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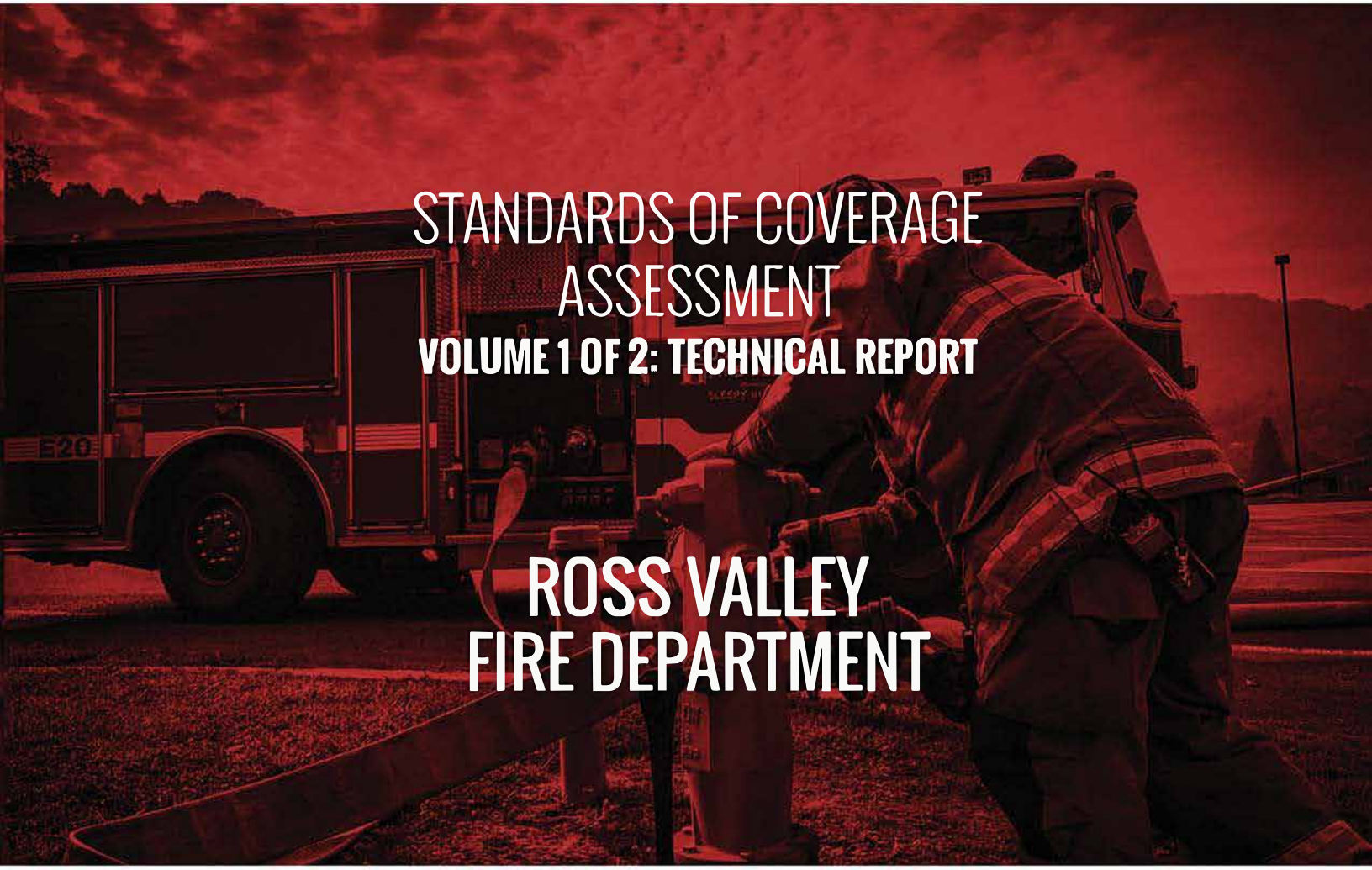

STANDARDS OF COVERAGE ASSESSMENT

VOLUME 1 OF 2: TECHNICAL REPORT

ROSS VALLEY FIRE DEPARTMENT

SEPTEMBER 2019

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TABLE OF CONTENTS

VOLUME 1 of 2 – Technical Report (this volume)

Section **Page**

Table of Tables

Table of Figures

VOLUME 2 of 2 – Map Atlas (separately bound)

EXECUTIVE SUMMARY

The Ross Valley Fire Department (Department) is a consolidated department protecting lives, property, and the environments of Ross, San Anselmo, Sleepy Hollow, and Fairfax. The Department retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Standards of Coverage (SOC) assessment to provide a foundation for future fire service planning. The goal of this assessment is to identify both current services and desired service levels, and then to assess the Department's ability to provide them. As part of this study, the Town of Ross (Town) requested an analysis of the impact on the current level of services if the fire engine in the Town was relocated, and alternatively, the fire engine and ambulance were relocated from their present location in the Town. After understanding any possible gaps in operations and resources, Citygate has provided recommendations to improve Department operations and services over time.

This assessment is presented in several parts, including this Executive Summary outlining the most significant findings and recommendations; the fire station/crew deployment analysis supported by maps and response statistics; and an assessment of specific fire crew deployment choices for the Town of Ross. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this report. Overall, there are 18 findings and 3 specific action 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 are a *local policy decision* and communities have the level of fire services that they 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 CURRENT ROSS VALLEY FIRE CREW DEPLOYMENT

Citygate finds that that the Department is well organized being a partnership of several agencies to accomplish its mission to serve a suburban population in a municipal land-use pattern although in hilly terrain with few cross-connecting roads aside from the main roads on the valley floor. The Department serves mostly residential and small downtown populations with a mixed land-use pattern typical of Marin County communities. The small towns and the road to West Marin attract a high number of visitors that also must be protected. However, the hilly geography and the limited road network, which is dependent on one main connector road, makes the area very difficult to serve efficiently from a small number of fire stations.

Fire service deployment, simply stated, 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 time interval to

achieve desired outcomes. *Weight* refers to multiple-unit responses (Effective Response Force, or ERF, commonly also called a First Alarm) 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 interval to safely control the emergency and prevent it from escalating into a more serious event.

Most suburban communities desire outcomes to include limiting building fire damage to only part of the inside of an affected building and/or minimizing permanent impairment resulting from a medical emergency. To do so, the 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 at the Marin County Sheriff's Dispatch Center (Comm Center), 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. Recommended best practices 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 urban/suburban areas.

In the Department, the current fire station system provides the following first-due unit response time performance across a variety of population density/risk areas for emergency medical and fire incident types. As Table 1 shows, *all* station areas receive service *longer* than a best practices goal point of 7:30 minutes.

Table 1—Call to Arrival Performance to 90 Percent of Fire and EMS Incidents (Taken from Table 16)

Station Area	2018
Department-Wide	08:45
Station 18	07:55
Station 19	07:45
Station 20	08:47
Station 21	09:07

The Department's dispatch times are *excellent*. Crew turnout times need modest improvement. The times in Table 1 do, however, reflect a longer *travel* time slower than an urban/suburban preferred 4:00 minutes for 90 percent of the incidents, as Table 2 displays.

Table 2—Travel Time Performance to 90 Percent of Fire and EMS Incidents (Taken from Table 15)

Station Area	2018
Department-Wide	06:09
Station 18	04:40
Station 19	05:38
Station 20	06:24
Station 21	06:30

The overall longer-than-desired first-due unit travel times are *not* the result of a lack of fire stations. They are the result of the non-grid street network design, simultaneous incidents at peak hours of the day, and traffic congestion—particularly rush hour and tourism on weekends.

CITYGATE'S OVERALL OPINIONS

The Department is very difficult to serve efficiently from a small number of fire stations due to the hilly geography and the limited road network, which is dependent on one main connector road. Over time, each population cluster opened a fire station for a minimum single first unit response and knew they were co-dependent on each other for multiple-unit serious emergencies. The geography cannot be changed and improving the road network is not politically feasible or cost-effective. Thus, reducing coverage by removing any one or more fire engines or the paramedic ambulance will increase response times to the local community receiving reduced coverage.

While the state fire code now requires fire sprinklers even in residential dwellings, it will be many more years before the vast majority of homes are replaced or remodeled with automatic fire sprinklers. If the communities' desired outcomes include limiting building fire damage to only part of the inside of an affected building, minimizing permanent impairment resulting from a medical emergency, and keeping wildland fires small to a few acres at the ignition point, then the communities served by the Ross Valley Fire Department will need first-due unit coverage in all neighborhoods.

However, even with maintaining the current four-station spacing, given the topography, not all hillside areas can receive response time coverage consistent with suburban best practice incident outcomes and a Citygate performance recommendation of a first-due arrival within 7:30 minutes from 9-1-1 dispatch notification and a multiple-unit Effective Response Force (ERF) arrival occurring within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability.

The Department's call processing performance is excellent. The crew turnout time needs modest improvement but even such attainable improvement cannot substantially lower the fire unit travel

times which are longer than desired. Department resources and equipment are appropriate to protect against the hazards likely to impact the Department's service area, but the daily staffing of eight firefighters on four engines, plus a two-firefighter/paramedic ambulance from the Ross Valley Paramedic Authority (RVPA) and a Duty Chief Officer only provides a *minimum* total response force sufficient to begin controlling a single emerging to serious fire incident, or to provide care at an EMS incident with one to five patients.

In terms of emergency incident workload per unit, no single fire unit or station area is approaching workload saturation. The level of simultaneous incidents is not high enough to warrant another unit at peak hours of the day. Citygate is, however, concerned about the overall limited Department staffing per day and its ability to respond with more "weight of attack" to keep emerging serious emergencies controlled. Even Countywide mutual aid resources are not quickly available in this part of Marin County, as they would be in an urban area with flat terrain and interconnected roads.

The quantity of calls in the Town of Ross (or any other single historic population cluster in the joint Department's service area) is too small and too volatile from which to use historical incidents as the only criteria to maintain the fire station. Providing fire services is akin to purchasing fire insurance, and it is important to consider the desired level of protection. The public policy issue is whether to have access to a fire station nearby or farther away, knowing that a station farther away, even with its unit(s) available for response, cannot offer more than edge suburban or emerging rural area response times to much of the Town of Ross.

DEPLOYMENT KEY FINDINGS AND RECOMMENDATIONS

The following are findings and recommendations presented throughout the report.

Finding #1: The Department has legacy response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International. However, they should be updated to reflect current risks and desired outcomes for all types of emergency risk outcomes.

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, specialty units, and command officers customarily needed to begin to control that type of incident based on Department experience.

Finding #3: The mapping analysis shows the need for neighborhood-based first response units for fire and EMS incidents.

Finding #4: The risk assessment maps show there are risks to be protected from fire besides just single-family homes, and some areas have lower fire flow capacity for serious or conflagration size fires.

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

Finding #6: The number of simultaneous incidents is volatile. However, in a four-station department, it is very rare that more than two incidents occur at once.

Finding #7: Call processing performance at 1:04 minutes is *better than* a best practice recommendation of 1:30 minutes.

Finding #8: Crew turnout performance at 2:41 minutes is *slower* than a Citygate-recommended goal of 2:00 minutes or less.

Finding #9: First-due unit travel time performance to 90 percent of the incidents Department-wide at 6:09 minutes is well past the Department's likely goal of 4:00 minutes, a goal consistent with best practices.

Finding #10: The Department's call to arrival time to 90 percent of the incidents at 8:45 is slower than a Citygate's recommended goal of 7:30 minutes in developed suburban areas. The principal reason is the longer travel times, reflective of the topography and road network in the Department's service area.

Finding #11: The Effective Response Force (First Alarm) *travel* times are only modestly longer than a best practices goal of 8:00 minutes and are reflective of the good, central placement of the four fire stations.

Finding #12: In the Town of Ross, on EMS emergencies, Engine 18 responded 214 times and Medic 18 responded 169 times in a two-year period.

Finding #13: In the Town of Ross, adjoining Engines 17 (Kentfield) and Engine 19 each arrived first over a two-year period 19 and 20 times, totaling 39. Thus, the outside units only arrived/were needed first 12.6 percent of the time.

Finding #14: In a two-year period, Engines 18 and 17 (Kentfield) were assigned to incidents at the same time 78 times or 16 percent of Engine 18's total responses. Stated this way, if Engine 18 was closed, there are approximately 1.5 incidents per week to which Engine 17 will not be available to respond.

Finding #15: Closing Station 18 will add about 2:00 minutes *minimum* of travel time into that station area.

Finding #16: In the Ross Valley Fire Department, Station 18 has the best travel time of any of the four station areas at 4:40 minutes, only 40 seconds longer than an urban/suburban best practice recommendation of 4:00 minutes. Adding 2:00 minutes travel, plus dispatch and turnout time of at least 3:00 minutes, moves a Town of Ross total response time from 7:40 to 9:40 which would be more like an edge suburban area or emerging rural area. First unit response times of 10:00 minutes-plus means small fires will become larger and critical EMS patients may not receive lifesaving care.

Finding #17: If the Engine 18 daily firefighter count of two were transferred to Engine 19, or reduced to one being transferred, they would be joining an engine that serves a much larger area and is more exposed to simultaneous incident demand. Due the dynamic nature of 9-1-1 emergencies, there is no way to predict if all of the Town of Ross Engine 18 and Medic 18 first arrivals would be covered by just Engines 19 and 17 (Kentfield) or by other units even farther away.

Finding #18: Covering the Town of Ross from either Station 19 or 17 (Kentfield) depends on essentially one road being open and not congested with traffic. Any one accident or natural emergency could close the road, effectively making the Town of Ross a cul-de-sac served from one direction and, in a sub-regional emergency, either Engine 19 or 17 would be shared with a larger service area.

Recommendation #1: **Adopt Updated Deployment Policies:** The Ross Valley Fire Department governing Board 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 medically salvageable upon arrival and to 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 8:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at dispatch; this equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-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, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 12 personnel, including at least one Duty Chief Officer, should arrive within 12:30 minutes from the time of 9-1-1 call receipt in dispatch, 90 percent of the time; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 9:00-minute travel time.

1.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the Department's service areas from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Fire 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 8:30 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.

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 8:30 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 12:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

Recommendation #2: Consider maintaining the current location of all four engines and keeping Medic 18 in the Town of Ross to balance its coverage area to the west and east.

Recommendation #3: Consider providing a third firefighter per day on the three engines other than Engine 18. Doing so would raise the daily weight of attack from 12 to 15 and, with Kentfield's three personnel, to 18. This force would be sufficient to provide the weight of attack and simultaneous incident

redundancy for suburban positive outcomes. Especially on serious building and wildland fire ignitions, there is no second chance to stop the fire. This is a local policy decision to be made by the affected communities to determine the level of fire service that they can afford.

NEXT STEPS

- Review and absorb the content, findings, and recommendations of this report.
- Adopt revised response performance goals as recommended.
- Request staff to return with a community engagement plan to discuss adding up to three more firefighters per day, one on each of the three engines other than Engine 18.

SECTION 1—INTRODUCTION AND BACKGROUND

The Ross Valley Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Standards of Coverage (SOC) assessment to provide a foundation for future fire service planning. The goal of this assessment is to identify both current services and desired service levels and then to assess the Department's ability to provide them. 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 Department.

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.

Section 3 Town of Ross Focused Study: An assessment of the effectiveness of locating one of the Department's engines and/or ambulances in the Town of Ross.

Section 4 Overall Evaluation: An overall deployment evaluation with concluding recommendations.

Appendix A Risk Assessment

1.1.1 Goals of the Report

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

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

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

1.1.2 Limitations of 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, and then choose its level of fire services. *If* fire services are provided at all, federal and state regulations specify how to do so safely 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 can they cost out every possible alternative in detail. Once final strategic choices receive policy approval, Department staff can conduct any final costing and fiscal analysis 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 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 Department's service area and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected future fire service deployment, with the goal to identify the location(s) of stations and crew quantities required to best serve the Department as it currently exists and to facilitate future deployment planning.

Once Citygate gained an understanding of the Department's service area and its fire and non-fire risks, the Citygate team then 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 service area growth and service demand by risk types. This resulted in Citygate proposing an approach to both address current needs with effective and efficient use of existing resources and long-range needs. The result is a framework for enhancing Fire Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Project Scope of Work

Citygate's approach to this Standards of Coverage assessment involved:

- Reviewing information provided by the Department and the Town along with conducting stakeholder listening sessions with project stakeholders.
- Utilizing a geographic mapping software program to model fire station travel time coverage.
- Using an incident response time analysis program called StatsFD™ to review the statistics of prior incident performance, plotting the results on graphs and geographic mapping exhibits.
- Identifying and evaluating future Department 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.
- Utilizing the CFAI self-assessment criteria and other NFPA standards as the basis for evaluating the deployment services provided.

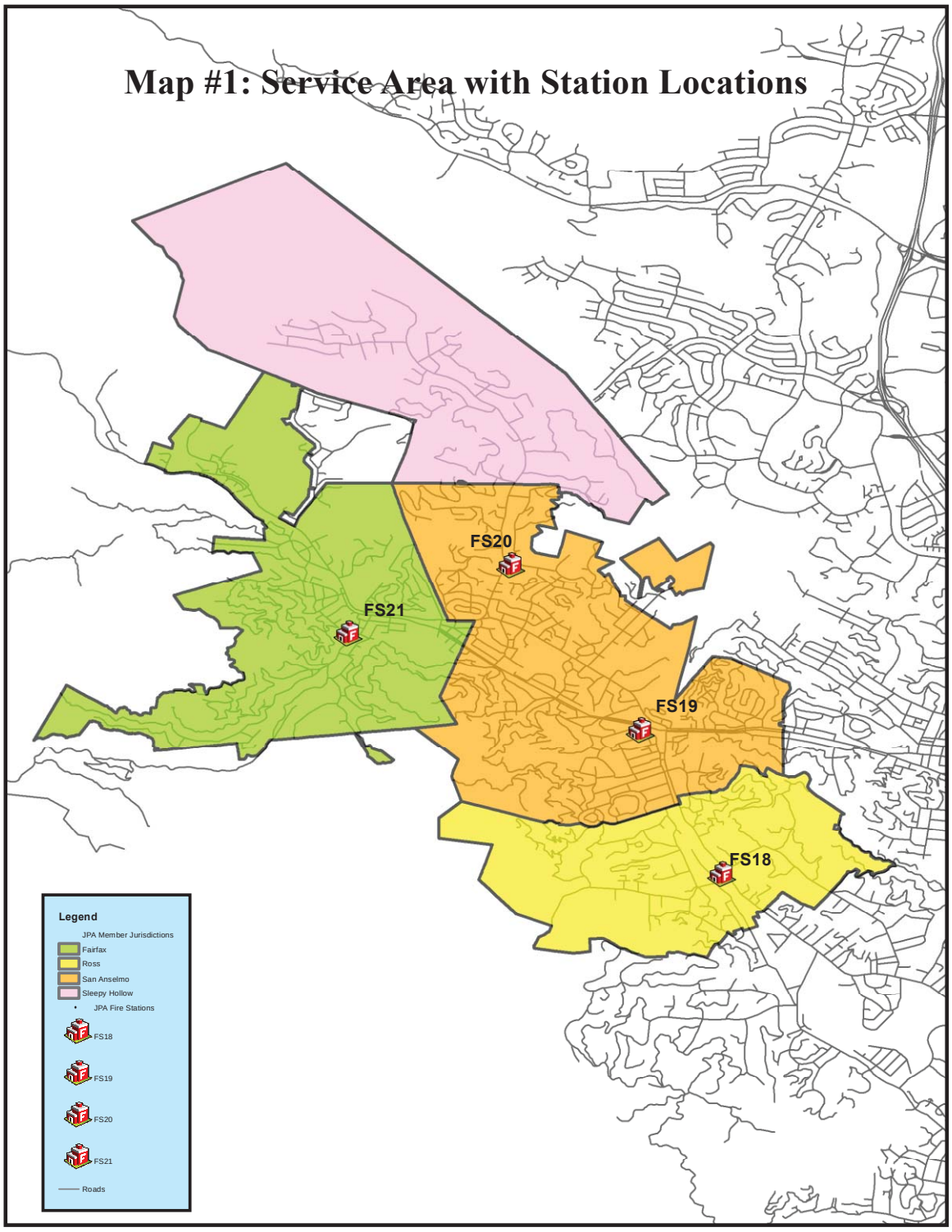
1.3 Communities Served Overview

The Department is a consolidated department protecting lives, property, and the environments of Ross, San Anselmo, Sleepy Hollow, and Fairfax. Ross Valley fire departments trace their history to the early 1900s, with the formation of small volunteer fire departments in the newly formed towns of Ross, San Anselmo, and Fairfax. Built near the wildfire prone slopes of Mount Tamalpais, these communities were and continue to be acutely aware of the risk of fire.

In 1982, the Fairfax Fire Department and the San Anselmo Fire Department joined forces and became known as the Ross Valley Fire Service. At the time Sleepy Hollow was receiving fire protection from the Town of San Anselmo through a contract for service and Sleepy Hollow chose not to become a member of the joint powers authority (JPA) while maintaining a non-voting seat on the Board. In 2010, the JPA was expanded to make Sleepy Hollow a full member of the JPA, ending its contract for service with the Town of San Anselmo. With the expansion of the JPA, the name was changed to the Ross Valley Fire Department. In 2012, Ross Valley Fire Department's Board of Directors voted to consolidate fire services with the Town of Ross, incorporating the

Town of Ross Fire Station 18 into the Ross Valley Fire Department. The current aggregate population of the Department's service area is estimated to be 24,785.

Figure 1—Fire Station Districts and General Geography



1.4 FIRE DEPARTMENT OVERVIEW

The Department's service capacity for building fire, wildland fire, medical emergency, hazardous materials, and technical rescue risk consists of eight personnel on duty daily staffing four Type-1 fire engines and one Duty Battalion Chief, operating from the Department's four fire stations. In addition, Medic 18 with two paramedic/firefighters from the Ross Valley Paramedic Authority (RVPA) is located at Station 18 in the Town of Ross.

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 the RVPA in the Department's service area.

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 for support for the Countywide hazardous material response team.

The Department also operates a cross-staffed Office of Emergency Services (OES) Type-1 (Structural Fire) engine from Station 20, a cross-staffed Type-3 (Wildland Fire) engine from Station 21, plus two reserve structure fire engines, one breathing air resupply unit, one hazardous materials response unit, and one utility truck. Technical rescue personnel and heavy rescue equipment would come from the County mutual aid system.

1.4.1 Facilities and Resources

The Department provides the aforementioned services from four fire stations as shown in Table 3.

Table 3—Fire Department Facilities and Assigned Resources

Station	Location	*Primary* Assigned Resources	*Minimum* Staffing
18	33 Sir Francis Drake Blvd., Ross	Engine	2
19	777 San Anselmo Ave., San Anselmo	Engine Battalion Chief	2 1
20	150 Butterfield Rd., San Anselmo	Engine	2
21	10 Park Road, Fairfax	Engine	2
Total *Per Day*			9

Source: Fire Department

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SECTION 2—STANDARDS OF COVERAGE ASSESSMENT

This section provides a detailed, in-depth 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 to 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 *Standards of Cover*, 5th and 6th editions, which is a systems-based approach to fire department deployment published by the Commission on Fire Accreditation International (CFAI). This approach uses local risk and demographics to determine the level of protection best fitting a community's needs.

The Standards of Coverage (SOC) method evaluates deployment as part of a fire agency's self-assessment process. This approach uses risk and community expectations on outcomes to help elected officials make informed decisions on fire and emergency medical services deployment levels. Citygate has adopted this multi-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 singular component. For instance, if only travel time is considered, and frequency of multiple calls is not considered, 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.

Table 4 describes the eight elements of the Standards of Coverage process.

Table 4—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 Standard of Coverage statements by risk type as necessary.

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

Fire service deployment, simply summarized, is about the *speed* and *weight* of the response. *Speed* refers to initial response (first-due), all-risk intervention resources (engines, trucks, and/or ambulances) strategically deployed across a jurisdiction for response to emergencies within a specified time interval to control routine to moderate emergencies without the incident escalating to greater size or severity. *Weight* refers to multiple-unit responses 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 interval to safely control the emergency and prevent it from escalating into a more serious event. Table 5 illustrates this deployment paradigm.

Table 5—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 without the incident 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 some cases, the call must then be transferred to a separate dispatch center. In this setting, the response time clock starts when the dispatch center receives the 9-1-1 call into its computer-aided dispatch (CAD) system. Response time increments include dispatch center call processing, crew alerting and response unit boarding (commonly called turnout time), and actual driving (travel) time.

The Department's response time goals are somewhat dated and not completely up to best practice recommendations. They were most recently discussed in a 2005 Standards of Cover (adopted March of 2005) done by staff as a companion to the 2005 Strategic Plan:

- First unit on-scene within total reflex time of 7-minutes to all areas served with a high potential for life loss, economic value or fire flow. Further 8-minutes for areas with a moderate or low potential for life loss, economic value or fire flow. Time was to be from the 911 call receipt to 90% of the incidents.

- Confine 90% of all structure fires within 30-minutes of arrival after 911 call receipt to the area of involvement as reported by the first arriving fire units, using an Effective Response Force of 14 firefighters with a fire flow stream(s) application of 1,500 gallons per minute (GPM).
- Maintain an emergency response capability, measured from 911 call receipt to arrival, that will ensure initiation of wildland structural fire protection with the first arriving unit within 8-minutes, and the first alarm companies within 12-minutes to 90% of all responses in all areas.
- Maintain an Emergency Medical Response of EMT-Ds,[1] measured from 911 call receipt to arrival, within 8-minutes to 90% of the incidents in all areas served.

Cities, towns, and counties in California have General Plans for land use regulation. One required chapter is a Safety Element. In reviewing the Ross Valley Fire Department's partners General Plans, none of them mention response times. As would be expected in the Marin County region, all of the General Plans contain significant goals and policies for the mitigation of wildfire, including vegetation management, structure resistance to fires, and road access.

The Department does not appear to regularly report measures of response time performance, per the 2005 criteria, to itself and its partner local governments. Internally, Service Level Objectives were reviewed on a regular basis until 2013.

Having adopted performance measures pertaining to all types of risks beside fire and EMS, such as hazardous materials and technical rescues, is considered a best practice today. The Department does have a service level history that can be documented in retrospective response times, number of response companies, and minimum staffing.

Currently, National Fire Protection Association (NFPA) Standard 1710,[2] a recommended deployment standard for career fire departments in urban/suburban areas, recommends initial (first-due) intervention unit arrival within 4:00 minutes *travel* time and recommends arrival of all the resources comprising the multiple-unit First Alarm within 8:00 minutes *travel* time, at 90 percent or better reliability.

As the Department's 2005 goals properly cited, response time begins with the receipt of the 9-1-1 call. The most recent published best practices by the NFPA for dispatching have increased the dispatch processing time up to 90 seconds and, if there are language barriers, 120 seconds. Further,

[1] Emergency Medical Technician – Defibrillator capable.

[2] 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).

for crew turnout time, 60-80 seconds is recommended depending on the type of protective clothing that has to 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 unit arrival goal is now 7:30 minutes from the time of the Marin County Sheriff's Dispatch Center (Comm Center) receiving the call. This is comprised of 90 seconds dispatch + 2:00 minutes crew turnout + 4:00 minutes travel.

Finding #1:	The Department has legacy response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International. However, they should be updated to reflect current risks and desired outcomes for all types of emergency risk outcomes.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of four engines staffed with a minimum of two personnel each and one Battalion Chief, for a total daily minimum year-round continuous staffing of at least 9 personnel operating from four fire stations, plus a two-firefighter/paramedic ambulance from the Ross Valley Paramedic Authority (RVPA). The Department has automatic and mutual aid agreements with all the fire agencies in Marin County and is also a signatory to the State of California Mutual Aid Agreements.

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. The Sheriff's Dispatch Center (Comm Center) process selects and dispatches the closest and most appropriate resource types pursuant to the Department's response plan, as shown in Table 6.

Table 6—Response Plan by Incident Type

Incident Type	Resources Dispatched	Total Personnel*
Single-Patient EMS	1 Engine + 1 Paramedic Ambulance	**4**
Vehicle Fire	1 Engine	**2**
Building Fire, Initial Response**	3 Engines, 1 Ladder Truck, 1 Paramedic Ambulance, 1 Battalion Chief	**12**
Wildland Fire	4 Engines or Wildland Engines, 1 Paramedic Ambulance, 1 Battalion Chief	**12**
Rescue	3 Engines, 1 Ladder Truck, 1 Paramedic Ambulance, 1 Battalion Chief	**12**
Hazardous Material	4 Engines, 1 Paramedic Ambulance, 1 Battalion Chief	**12**

* Personnel were calculated as follows: engines = 2 personnel (except if Engine 17 (Kentfield) staffs 3 personnel); ladder truck = 3 personnel from outside the Department; paramedic ambulance = 2 personnel.

** Confirmed serious fires receive a second Battalion Chief and a fourth engine

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, specialty units, and command officers customarily needed to begin to control that type of incident based on Department experience.

2.3 Outcome Expectations

SOC Element 2 of 8
Community Outcome Expectations

The Standards of Coverage process begins by reviewing existing emergency services outcome expectations. This includes determining for what purpose the response system exists and whether the governing body has adopted any response performance measures. If so, the time measures used must be understood and good 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.[3] This is because measuring the average only identifies the central or middle point of response time

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

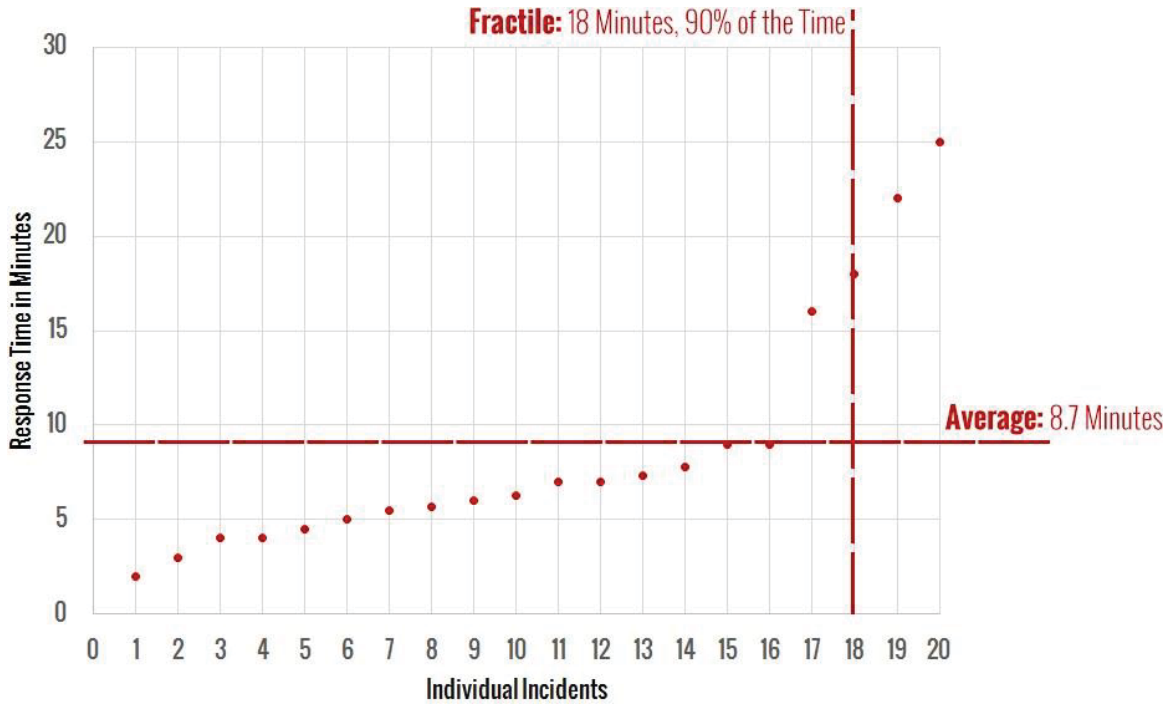
performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were way above the average or just above.

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 response time 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 exceeding 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 point.

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.

Figure 2—Fractile versus Average Response Time Measurements



More importantly, within the Standards of Coverage process, positive outcomes are the goal, and 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 and other events can cause oxygen deprivation to the brain. Cardiac arrests make up a small percentage; drowning, choking, trauma constrictions, or other similar events have the same effect. 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, most urban/suburban population density communities desire a first-due response goal that is within a range to give the situation hope for a positive outcome. It is important to note the fire or medical emergency continues to deteriorate from the time of inception, not 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, 1:00 minute. Then crew notification and travel time take additional minutes. Upon arrival, the crew must approach the patient or emergency, assess the situation, and deploy its skills and tools appropriately. 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 the response system down. 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 Marin County Sheriff's Dispatch Center (Comm Center) dispatch processing plus crew turnout, and road travel time steps. This is consistent with CFAI and NFPA and Citygate best practice recommendations.

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.

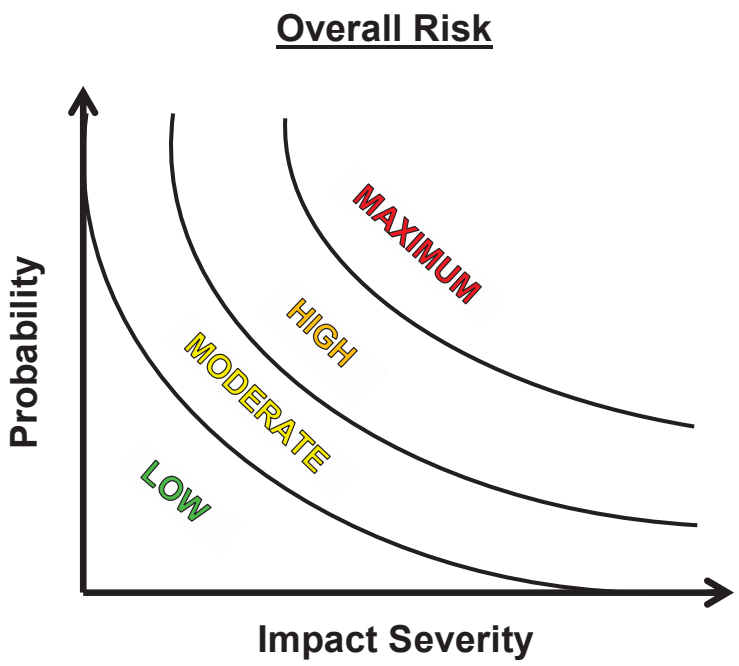
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant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

Citygate's comprehensive risk assessment is contained in Appendix A of this study. Citygate's evaluation of the values at risk and hazards likely to impact the Ross Valley Fire Department service area yields the following:

1. The Department serves a diverse population, with densities ranging from less than 500 people per square mile to approximately 5,000 per square mile, over a varied land use pattern.
2. The Department's service area population is projected to grow by only 7.7 percent over the next 11 years to 2030, or an average annual growth of approximately 0.7 percent.
3. The service area includes nearly 11,000 housing units, as well as a large inventory of non-residential occupancies.
4. Marin County has a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.
5. The Department's overall risk for five hazards related to emergency services provided range from **Low** to **High**, as summarized in Table 7.

The values in the summary table *do not* place a severity measure on any one risk type; they reflect a composite formula of the probability of occurrence in combination with probable impact severity. For example, while the Department's service area has significant wildland fire risks, the Department experienced only 19 vegetation fires over this study's two-year period, comprising 0.34 percent of total service demand. However, EMS is a daily occurrence, ranging from low- to high-risk individual medical events.

Table 7—Overall Risk by Hazard

Hazard	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Building Fire	*Low*	*Low*	*Moderate*	*Moderate*
Vegetation Fire	*Low*	*Low*	*Low*	*Low*
Medical Emergency	*High*	*High*	*High*	*High*
Hazardous Material	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Technical Rescue	*Low*	*Low*	*Low*	*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

Standards of Coverage (SOC) studies use critical task information to determine the number of firefighters needed within a timeframe to achieve desired objectives on fire and emergency medical incidents. Table 8 and Table 9 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 Ross Valley, *but with the more typical* unit staffing of three personnel per engine and two personnel per ambulance. 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.

- Some tasks must be conducted by a minimum of two firefighters to comply with safety regulations. For example, two firefighters are required to search a smoke-filled room for a victim.
- Given the two-firefighter staffing on the Department units, the time to completion will be longer, at times significantly depending on task complexity or a hard to access patient or fire location.

2.5.1 Critical Firefighting Tasks

Table 8 illustrates the critical tasks required to control a typical single-family dwelling fire with six response units (engines/chief), for a total Effective Response Force of *16* personnel, where the Ross Valley Fire Department initially sends **12**. A confirmed serious fire additionally receives a second Battalion Chief and a fourth engine raising this to 15 personnel. However, in many locations these additional units come from much farther away. These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the Standards of Coverage process. No conditions exist to override the Occupational Safety and Health Administration two-in/two-out safety policy, which requires that firefighters enter Immediately Dangerous to Life and Health atmospheres, such as building fires, in teams of two, while two more firefighters are outside and immediately ready to rescue them should trouble arise.

Scenario: *Simulated approximately 2,000 square-foot, two-story residential 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 8—First Alarm Residential Fire Critical Tasks – 16 Personnel

Critical Task Description		Personnel Required
1st-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	2
2nd-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 (IRIC)	2
1st-Due Truck (3 personnel)		
10	Conduct initial search and rescue if not already completed	2
11	Deploy ground ladders to roof	1–2
12	Establish horizontal or vertical building ventilation	1–2
13	Open concealed spaces as required	2
Chief Officer		
14	Transfer of incident command	2
15	Establish exterior command and scene safety	1
3rd Due Engine and Rescue Unit (3 personnel each)		
16	Establish Initial Rapid Intervention Crew (IRIC)	3
17	Secure utilities	2
18	Deploy second attack line as needed	2
19	Conduct secondary search	2

The duties in Table 8, grouped together, form an Effective Response Force (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. These tasks are also consistent with nationally published research studies.[4]

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 responds to more than 1,407 EMS incidents annually, including vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies.

For comparison, Table 9 summarizes the critical tasks required for a cardiac arrest patient, typically with at least five personnel responding, where the Department sends four.

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

Table 9—Cardiac Arrest Critical Tasks – Three Engine Personnel + Two Personnel ALS Ambulance

Critical Task		Personnel Required	Critical Task Description
1	Chest compressions	1–2	Compression of chest to circulate blood
2	Ventilate/oxygenate	1–2	Mouth-to-mouth, bag-valve-mask, apply O_2
3	Airway control	1–2	Manual techniques/intubation/cricothyroidomy
4	Defibrillate	1–2	Electrical defibrillation of dysrhythmia
5	Establish I.V.	1–2	Peripheral or central intravenous access
6	Control hemorrhage	1–2	Direct pressure, pressure bandage, tourniquet
7	Splint fractures	2–3	Manual, board splint, HARE traction, spine
8	Interpret ECG	2	Identify type and treat dysrhythmia
9	Administer drugs	2	Administer appropriate pharmacological agents
10	Spinal immobilization	2–5	Prevent or limit paralysis to extremities
11	Extricate patient	3–4	Remove patient from vehicle, entrapment
12	Patient charting	1–2	Record vitals, treatments administered, etc.
13	Hospital communication	1–2	Receive treatment orders from physician
14	Treat en route to hospital	2–3	Continue to treat/monitor/transport patient

2.5.3 Critical Task Analysis and Effective Response Force Size

What does a deployment study derive from a critical task analysis? The time required to complete the critical tasks necessary to stop the escalation of an emergency (as shown in Table 8 and Table 9) must be compared to outcomes. As shown in nationally published fire service time vs. temperature tables, after approximately 4:00 to 5:00 minutes of free burning 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 plus automatic aid is sufficient to deliver a single ERF of **12** personnel 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 analogy; if too few personnel arrive too slowly, then 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 timeframe 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 where fire stations are spaced too far apart, and one unit must cover another unit's area or multiple units are needed, these units can be too far away and the emergency will escalate and/or result in less-than-desirable outcomes.

Previous critical task studies conducted by Citygate, the National Institute of Standards,[5] and NFPA Standard 1710 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.

A question one might ask is, "If fewer firefighters arrive, such as does occur in the Ross Valley Department, *what* from the list of tasks mentioned would not be completed?" This is also critical as given the two-firefighter staffing, the initial force is a smaller count as it takes the third- and fourth-due units much longer to 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.

Sixteen initial personnel could handle a moderate-risk, confined residential fire; however, even an ERF of 16 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.

The Department has to initially dispatch extra units via mutual aid to deliver more personnel, given the two-firefighter per unit staffing, but doing so to deliver the "weight of attack" comes at two disadvantages—first, it takes longer (speed of attack) and second, more units are out of service should another simultaneous incident occur.

Given that the Department's ERF plan delivers **12** personnel to a moderate-risk building fire, it reflects a goal to confine serious building fires to the *building of origin, not* the room of origin or

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

to prevent the spread of fire to adjoining buildings or wildland areas. This is a lesser desired outcome for urban/suburban areas, where the goal is to confine a building fire to or very near to the room of origin. That goal requires more firefighters more quickly.

The Department's current physical response to building fires is, in effect, its de-facto deployment measure to its populated 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 Department is served today by four fire stations deploying four engine companies and one Battalion Chief as the duty Incident Commander. It is appropriate to understand using geographic mapping tools what the existing stations do and do not cover for both risks to be protected and the geography that units must travel over.

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 receive sufficient resources from multiple fire stations quickly. As indicated, this is known as the **Effective Response Force**, 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 risks to be protected and coverage, Citygate used a geographic mapping tool to produce the maps described in the following subsection, which can be found in **Volume 2**.

2.6.1 Deployment Baselines

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

Map #1 shows the Department boundary, communities, and fire station service areas. This is a reference map for other maps that follow.

Map #2a – Risk Assessment: Planning Zones

Map #2a shows the four 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: High Risk Occupancies

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

Map #2c – Risk Assessment: Hazardous Materials Use/Storage Occupancies

Map #2c displays the locations of the higher-risk commercial building occupancies that use and/or store regulated Hazardous Materials. The regulations for these uses are enforced by the County Department of Public Works as the State-designated Certified Unified Program Agency (CUPA) for the County.

Map #2d – Risk Assessment: Wildland Fire Severity Zones

Map #2d displays the California Department of Forestry and Fire Protection (CAL FIRE) State Responsibility Areas for wildland fire protection, where the state has primary fiscal responsibility for wildfires through the Marin County Fire Department.

Map #2e – Risk Assessment: Lower Fire Flow (Water) Locations

Map #2e displays the locations of fire hydrants on older, smaller water mains that can only provide up to 500 or 1,000 gallons per minute of firefighting flow. Most newer communities can provide neighborhood fire flows substantially higher than this and most current fire department pumpers can easily pump 1,500-2,000 gallons per minute. Larger commercial building fires can require 2,000 to 5,000 gallons per minute, provided by several pumpers and hydrants.

Map #3 – Distribution: First-Due Travel Distance Coverage

This map displays the Insurance Service Office (ISO) recommendation that fire stations in developed areas 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. Thus the 1.5-mile measure is a reasonable indicator of station spacing and overlap. This map shows first-due unit coverage distance of 1.5 miles across the public road network from the Department's current fire station locations. The 1.5-mile coverage goes from very light meaning a single unit to very dark where three units overlap. The coverage also assumes all units are in station and available for response.

The purpose of response coverage 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 in the next section of this study 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, there is some overlap coverage in the more built-up areas of the Department.

Map #4 – Medic 18 Ambulance Coverage Areas

This map displays the service area assigned to Medic 18, where the goal is to cover the most populated areas within 8:00 minutes *travel* time. This map shows the importance for Medic 18 to be centrally located to cover from Greenbrae west to Sleep Hollow and Fairfax.

Map #5 – All Incident Locations

Map #5 shows the location of all incidents from 2017 through 2018. It is apparent that incidents occur in most all areas of the Department and to other areas for mutual aid.

Map #6 – Emergency Medical Services and Rescue Incident Locations

Map #9 illustrates only the emergency medical and rescue incident locations over the last two years. With the majority of the calls for service being medical emergencies, virtually all areas of the Department need pre-hospital emergency medical services. The greatest population density also incurs the highest EMS demand patterns. Medic 18 responses are not located on this map.

Map #7 – All Fire Locations

This map identifies the location of all fires within the Department over the last two 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, it is evident that fires occur in all fire station areas.

Map #8 – Structure Fire Locations

Map #8 displays the location of the structure fire incidents over the last two 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 Department overall, which in Citygate's experience is consistent with other similar smaller communities in the western United States.

Finding #3:	The mapping analysis shows the need for neighborhood-based first response units for fire and EMS incidents.

> **Finding #4:** The risk assessment maps show there are risks to be protected from fire besides just single-family homes, and some areas have lower fire flow capacity for serious or conflagration size fires.

2.7 STATISTICAL ANALYSIS

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

The map sets described in Section 2.6 above and presented in **Volume 2** show the ideal situation for response times and the response effectiveness given perfect conditions with no competing calls, traffic congestion, 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 both federal National Fire Reporting System (NFIRS) version 5 incident and computer-aided dispatch (CAD) apparatus response data for two complete years from January 1, 2017 through December 31, 2018.

In 2018, the Department responded to 2,685 incidents, which is a daily demand of 7.36 incidents. During this same period, there were 7,503 individual apparatus responses. This means there was an average of 2.8 apparatus responses per incident, which is considered high and is likely due to the low staffing levels on each apparatus. The number of incidents has been calculated from NFIRS 5 records furnished for 2017 and 2018. According to these records, the Department experienced a decline in the number of incidents from 2017 through 2018.

Figure 4—Annual Service Demand by Year

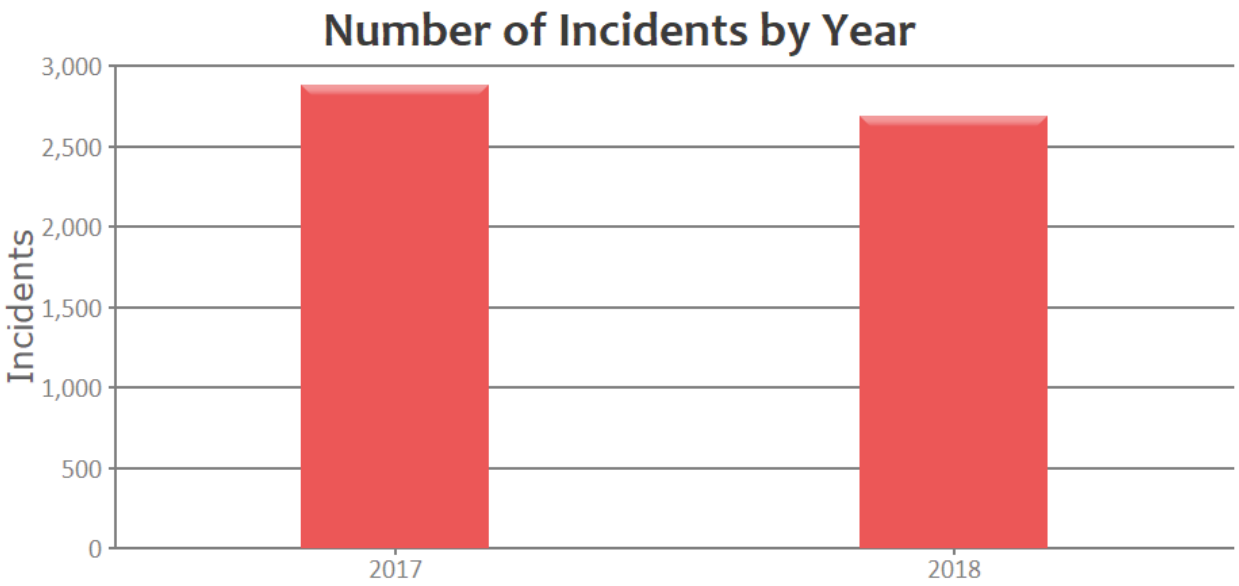


Figure 5 illustrates the number of incidents by incident type. While fire and EMS incidents remained relatively constant, there was a decrease in the number of other incident types. A reduction in the number of "other" incidents was most responsible for the decline in the total number of incidents.

Figure 5—Number of Incidents by Year – All Incident Types

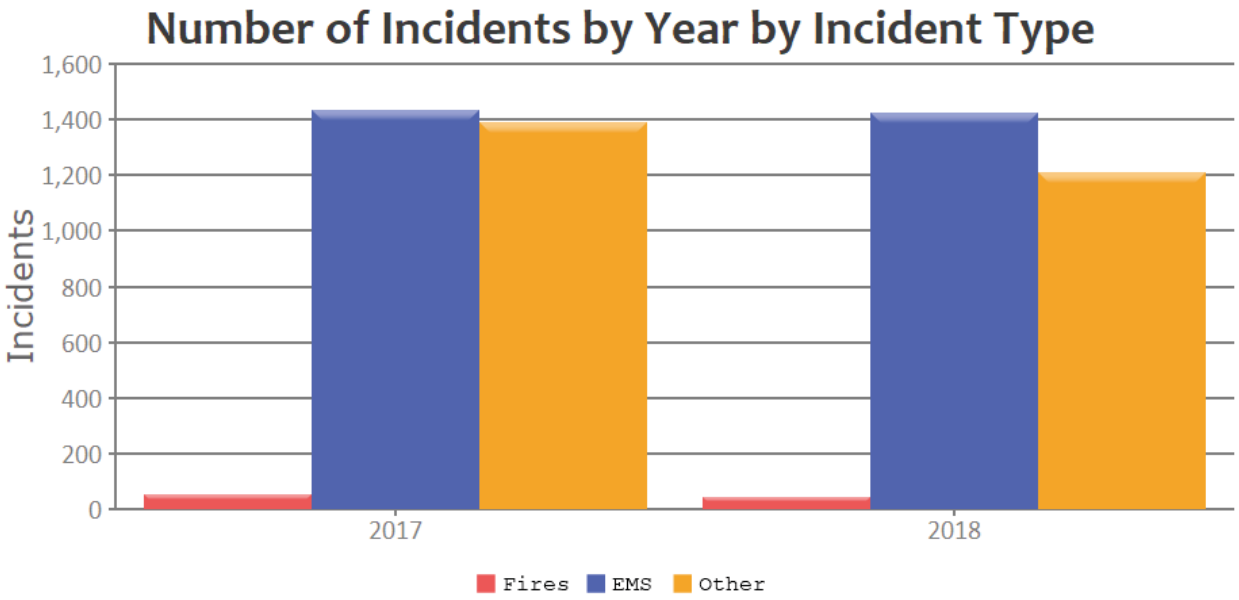
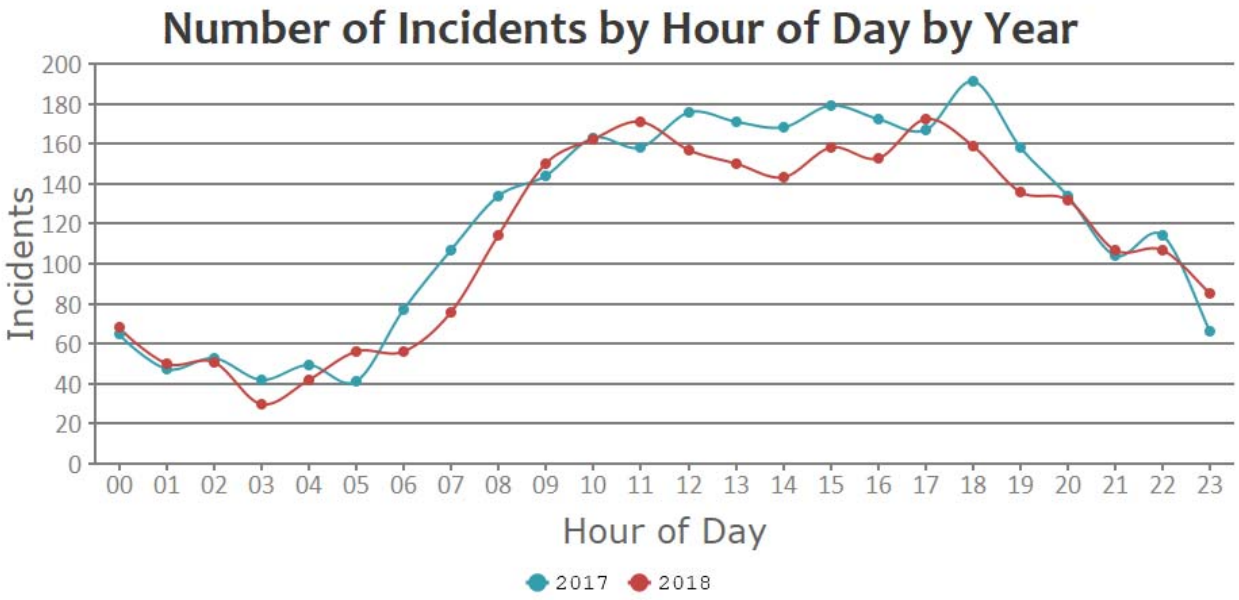


Figure 6 shows service demand by hour of day, illustrating that calls for service occur at every hour of the day and night, requiring fire and EMS response capability 24 hours per day, every day of the year. There was also a pattern of increased activity in 2017 during the morning, afternoon, and early evening hours.

Figure 6—Service Demand by Hour of Day and Year



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

The next figure illustrates the number of incidents by station area in 2018. Station 21 had the highest volume of activity.

Figure 7—Number of Incidents by Station – 2018

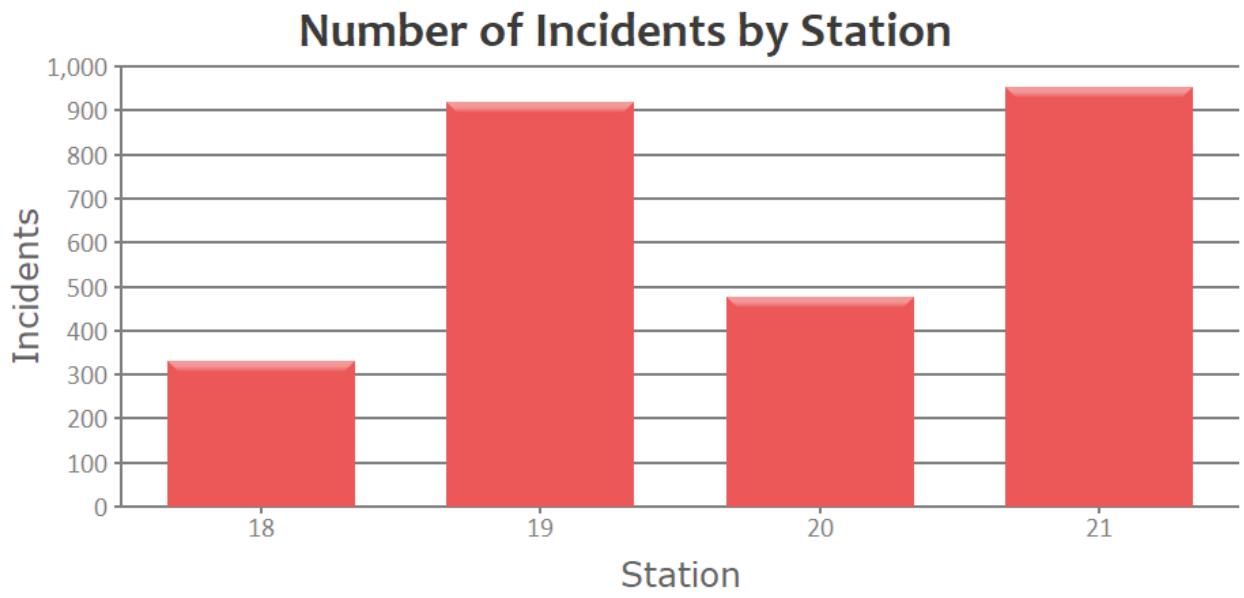


Table 10 lists the activity rankings of incidents by incident quantity, for more than 15 occurrences in a year. Note the strong ranking for EMS incidents.

Table 10—Incidents: Quantity by Incident Type – 2018

Incident Type	2018
321 EMS call, excluding vehicle accident with injury	1,343
611 Dispatched and canceled en route	232
553 Public service	197
554 Assist invalid	135
651 Smoke scare, odor of smoke	126
550 Public service assistance, other	75
322 Vehicle accident with injuries	51
743 Smoke detector activation, no fire – unintentional	49
700 False alarm or false call, other	41
745 Alarm system sounded, no fire – unintentional	35
412 Gas leak (natural gas or LPG)	32
444 Power line down	31

Incident Type	2018
600 Good intent call, other	30
622 No incident found on arrival of incident address	22
733 Smoke detector activation due to malfunction	20
740 Unintentional transmission of alarm, other	17
324 Motor vehicle accident no injuries	16
500 Service call, other	16
111 Building fire	16
735 Alarm system sounded due to malfunction	16
736 CO detector activation due to malfunction	15

Table 11 illustrates the ranking of incidents by property types. The highest rankings for incidents by property type are residential dwellings. Only those property types with 25 or more incidents are shown.

Table 11—Incidents: Quantity by Property Use – 2018

Property Use (NFIRS Code/Description)	2018
419 1 or 2 family dwelling	1,338
429 Multifamily dwellings	271
962 Residential street, road or residential driveway	218
960 Street, other	157
963 Street or road in commercial area	80
900 Outside or special property, other	72
311 24-hour care nursing homes, 4 or more persons	58
215 High school/junior high school/middle school	39
965 Vehicle parking area	34
161 Restaurant or cafeteria	29
888 Fire station	29
519 Food and beverage sales, grocery store	26
931 Open land or field	25

2.7.2 Simultaneous Emergency Incident Activity

Simultaneous incidents occur when other incidents are underway at the time a new incident develops. In the Department's response area during 2018, 16.05 percent of incidents occurred

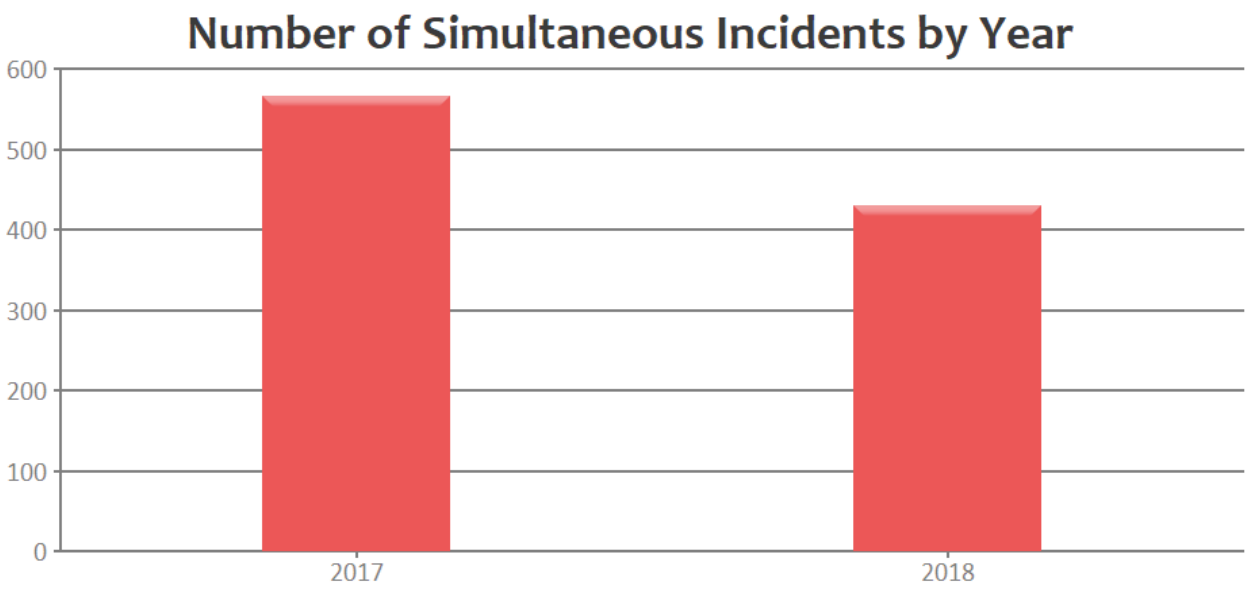
while one or more other incidents were underway. The following is the percentage of simultaneous emergency incidents broken down by the number of simultaneous incidents. Non-emergency incidents are not included as a unit can be re-dispatched to a serious emergency.

Table 12—Percentage by Number of Simultaneous *Emergency* Incidents

Number of Simultaneous Incidents	Percentage
1 or more simultaneous incidents	16.05%
2 or more simultaneous incidents	01.30%
3 or more simultaneous incidents	00.01%

The following graph shows the number of simultaneous incidents can be volatile and recently decreased.

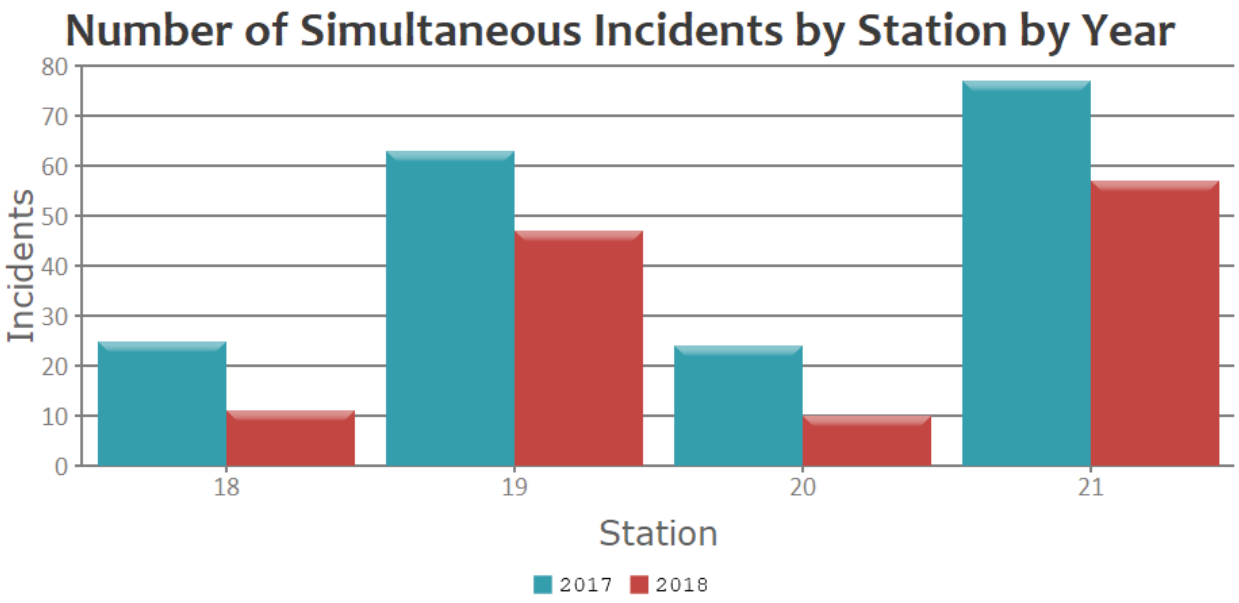
Figure 8—Number of Simultaneous Incidents by Year



In a larger region, 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.

Figure 9 illustrates the number of single-station simultaneous incidents by station area by year. Station 21 has the highest number of in-station-area simultaneous incidents. Each station area experienced a significant drop in the number of simultaneous incidents from the previous year.

Figure 9—Number of Single-Station Simultaneous Incidents by Station by Year



Finding #6: The number of simultaneous incidents is volatile. However, in a four-station department, it is very rare that more than two incidents occur at once.

2.7.3 Operational Performance

Measurements for the performance for the first apparatus to arrive on the scene of emergency incidents are the number of minutes and seconds necessary for 90 percent completion of the following components:

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

Each one of these components starts with a year-to-year comparison followed by a representation of performance over incremental time segments. Finally, each section includes a graph breaking down compliance with a stated goal by hour of day.

2.7.4 Call Processing

Call processing measures the time from the first incident time stamp in the Marin County Sheriff's Dispatch Center (Comm Center) until apparatus are notified of the request for assistance.

Table 13 shows call processing is 1:04 minutes for 90 percent compliance.

Table 13—Call Processing Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Department-Wide	**01:04**
Station 18	01:12
Station 19	01:03
Station 20	01:01
Station 21	01:04

Finding #7: Call processing performance at 1:04 minutes is *better than* a best practice recommendation of 1:30 minutes.

2.7.5 Turnout Time

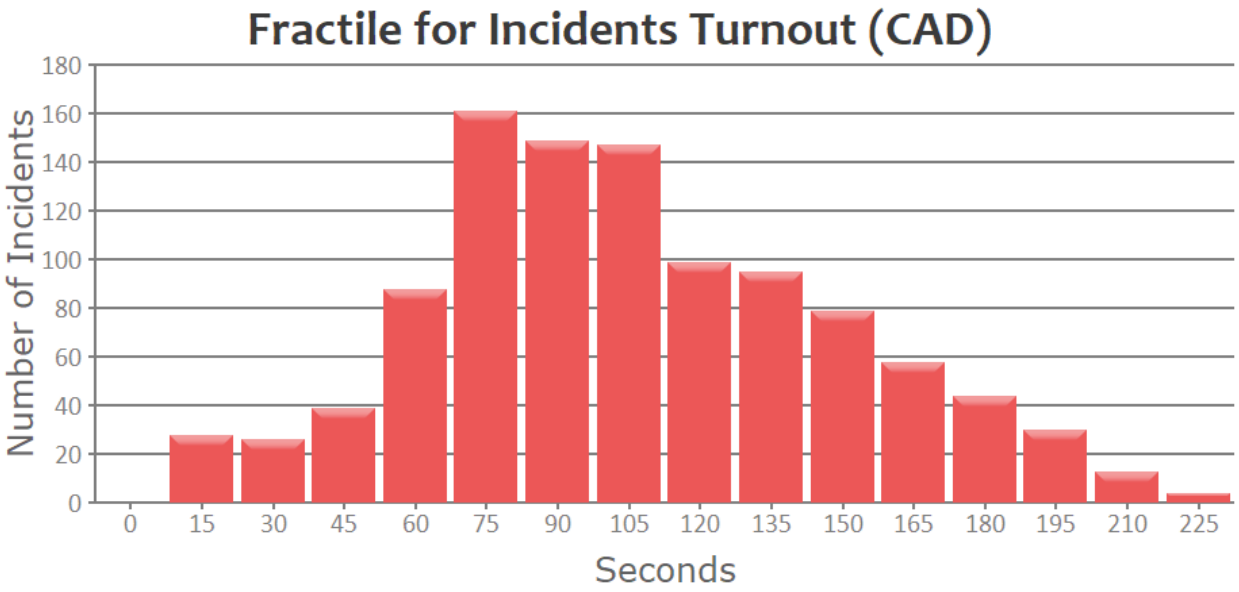
Turnout time measures the time from apparatus notification until apparatus starts traveling to the scene. In Table 14, a 2:00-minute Citygate recommended goal is used for measurement. Only one fire station is less than 30 seconds from a 2:00-minute turnout time.

Table 14—Turnout Time Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Department-Wide	**02:41**
Station 18	02:19
Station 19	02:50
Station 20	02:38
Station 21	02:40

Figure 10 illustrates fractile turnout time performance. The peak segment for turnout performance is 75 seconds.

Figure 10—Fractile for Incidents Turnout (CAD)



Finding #8: Crew turnout performance at 2:41 minutes is *slower* than a Citygate-recommended goal of 2:00 minutes or less.

2.7.6 Travel Time

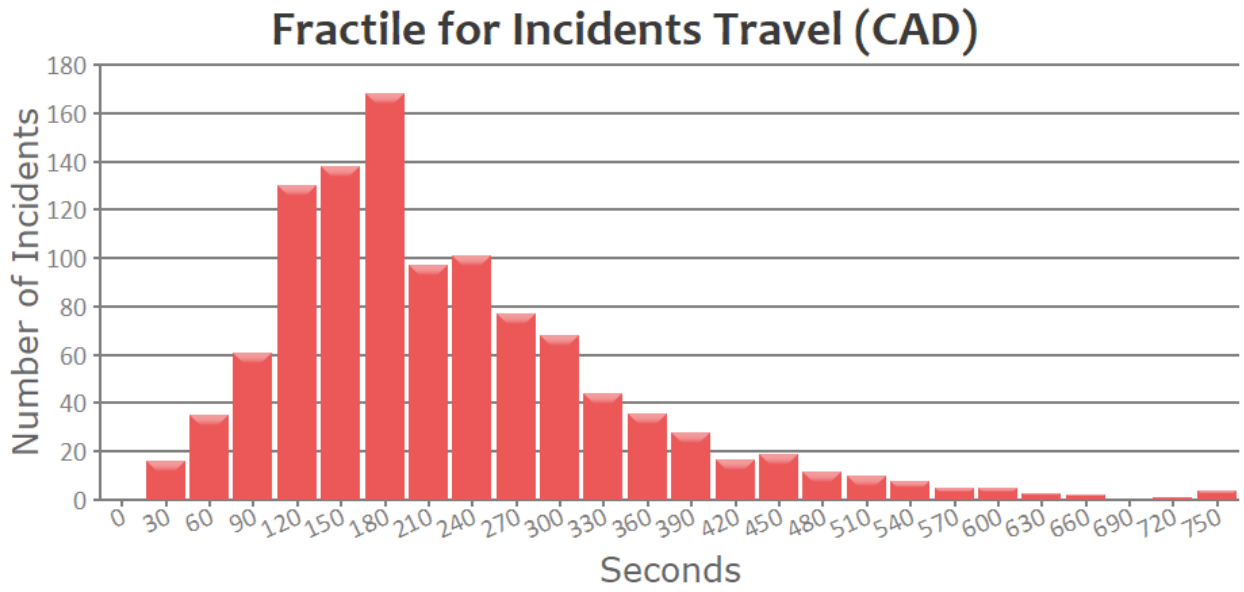
Travel time measures time to travel to the scene of the emergency. In most urban and suburban fire departments, a 4:00-minute travel time 90 percent of the time would be considered highly desirable. Table 15 shows that no stations achieve that goal.

Table 15—Travel Time Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Department-Wide	**06:09**
Station 18	04:40
Station 19	05:38
Station 20	06:24
Station 21	06:30

The following graph illustrates fractile travel time performance. The peak segment for travel time performance is 180 seconds, or 3:00 minutes. There is a rapid drop-off in volume after the 180-second mark.

Figure 11—Fractile for Incidents Travel (CAD)



Finding #9: First-due unit travel time performance to 90 percent of the incidents Department-wide at 6:09 minutes is well past the Department's likely goal of 4:00 minutes, a goal consistent with best practices.

2.7.7 Call to Arrival

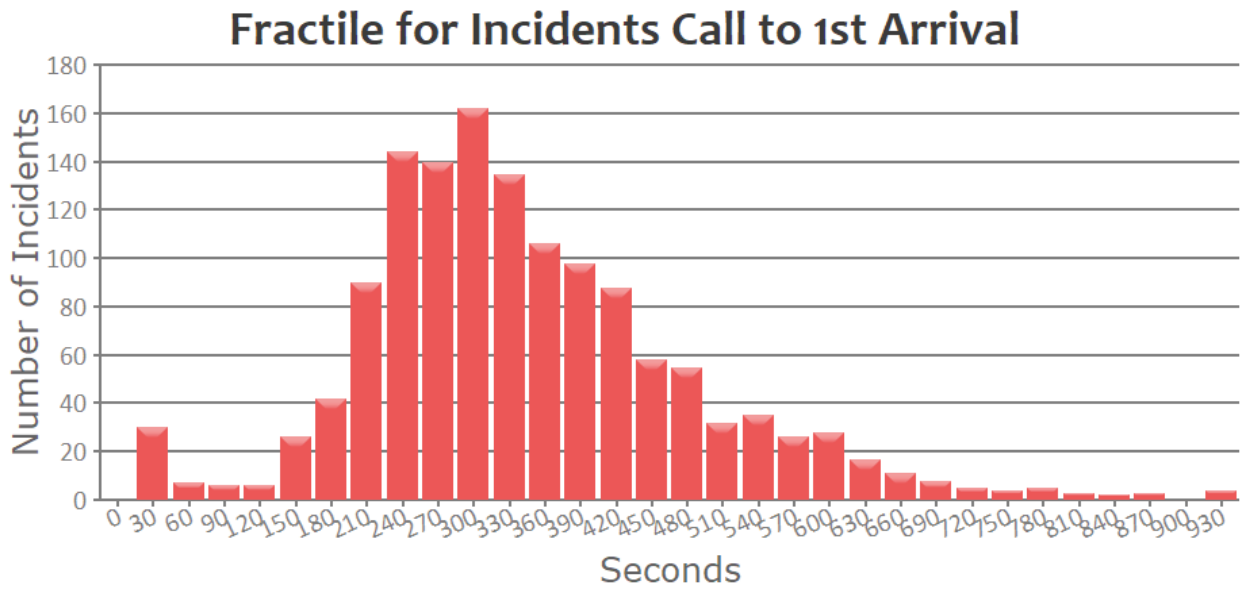
Call to arrival measures time from receipt of the request for assistance until the apparatus arrives on the scene. The existing Department total response time goal is 7:00 minutes to 90 percent of the emergency incidents.

Table 16—Call to Arrival Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Department-Wide	**08:45**
Station 18	07:55
Station 19	07:45
Station 20	08:47
Station 21	09:07

The following graph illustrates fractile call to arrival performance. The peak segment is 300 seconds, or 5:00 minutes. The right-shifted graph indicates a number of incidents with longer travel times.

Figure 12—Fractile for Incidents Call to First Arrival



Finding #10: The Department's call to arrival time to 90 percent of the incidents at 8:45 is slower than a Citygate's recommended goal of 7:30 minutes in developed suburban areas. The principal reason is the longer travel times, reflective of the topography and road network in the Department's service area.

2.7.8 Effective Response Force (First Alarm) Concentration Measurements

The minimum (not including the Chief Officer or ambulance) ERF for structure fires from the Department is three engines and one ladder truck. Additionally, an ambulance unit and one Chief Officer are sent. A best practices goal is for the last arriving unit's travel time to be less than 8:00 minutes in developed areas.

Table 17—Distribution – Structure Fire Initial Response – Fourth-Due Unit Travel Time Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Station 18	08:50
Station 19	08:19
Station 20	10:20
Station 21	10:21

Finding #11: The Effective Response Force (First Alarm) *travel* times are only modestly longer than a best practices goal of 8:00 minutes and are reflective of the good, central placement of the four fire stations.

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SECTION 3—TOWN OF ROSS FOCUSED STUDY

As part of the overall Standards of Cover assessment for the Ross Valley Fire Department partnership, the Town of Ross requested a focused study for the need to maintain the fire engine and/or Medic Ambulance 18 in the Town's fire station which dates to 1926. As all the partners know, replacing or relocating this station will be very difficult due to land use limitations. To evaluate the need for a station in the Town of Ross a series of questions must be considered. These questions are all answered in this section. After this section and Citygate's resultant findings, the last section of this study will provide a set of comprehensive recommendations.

The incident data range used in this section (except for items #1 and #2 below) is the same as the overall analysis in Section 2.7—January 1, 2017 through December 31, 2018.

3.1 QUESTIONS REGARDING STATION 18

1. How many fires have there been in the Town in each of the last six years? How many of them were structure versus non-structural?

   - One structure fire; 25 non-significant structure fires such as arcing wires or smell of smoke from equipment.

2. What is the fire loss estimate in the Town for the last six years?

   - $198,107

3. What is the breakdown of calls by year in the Town for two or three years?

Figure 13—Number of Incidents by Year by Incident Type – Station 18

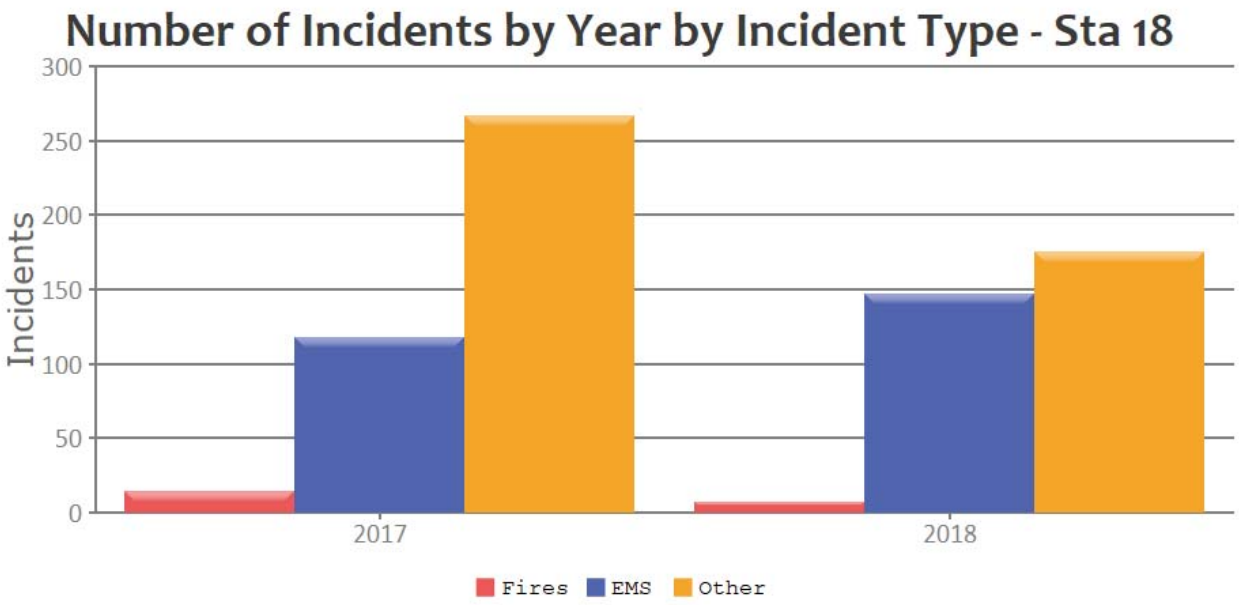


Table 18—Incidents: Quantity – Year by Incident Type for Station 18 – 2017 and 2018

Incident Type	2017	2018
321 EMS call, excluding vehicle accident with injury	114	133
611 Dispatched and canceled en route	71	38
553 Public service	28	20
554 Assist invalid	25	6
550 Public service assistance, other	11	15
651 Smoke scare, odor of smoke	10	11
412 Gas leak (natural gas or LPG)	11	9
571 Cover assignment, standby, move-up	8	11
743 Smoke detector activation, no fire – unintentional	8	10
745 Alarm system sounded, no fire – unintentional	10	7
400 Hazardous condition, other	13	2
444 Power line down	7	6
322 Vehicle accident with injuries	2	10
700 False alarm or false call, other	8	3
744 Detector activation, no fire – unintentional	5	5
622 No incident found on arrival of incident address	7	3

Incident Type	2017	2018
733 Smoke detector activation due to malfunction	6	3
735 Alarm system sounded due to malfunction	5	3
111 **Building fire**	**7**	
736 CO detector activation due to malfunction	3	3
740 Unintentional transmission of alarm, other	1	4
324 Motor vehicle accident no injuries	2	3
500 Service call, other	2	2
900 Special type of incident, other	1	2
730 System malfunction, other	2	1
650 Steam, other gas mistaken for smoke, other	1	2
600 Good intent call, other	1	2
531 Smoke or odor removal	1	2
440 Electrical wiring/equipment problem, other	3	
812 Flood assessment	2	
800 Severe weather or natural disaster, other	2	
746 Carbon monoxide detector activation, no CO	2	
734 Heat detector activation due to malfunction	2	
653 Barbecue, tar kettle	1	1
551 Assist police or other governmental agency	1	1
520 Water problem, other	1	1
463 Vehicle accident, general cleanup	1	1
131 Passenger vehicle fire	1	1
118 Trash or rubbish fire, contained	2	
100 Fire, other		2
813 Wind storm, tornado/hurricane assessment	1	
621 Wrong location	1	
552 Police matter	1	
522 Water or steam leak		1
521 Water evacuation	1	
462 Aircraft standby		1
461 Building or structure weakened or collapsed	1	
441 Heat from short circuit (wiring), defective/worn	1	
422 Chemical spill or leak	1	

Incident Type	2017	2018
354 Trench/below grade rescue		1
162 Outside equipment fire	1	
160 Special outside fire, other		1
151 Outside rubbish, trash or waste fire		1
142 Brush, or brush and grass mixture fire	1	
141 Forest, woods or wildland fire		1
140 Natural vegetation fire, other	1	
130 Mobile property (vehicle) fire, other	1	
116 Fuel burner/boiler malfunction, fire confined	1	
113 Cooking fire, confined to container		1
Total	**400**	**330**

4. What is the service call comparison between each of the four stations? Are there industry averages or norms with which that can be compared?

   - There are no comparisons; all communities are different and "purchase" fire protection stand-by as "fire insurance" if they use it once a year or once a day.
   - See Figure 7 on page 37 for volume by station.

5. In the Town, what is the 90 percent response time to fire calls, emergency calls, and all calls – anywhere Station 18 went?

   - The following table shows the Station 18 response times to emergency incidents. The time listed is the time to completion, 90 percent of the time; the number in parenthesis is the number of records included in the calculation.

Table 19—Station 18 Response Times to All Calls at 90 Percent Compliance

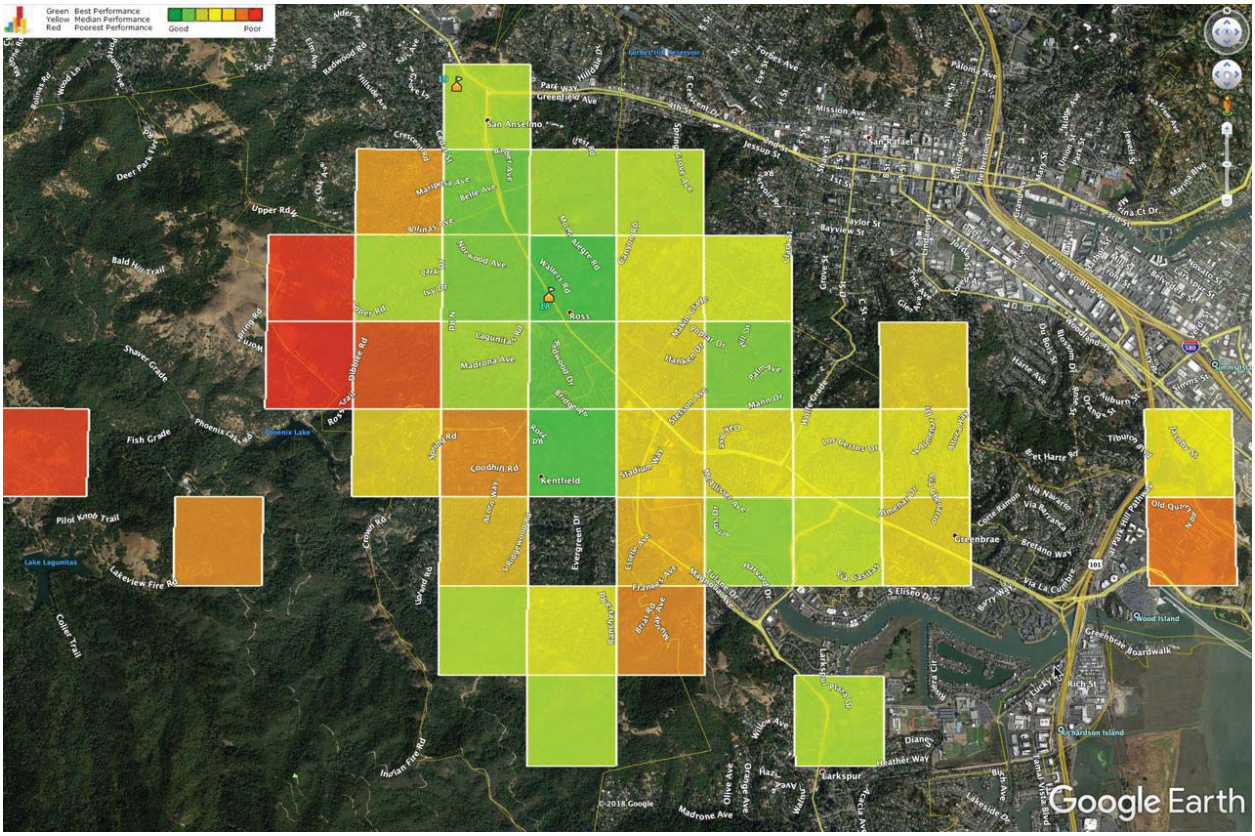
Response Element—Station 18	Overall	2017	2018
Dispatch Processing	01:12 (214)	00:52 (93)	01:12 (121)
Crew Turnout	02:32 (170)	02:38 (77)	02:19 (93)
Travel Time	05:05 (174)	05:14 (78)	04:40 (96)
Call to Arrival	08:28 (226)	08:40 (100)	07:55 (126)

6. What does the map that shows 90 percent response times by Station 18 look like?

   ➢ As would be expected, the better response times tend to be closer to the stations and along the main road network. However, given the low quantity of incidents (small sample size math) and that some incidents are covered by units not in the station, or are responded to by a station farther away due to simultaneous incidents, the following map is <u>not</u> a static picture year over year.

   The following map shows in green where travel time is the fastest—at or near the desired goal point of 4:00 minutes. Orange to red indicates the longest travel times of 5:00 to 9:00 minutes.

<u>Figure 14—90 Percent Response Times by Distance for All Department Stations</u>



7. What is the number of events that Station 18 responded to in the response areas for Stations 19, 20, and 21?

   ➢ The following table lists the responses by vehicle ID.

- The table also includes multiple-unit responses as some complex incidents require more staffing.

Table 20—Responses by Vehicle ID – 2017 and 2018

City	E18	E19	E20	E21	M14	M18
San Anselmo	133	1,550	761	117	188	1,012
Fairfax	12	29	213	1,733	22	707
Ross	**287**	15		3	38	187
Sleepy Hollow			95	11		42
Kentfield	**44**	3				804
Woodacre				7		
Fallon				4		2
Larkspur	2	1		2		131
Greenbrae	2					756
Forest Knolls				2		
San Rafael		1				
San Geronimo				1		
Point Reyes Station				1		
Corte Madera	1					151
Total	**481**	**1,599**	**1,069**	**1,881**	**248**	**3,792**

8. What is the number of medical emergencies the Ross Valley Paramedic Authority responds to in the Town per year?

   - The following table shows the number of responses by apparatus by destination station area.

Table 21—EMS Responses by Station 18 Apparatus by Destination Station Area

Station	E18	M18	Total
18	214	169	383
19	60	862	922
20	12	192	204
21	12	707	719
Total	**298**	**1,930**	**2,228**

The previous table shows Medic 18's most frequent destination is Station 19, followed by Station 21. The station least likely to require a medic unit is Station 18. However, Medic 18 is a regional unit and, as such, is properly located in the middle of its response area east to west. This table also shows Engine 18 is more likely to remain inside Station 18's area but, if drawn outside, is most likely to travel into Station 19's area.

The following list shows which engine arrived first to EMS events in the Town of Ross. When both Station 18 units respond from inside the Town, arriving first is only a matter of seconds. The purpose of this table is to also show units other than those at Station 18 which arrive first:

- Engine 18 arrived first 165 times
- Engine 23 arrived first 40 times
- Engine 19 arrived first 6 times
- Engine 17 arrived first 3 times (Kentfield)
- Engine 21 arrived first 1 time
- Medic 18 arrived first 33 times
- Medic 14 arrived first 2 times

These numbers were calculated for all apparatus responding to EMS incidents and tend to mimic actual operational arrivals. If the search from the regional CAD data for the last two years is for where Station 18 EMS incidents involved both Engine 18 and Medic 18, there were 224 incidents.

9. How often was Station 17 (Kentfield) first on scene to a Town call? What is Station 17's response time to a Town call?

   - In 2017 and 2018, **Engine 17** arrived first in Station 18's area 19 times for *all* incident types. The 90 percent travel time was a little over 8:00 minutes, but this figure is highly volatile and ranges from 5:00 minutes to 21:00 minutes travel time across the various areas of the Town.

10. How often was Station 19 (San Anselmo) first on scene to a Town call?

    - In 2017 and 2018, **Engine 19** arrived first in Station 18's area 20 times to *all types* of incidents. The 90 percent travel time was about 9:45 minutes; again, this figure is highly volatile.

11. What is Station 19's average response time to a Town call?

    ➢ By national best practices, response times are not reported as averages, but as a fractile percent of a goal point. The following table lists anywhere Station 19 responded. The time listed is the time to completion 90 percent of the time; the number in parenthesis is the number of records included in the calculation.

Table 22—Station 19 Response Times to All Calls at 90 Percent Compliance

Response Element—Station 19	Overall	2017	2018
Dispatch Processing	01:02 (971)	01:01 (481)	01:03 (490)
Crew Turnout	02:44 (773)	02:40 (383)	02:50 (390)
Travel Time	05:50 (788)	06:00 (387)	05:38 (401)
Call to Arrival	08:03 (991)	08:23 (490)	07:45 (501)

3.2 Impact if Fire Station 18 Closes

12. Provide a current map of the first response for Stations 17, 18, 19, 20, and 21.

    ➢ Please refer to Map #3 in the Map Atlas of this report in **Volume 2**.

13. If Station 18 closed, what is the first response map for Stations 17, 19, 20, and 21? What is the zone of coverage map for the back-up initial response with closure of Station 18?

    ➢ Station 17 is outside of Citygate's historical statistical and geographic analysis. The Marin County Fire Chiefs Association would have to create a response matrix based on fire reporting districts to create a map. Based on existing station locations for 17 and 19, the Town of Ross would not receive the same coverage as from Station 18.

14. What is the impact to response times in Stations 19, 20, and 21 areas without Station 18?

    ➢ Simultaneous incidents occur when other incidents are underway at the time a new incident begins. In the entire Ross Valley Fire Department's response area during 2018, 16.05 percent of incidents occurred while one or more other incidents were underway.

      In 2017, Station 17 was on an incident *at the same time as Station 18* **45** times. In 2018, Engines 17 and 18 were on incidents at the same time **33** times.

In 2017 and 2018 combined, Engine 18 had 481 responses anywhere. Across two years, Engines 17 and 18 were active at the same time 78 times, or **16** percent of all of Engine 18's responses.

Stated this way, if Engine 18 was closed, there are approximately 1.5 incidents per week to which Engine 17 will not be available to respond.

Then for Engine 18 and Engine 19 from the other direction, based on year 2018 data, both units are committed together approximately 109 times, or two times per week. This is higher than the Engine 18/17 measure. Most occurrences average a joint co-commitment time of 38 minutes.

So, when Engine 18 is busy there is a small chance every week that either or both Engines 17 and 19 also will not be available. This makes sense as all units have more calls for service during peak daylight hours of the day, versus after midnight.

Table 23—Distribution Travel Time Analysis of Fire and EMS Responses from 01/01/17 to 12/31/18

Station Area	Apparatus Arrivals	Home Resources	Outside Resources	Outside Percent	Overall Travel	Home Travel	Outside Travel	Delta Home/Out
18	969	881	88	9.08%	07:03 (602)	06:43 (550)	08:44 (52)	2:01
19	2,586	1,859	727	28.11%	06:38 (1,913)	06:29 (1,385)	07:13 (528)	0:44
20	1,248	903	345	27.64%	07:05 (1,022)	06:33 (756)	08:28 (266)	1:55
21	2,627	1,992	635	24.17%	07:22 (1,629)	06:46 (1,303)	08:31 (326)	1:45

Closing Station 18 will add about 2:00 minutes of travel time into that station area. Overall medic travel times will be reduced to some incidents if Medic 18 were to be moved west, as the unit is located closer to a higher medic demand area.

15. What is the impact of having first response from Station 19 with a three-person engine and Station 17 with a four-person engine versus Station 18 as a two-person engine?

    - Total staff (weight) is the same firefighter count of eight. But the Town firefighters are now located in and serving two other areas and are thus subject to simultaneous incident use in Stations 19 and 17's areas.

16. If RVPA stays in the Town, is there a response time change to medical emergencies?

- No, if the ambulance is available. Otherwise response time depends on Engine 19 or Engine 17 being available to respond.
- Other medic units needed in the Town of Ross when Medic 18 was not available were Medic 14 (53 times), Medic 95 (eight times), and one each for Medic 97, Medic 94, Medic 59, and Medic 13. This means other medic units needed to respond into Station 18's territory 65 times in two years.

17. If RVPA moves to Station 17 or Station 19, what is the average change in response time to a medical emergency?

- Per Table 23, without a Station 18 resource, there are an additional 2:00 minutes of travel time, meaning total response time (dispatch processing, turnout, and travel time) is almost 12:00 minutes from 9-1-1, which is the same as a rural level of response.
- Moving Medic 18 to Station 17 would also move it farther away from the highest incident densities that it serves.

Finding #12: In the Town of Ross, on EMS emergencies, Engine 18 responded 214 times and Medic 18 responded 169 times in a two-year period.

Finding #13: In the Town of Ross, adjoining Engines 17 (Kentfield) and Engine 19 each arrived first over a two-year period 19 and 20 times, totaling 39. Thus, the outside units only arrived/were needed first 12.6 percent of the time.

Finding #14: In a two-year period, Engines 18 and 17 (Kentfield) were assigned to incidents at the same time 78 times or 16 percent of Engine 18's total responses. Stated this way, if Engine 18 was closed, there are approximately 1.5 incidents per week to which Engine 17 will not be available to respond.

Finding #15: Closing Station 18 will add about 2:00 minutes *minimum* of travel time into that station area.

Finding #16: In the Ross Valley Fire Department, Station 18 has the best travel time of any of the four station areas at 4:40 minutes, only 40 seconds longer than an urban/suburban best practice recommendation of 4:00 minutes. Adding 2:00 minutes travel, plus dispatch and turnout time of at least 3:00 minutes, moves a Town of Ross total response time from 7:40 to 9:40 which would be more like an edge suburban area or emerging rural area. First unit response times of 10:00 minutes-plus means small fires will become larger and critical EMS patients may not receive lifesaving care.

Finding #17: If the Engine 18 daily firefighter count of two were transferred to Engine 19, or reduced to one being transferred, they would be joining an engine that serves a much larger area and is more exposed to simultaneous incident demand. Due the dynamic nature of 9-1-1 emergencies, there is no way to predict if all of the Town of Ross Engine 18 and Medic 18 first arrivals would be covered by just Engines 19 and 17 (Kentfield) or by other units even farther away.

Finding #18: Covering the Town of Ross from either Station 19 or 17 (Kentfield) depends on essentially one road being open and not congested with traffic. Any one accident or natural emergency could close the road, effectively making the Town of Ross a cul-de-sac served from one direction and, in a sub-regional emergency, either Engine 19 or 17 would be shared with a larger service area.

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SECTION 4—OVERALL EVALUATION

SOC ELEMENT 8 OF 8
OVERALL EVALUATION

The Department serves mostly residential and small downtown populations with a mixed land-use pattern typical of Marin County communities. However, the hilly geography and the limited road network dependent on one main connector road, is very difficult to serve efficiently from a small number of fire stations.

Over time, each population cluster opened a fire station for a minimum single first unit response and knew they were co-dependent on each other for multiple-unit serious emergencies. The geography cannot be changed and improving the road network is not politically feasible or cost-effective. Thus, reducing coverage by removing any one or more fire engines or the paramedic ambulance will increase response times to the local community receiving reduced coverage.

While the state fire code now requires fire sprinklers even in residential dwellings, it will be many more years before the vast majority of homes are replaced or remodeled with automatic fire sprinklers. If the communities' desired outcomes include limiting building fire damage to only part of the inside of an affected building, minimizing permanent impairment resulting from a medical emergency, and keeping wildland fires small to a few acres at the ignition point, then the communities served by the Ross Valley Fire Department will need first-due unit coverage in all neighborhoods.

However, even with maintaining the current four-station spacing, given the topography, not all hillside areas can receive response time coverage consistent with suburban best practice incident outcomes and a Citygate performance recommendation of a first-due arrival within 7:30 minutes from 9-1-1 dispatch notification and a multiple-unit Effective Response Force (ERF) arrival occurring within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability.

The Department's call processing performance is excellent. The crew turnout time needs modest improvement but even such attainable improvement cannot substantially lower the fire unit travel times which are longer than desired over the challenging geography and road network.

Department resources and equipment are appropriate to protect against the hazards likely to impact the Department's service area, but the daily staffing of eight firefighters on four engines, plus a two-firefighter/paramedic ambulance from the Ross Valley Paramedic Authority (RVPA) and a Duty Chief Officer only provides a *minimum* total response force sufficient to begin controlling a single emerging to serious fire incident, or to provide care at an EMS incident with one to five patients.

In terms of emergency incident workload per unit, no single fire unit or station area is approaching workload saturation. The level of simultaneous incidents is not high enough to warrant another unit at peak hours of the day. Citygate is, however, concerned about the overall limited Department

staffing per day and its ability to respond with more "weight of attack" to keep emerging serious emergencies controlled. Even Countywide mutual aid resources are not quickly available in this part of Marin County, as they would be in an urban area with flat terrain and interconnected roads.

In reviewing the Town of Ross questions about the utility of its fire station, while maintaining a fire crew in town is expensive, any alternative solution will raise response times beyond suburban best practice goals and come at the cost of sharing staffing with a larger service area. Relocating the crews out of the Town of Ross impacts more than just the Town. As an example, even if the Town paid Kentfield for fire coverage, Kentfield would be serving the entire Town of Ross in addition to its own community, which would mean the Kentfield fire unit would occasionally not be available to respond to an emergency call in its primary area.

The quantity of calls in the Town of Ross (or any other single historic population cluster in the joint Department's service area) is too small and too volatile from which to use historical incidents as the only criteria to maintain the fire station. Providing fire services is akin to purchasing fire insurance, and it is important to consider the desired level of protection. The public policy issue is whether to have access to a fire station nearby or farther away, knowing that a station farther away, even with its unit(s) available for response, cannot offer more than edge suburban or emerging rural area response times to much of the Town of Ross.

4.1 DEPLOYMENT RECOMMENDATIONS

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

Recommendation #1:	**Adopt Updated Deployment Policies:** The Ross Valley Fire Department governing Board 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 medically salvageable upon arrival and to 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 8:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at dispatch; this equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-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, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 12 personnel, including at least one Duty Chief Officer, should arrive within 12:30 minutes from the time of 9-1-1 call receipt in dispatch, 90 percent of the time; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 9:00-minute travel time.

1.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the Department's service areas from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Fire 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 8:30 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.

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 8:30 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 12:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.
Recommendation #2:	Consider maintaining the current location of all four engines and keeping Medic 18 in the Town of Ross to balance its coverage area to the west and east.
Recommendation #3:	Consider providing a third firefighter per day on the three engines other than Engine 18. Doing so would raise the daily weight of attack from 12 to 15 and, with Kentfield's three personnel, to 18. This force would be sufficient to provide the weight of attack and simultaneous incident redundancy for suburban positive outcomes. Especially on serious building and wildland fire ignitions, there is no second chance to stop the fire. This is a local policy decision to be made by the affected communities to determine the level of fire service that they can afford.

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.

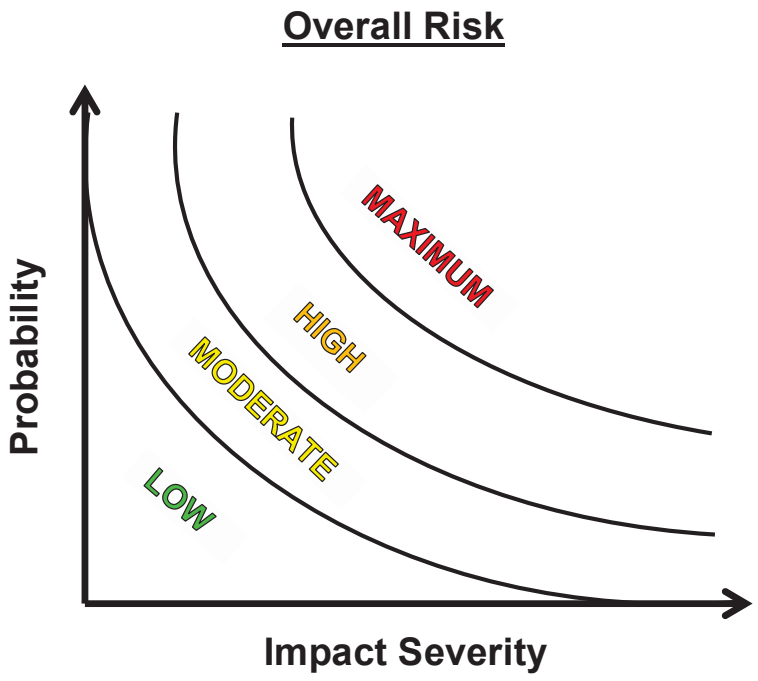
A hazard is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. Risk is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts* 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 15.

Figure 15—Overall Risk



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

- U.S. Census Bureau population and demographic data
- District Geographical Information Systems (GIS) data
- Marin County General Plan and Zoning information
- Marin County Multi-Jurisdictional 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 Ross Valley Fire Department service area yields the following:

1. The Department serves a diverse population, with densities ranging from less than 500 people per square mile to approximately 5,000 per square mile over a varied land use pattern.
2. The Department's service area population is projected to grow by only 7.7 percent over the next 11 years to 2030, or an average annual growth of approximately 0.7 percent.

3. The service area includes nearly 11,000 housing units as well as a large inventory of non-residential occupancies.

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

5. The Department's overall risk for five hazards related to emergency services provided range from **Low** to **High**, as summarized in Table 24.

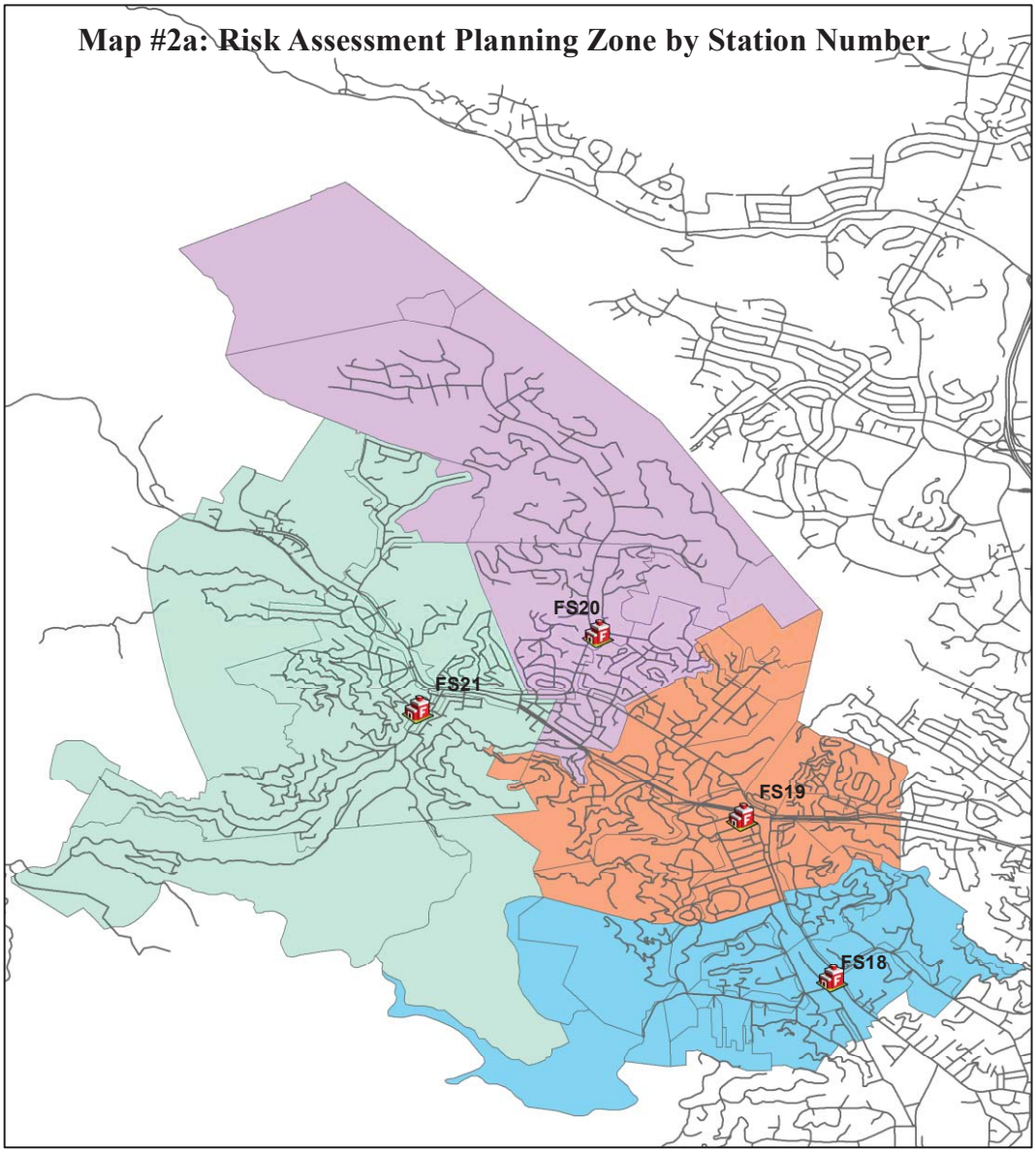
Table 24—Overall Risk by Hazard

Hazard	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Building Fire	*Low*	*Low*	*Moderate*	*Moderate*
Vegetation Fire	*Low*	*Low*	*Low*	*Low*
Medical Emergency	*High*	*High*	*High*	*High*
Hazardous Material	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Technical Rescue	*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 were 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 four planning zones, incorporating each fire station's first-due response area, as shown in Figure 16.

Figure 16—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 25 summarizes key demographic data for the Ross Valley Fire Department's service area.

Table 25—Key Demographic Data – Ross Valley Fire Department

Demographic	2017	Percentage
Population	**24,785**	
Under 10 years	2,150	**8.67%**
10 – 19 years	3,483	**14.05%**
20 – 64 years	14,217	**57.36%**
65-74 years	3,111	**12.55%**
75 years and older	1,824	**7.36%**
Median age	**48.4**	**N/A**
Housing Units	**10,813**	
Owner-Occupied	7,683	**71.05%**
Renter-Occupied	2,534	**23.43%**
Average Household Size	**2.53**	**N/A**
Ethnicity		
Caucasian	22,492	**90.75%**
Asian	910	**3.67%**
Other	1,383	**5.58%**
Education (population over 24 yrs. of age)	**18,158**	**73.26%**
High School Graduate	17,546	**96.63%**
Undergraduate Degree	11,134	**61.32%**
Graduate/Professional Degree	5,309	**29.24%**
Employment (population over 15 yrs. of age)	**20,261**	**81.75%**
In Labor Force	13,816	**68.19%**
Unemployed	626	**4.53%**
Population Below Poverty Level	1,091	**4.40%**
Population without Health Insurance Coverage	487	**1.96%**

Source: U.S. Census Bureau (2017)

Of note from Table 25 is the following:

- More than 28.5 percent of the population is under 10 years or over 65 years of age.

- The Department's service area population is predominantly Caucasian (91 percent), followed by Asian (3 percent), and other ethnicities (6 percent).
- Of the population over 24 years of age, more than 96 percent has completed high school or equivalency.
- Of the population over 24 years of age, more than 61 percent have a college degree.
- Slightly more than 68 percent of the population 15 years of age or older is in the workforce; of those, 4.5 percent are unemployed.
- The population below the federal poverty level is 4.4 percent.
- Only two percent of the population does not have health insurance coverage.

The service area population is projected to increase by approximately 1,900 (7.7 percent) to nearly 27,000 over the next 11 years to 2030,[6] for an average annual growth of approximately 175 (0.7 percent).

Buildings

The service area includes nearly 11,000 housing units, as well as a large inventory of non-residential occupancies, including office, research, professional service, retail sales, restaurants/bar, motel, church, school, government facility, healthcare, 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.

[6] Reference: Marin County Housing Element 2015-2023, Figure II-2

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 service area building inventory reveals 174 high risk building uses as they relate to the CFAI building fire risk categories as summarized in Table 26, Table 27, and Map #2B in **Volume 2** (Map Atlas).

Table 26—High Risk Building Occupancy Inventory by Risk Category

Building Occupancy Classification[2]		Number	Risk Category[1]
A-1	Assembly	5	***High***
H	Hazardous	0	***High***
I-4	Institutional	1	***High***
R-1	Hotel/Motel	2	***High***
R-2	Multi-Family Residential	148	***High***
R-2.1	Assisted Living Facilities	4	***High***
R-3.1	Residential Care Facilities	9	***High***
R-4	Care Facilities – Greater than 6 Persons	5	***High***
Total		**174**	

[1] CFAI *Standards of Cover* (5th Edition)
Source: Ross Valley Fire Department

Table 27—High Risk Occupancy Inventory by Planning Zone

Occupancy Classification	Planning Zone				Total
	Sta. 18	Sta. 19	Sta. 20	Sta. 21	
A-1	1	2	1	1	**5**
I-4		1			**1**
R-1		1	1		**2**
R-2	1	110	37		**148**
R-2.1	2	1	1		**4**
R-3.1	1	5	2	1	**9**
R-4		4	1		**5**
Total	**5**	**124**	**43**	**2**	**174**

Source: Ross Valley Fire Department

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. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services. No critical facilities or key resources were identified by the Department for this assessment.

Economic Resources

No economic resources were identified for this assessment.

Natural Resources

No natural resources were identified for this assessment.

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 2018 Marin County Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP) identifies the following 13 hazards for the County.

Table 28—Marin County Hazards

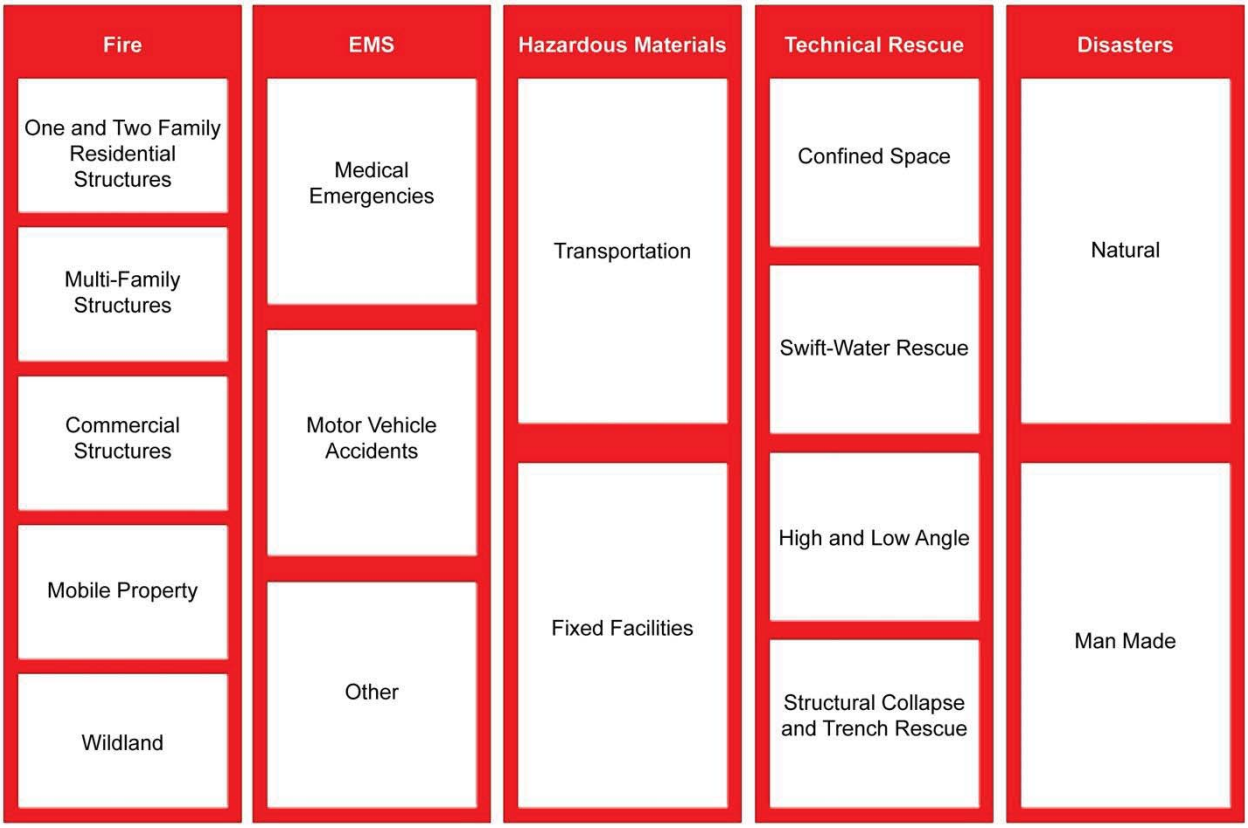
Hazard	
1	Coastal erosion
2	Dam failure
3	Drought
4	Earthquake
5	Flood
6	Heat
7	Landslide/mudslide/debris flow
8	Levee failure
9	Liquefaction
10	Severe wind/tornado
11	Severe storm
12	Tsunami/seiche
13	Wildfire

Reference: 2018 Marin County LHMP, Table 3-1

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 all these hazards, 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 17. 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.

Figure 17—Commission on Fire Accreditation International Hazard Categories



Source: CFAI *Standards of Cover* (5th Edition).

Subsequent to review and evaluation of the hazards identified in the 2018 Marin County Multi-Jurisdictional LHMP 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:

- Building Fire
- Vegetation Fire
- Medical Emergency
- Hazardous Material Release/Spill
- 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 building and vegetation fire, medical emergency, hazardous materials, and technical rescue risk consists of eight firefighters on four engines, plus a two-firefighter/paramedic ambulance from the Ross Valley Paramedic Authority (RVPA) and a Duty Chief Officer.

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 the Ross Valley Paramedic Authority (RVPA). Air ambulance services, when needed, are provided by Reach Air Medical Services (Concord, Santa Rosa, or Napa), LifeFlight (Palo Alto), the California Highway Patrol, or Sonoma County Sheriff. Three regional hospitals provide emergency medical services, including Marin General Hospital, Kaiser Permanente Medical Center San Rafael, and Novato Community Hospital. Marin General Hospital is also a Level-III trauma center.

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. Additional hazardous materials response capacity is available from the Marin County Hazardous Materials Response Team. The Hazardous Materials Response Unit is housed at the Ross Valley Fire Department and is cross-staffed by Ross Valley personnel as needed for regional response.

Technical rescue services are provided by the Marin County Urban Search and Rescue (US&R) Regional Task Force, a multi-agency/discipline team with the tools, equipment, and training to conduct confined space, low/high-angle rope rescue, breaching, shoring, excavation, trench, and water rescue operations.

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 29 describes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 29—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 30 describes the five impact severity categories and related scoring criteria used for this analysis.

Table 30—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 expected • 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 expected • 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 rating* as shown in Table 31.

Table 31—Overall Risk Score and Rating

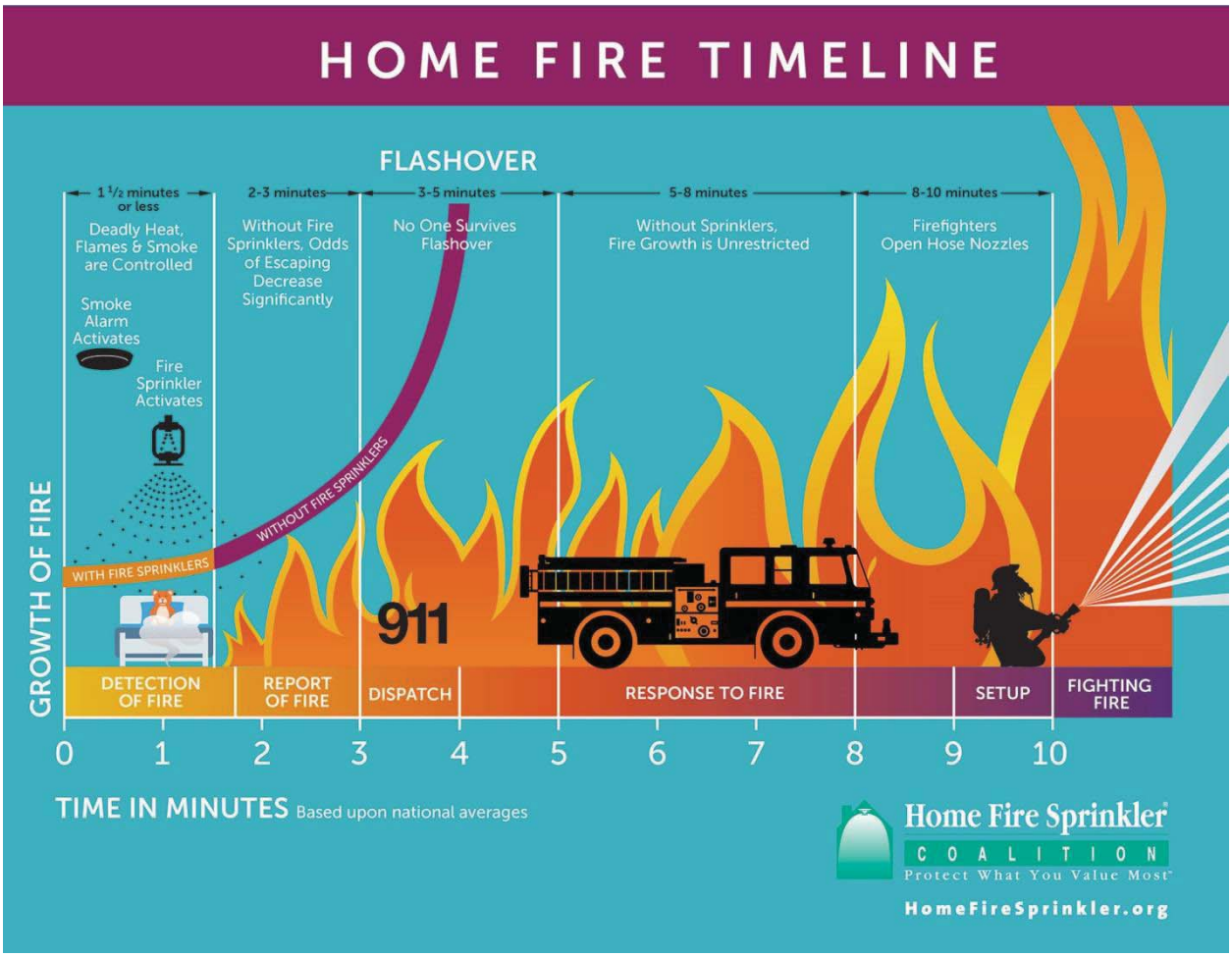
Overall Risk Score	Overall Risk Rating
0–5.99	***LOW***
6.0–11.99	***MODERATE***
12.0–19.99	***HIGH***
20.0–25.0	***MAXIMUM***

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 and the U.S. Census Bureau to assist in determining the Department's building fire risk.

Figure 18 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 18—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org

Population Density

Population density within the service area ranges from less than 500 to approximately 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.

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 Marin Municipal Water District,

and according to Fire Department staff, available fire flow is insufficient in several sections of the service area as shown in Map #2E in **Volume 2** (Map Atlas).

Building Fire Service Demand

For calendar years 2017 and 2018, the Department experienced 44 building fire incidents comprising 1 percent of total service demand over the same period, as summarized in Table 32.

Table 32—Building Fire Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 18	Sta. 19	Sta. 20	Sta. 21		
Building Fire	2017	3	3	7	11	**24**	0.83%
	2018	0	5	7	8	**20**	0.75%
Total		**3**	**8**	**14**	**19**	**44**	**0.79%**
Percent of Total Service Demand		.79%	0.42%	1.46%	0.97%	**0.79**%	

Source: Ross Valley Fire Department incident data

As Table 32 illustrates, building fire service demand was consistent across the two-year study period, with the highest volume of incidents occurring at Station 21 and the lowest at Station 19. Overall, the Department's building fire service demand is very low, comprising less than one percent of all calls for service, which is consistent with other California jurisdictions of similar size and demographics.

Probability of Building Fire Occurrence

Table 33 summarizes Citygate's scoring of building fire probability by planning zone based on building fire service demand from Table 32.

Table 33—Building Fire Probability Scoring

Building Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Probability Score	1.25	1.50	2.0	2.25

Building Fire Impact Severity

Table 34 summarizes Citygate's scoring of the Department's probable building fire impact severity by planning zone.

Table 34—Building Fire Impact Severity Scoring

Building Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Impact Severity Score	3.0	3.0	3.0	3.0

Overall Building Fire Risk

Table 35 summarizes the Department's overall building fire risk scores and ratings by planning zone.

Table 35—Overall Building Fire Risk

Building Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Total Risk Score	3.75	4.50	6.00	6.75
Risk Rating	***Low***	***Low***	***Moderate***	***Moderate***

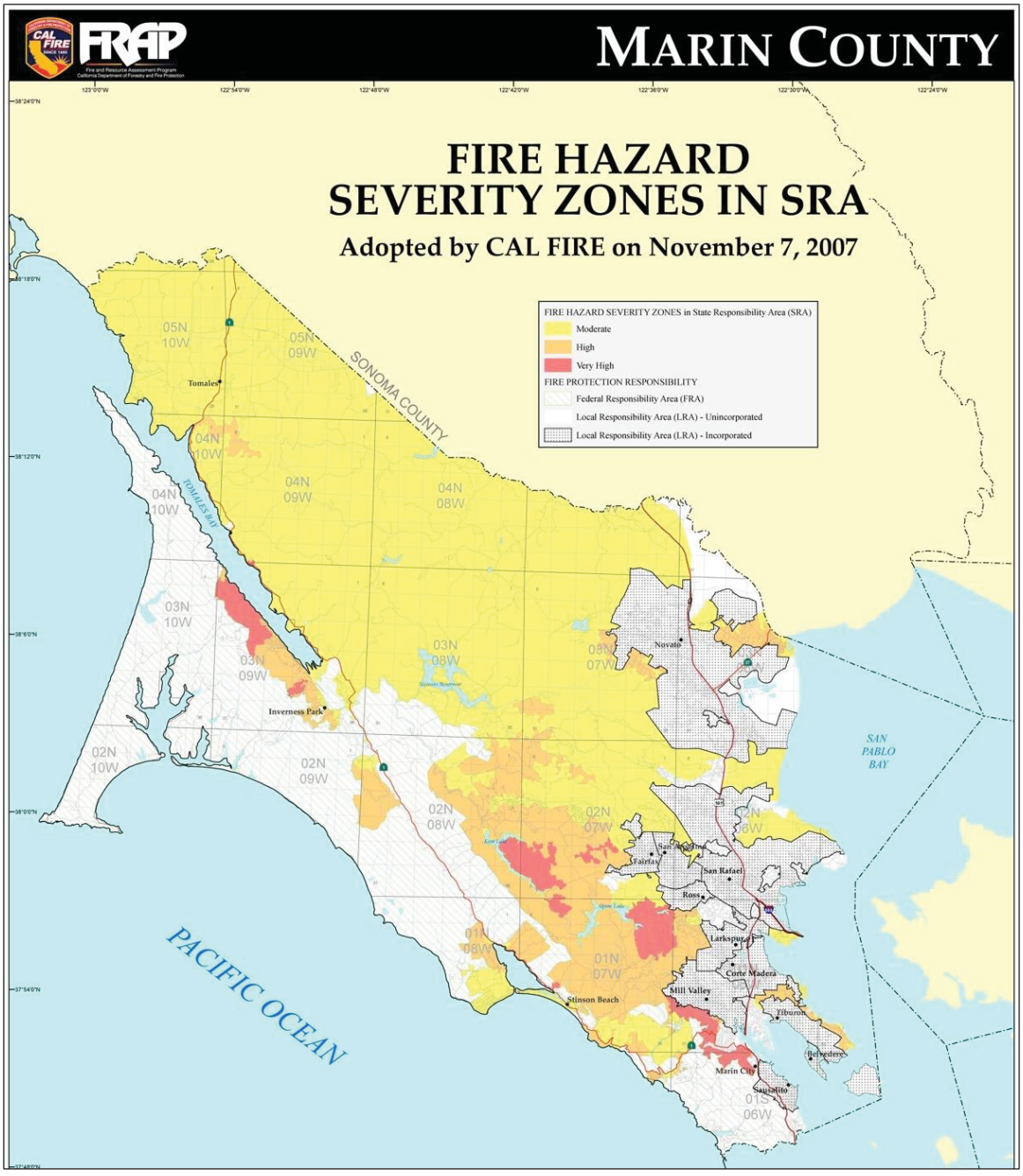
A.1.11 Vegetation Fire Risk

Most of the service area is susceptible to a vegetation fire, particularly along the northern and western edges abutting the Mount Tamalpais watershed.

Wildland Fire Hazard Severity Zones

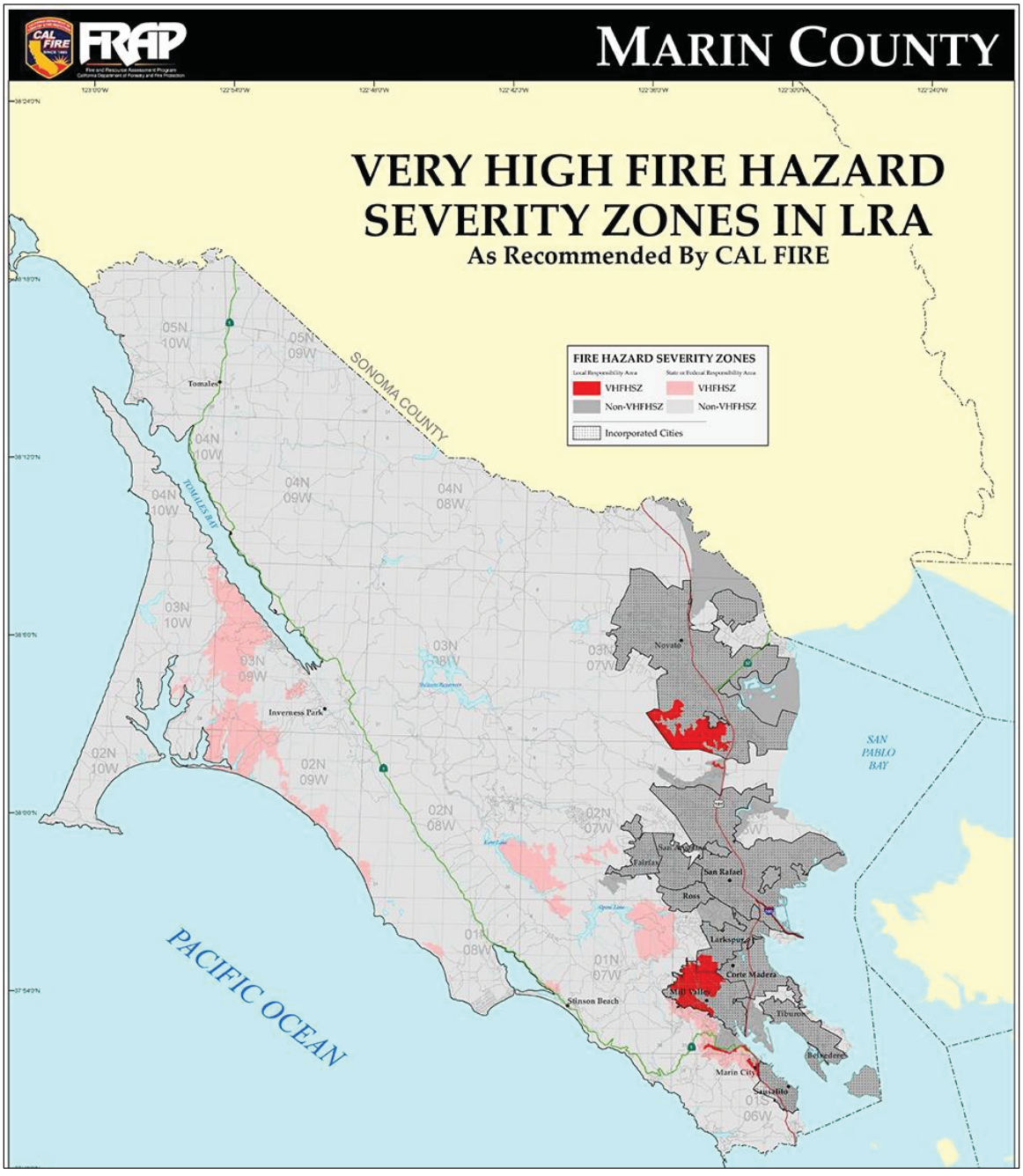
The California Department of Forestry and Fire Protection (CAL FIRE) designates wildland Fire Hazard Severity Zones (FHSZ) throughout the State based on analysis of multiple wildland fire hazard factors and modeling of potential wildland fire behavior. For State Responsibility Areas (SRAs) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates Moderate, High, and Very High FHSZs by county, as shown in Figure 19 for Marin County. Note the ***Moderate***, ***High***, and ***Very High*** FHSZs immediately to the north, northeast, and west of the service area.

Figure 19—SRA Wildland Fire Hazard Severity Zones – Marin County



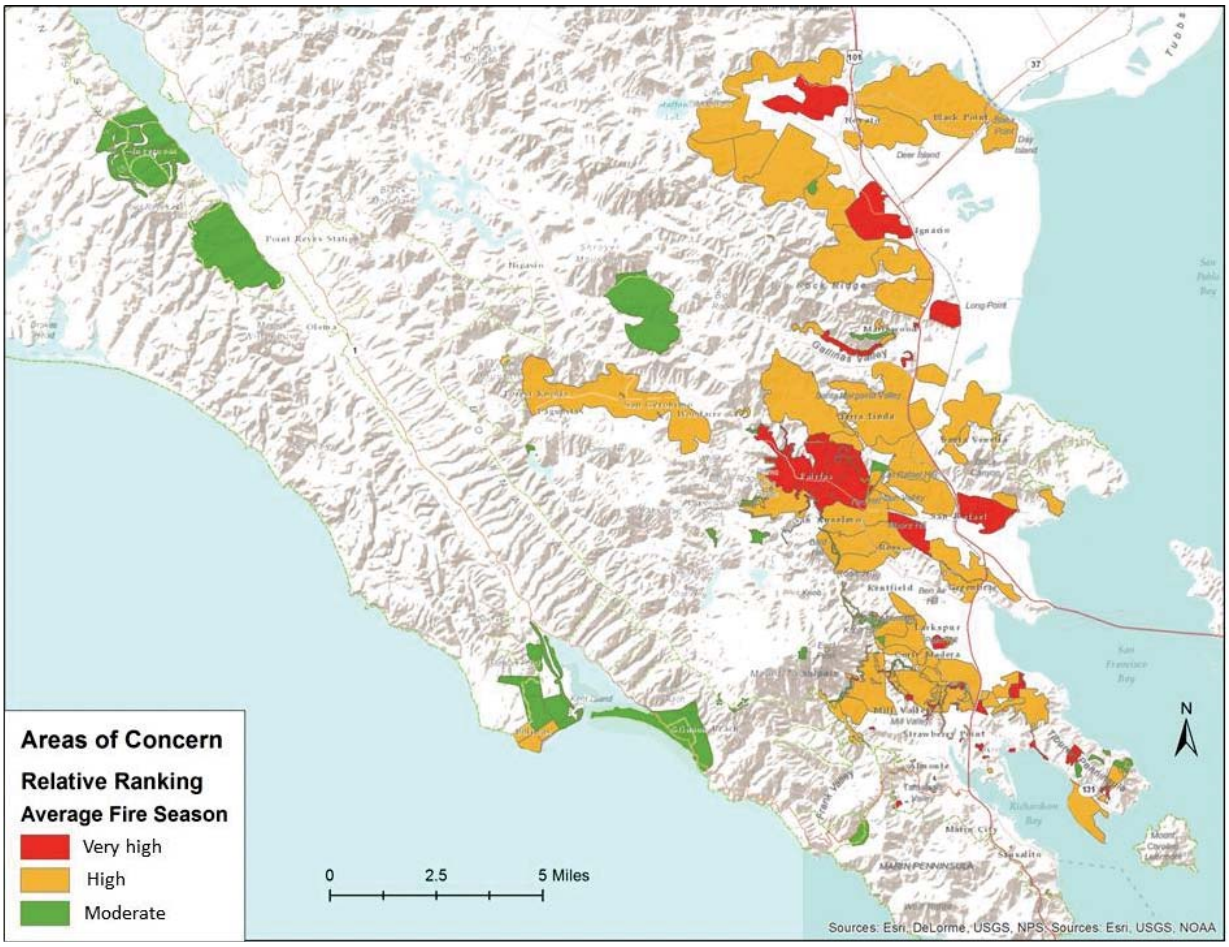
CAL FIRE also identifies recommended FHSZs for Local Responsibility Areas (LRAs), where a local jurisdiction bears the fiscal responsibility for wildland fire protection, including incorporated cities, as shown in Figure 20 for Marin County.

Figure 20—Wildland Fire Hazard Map



Note that there are no recommended FHSZs within the Department's service area. The 2016 Marin County Fire Department Community Wildfire Protection Plan (CWPP), however, identifies significant sections of the service area as **Moderate**, **High** and **Very High** Areas of Concern based on composite geospatial modeling of population density, potential flame length, and potential rate of spread as shown in Figure 21.

Figure 21—Areas of Wildfire Concern – Marin County CWPP



Reference: 2016 Marin County CWPP, Figure 15

Vegetative Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (species), height, arrangement, density, and moisture. Vegetative fuels within the service area, in addition to decorative landscape species, include both native and non-native annual and perennial plant species, including grasses, weeds, shrubs, and chamise, and mostly hardwood trees including bay, eucalyptus, madrone, and oak. The majority of the service area has moderate to high vegetative fuel density. 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 vegetation fires are most likely to occur due to fuel and weather conditions, occurs from approximately June through October in Marin County. Summer weather within the service area typically includes cool mornings, warm afternoons and evenings, and west/northwest breezes that can reach 15-25 miles per hour. Occasional summer gradients can produce temperatures in the high 90s to low 100s, low relative humidity, and offshore winds as high as 40 miles per hour. These weather conditions create the potential for a large, damaging wildfire.

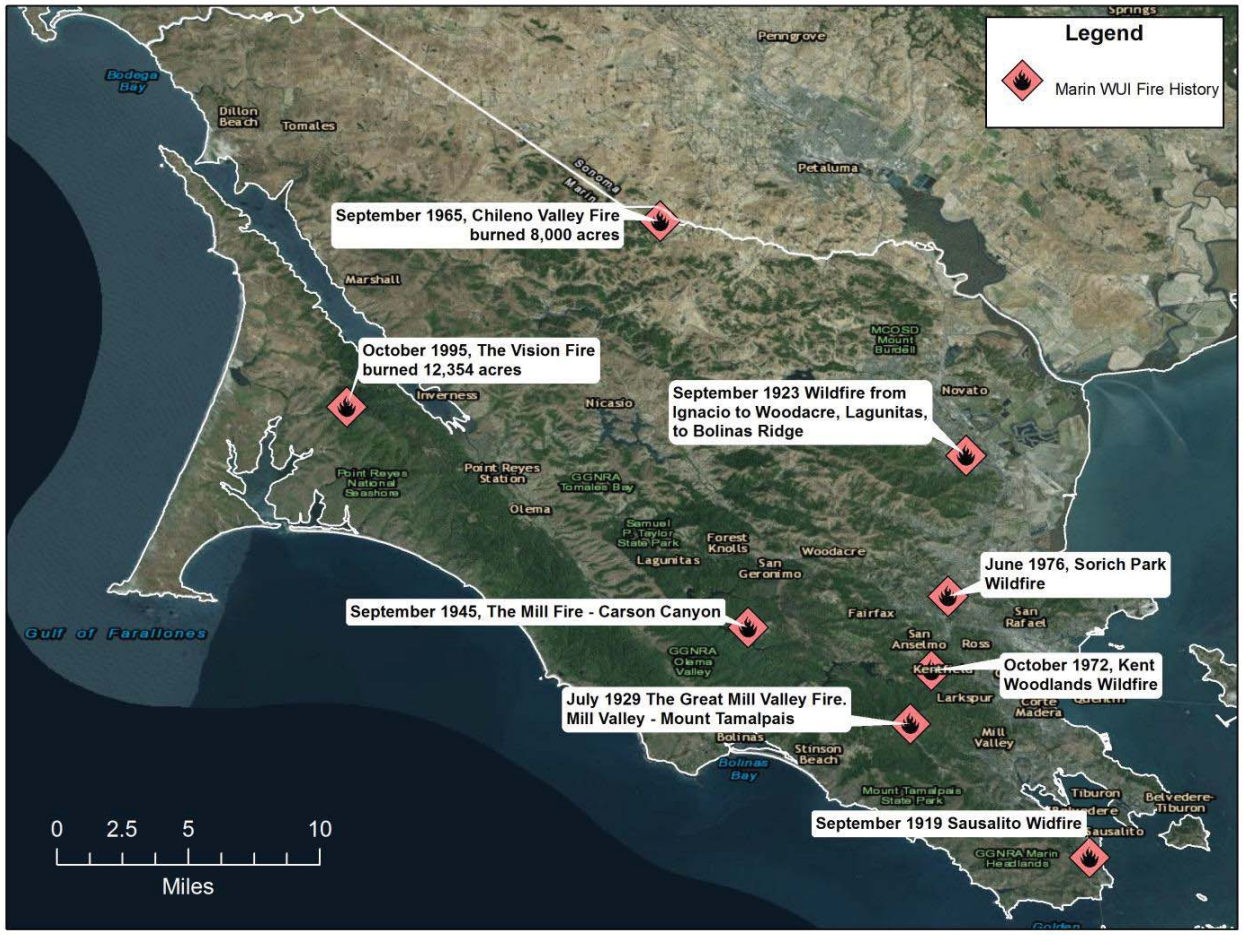
Topography

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 service area's terrain varies from flat to steep slopes, which can contribute significantly to wildfire behavior and spread.

Wildfire History

Since the early 1900s, there have been several large wildland fires in Marin County, including the 1972 Kent Woodlands Fire, 1976 Scorich Park Fire, and 1995 Vision Fire (12,354 acres) as shown in Figure 22.

Figure 22—Marin County Wildfire History



Source: Marin County CWPP, Figure 6

Water Supply

Another significant vegetation fire impact severity factor is water supply immediately available for fire suppression. According to Department staff, available fire flow is insufficient in several sections of the service area as shown in Map #2E in **Volume 2** (Map Atlas).

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 Towns of Ross, San Anselmo, and Fairfax, and the Sleepy Hollow Fire Protection District, have adopted the 2016 California Fire Code and the 2015 International Wildland Urban Interface Code with amendments.

The 2016 Marin County CWPP identifies the following wildfire hazard mitigation strategies, in addition to building codes, ordinances, and standards, and defensible space enforcement and public education strategies:

- Residential chipper programs
- Increasing dedicated staffing for vegetation management programs
- Annual weed abatement program
- Implementing an enhanced County Vegetation Management Program (conditional on voter approval of a Municipal Service Tax)
- Fuel breaks
- Eucalyptus and pine tree removal
- Roadside fuel reduction
- Evacuation route fuel reduction
- Creation of shaded fuel breaks in WUI transition zones

Vegetation Fire Service Demand

The Department experienced only 19 vegetation fires over the two-year study period, comprising 0.34 percent of total service demand over the same period, as summarized in Table 36.

Table 36—Vegetation Fire Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 18	Sta. 19	Sta. 20	Sta. 21		
Vegetation Fire	2017	2	3	1	5	**11**	0.38%
	2018	1	3	2	2	**8**	0.30%
Total		**3**	**6**	**3**	**7**	**19**	**0.34%**
Percent of Total Service Demand		0.41%	0.32%	0.31%	0.36%	0.34%	

Source: Ross Valley Fire Department incident data

As Table 36 shows, overall vegetation fire service demand is extremely low.

Probability of Vegetation Fire Occurrence

Table 37 summarizes Citygate's scoring of vegetation fire probability by planning zone based on vegetation fire service demand from Table 36.

Table 37—Vegetation Fire Probability Scoring

Vegetation Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Probability Score	1.25	1.50	1.25	1.50

Vegetation Fire Impact Severity

Table 38 summarizes Citygate's scoring of probable vegetation fire impact severity by planning zone.

Table 38—Vegetation Fire Impact Severity Scoring

Vegetation Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Impact Severity Score	3.0	3.0	3.0	3.0

Overall Vegetation Fire Risk

Table 39 summarizes the Department's overall vegetation fire risk scores and ratings by planning zone.

Table 39—Overall Vegetation Fire Risk

Vegetation Fire	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Total Risk Score	3.75	4.50	3.75	4.50
Risk Rating	***Low***	***Low***	***Low***	***Low***

A.1.12 Medical Emergency Risk

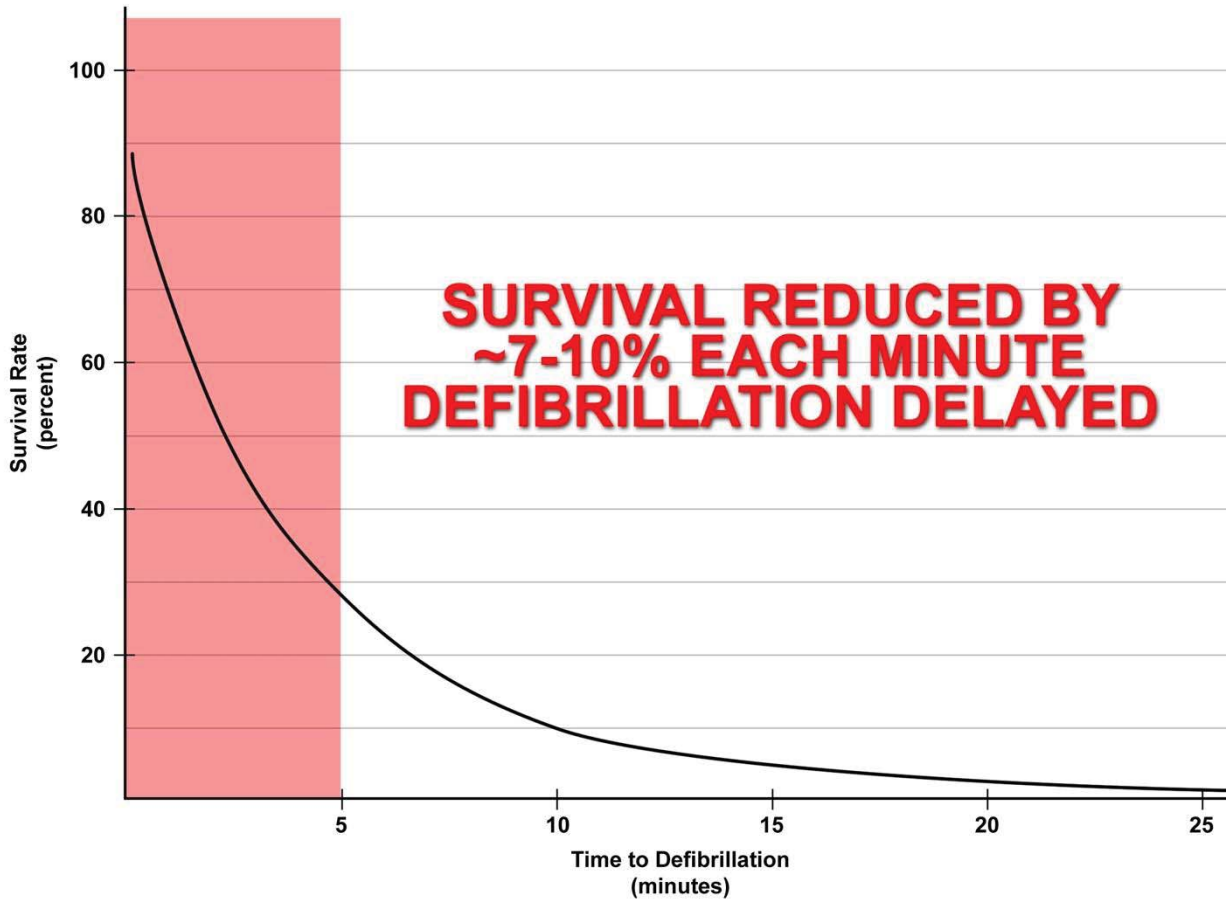
Medical emergency risk in most communities is predominantly a function of population density, demographics, violence, health insurance coverage, and vehicle traffic.

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 23 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 23—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org

Population Density

The Department's service area population density ranges from less than 500 people per square mile to approximately 5,000 per square mile. 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 20 percent of the service area population is 65 and older; 4.4 percent of the population is at or below poverty level; only 3.4 percent of the population over 24 years of age has less than a high school education or equivalent; and only two

percent of the population does not have health insurance coverage.[7] Overall, this indicates a well-educated and employed population with good health insurance coverage, all factors that can contribute to reducing medical emergency service demand.

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 service area transportation network includes Sir Francis Drake Boulevard, the primary two-lane regional thoroughfare with a very high daily traffic volume, particularly during weekday commute hours and on weekends.

Medical Emergency Service Demand

Medical emergency service demand over the two-year study period includes more than 2,800 calls for service comprising slightly more than 51 percent of total service demand over the same period, as summarized in Table 40.

Table 40—Medical Emergency Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 18	Sta. 19	Sta. 20	Sta. 21		
Medical Emergency	2017	118	488	243	584	**1,433**	49.81%
	2018	146	499	240	539	**1,424**	53.10%
Total		**264**	**987**	**483**	**1,123**	**2,857**	**51.39%**
Percent of Total Service Demand		36.16%	51.98%	50.21%	57.06%	51.39%	

Source: Ross Valley Fire Department incident data

As Table 40 shows, medical emergency service demand varies by planning zone and is trending consistently over the past two years. Overall, the Department's medical emergency service demand is similar to other California jurisdictions of similar size and demographics.

Probability of Medical Emergency Occurrence

Table 41 summarizes Citygate's scoring of medical emergency probability by planning zone based on medical emergency service demand from Table 40.

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

Table 41—Medical Emergency Probability Scoring

Medical Emergency	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Probability Score	4.0	4.5	4.25	4.75

Medical Emergency Impact Severity

Table 42 summarizes Citygate's scoring of probable medical emergency impact severity by planning zone.

Table 42—Medical Emergency Impact Severity Scoring

Medical Emergency	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Impact Severity Score	3.0	3.0	3.0	3.0

Overall Medical Emergency Risk

Table 43 summarizes the Department's overall medical emergency risk scores and ratings by planning zone.

Table 43—Overall Medical Emergency Risk

Medical Emergency	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Total Risk Score	12.0	13.5	12.75	14.25
Risk Rating	***High***	***High***	***High***	***High***

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 materials into or through a jurisdiction; vulnerable populations; emergency evacuation planning and related training; and specialized hazardous material service capacity.

Fixed Hazardous Materials Facilities

The Marin County Department of Public Works, serving as the State-designated Certified Unified Program Agency for the County, identified 38 facilities within the Department's service area requiring a State or County hazardous material operating permit as shown on Map #2C in **Volume 2** (Map Atlas).

Transportation-Related Hazardous Materials

The Department also has transportation-related hazardous material risk due to hazardous materials transported into or through its service area, primarily on Sir Francis Drake Boulevard.

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. The service area population density ranges from less than 500 people per square mile to approximately 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. Almost 29 percent of the service area population is under age 10 years 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 Office of Emergency Services (OES), within the Marin County Sheriff's Office, is responsible for disaster/emergency preparedness and management in the unincorporated areas of the County, including hazard information, coordination with other local/regional emergency management organizations, emergency preparedness, and disaster response, communications, and recovery. OES also manages AlertMarin, 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. AlertMarin notifications can be initiated by designated fire or law enforcement agency personnel.

The Sheriff's Office is also responsible for initiating emergency evacuations in the unincorporated areas of the County. No information was identified for this assessment relative to pre-planned evacuation routes, evacuation procedures, or evacuation exercises.

Hazardous Material Service Demand

The Department responded to 91 hazardous material incidents over the two-year study period, comprising 1.64 percent of total service demand over the same period, as summarized in Table 44.

Table 44—Hazardous Material Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 18	Sta. 19	Sta. 20	Sta. 21		
Hazardous Material	2017	12	18	7	**12**	**49**	**53.8%**
	2018	9	14	10	**9**	**42**	**46.2%**
Total		**21**	**32**	**17**	**21**	**91**	**100%**
Percent of Total Service Demand		2.88%	1.69%	1.77%	1.07%	1.64%	

Source: Ross Valley Fire Department incident data

As Table 44 indicates, hazardous material service demand is relatively consistent across all planning zones and years. While this service demand seems high for this size agency and jurisdiction, it is most likely due to Department personnel cross-staffing the Hazardous Materials Response unit for responses to other regional jurisdictions, rather than hazardous materials incidents within the service area. Overall, the Department's hazardous material service demand is low.

Probability of Hazardous Material Occurrence

Table 45 summarizes Citygate's scoring of hazardous materials probability by planning zone based on hazardous material service demand from Table 44.

Table 45—Hazardous Material Probability Scoring

Hazardous Material	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Probability Score	2.50	2.75	2.25	2.50

Hazardous Material Impact Severity

Table 46 summarizes Citygate's scoring of probable hazardous material impact severity by planning zone.

Table 46—Hazardous Material Impact Severity Scoring

Hazardous Materials	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Impact Severity Score	3.0	3.0	3.0	3.0

Overall Hazardous Material Risk

Table 47 summarizes the Department's overall hazardous material risk scores and ratings by planning zone.

Table 47—Overall Hazardous Material Risk

Hazardous Materials	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Total Risk Score	7.50	8.25	6.75	7.50
Risk Rating	***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, and/or infrastructure construction activity occurring within the Department's service area.

Confined Spaces

There are multiple tanks, vaults, and temporary open trenches within the Department's service area.

Bodies of Water

Bodies of water within the Department's service area include Corte Madera, Fairfax, Ross, San Anselmo, and Sleepy Hollow creeks.

Transportation Volume

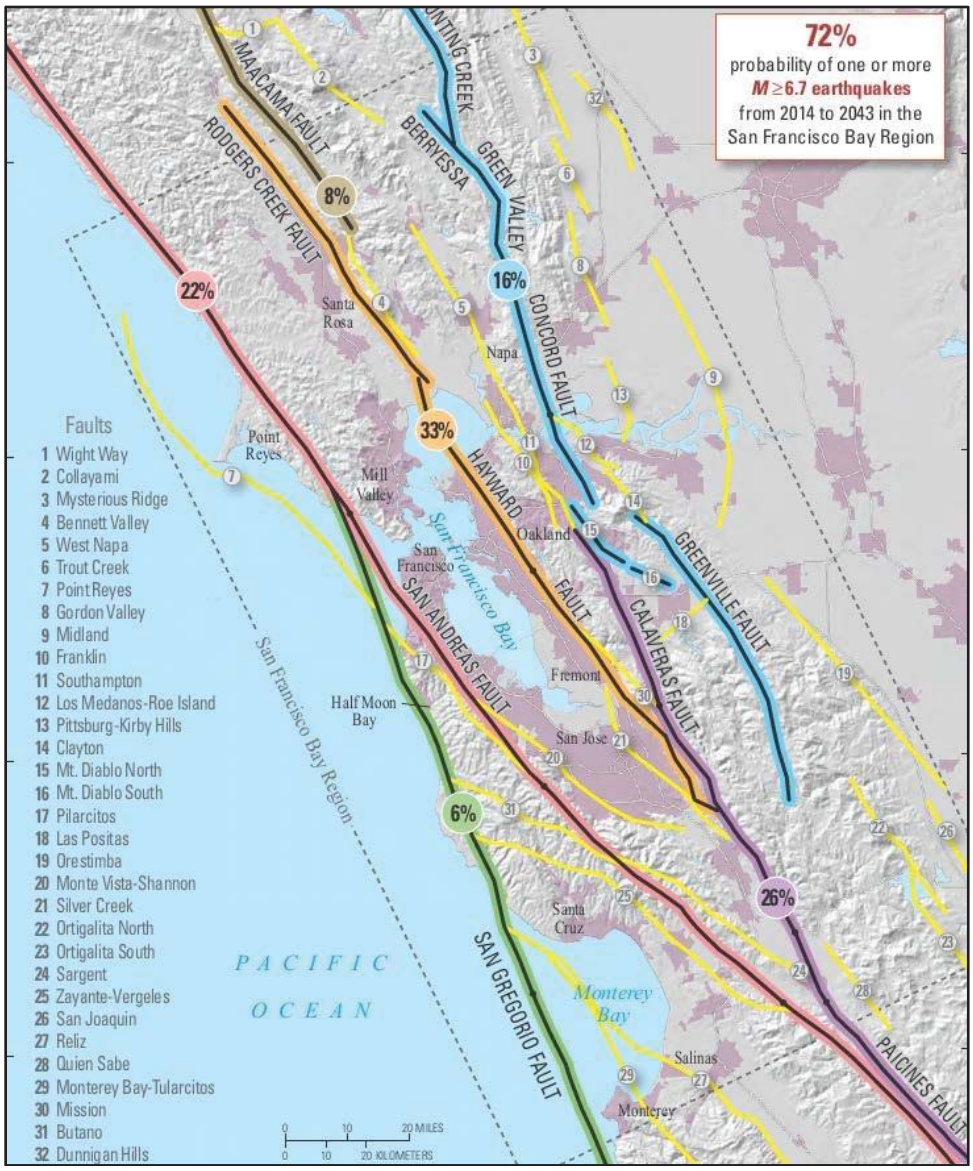
Another factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the service area, with Sir Francis Drake Boulevard carrying a high daily traffic volume.

Earthquake Risk[8]

The potential for earthquake damage exists throughout Marin County due to the combination of the number of active faults within and near the County and the presence of soils vulnerable to liquefaction. Active faults include the Hayward, Rodgers Creek, and San Andreas as shown in Figure 24. According to the Working Group on California Earthquake Probabilities, there is a 72 percent probability of at least one earthquake of magnitude 6.7 or greater within the Bay Area before 2043. The Association of Bay Area Governments (ABAG) Resilience Program projects a 52 percent chance of a magnitude 6.7 or greater earthquake on one of the faults affecting Marin County by 2036.

[8] Reference: 2018 Marin County Multi-Jurisdictional Local Hazard Mitigation Plan, Section 3

Figure 24—Earthquake Faults



Flood Risk[9]

All of Marin's watersheds are small and largely prone to flash flooding. Several Marin communities, including Ross Valley, are protected by levees. Flooding has historically resulted in extensive damage in many County communities, including most of the Department's service area, from significant flood events in 1955, 1958, 1964, 1969, 1970, 1982, 1983, 1986, 1995, 1997,

[9] Reference: 2018 Marin County Multi-Jurisdictional Local Hazard Mitigation Plan, Section 3

1998, 2005, 2006, and 2017. Figure 25 shows the flood hazard zones within the Department's service area as identified by the Federal Emergency Management Agency (FEMA).

Figure 25—Flood Hazard Areas

Technical Rescue Service Demand

Over the two-year study period, there were a total of six technical rescue incidents comprising 0.11 percent of total service demand for the same period, as summarized in Table 48.

Table 48—Technical Rescue Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 18	Sta. 19	Sta. 20	Sta. 21		
Technical Rescue	2017	0	0	0	3	**3**	0.10%
	2018	1	1	0	1	**3**	0.11%
Total		**1**	**1**	**0**	**4**	**6**	**0.11%**
Percent of Total Service Demand		0.14%	0.05%	0.00%	0.20%	0.11%	

Source: Ross Valley Fire Department incident data

As Table 48 shows, technical rescue service demand is extremely low.

Probability of Technical Rescue Occurrence

Table 49 summarizes Citygate's technical rescue probability scoring by planning zone based on service demand from Table 48. These probability scores are based predominantly on known historical flood data rather than recent service demand history.

Table 49—Technical Rescue Probability Scoring

Technical Rescue	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Probability Score	1.25	1.25	1.25	1.25

Technical Rescue Impact Severity

Table 50 summarizes Citygate's scoring of probable technical rescue impact severity by planning zone.

Table 50—Technical Rescue Impact Severity Scoring

Technical Rescue	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Impact Severity Score	3.0	3.0	3.0	3.0

Overall Technical Rescue Risk

Table 51 summarizes the Department's overall technical rescue risk scores and ratings by planning zone.

Table 51—Overall Technical Rescue Risk

Technical Rescue	Planning Zone			
	Sta. 18	Sta. 19	Sta. 20	Sta. 21
Total Risk Score	3.75	3.75	3.75	3.75
Risk Rating	***Low***	***Low***	***Low***	***Low***