described in Table 7.

Table 7—Overall Risk Score and Rating

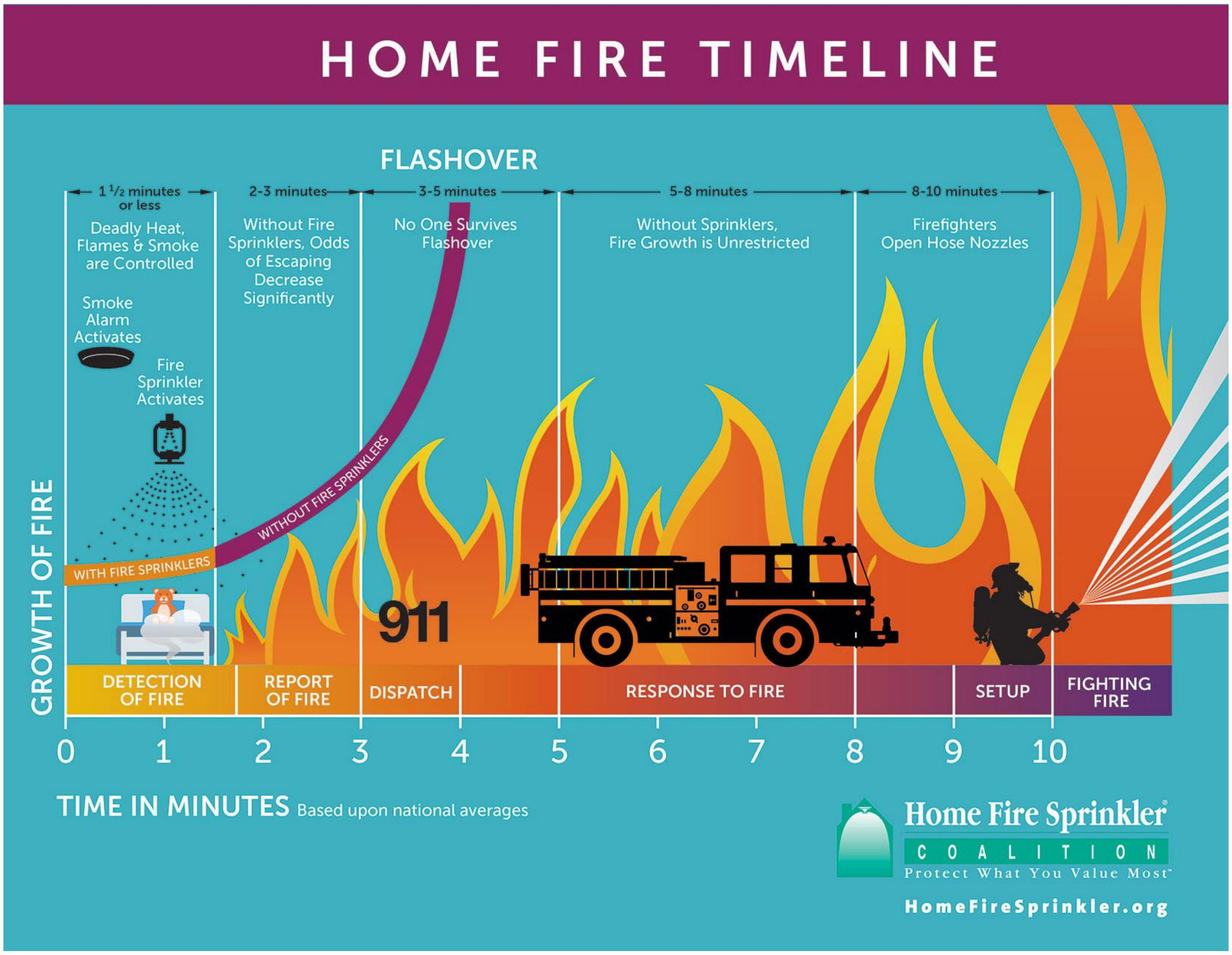
Overall Risk Score	Overall Risk Rating
0–5.99	***LOW***
6.0–11.99	***MODERATE***
12.0–19.99	***HIGH***
20.0–25.0	***MAXIMUM***

A.1.10 Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building size, age, construction type, density, occupancy, number of stories above ground level, required fire flow, proximity to other buildings, built-in fire protection/alarm systems, available fire suppression water supply, building fire service capacity, fire suppression resource deployment (distribution/concentration), staffing, and response time. Citygate used available data from the Department, the U.S. Census Bureau, and the Insurance Services Office (ISO) to assist in determining the City's building fire risk.

Figure 4 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as three to five minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

Figure 4—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org.

Population Density

Population density within the City ranges from less than 500 to more than 5,000 people per square mile. Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multiple-story buildings.

High Fire Flow Requirements

One of the many factors evaluated by the ISO is needed fire flow (NFF), which is the amount of water that would be required in gallons per minute (GPM) if the building were seriously involved in fire. For Fremont, the ISO database evaluated 2,200 buildings, 378 of which have an NFF of more than 2,500 GPM, as shown in Map #2e (**Volume 2—Map Atlas**).

This is a significant amount of firefighting water to deploy, and a major fire at any one of these buildings would require commitment of the Department's entire on-duty force plus mutual aid. Using a generally accepted figure of 50 GPM per firefighter on large building fires, a fire in a building requiring 2,500 GPM would require 50 firefighters, which exceeds the Department's daily on-duty staffing. A significant fire in any of these buildings not protected by an automatic fire sprinkler and/or a fire detection/alarm system would have a high probable impact severity.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration in close proximity to all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. Potable water is provided by the City, and according to Fire Department staff, available fire flow is sufficient throughout the City with no areas of sub-standard flow or pressure.

Building Fire Service Demand

For the three-year period from July 1, 2015, through June 30, 2018, the City experienced 459 building fire incidents comprising .95 percent of total service demand over the same period, as summarized in Table 8.

Table 8—Building Fire Service Demand

Risk	Year	Planning Zone											Total Incidents	Percent of Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11		
Building Fire	RY 15/16	24	3	21	5	9	25	24	16	15	10	2	**154**	0.98%
	RY 16/17	22	10	24	5	11	20	11	15	18	13	0	**149**	0.90%
	RY 17/18	25	18	21	7	16	12	12	10	15	18	2	**156**	0.98%
Total		**71**	**31**	**66**	**17**	**36**	**57**	**47**	**41**	**48**	**41**	**4**	**459**	**0.95%**
Percent of Total Service Demand		0.60%	1.24%	1.21%	0.67%	0.88%	1.13%	0.83%	1.18%	1.68%	1.12%	0.43%	0.95%	

Source: City of Fremont Fire Department incident records

As Table 8 illustrates, building fire service demand was consistent across the three-year study period, with the highest volume of incidents occurring at Station 1 and the lowest at Station 11. Overall, the Department's building fire service demand is low, comprising less than one percent of all calls for service, which is typical of other California jurisdictions of similar size and demographics.

Probability of Building Fire Occurrence

Table 9 summarizes Citygate's scoring of building fire probability by planning zone based on building fire service demand from Table 8.

Table 9—Building Fire Probability Scoring

Building Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Probability Score	2.50	2.25	2.50	1.50	2.25	2.50	2.50	2.25	2.25	2.25	1.25

Building Fire Impact Severity

Table 10 summarizes Citygate's scoring of the City's probable building fire impact severity by planning zone.

Table 10—Building Fire Impact Severity Scoring

Building Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Impact Severity Score	3.0	3.0	3.0	3.0	4.0	3.0	4.0	3.0	3.0	3.5	4.0

Overall Building Fire Risk

Table 11 summarizes the City's overall building fire risk scores and ratings by planning zone.

Table 11—Overall Building Fire Risk

Building Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Total Risk Score	7.50	6.75	7.50	4.50	9.00	7.50	10.00	6.75	6.75	7.88	5.00
Risk Rating	*Moderate*	*Moderate*	*Moderate*	*Low*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Low*

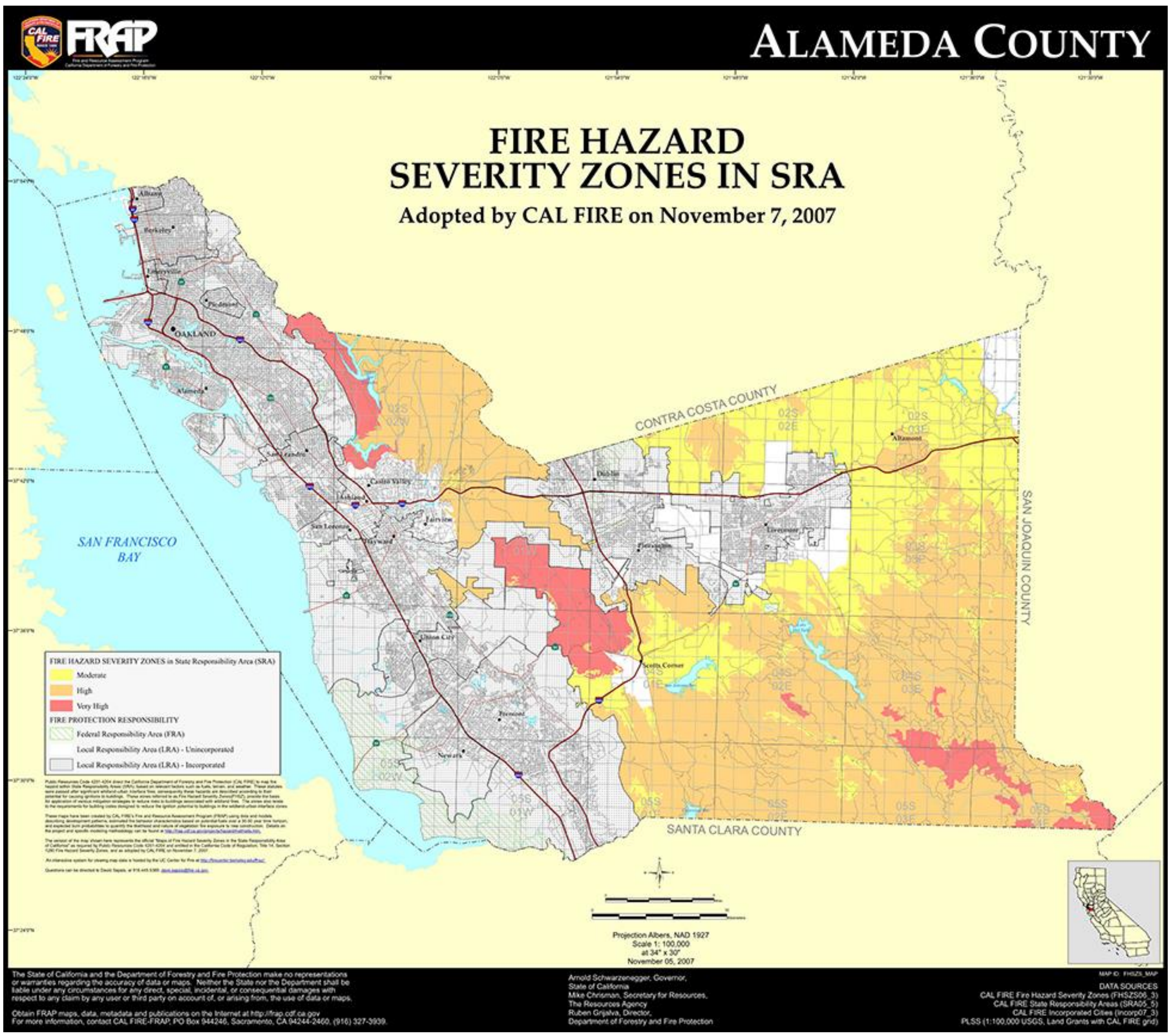
A.1.11 Vegetation/Wildland Fire Risk

Many areas within the City are susceptible to a vegetation fire, however the area east of Mission Boulevard is particularly vulnerable to wildland fire.

Wildland Fire Hazard Severity Zones

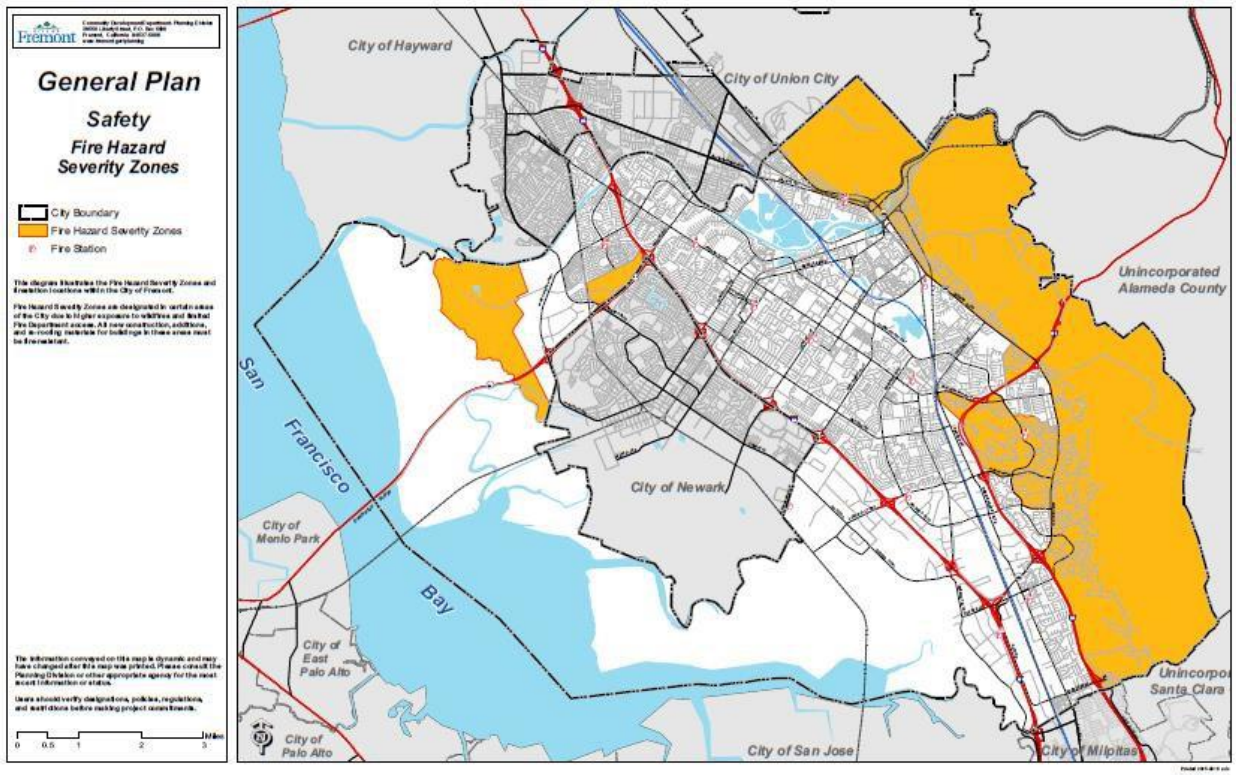
The California Department of Forestry and Fire Protection (CAL FIRE) designates wildland Fire Hazard Severity Zones (FHSZ) throughout the State based on analysis of multiple wildland fire hazard factors and modeling of potential wildland fire behavior. For State Responsibility Areas (SRAs) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates Moderate, High, and Very High FHSZs by county, as shown in Figure 5 for Alameda County. Note that the areas immediately east of the City are classified as ***Moderate*** to ***Very High***.

Figure 5—SRA Wildland Fire Hazard Severity Zones – Alameda County



CAL FIRE also identifies recommended FHSZs for Local Responsibility Areas (LRAs), where a local jurisdiction bears the fiscal responsibility for wildland fire protection, including incorporated cities. In 2007, Fremont adopted a Wildland-Urban Interface Area to the Fremont Municipal Code which designated the locations and boundaries of the CAL-FIRE-recommended ***Very High*** FHSZs as shown in Figure 6.

Figure 6—Fire Hazard Severity Zones – City of Fremont



Vegetative Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. Vegetative fuels within the City, in addition to decorative landscape species, consist of a mix of annual grasses and weeds, and deciduous, eucalyptus, and mixed conifer trees. Once ignited, vegetation fires can burn intensely and contribute to rapid fire spread under the right fuel, weather, and topographic conditions.

Weather

Weather elements such as temperature, relative humidity, wind, and lightning also affect vegetation fire potential and behavior. High temperatures and low relative humidity dry out vegetative fuels, creating a situation where fuels will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing vegetation fire behavior; higher wind speeds increase fire spread and intensity. Wildland fire season, when wildland fires are most likely to occur due to fuel and weather conditions, occurs from approximately May through October in Alameda County.

Topography

Vegetation fires tend to burn more intensely and spread faster when burning uphill and up-canyon, except for a wind-driven downhill or down-canyon fire. The hilly terrain east of Mission Boulevard can contribute to wildland fire behavior and spread.

Water Supply

Another significant vegetation fire impact severity factor is water supply immediately available for fire suppression. According to Fire Department staff, available fire flow is sufficient throughout the City, and the Department cross-staffs a water tender at Station 3 for wildland fires.

Wildland Fire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring and/or to minimize the severity of impacts resulting from a hazard occurrence. While none of the hazards subject to this study can be entirely prevented, measures *can* be taken to minimize the consequences or impacts when those hazards do occur.

The City's 2016–2021 LHMP identifies utilizing vegetation management to reduce risks in existing development as vegetation/wildland fire mitigation strategy #18,[3] with the following specific actions:

- Increase awareness of vegetation management standards for fire fuel reduction
- Maintain Fire Abatement Standards, especially in the hillside and Wildland-Urban Interface (WUI) areas
- Encourage property owners to proactively maintain trees prior to storm season to prevent damage to buildings and/or utility lines
- Conduct a baseline tree inventory to have a baseline of existing vegetative conditions
- Periodically review CAL FIRE-generated maps to understand existing vegetation and evaluate management strategies
- Encourage the use of least flammable mulches, such as coarse compost

In addition, the City participated in the development of the Alameda County Community Wildfire Protection Plan (CWPP) that includes the following specific recommended actions for Fremont:

- Evacuation planning

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[3] City of Fremont 2016–2021 Local Hazard Mitigation Plan, Section 6.

- Annual weed abatement enforcement
- Weed abatement in high-hazard areas

Vegetation/Wildland Fire Service Demand

The City experienced 260 vegetation/wildland fires over the three-year study period, comprising 0.54 percent of total service demand over the same period, as summarized in Table 12.

Table 12—Vegetation/Wildland Fire Service Demand

Risk	Year	Planning Zone											Total Incidents	Percent of Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11		
Vegetation/ Wildland Fire	RY 15/16	10	10	10	4	12	2	11	5	7	5	2	**78**	0.49%
	RY 16/17	7	15	13	4	9	8	8	6	11	12	1	**94**	0.57%
	RY 17/18	7	18	7	3	6	8	10	12	5	10	2	**88**	0.55%
Total		**24**	**43**	**30**	**11**	**27**	**18**	**29**	**23**	**23**	**27**	**5**	**260**	**0.54%**
Percent of Total Service Demand		0.96%	0.79%	1.18%	0.27%	0.54%	0.32%	0.84%	0.81%	0.63%	2.90%	3.29%	0.54%	

Source: City of Fremont Fire Department incident records

As Table 12 shows, vegetation/wildland fire service demand was consistent over the three-year study period, with the highest occurrence at Station 2 and the lowest occurrence at Station 11. While overall vegetation fire service demand is very low, there are Wildland Urban Interface (WUI) areas in the northeastern and eastern sections of the City where the wildland fire risk is higher than the other areas of the City.

Probability of Vegetation/Wildland Fire Occurrence

Table 13 summarizes Citygate's scoring of vegetation/wildland fire probability by planning zone based on vegetation fire service demand from Table 12.

Table 13—Vegetation/Wildland Fire Probability Scoring

Vegetation / Wildland Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Probability Score	**2.00**	**2.25**	**2.25**	**2.00**	**2.25**	**1.75**	**2.00**	**2.25**	**2.00**	**2.25**	**1.25**

Vegetation/Wildland Fire Impact Severity

Table 14 summarizes Citygate's scoring of probable vegetation/wildland fire impact severity by planning zone.

Table 14—Vegetation/Wildland Fire Impact Severity Scoring

Vegetation / Wildland Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Impact Severity Score	1.50	3.00	1.50	3.25	3.00	1.50	1.50	1.50	3.00	2.00	1.50

Overall Vegetation/Wildland Fire Risk

Table 15 summarizes the Department's overall vegetation/wildland fire risk scores and ratings by planning zone.

Table 15—Overall Vegetation/Wildland Fire Risk

Vegetation / Wildland Fire	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Total Risk Score	3.00	6.75	3.38	6.50	6.75	2.63	3.00	3.38	6.00	4.50	1.88
Risk Rating	*Low*	*Moderate*	*Low*	*Moderate*	*Moderate*	*Low*	*Low*	*Low*	*Moderate*	*Low*	*Low*

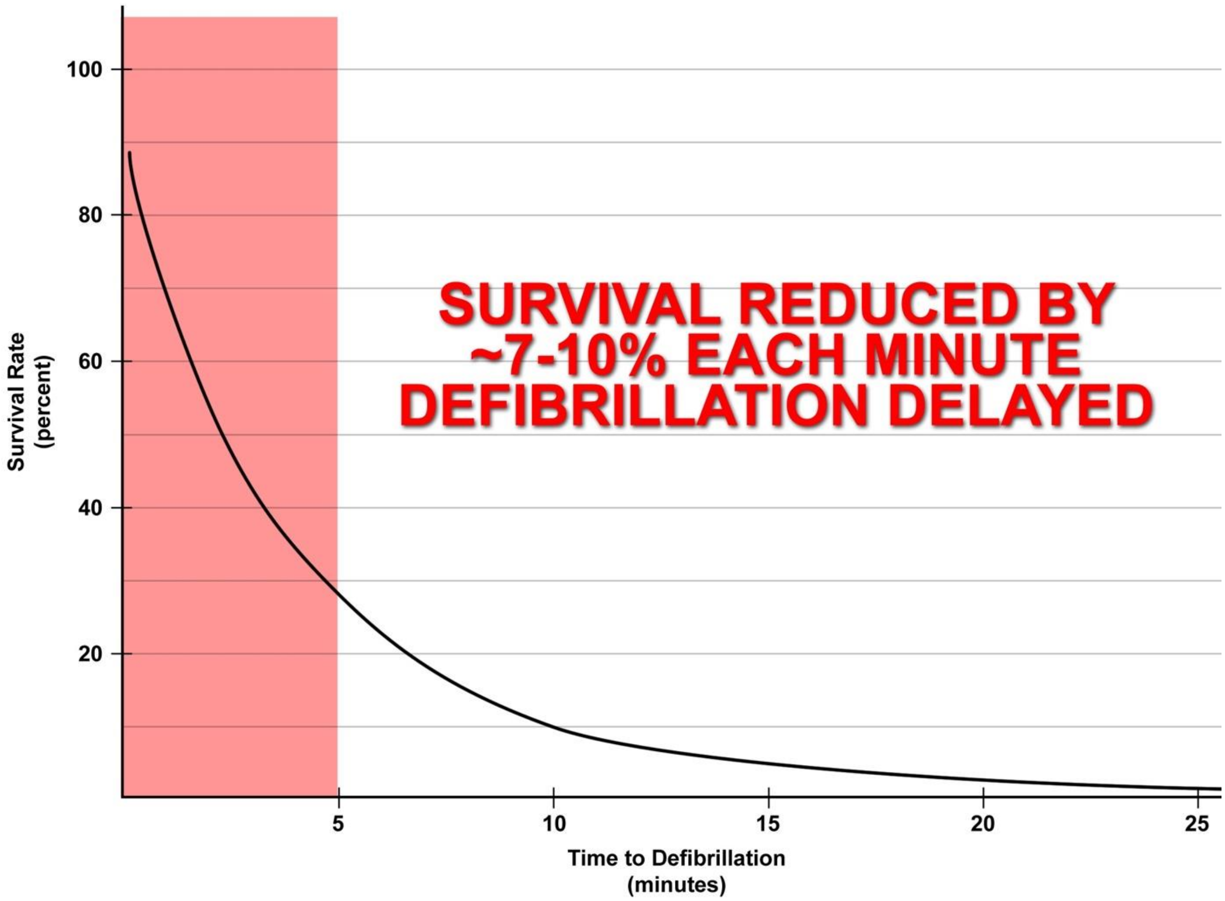
A.1.12 Medical Emergency Risk

Medical emergency risk in most communities is predominantly a function of population density, demographics, violence, health insurance coverage, and vehicle traffic.

Medical emergency risk can also be categorized as either a medical emergency resulting from a traumatic injury or a health-related condition or event. Cardiac arrest is one serious medical emergency among many where there is an interruption or blockage of oxygen to the brain.

Figure 7 illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases. While early defibrillation is one factor in cardiac arrest survivability, other factors can influence survivability as well, such as early CPR and pre-hospital advanced life support interventions.

Figure 7—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org.

Population Density

The City's population density ranges from less than 500 people per square mile to more than 5,000 per square mile, as shown in Map #2b (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. According to the U.S. Census Bureau, nearly 12 percent of the City's population is 65 and older; 4.9 percent of the population is at or below poverty level; less than 7 percent of the population over 24 years of age has less than a high school education or equivalent; and 3.4 percent of the population does not have health insurance coverage.[4] It should also be noted that approximately eight percent of the Department's total service demand has a nexus to homelessness.[5]

Violence

As would be expected, medical emergency risk is also higher in communities or segments of communities with higher rates of violence. For the five-year period from January 1, 2010 through December 31, 2014, the most recent years of available data, there were 1,735 violent crimes committed in Fremont,[6] for an annualized average of 347. Given an estimated 2014 population of 227,500, this represents a violent crime rate of 0.15 percent, suggesting that violent crime very minimally influences the City's medical emergency risk.

Table 16—Violent Crime Incidents

Year	Number of Violent Crimes
2010	488
2011	384
2012	306
2013	273
2014	284
Total	**1,735**

Source: FBI Uniform Crime Reporting Data.

Vehicle Traffic

Medical emergency risk tends to be higher in those areas of a community with high daily vehicle traffic volume, particularly those areas with high traffic volume traveling at high speeds. The City's transportation network includes Highways 84, 238, 262, 680, and 880, which carry an aggregate annual average daily traffic volume of nearly 574,000 vehicles, with a peak-hour load of 48,400 vehicles.[7] This high daily traffic volume has created a significant congestion problem throughout the City during workday hours, including most primary and secondary surface routes in addition to the highways.

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[4] Source: U. S. Census Bureau (2017).

[5] Source: Division Chief Rick Cory.

[6] Source: FBI Uniform Crime Reporting Data.

[7] Source: California Department of Transportation (2017).

Medical Emergency Service Demand

Medical emergency service demand over the three-year study period includes more than 31,000 calls for service comprising slightly more than 65 percent of total service demand over the same period, as summarized in Table 17.

Table 17—Medical Emergency Service Demand

Risk	Year	Planning Zone											Total Incidents	Percent of Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11		
Medical Emergency	RY 15/16	2,773	525	1,205	521	759	1,080	1,120	764	516	769	164	**10,196**	64.58%
	RY 16/17	2,852	586	1,265	531	918	1,143	1,260	786	539	793	161	**10,834**	65.62%
	RY 17/18	2,582	575	1,285	536	974	1,027	1,180	829	489	772	128	**10,377**	65.01%
Total		**8,207**	**1,686**	**3,755**	**1,588**	**2,651**	**3,250**	**3,560**	**2,379**	**1,544**	**2,334**	**453**	**31,407**	**65.08%**
Percent of Total Service Demand		68.98%	67.33%	68.62%	62.72%	65.07%	64.61%	62.80%	68.58%	54.14%	63.74%	48.66%	65.08%	

Source: City of Fremont Fire Department incident records

As Table 17 shows, medical emergency service demand varies significantly by planning zone and is trending upward an average of approximately one percent annually over the past two years. Overall, the City's medical emergency service demand is typical of other jurisdictions with similar demographics.

Probability of Medical Emergency Occurrence

Table 18 summarizes Citygate's scoring of medical emergency probability by planning zone based on medical emergency service demand from Table 17.

Table 18—Medical Emergency Probability Scoring

Medical Emergency	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Probability Score	**5.00**	**4.50**	**5.00**	**4.25**	**4.75**	**5.00**	**5.00**	**4.75**	**4.25**	**4.75**	**3.50**

Medical Emergency Impact Severity

Table 19 summarizes Citygate's scoring of probable medical emergency impact severity by planning zone.

Table 19—Medical Emergency Impact Severity Scoring

Medical Emergency	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Impact Severity Score	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Overall Medical Emergency Risk

Table 20 summarizes the Department's overall medical emergency risk scores and ratings by planning zone.

Table 20—Overall Medical Emergency Risk

Medical Emergency	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Total Risk Score	15.00	13.50	15.00	12.75	14.25	15.00	15.00	14.25	12.75	14.25	10.50
Risk Rating	*High*	*High*	*High*	*High*	*High*	*High*	*High*	*High*	*High*	*High*	*Moderate*

A.1.13 Hazardous Material Risk

Hazardous material risk factors include fixed facilities that store, use, or produce hazardous chemicals or waste; underground pipelines conveying hazardous materials; aviation, railroad, maritime, and vehicle transportation of hazardous commodities into or through a jurisdiction; vulnerable populations; emergency evacuation planning and related training; and specialized hazardous material service capacity.

Fixed Hazardous Materials Facilities

The Alameda County Department of Environmental Health, serving as the State-designated Certified Unified Program Agency (CUPA) for the County, identified 1,162 facilities within Fremont requiring a state or county hazardous material operating permit, or a Hazardous Materials Business Plan as shown on Map #2f (**Volume 2—Map Atlas**).

High-pressure natural gas transmission pipelines are also located along the Highway 880 and Highway 84 corridors, as well as along Central Avenue, Niles Boulevard, and Auto Mall Parkway alignments.

Transportation-Related Hazardous Materials

The City has transportation-related hazardous material risk as a result of its road transportation network, including Highways 84, 238, 262, 680, and 880, 237, with heavy daily truck traffic volume, many carrying hazardous commodities, as summarized in Table 21.

Table 21—Average Annual Daily Truck Traffic

Highway	Crossing	AADT[1]	Truck AADT by Axles				% Truck AADT by Axles			
			2	3	4	5+	2	3	4	5+
84	Route 880	3,590	1,921	366	75	1,228	53.50%	10.20%	2.10%	34.20%
238	Route 880	2,856	1,148	297	163	1,248	40.20%	10.40%	5.70%	43.70%
262	Route 880	5,069	2,023	461	284	2,301	39.90%	9.10%	5.60%	45.40%
680	Route 262	14,085	3,690	1,113	493	8,789	26.20%	7.90%	3.50%	62.40%
880	Route 262	10,751	5,150	1,161	688	3,752	47.90%	10.80%	6.40%	34.90%
Total		**36,351**	**13,932**	**3,398**	**1,703**	**17,318**	**38.33%**	**9.35%**	**4.68%**	**47.64%**

[1] Average Annual Daily Trips

Source: California Department of Transportation (2017)

The City also has transportation-related hazardous material risk due to Union Pacific Railroad freight traffic into and through the City, much of which also transports hazardous commodities.

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As shown in Map #2b (**Volume 2 – Map Atlas**), the City's population density ranges from less than 500 people per square mile to more than 5,000 per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include those individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they are unable to leave voluntarily. As shown in Table 3, slightly more than 25 percent of the City's population is under age 10 or is 65 years of age and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

Another significant hazardous material impact severity factor is a jurisdiction's shelter-in-place / emergency evacuation planning and training. In the event of a hazardous material release or spill, time can be a critical factor in notifying potentially affected persons, particularly at-risk populations, to either shelter-in-place or evacuate to a safe location. Essential to this process is an effective emergency plan that incorporates one or more mass emergency notification capabilities, as well as pre-established evacuation procedures. It is also essential to conduct regular, periodic exercises involving these two emergency plan elements to evaluate readiness and to identify and remediate any planning and/or training gaps to ensure ongoing emergency incident readiness and effectiveness.

The City has tasked a multi-department team to develop a comprehensive emergency evacuation plan, which is expected to be completed in the near future. The City is also a member of the Alameda County Emergency Alert System (AC Alert) administered and operated by the Alameda County Sheriff's Office. AC Alert is a free, subscription-based, mass emergency notification system that can provide emergency alerts, notifications, and other emergency information to email accounts, cell phones, smartphones, tablets, and landline telephones. Within Fremont, AC Alert notifications can be initiated by designated Fire or Police Department command staff. The City conducts regular Emergency Operations Center training, and although protocols prohibit testing, AC Alert is regularly utilized throughout the County.

Hazardous Material Service Demand

The City experienced 373 hazardous material incidents over the three-year study period, comprising 0.77 percent of total service demand over the same period, as summarized in Table 22.

Table 22—Hazardous Material Service Demand

Risk	Year	Planning Zone											Total Incidents	Percent of Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11		
Hazardous Materials	RY 15/16	20	4	16	11	19	10	20	6	6	18	6	**136**	0.86%
	RY 16/17	21	7	12	8	10	10	24	7	13	6	6	**124**	0.75%
	RY 17/18	12	5	10	9	13	14	20	14	7	6	3	**113**	0.71%
Total		**53**	**16**	**38**	**28**	**42**	**34**	**64**	**27**	**26**	**30**	**15**	**373**	**0.77%**
Percent of Total Service Demand		0.45%	0.64%	0.69%	1.11%	1.03%	0.68%	1.13%	0.78%	0.91%	0.82%	1.61%	0.77%	

Source: City of Fremont Fire Department incident records

As Table 22 indicates, hazardous material service demand varies by planning zone and was relatively constant over the past three years, with Station 7 having the highest demand and Station 11 the lowest. Overall, the City's hazardous material service demand is low, due in large part to an effective state-authorized Certified Unified Program Agency (CUPA) inspection and enforcement program.

Probability of Hazardous Material Occurrence

Table 23 summarizes Citygate's scoring of hazardous materials probability by planning zone based on hazardous material service demand from Table 22.

Table 23—Hazardous Material Probability Scoring

Hazardous Materials	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Probability Score	2.25	1.75	2.25	2.00	3.00	2.25	3.00	2.25	2.25	2.25	2.00

Hazardous Material Impact Severity

Table 24 summarizes Citygate's scoring of probable hazardous material impact severity by planning zone.

Table 24—Hazardous Material Impact Severity Scoring

Hazardous Materials	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Impact Severity Score	2.00	3.00	2.00	3.00	4.00	2.00	4.00	3.00	3.00	3.00	3.00

Overall Hazardous Material Risk

Table 25 summarizes the City's overall hazardous material risk scores and ratings by planning zone.

Table 25—Overall Hazardous Material Risk

Hazardous Materials	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Total Risk Score	4.50	5.25	4.50	6.00	12.00	4.50	12.00	6.75	6.75	6.75	6.00
Risk Rating	*Low*	*Low*	*Low*	*Moderate*	*High*	*Low*	*High*	*Moderate*	*Moderate*	*Moderate*	*Moderate*

A.1.14 Technical Rescue Risk

Technical rescue risk factors include active construction projects; structural collapse potential; confined spaces, such as tanks and underground vaults; bodies of water, including rivers and streams; industrial machinery use; transportation volume; and earthquake, flood, and landslide potential.

Construction Activity

There is ongoing residential, commercial, industrial, and/or infrastructure construction activity occurring within Fremont.

Confined Spaces

There are multiple confined spaces within the City, including tanks, vaults, open trenches, etc.

Bodies of Water

There are multiple bodies of water within the City, including San Francisco Bay and tidelands, Lake Elizabeth, Quarry Lakes, Lakeshore Park, Alameda Creek, and numerous other smaller ponds and minor waterways, including Alameda Creek through Niles Canyon, which presents a significant swiftwater hazard when flowing.

Transportation Volume

Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the City, with Highways 84, 238, 262, 680, and 880 carrying nearly 574,000 vehicles daily.

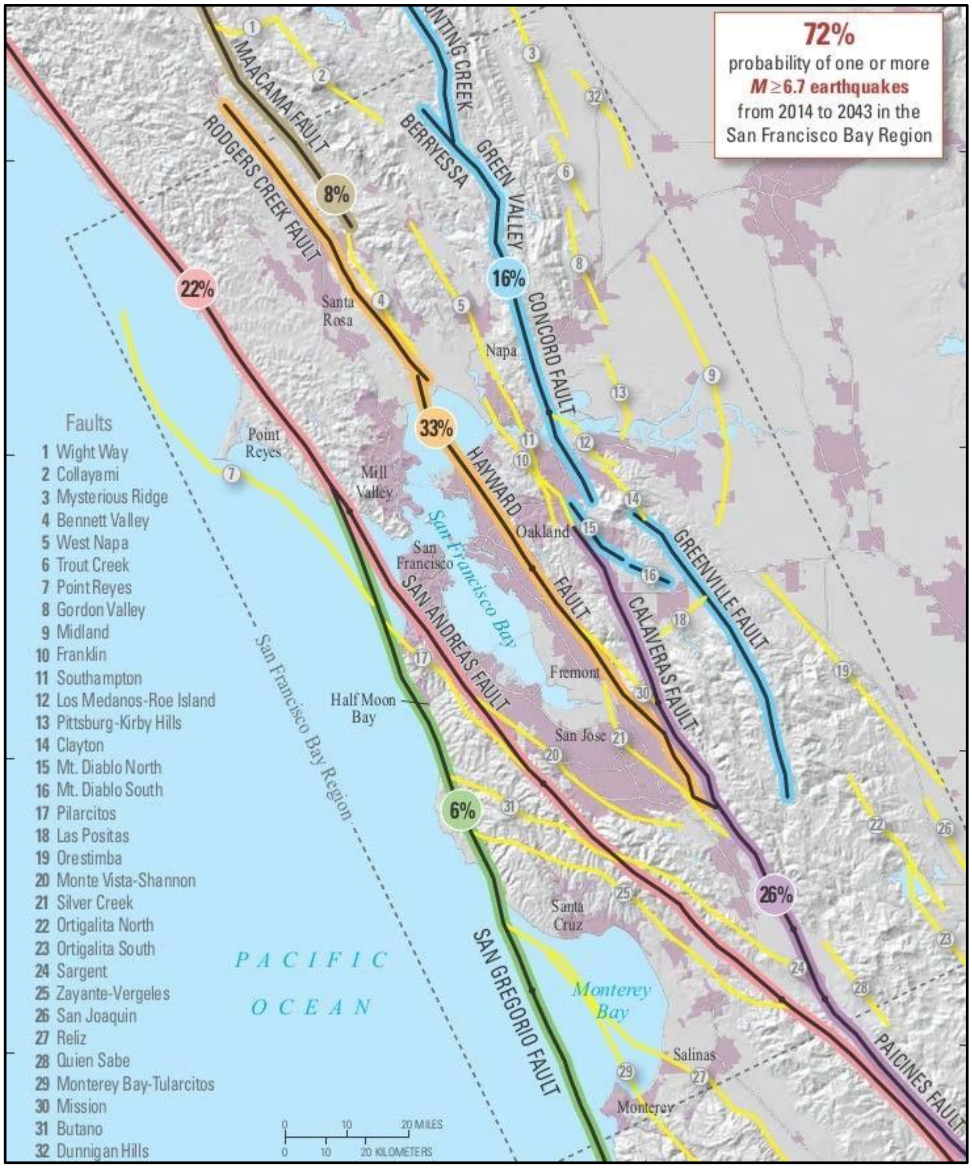
Earthquake Risk[8]

Three major seismic faults within the region have the potential to impact Fremont, including the Calaveras, Hayward, and San Andreas Faults. Fremont has not experienced an earthquake resulting in a local, state, or federal declared disaster, however minor earthquakes of less than magnitude 5.0 have occurred without any major property damage. There is also no history of surface fault rupture, ground shaking, liquefaction, earthquake-induced landslide, tsunami, seiche, or fire following an earthquake in Fremont.

According to the U.S.G.S., there is a 72 percent probability of a magnitude 6.7 or greater earthquake in the San Francisco Bay Area region within the next 25 years. Figure 8 shows the location of the various Bay Area seismic faults.

[8] Reference: City of Fremont 2016–2021 Local Hazard Mitigation Plan, Section 4.3.1.

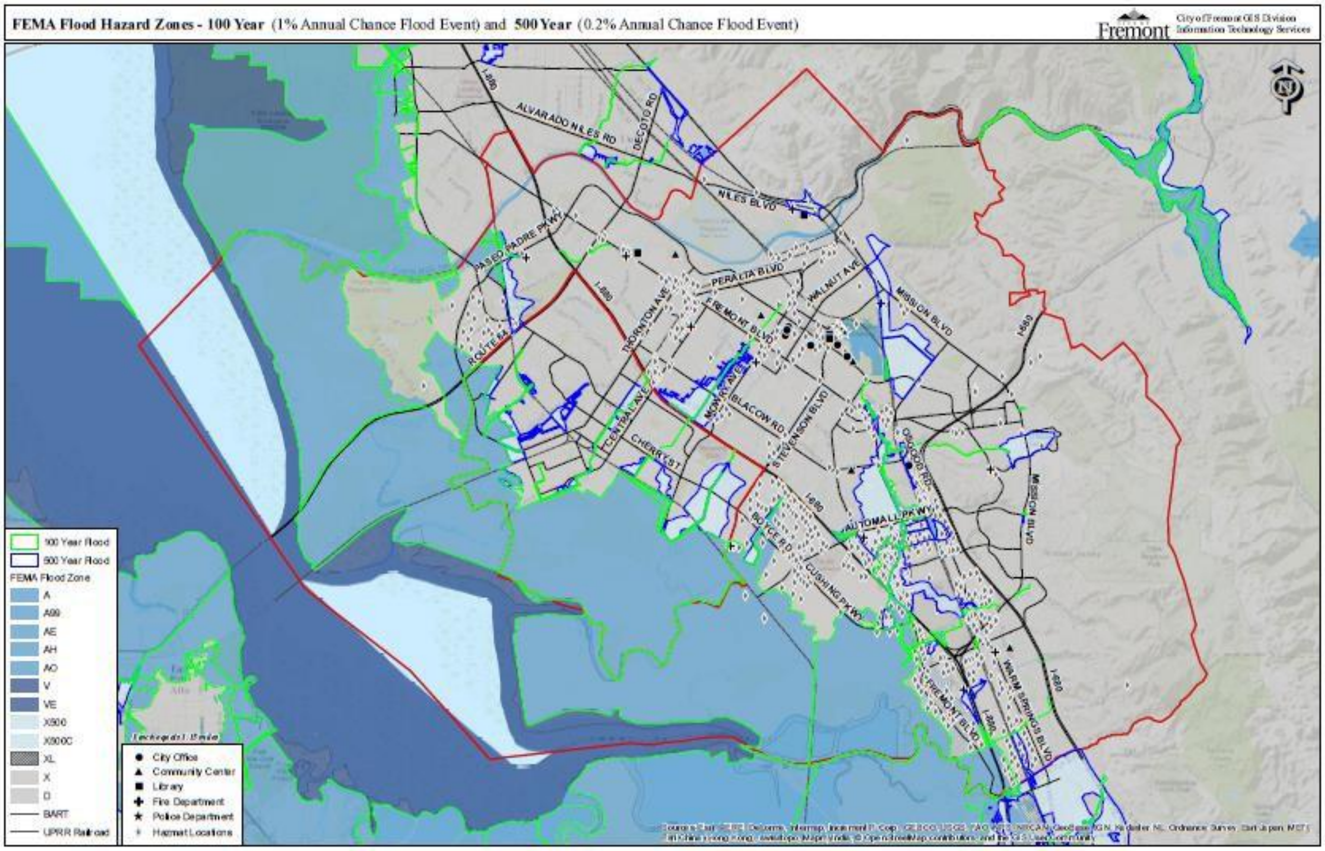
Figure 8—Earthquake Faults



Flood Risk[9]

Figure 9 shows the flood hazard areas for Fremont as identified by FEMA.

Figure 9—Flood Hazard Areas



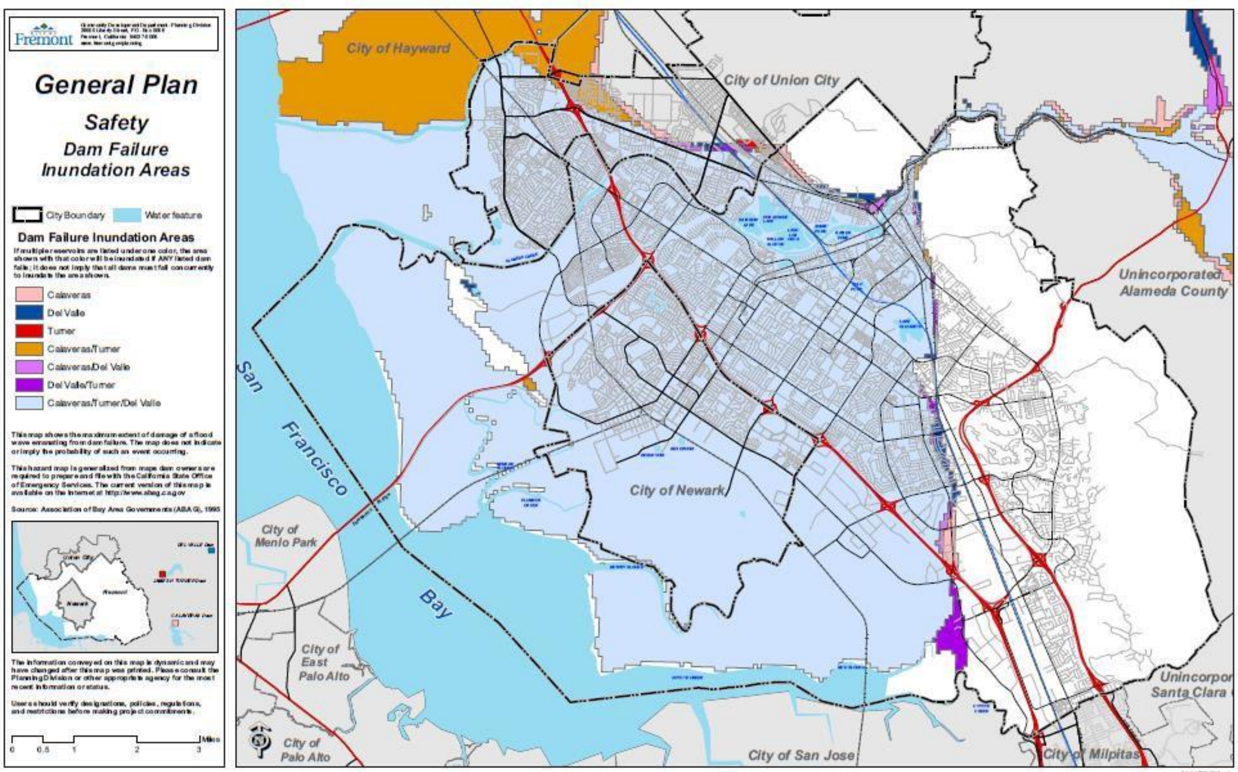
As Figure 9 shows, flooding from a 100-year or greater flood could affect portions of north Fremont surrounding Coyote Hills and portions of the City's industrial area west of I-880 and south of Stevenson Boulevard. Most of the areas prone to historical flooding are located in the western portions of the City and have been designated primarily for permanent open space uses. Other areas of the City where inundation from flooding is possible include Alameda Creek through Niles Canyon; the area surrounding Lake Elizabeth, extending into the Mission Valley neighborhood; Laguna Creek; the Crandall Creek area west of Deep Creek Road; and the KGO radio transmitter site along the approach to the Dumbarton Bridge. There is also localized flooding potential along the urban fringe near the base of the hills and in scattered flatland areas.

[9] Reference: City of Fremont 2016–2021 Local Hazard Mitigation Plan, Section 4.3.3.

Figure 10 shows the areas of the City subject to flooding due to dam failure. As the map shows, the majority of Fremont's urbanized areas are at risk of inundation as a result of a failure of one or more of the following dams:

- Anderson Reservoir Dam
- Calaveras Reservoir Dam
- Del Valle Dam / Lake Del Valle
- James. H. Turner Dam / San Antonio Reservoir

<u>Figure 10—Dam Inundation Areas</u>



Technical Rescue Service Demand

Over the three-year study period, there were 91 technical rescue incidents comprising 0.19 percent of total service demand for the same period, as summarized in Table 26.

Table 26—Technical Rescue Service Demand

Risk	Year	Planning Zone											Total Incidents	Percent of Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11		
Technical Rescue	RY 15/16	6	0	3	2	2	4	1	2	0	9	0	**29**	0.18%
	RY 16/17	4	0	6	3	2	0	2	4	6	3	0	**30**	0.18%
	RY 17/18	7	1	6	2	2	3	4	0	2	2	3	**32**	0.20%
Total		**17**	**1**	**15**	**7**	**6**	**7**	**7**	**6**	**8**	**14**	**3**	**91**	**0.19%**
Percent of Total Service Demand		0.14%	0.04%	0.27%	0.28%	0.15%	0.14%	0.12%	0.17%	0.28%	0.38%	0.32%	0.19%	

Source: City of Fremont Fire Department incident records

As Table 26 shows, technical rescue service demand is very low, with Station 1 experiencing the highest demand.

Probability of Technical Rescue Occurrence

Table 27 summarizes Citygate's technical rescue probability scoring by planning zone based on service demand from Table 26.

Table 27—Technical Rescue Probability Scoring

Technical Rescue	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Probability Score	**1.50**	**1.00**	**1.50**	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**	**1.50**	**1.00**

Technical Rescue Impact Severity

Table 28 summarizes Citygate's scoring of probable technical rescue impact severity by planning zone.

Table 28—Technical Rescue Impact Severity Scoring

Technical Rescue	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Impact Severity Score	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**

Overall Technical Rescue Risk

Table 29 summarizes the Department's overall technical rescue risk scores and ratings by planning zone.

Table 29—Overall Technical Rescue Risk

Technical Rescue	Planning Zone										
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11
Total Risk Score	3.75	2.50	3.75	3.13	3.13	3.13	3.13	3.13	3.13	3.75	2.50
Risk Rating	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*