Office of the City Manager

January 24, 2024

To: Honorable Mayor and Members of the City Council

From: Dee Williams-Ridley, City Manager

Re: Final report, recommendations from the Standards of Coverage and Community Risk Assessment Study

On July 27, 2021 the City Council authorized (Resolution No. 69,973-N.S.) the Department to enter into a contract with Citygate to conduct the City's first Standards of Cover (SOC) Study and Community Risk Assessment. That work concluded in December, 2023. The SOC is the national standard used to define appropriate levels of service and is based on a comprehensive analysis of historical performance; expectations; and existing and projected community risk factors, hazards, population growth and aging, topography, and the density and vertical growth of the build environment. Deployment strategies are then proposed as indicated by the analysis. The SOC will assist the City in determining whether the current levels of service are appropriate for the risks to be protected and with Council and community expectations.

Following are all recommendations presented in the SOC. The blue highlighted text is the current status of each recommendation from the Department.

Recommendation #1: Proceed with the planned conversion to staffing the four current ambulances with non-firefighter paramedics and EMTs. The City has established two new classifications, EMT and Paramedic. There have been two groups of Paramedics hired and they are operational on Department ambulances. The Department has had to pause recruitment of EMTs until a Headquarters/EMS Deployment center can be leased or purchased as there is no room to deploy additional ambulances in any existing facility.

Recommendation #2: The Department needs to add two additional ambulances, requiring 16 additional non-firefighter Paramedics and/or EMT FTE personnel. The Department is seeking a Headquarters/EMS Deployment Center in order to deploy these new units.

Recommendation #3: The City needs to upgrade its dispatch staffing, training, and software to allow for clinical call triage to send Basic Life Support (BLS) ambulances or alternative care units to low-acuity EMS requests, as outlined in the City's separate Dispatch Needs Analysis. A consultant, Federal Engineering, completed a Dispatch Needs Assessment, it was presented to the Public Safety Policy Committee on May 15, 2023. Due to the substantial recommendations in the report the Department pursued a second opinion, from Mission Critical Partners, which will be completed in early 2024. The Federal Engineering report indicated the dispatch center will require an investment to increase and modernize the facility, equipment, add more staff, new technology, and train employees. If these enhancements cannot be made, the City will need to explore alternate options to provide modern fire and EMS dispatch services that will allow triaged response based on the type and severity of the emergency.

Recommendation #4: The Berkeley Public Works and Fire departments should develop and implement holistic policies and traffic calming/controls that promote broad-based public safety through tandem reductions in both traffic-related injury/death and response/evacuation times. The Department has contracted with a consultant to perform an Evacuation and Response Time Study, which is projected to be completed in the Fall of 2024. The Department plans to participate in the upcoming revision to the City's Bike Plan. The Department would like to be more engaged and lead on other collaborative efforts to advance the City's complete streets initiatives however, additional funding for contractor support or FTE would be required.

Recommendation #5: Increase the staffing on six of the nine firefighting units (four engines, two aerial trucks) from three to four personnel per day. The transition to staffing ambulances with non-firefighter paramedics will allow the Department to reassign a fourth firefighter to three of the six recommended firefighting units, beginning with the companies in the downtown core. This transition is anticipated to be complete no later than July 1, 2025. The Department will also continue to pursue FEMA grant funding to add a fourth firefighter on additional engine companies.

Recommendation #6: Provide the overtime staffing increase from three to four firefighters for engines 3, 4, and 7, which are closest to the eastern hills during high-hazard wildfire threat periods. This can be implemented in the 2024 wildfire season for Extreme Fire Weather Days as there is anticipated to be a minimal number of these. However, in order to implement this policy on Red Flag Days and as the climate changes, additional funding for the Department's overtime budget will be required.

Recommendation #7: If ambulance and dispatch improvements do not improve acute emergency response times and lower unit-hour utilization (UHU) workload to no more than 30 percent for long, contiguous hours of the day, the City should construct infill fire or ambulance-only stations between the current busiest station pairs of 2 and 5 and 1 and 6. The Department is working with the Police Department to pursue enhancements to the City's Dispatch Center and is working to add ambulances to the system. Both of these solutions are ideal as the process to acquire and maintain additional facilities would require a substantial new investment.

Recommendation #8: Adopt updated deployment policies: City Council should consider adopting complete performance measures that begin with a 9 1 1 call being answered and end with the Fire Department and/or an ambulance arriving at the emergency incident. The measures of time should be designed to save patients and keep small but serious fires from becoming more

complex or damaging. The Department is in the process of adopting a Response Time Performance policy.

Recommendation #9: Adopt a split turnout time measure consisting of 2:00 minutes or less, 90 percent of the time, averaged over a 24-hour period, and within that, a daytime measure of 1:30 minutes or less, 90 percent of the time, from 0700–2200 hours. The Department is in the process of adopting a Response Time Performance policy.

Recommendation #10: The City should add a second field operations Battalion Chief 24/7 as soon as fiscally possible. The Department will continue to pursue ways to partially or fully fund the implementation of this recommendation.

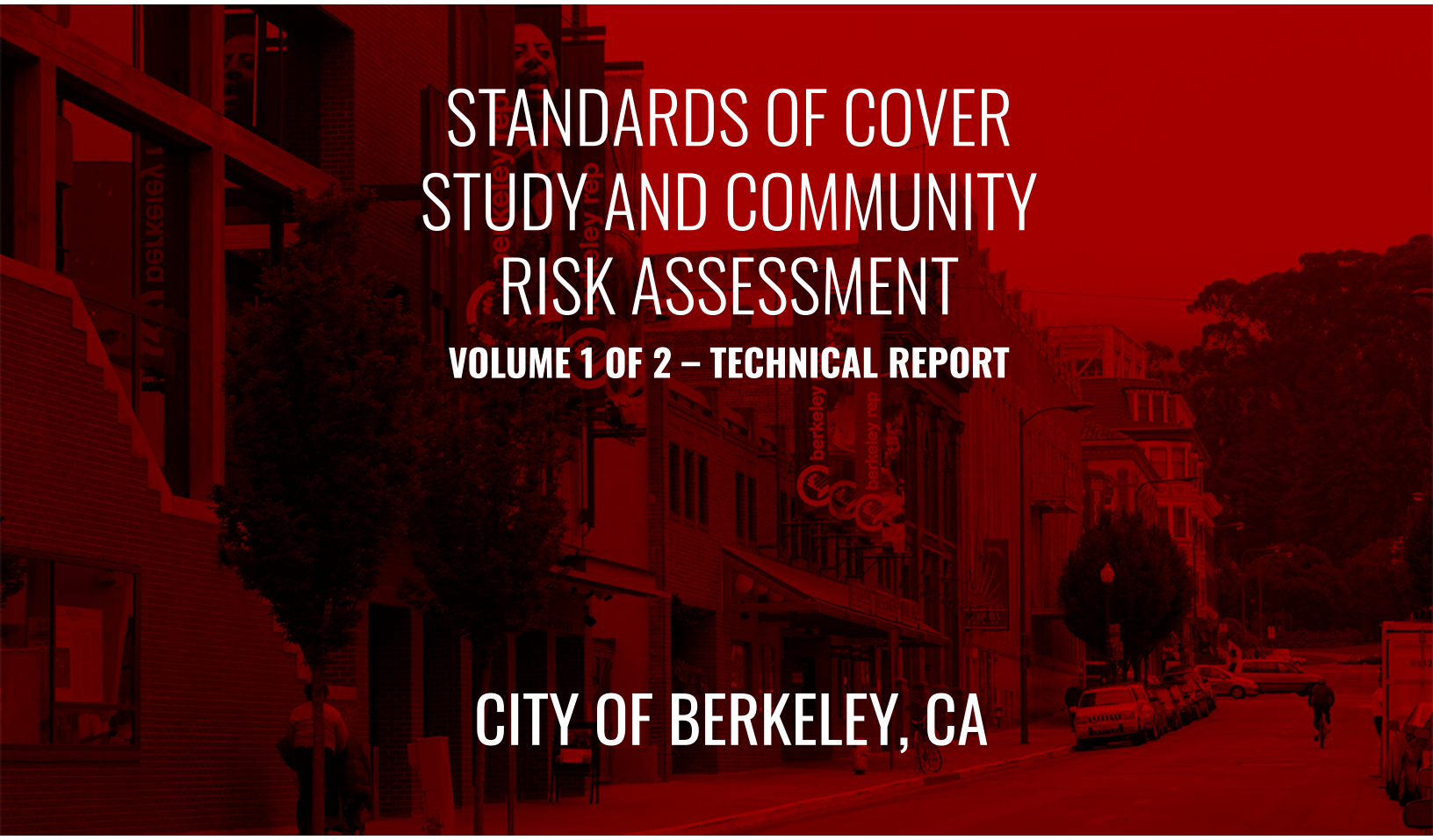
Attachments:

1. Vol 1 - Berkeley Fire Department SOC - Final Technical Report (12-13-23).pdf
2. Vol 2 - Berkeley Fire Department SOC - Map Atlas (12-13-23).pdf

cc:

LaTanya Bellow, Deputy City Manager
Anne Cardwell, Deputy City Manager
Jenny Wong, City Auditor
Mark Numainville, City Clerk
Matthai Chakko, Assistant to the City Manager
Farimah Brown, City Attorney

CITYGATE ASSOCIATES, LLC
PUBLIC SAFETY SERVICES



STANDARDS OF COVER STUDY AND COMMUNITY RISK ASSESSMENT

VOLUME 1 OF 2 – TECHNICAL REPORT

CITY OF BERKELEY, CA

DECEMBER 13, 2023

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EXECUTIVE SUMMARY

The City of Berkeley (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct the City's first Standards of Cover (SOC) Study and Community Risk Assessment to define appropriate levels of service based on a comprehensive analysis of historical performance; expectations; and existing and projected community risk factors, hazards, population growth and aging, topography, and the density and vertical growth of the built environment. Deployment strategies will then be proposed as indicated by the analysis. The study will assist the City in determining whether the current levels of service are appropriate for the risks to be protected in the City, and that the methods to ensure suitable service levels are consistent with generally accepted national standards and benchmarks.

This report is presented in two volumes. The Technical Report (**Volume 1**) includes: this Executive Summary, which contains a summary of our analysis and suggested next steps; Sections 1 and 2, which contain the deployment and SOC portions of the study; and a comprehensive Community Risk Assessment provided as **Appendix A**. A Map Atlas of deployment coverage measures is provided in **Volume 2**.

Throughout this report, Citygate makes key findings and, where appropriate, specific action item recommendations. Overall, there are 17 key findings and 10 specific action item recommendations. This summary cannot discuss every single issue in depth, but all are important and would not have been included in the Final Report otherwise.

POLICY CHOICES FRAMEWORK

While there are no mandatory federal or state regulations directing the level of fire service response times and outcomes, there are guidelines and best practices from the National Fire Protection Association (NFPA), the Insurance Services Office (ISO), the Commission on Fire Accreditation International (CFAI), and the California Occupational Safety and Health Administration (Cal/OSHA). The level of service provided, and any resultant costs, is the choice of local communities in the United States. The body of regulations related to fire services suggests that if fire services are provided, they must be provided with the safety of the firefighters and the public in mind. Thus, there is often a constructive tension between the desired level of service and the level that can be funded, and many communities may not have the level of service they desire. The City's investments in fire services over the past decades serve as its baseline commitment today.

This study identifies that the community has a high expectation for service delivery and, in order to meet that expectation, additional investment in fire services is necessary. The fundamental policy choices that drive a city's investment in fire services are derived from two key questions:

1. **What outcomes are desired for the emergencies to which the Department responds?** Is the desire to keep a building fire to the room, building, or block of

origin, and to provide emergency medical care in time to lessen the possibility of preventable death and severe disability?

2. **Should equitable response time coverage be provided to all neighborhoods with similar risks (building types and population density) to protect?** Once desired outcomes are determined, fire and emergency medical services (EMS) first responder and ambulance deployment can then be designed to cover the most geography in the fewest minutes to meet stated outcome goals. In a large city with multiple neighborhoods such as Berkeley, it must be determined whether similarly populated areas should receive similar response time performance from both fire and ambulance services units.

RESPONSE PERFORMANCE SUMMARY

Citygate finds that the Department is organized only to accomplish "yesterday's mission" and is struggling to meet current demand, much less the future growth of the City and university. The Department is working to adopt best practices, become proactive, and pursue understanding and service provision that is data driven. Citygate found a caring, committed workforce that is *strongly dedicated* to the City and agency, using best practices where possible to anticipate and meet the risks to be protected in the City. In conducting this study, Citygate received outstanding cooperation from Department and City executives. However, the Department is challenged by EMS call volume growth, which significantly exceeds crew workload limits. The growth in population and medical incident demand which has occurred in the City over the past two decades, and which is projected to continue, will increasingly strain the Department's response times, which are already substantially slower than best practice recommendations. Response times are further impacted in several large portions of the City due to the vast network of winding, narrow, non-conforming roadways. There are solutions to these issues that will take more than one fiscal year to correct. City leadership can use this study as a master plan to drive policy choices over the next several years.

The Department serves a diversity of populations, from residents to business employees and students. These populations, across a varied zoning pattern combined with topography and road design constraints, place significant restrictions on best practice-based fire and EMS response times. Population drives service demand, and development brings population. Of the top 50 largest cities in California, Berkeley is already the second most densely populated city per square mile—second only to San Francisco—*without* factoring in the daily influx of students, Citywide employment, tourism, and cars on the freeways. The City needs an ***urban*** level of fire, EMS, and specialty rescue services.

The Department protects large tourism and non-resident population densities. As different areas continue to infill develop with resultant increases in population density, the Department's

firefighting and ambulance services will need adjustment just to *recover* timely response capacity, much less *improve* response times equitably across all neighborhoods—more so when simultaneous incidents occur at peak hours of the day.

Fire service deployment, simply summarized, is about the *speed* and *weight* of response. *Speed* refers to initial (first-due) response of all-risk intervention resources (e.g., engines, ladder trucks, and ambulances) strategically deployed across a jurisdiction for response to emergencies within a travel time interval sufficient to control routine-to-moderate emergencies without the incident escalating to greater size or severity. *Weight* refers to multiple-unit (Effective Response Force, or ERF) 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, enough firefighters must be assembled within a time interval to safely control the emergency and prevent it from escalating into an even more serious event.

Throughout the City, while the substantial growth in EMS incidents over the past two decades seems all-consuming, for the foreseeable future there will always be the need for both a first-due unit and multiple-unit response consistent with current best practices to limit the risk of fire damage to only part of an affected building and keep wildland fires small within the initial response force's capabilities. Stated this way, *all neighborhoods need a standby and readily available firefighting force* that can respond when fires break out, regardless of peak-hour EMS workload. As demonstrated by current extreme weather emergencies, there is also a need for a strong Fire Department during natural disasters, as the vulnerable members of the City's population will need help from first responders.

Integrated Challenges – Response Time, Incident Volume, and Growth

The following table summarizes Citygate's benchmarking the Department's operational response performance for reporting year (RY) 2020/21 relative to national recognized best practices. These best practices were used as the City/Department do not yet have adopted performance measures.

Table 1—Response Performance Summary – RY 20/21

Response Component	Best Practice		90th Percentile Performance	Performance Versus Best Practice and Current Goal
	Time	Reference		
Call Processing / Dispatch	1:30	NFPA	**2:29**	**+ 0:59**
Crew Turnout	2:00	Citygate	**2:05**	**+ 0:05**
First-Unit Travel	4:00	NFPA	**5:53**	**+ 1:53**
First-Unit Call to Arrival	7:30	Citygate	**9:32**	**+ 2:02**
ERF Call to Arrival	11:30	Citygate	**18:50**	**+ 7:20**

As the table shows, call processing is taking longer than best practice. Crew turnout performance is nearly meeting recognized best practice goals. First-unit travel performance is 1:53 minutes *slower* than the 4:00-minute best practice goal due to several factors: station location, open spaces, terrain, and traffic congestion. Overall, first-unit call-to-arrival and ERF call-to-arrival performance, which is a fire agency's true customer service measure, are both significantly *slower* than their respective 7:30-minute and 11:30-minute best practice goals.

To set a travel time goal and a resultant total response time goal for Berkeley, Citygate assessed the results by the *fifth* minute of travel, which we find to be acceptable in *urban* areas. In the City, the fifth *travel* minute coverage per fire station area ranges from 53.5 percent to 90.5 percent. The three most populated and highest incident volume station areas are stations 1, 2, and 5, whose grouping is the "triangle" of stations at the City's core. By the fifth minute of travel, performance across all three stations averages 86.9 percent, with stations 2 and 5 both hitting 90 percent. Thus, the largest population, risk, and incident densities are reached by the fifth minute of travel.

Based on fifth-minute coverage in the core of the City, and due to the fact that the waterfront and upper hills areas cannot be covered as quickly due to road design and topography, **Citygate recommends the City adopt a 5:00-minute *travel* time goal** which, when added to an improved, best practice dispatch time of 1:30 minutes and a turnout goal of 2:00 minutes, yields a total response time goal of 8:30 minutes. This will deliver first responder paramedics to the highest-risk areas in an acceptable amount of time.

The City is also evolving to improve its housing shortages by approving mid-rise and high-rise residential buildings. UC Berkeley is completing its new master plan to add students, faculty, on-campus buildings and housing off-campus.

The ongoing intensification of land uses, building heights, and population density will make several sections of the City very urban—typical of the largest metropolitan cities for building fire and rescue/EMS challenges. The cumulative effect of these projects around the City necessitates a shift in staffing and response models as well as an increase in the flexibility of emergency medical resources. The City's fire and ambulance programs must evolve to those suitable for a major urban fire department in staffing, unit types, and facility locations. Citygate acknowledges this will not only be costly but also very difficult to find new locations for responders.

While state fire code requires fire sprinklers in residential dwellings, it will be many more decades before enough residential units are replaced or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an affected building and minimizing permanent impairment resulting from a medical emergency, then the City will need coverage in all neighborhoods that is consistent with Citygate's response performance recommendation for Berkeley. Based on Citygate's study, this response performance recommendation entails *no more than* 8:30 minutes for the arrival of a single first responder, and 11:30 minutes for a multiple-unit arrival to more serious incidents, from the time of 9-1-1 notification at the Berkeley Police Communications Center—all at 90 percent or better reliability.

Dispatch, turnout, and travel times all need to be reduced. Dispatch time must decrease by 0:59 seconds to meet a 1:30-minutes call-processing goal, turnout time by :05 seconds to meet a 2:00-minute goal, and travel time by 0:53 seconds to meet a proposed goal of no more than 5:00 minutes for first-due units in *congested urban* areas. Collectively, Citygate's recommended first-unit total response time goal is 8:30 minutes (1:30 + 2:00 + 5:00).

Berkeley must act (1) to restore emergency responder availability for serious, life-threatening fires and emergency medical service events and (2) to field enough firefighters to serious building or wildland fires quickly.

Overall Summary of City Fire Service Deployment

Recovering response time and unit capacity goals will require multiple changes over the next three years to first improve and then maintain response times as growth occurs:

1. Increasing the number of ambulances from four to six.
2. Shifting responsibility for non-acute EMS calls from the 9-1-1 Fire/Ambulance program to a Mobile Integrated Health program like the City's pilot Mobile Integrated Paramedic (MIP) program.
3. Improving dispatch staffing and systems to allow for EMS clinical call triage.
4. Working collaboratively with Public Works staff and traffic safety advocates to engineer methods to lessen disproportionate impacts on emergency response times as the City redesigns streets using its Complete Streets policy.

5. Increasing staffing to four personnel each on key engines and ladder trucks.
6. Adding a second field operations Battalion Chief 24/7 for improved crew supervision and to add an immediate scene safety officer to support the Battalion Chief / Incident Commander for serious emergency incidents.

If these six strategies do not improve acute emergency response times *and lower unit-hour utilization (UHU) workload to no more than 30 percent,* the City should construct infill fire or ambulance-only stations between the current busiest station pairs of 2 and 5 and 1 and 6. These areas are also where much of the infill development, high-rise building, and UC Berkeley campus growth will occur.

Citygate finds the Department's response apparatus types to be appropriate to protect against the hazards likely to impact the City. However, *fire crew staffing of three per unit is insufficient* to provide the necessary "weight" of response to serious fires—especially so in mid- and high-rise buildings and for severe wildland fires that start in the hills. Currently, the Department's service capacity for fire and non-fire risk consists of 37 personnel on duty daily, including one Battalion Chief, one mobile Paramedic Supervisor, and 27 firefighters staffing seven engines and two aerial ladder trucks. An additional eight firefighters currently staff four ambulances and operate from the Department's seven fire stations. However, engines are very busy providing EMS response, and the firefighters staffing ambulances are not consistently available for firefighting at present. Over the next several years, three firefighters per day will be moved to an engine and both ladders, thus raising three of the nine firefighting units to four-firefighter staffing consistent with NFPA Standard 1710 and Citygate best practices for high-density urban core areas. These firefighters will be replaced by non-firefighter EMS personnel on the ambulances, thus aligning the classification with the work and creating a more efficient system. However, only three units with four-firefighter staffing will not be enough. At a minimum, four-firefighter staffing should be provided:

- On four engines: 1, 2, 5, and 6
- On trucks 2 and 5
- Occasionally (on high-fire danger wildland fire days) on engines 3, 4, and 7.

When increasing firefighting units to four crew members each, one additional firefighter per day will have to be newly funded, which amounts to a total of three added firefighting personnel *per crew* (plus the overtime to cover their leave absences) on a three-platoon fire crew rotation system. The wildfire threat days which increase staffing to four each can be handled via overtime during daylight hours or when winds are most severe. When the engine and ladder units identified are staffed with four personnel each, the daily staffing for units other than ambulances increases from 27 to 33 per day—much more consistent with the risks to be protected in a thriving, growing urban area with internationally known assets and a tragic history of wildland fires.

FINDINGS AND RECOMMENDATIONS

Following are all findings and recommendations presented throughout this report.

Findings

Finding #1: The Department's physical response unit *types* are appropriate to protect against the hazards likely to impact the City.

Finding #2: The Department's minimum daily Citywide staffing of 27 firefighting unit response personnel assigned to engine and truck companies is only sufficient for a modest single-family house fire or small commercial building fire at the ground floor.

Finding #3: The Department has not established response performance goals consistent with best practice recommendations as published by the Commission on Fire Accreditation International. The current City Council budget goal measures do not reflect policy resolution or a specific General Plan policy.

Finding #4: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Finding #5: The mapping evaluation of coverage demonstrates that the City has an adequate number of fire stations. However, as incident statistics demonstrate, best practice travel times are not being delivered due to multiple factors.

Finding #6: As shown in this study's GIS models, traffic congestion decreases first-unit road mile coverage by only 3.6 percent, which, in Citygate's experience, is not severe. However, overall traffic congestion does still contribute to the Department's slower real-world, non-GIS-modeled travel times. There is a more significant impact on multiple-unit ERF responses, eroding road mile coverage by 26 percent.

Finding #7: At least two simultaneous incidents are occurring nearly 47 percent of the time. This primarily impacts station areas 5, 2, and 1.

Finding #8: While the annual number of simultaneous incidents has decreased slightly, the response time coverage provided by the busiest companies to their own and to adjacent station areas remains diminished, shifting workload to other companies.

Finding #9: The City's ambulance system must provide an increased number of full- and part-time ambulances.

Finding #10: The City's call processing / dispatch performance is *not* meeting Citygate's recommended best-practice goal of 1:30 minutes at 90 percent or better reliability.

Finding #11: At 2:05 minutes averaged over 24 hours, the Department is just over meeting Citygate's recommended 2:00-minute crew turnout performance goal. As sleeping hours increase turnout time, consider adopting a turnout measure of 1:30 minutes during daytime hours to provide greater clarity and reflect Department performance more accurately.

Finding #12: At 5:53 minutes, 90th percentile first-unit travel time is *significantly* higher than the 5:00-minute best practice goal for urban areas.

Finding #13: At 9:32 minutes in RY 20/21, 90th percentile first-unit call-to-arrival performance is 2:02 minutes *slower* than an optimum best practice goal of 7:30 minutes for urban areas.

Finding #14: At 18:50 minutes across the three years of data, 90th percentile ERF (First Alarm) call-to-arrival performance *is 7:20 minutes slower than* the 11:30-minute Citygate-recommended best practice goal for urban areas.

Finding #15: The Public Works and Fire departments have not yet established an effective set of integrated policies and traffic-calming methods to improve public safety by minimizing roadway injuries, deaths, and response/evacuation times.

Finding #16: The City's planned expansion of ambulance service is consistent with best practices and will provide needed improvement, but upgrades in dispatcher skills for clinical evaluation to recognize and separate low-acuity incidents will not be fully realized for at least three more years, and likely longer. Given the ongoing strain on ambulances staffed with only firefighter/paramedics, the process of conversion and expansion of ambulances is too slow to meet current (and growing) EMS service demands.

Finding #17: Based on the most recent year's quantity of mental health patients being transported, if the Department is tasked with management of these patients, it would require the addition of one 24-hour ambulance and one 12-hour peak ambulance—both operating seven days a week. At present, the Department does not have the units or personnel to administer this workload.

Recommendations

Recommendation #1: Proceed with the planned conversion to staffing the four current ambulances with non-firefighter paramedics and EMTs.

Recommendation #2: The Department needs to add two additional ambulances, requiring 16 additional non-firefighter Paramedics and/or EMT FTE personnel.

Recommendation #3: The City needs to upgrade its dispatch staffing, training, and software to allow for clinical call triage to send Basic Life Support (BLS) ambulances or alternative care units to low-acuity EMS requests, as outlined in the City's separate Dispatch Needs Analysis.

Recommendation #4: The Berkeley Public Works and Fire departments should develop and implement holistic policies and traffic calming/controls that promote broad-based public safety through tandem reductions in both traffic-related injury/death and response/evacuation times.

Recommendation #5: Increase the staffing on six of the nine firefighting units (four engines, two aerial trucks) from three to four personnel per day.

Recommendation #6: Provide the overtime staffing increase from three to four firefighters for engines 3, 4, and 7, which are closest to the eastern hills during high-hazard wildfire threat periods.

Recommendation #7: If ambulance and dispatch improvements do not improve acute emergency response times and lower unit-hour utilization (UHU) workload to no more than 30 percent for long, contiguous hours of the day, the City should construct infill fire or ambulance-only stations between the current busiest station pairs of 2 and 5 and 1 and 6.

Recommendation #8: Adopt updated deployment policies: City Council should consider adopting complete performance measures that begin with a 9-1-1 call being answered and end with the Fire Department and/or an ambulance arriving at the emergency incident. The measures of time should be designed to save patients and keep small but serious fires from becoming more complex or damaging. With this is mind, Citygate recommends the following outcome-based measures for the major emergency types:

8.1: **Geographic Distribution of Fire Stations:** To treat medical patients and control small fires, the first-due unit should arrive within 8:30

minutes, 90 percent of the time, from receipt of the 9-1-1 call in the fire dispatch center. This equates to a 90-second dispatch time, a maximum 2:00-minute nighttime company turnout time, and a 5:00-minute travel time, which is realistic for Berkeley as a more urban area.

8.2: **Multiple-Unit Effective Response Force for Serious Emergencies:** To confine fires near the room of origin and treat up to five medical patients at once, a multiple-unit response of a minimum of four engines, two ladder trucks, one ambulance, one Medic Supervisor, and one Battalion Chief—totaling a minimum of 22 personnel—should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and an 8:00-minute travel time.

8.3: **Hazardous Materials Response:** The Department needs to maintain its hazardous materials response as designed to protect the community from hazards associated with uncontrolled release of hazardous and toxic materials. The first-due unit should arrive to investigate a hazmat release at the operations level within 8:30 minutes, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time in urban population areas. After assessment and scene evaluation is completed, a determination can be made whether to request additional resources.

8.4: **Technical Rescue:** To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due company to arrive for assessment of the rescue should achieve a 5:00-minute travel time in urban to suburban areas, 90 percent of the time. Additional resources capable of initiating a rescue should be assembled within a total response time of 11:30 minutes, 90 percent of the time, with the result being a safe and complete rescue/extrication to ensure delivery of patients to a definitive care facility.

Recommendation #9: Adopt a split turnout time measure consisting of 2:00 minutes or less, 90 percent of the time, averaged over a 24-hour period, and within that, a daytime measure of 1:30 minutes or less, 90 percent of the time, from 0700–2200 hours.

Recommendation #10: The City should add a second field operations Battalion Chief 24/7 as soon as fiscally possible.

NEXT STEPS

Near Term

- Review and absorb the content, findings, and recommendations of this report.
- Adopt revised response performance goals and begin reporting to City Council at least annually.
- As soon as possible, increase the pace of the conversion program for Department ambulances to add non-firefighter ambulance crews, add two more ambulances, increase fire unit staffing, and upgrade dispatch EMS capabilities.
- Start long-term planning for infill fire and EMS stations if response times cannot be improved per the recommendations in this study. Consider working now with large block redevelopment applicants to provide street-level small spaces for a single emergency response unit/crew.

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SECTION 1—INTRODUCTION AND BACKGROUND

The City of Berkeley (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a Standards of Cover (SOC) Study and Community Risk Assessment to define appropriate levels of service based on a comprehensive analysis of historical performance; expectations; and existing and projected community risk factors, hazards, population growth and aging, topography, and the density and vertical growth of the build environment. Deployment strategies will then be proposed as indicated by the analysis. The study will assist the Department in determining whether the current levels of service are appropriate for the risks to be protected in the City, and that the methods to ensure suitable service levels are consistent with generally accepted national standards and benchmarks.

Citygate's scope of work conforms with the methodology outlined in *Standards of Response Coverage* (fifth and sixth editions) as published by the Commission on Fire Accreditation International (CFAI) and addresses all elements of the City's requested scope of work. The study also incorporates guidelines and best practices in the field of deployment and risk analysis from the National Fire Protection Association (NFPA), the Insurance Services Office (ISO), the CFAI, the California Occupational Safety and Health Administration (Cal/OSHA), relevant federal and state laws and regulations, and other recognized industry best practices.

1.1 REPORT ORGANIZATION

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

Executive Summary	Summarizes fire service policy choices and all findings and recommendations that can be used to strategically guide the City's and Department's efforts.
Section 1	**Introduction and Background**: Describes Citygate's project approach, methodology, and scope of work and provides an overview of the City and Department.
Section 2	**Standards of Cover Analysis**: Describes Citygate's updated service demand and response performance analysis in detail, as well as our findings and recommendations for each Standards of Cover element.
Appendix A	**Community Risk Assessment**: Provides a comprehensive analysis of the fire and non-fire hazards likely to impact the City.

1.1.1 Goals of Report

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

This document provides technical information about how 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 and City.

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

1.1.2 Limitations of 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 safely provide them for the public and for the personnel providing the services.

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

1.2 Project Approach and Scope of Work

1.2.1 Project Approach and Methodology

At the start of this study, Citygate reviewed relevant background data and information to better understand current service levels, costs, and the history of service level decisions, including prior studies.

Citygate subsequently reviewed demographic information about the City and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected fire service deployment, with the goal to identify the location(s) of stations and crew quantities required to best serve the City 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 deployment model that was tested against the travel time

mapping and prior response data to ensure an appropriate fit. Citygate also evaluated future City growth as well as UC Berkeley's proposed on- and off-campus expansion to model service demand by risk type and evaluate potential alternative emergency service delivery models. This resulted in Citygate proposing an approach to address current and long-range needs with effective and efficient use of existing resources. The result is a framework for enhancing Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Scope of Work

Citygate's approach to this study included:

- Reviewing relevant information data and information provided by the Department and City.
- Interviewing internal City and Department study team members and stakeholders.
- Receiving a general summary of the City and services provided by the Fire Department.
- Using best practice study guidelines as needed from the CFAI, the NFPA, the International Code Council, the ISO, Cal/OSHA, federal and state laws, and recognized industry best practices.
- Obtaining the Department's historical incident data.
- Understanding and forecasting the Department's ambulance delivery system needs.
- Conducting a comprehensive Community Risk Assessment.
- Preparing a comprehensive report that includes analysis-based findings and recommendations, including an executive summary presentation of the written report for City stakeholders.

1.3 CITY OVERVIEW[1]

The City of Berkeley is in Alameda County on the east side of the San Francisco Bay approximately ten miles east of San Francisco. The City encompasses 10.43 square miles of land and 7.22 square miles of water for a total area of 17.66 square miles, and has an estimated *resident* population of 124,563,[2] making it the second most densely populated of the 51 most populated Cities in California, second only to San Francisco.

The City is among the oldest cities in California. Founded in 1864, it was incorporated as a town in 1878 and as a city in 1909. The original City Charter was adopted in 1895. As the geographic

[1] City of Berkeley Comprehensive Annual Financial Report FY 2021, pages 9 and 10.
[2] State of California Department of Finance E-1 Report, May 2022.

midpoint of the Greater Bay Area, Berkeley is 20 minutes from San Francisco and close to population centers in Contra Costa County and the Silicon Valley.

The City is governed by a City Council composed of members elected from eight districts to serve four-year terms, and a Mayor who serves as the president of the City Council, elected Citywide to a four-year term. The City's fiscal year (FY) 2021 adopted budget included $447,702,457 of expenditures and reserves, of which $194,718,710 was allocated to the General Fund of the City and $252,983,747 to all other funds. The City employs approximately 1,579 full-time equivalent (FTE) employees. The City provides a full range of services exceeding that of most similarly sized cities in California.

To a large degree, the City is defined both culturally and economically by the presence of the University of California campus located on the eastern side of the City. The City has a diversified economy led by UC Berkeley, Lawrence Berkely National Laboratory, tourism, technology, and commercial/industrial businesses. The City provides a full range of urban community services, including police, fire, marina, water, refuse and recycling, street, parking, planning, building, engineering, parks, economic development, library, recreation, cultural, and educational services.

With 45,057 students and approximately 20,129[3] employees of all types, the UC Berkeley institution provides a high degree of economic stability for the City and has spurred growth in the high technology and biotechnology sectors. The Federal Government Lawrence Berkeley Laboratory also has 4,200 employees, and the Alta Bates Medical Center has approximately 3,100 employees. The City's current economic base consists of approximately 12,100 active licensed businesses operating in the City. These businesses include private manufacturing, technology research, retail and service businesses, educational services, healthcare and social assistance, cannabis clubs, consulting, arts and entertainment, and hospitality services, along with several state, federal, and non-profit institutions.[4]

1.3.1 Future Growth and Development

The previous Association of Bay Area Governments (ABAG) 2040 Plan projected that Berkeley's population would grow by 17.8 percent to 140,935 by 2040.[5] That plan is now obsolete, however, and the new 2050 One Bay Area Plan does not make specific projections for local communities, focusing instead on regional growth. As the following table shows, historical population data from the State Department of Finance cites Berkeley's prior population growth rate at 8.9 percent *when accounting solely for residents.*

[3] Cal Online facts, student and staff counts.
[4] Ibid #1.
[5] Source: Plan Bay Area 2040, Plan Bay Area Projections 2040.

Table 2—Population Change in State, County, and Neighboring Cities (2000–2020)

Jurisdiction	2000	2010	2020	% Change 2000-2010	% Change 2010-2020
California	33,871,648	37,253,956	39,782,870	10.0%	6.8%
Alameda County	1,443,741	1,510,271	1,670,834	4.6%	10.6%
Berkeley	102,743	112,580	122,580	9.6%	8.9%
Oakland	399,484	390,724	433,697	-2.2%	11.0%
Fremont	203,413	214,089	234,220	5.2%	9.4%
San Francisco	776,733	805,235	897,806	3.7%	11.5%
San Leandro	79,452	84,950	87,930	6.9%	3.5%
Hayward	140,030	144,186	160,311	3.0%	11.2%
Richmond	99,216	103,701	111,217	4.5%	7.2%

Sources: Decennial Census, 2000, 2010; California Department of Finance, E-5 series, 2020.

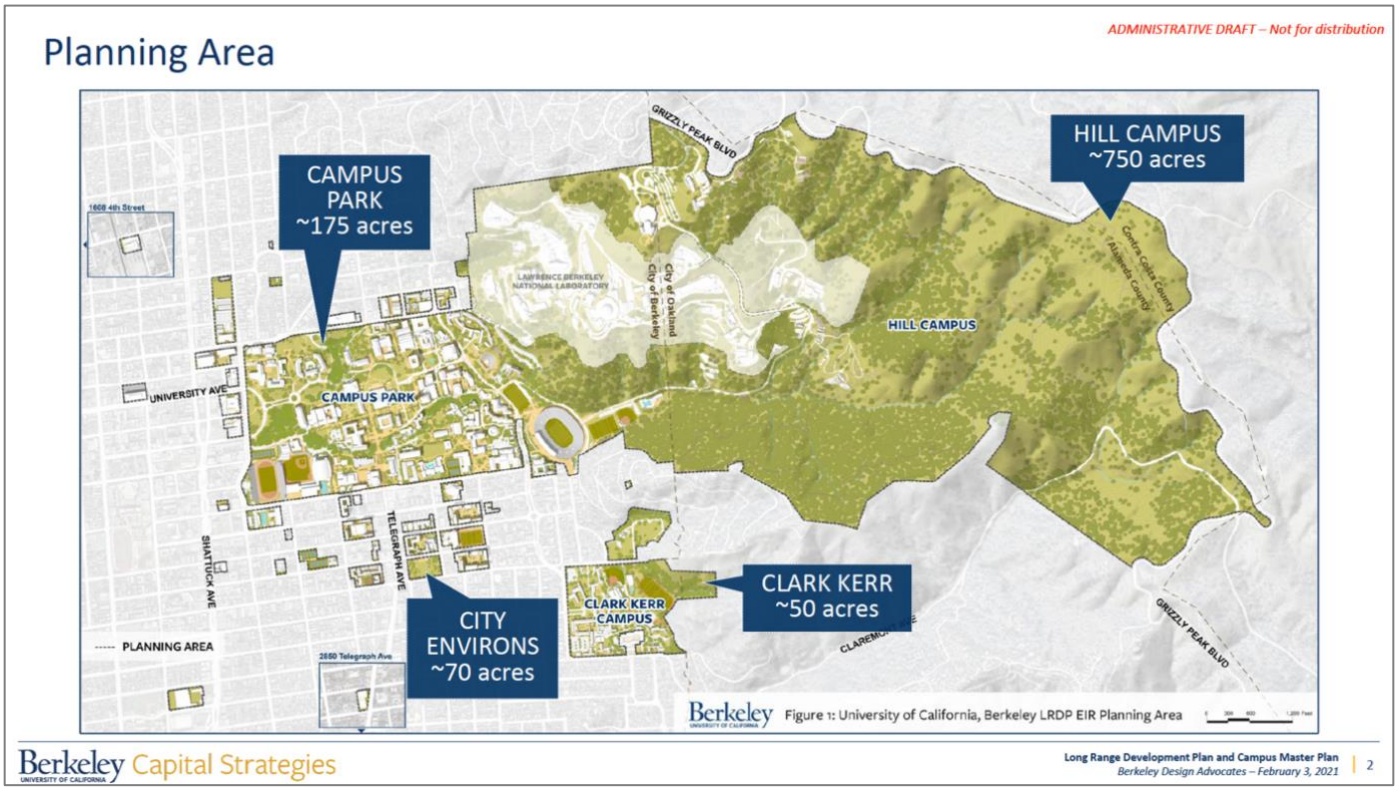
However, for the purposes of this fire and EMS services assessment, prior growth rates should not be used. The City recently updated single-family zoning and accessory dwelling unit (ADU) allowances along with processing multiple mid- and high-rise residential building plans. As of late 2021, the City has 61 residential units of all types approved or under construction totaling 3,560 units. Another 11 projects were in design that would contain several hundred more residential units. All but two of these projects ranged in height from three to six stories. The City has moved in many areas to increased density development and redevelopment over that of single-family zoning. For example, 5,000 more dwelling units with an average of 2.44 people[6] per unit could add 12,200 more residents in three to seven years, which—in addition to the current population of 124,563—would be an increase of 9.8 percent, which is likely a low estimate.

UC Berkeley Growth

Since late 2020, UC Berkeley has been doing advance planning for its future needs in cooperation with the City. Two planning projects are processing together—the 2021 Long Range Development Plan (LRDP) and the Campus Master Plan. The LRDP is the regulatory framework to drive high-level population projections and a subsequent EIR. The Campus Master Plan is an aspirational planning document. The LRDP was completed mid-2021 and focuses on the planning areas shown in the following figure.

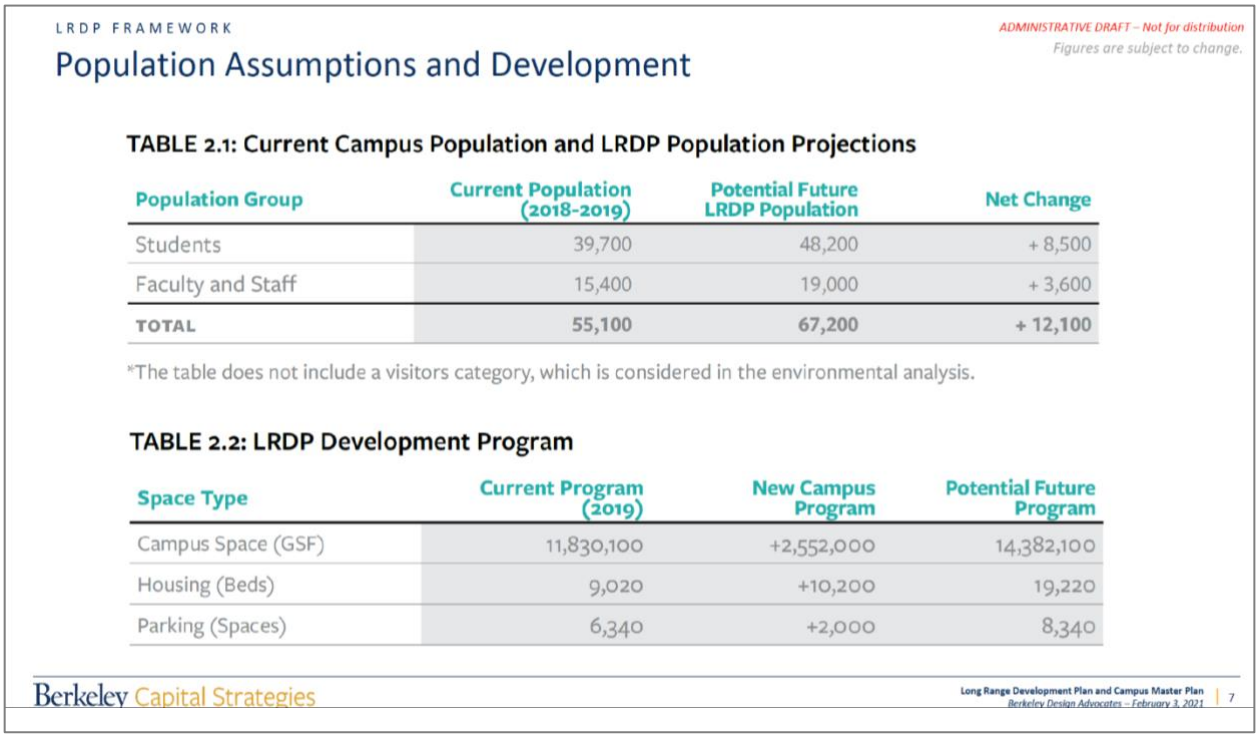
[6] City of Berkeley Draft Housing Element Update, November 2022.

Figure 1—Long-Range Development Planning Areas



To date, the planning projects have generated these campus community population projections. The potential student and faculty residential developments are at all sides of core campus and at the Clark Kerr campus. All development areas are at the perimeter or just inside the City, and thus are protected by the Department.

Figure 2—Population Assumptions and Development



LRDP FRAMEWORK

ADMINISTRATIVE DRAFT – Not for distribution
Figures are subject to change.

Population Assumptions and Development

TABLE 2.1: Current Campus Population and LRDP Population Projections

Population Group	Current Population (2018-2019)	Potential Future LRDP Population	Net Change
Students	39,700	48,200	+ 8,500
Faculty and Staff	15,400	19,000	+ 3,600
TOTAL	55,100	67,200	+ 12,100

*The table does not include a visitors category, which is considered in the environmental analysis.

TABLE 2.2: LRDP Development Program

Space Type	Current Program (2019)	New Campus Program	Potential Future Program
Campus Space (GSF)	11,830,100	+2,552,000	14,382,100
Housing (Beds)	9,020	+10,200	19,220
Parking (Spaces)	6,340	+2,000	8,340

Berkeley Capital Strategies

Long Range Development Plan and Campus Master Plan
Berkeley Design Advocates – February 3, 2021 | 7

If all campus population and facility square footage growth projected in the previous figure is eventually realized, the result will be significant, measurable impacts to the Department, as will be discussed elsewhere in this study.

Service Demand of Population by Age

Population drives demand for EMS services. However, it is not easy to account for multiple variables by age group, such as basic access to health care, being fully insured, access to preventive care, cultural and language barriers etc. One recent estimate put forth 40 percent of California's population as eligible for MediCal (Medicaid); however, this does not mean that percentage of the population is enrolled. Further, MediCal has not historically covered more than a token payment against the true, full cost of an ambulance transport.

Utilizing EMS incident data for the City, generally 40 percent of patients are over age 65, which represents only 13.7 percent of the total population according to census data. Patients between 18 and 23 years of age account for approximately 10 percent of patients. Patients between the ages of 18 and 23, and those 65 or older, account for roughly half of all the documented patients in Berkeley. According to the same data, the number of documented patients over 65 has steadily risen since 2013. It is commonly understood that America is "graying," but this generality does not mean that every senior is dependent on EMS for primary health care access. The houseless represent many age groups and most have no routine health care. What can be said is that until

there is fundamental health care reform economically in America, the issues that have dramatically increased ambulance demand over the last two decades show no signs of slowing.

1.4 Fire Department Overview

1.4.1 Organization

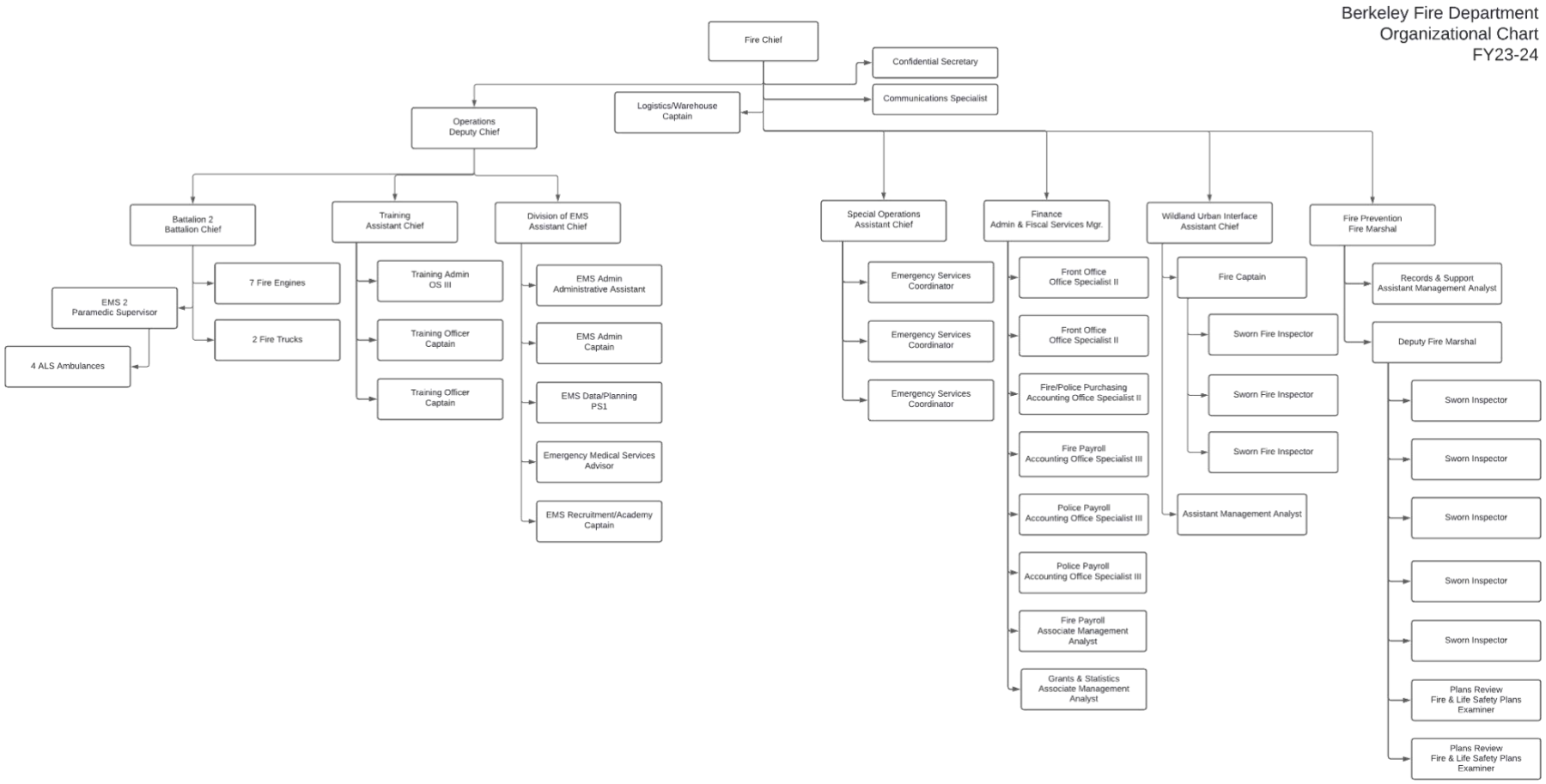
The Department provides fire suppression, Advanced Life Support (ALS) ground ambulance transportation, ALS pre-hospital emergency medical, water rescue, hazardous material release, fire prevention, wildland-urban interface, office of emergency services, community outreach, and related fire and life safety services with a staff of 154 personnel organized into five divisions, as summarized in the following table and figure.

Table 3—Budgeted FTE – Fire Department

Division	Budgeted FTE[1]
Office of the Fire Chief	3
Administrative and Fiscal Services	10
Fire/EMS Operations	122
Office of Emergency Services (OES)	4
Wildland-Urban Interface	5
Fire Prevention	10
Total	**154**

[1] FTE = Full-Time Equivalent
Source: City of Berkeley Fiscal Year 2022-23 Adopted Budget

Figure 3—Fire Department Organization



1.4.2 Facilities and Resources

The Department provides services from seven fire stations and Fire Administration located in the Public Safety building with the Police Department and 9-1-1 Dispatch.

Table 4—Fire Department Facilities, Resources, and Daily Response Staffing – 2022 (Prior to the Expansion of the Ambulance Program)

Station Number	Address	Unit Staffing (Minimum/Maximum)
1	2442 Eighth St.	Engine 1 Ambulance Medic 1 Confidence (boat – cross-staffed by E1/M1) RWC 1 (jet ski – cross-staffed by E1/M1)
2	2029 Berkeley Way	Engine 2 Truck 2 Ambulance Medic 2 Battalion 2 HM2 (Hazmat – cross-staffed by E2/T2) E602 (Type VI – cross-staffed by T2)
3	2710 Russell St.	Engine 3 Ambulance Medic 3
4	1900 Marin Ave.	Engine 4
5	2680 Shattuck Ave.	Engine 5 Truck 5 Ambulance Medic 5 E305 (Type III cross-staffed by T5)
6	999 Cedar St.	Engine 6
7	3000 Shasta Rd.	Engine 7 QRV7 (Polaris cross-staffed) OES Type VI (cross-staffed)

All front-line engine, ladder, and ambulance units are staffed with firefighter/EMTs and firefighter/paramedics as appropriate.

1.4.3 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 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 fire and non-fire risk consists of 37 personnel on duty daily—including one mobile Paramedic Supervisor and one Battalion Chief—staffing seven engines, two aerial ladder trucks, and four ambulances, and operating from the Department's seven fire stations. The Department also has one Type-3 wildland engine, two Type-6 wildland engines, one hazardous materials apparatus, one fireboat, one rescue watercraft, and two all-terrain vehicles (ATVs) that can be cross-staffed by on-duty personnel as needed.

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. All engines are staffed with a minimum of one EMT-Paramedic, and ambulances are staffed with two paramedics. The Department also provides ground ambulance services; air ambulance services, when needed, are provided by CALSTAR/REACH from Concord, Stanford Life Flight from Palo Alto, East Bay Regional Parks Police Department, or the California Highway Patrol. Emergency room services are available at Alameda Hospital (Alameda), Alan Bates Summit Medical Centers and Highland Hospital (Oakland), Kaiser Oakland (Oakland), and UCSF Benioff Children's Hospital (Oakland). Highland Hospital and UCSF Benioff Children's Hospital are also Level 1 Trauma Centers, and Eden Medical Center is a Level 2 Trauma Center.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. When needed, technical hazardous materials response is provided by Station 2 personnel trained to the Hazardous Materials Specialist level cross-staffing a hazardous material apparatus. For significant spills and releases, the Department responds via the Alameda County Fire Department Hazardous Materials Team.

All response personnel are further trained to the Confined Space Awareness level, with technical rescue capability available as needed from the City of Oakland. The Department has obtained a Cal OES Type-2 Urban Search and Rescue trailer and is designing a technical rescue program.

Marine response capacity includes up to 24 personnel certified to the State Fire Training Open Water Rescuer and/or Open Water Rescue Boat Operator level. In addition, the Department cross-staffs a 27-foot Type IV fireboat and a trailered rescue watercraft—moored at the Berkeley Marina and staffed with on-duty Station 1 and Station 6 personnel as needed.

The Department has automatic and mutual aid agreements with all the directly adjoining departments in both Alameda and Contra Costa counties, along with being a signatory to the Alameda County Fire Mutual Aid Plan and California Master Mutual Aid Agreement.

Finding #1:	The Department's physical response unit *types* are appropriate to protect against the hazards likely to impact the City.
Finding #2:	The Department's minimum daily Citywide staffing of 27 firefighting unit response personnel assigned to engine and truck companies is only sufficient for a modest single-family house fire or small commercial building fire at the ground floor.

SECTION 2—STANDARDS OF COVER ANALYSIS

This section provides a detailed analysis of the Department's current ability to deploy and mitigate hazards 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 COVER PROCESS OVERVIEW

The core methodology used by Citygate in the scope of its deployment analysis work is *Standards of Response Coverage* (fifth and sixth editions), which is a systems-based approach to fire department deployment published by the CFAI. This approach uses local risks and demographics to determine the level of protection best fitting a community's needs.

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

In contrast to a one-size-fits-all prescriptive formula, such a systems approach to deployment 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 the frequency of multiple calls is not, the analysis could miss overworked companies. If a risk assessment for deployment is not considered and deployment is based only on travel time, a community could under-deploy to incidents.

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

Table 5—Standards of Coverage Process Elements

SOC Element		Description
1	**Existing Deployment System**	Overview of the community served, authority to provide services, and current deployment model and performance metrics
2	**Community Outcome Expectations**	Review of the community's expectations relative to response services provided by the agency
3	**Community Risk Assessment**	Description of the values to be protected within the service area, and analysis of the fire and non-fire risks likely to impact the service area
4	**Critical Task Analysis**	Review of the essential tasks that must be performed and the personnel required to deliver a stated outcome for an Effective Response Force (ERF)
5	**Distribution Analysis**	Review of the spacing of initial response (first-due) resources (typically engines) to control routine emergencies to achieve desired outcomes
6	**Concentration Analysis**	Review of the spacing of fire stations so that larger or more complex emergencies receive sufficient resources in a timely manner (ERF) to achieve desired outcomes
7	**Reliability and Historical Response Effectiveness Analysis**	Using recent prior response statistics, determining the percentage of conformance to established response performance goals the existing deployment system delivers
8	**Overall Evaluation**	Proposing Standards of Coverage statements by risk type as appropriate

Source: CFAI, *Standards of Cover*, fifth edition

Fire service deployment, simply summarized, is about the *speed* and *weight* of response. *Speed* refers to initial (first-due) response of all-risk intervention resources (e.g., engines, ladder trucks, and ambulances) strategically deployed across a jurisdiction for response to emergencies within a travel time interval sufficient to control routine-to-moderate emergencies without the incident escalating to greater size or severity. *Weight* refers to multiple-unit ERF 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, enough firefighters must be assembled within a time interval to safely control the emergency and prevent it from escalating into an even more serious event.

The following table illustrates this deployment paradigm.

Table 6—Fire Service Deployment Paradigm

Element	Description	Purpose
***Speed** of Response*	Response time of initial 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- or two-unit response (engine or specialty resource such as an ambulance) within a relatively short response time. Larger or more complex incidents require more units and personnel to control. In either case, if 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 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 fire dispatch center. In this setting, the response time clock starts when the fire 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 following table summarizes the Department's current response performance goals;[7] however, City Council has not, by separate Council policy, adopted performance goals. The General Plan does not contain specific response measures, but rather strategies reflecting the need to protect the community from fire. In the annual City Fire Department budget measure page, the Department does report the following response time measure. While the entire budget is adopted by the Council, it would be a stronger best practice to adopt, by Council resolution, performance measures

[7] Source: City of Berkeley 2022 Proposed Budget, page 208.

by which to govern fire and emergency medical services. Otherwise, at any given budget cycle, a council could choose to deviate from the Department's reported measures without a specific vote on changing the response time goals.

Table 7—Current City Budget Response Performance Goals

Response Component	Current Performance Goal	Percentage Reliability Goal
Call Processing / Dispatch	None	90%
Crew Turnout (*internal FD policy*)	60–90 sec	90%
First-Due Travel	None	90%
First-Due Call-to Arrival (Distribution)	None	90%
Fire Crew Notification to First-Unit Arrival	5:15 average 4:46 median	None
Multiple-Unit ERF Call to Arrival (Concentration)	None	90%
Ambulance Call to Arrival	None	90%

The Department's current response performance goals *do not* mirror industry-recognized best practices for first-unit responses, including all three response elements and reliability percentages.[8] NFPA Standard 1710, a recommended deployment standard for career fire departments in urban/suburban areas, recommends initial (first-due) intervention units arrive within a travel time of 4:00 minutes, and all resources comprising a multiple-unit First Alarm arrive within a travel time of 8:00 minutes, all at 90 percent or better reliability.

The most recently published NFPA best practices have decreased recommended dispatch / call processing time to 1:00 minute for events with an imminent threat to life or significant property damage and 1:30 minutes for hazardous materials or technical rescue incidents, for joint response with law enforcement involving weapons, or for incidents involving language barriers.[9] Further, for crew turnout time, 60 to 80 seconds is recommended. However, the prior edition of NFPA Standard 1221—and Citygate's experience across many systems—finds 90 seconds for dispatch, and a turnout time of 2:00 minutes across a 24-hour-per-day average, to be effective and safe goals. During high demand daylight hours, the turnout goal should be closer to 1:30 minutes.

If the travel time measures recommended by the NFPA and Citygate are added to dispatch processing and crew turnout times recommended by Citygate and NFPA best practices, then a

[8] 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 (2020 Edition).
[9] NFPA 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2019 Edition).

realistic 90 percent first-due unit response performance goal is now 7:30 minutes (or 8:30 minutes if a 5:00-minute *travel* time is used) from the time of the Berkeley Police 9-1-1 dispatch center receiving the call. This includes 1:30 minutes for call processing / dispatch, 2:00 minutes for crew turnout, and 4:00–5:00 minutes for travel time.

Finding #3:	The Department has not established response performance goals consistent with best practice recommendations as published by the Commission on Fire Accreditation International. The current City Council budget goal measures do not reflect policy resolution or a specific General Plan policy.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model meets the minimum staffing standards for building fires as recommended by NFPA 1710, providing sufficient personnel for serious fire incidents or other emergencies requiring a multiple-unit response to effectively resolve, along with providing additional response capacity for one to two simultaneous incidents.

At present, the Department's EMS Division provides paramedic ambulance transport services with four ambulances, supplemented by a paramedic on each fire crew. The ambulance program has grown in volume and was being expanded concurrently with Citygate's study. This expansion will be reviewed in more detail in the deployment recommendations section.

Response Plan

The Department is an all-risk fire agency providing the population it protects with services that include fire suppression; pre-hospital paramedic (ALS) emergency medical services; ambulance transport; hazardous material and technical rescue response; open water safety/response; and other non-emergency services, including fire prevention, wildland-urban interface, office of emergency services, community outreach, 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 City's 9-1-1 dispatch CAD system selects and dispatches the closest and most appropriate resource(s) pursuant to the Department's response plan, as summarized in the following table.

Table 8—Response Plan by Type of Emergency

Incident Type	Response	Total Personnel
Medical Emergency	1 Engine or Truck, 1 Ambulance	**5**
Building Fire	4 Engines, 2 Trucks, 1 Ambulance, 1 Medic Supervisor, 1 Battalion Chief	**22**
Vehicle Fire	1 Engine	**3**
Traffic Collision	1 Engine or 1 Truck, 1 Ambulance	**5**
Hazardous Material Incident	2 Engines, 1 Hazmat Unit, 1 Ambulance, 1 Medic Supervisor, 1 Battalion Chief	**13**
Technical Rescue	2 Engines, 1 Truck, 1 Ambulance, 1 Medic Supervisor, 1 Battalion Chief	**12**

Source: City Dispatch Unit Assignments List

Finding #4: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

2.3 OUTCOME EXPECTATIONS

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The SOC process begins by reviewing existing emergency services outcome expectations. This includes determining for what purpose the response system exists and whether the governing body has adopted any response performance measures. If it has, 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.[10] This is because measuring the average only identifies the central or middle point of response time

[10] 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.

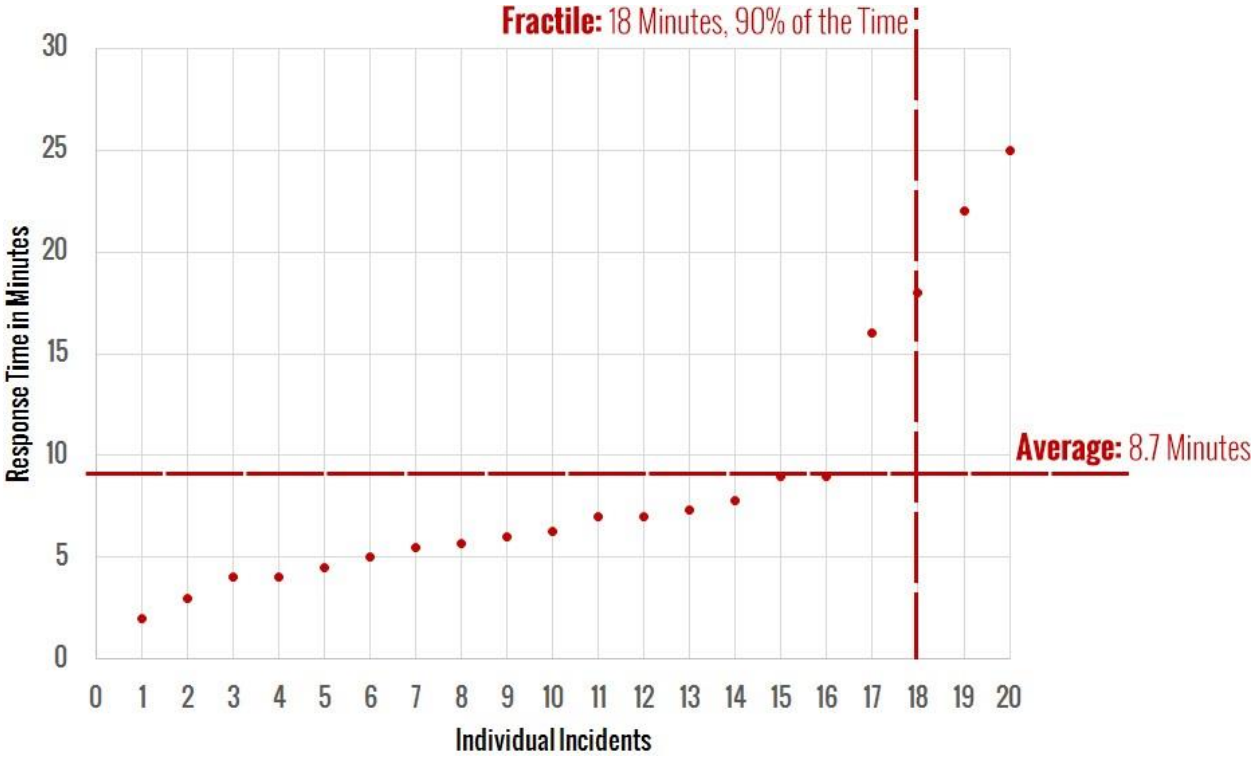
performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were far above the average or just above.

For example, the following figure shows response times for a hypothetical small fire department that receives 20 calls for service each month. Each response time has been plotted on the graph from shortest response time to longest response time.

The following figure 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 the figure that 20 percent of responses are far too slow, and that this hypothetical jurisdiction has a potential life-threatening service delivery problem. Average response time as a fire service delivery measurement 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 all responses, this small jurisdiction has a response time of 18:00 minutes, 90 percent of the time. Stated another way, 90 percent of all responses are 18:00 minutes or less. This fractile measurement is far more accurate in reflecting the service delivery situation of this small agency.

Figure 4—Fractile versus Average Response Time Measurements



More importantly, within the SOC process, positive outcomes are the goal. From that, crew size and response time can be calculated to provide appropriate fire station spacing (distribution and concentration) to achieve the desired goal. 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, with drowning, choking, trauma constrictions, or other similar events having the same effect. In a building fire, a small incipient fire can grow to involve the entire room in a 3:00- to 5:00-minute time frame. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, *all* responding crews must arrive, assess the situation, and deploy effective measures before brain death occurs or the fire spreads beyond the room of origin.

Thus, from the time of 9-1-1 receiving the call, an effective deployment system is *beginning* to manage the problem within a 7:00- to 8:00-minute total response time. This is right at the point that brain death is becoming irreversible, and the fire has grown to the point of leaving the room of origin and becoming very serious. Thus, the City needs a first-due response goal that is within a range to give the situation hope for a positive outcome. It is important to note that fire or medical emergency events continue to deteriorate from the time of inception, not from the time the fire engine or ambulance 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 appropriately deploy its skills and tools. Even in easy-to-access situations, this step can take 2:00 minutes or more. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multiple-story buildings, or enclosed shopping centers.

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

For this report, total response time is the sum of the Berkeley Police 9-1-1 center call processing/dispatch, fire crew turnout, and road travel time intervals, which is consistent with CFAI and NFPA 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.

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 likely to impact the community or service area relative to services provided by the fire agency.
- Determination of the probability of occurrence for each hazard.
- Determination of the *likely* impact severity for each hazard by planning zone.
- Determination of overall risk by hazard considering probability of occurrence and likely impact severity according to the following template.

Table 9—Overall Risk Template

Probability of Occurrence	Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	*Low*	*Low*	*Low*	*Moderate*	*High*
Unlikely	*Low*	*Low*	*Low*	*Moderate*	*High*
Possible	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Probable	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Frequent	*Low*	*Moderate*	*High*	*Extreme*	*Extreme*

2.4.2 Values to Be Protected

Broadly defined, *values* are those tangibles of significant importance or value to the community or jurisdiction that are potentially at risk of harm or damage from a hazard occurrence. Values at risk typically include people, buildings, critical facilities/infrastructure, and key economic, cultural, historic, and 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 younger than 10 years, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:[11]

- The Department serves a diverse urban population with densities ranging from less than 5,000 to more than 40,000 people per square mile over a varied land use pattern.
- The City's population is projected to increase by nearly 18 percent by 2040 for an average annualized increase of slightly less than one percent.
- The City has a large inventory of residential and non-residential buildings to protect as identified in this assessment.
- The City also has significant economic and other resource values to be protected as identified in this assessment.
- The City and Alameda County have a mass emergency notification system to effectively communicate crucial information to the public in a timely manner.

[11] Source: Esri Community Profile (2021).

- The City's overall risk for six hazards related to emergency services provided by the Department range from **Low** to **Extreme,** as will be summarized in Table 9.

Buildings

The City has more than 51,000 housing units and nearly 7,000 businesses, including offices, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other business types as described in **Appendix A**.[12]

Critical Infrastructure / Key Resources

The City has identified 81 critical facilities. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Cultural, Economic, Historic, and Natural Resources

Of the nearly 7,000 businesses employing more than 98,000 people in Berkeley, top industries include services and retail sales, followed by manufacturing and construction, as identified in **Appendix A** of this report.[13] Top employers with more than 500 employees include:[14]

- University of California Berkeley
- Lawrence Berkeley National Laboratory
- Sutter East Bay Medical Foundation
- City of Berkeley
- Bayer Corporation
- Berkeley Unified School District
- Kaiser Permanente Medical Group
- Siemens Corporation / Healthcare Diagnostics, Inc.
- Berkeley Bowl Produce

Natural Resources

Key natural resources to be protected within the City include:

- San Francisco Bay

[12] Source: Esri Community Analyst Business Summary (2021).
[13] Source: Esri Community Business Summary (2021).
[14] Source: City of Berkeley Fiscal Year 2020/2021 Annual Comprehensive Financial Report

- Aquatic Park
- Shorebird Park Nature Center
- McLaughlin East Shore State Seashore

Cultural/Historic Resources

Key cultural/historic resources within Berkeley include:

- Berkeley Art Museum and Pacific Film Archive
- Berkeley History Center
- Berkeley Public Library
- Berkeley Repertory Theater
- Hearst Greek Theater
- Judah Magnes Museum

Special/Unique Resources

Following are special/unique resources to be protected within the City of Berkeley:

- University of California Berkeley
- Lawrence Berkeley National Laboratory
  - The laboratory, in some very controlled settings, does use extremely toxic hazardous materials for research and development. Quantities are typically low, and the lab employs fire and hazardous materials safety personnel to ensure best practice mechanical controls are used to prevent a sustained, dangerous release. However, a catastrophic accident could occur that could spread downwind beyond a parking lot buffer and into other lab buildings, the UC campus, or the City itself. The lab and its fire department contractor, along with the Berkeley Fire Department, are trained and have plans for such a rare occurrence.

2.4.3 Hazard Identification

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

The 2019 City of Berkeley Local Hazard Mitigation Plan (LHMP) identifies the following seven hazards with potential to impact the City:

1. Earthquake
2. Wildland-Urban Interface Fire
3. Rainfall-Triggered Landslide
4. Floods
5. Tsunami
6. Climate Change
7. Extreme Heat

Although the Department has no legal authority or responsibility to mitigate any of these hazards other than wildland-urban interface fires, it does provide services related to all hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

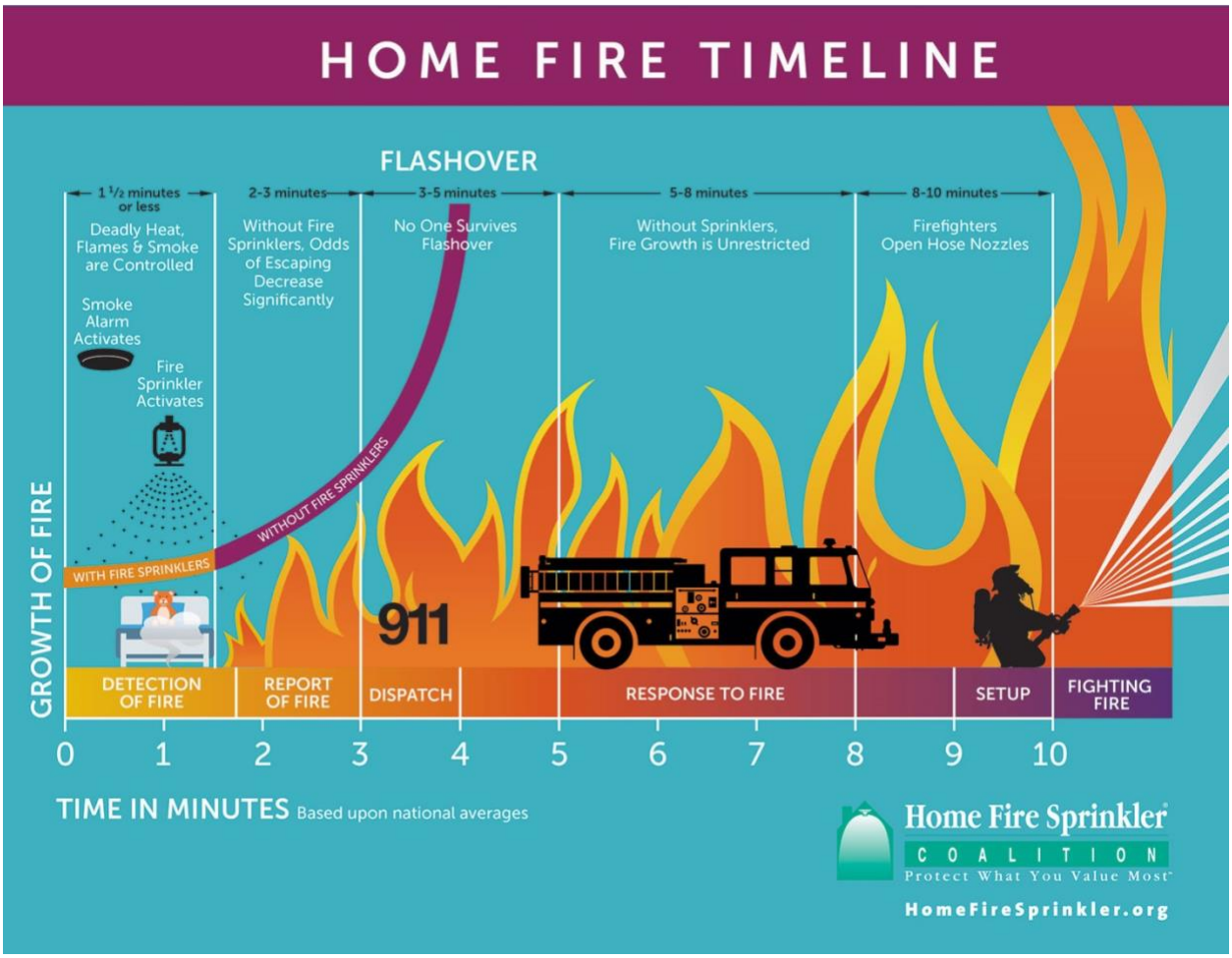
The following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all six hazards.

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, and 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; and fire suppression resource deployment (distribution/concentration), staffing, and response time.

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

Figure 5—Building Fire Progression Timeline

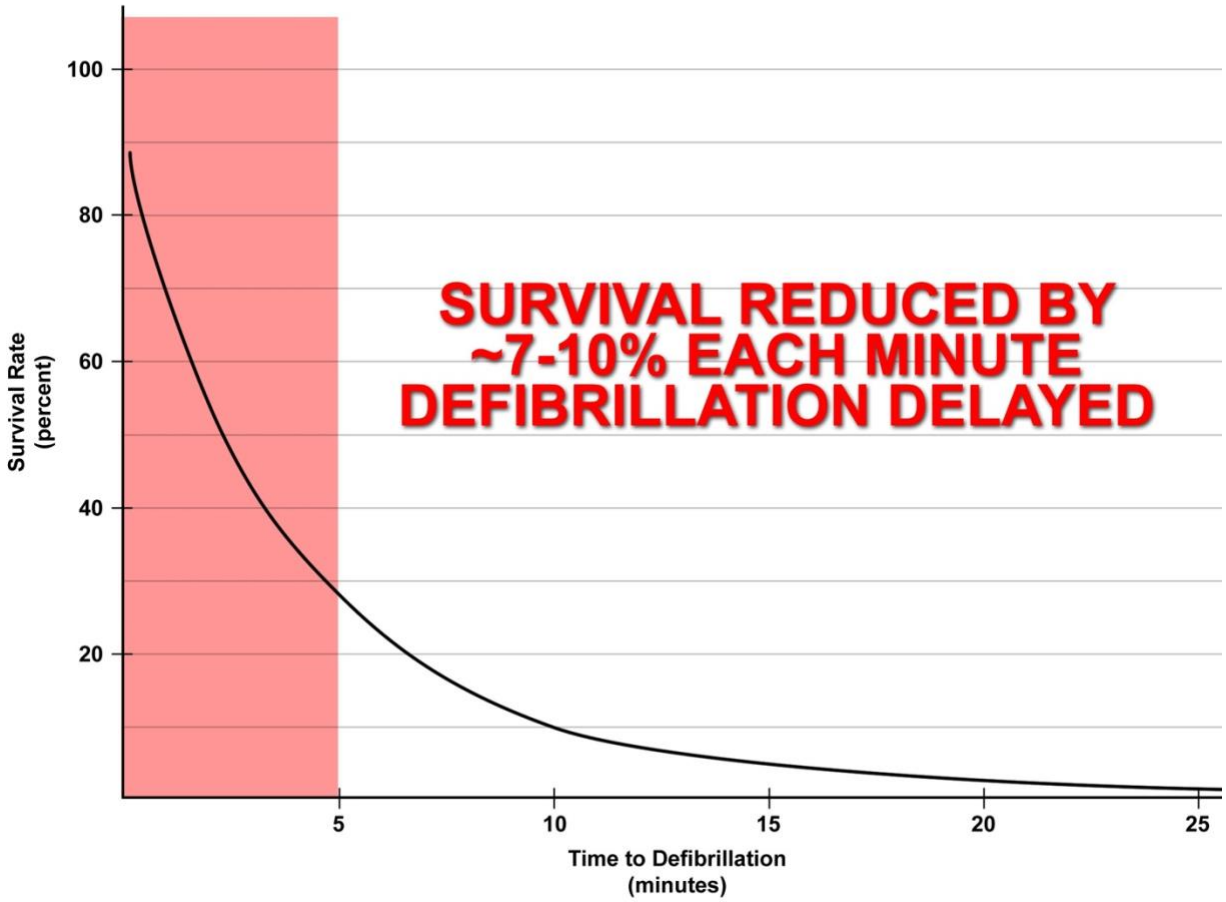


Source: http://www.firesprinklerassoc.org.

Medical Emergency Risk

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

Figure 6—Survival Rate versus Time of Defibrillation



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

2.4.4 Risk Assessment Summary

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

- The City has a large inventory of residential and non-residential buildings to protect, as identified in this assessment.
- The City also has significant economic and other resource values to be protected, as identified in this assessment.
- The City utilizes multiple methods to effectively communicate emergency notifications and information to the public in a timely manner.

- The City's overall risk for six hazards related to emergency services provided by the Fire Department range from **Low** to **Extreme**, as summarized in the following table.

Table 10—Overall Risk by Hazard

Hazard		Risk Planning Zone						
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
1	Building Fire	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
2	Vegetation/Wildland Fire	*Low*	*Extreme*	*Extreme*	*Extreme*	*Moderate*	*Low*	*Extreme*
3	Medical Emergency	*High*	*High*	*High*	*High*	*High*	*High*	*High*
4	Hazardous Materials	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
5	Technical Rescue	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Low*
6	Marine Incident	*Moderate*	*Low*	*Low*	*Low*	*Low*	*Moderate*	*Low*

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

SOC Element 4 of 8
Critical Task Time Study

SOC studies use critical task information to determine the number of firefighters needed within a time frame to achieve desired objectives on fire and emergency medical incidents. The following tables 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 like Berkeley, with units staffed with three personnel per engine or ladder truck. It is important to understand the following relative to these tables:

- It can take considerable time after a task is ordered by command to complete the task and achieve 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.

2.5.1 Critical Firefighting Tasks

The following table illustrates the critical tasks required to control a typical single-family dwelling fire with nine response units for a total ERF of 22 personnel (four engines, two ladder trucks, one ambulance, one Medic Supervisor, and one Battalion Chief). These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the SOC process. No conditions exist to override the Occupational Safety and Health Administration (OSHA) two-in/two-out safety policy, which requires that firefighters enter atmospheres that are immediately dangerous to life and health, such as building fires, in teams of two while two more firefighters are outside 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 11—First Alarm Residential Fire Critical Tasks – 22 Personnel

Critical Task Description		Personnel Required
First-Due Engine (3 Personnel)		
1	Conditions report	**1**
2	Establish supply line to hydrant	**2**
3	Deploy initial fire attack line to point of building access	**1–2**
4	Operate pump and charge attack line	**1**
5	Or skip the above and establish incident command	**1**
6	Or conduct primary search within OSHA regulations	**2**
Second-Due Engine (3 Personnel)		
1	If necessary, establish supply line to hydrant	**1–2**
2	Deploy an attack or backup attack line	**1–2**
3	Or establish Initial Rapid Intervention Team (IRIT)	**2**
First Due Truck (3 Personnel)		
1	Conduct initial search and rescue, if not already completed	**2**
2	Deploy ground ladders to roof	**1–2**
3	Establish horizontal or vertical building ventilation	**1–2**
4	Open concealed spaces as required	**2**
First Chief Officer		
1	Transfer of incident command from first- or second-in Captain	**1**
2	Establish exterior command and scene safety	
Third- and Fourth-Due Engines (6 Personnel)		
1	Establish full Rapid Intervention Crew	**4**
2	Secure utilities	**1**
3	Or deploy second attack line(s) as needed	**2**
Ambulance Unit		
1	Establish incident rehab	**2**

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

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 3:00 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 building occupants.

2.5.2 Critical Medical Emergency Tasks

The Department responds to approximately 7,800 EMS incidents annually, including vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies. For comparison, the following table summarizes the critical tasks required for a cardiac arrest patient.

Table 12—Cardiac Arrest Critical Tasks – Three Engine or Truck 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/cricothyroidotomy
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	**2–3**	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

The time required to complete the critical tasks necessary to stop the escalation of an emergency (as shown in Table 11 and Table 12) must be compared to outcomes. As shown in nationally published fire service time-versus-temperature tables, a building fire will escalate to the point of flashover after approximately 4:00 to 5:00 minutes of free burning in an enclosed room. At this

point, the entire room is engulfed in fire, the fire extends rapidly both horizontally and vertically, 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 provides an ERF of 22 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 smaller or arrives later.

The quantity of staffing and the arrival time frame can be critical in a serious fire. Fires in older or multiple-story buildings could require the initial firefighters 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. However, 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 or result in a less-than-desirable outcome.

Previous critical task studies conducted by Citygate, the National Institute of Standards and Technology (NIST), and NFPA Standard 1710 find that all units need to arrive with 15 or more firefighters within 11:30 minutes (from the time of 9-1-1 call) at a building fire to be able to *perform the tasks of rescue, fire suppression, and ventilation simultaneously and effectively*.

A question one might ask is, "If fewer firefighters arrive, *what* from the list of tasks mentioned would not be completed?" 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.

An initial response of 22 personnel can handle a moderate-risk confined building fire; however, even this ERF 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.

Given that the Department's ERF plan delivers 22 City personnel to a building fire, it reflects a goal to confine serious building fires to or near the room of origin and to prevent the spread of fire to adjoining buildings. This is a typical desired outcome in urban/suburban areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, not room, of origin.

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

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

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The City is served today by seven fire stations deploying the resources and staffing identified in Table 4. It is appropriate to understand, using geographic mapping tools, what the existing stations do and do not cover within specified travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

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

- **Distribution** – the spacing of first-due fire units to control routine emergencies before they escalate and require additional resources.
- **Concentration** – the spacing of fire stations sufficiently close to each other so that more complex emergency incidents can quickly receive sufficient resources from multiple fire stations. As indicated, this is known as the **Effective Response Force** (ERF), or, more commonly, the First Alarm Assignment—the collection of a sufficient number of firefighters on scene, delivered within the concentration time goal to stop the escalation of the problem.

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

2.6.1 Deployment Baselines

All maps referenced can be found in **Volume 2—Map Atlas**.

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

Map #1 shows the City boundary and fire station locations. This is a reference map for other maps that follow. Station symbols denote the type of staffed fire apparatus at each station. All engines and trucks are staffed with a minimum of three personnel each, and there are four ambulance units that are staffed with two firefighter/paramedics each.

Map #2 – Risk Assessment: Population Density

Map #2a shows population densities in the City. EMS incidents are principally driven by population density. In the City's case, with rental housing for students and others, it is apparent the highest density areas are adjacent to the UC Berkeley campus.

Map #2a – Risk Assessment: High Wildfire Hazard Zones

This map displays the locations of the City's identified high fire hazard areas as required by state law to adopt or use the CAL FIRE maps generated statewide. Even without knowing the history of the Hills Fires in 1991 and 1923, due to the hilly terrain and natural vegetation types, the areas pose a dangerous threat of wildfire to populations and buildings.

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

Map #3 shows in green the City's public road miles that should be expected to be reached within 4:00 minutes of travel time from the City's seven fire station locations *without traffic congestion*, assuming the responding resource is in-station.

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against actual response data to reflect actual travel 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.

Map #3a – Distribution: 4:00-Minute First-Due Travel Time Coverage With Automatic Aid

This map factors in the coverage provided by partner agencies under automatic aid agreements from Kensington Fire District and the Alameda County Fire Department which serves Emeryville. There is small added coverage into the hills north of Station 4 and almost no added coverage from Emeryville. While this helps when Berkeley units are busy with other incidents, automatic aid coverage is not large enough to replace that of a Berkeley fire station.

Map #3b – Distribution: 4:00-Minute First-Due Travel Time Coverage with Traffic Congestion

This map shows reduced traffic congestion coverage in red color over that of the green 4:00-minute travel time reach. While densely populated in non-hills areas, coverage loss due to traffic congestion is minimal as it is being mitigated by the City's well-spaced fire stations.

Map #4 – Insurance Services Office 1.5-Mile Coverage

Map #4 displays the ISO recommendation that urban stations cover a 1.5-mile *distance* response area. Depending on a jurisdiction's road network, the 1.5-mile measure usually equates to a 3:30- to 4:00-minute travel time. However, a 1.5-mile measure is a reasonable indicator of station spacing and overlap. As can be seen, the 1.5-mile ISO coverage is good except in small pockets at the eastern central Hills area, and the Marina on the Bay. This coverage shows the value of the seven fire station locations.

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

This map shows, in green, the City's public road miles that *should* be reachable within 8:00 minutes of travel time for a minimum initial ERF of four engines, two ladder trucks, one ambulance, one Medic Supervisor, and one Battalion Chief *without traffic congestion*. This quantity of units is a challenging number to deliver to the entire City within a *travel* time of 8:00 minutes, and there are coverage gaps in three corners of the City, mostly in the hills.

Map #5a – Concentration: 8:00-Minute ERF Travel Time Coverage with Traffic Congestion

This map shows the significant *reduction* in 8:00-minute ERF travel time coverage *with traffic congestion*, primarily impacting all but the center core of the City.

Map #6 – Concentration: 8:00-Minute ERF Travel Time Coverage – Ladder Trucks

Map #6 shows the ERF coverage from the City's two ladder trucks. As can be seen the two units are properly located to cover the entire City.

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

This map displays 8:00-minute travel time coverage for a Battalion Chief from Station 1 without traffic congestion. It is apparent that the single Battalion Chief travel time coverage includes nearly all the City except for the extreme southeast corner.

Map #8 – All Incident Locations

This map shows the location of all incident responses from July 1, 2018, through June 30, 2021, which occurred on almost every street segment in the City. Incidents plotted outside the city are due to the City's mutual aid supporting other agencies.

Map #9 – Emergency Medical Services and Rescue Incident Locations

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

Map #10 – All Fire Locations

This map displays the location of all fires within the City in the three reporting years being studied, which includes any type of fire call, from vehicle, to dumpster, to building. There are obviously fewer fires than medical or rescue calls. Even given this fact, it is evident that fires occur in all fire station areas and clustered along major arterials and the more densely populated areas on two sides of the UC Berkeley campus.

Map #11 – Building Fire Locations

Map #11 shows the locations of all building fire incidents in the three reporting years being studied. While the number of building fires is a smaller subset of total fires, in Citygate's experience this is consistent with other, similar cities in the western United States. As with the prior map showing all types of fires, there are more building fires in the more densely populated and older building stock areas close to the UC Berkeley campus.

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

This map displays, by mathematical density, where clusters of EMS and rescue incident activity occurred during the three reporting years of data analyzed by Citygate. In this set, the darker density color plots the highest concentration of EMS and rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS and rescue incidents, as was shown in Map #9.

This perspective is important because the deployment system needs an overlap of units to ensure the delivery of multiple units when needed for more serious incidents or to handle simultaneous calls for service, as is evident for the higher population density areas of the City. There is a particular incident density west and southwest of the UC Berkeley campus, close to Station 2 and Station 5.

Map #13 – Fire Incident Location Densities

Map #13 shows the hot spots for all types of fire incidents (shown in Map #10).

Map #14 – Building Fire Incident Location Densities

This map shows the hot spots for building fire incidents (shown in Map #11). The density of structure fire incidents is most pronounced around the UC Berkeley campus and in the western region of the City near the Marina.

2.6.2 Travel Time Road Mile Coverage Measures

In addition to the visual displays of coverage that maps provide, the following table summarizes non-congested coverage versus the impacts of traffic congestion, both with the current station location and with stations 5 and 8 being relocated.

Table 13—First-Due and ERF Road Mile Coverage of 327 Miles – Congested Versus Non-Congested Traffic

Map	Travel Time Measure	Road Miles Covered	Percentage of Miles Covered
3	**4:00-Minute First-Due**	285.27	**87%**
3b	**4:00-Minute First-Due – Congested**	273.61	**84%**
5	**8:00-Minute ERF** (4 Engines, 1 Truck, 1 Battalion Chief, 1 Medic)	257.35	**79%**
5a	**8:00-Minute ERF** (4 Engines, 1 Truck, 1 Battalion Chief, 1 Medic) – **Congested**	172.42	**53%**

As the table shows, 4:00-minute first-due unit coverage is reduced by 3.6 percent with traffic congestion. With 4:00 minutes as a desirable first-due travel time goal, and data in Table 23 showing the Department's 90th percentile first-due travel time performance is 5:40 minutes, traffic congestion is, at least in part, impacting the additional 1:40 minutes of travel time. The 8:00-minute ERF travel time coverage without traffic congestion is adequate at 79 percent of total road miles, but congestion significantly erodes it by 26 percent.

Finding #5: The mapping evaluation of coverage demonstrates that the City has an adequate number of fire stations. However, as incident statistics demonstrate, best practice travel times are not being delivered due to multiple factors.

Finding #6: As shown in this study's GIS models, traffic congestion decreases first-unit road mile coverage by only 3.6 percent, which, in Citygate's experience, is not severe. However, overall traffic congestion does still contribute to the Department's slower real-world, non-GIS-modeled travel times. There is a more significant impact on multiple-unit ERF responses, eroding road mile coverage by 26 percent.

2.7 STATISTICAL ANALYSIS

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

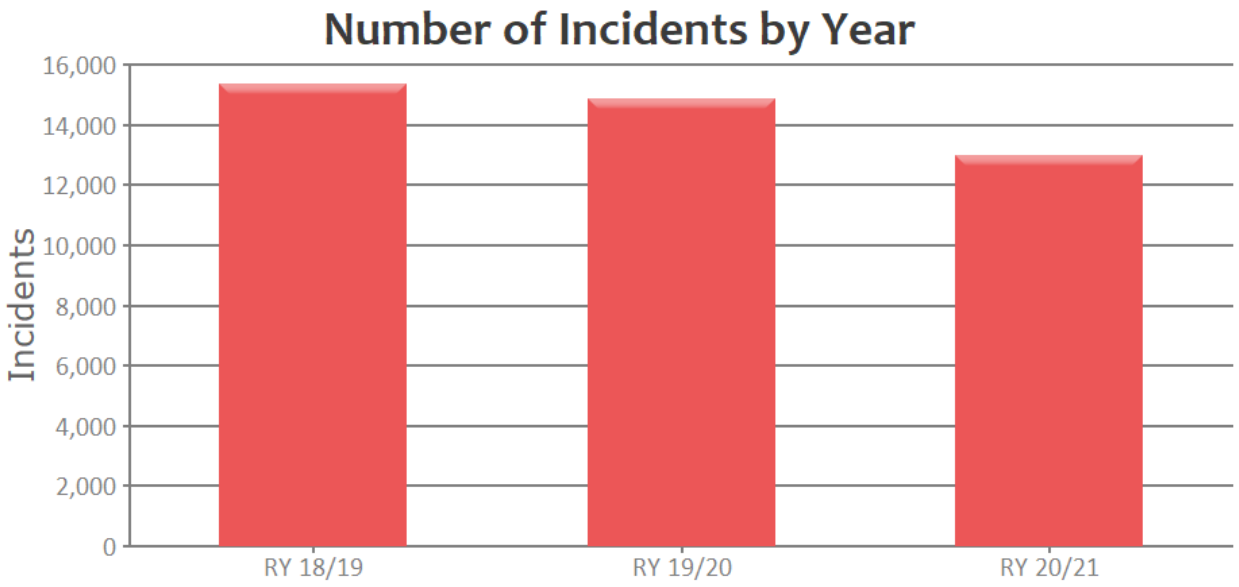
The maps described in **Section 2.6** and presented in **Volume 2—Map Atlas** show the ideal situation for response times and response effectiveness given no competing calls, units out of place, or simultaneous calls for service. Examination of the response time data provides a picture of actual response 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 NFIRS 5 incident and records management system apparatus response data from July 1, 2018, through June 30, 2021. These two data sets were merged, providing 43,260 incidents and 87,805 apparatus response records across the three reporting years being analyzed. The Department experienced a decrease in incident activity in the last reporting year, most likely due to the ongoing COVID-19 pandemic.

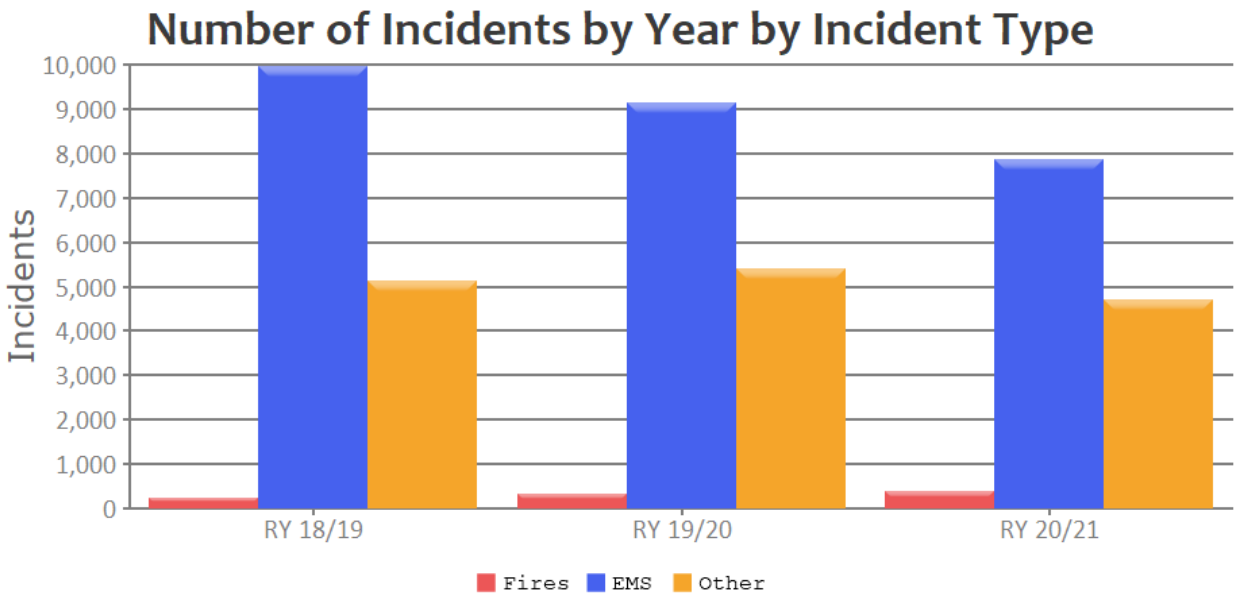
Figure 7—Total Service Demand by Year



In RY 20/21, the Department responded to 13,003 incidents. During the year, the City had a daily demand of 35.62 incidents, of which 3.15 percent were fire incidents, 60.53 percent were EMS incidents, and 36.32 percent were other incident types. During this same period there were 27,402 total apparatus responses, which means there was an average of 2.11 apparatus responses per incident (typically a fire truck and an ambulance).

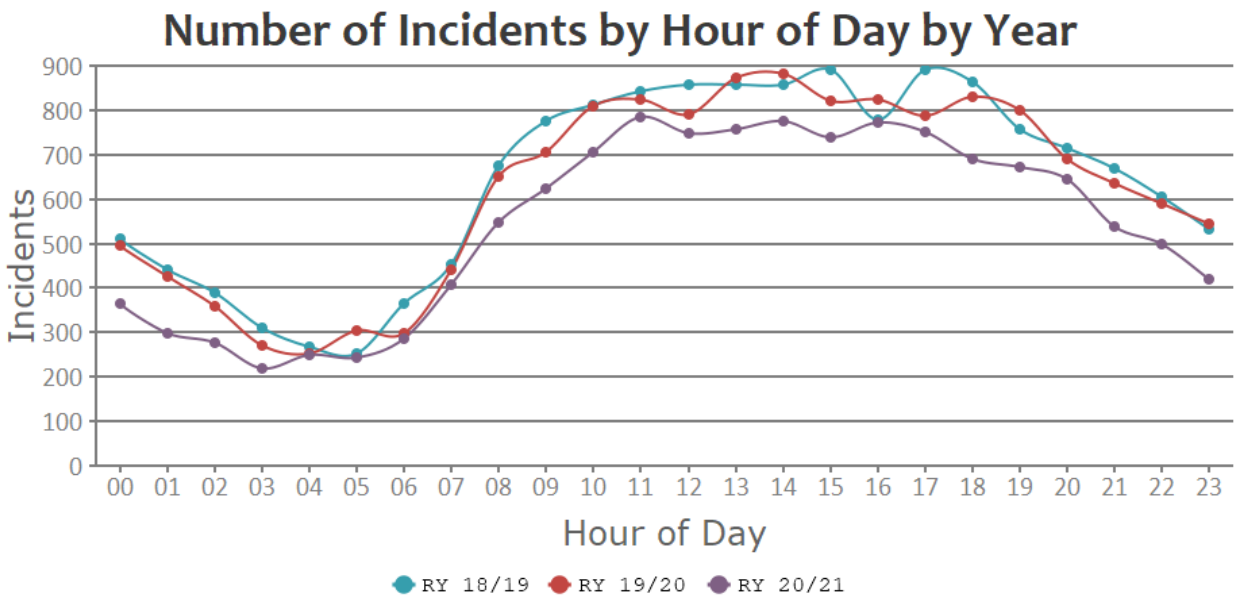
The following figure illustrates the number of incidents by incident type by reporting year. The number of EMS incidents appears to have declined by about 1,000 per year over the three reporting years assessed for this study. However, given the disruptions and changes brought about by COVID-19, it likely not a permanent trend.

Figure 8—Annual Service Demand by Incident Type



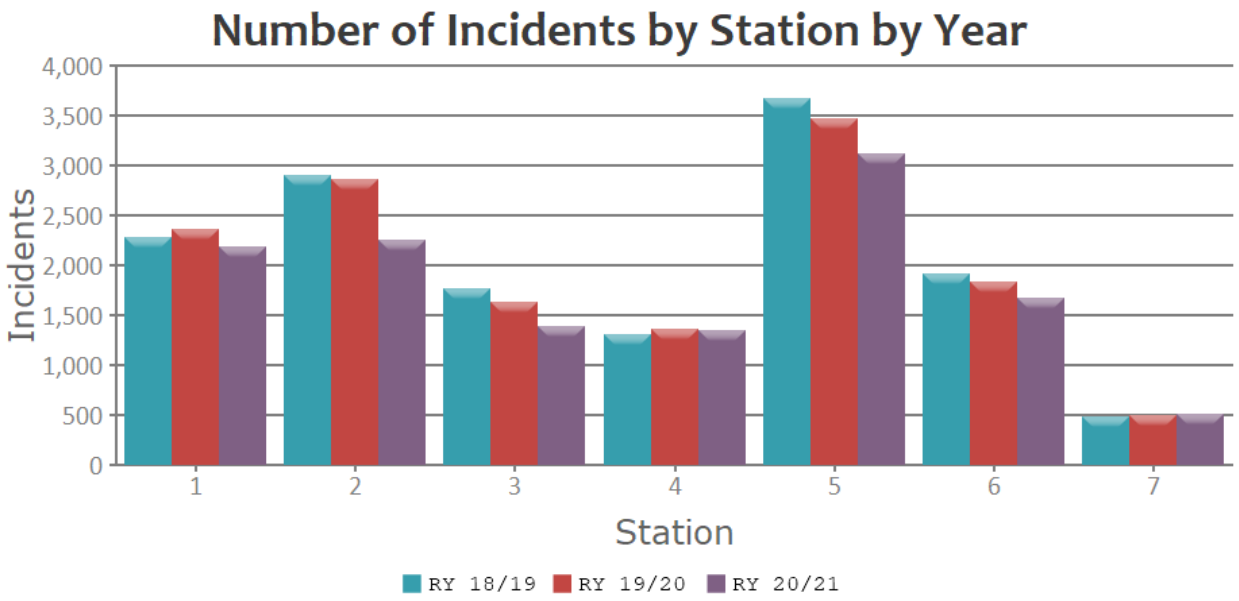
The following figure breaks down incidents by hour of the day by reporting year. There was a slight decline in incident activity in RY 20/21 throughout the late morning and early afternoon hours, and then again from the early evening hours through the early morning hours.

Figure 9—Service Demand by Hour of Day and Year



The following figure is a breakdown of the number of incidents by station area by reporting year. Activity in all but Station 4 and Station 7 seems to have declined, but this may be due to COVID-19.

Figure 10—Service Demand by Station Area by Year



The following table shows the activity rankings of incidents by incident type by reporting year. There was a strong ranking for EMS incidents. Cancelled en route incidents also ranked high on the list. Only incident types with more than **30** calls for service over five years are shown. Also, responding units were cancelled prior to arrival on 4.6 percent of all incidents.

Table 14—Service Demand by Incident Type – RY 20/21

Incident Type	RY 20/21
321 EMS call, excluding vehicle accident with injury	5,552
320 Emergency Medical Service, other	1,215
611 Dispatched and canceled en route	604
745 Alarm system sounded, no fire – unintentional	525
300 Rescue, emergency medical call (EMS) call, other	473
700 False alarm or false call, other	414
554 Assist invalid	383
622 No incident found on arrival of incident address	299
400 Hazardous conditions, other	224
743 Smoke detector activation, no fire – unintentional	223
651 Smoke scare, odor of smoke	216
600 Good intent call, other	192
311 Medical assist, assist EMS crew	181
324 Motor vehicle accident no injuries	168
322 Vehicle accident with injuries	146
740 Unintentional transmission of alarm, other	127
500 Service Call, other	115
510 Person in distress, other	112
151 Outside rubbish, trash, or waste fire	109
150 Outside rubbish fire, other	107
744 Detector activation, no fire – unintentional	101
550 Public service assistance, other	99
412 Gas leak (natural gas or LPG)	93
444 Power line down	75
522 Water or steam leak	70
440 Electrical wiring/equipment problem, other	64
710 Malicious, mischievous false call, other	61
323 Motor vehicle/pedestrian accident (MV Ped)	59

Incident Type	RY 20/21
520 Water problem, other	57
746 Carbon monoxide detector activation, no CO	48
531 Smoke or odor removal	47
733 Smoke detector activation due to malfunction	42
424 Carbon monoxide incident	41
730 System malfunction, other	40
736 CO detector activation due to malfunction	39
353 Removal of victim(s) from stalled elevator	38
131 Passenger vehicle fire	34
551 Assist police or another governmental agency	33
553 Public service	33
100 Fire, other	33
711 Municipal alarm system, malicious false alarm	32
900 Special type of incident, other	31
111 Building fire	**30**

The following table ranks incidents by property use where occurrences were greater than **100**. The highest rankings for incidents by property use were residential dwellings.

Table 15—Service Demand by Property Use – RY 20/21

Property Use	RY 20/21
419 One- or two-family dwelling	3,120
429 Multifamily dwellings	2,258
963 Street or road in commercial area	1,059
400 Residential, other	917
900 Outside or special property, other	744
960 Street, other	590
962 Residential street, road, or residential driveway	441
311 24-hour care Nursing homes, four or more persons	321
961 Highway or divided highway	267
331 Hospital - medical or psychiatric	221
340 Clinics, Doctors' offices, hemodialysis centers	212
965 Vehicle parking area	140
462 Sorority house, fraternity house	128
449 Hotel/motel, commercial	127
460 Dormitory type residence, other	117
241 Adult education center, college classroom	114
500 Mercantile, business, other	105
519 Food and beverage sales, grocery store	101
931 Open land or field	100

2.7.2 Simultaneous Incident Activity

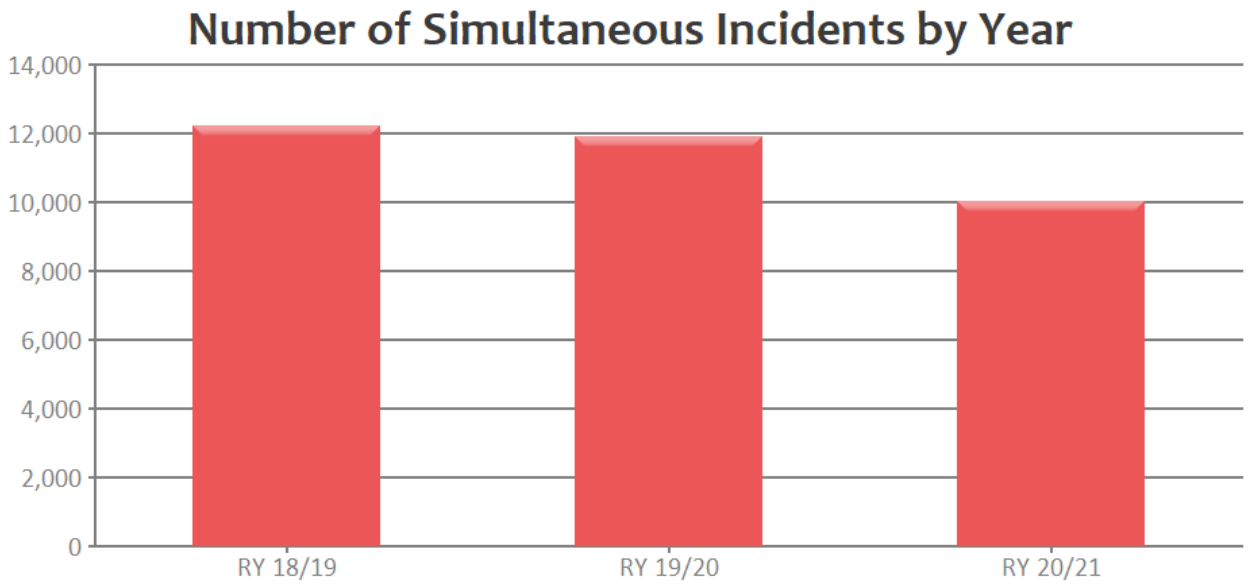
Simultaneous incidents occur when other incidents are underway at the time a new incident begins. During RY 20/21, 77.31 percent of the City's incidents occurred while one or more other incidents were underway.

Table 16—Simultaneous Incident Activity – RY 20/21

Number of Simultaneous Incidents	Percentage
1 or more	77.31%
2 or more	47.18%
3 or more	23.49%
4 or more	9.67%
5 or more	3.36%
6 or more	.97%

This following figure shows the number of simultaneous incidents by year. As with incident volume, there was a decrease in the number of simultaneous incidents in RY 20/21, which may be due to COVID-19.

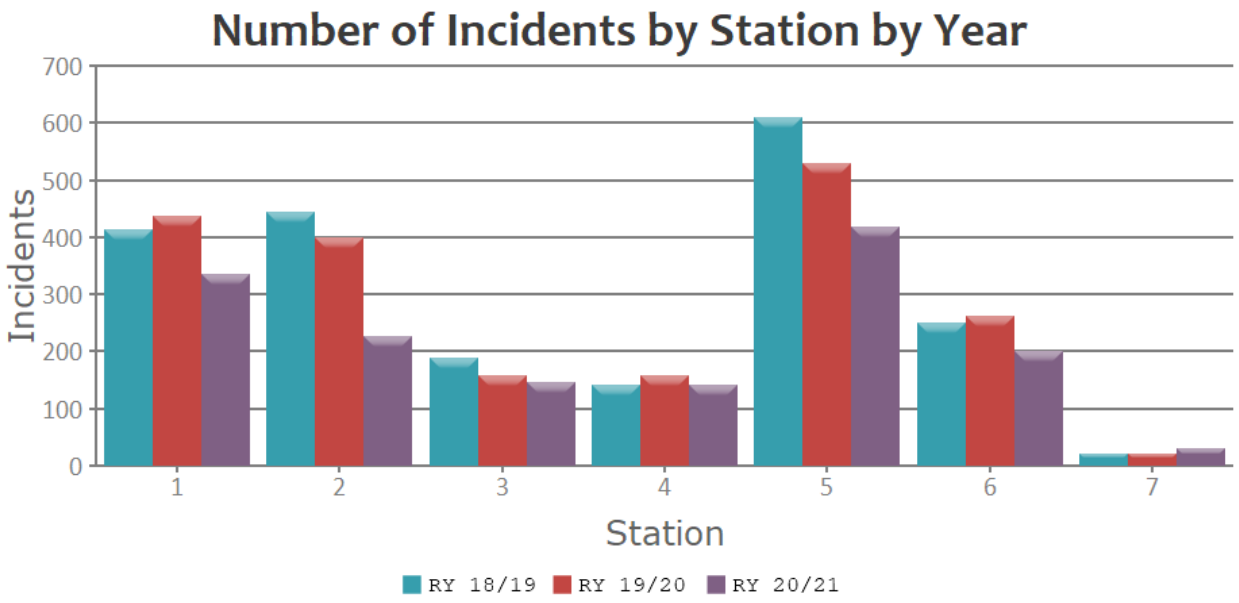
Figure 11—Number of Simultaneous Incidents by Year



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

The following figure illustrates the number of single-station simultaneous incidents by station area by reporting year. Station 5 had the greatest number of single-station simultaneous incidents over the three reporting years. Station 7 had the lowest.

Figure 12—Number of Single-Station Simultaneous Incidents by Station by Year



Finding #7:	At least two simultaneous incidents are occurring nearly 47 percent of the time. This primarily impacts station areas 5, 2, and 1.
Finding #8:	While the annual number of simultaneous incidents has decreased slightly, the response time coverage provided by the busiest companies to their own and to adjacent station areas remains diminished, shifting workload to other companies.

2.7.3 Apparatus Deployment – Simultaneous Incident Impact

The following table shows 90 percent travel time performance in minutes and seconds. This table illustrates that Station 1's area has a 7:38 minute travel time for Station 1 units. However, when resources respond from Station 1 (column 1, row 6) they take 9:17 minutes (time to 90 percent compliance) to arrive in Station 6's territory.

Table 17—Apparatus: 90 Percent Performance Minutes – Assigned Station by Station Area

Station Area	Assigned Station of the First-Arriving Apparatus						
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Station 1	07:38 (2,001)	10:21 (203)	12:00 (84)	06:08 (5)	09:22 (263)	08:06 (122)	13:30 (3)
Station 2	10:50 (82)	06:00 (2,133)	09:14 (98)	06:09 (25)	07:49 (232)	08:20 (14)	10:18 (5)
Station 3	13:42 (12)	08:59 (36)	06:21 (1,208)	06:39 (2)	07:52 (95)	02:54 (1)	09:27 (1)
Station 4	11:10 (36)	09:19 (523)	13:56 (42)	06:43 (683)	12:39 (115)	08:25 (25)	07:38 (15)
Station 5	08:11 (177)	07:32 (175)	07:26 (344)	09:53 (8)	05:55 (3,259)	07:08 (11)	08:03 (1)
Station 6	09:17 (706)	09:57 (267)	12:28 (32)	10:48 (19)	10:15 (75)	06:22 (937)	-
Station 7	16:50 (3)	12:26 (165)	14:19 (20)	12:34 (12)	14:54 (41)	06:32 (1)	07:53 (239)

2.7.4 Unit-Hour Utilization

The unit-hour utilization percentage is calculated using the number of responses and duration of the responses to show the percentage of time that a response resource is committed to an active incident during a given hour of the day. **In Citygate's experience, a unit-hour utilization of 30 percent or higher over *multiple* consecutive hours becomes the point at which other responsibilities, such as training, do not get completed.**

The following table shows a unit-hour utilization summary for the City's engine companies. The busiest engines are listed first. Engine 5 has two hours over 50 percent utilization and 11 consecutive hours over 30 percent utilization.

Table 18—Unit-Hour Utilization – Engines (20/21)

Hour	Engine 5	Engine 1	Engine 2	Engine 6	Engine 4	Engine 3	Engine 7
00:00	23.23%	15.11%	17.16%	9.62%	10.14%	11.33%	0.58%
01:00	25.88%	10.21%	15.51%	11.19%	6.41%	9.09%	3.37%
02:00	18.81%	12.81%	10.79%	11.12%	9.66%	7.74%	3.56%
03:00	13.47%	6.63%	12.40%	6.71%	7.76%	4.40%	2.06%
04:00	11.55%	13.59%	10.26%	10.62%	7.61%	7.62%	1.69%
05:00	15.01%	6.44%	7.62%	3.69%	9.87%	4.93%	2.59%
06:00	11.08%	19.01%	10.05%	9.78%	13.02%	5.63%	3.00%
07:00	25.01%	21.97%	20.84%	18.37%	13.97%	8.97%	6.10%
08:00	30.47%	31.19%	22.80%	20.58%	20.92%	13.10%	5.44%
09:00	38.00%	31.75%	22.75%	28.75%	21.67%	14.57%	5.65%
10:00	41.58%	42.32%	28.32%	23.47%	25.77%	19.88%	11.49%
11:00	52.86%	31.20%	35.07%	41.62%	28.02%	23.70%	7.28%
12:00	49.05%	28.41%	31.70%	34.37%	20.78%	18.56%	9.29%
13:00	53.48%	43.37%	30.66%	31.32%	31.70%	29.91%	7.95%
14:00	45.24%	43.90%	39.12%	34.42%	36.53%	25.40%	15.68%
15:00	38.09%	38.93%	32.49%	31.93%	20.30%	18.31%	7.38%
16:00	47.27%	34.35%	34.50%	28.96%	22.18%	20.99%	12.14%
17:00	44.46%	33.94%	34.26%	22.25%	22.90%	20.69%	8.62%
18:00	32.84%	31.45%	30.75%	22.85%	23.40%	20.74%	11.46%
19:00	29.80%	30.92%	25.06%	29.59%	21.39%	18.51%	10.09%
20:00	25.59%	32.76%	23.66%	24.96%	20.72%	15.76%	9.20%
21:00	29.23%	20.37%	20.49%	18.23%	12.64%	12.76%	6.77%
22:00	26.99%	21.79%	16.67%	12.63%	9.51%	12.90%	4.69%
23:00	19.81%	24.27%	15.45%	21.47%	16.11%	8.64%	3.85%

The following table shows unit-hour utilization for the two truck companies for RY 20/21.

Table 19—Unit-Hour Utilization – Trucks (20/21)

Hour	Truck 5	Truck 2
00:00	6.87%	5.07%
01:00	4.84%	4.42%
02:00	4.63%	3.45%
03:00	1.68%	1.41%
04:00	3.10%	3.53%
05:00	1.95%	2.76%
06:00	4.25%	6.36%
07:00	3.96%	7.08%
08:00	7.73%	11.87%
09:00	20.38%	14.38%
10:00	24.35%	18.19%
11:00	26.10%	15.98%
12:00	14.58%	13.39%
13:00	23.15%	20.47%
14:00	20.43%	13.91%
15:00	16.57%	12.32%
16:00	22.90%	13.25%
17:00	24.16%	12.88%
18:00	14.36%	13.44%
19:00	11.24%	8.43%
20:00	9.11%	11.14%
21:00	6.00%	6.70%
22:00	6.74%	7.34%
23:00	4.05%	8.37%

The following table illustrates a unit-hour utilization summary for the City's EMS apparatus. M5, M2, and M1 each have several hours of 50 percent utilization and Medic 5 and Medic 2 each have one hour over 60 percent utilization and at least 13 consecutive hours at or above 30 percent utilization.

Table 20—Unit-Hour Utilization – EMS Units (20/21)

Hour	M5	M2	M1	M3
00:00	22.87%	17.48%	12.56%	9.32%
01:00	22.85%	15.75%	19.46%	9.27%
02:00	17.34%	16.40%	17.53%	7.35%
03:00	13.61%	16.98%	10.92%	4.04%
04:00	8.71%	14.86%	18.86%	6.86%
05:00	13.06%	14.24%	8.26%	3.46%
06:00	8.95%	13.17%	16.14%	2.94%
07:00	25.50%	34.83%	33.70%	12.56%
08:00	48.33%	29.77%	33.16%	15.43%
09:00	44.71%	39.61%	38.97%	27.70%
10:00	48.82%	45.75%	42.94%	33.54%
11:00	51.40%	60.08%	41.92%	34.01%
12:00	49.60%	55.48%	42.34%	27.61%
13:00	51.46%	44.70%	54.43%	42.82%
14:00	65.37%	47.39%	56.38%	36.85%
15:00	45.36%	37.26%	52.01%	28.99%
16:00	52.28%	54.10%	44.79%	36.74%
17:00	41.93%	46.57%	42.89%	27.86%
18:00	48.24%	46.87%	35.45%	25.95%
19:00	31.61%	34.82%	42.09%	19.44%
20:00	30.19%	34.40%	38.01%	15.91%
21:00	22.49%	30.65%	26.78%	17.02%
22:00	26.16%	22.41%	23.65%	11.37%
23:00	21.09%	26.63%	25.70%	6.88%

Three of the ambulance units exceeded a 30 percent threshold for long periods of time during consecutive daylight hours in RY 20/21.

Finding #9:	The City's ambulance system must provide an increased number of full- and part-time ambulances.

2.7.5 Operational Performance

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

- Call processing / dispatch
- Crew turnout
- Travel
- Call to arrival

Call Processing / Dispatch

Call processing measures the time from the first incident timestamp until completion of the dispatch notification. Call processing performance depends on what is being measured. If the first incident timestamp takes place at the time the public-safety answering point (PSAP) physically answers a 9-1-1 call (at times, calls can be briefly held in queue), then call processing begins at *PSAP Time*. In Berkeley this is the Police Department, which also dispatches for the Fire Department.

In addition, not all requests for assistance are received via landline 9-1-1. Generally, there are numerous ways that requests for assistance are received, including landline telephone, cellular telephone, SMS text message, fire or police officer-initiated requests, TTY/TDD operator, etc., that each have a separate timestamp at a different point in the processing operation. This is not as much of a factor if most requests are received via 9-1-1 PSAP.

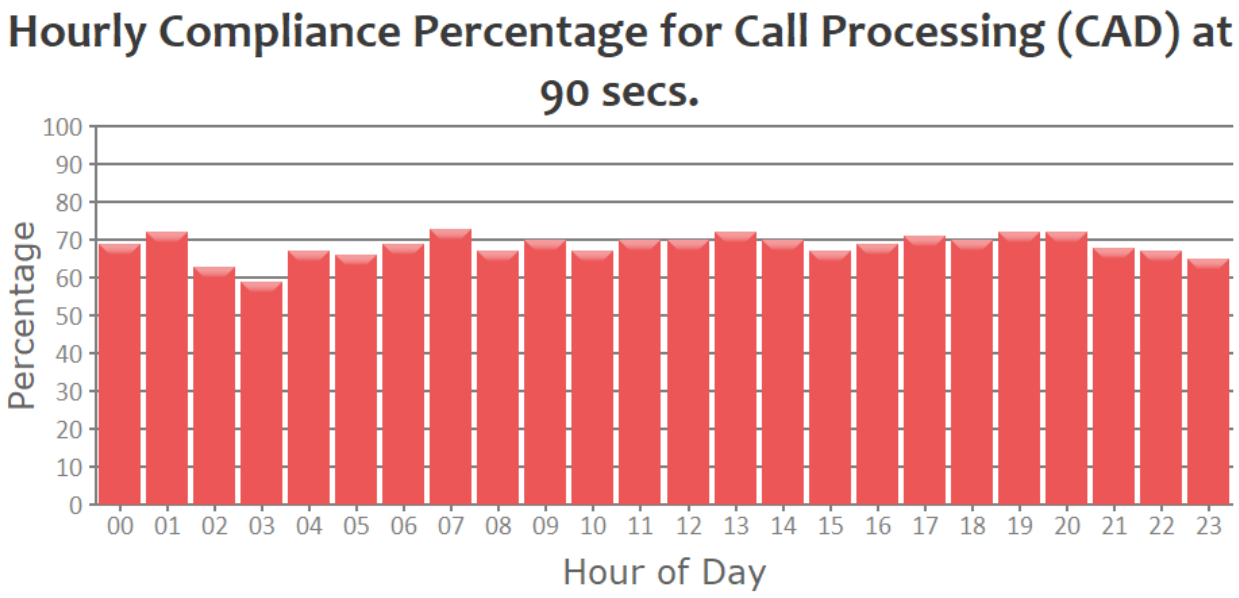
The following table shows call processing / dispatch performance from time of call receipt at the Police Department. This performance does not meet a 1:30-minute Citygate best practice goal, nor a more aggressive NFPA Standard 1710 recommendation of 65 seconds. Also noteworthy is the consistency of performance across all three reporting years. Stated this way, COVID-19 only slightly lengthened dispatch processing time by approximately five seconds.

Table 21—90th Percentile Call Processing / Dispatch Performance

Station	Overall	RY 18/19	RY 19/20	RY 20/21
Department-Wide	2:27	2:24	2:29	2:29

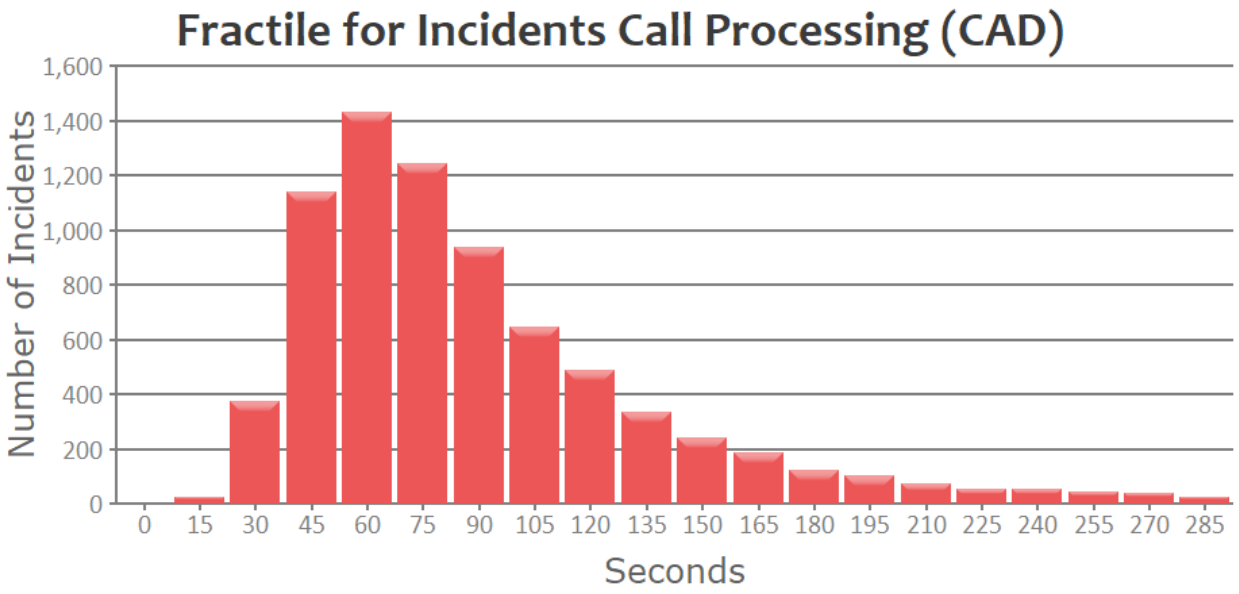
The following is an hourly **compliance** figure revealing call processing compliance between 60 percent and 70 percent nearly every hour of the day.

Figure 13— Hourly Compliance Percentage for Call Processing (CAD) – 2020



The following figure illustrates that most requests are being processed within 90 seconds, with a peak at 60 seconds.

Figure 14—Fractile for Incidents Call Processing (CAD)



Finding #10: The City's call processing / dispatch performance is *not* meeting Citygate's recommended best-practice goal of 1:30 minutes at 90 percent or better reliability.

Crew Turnout

Crew turnout performance measures the time interval from completion of the dispatch notification until the start of apparatus travel to the incident. While the most recent NFPA recommendation for crew turnout performance is 1:00 minute at 90 percent reliability for EMS incidents and 1:20 minutes at 90 percent reliability for fire incidents, Citygate has found over hundreds of fire department studies that few, if any, departments are able to achieve this level of performance when measured across a 24-hour shift.[15] Thus, for many years, Citygate has recommended a 2:00-minute best practice goal for crew turnout at 90 percent or better reliability.

The following table summarizes the City's crew turnout performance for the three reporting years, which very nearly meets Citygate's recommendation of 2:00 minutes. Continued focus on this important measure will be needed to maintain this positive effort.

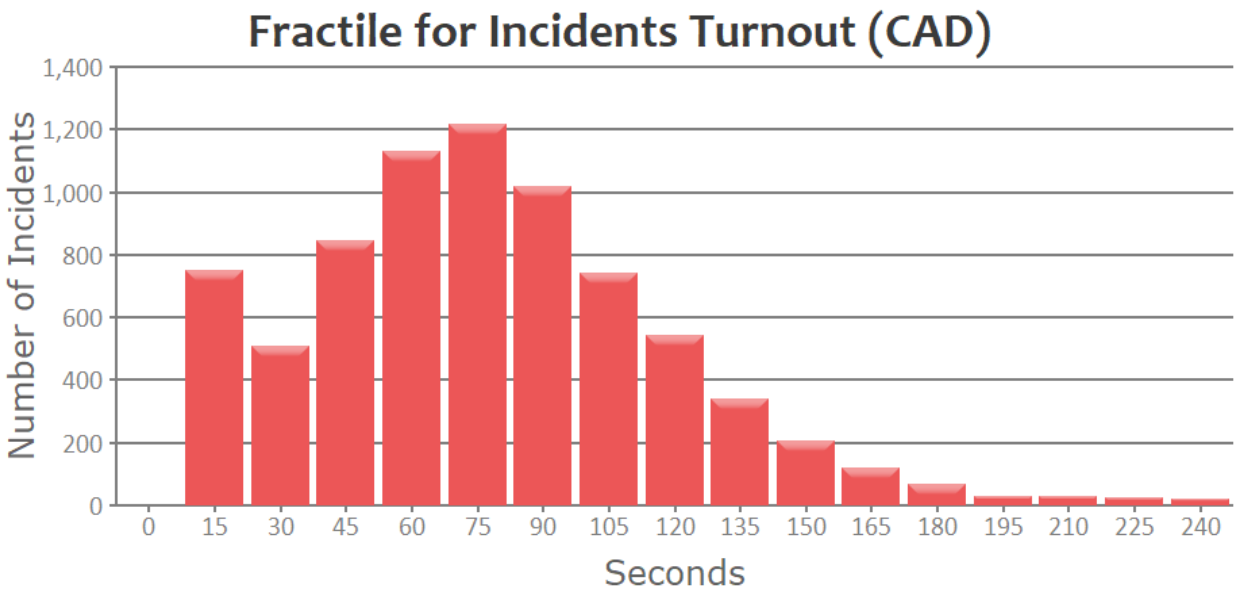
[15] NFPA 1710 – Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition).

Table 22—90th Percentile Crew Turnout Performance

Station	Overall	RY 18/19	RY 19/20	RY 20/21
Department-Wide	2:03	2:03	2:02	2:05

The following figure illustrates turnout performance by number of seconds. Most turnout occurs in 120 seconds or less, but there are turnouts for emergency incidents that take longer.

Figure 15—Fractile Crew Turnout Performance (2020)



Finding #11: At 2:05 minutes averaged over 24 hours, the Department is just over meeting Citygate's recommended 2:00-minute crew turnout performance goal. As sleeping hours increase turnout time, consider adopting a turnout measure of 1:30 minutes during daytime hours to provide greater clarity and reflect Department performance more accurately.

Fire Station Distribution: First-Unit Travel

Travel performance measures the interval from start of first-due apparatus movement to arrival at the emergency incident. For most urban/suburban jurisdictions, a 4:00-minute first-due unit travel time 90 percent of the time would be considered highly desirable.

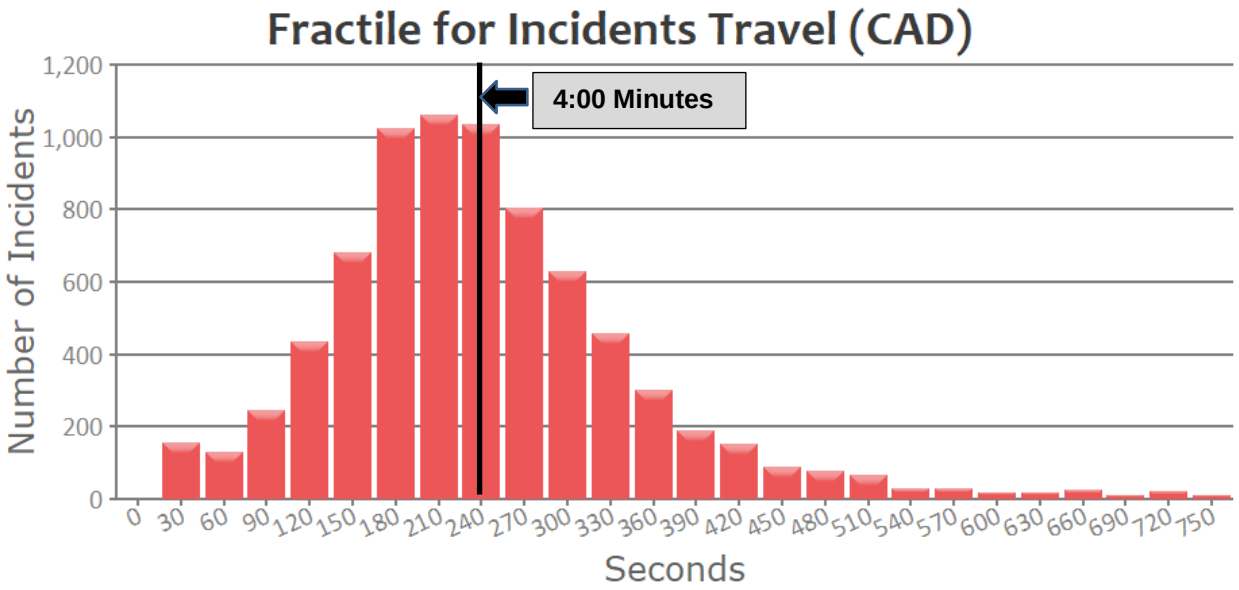
As the following table illustrates, the Department's 90th percentile first-due unit travel time performance over the past three reporting years is 5:40 minutes, which is *30 percent slower* than a best practice-based 4:00-minute goal for highly urban areas. In addition, stations 4 and 7 have overall travel times *both less than and greater than 7:00 minutes*.

Table 23—90th Percentile First-Unit Travel Time Performance

Station	Overall	RY 18/19	RY 19/20	RY 20/21
Department-Wide	**05:40**	**05:25**	**05:42**	**05:53**
Station 1	06:00	05:31	05:57	06:19
Station 2	04:57	04:40	04:57	05:13
Station 3	05:16	05:12	05:15	05:23
Station 4	06:58	06:49	07:20	06:51
Station 5	04:56	04:49	04:52	05:09
Station 6	06:04	05:46	06:10	06:18
Station 7	08:14	08:12	08:30	08:05

The following figure illustrates fractile travel time performance. The peak segment for travel performance is 210 seconds, or 3:30 minutes, with a slow drop-off in volume after the 240-second mark, indicating that 68 percent of incidents are reached within the first 4:00 minutes, though a significant number of incidents require much longer travel time.

Figure 16—Fractile for First-Due Travel Performance (CAD)



Finding #12: At 5:53 minutes, 90th percentile first-unit travel time is *significantly higher* than the 4:00-minute best practice goal for urban areas.

Fire Station Distribution: Call to First-Unit Arrival

Call to first-unit arrival performance measures the time interval from receipt of the 9-1-1 call in the Berkeley Police dispatch center until first-unit arrival at the emergency incident. This measure is a fire agency's primary customer service metric. For urban population areas, Citygate typically recommends a 7:30- to 8:30-minute first-unit call-to-arrival goal at 90 percent compliance.[16] As the following table shows, the Department's overall 90th percentile call-to-arrival performance across three reporting years is 9:23 minutes, or 1:53 minutes *slower* than an optimum 7:30-minute goal.

Across all reporting years, and in each station area, the weak performance is consistent:

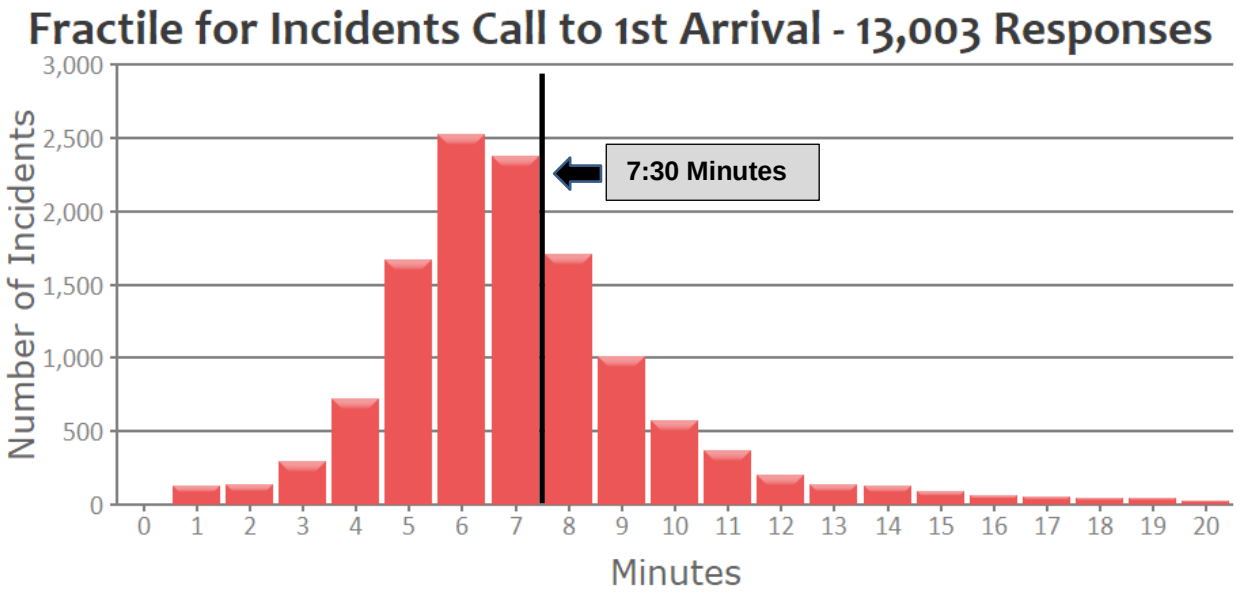
Table 24—90th Percentile First-Unit Call-to-Arrival Performance

Station	Overall	RY 18/19	RY 19/20	RY 20/21
Department-Wide	**09:23 (25,366)**	**09:00 (9,161)**	**09:32 (8,552)**	**09:32 (7,653)**
Station 1	09:51 (4,269)	09:35 (1,482)	09:52 (1,425)	09:59 (1,362)
Station 2	08:38 (5,154)	08:26 (1,914)	08:35 (1,846)	08:56 (1,394)
Station 3	09:05 (2,450)	08:56 (918)	09:07 (817)	09:07 (715)
Station 4	09:55 (2,290)	09:50 (745)	10:27 (771)	09:36 (774)
Station 5	08:16 (6,977)	08:03 (2,601)	08:17 (2,290)	08:26 (2,086)
Station 6	10:10 (3,471)	09:21 (1,289)	10:39 (1,141)	10:37 (1,041)
Station 7	12:11 (755)	11:49 (212)	12:30 (262)	12:11 (281)

The following figure shows peak call to first-unit arrival occurring at 6:00 minutes (360 seconds), and the right-shifted graph indicates the number of incidents with longer call to arrival time.

[16] The 7:30-minute call to first-unit arrival goal in urban areas includes 1:30 minutes for call processing / dispatch time, 2:00 minutes for crew turnout time, and 4:00 minutes for travel time.

Figure 17—Fractile Call to First-Unit Arrival Performance – RY 20/21



Finding #13: At 9:32 minutes in RY 20/21, 90th percentile first-unit call-to-arrival performance is 1:53 minutes *slower* than an optimum best practice goal of 7:30 minutes for urban areas.

Fire Station Concentration: ERF (First Alarm) Call to Arrival

The Department's ERF for building fires includes four engines, two ladder trucks, one ambulance, one Medic Supervisor, and one Battalion Chief for a total of 22 personnel. Over the period of three reporting years that were studied, there were 24 incidents for which the entire ERF arrived, with a 90th percentile call-to-arrival performance of 18:50 minutes, which is 7:20 minutes *slower* than Citygate's recommended 11:30-minute goal for urban areas. Most of this slower response is due to the longer travel times, when several units must cross most of the City to reach the incident.

Table 25—90th Percentile ERF Call-to-Arrival Performance

Station	Overall	RY 18/19	RY 19/20	RY 20/21
Department-Wide	18:50 (25)	11:50 (6)	16:29 (9)	18:50 (10)
Station 1	18:50 (2)	-	-	18:50 (2)
Station 2	13:18 (8)	11:50 (3)	13:18 (2)	25:28 (3)
Station 3	15:20 (4)	-	11:17 (2)	15:20 (2)
Station 4	20:59 (2)	-	20:59 (2)	-
Station 5	10:16 (6)	09:45 (2)	16:29 (2)	08:29 (2)
Station 6	17:28 (3)	17:28 (1)	07:40 (1)	08:47 (1)
Station 7	-	-	-	-

Finding #14: At 18:50 minutes across the three years of data, 90th percentile ERF (First Alarm) call-to-arrival performance *is 7:20 minutes slower than* the 11:30-minute Citygate-recommended best practice goal for urban areas.

Response Performance Summary

The following table summarizes the Department's operational response performance over the three-reporting-year period of data studied relative to recognized best practices. As the table illustrates, response performance for RYs 18/19, 19/20, and 20/21 was *slower* than Citygate's best practice recommendation to ensure positive outcomes for serious emergencies.

Table 26—Response Performance Summary

Response Component	Best Practice		90th Percentile Performance	Performance Versus Best Practice and Current Goal
	Time	Reference		
Call Processing / Dispatch	1:30	NFPA	**2:29**	**+ 0:59**
Crew Turnout	2:00	Citygate	**2:05**	**+ 0:05**
First-Unit Travel	4:00	NFPA	**5:53**	**+ 1:53**
First-Unit Call to Arrival	7:30	Citygate	**9:32**	**+ 2:02**
ERF Call to Arrival	11:30	Citygate	**18:50**	**+ 7:20**

2.8 Traffic Congestion, Street Safety Improvements, and Emergency Response

This study has noted how emergency incident travel times are 1:53 minutes slower than recommended best practice travel times to serious events. This measure is consistent across the City and by fire station district. Even in 2020, with many shutdowns related to the onset of the COVID-19 pandemic, travel time remained sluggish.

The GIS data measured only a small, 3.6 percent reduction in first-due road mile coverage resulting from traffic congestion. In Citygate's experience with many other Bay Area cities, this is the most minimal impact between peak and off-peak hours we have witnessed. Some area cities see peak-hour impacts which decrease the road miles covered by approximately 15–25 percent.

Residing in Alameda County, and having visited Berkeley multiple times, Citygate's lead consultant on this project took note of the City's street designs, the hills, street parking, buildings at corners and trees affecting sight lines—plus the large volume of traffic during most hours of the day, with the exception of very late evening to pre-morning rush hour. All these factors combine to negatively impact travel times for emergency vehicles in general. Traffic congestion specifically plays only a minor part in delaying first-due units; however, traffic congestion does severely impact multiple-unit ERF travel times—even with traffic signal preemption control, as there is nowhere cars and trucks can move to make space for emergency vehicles.

To protect pedestrians and automobile passengers, the City has long used various traffic-calming measures, including barriers on some residential streets, to stop "cut-through" traffic. The street closure barriers were built to allow the passage of fire trucks—*but only slowly*. Emergency

response units cannot drive over these barriers at the speed limit. Many of these devices completely restrict ambulance passage as ambulances sit lower to the ground than fire trucks.

Throughout the country over the last 20 plus years, traffic engineers have deployed approximately 20 street design elements to slow through traffic. A few examples of such elements are speed humps, lumps, split lumps, intersection bulb-outs, traffic circles, and raised intersections. Most communities have a formal process to consider these tools during development or upon neighborhood request. The more common devices that slow traffic—such as lumps or traffic circles—slow a fire unit by 9–10 seconds *per device encountered.* Thus, if a unit had to encounter and navigate three devices en route to an incident, 27–30 seconds would be lost across the total response time.

Berkeley has done commendable work to incentivize shifts toward non-automotive means of mobility. More people opting to walk, bike, and utilize public transit means fewer cars on the road, reduced congestion, less pollution, and improved response times. It also encourages active transportation—which improves public health, reducing emergency medical needs in the long term. Further, improving roadway safety reduces deaths, injuries, and related calls for service. As Berkeley adds additional housing through mixed-use, accessory dwelling units and middle housing, it will be important for the City to further improve and incentivize alternatives to driving to counteract the effects of potential additional vehicles on pedestrian/cyclist safety and response times.

Priority Response Routes

The City has adopted a Complete Streets policy as a set of strategies to significantly improve pedestrian and bicycle safety. Fire departments are typically involved in the approval process for traffic-calming elements to understand the impacts to response time. One strategy to lessen impacts on fire and ambulance response times is to have the Department identify "priority response routes" that are the prime arterials and/or main boulevards leaving a fire station, and which allow units to quickly travel across half of a fire station district to the actual residential streets in need of service. Priority response routes should be identified based on specific criteria and could employ fewer, or perhaps differently designed, traffic-calming methods. Relatedly, the City should explore roadway configurations, such as dedicated transit/emergency lanes, that could serve multiple City goals related to mobility, emergency response, and evacuation.

Housing Impacts on Response Time Performance

Increased populations in taller buildings mean emergency response times may be longer. After a unit reaches an address, personnel must then ascend several stories to where the patient or fire is. Thus, the arrival of responders to the actual incident or patient location can be minutes after the official arrival time is logged in the CAD system. Dense, high-rise and in-fill housing plays an

important role in meeting the City's housing goals. Such housing and development is also changing the risk profile the Department is trained and staffed to mitigate.

As the City grows and changes, the Department must monitor and publicly report travel times and other relevant performance data. The Department must also be more involved in traffic design, approvals, setting forth priority response routes, and working with Public Works to request funding for traffic signal/control ("smart corridor") technology to sync several traffic signals at once along an emergency response route.

It may be necessary to add infill fire/ambulance stations between existing sites to lower travel distances. This is essentially the way downtown urban cores such as Manhattan, Chicago, and Los Angeles must provide coverage. In these agencies, fire/EMS stations are almost in sight of each other due to traffic congestion and high-rise building populations.

Existing Non-Conforming Street Width Impacts to Response Times

The majority of roadways in the eastern portion of the City—and others scattered throughout the balance of the City—are existing and non-conforming with regard to their width. When vehicles are parked on one or both sides of these narrow roadways, the remaining width often leaves inches of clearance on either side of an emergency vehicle that is navigating these areas, which significantly slows travel times in these districts. Furthermore, these roads are commonly left impassable for emergency vehicles due to carless parking configurations, vegetation growth adjacent to the road that pushes parked vehicles toward the centerline, delivery or other commercial vehicles left temporarily unattended, construction activity, and a variety of other circumstances. These delays can often add minutes to a response as responders have to stop, locate the driver of the vehicle blocking the roadway, or slowly back the emergency vehicle to the closest intersection and re-route to the emergency scene.

There is little that can be done with regard to widening these roadways, so the City is left to focus on other strategies to maintain the maximum width possible (if not compliant with the Fire Code). Some strategies could be, but are not limited to, roadside adjacent vegetation enforcement and management, an in-depth study that analyzes large-scale evacuations of the Berkeley Hills area, which may drive proposals for strategic parking restrictions and enforcement, advocacy for better public transit serving these portions of the City coupled with incentives to reduce the size of vehicles, and incentives to reduce the number of vehicles parked on the public right-of-way.

Finding #15: The Public Works and Fire departments have not yet established an effective set of integrated policies and traffic-calming methods to improve public safety by minimizing roadway injuries, deaths, and response/evacuation times.

2.9 PLANNED AMBULANCE SYSTEM IMPROVEMENTS

This study has identified how overcommitted the Department's four paramedic ambulance units are for most of the daytime to mid-evening hours. This is due to the City not adding a sufficient number of new ambulances over the years, a dispatch center that is not capable of triaging and diverting non-urgent calls for service, increases in population, and—given the state of health care and housing in America—the increase in non-medically insured populations, both housed and houseless.

In parallel with beginning this study, the Department understood the issues associated with the workload per ambulance per hour and gained City support for a plan to grow and change the deployment of Department ambulances. Over the next three years, the Department will make the transition from ambulances staffed with only firefighter/paramedics to ambulances staffed with non-firefighter/paramedics and EMTs. During this transition to staffing ambulances with full-time medical personnel only, some existing firefighter/paramedics will be reduced through attrition, and some will be reassigned to ladder units to increase first responder staffing to emergencies that firefighters are trained for.

Initially, the program will alter staffing for the existing four ambulances, which will **not reduce** unit workload. As a second step, the Department will add BLS ambulances to handle low-acuity patients who do not require ALS paramedic care, but this change will also require upgrades to dispatcher training and technology to sort 9-1-1 callers into clinical categories.

Over time, ambulance staffing changes will reduce the cost associated with each ambulance staff member by approximately 20 percent for non-firefighter paramedics and 50 percent for non-firefighter EMTs. These cost savings will allow the Department to strategically increase some fire apparatus staffing from three to four crew members and deploy additional ambulances at a lower cost.

This conversation will also allow the Department to build a recruitment pathway from local vocational schools to provide entry-level EMT positions that pay well and provide good benefits. An employee is then inside the Department and can be further mentored and developed to take on a variety of career paths valuable to the City—all of which are high skill, high pay, and in need of qualified applicants.

In early 2023, the Department will begin transitioning staffing for ALS ambulances to non-firefighter paramedics. This will require at least four paramedic recruitments over three years. The anticipated sequence of ambulance conversion will be Medic 2, Medic 1, Medic 3, and Medic 5.

The Department will also work to deploy BLS ambulances staffed with EMTs. These positions will be entry-level, with limited-term contracts, that will provide the primary recruitment tool for

the organization. Employment contracts will last for three years but may be extended to five if the employee enrolls in a fire academy or paramedic program.

The Department would like to hire as many as 28 EMTs (with current funding for 10). The soonest that EMT ambulance positions can be added would be 2024. Thus, it is all but impossible for the Department to add a fifth or sixth ambulance of any type before early 2024.

Finding #16: The City's planned expansion of ambulance service is consistent with best practices and will provide needed improvement, but upgrades in dispatcher skills for clinical evaluation to recognize and separate low-acuity incidents will not be fully realized for at least three more years, and likely longer. Given the ongoing strain on ambulances staffed with only firefighter/paramedics, the process of conversion and expansion of ambulances is too slow to meet current (and growing) EMS service demands.

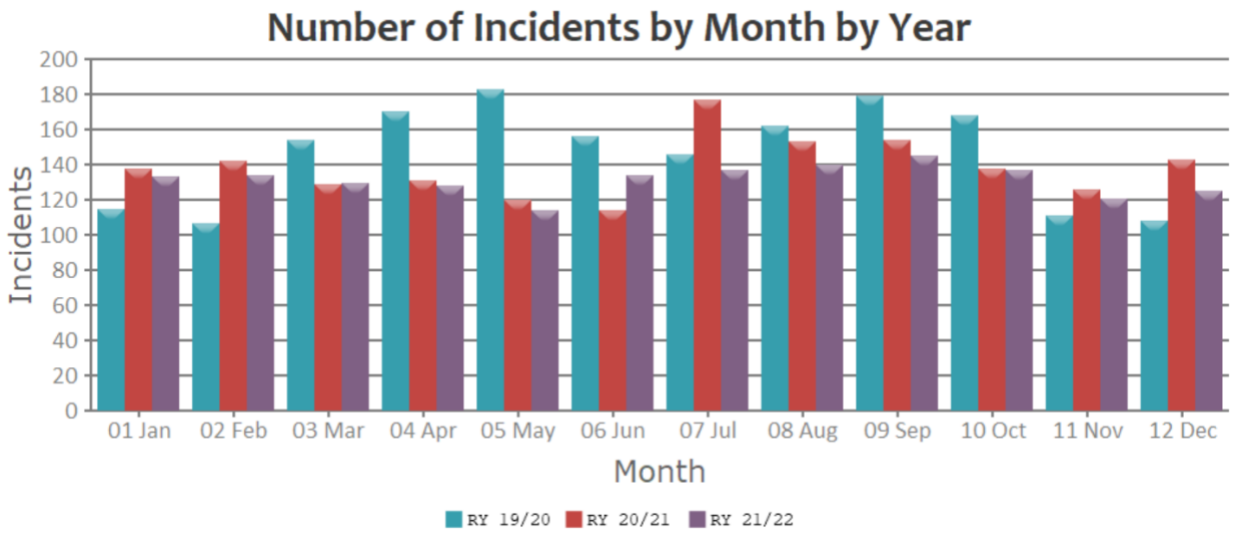
2.10 Mental Health Patient Transport

Another type of EMS patient care is when a patient is experiencing a mental health crisis so severe that a police officer can require the person be placed on 72-hour hold for in-patient mental health evaluation. To date in Alameda County, these patients are transported by the County's ambulance provider to several facilities. In addition to police, Department first responders and ambulances also respond at times given uncertainty as to the medical situation when 9-1-1 is first called. The short form name for these incidents comes from the California Government Code for the mental health holds—Section 5150. These 5150 incidents are separately counted in the Berkeley Police and Fire incident records and as such are not included in the EMS incident counts elsewhere in this study.

Citygate was provided 5150 incident data for three reporting years between 7/1/2019 and 6/30/2022. During this period, there were 5,002 mental health incidents and 15,534 apparatus response records—demonstrating that, for many incidents, the initial response is three units: police, fire first responder, and fire ambulance. In the last reporting year, there were 1,578 total incidents and 3.1 apparatus responses per incident. The number of incidents per day was 4.32.

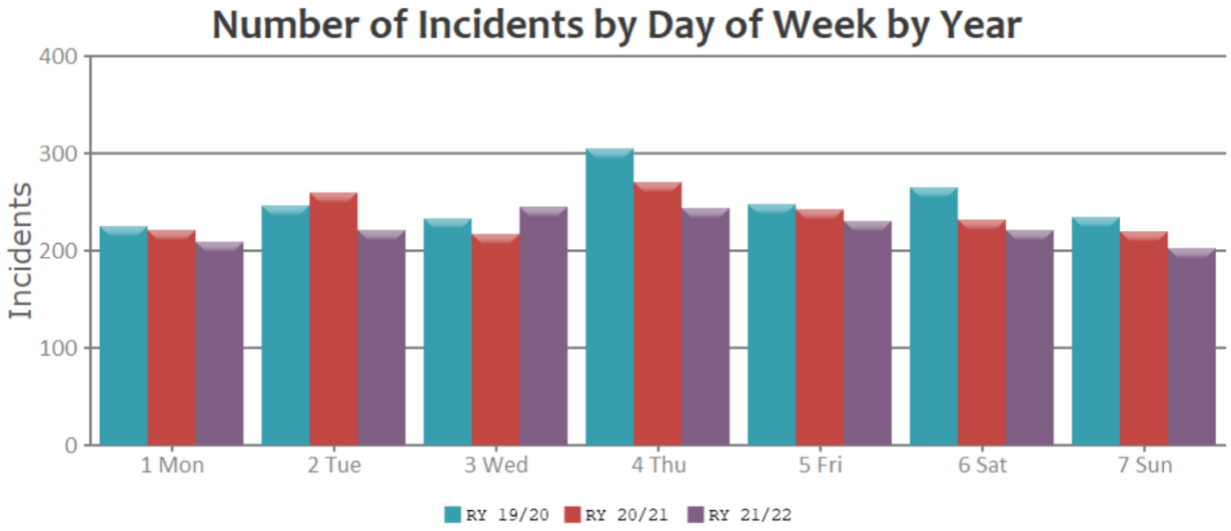
The following figure illustrates the number of incidents by month by year. There is more activity during summer months, with activity decreasing during winter months.

Figure 18—Number of 5150 Incidents by Month by Year



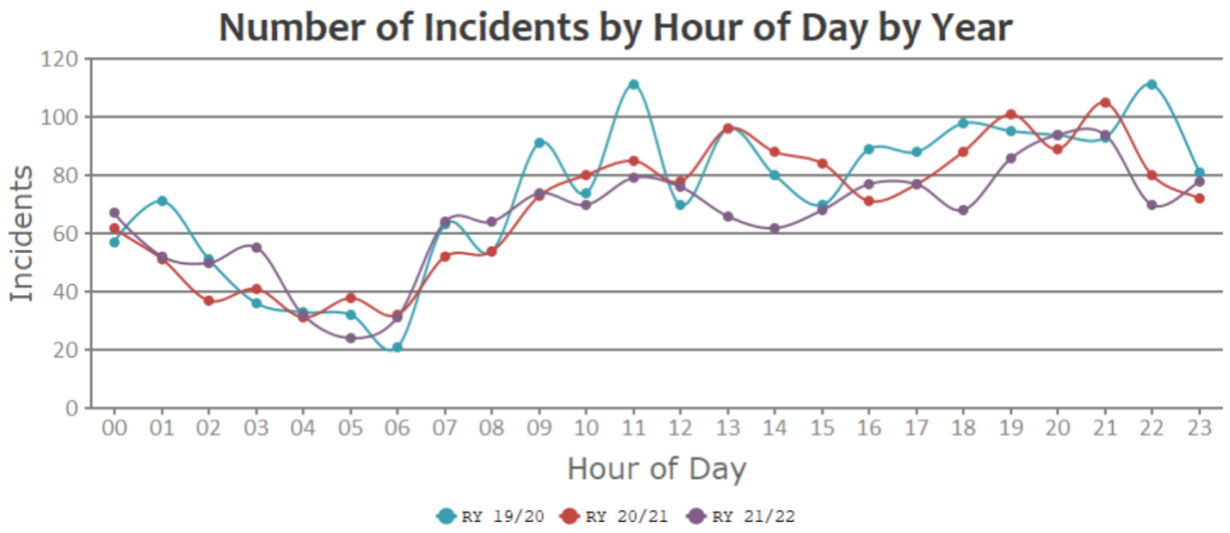
The following figure shows that peak activity occurs on Thursday, with minimal activity on Sunday and Monday.

Figure 19—Number of 5150 Incidents by Day of Week by Year



The following figure illustrates the breakdown of incidents by hour of day by year.

Figure 20—Number of 5150 Incidents by Hour of Day by Year



The following table illustrates the total number of hours spent for 5150 incidents by department.

Table 27—5150 Incidents – Total Duration Hours by Year by Department

Department	RY 19/20	RY 20/21	RY 21/22	Total
Berkeley Fire Department	15.4	14.3	18.8	**48.5**
Berkeley Police Department	696.2	696.1	738.4	**2130.7**
County Ambulance System Transport	1835.9	1755.6	1821.0	**5412.5**
Total	**2547.6**	**2466.0**	**2578.2**	**7591.8**

The following table illustrates 5150 incidents by destination hospital by year.

Table 28—5150 Incident Count – Year by Destination Hospital

Hospital	RY 19/20	RY 20/21	RY 21/22	Total
-Blank-	786	525	462	**1,773**
Alameda County Fairmont Hospital			1	**1**
Alameda County Medical Center, Highland	8	15	10	**33**
Alta Bates Summit Medical Center, Alta Bates Campus	472	654	536	**1,662**
Alta Bates Summit Medical Center, Herrick Campus	5	4	10	**19**
Alta Bates Summit Medical Center, Summit Campus	25	33	46	**104**
Children's Hospital & Research Center Oakland	9	10	4	**23**
Eden Medical Center	4	3	2	**9**
John George Psychiatric Pavilion	372	374	434	**1,180**
Kaiser Permanente, Oakland Medical Center	43	36	56	**135**
Kaiser Permanente, San Leandro Medical Center		1	2	**3**
San Leandro Hospital	11	4	12	**27**
Willow Rock Center	22	6	3	**31**
Total	**1,759**	**1,665**	**1,578**	**5,002**

The following table illustrates hours and minutes to 90 percent duration performance for 5150 incidents by destination hospital by year. Given the number of mental health crisis patients in the north county, take note of the time it takes the ambulance to transfer care of the patient at the County's John George facility and Alta Bates Summit Center:

Table 29—90 Percent Performance Minutes for 5150 Incidents – Year per Hospital

Hospital	RY 19/20	RY 20/21	RY 21/22
-Blank-	02:35 (786)	02:32 (525)	02:23 (462)
Alameda County Fairmont Hospital			03:22 (1)
Alameda County Medical Center, Highland	02:07 (8)	03:25 (15)	04:02 (10)
Alta Bates Summit Medical Center, Alta Bates Campus	**02:29 (472)**	**02:37 (654)**	**02:38 (536)**
Alta Bates Summit Medical Center, Herrick Campus	01:48 (5)	01:11 (4)	02:44 (10)
Alta Bates Summit Medical Center, Summit Campus	01:56 (25)	04:22 (33)	03:07 (46)
Children's Hospital & Research Center Oakland	01:33 (9)	02:32 (10)	05:08 (4)
Eden Medical Center	02:44 (4)	04:16 (3)	03:32 (2)
John George Psychiatric Pavilion	**02:53 (372)**	**02:52 (374)**	**03:32 (434)**
Kaiser Permanente, Oakland Medical Center	02:09 (43)	02:27 (36)	02:43 (56)
Kaiser Permanente, San Leandro Medical Center		01:41 (1)	03:31 (2)
San Leandro Hospital	02:54 (11)	02:41 (4)	04:34 (12)
Willow Rock Center	02:50 (22)	03:08 (6)	03:23 (3)

It is not uncommon for more than one of these incidents to occur at the same time in the City.

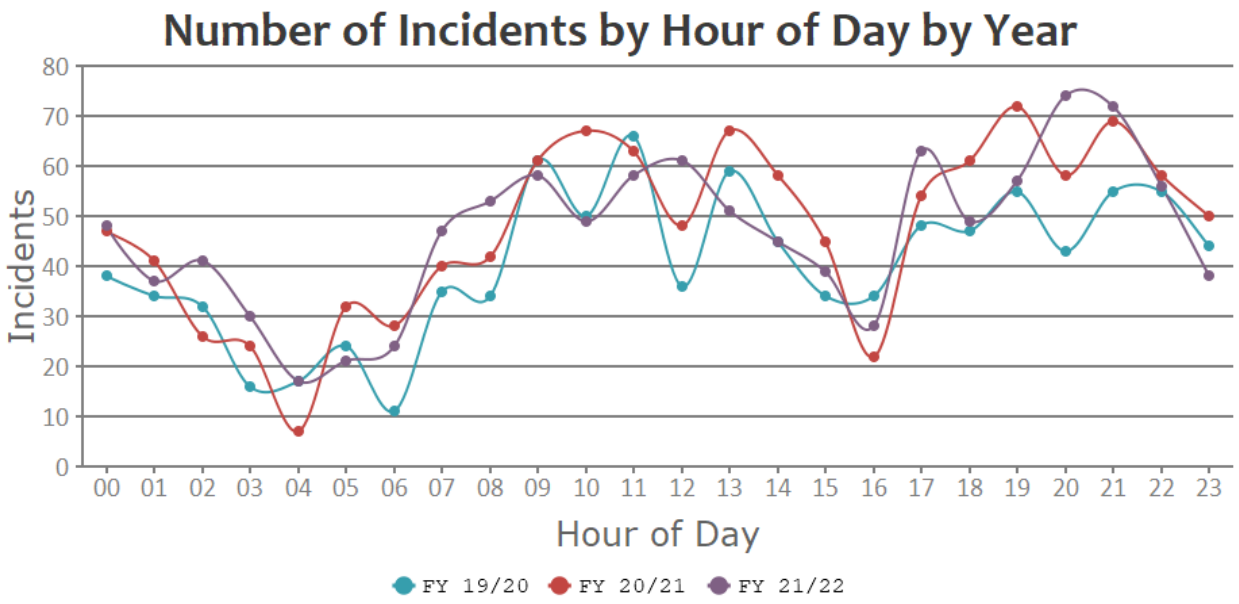
The following table shows simultaneous 5150 incidents by hour of day and day of week.

Table 30—Simultaneous 5150 Incidents (Two or More at the Same Time)

Hour	1 Mon	2 Tue	3 Wed	4 Thu	5 Fri	6 Sat	7 Sun	Total
00:00	11	17	7	11	15	12	9	**82**
01:00	10	7	4	12	11	5	10	**59**
02:00	5	10	10	13	6	9	4	**57**
03:00	8	9	7	8	8	5	5	**50**
04:00	5	2	9	7	2	5	4	**34**
05:00	2	7	2	4	4	7	8	**34**
06:00	9	4	7	6	3	4	3	**36**
07:00	5	6	9	15	14	12	11	**72**
08:00	7	7	16	16	14	7	4	**71**
09:00	17	19	11	22	17	13	9	**108**
10:00	11	15	17	21	16	14	6	**100**
11:00	20	21	8	13	18	16	18	**114**
12:00	18	16	10	16	8	9	18	**95**
13:00	24	23	16	18	16	12	14	**123**
14:00	17	17	12	14	15	10	14	**99**
15:00	14	18	13	22	5	18	10	**100**
16:00	17	13	16	22	14	15	2	**99**
17:00	12	5	17	23	13	23	7	**100**
18:00	10	10	19	16	12	17	16	**100**
19:00	16	11	13	25	23	16	27	**131**
20:00	10	19	9	24	17	17	17	**113**
21:00	14	19	23	20	27	11	12	**126**
22:00	10	13	21	14	18	15	19	**110**
23:00	13	15	15	10	19	15	14	**101**
Total	**285**	**303**	**291**	**372**	**315**	**287**	**261**	**2,114**

The following figure illustrates the breakdown of transport incidents by hour of the day by year.

Figure 21—Number of 5150 Transport Incidents by Hour of Day by Year



The number and frequency of mental health evaluation holds and resultant transports to an appropriate care facility are a significant daily event in the City.

Finding #17: Based on the most recent year's quantity of mental health patients being transported, if the Department is tasked with management of these patients, it would require the addition of one 24-hour ambulance and one 12-hour peak ambulance—both operating seven days a week. At present, the Department does not have the units or personnel to administer this workload.

2.11 Overall Deployment Evaluation

SOC Element 8 of 8
Overall Evaluation

The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern typical of an East San Francisco Bay area city. Due to the City's bayfront location, the University of California campus and the Lawrence Berkeley National Laboratory, the Department protects large tourism and non-resident population densities. The City also is evolving to improve its housing shortages by approving mid- and high-rise residential buildings. UC Berkeley is completing its new master plan to add students, faculty, on-campus buildings and housing off-campus.

The intensification of land uses and populations will make several sections of Berkeley very "urban" to a degree typical of the largest metropolitan cities for population densities and traffic. This will require the City's fire and ambulance programs to evolve beyond those of a "suburban" agency to those suitable for a major urban fire department in staffing, unit types, and facility locations. Citygate acknowledges this will not only be costly but also difficult to find new locations for responders in an already built-up City.

For comparison, the following table displays population density per square mile. Of the top 50 largest cities in California, Berkeley is already the second most densely populated city per square mile—even *without students, citywide employment, tourism, and cars on the freeways.* The City needs an ***urban*** level of fire, EMS, and specialty rescue services.

Table 31—California Cities: Population Density per Square Mile

Rank by Population	Rank by Density	City	Population	Size (Square Miles)	Population per Square Mile
4	1	San Francisco	873,965	46.91	18,630.68
51	**2**	**Berkeley**	**124,321**	**10.43**	**11,919.56**
13	3	Santa Ana	310,227	27.34	11,347.00
31	4	Garden Grove	171,949	17.96	9,574.00
7	5	Long Beach	466,742	50.71	9,204.14
1	6	Los Angeles	3,898,747	469.49	8,304.22
8	7	Oakland	440,646	55.93	7,878.53
22	8	Oxnard	202,063	26.53	7,616.40
23	9	Huntington Beach	198,711	27	7,359.67
46	10	Santa Clara	127,151	18.28	6,955.74
33	11	Salinas	163,542	23.52	6,953.32
36	12	Sunnyvale	155,805	22.08	7,056.39
40	13	Torrance	147,067	20.52	7,167.01
10	14	Anaheim	346,824	50.27	6,899.22
37	15	Pomona	151,713	22.99	6,599.09
41	16	Fullerton	143,617	22.42	6,405.75
24	17	Glendale	196,543	30.48	6,448.26
44	18	Pasadena	138,699	22.96	6,040.90
19	19	Modesto	218,464	43.05	5,074.66
3	20	San Jose	1,013,240	178.26	5,684.06
43	21	Orange	139,911	25.67	5,450.37
15	22	Chula Vista	275,487	49.64	5,549.70
6	23	Sacramento	524,943	98.61	5,323.43

Rank by Population	Rank by Density	City	Population	Size (Square Miles)	Population per Square Mile
11	24	Stockton	320,804	62.21	5,156.79
21	25	Fontana	208,393	43.07	4,838.47
5	26	Fresno	542,107	115.18	4,706.61
14	27	Irvine	307,670	65.61	4,689.38
25	28	Santa Rosa	178,127	42.53	4,188.27
28	29	Rancho Cucamonga	174,453	40.11	4,349.36
17	30	Santa Clarita	228,673	70.75	3,232.13
2	31	San Diego	1,386,932	325.88	4,255.96
29	32	Oceanside	174,068	41.27	4,217.79
26	33	Elk Grove	176,124	41.99	4,194.43
38	34	Escondido	151,038	37.35	4,043.86
20	35	Moreno Valley	208,634	51.33	4,064.56
50	36	Concord	125,410	30.55	4,105.07
35	37	Corona	157,136	39.94	3,934.30
39	38	Roseville	147,773	44.08	3,352.38
49	39	Vallejo	126,090	30.42	4,144.97
42	40	Visalia	141,384	37.94	3,726.52
12	41	Riverside	314,998	81.23	3,877.85
18	42	San Bernardino	222,101	62.13	3,574.78
34	43	Hayward	162,954	45.82	3,556.39
27	44	Ontario	175,265	49.97	3,507.40
48	45	Simi Valley	126,356	41.55	3,041.06
16	46	Fremont	230,504	78.31	2,943.48
9	47	Bakersfield	403,455	149.78	2,693.65
47	48	Thousand Oaks	126,966	55.26	2,297.61
30	49	Lancaster	173,516	94.27	1,840.63
45	50	Victorville	134,810	73.71	1,828.92
32	51	Palmdale	169,450	106.06	1,597.68

While state fire code requires fire sprinklers in residential dwellings, it will be many more decades before enough residential units are replaced or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an affected building and minimizing permanent impairment resulting from a medical emergency, then the City will need coverage in all neighborhoods that is consistent with Citygate's response performance recommendation for Berkeley. Based on Citygate's study, this response performance

recommendation entails *no more than* 8:30 minutes for the arrival of a single first responder, and 11:30 minutes for a multiple-unit arrival to more serious incidents, from the time of 9-1-1 notification at the Berkeley Police Communications Center—all at 90 percent or better reliability.

Dispatch, turnout, and travel times all need to be reduced. Dispatch time must decrease by 0:59 seconds to meet a 1:30-minutes call-processing goal, turnout time by :05 seconds to meet a 2:00-minute goal, and travel time by 0:53 seconds to meet a proposed goal of no more than 5:00 minutes for first-due units in *congested urban* areas. Collectively, Citygate's recommended first-unit total response time goal is 8:30 minutes (1:30 + 2:00 + 5:00).

Berkeley must act (1) to restore emergency responder availability for serious, life-threatening fires and emergency medical service events and (2) to field enough firefighters to serious building or wildland fires quickly.

Recovering response time and unit capacity goals will require multiple changes over the next three years to first improve and then maintain response times as growth occurs:

1. Increasing the number of ambulances from four to six.
2. Shifting responsibility for non-acute EMS calls from the 9-1-1 Fire/Ambulance program to a Mobile Integrated Health program like the City's pilot Mobile Integrated Paramedic (MIP) program.
3. Improving dispatch staffing and systems to allow for EMS clinical call triage.
4. Working collaboratively with Public Works staff and traffic safety advocates to engineer methods to lessen disproportionate impacts on emergency response times as the City redesigns streets using its Complete Streets policy.
5. Increasing staffing to four personnel each on key engines and ladder trucks.
6. Adding a second field operations Battalion Chief 24/7 for improved crew supervision and to add an immediate scene safety officer to support the Battalion Chief / Incident Commander for serious emergency incidents.

If these six strategies do not improve acute emergency response times *and lower unit-hour utilization (UHU) workload to no more than 30 percent*, the City should construct infill fire or ambulance-only stations between the current busiest station pairs of 2 and 5 and 1 and 6. These areas are also where much of the infill development, high-rise building, and UC Berkeley campus growth will occur.

One solution employed by some fire departments that struggle with UHU and response time is to deploy a smaller, two-firefighter staffed squad unit to handle low-risk / low-acuity calls. In the City, ambulances—at both ALS and BLS levels of care—are non-firefighting, two-person units. Proposed alternative response units like the Mobile Integrated Paramedic (MIP) or similar model could also employ two-person staffing. Given the large building, wildland fire, technical rescue,

and hazardous materials risks, City firefighter units require a fully staffed crew to arrive quickly and concurrently with all the needed tools to provide rapid mitigation of the problem. Adding personnel to existing units will result in the appropriate number of firefighters arriving in a shorter amount of time. Given these dynamics, Citygate is not recommending the use of firefighting squads in the City.

Given our analysis, Citygate finds the Department's response apparatus types to be appropriate to protect against the hazards likely to impact the City. However, *fire crew staffing of three per unit is insufficient* to provide the necessary "weight" of response to serious fires—especially so in mid- and high-rise buildings and for severe wildland fires that start in the hills. Currently, the Department's service capacity for fire and non-fire risk consists of 37 personnel on duty daily, including one Battalion Chief, one mobile Paramedic Supervisor, and 27 firefighters staffing seven engines and two aerial ladder trucks. An additional eight firefighters currently staff four ambulances and operate from the Department's seven fire stations. However, engines are very busy providing EMS response, and the firefighters staffing ambulances are not consistently available for firefighting at present. Over the next several years, three firefighters per day will be moved to an engine and both ladders, thus raising three of the nine firefighting units to four-firefighter staffing consistent with NFPA Standard 1710 and Citygate best practices for high-density urban core areas. These firefighters will be replaced by non-firefighter EMS personnel on the ambulances, thus aligning the classification with the work and creating a more efficient system. However, only three units with four-firefighter staffing will not be enough. At a minimum, four-firefighter staffing should be provided:

- On four engines: 1, 2, 5, and 6
- On trucks 2 and 5
- Occasionally (on high-fire danger wildland fire days) on engines 3, 4, and 7.

When increasing firefighting units to four crew members each, one additional firefighter per day will have to be newly funded, which amounts to a total of three added firefighting personnel *per crew* (plus the overtime to cover their leave absences) on a three-platoon fire crew rotation system. The wildfire threat days which increase staffing to four each can be handled via overtime during daylight hours or when winds are most severe. When the engine and ladder units identified are staffed with four personnel each, the daily staffing for units other than ambulances increases from 27 to 33 per day—much more consistent with the risks to be protected in a thriving, growing urban area with internationally known assets and a tragic history of wildland fires.

There is also a need to add a second field operations Battalion Chief 24 hours per day for improved crew supervision and to add an immediate scene safety officer to support the Battalion Chief / Incident Commander for serious emergency incidents.

The Department's on-duty operations staff has grown to 10 direct reports to a single on-duty Battalion Chief. This is beyond an effective span of control of 5–7 subordinates per supervisor. A 10:1 span of control provides no time for mentoring and training subordinates, which contributes to long-term challenges relating to succession planning. Further, this 10:1 ratio does not factor in any future expansion of the organization to meet the changing needs of the community.

Performing competent emergency incident command is very challenging, especially in the initial minutes of an incident when rapid decisions have to be made that influence the preservation of life, property, and the environment. Industry best practice is to have two chief officers on the scene of significant emergencies. As defined by National Institute of Occupational Safety and Health (NIOSH),[17] four of the top five contributing factors to firefighter fatalities on an emergency scene are the responsibility of the Incident Commander:

1. Improper or Inadequate Risk Assessment
2. Lack of Incident Command
3. Lack of Accountability
4. Inadequate or Poor Communications
5. Lack of SOPs or failure to follow established SOPs.

A novel forensic study of over 12,000 firefighter incident emergencies called Project Mayday[18] provides useful data to help fire department incident commanders predict and prevent firefighter injuries and deaths. Surprisingly, there have been at least 10 firefighter maydays called by City Firefighters since 2001—incidents where firefighters were in life-threatening situations and required immediate assistance from crews and complex coordination from the sole Incident Commander on scene.

1. Two crew members caught and burned in a rapid fire progression during a warehouse fire.
2. One crew member becomes disoriented, lost, and jumps out a window during the search of a residential structure on fire.
3. Two crew members trapped under a roof collapse during a structure fire on Milvia St.
4. Two crew members caught in a rapid fire event while fighting a residential structure fire on Fulton St.

[17] https://www.cdc.gov/niosh/fire/default.html
[18] http://projectmayday.net/

5. One crew member separated from other team members and caught in rapid fire progression, rescued from a window during a church fire.
6. Two crew members lost and become trapped during a search of a residential structure fire on Milvia St.
7. One crew member becomes disoriented and lost during the search of a commercial structure on fire on Ninth St.
8. One crew member falls into a swimming pool that was covered with foam and not visible.
9. Multiple crews escape electrocution when high-tension PG&E lines are burned through and drop during a warehouse fire on Fourth St.
10. Two crew members fall through a floor collapse at a fire on College Ave.

The Department has implemented a temporary second Duty Chief program where 40-hour staff chief officers rotate on-duty as second chief officers. Project Mayday tells us that 85 percent of firefighter emergencies occur during non-business hours, when a department's second Duty Chief system has personnel traveling from home often with a response time of 45:00 minutes or more. Project Mayday data reveals that 40 percent of firefighter emergencies occur within the first 25 minutes of operations. Thus, a response time of 45:00 minutes or more for additional chief-level support must be improved.

According to Dr. Richard Gasaway,[19] "[Task] Saturation results when the brain takes in the maximum amount of stimulation it can handle—it's working at full capacity—yet more and more information is coming in. When the brain gets completely saturated with task demands, it simply cannot process any more information." With only one chief officer on the scene of critical incidents, even seasoned incident commanders become task saturated as they are attempting to simultaneously:

- Manage communications on multiple radio channels
- Absorb face-to-face communication from civilians and firefighters
- Maintain incident accountability and resource tracking (on paper)
- Perform ongoing risk analysis
- Monitor strategy and tactics to ensure they are in alignment with the problem and standard operating guidelines

[19] https://www.samatters.com/task-saturation-impacts-situational-awareness/

- Order and coordinate mutual aid resources to provide coverage to Berkeley fire stations for other 9-1-1 calls that will continue to occur
- Initiate emergency call back of off-duty staff if needed such as the PIO and Fire Investigator
- Identify and initiate an evacuation plan using Zonehaven (if necessary)
- Develop and deploy emergency messaging to the community
- Perform the role of Safety Officer for the scene
- Make phone calls to dispatch and other members of command staff to coordinate and provide critical updates.

Partially due to task saturation and the resulting auditory exclusion, Project Mayday informs us that when a firefighter initiates an emergency and makes a critical "mayday" radio transmission to the incident commander, informing them of the situation and the urgent need for help—*which is sometimes the first and last transmission a seriously injured firefighter is able to make*—the incident commander misses these transmissions 36 percent of the time.

2.11.1 Overall Deployment Recommendations

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

Recommendation #1:	Proceed with the planned conversion to staffing the four current ambulances with non-firefighter paramedics and EMTs.
Recommendation #2:	The Department needs to add two additional ambulances, requiring 16 additional non-firefighter Paramedics and/or EMT FTE personnel.
Recommendation #3:	The City needs to upgrade its dispatch staffing, training, and software to allow for clinical call triage to send Basic Life Support (BLS) ambulances or alternative care units to low-acuity EMS requests, as outlined in the City's separate Dispatch Needs Analysis.

Recommendation #4: The Berkeley Public Works and Fire departments should develop and implement holistic policies and traffic calming/controls that promote broad-based public safety through tandem reductions in both traffic-related injury/death and response/evacuation times.

Recommendation #5: Increase the staffing on six of the nine firefighting units (four engines, two aerial trucks) from three to four personnel per day.

Recommendation #6: Provide the overtime staffing increase from three to four firefighters for engines 3, 4, and 7, which are closest to the eastern hills during high-hazard wildfire threat periods.

Recommendation #7: If ambulance and dispatch improvements do not improve acute emergency response times and lower unit-hour utilization (UHU) workload to no more than 30 percent for long, contiguous hours of the day, the City should construct infill fire or ambulance-only stations between the current busiest station pairs of 2 and 5 and 1 and 6.

Recommendation #8: Adopt updated deployment policies: City Council should consider adopting complete performance measures that begin with a 9-1-1 call being answered and end with the Fire Department and/or an ambulance arriving at the emergency incident. The measures of time should be designed to save patients and keep small but serious fires from becoming more complex or damaging. With this is mind, Citygate recommends the following outcome-based measures for the major emergency types:

8.1: **Geographic Distribution of Fire Stations:** To treat medical patients and control small fires, the first-due unit should arrive within 8:30 minutes, 90 percent of the time, from receipt of the 9-1-1 call in the fire dispatch center. This equates to a 90-second dispatch time, a maximum 2:00-minute nighttime company turnout time, and a 5:00-minute travel time, which is realistic for Berkeley as a more urban area.

8.2: **Multiple-Unit Effective Response Force for Serious Emergencies:** To confine fires near the room of origin and treat up to five medical patients at once, a multiple-unit response of a minimum of four engines, two ladder trucks, one ambulance, one Medic Supervisor, and one Battalion Chief—totaling a minimum of 22 personnel—should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and an 8:00-minute travel time.

8.3: **Hazardous Materials Response:** The Department needs to maintain its hazardous materials response as designed to protect the community from hazards associated with uncontrolled release of hazardous and toxic materials. The first-due unit should arrive to investigate a hazmat release at the operations level within 8:30 minutes, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time in urban population areas. After assessment and scene evaluation is completed, a determination can be made whether to request additional resources.

8.4: **Technical Rescue:** To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due company to arrive for assessment of the rescue should achieve a 5:00-minute travel time in urban to suburban areas, 90 percent of the time. Additional resources capable of initiating a rescue should be assembled within a total response time of 11:30 minutes, 90 percent of the time, with the result being a safe and complete rescue/extrication to ensure delivery of patients to a definitive care facility.

Recommendation #9:	Adopt a split turnout time measure consisting of 2:00 minutes or less, 90 percent of the time, averaged over a 24-hour period, and within that, a daytime measure of 1:30 minutes or less, 90 percent of the time, from 0700–2200 hours.
Recommendation #10:	The City should add a second field operations Battalion Chief 24/7 as soon as fiscally possible.

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 hazards with potential to adversely impact the community or service area.
- Quantify the overall risk associated with each hazard.
- Establish a foundation for current and 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 broader community.

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.
- Evaluation of *probable* impact severity for each hazard by planning zone using agency/jurisdiction-specific data and information.
- Determination of overall risk by hazard using the following template.

Table 32—Overall Risk Template

Probability of Occurrence	Probable Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Low	Moderate	High
Unlikely	Low	Low	Low	Moderate	High
Possible	Low	Low	Moderate	High	Extreme
Probable	Low	Low	Moderate	High	Extreme
Frequent	Low	Moderate	High	Extreme	Extreme

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

- Esri and U.S. Census Bureau population and demographic data
- City and County geographical information systems data
- City General Plan and Zoning information
- City of Berkeley Local Hazard Mitigation Plan
- Fire Department data and information

A.1.2 Risk Assessment Summary

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

- The Department serves a diverse urban population with densities ranging from less than 5,000 to more than 40,000 people per square mile over a varied land use pattern.
- The City's population is projected to increase by nearly 18 percent by 2040 for an average annualized increase of slightly less than one percent.
- The City has a large inventory of residential and non-residential buildings to protect as identified in this assessment.
- The City also has significant economic and other resource values to be protected as identified in this assessment.
- The City and Alameda County have a mass emergency notification system to effectively communicate emergency notifications and information to the public in a timely manner.

- Berkeley's overall risk for six hazards related to emergency services provided by the Fire Department range from **Low** to **Extreme** as summarized in the following table.

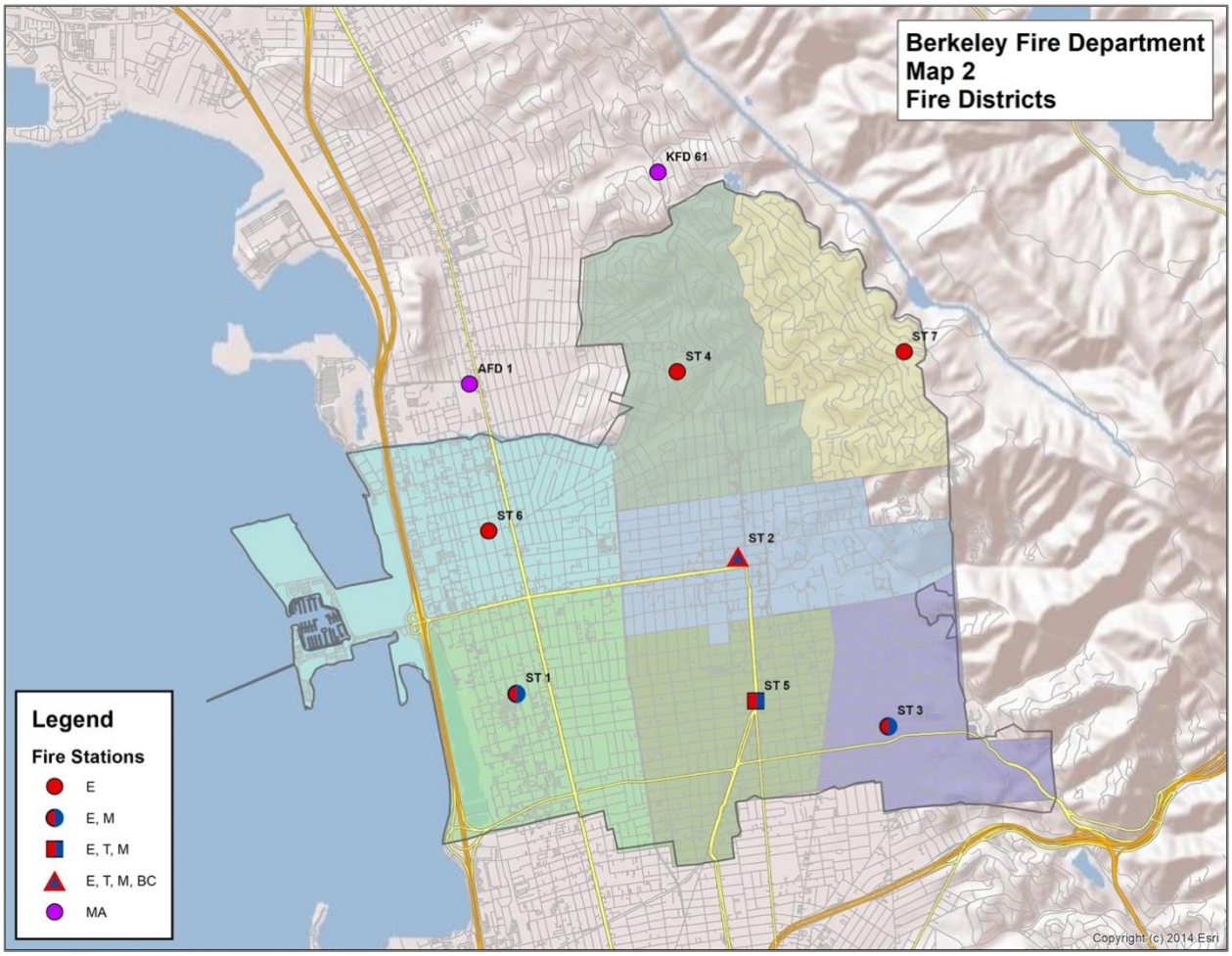
Table 33—Overall Risk by Hazard

Hazard		Risk Planning Zone						
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
1	Building Fire	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
2	Vegetation/Wildland Fire	*Low*	*Extreme*	*Extreme*	*Extreme*	*Moderate*	*Low*	*Extreme*
3	Medical Emergency	*High*	*High*	*High*	*High*	*High*	*High*	*High*
4	Hazardous Materials	*Moderate*	*Moderate*	*High*	*Moderate*	*Moderate*	*Moderate*	*High*
5	Technical Rescue	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Low*
6	Marine Incident	*Moderate*	*Low*	*Low*	*Low*	*Low*	*Moderate*	*Low*

A.1.3 Risk Planning Zones

The Commission on Fire Accreditation International (CFAI) recommends 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 may 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, high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, they become 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 appropriately evaluate service demand and response performance relative to each zone. As shown in the following map, Citygate utilized seven planning zones corresponding with the Department's current first-due response areas for this assessment.

Figure 22—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 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 under the age of 10, the elderly, and people housed in institutional settings. The following tables summarizes key demographic data for the City.

Table 34—Key Demographic Data – Berkeley

Demographic	2021
Population	**119,619**
Under 10 years	6.30%
10–14 years	3.40%
15–64 years	74.40%
65–74 years	9.30%
75 years and older	6.60%
Median age	32.8
Daytime population	144,863
Housing Units	**51,470**
Owner-Occupied	37.60%
Renter-Occupied	57.00%
Vacant	5.30%
Average Household Size	2.19
Median Home Value	$1,203,262
Race/Ethnicity	
White	53.90%
Asian	28.70%
Black / African American	7.60%
Other / Two or More Races	9.80%
Hispanic/Latino	11.20%
Diversity Index	72.3
Education (population over 24 years of age)	**75,144**
High School Graduate	96.80%
Undergraduate Degree	75.20%
Graduate/Professional Degree	40.50%
Employment (population over 15 years of age)	**65,514**
In Labor Force	92.60%
Unemployed	7.40%
Median Household Income	$92,345
Population Below Poverty Level	18.70%
Population without Health Insurance Coverage	2.60%

Source: Esri Community Analyst (2021) and U.S. Census Bureau

Of note from the table:

- Slightly more than 22 percent of the population is under 10 years or 65 years of age and older.

- The City's daytime population is 21 percent more than its resident population.
- The City's population is predominantly White (54 percent), followed by Asian (29 percent), Black / African American (8 percent), and Other (10 percent), with those of Hispanic/Latino ethnicity representing 11 percent of the population.
- Of the population over 24 years of age, nearly 97 percent have a high school or equivalent level of education.
- More than 75 percent of the population over 24 years of age has an undergraduate, graduate, or professional degree.
- Of the population older than 15 years of age, nearly 93 percent are in the workforce.
- The median household income is slightly more than $92,000.
- The population below the federal poverty level is 18.7 percent.
- The population without health insurance coverage is 2.6 percent.

The Association of Bay Area Governments (ABAG) projects that Berkeley's population will grow by 17.8 percent to 140,935 by 2040.[20]

Buildings

Berkeley has more than 51,000 housing units and nearly 7,000 businesses, including offices, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other business types.[21]

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 fewer 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

[20] Source: Plan Bay Area 2040, Plan Bay Area Projections 2040
[21] Source: Esri Community Analyst Business Summary (2021).

high fuel loading or hazardous materials; and similar occupancies with potential for substantial loss of life or unusual property damage or financial impact.

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

Evaluation of the City's building inventory identified 3,971 high/maximum-risk building uses as they relate to the CFAI building fire risk categories, as summarized in the following table.

Table 35—High-Risk Building Occupancies

Occupancy Classification		Number[1]	Risk Category[2]
A-1	Assembly	**15**	***Maximum***
H	Hazardous	**17**	***Maximum***
I	Institutional	**25**	***High***
R-1	Hotel/Motel	**22**	***High***
R-2	Multi-Family Residential	**3,892**	***High***
	Total	**3,971**	

[1] Source: City of Berkeley
[2] CFAI *Standards of Cover* (Fifth Edition)

Critical Facilities

The U.S. Department of Homeland Security defines critical infrastructure and key resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The City has identified 81 critical facilities as summarized in the following table. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Table 36—Critical Facilities

Critical Facility Category	Number
Communications	1
Community Services	7
Education	18
Government Services	11
Healthcare	7
Public Safety	21
Transportation	3
Utility	13
Total	**81**

Source: City of Berkeley

Economic Resources

Of the nearly 7,000 businesses employing more than 98,000 people in the City, top industries include services and retail sales, followed by manufacturing and construction.[22] Top employers with more than 500 employees include:[23]

- University of California Berkeley
- Lawrence Berkeley National Laboratory
- Sutter East Bay Medical Foundation
- City of Berkeley
- Bayer Corporation
- Berkeley Unified School District
- Kaiser Permanente Medical Group
- Siemens Corporation/Healthcare Diagnostics, Inc.
- Berkeley Bowl Produce

[22] Source: Esri Community Business Summary (2021).
[23] Source: City of Berkeley Fiscal Year 2020/2021 Annual Comprehensive Financial Report.

Natural Resources

Key natural resources to be protected within the City include:

- San Francisco Bay
- Aquatic Park
- Shorebird Park Nature Center
- McLaughlin Eastshore State Seashore

Cultural/Historic Resources

Key cultural/historic resources within Berkeley include:

- Berkeley Art Museum and Pacific Film Archive
- Berkeley History Center
- Berkeley Public Library
- Berkeley Repertory Theater
- Hearst Greek Theater
- Judah Magnes Museum

Special/Unique Resources

Following are special/unique resources to be protected within the City of Berkeley:

- University of California Berkeley
- Lawrence Berkeley National Laboratory

A.1.5 Hazard Identification

Citygate utilized 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 2019 City of Berkeley Local Hazard Mitigation Plan (LHMP) identifies the following seven hazards with potential to impact the City.

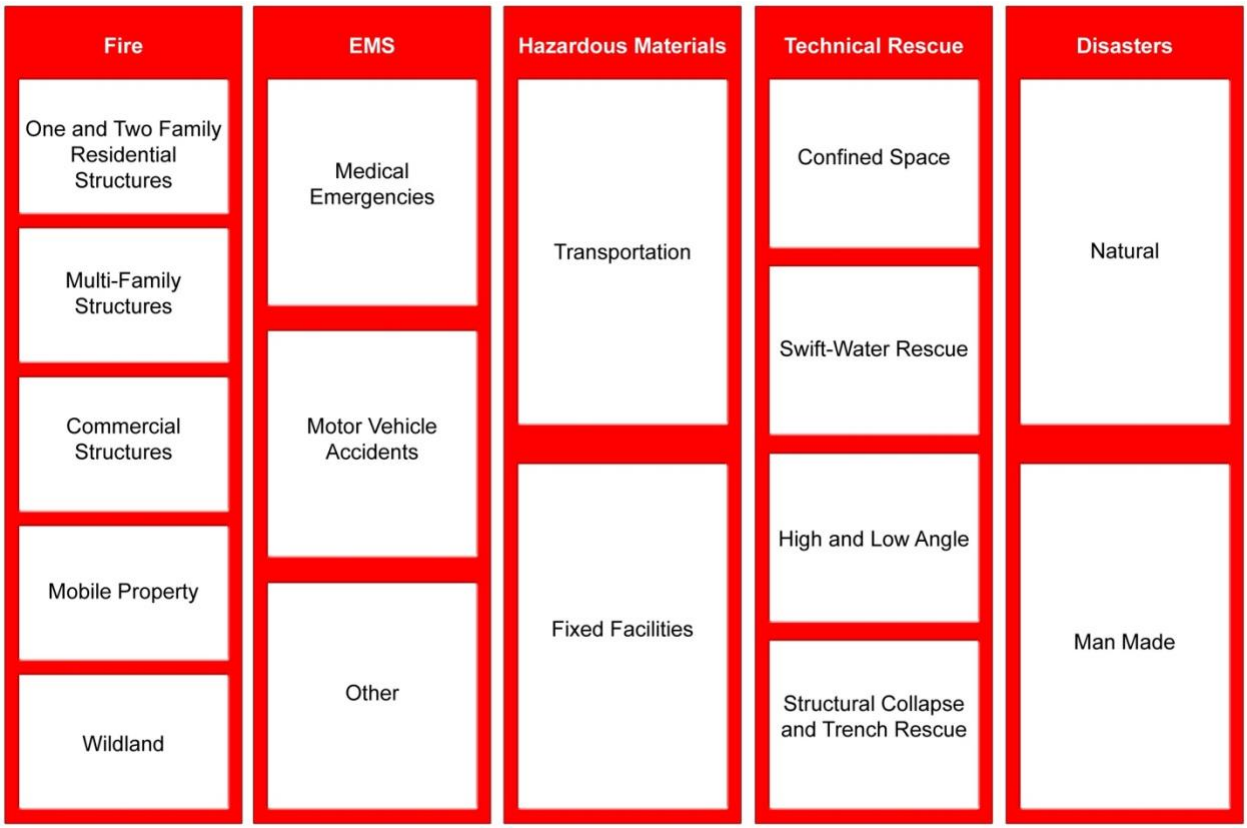
1. Earthquake
2. Wildland Urban Interface Fire
3. Rainfall-Triggered Landslide
4. Floods
5. Tsunami

6. Climate Change
7. Extreme Heat

Although the Department has no legal authority or responsibility to mitigate any of these hazards other than wildland-urban interface fires, it does provide services related to all 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 the following table. 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 23—Commission on Fire Accreditation International Hazard Categories



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

Following review and evaluation of the hazards identified in the City of Berkeley 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 six hazards for this risk assessment:

1. Building fire
2. Vegetation/wildland fire
3. Medical emergency

4. Hazardous material release/spill
5. Technical rescue
6. Marine Incident

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 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 fire and non-fire risk consists of 37 personnel on duty daily—including one mobile Paramedic Supervisor and one Battalion Chief—staffing seven engines, two aerial ladder trucks, and four ambulances, and operating from the Department's seven fire stations. The Department also has one Type-3 wildland engine, two Type-6 wildland engines, one hazardous materials apparatus, one fireboat, one rescue watercraft, and two ATVs that can be cross-staffed by on-duty personnel as needed.

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. All engines are staffed with a minimum of one EMT-Paramedic, and ambulances are staffed with two paramedics. The Department also provides ground ambulance services; air ambulance services, when needed, are provided by CALSTAR/REACH from Concord, Stanford Life Flight from Palo Alto, East Bay Regional Parks Police Department, or the California Highway Patrol. Emergency room services are available at Alameda Hospital (Alameda), Alan Bates Summit Medical Centers and Highland Hospital (Oakland), Kaiser Oakland (Oakland), and UCSF Benioff Children's Hospital (Oakland). Highland Hospital and UCSF Benioff Children's Hospital are also Level 1 Trauma Centers, and Eden Medical Center is a Level 2 Trauma Center.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. When needed, technical hazardous materials response is provided by Station 2 personnel trained to the Hazardous Materials Specialist level cross-staffing a hazardous material apparatus. For significant spills and releases, the Department responds via the Alameda County Fire Department Hazardous Materials Team.

All response personnel are further trained to the Confined Space Awareness level, with technical rescue capability available as needed from the City of Oakland. The Department is in the process of obtaining a Cal OES Type-2 Urban Search and Rescue trailer.

Marine response capacity includes up to 24 personnel certified to the State Fire Training Open Water Rescuer and/or Open Water Rescue Boat Operator level. In addition, the Department cross-staffs a 27-foot Type IV fireboat and a trailered rescue watercraft—moored at the Berkeley Marina and staffed with on-duty Station 1 and Station 6 personnel as needed.

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. The following table describes the five probability of occurrence categories and related characteristics used for this analysis.

Table 37—Probability of Occurrence Categories

Probability	General Characteristics	Expected Frequency of Occurrence
Rare	• Hazard ***may occur*** rarely under unusual conditions.	> 10 years
Unlikely	• Hazard ***could occur*** infrequently. • No recorded or anecdotal evidence of occurrence. • Little opportunity, reason, or means for hazard to occur.	2–10 years
Possible	• Hazard ***should occur*** occasionally. • Infrequent, random recorded or anecdotal evidence of occurrence. • Some opportunity, reason, or means for hazard to occur.	1–23 months
Probable	• Hazard will ***probably occur*** regularly. • Regular recorded or strong anecdotal evidence of occurrence. • Considerable opportunity, reason, or means for hazard to occur.	1–4 weeks
Frequent	• Hazard is ***expected to occur*** frequently. • High level of recorded or anecdotal evidence of regular occurrence. • Strong opportunity, reason, or means for hazard to occur. • Frequent hazard recurrence.	Daily to weekly

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

A.1.8 Impact Severity

Impact severity refers to the *probable* extent a hazard occurrence impacts people, buildings, lifeline services, the environment, and the broader community. The following table summarizes the five impact severity categories and related general criteria used for this assessment.

Table 38—Impact Severity Categories

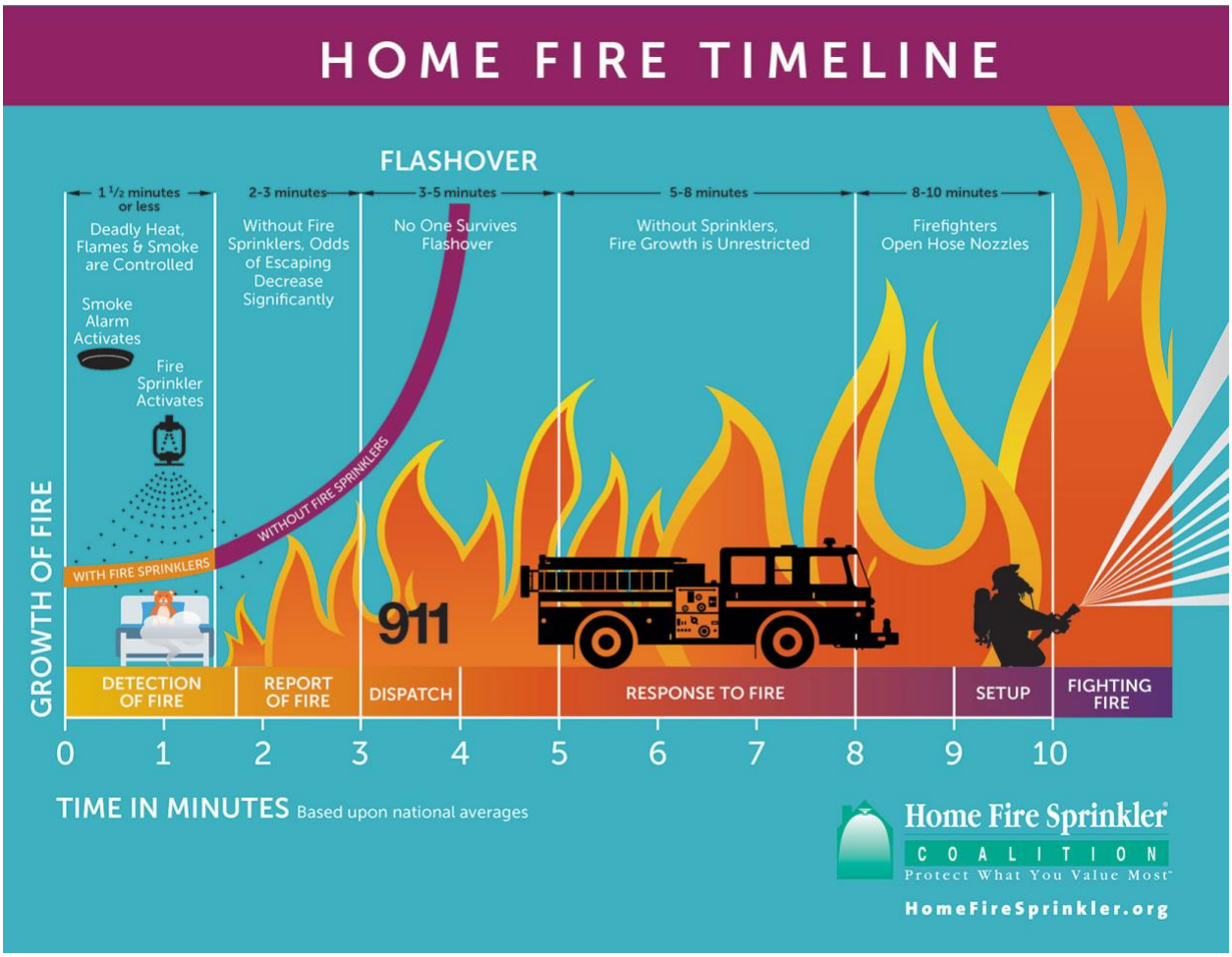
Impact Severity Category	Characteristics
Insignificant	• No injuries or fatalities • None to few persons displaced for short duration • Little or no personal support required • None to inconsequential damage • None to minimal community disruption • No measurable environmental impacts • None to minimal financial loss • No wildland Fire Hazard Severity Zones (FHSZs)
Minor	• Few injuries; no fatalities; minor medical treatment only • Some displacement of persons for less than 24 hours • Some personal support required • Some minor damage • Minor community disruption of short duration • Small environmental impacts with no lasting effects • Minor financial loss • No wildland FHSZs
Moderate	• Medical treatment required; some hospitalizations; few fatalities • Localized displacement of persons for fewer than 24 hours • Personal support satisfied with local resources • Localized damage • Normal community functioning with some inconvenience • No measurable environmental impacts with no long-term effects, or small impacts with long-term effect • Moderate financial loss • Less than 25% of area in *Moderate* or *High* wildland FHSZs
Major	• Extensive injuries; significant hospitalizations; many fatalities • Large number of persons displaced for more than 24 hours • External resources required for personal support • Significant damage • Significant community disruption; some services not available • Some impact to environment with long-term effects • Major financial loss with some financial assistance required • More than 25% of area in *Moderate* or *High* wildland FHSZs; less than 25% in *Very High* wildland FHSZs
Catastrophic	• Large number of severe injuries requiring hospitalization; significant fatalities • General displacement for extended duration • Extensive personal support required • Extensive damage • Community unable to function without significant external support • Significant impact to environment and/or permanent damage • Catastrophic financial loss; unable to function without significant support • More than 50% of area in *High* wildland FHSZs; more than 25% of area in *Very High* wildland FHSZs

A.1.9 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 City's building fire risk.

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

Figure 24—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org

Population Density

The population density in the City ranges from less than 5,000 to more than 40,000 people per square mile as shown in Map #2 (**Volume 2—Map Atlas**). 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 near all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. Potable water for the City is provided by the East Bay Municipal Utility District. According to City staff, fire flow, pressure, and hydrant spacing are adequate throughout the City except for in areas west of I-80 and some of the higher elevation areas in the eastern/northeastern Berkeley Hills.

Building Fire Service Demand

For the three-year study period from July 1, 2018, through June 30, 2021, the Department responded to 193 building fire incidents comprising 0.45 percent of total annual service demand over the same period, as summarized in the following table.

Table 39—Building Fire Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Building Fire	RY 18/19	8	13	7	0	13	10	1	1	**53**	0.35%
	RY 19/20	8	19	10	8	23	11	2	3	**84**	0.56%
	RY 20/21	16	8	2	7	15	6	0	2	**56**	0.43%
Total		**32**	**40**	**19**	**15**	**51**	**27**	**3**	**6**	**193**	**0.45%**
Percent Total Station Demand		0.47%	0.50%	0.40%	0.37%	0.50%	0.50%	0.20%	0.26%		

As the table shows, building fire service demand was consistent over the three-year study period, with the greatest demand in Station 5's response area, and the least demand in Station 7's response area. **Overall, building fire service demand is like that of other California jurisdictions of similar size and demographics.**

Building Fire Risk Assessment

The following table summarizes Citygate's assessment of the City's building fire risk by planning zone.

Table 40—Building Fire Risk Assessment

Building Fire Risk	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Possible*	*Probable*	*Possible*	*Possible*	*Probable*	*Possible*	*Possible*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***

A.1.10 Vegetation/Wildland Fire Risk

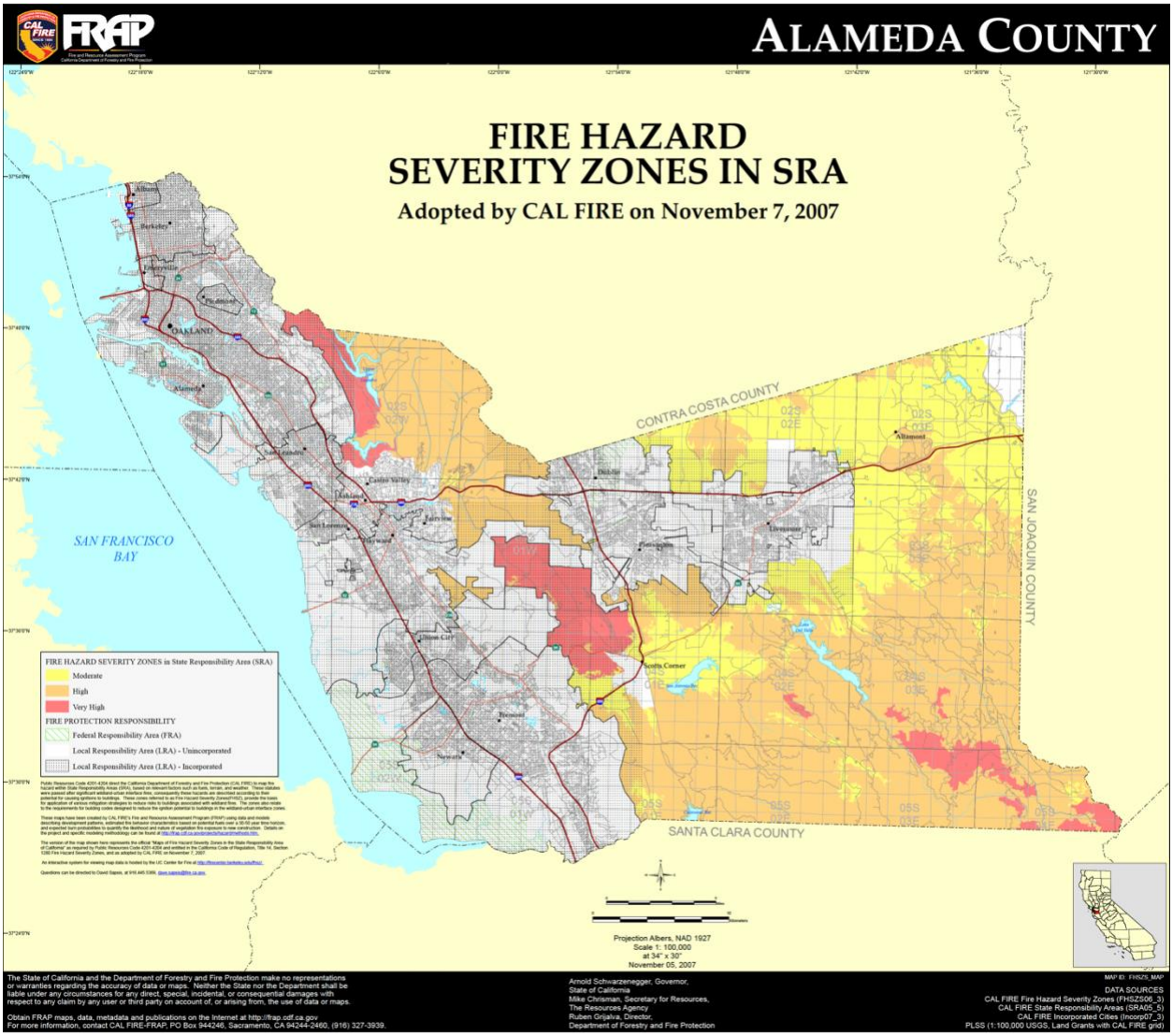
Many areas within and adjacent to the City are susceptible to a vegetation/wildland fire, particularly a wind-driven fire along the City's eastern Berkeley Hills border. The fire risk facing people and properties in the eastern hills is compounded by the area's mountainous topography, limited water supply, and limited access/egress routes. The City's flatlands are also exposed to a fire that spreads west from the hills. The flatlands are densely covered with old wooden buildings housing low-income and vulnerable populations, including isolated seniors, people with disabilities, and students.

Vegetation/wildland fire risk factors include vegetative fuel types and configuration, weather, topography, prior fires, water supply, mitigation measures, and vegetation fire service capacity.

Wildland Fire Hazard Severity Zones

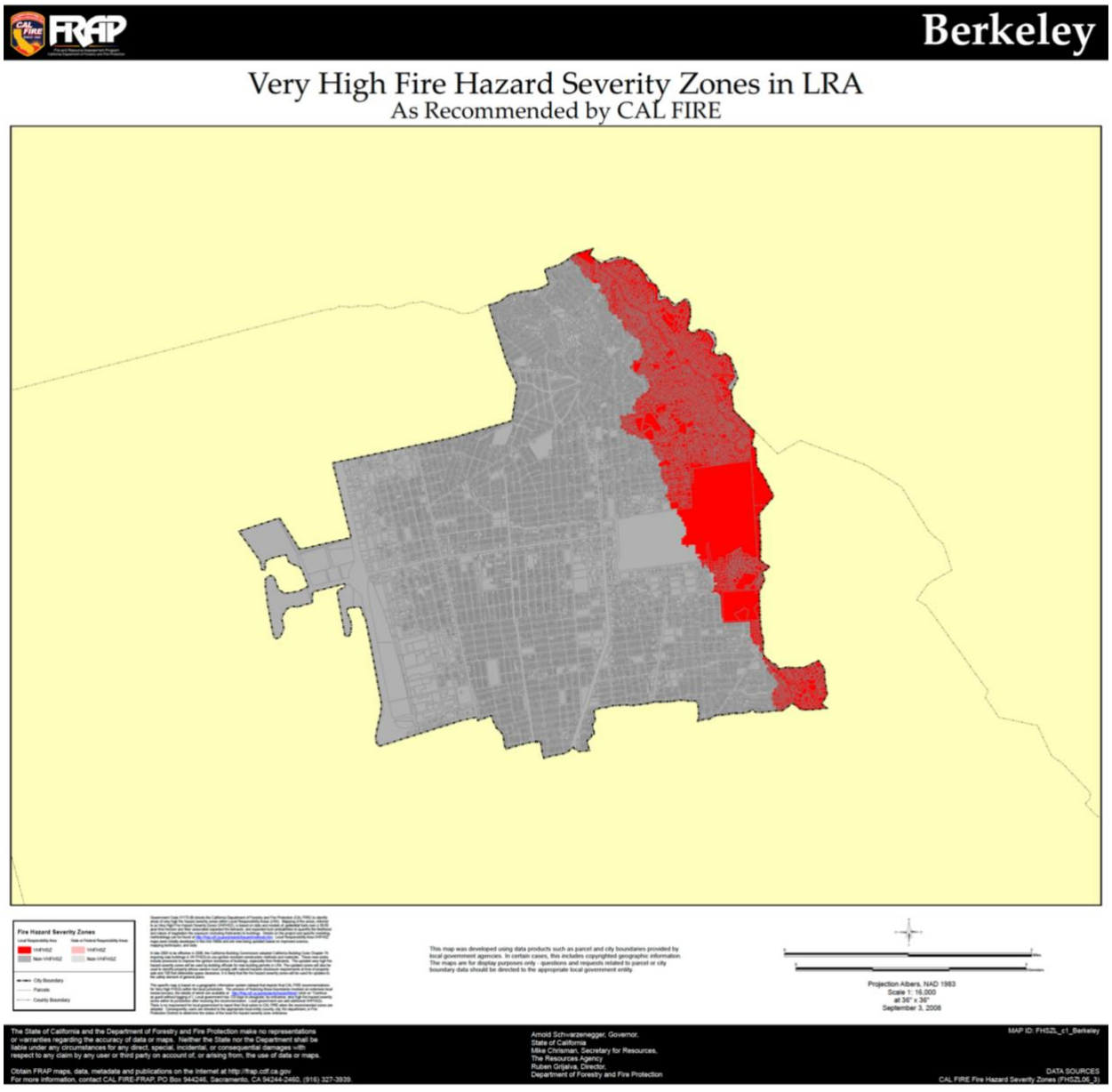
The California Department of Forestry and Fire Protection (CAL FIRE) designates wildland Fire Hazard Severity Zones (FHSZ) throughout the state based on analysis of multiple wildland fire hazard factors and modeling of potential wildland fire behavior. For State Responsibility Areas (SRAs) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates ***Moderate***, ***High***, and ***Very High*** FHSZs by county, as shown in yellow, orange, and red, respectively, in the following map for Alameda County. Although not shown on this map, the entire western edge of Contra Costa County east of the City is a ***Very High*** FHSZ.

Figure 25—SRA Wildland Fire Hazard Severity Zones – Alameda County



CAL FIRE also identifies recommended ***Very High*** FHSZs for Local Responsibility Areas (LRAs) where the local jurisdiction is responsible for wildland fire protection, including incorporated cities, as shown in red in the following map for the City.

Figure 26—Berkeley Recommended Very High Wildland Fire Hazard Severity Zones in LRA

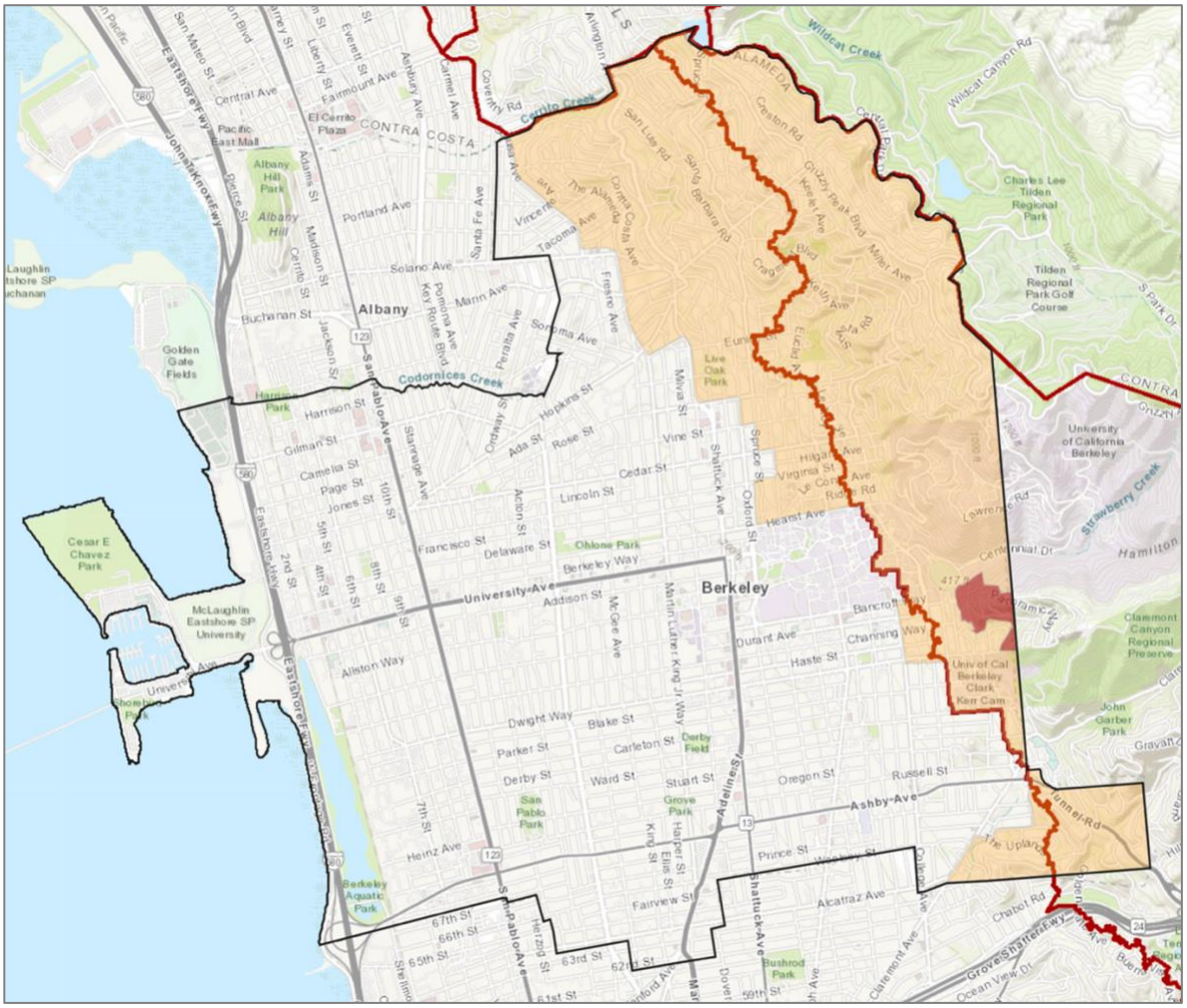


On December 6, 2023, via Ordinance #7845 adopting its Fire Code, the City of Berkeley adopted a more locally tailored VHFHSZ expanding CAL FIRE's recommended area shown in the previous figure. Instead, and as shown in the following figure, the City adopted all of the orange- and red-shaded areas as Berkeley's VHFHSZ.

In addition, the City has divided Berkeley into three separate Hazardous Fire zones, as also shown in the following figure. Fire Zone 3 is the Panoramic area, shaded in red. Fire Zone 2 is the

remainder of the Berkeley Hills (and VHFHSZ) area, shaded in orange. The Berkeley flats are not shaded, and represent Fire Zone 1.[24]

Figure 27—Very High Fire Hazard Severity Zone and Hazardous Fire Zones – Berkeley



Sources: Fire Zones 1, 2, and 3 as of 01/2013 Berkeley Ordinance NO. 7,157-N.S., and California Department of Forestry. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

[24] Source: City of Berkeley 2019 Local Hazard Mitigation Plan, Map 16.

Vegetative Fuels

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

Weather

Weather elements, including temperature, relative humidity, wind, and lightning, also affect vegetation/wildland 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/wildland fire behavior, with higher wind speeds increasing fire spread and intensity. The City has a Mediterranean climate with warm, dry summers and cool, wet winters. Summers are cooler than a typical Mediterranean climate due to foggy nights and mornings. Average summer high temperatures are in the mid-70s, with an average of less than three days per year over 90 degrees Fahrenheit. Strong offshore winds develop in late spring and early fall producing higher temperatures and lower humidity. Average annual rainfall is 25 inches. Fuel and weather conditions conducive to vegetation/wildland fires primarily occur during the summer and fall months.

Topography

Vegetation/wildland 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 City's topography transitions from being flat / sea level along San Francisco Bay in the west to steeper, sloped terrain approaching 1,000 feet in elevation in the Berkeley Hills along the City's eastern edge. The eastern Berkeley Hills area of the City can influence vegetation/wildland fire behavior and spread.

Water Supply

Another significant vegetation fire impact severity factor is the water supply immediately available for fire suppression. According to Fire Department staff, available fire flow, pressure, and hydrant spacing is adequate except west of I-80 and some areas in the Berkeley Hills sections of the City with wharf type hydrants with low flow and pressure.

Wildland Fire History

The risk of a wildland-urban interface (WUI) fire in the City was clearly demonstrated in the 1991 Tunnel Fire, which resulted in 25 deaths and 62 homes destroyed in Berkeley and more than 3,000 in Oakland. Accounts of major wildfires in the City date back to at least 1905 when a fire burned

through Strawberry Canyon and threatened the University campus and the small Panoramic Hill subdivision. Other major fires occurred in the 1970s and 1980s.

Vegetation/Wildland Fire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring 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 impacts when those hazards do occur.

The City employs a comprehensive strategy to reduce both the occurrence and severity of its vegetation/wildland fires, including strict building and fire code provisions with more restrictive local amendments, annual inspection, and enforcement of vegetation fire hazard clearances in high-risk areas, improvement of access/egress routes, and infrastructure maintenance. Fire Department staff inspect more than 1,400 properties in Fire Hazard Zones 2 and 3 each year, and other properties throughout the City on a complaint basis. The City also has several other ongoing fuel management/reduction programs to reduce vegetative fuel loading in higher fire hazard areas.

Vegetation/Wildland Fire Service Demand

The Department responded to 59 vegetation fires over the three-year study period, comprising 0.14 percent of total service demand over the same period, as summarized in the following table.

Table 41—Vegetation/Wildland Fire Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Vegetation / Wildland Fire	RY 18/19	5	1	1	2	1	4	1	1	**16**	0.10%
	RY 19/20	3	0	2	1	2	3	2	2	**15**	0.10%
	RY 20/21	5	7	0	1	0	8	2	5	**28**	0.22%
Total		**13**	**8**	**3**	**4**	**3**	**15**	**5**	**8**	**59**	**0.14%**
Percent Total Station Demand		0.19%	0.10%	0.06%	0.10%	0.03%	0.28%	0.33%	0.34%		

Vegetation/Wildland Fire Risk Assessment

The following table summarizes Citygate's assessment of the City's vegetation/wildland fire risk by planning zone.

Table 42—Vegetation/Wildland Fire Risk Assessment

Vegetation/Wildland Fire Risk	Risk Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Possible*	*Possible*	*Possible*	*Possible*	*Possible*	*Possible*	*Possible*
Probable Impact Severity	*Minor*	*Catastrophic*	*Catastrophic*	*Catastrophic*	*Moderate*	*Minor*	*Catastrophic*
Overall Risk	***Low***	***Extreme***	***Extreme***	***Extreme***	***Moderate***	***Low***	***Extreme***

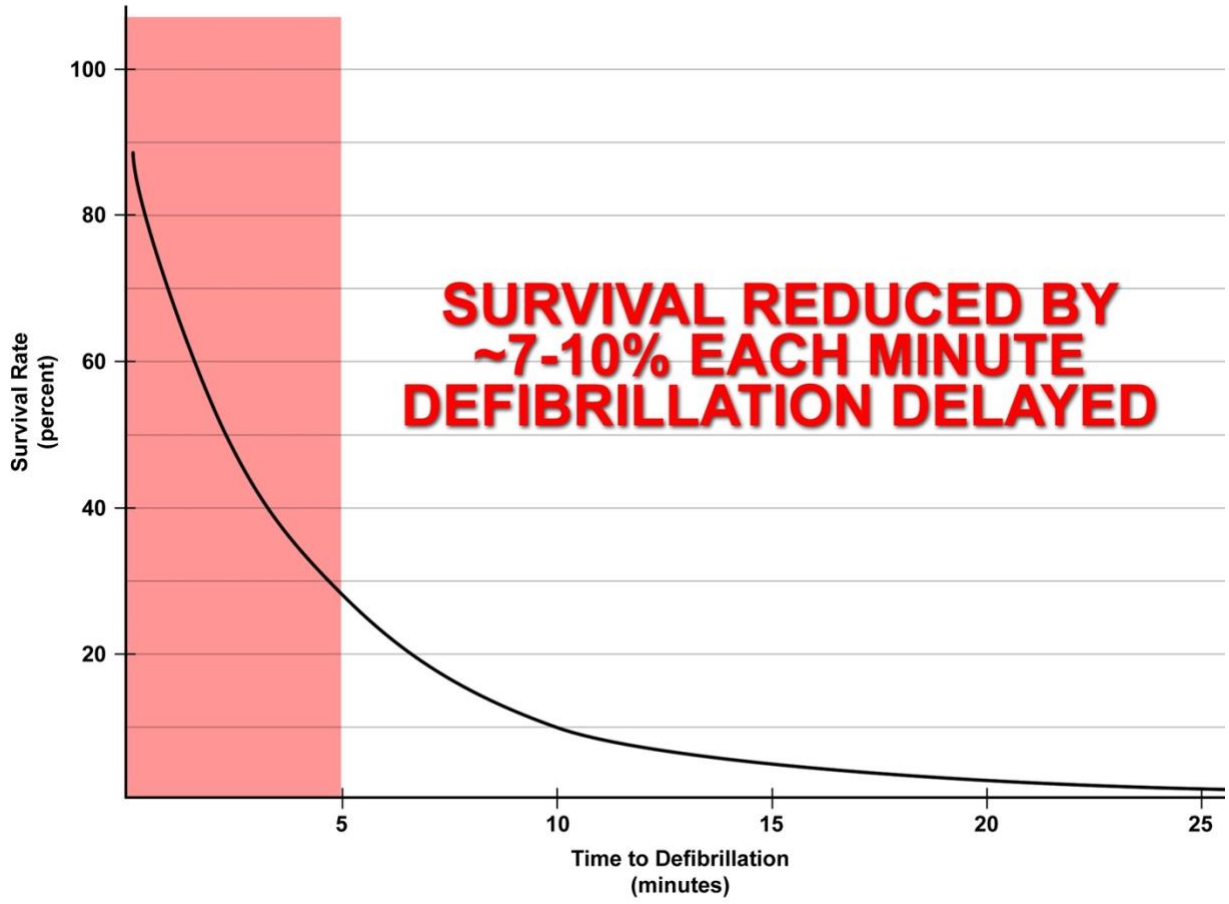
A.1.11 Medical Emergency Risk

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 from 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.

The following figure 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 28—Survival Rate Versus Time to Defibrillation



Population Density

Population density in the City ranges from less than 5,000 to more than 40,000 people per square mile, as shown in Map #2 (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. As shown in Table 32, nearly 16 percent of the population is 65 and older, only slightly more than 3 percent of the population over 24 years of age has less than a high school education or equivalent, nearly 19 percent of the population is at or below poverty level, and 2.6 percent of the population does not have health insurance coverage.[25]

[25] Source: Esri Community Analyst Community Profile (2021) and U. S. Census Bureau.

Vehicle Traffic

Medical emergency risk tends to be higher in areas of a community with high daily vehicle traffic volume, particularly areas with high traffic volume traveling at high speeds. The City's transportation network includes State Routes 13 and 123, and Interstate 80 carrying an aggregate annual average daily traffic volume of more than 278,000 vehicles, with a peak-hour load of more than 20,000 vehicles.[26]

Medical Emergency Service Demand

Medical emergency service demand over the three-year study period includes more than 23,000 calls for service comprising 53.2 percent of total service demand over the same period, as summarized in the following table.

Table 43—Medical Emergency Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Medical Emergency	RY 18/19	1,358	1,871	863	681	2,055	1,223	213	542	**8,806**	57.33%
	RY 19/20	1,341	1,711	666	572	1,614	1,042	252	438	**7,636**	51.26%
	RY 20/21	1,261	1,330	460	639	1,551	889	271	183	**6,584**	50.63%
Total		**3,960**	**4,912**	**1,989**	**1,892**	**5,220**	**3,154**	**736**	**1,163**	**23,026**	**53.23%**
Percent Total Station Demand		57.78%	61.25%	41.39%	47.03%	50.81%	58.10%	48.87%	49.49%		

As the previous table shows, medical emergency service demand varies significantly by planning zone and *decreased* more than 25 percent over the three-year study period. Overall, medical emergency service demand is typical of other jurisdictions with similar demographics.

Medical Emergency Risk Assessment

The following table summarizes Citygate's assessment of medical emergency risk by planning zone.

[26] Source: California Department of Transportation (2020).

Table 44—Medical Emergency Risk Assessment

Medical Emergency Risk	Risk Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***High***	***High***	***High***	***High***	***High***	***High***	***High***

A.1.12 Hazardous Material Risk

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

Fixed Hazardous Materials Facilities

City staff identified six facilities within Berkeley that require a state or local Certified Unified Program Agency (CUPA) operating permit, and an additional 294 facilities that generate hazardous waste. There are also PG&E natural gas transmission pipelines running generally north/south along Seventh Street, and east/west along Allston Way and Russell Streets.

There are 15 different locations on the UC Berkeley Campus where regulated quantities of hazardous materials are used. Many materials are in small quantities for research and teaching purposes. All use locations are inspected by City Fire and or City Toxics Management staff amounting to approximately six inspections per year as part of a three-year cycle. The Campus safety staffs also provide oversight to these locations. The regulations, reporting and oversight inspections are the same as any other commercial site in the City. Further, the Fire Department's Hazardous Material incident response capability is prepared for these types of materials and will respond appropriately should an accidental release occur.

The Lawrence Berkeley National Laboratory (LBNL) is a 202-acre facility in the Berkeley Hills above the UC Berkeley campus supported by the U.S. Department of Energy (DOE) Office of Science and managed by the University of California. Employing approximately 5,200 scientists, engineers, and support staff to conduct unclassified research across a wide range of scientific disciplines. The lab hosts an average of 19,000 visitors annually, including U.S. citizens and foreign nationals. Additional on-site contractors, visiting researchers, students, and other guests frequent the LBNL campus in part to use or support the five National User Facilities: the Advanced Light Source, Energy Sciences Network, Joint Genome Institute, Molecular Foundry, and National Energy Research Scientific Computing Center in addition to the other on-site and off-site user

facilities. The main campus consists of approximately 226 facilities and structures, of which approximately 82 are occupied by LBNL staff, researchers, or visitors.

The laboratory, in some very controlled settings, does use extremely toxic hazardous materials for research and development. Quantities are typically low, and the lab employs fire and hazardous materials safety personnel to ensure best practice mechanical controls are used to prevent a sustained, dangerous release. However, a catastrophic accident could occur that could spread downwind beyond a parking lot buffer and into other lab buildings, the UC campus, or the City itself. The lab and its fire department contractor, along with the Berkeley Fire Department, are trained and have plans for such a rare occurrence.

In addition to having on-site emergency assessment and response teams, LBNL contracts with the Alameda County Fire Department (ACFD) for on-site fire and EMS services, including a full ACFD hazardous materials response team that coordinates closely with facility staff and the Department's Hazardous Materials Response Team. All hazardous materials and processes are regularly screened for quantity, toxicity, and dispersibility, and comprehensive emergency plans developed to largely mitigate risks to the interior of an affected building in conformance with federal Emergency Management Program requirements, however a worst-case scenario could potentially affect eastern Berkeley including the UC campus.

Transportation-Related Hazardous Materials

The City also has transportation-related hazardous material risk because of its road transportation network, including State Routes 13 and 123, and Interstate 80, with heavy daily truck traffic volume, many carrying hazardous commodities, as summarized in the following table.

Table 45—Average Annual Daily Truck Traffic

Highway	Crossing	AADT[1]	Truck AADT by Axles				Percentage of Truck AADT by Axles			
			2	3	4	5+	2	3	4	5+
SR 13	SR 123	758	522	123	26	86	68.87%	16.23%	3.43%	11.35%
I-80	SR 13	10,438	3,655	1,041	416	5,327	35.02%	9.97%	3.99%	51.03%
SR 123	SR 13	431	338	53	8	32	78.42%	12.30%	1.86%	7.42%
	Total	**11,627**	**4,515**	**1,217**	**450**	**5,445**	**38.83%**	**10.47%**	**3.87%**	**46.83%**

[1] Average Annual Daily Trips
Source: California Department of Transportation (2020)

There is also a Union Pacific railroad line running generally north/south between Interstate 80 and State Route 123, and it is reasonable to assume that some railcars are transporting hazardous commodities.

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As shown in Map #2 Population Density by Block Group (**Volume 2—Map Atlas**), the population density within the City ranges from less than 5,000 to more than 40,000 people per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they are unable to leave voluntarily. As shown in Table 34, slightly more than 22 percent of the population is under age 10 or is 65 years of age and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

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

Through Berkeley Ready, the Department's Office of Emergency Services (OES) coordinates a suite of programs to build and maintain community disaster resilience. For example, OES maintains real-time online evacuation maps that are accessible to the public and provide incident location(s), evacuation route(s), and temporary evacuation shelter locations.[27]

In addition, the City participates in AC Alert, a free subscription and reverse 9-1-1-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. The City also utilizes social media, Wireless Emergency Alerts (WEA), local AM and FM radio stations, and local television outlets to provide timely emergency information and alerts. OES has established 78 pre-designated geographic evacuation zones within the City, and AC Alert emergency notification messages can be issued by numerous designated OES, City Manager's Office, and Fire and Police Department personnel down to the supervisor level. OES also conducts

[27] https://community.zonehaven.com

ongoing Emergency Operations Center training as needed and strives to conduct a full EOC exercise at least annually.

Hazardous Material Service Demand

The Department responded to 565 hazardous material incidents over the study period of three reporting years, comprising 1.31 percent of total service demand over the same period, as summarized in the following table.

Table 46—Hazardous Material Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Hazardous Material	RY 18/19	33	33	20	26	41	19	7	9	**188**	1.22%
	RY 19/20	32	35	19	18	43	42	10	5	**204**	1.37%
	RY 20/21	20	33	20	17	38	29	9	7	**173**	1.33%
Total		**85**	**101**	**59**	**61**	**122**	**90**	**26**	**21**	**565**	**1.31%**
Percent Total Station Demand		1.24%	1.26%	1.23%	1.52%	1.19%	1.66%	1.73%	0.89%		

As the table shows, hazardous material service demand varies significantly by planning zone and was generally consistent over the three reporting years analyzed within this study.

Hazardous Materials Risk Assessment

The following table summarizes Citygate's assessment of the City's hazardous materials risk by planning zone.

Table 47—Hazardous Materials Risk Assessment

Hazardous Materials Risk	Risk Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Probable*	*Probable*	*Probable*	*Probable*	*Probable*	*Probable*	*Possible*
Probable Impact Severity	*Moderate*	*Moderate*	*Major*	*Moderate*	*Moderate*	*Moderate*	*Major*
Overall Risk	***Moderate***	***Moderate***	***High***	***Moderate***	***Moderate***	***Moderate***	***High***

A.1.13 Technical Rescue Risk

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

Construction Activity

There is ongoing residential, commercial, industrial, and infrastructure construction activity occurring within the City.

Confined Spaces

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

Bodies of Water

Bodies of water within the City include San Francisco Bay and smaller ponds, creeks, and seasonal waterways.

Transportation Volume

Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the service area, with State Routes 13 and 123 and Interstate 80 carrying an aggregate annual average daily traffic volume of more than 278,000 vehicles, with a peak-hour load of more than 20,000 vehicles.

Earthquake Risk[28]

A significant earthquake event is one of the hazards of greatest concern to the City, with a high probability of occurrence and the potential for widespread damage. There are several known and potentially undiscovered faults in Alameda County, including the Hayward Fault with three fault segments, the San Andreas Fault with ten fault segments, and the Northern Calaveras and Greenville Faults.

Numerous destructive earthquakes have occurred historically in the greater San Francisco Bay Area region, and the U.S. Geological Service (USGS) predicts a 72 percent probability of one or more Magnitude 6.7 or greater earthquakes over the next 21 years.

Flood Risk[29]

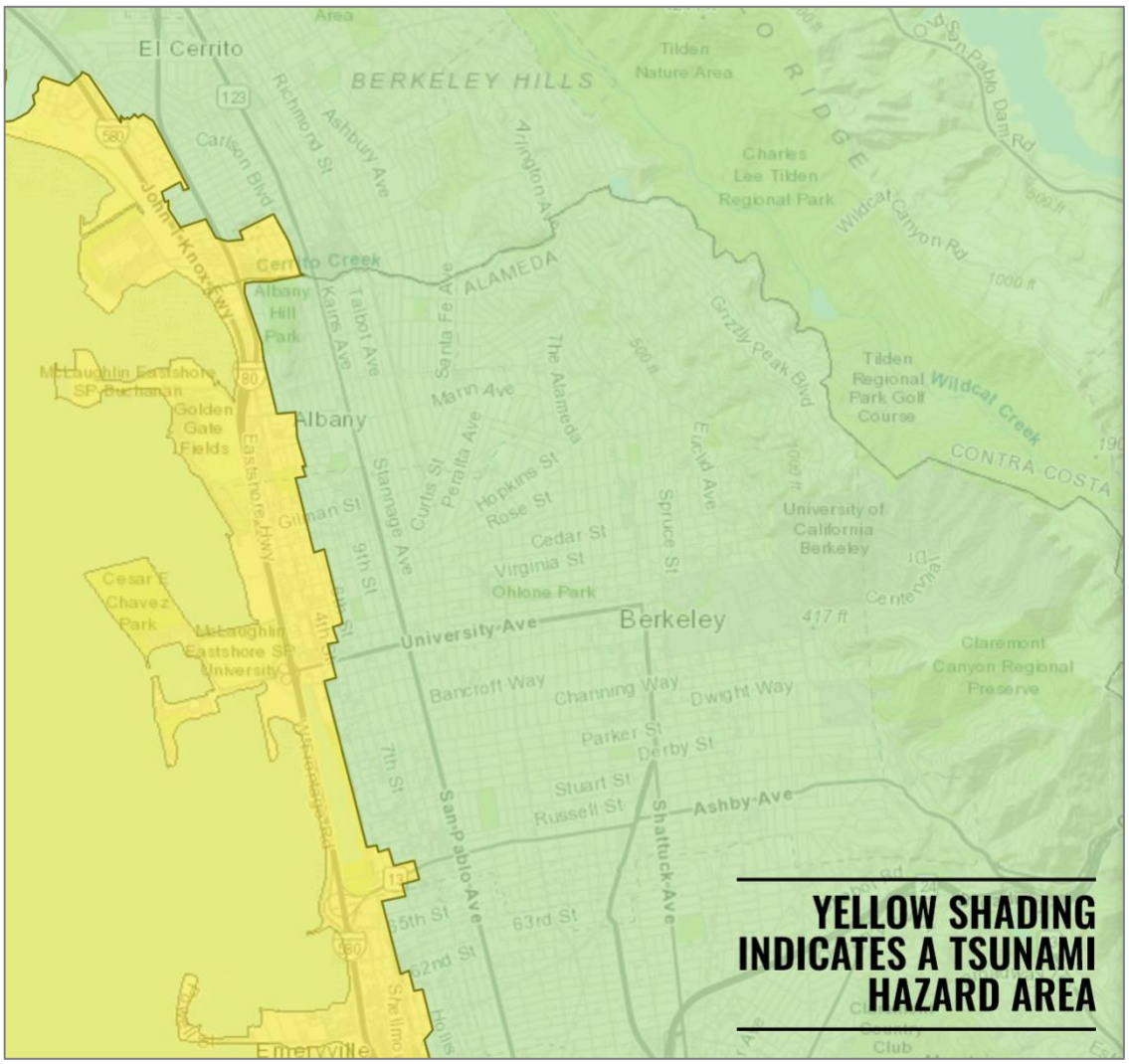
Some areas of the City are subject to minor flooding hazard, primarily from local creek flooding and storm drain overflow along the western edge of the City adjacent to San Francisco Bay, the low-lying areas between Harrison Street and Dartmouth Street, and some areas of the UC Berkeley campus.

[28] Source: 2019 City of Berkeley Hazard Mitigation Plan, Section B.5.
[29] Source: 2019 City of Berkeley Hazard Mitigation Plan, Section B.8.

Tsunami Risk[30]

Tsunamis affecting the Bay Area can result from offshore earthquakes within the Bay Area, or from more distant events. While it is most common for tsunamis impacting the Bay Area to be generated by faults in Washington and Alaska, local tsunamis can be generated from local underwater faults. While tsunamis entering San Francisco Bay are rare, a March 2011 tsunami event resulted in a half-meter-tall surge and $158,000 damage to boats and docks in the Berkeley Marina. The following map shows the areas of the City potentially subject to inundation from a tsunami event.

Figure 29—Tsunami Inundation Zones



Source: California Department of Conservation Tsunami Maps (Updated 2022)

[30] Source: 2019 City of Berkeley Hazard Mitigation Plan, Section B.9.

Technical Rescue Service Demand

Over the three-year study period, there were 224 technical rescue incidents in the City comprising 0.52 percent of total service demand, as summarized in the following table.

Table 48—Technical Rescue Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Technical Rescue	RY 18/19	10	14	14	6	18	11	2	9	**84**	0.55%
	RY 19/20	8	19	13	3	19	8	0	3	**73**	0.49%
	RY 20/21	16	12	4	4	15	14	0	2	**67**	0.52%
Total		**34**	**45**	**31**	**13**	**52**	**33**	**2**	**14**	**224**	**0.52%**
Percent Total Station Demand		0.50%	0.56%	0.65%	0.32%	0.51%	0.61%	0.13%	0.60%		

Technical Rescue Risk Assessment

The following table summarizes Citygate's assessment of technical rescue risk by planning zone.

Table 49—Technical Rescue Risk Assessment

Technical Rescue Risk	Risk Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Possible*	*Probable*	*Possible*	*Possible*	*Probable*	*Possible*	*Unlikely*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Low***

A.1.14 Marine Incident Risk

Marine incident risk factors include water and near-shore recreational activity, and watercraft storage and use in or on City waterways. Marine incidents include watercraft fires, searches for person(s) in water, and water and watercraft rescues.

Waterways

The primary bodies of water in the City are San Francisco Bay and Aquatic Park.

Berkeley Marina

The Berkeley Marina, located on the western side of the City adjacent to San Francisco Bay, has approximately 925 slips accommodating boats up to 80+ feet in length.

Recreational Activity

The Berkeley waterfront / San Francisco Bay is a popular destination for near-shore and open water recreational activities, including boating, swimming, snorkeling, diving, fishing, etc.

Marine Incident Service Capacity

The Department's marine incident service capacity includes up to 24 personnel certified by State Fire Training as Open Water Rescue swimmers, a 27-foot aluminum fire boat, and one rescue watercraft.

Marine Incident Service Demand

Over the three-year study period, the Department responded to 40 marine incidents comprising 0.09 percent of total service demand over the same period as shown in the following table.

Table 50—Marine Incident Service Demand

Hazard	Year	Risk Planning Zone								Total	Percent Total Annual Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Other		
Marine Incident	RY 18/19	0	0	0	0	0	10	0	2	**12**	0.08%
	RY 19/20	4	0	0	1	0	8	0	0	**13**	0.09%
	RY 20/21	3	0	0	0	0	10	0	2	**15**	0.12%
Total		**7**	**0**	**0**	**1**	**0**	**28**	**0**	**4**	**40**	**0.09%**
Percent Total Station Demand		0.10%	0.00%	0.00%	0.02%	0.00%	0.52%	0.00%	0.17%		

Marine Incident Risk Assessment

The following table summarizes Citygate's assessment of the City's marine incident risk by planning zone.

Table 51—Marine Incident Risk Assessment

Marine Incident Risk	Risk Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability of Occurrence	*Possible*	*Rare*	*Rare*	*Unlikely*	*Rare*	*Possible*	*Possible*
Probable Impact Severity	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Minor*
Overall Risk	***Moderate***	***Low***	***Low***	***Low***	***Low***	***Moderate***	***Low***

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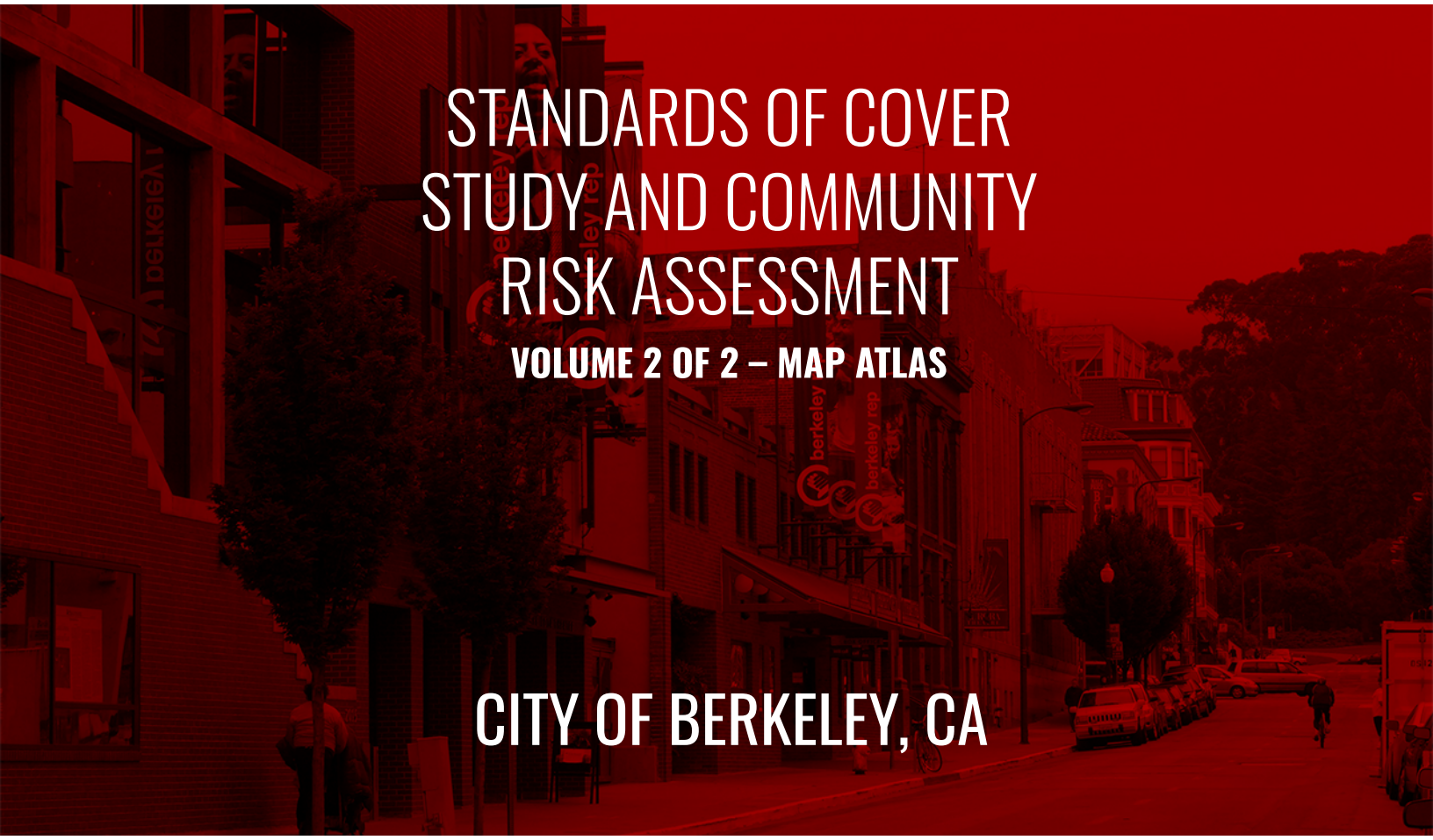

STANDARDS OF COVER STUDY AND COMMUNITY RISK ASSESSMENT

VOLUME 2 OF 2 – MAP ATLAS

CITY OF BERKELEY, CA

DECEMBER 13, 2023

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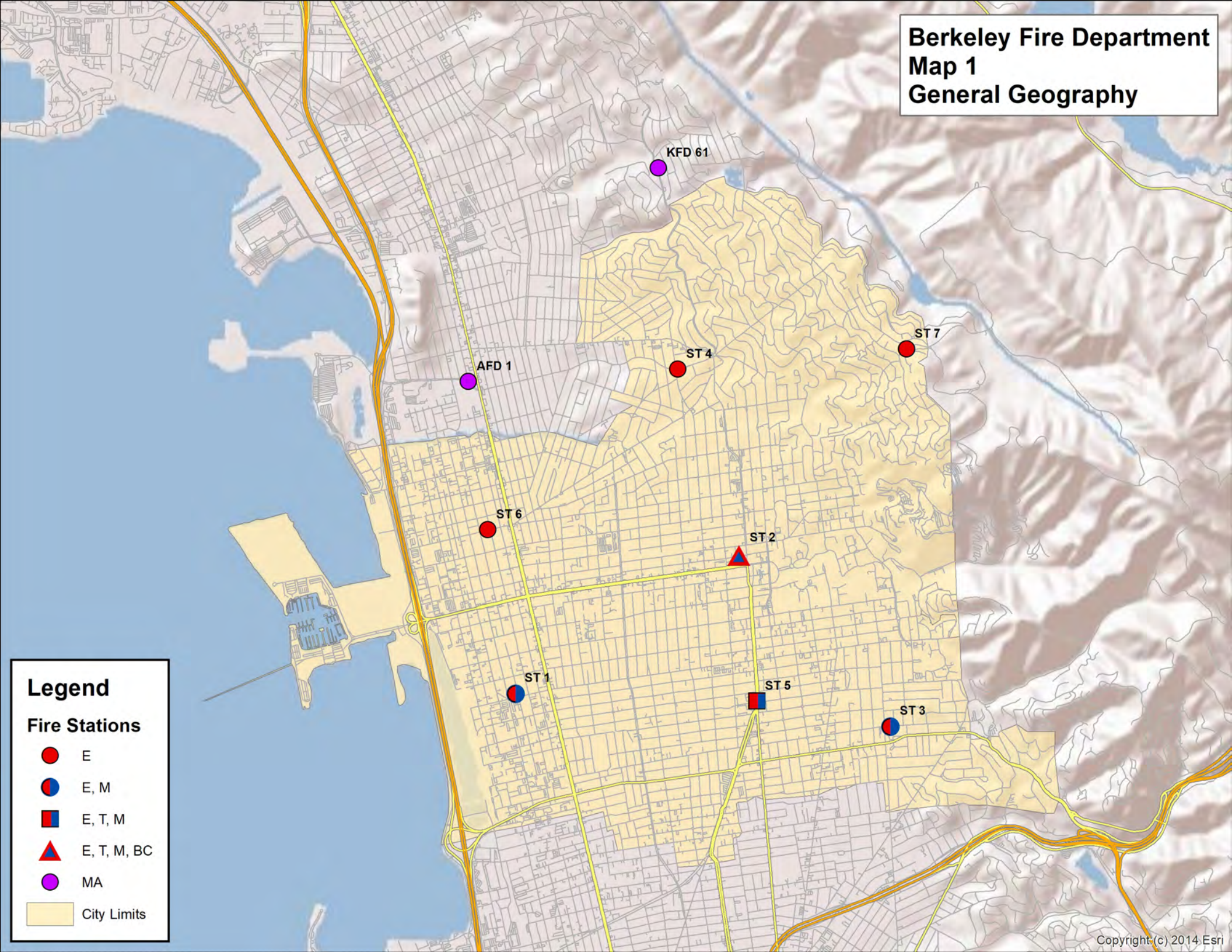
Berkeley Fire Department
Map 1
General Geography
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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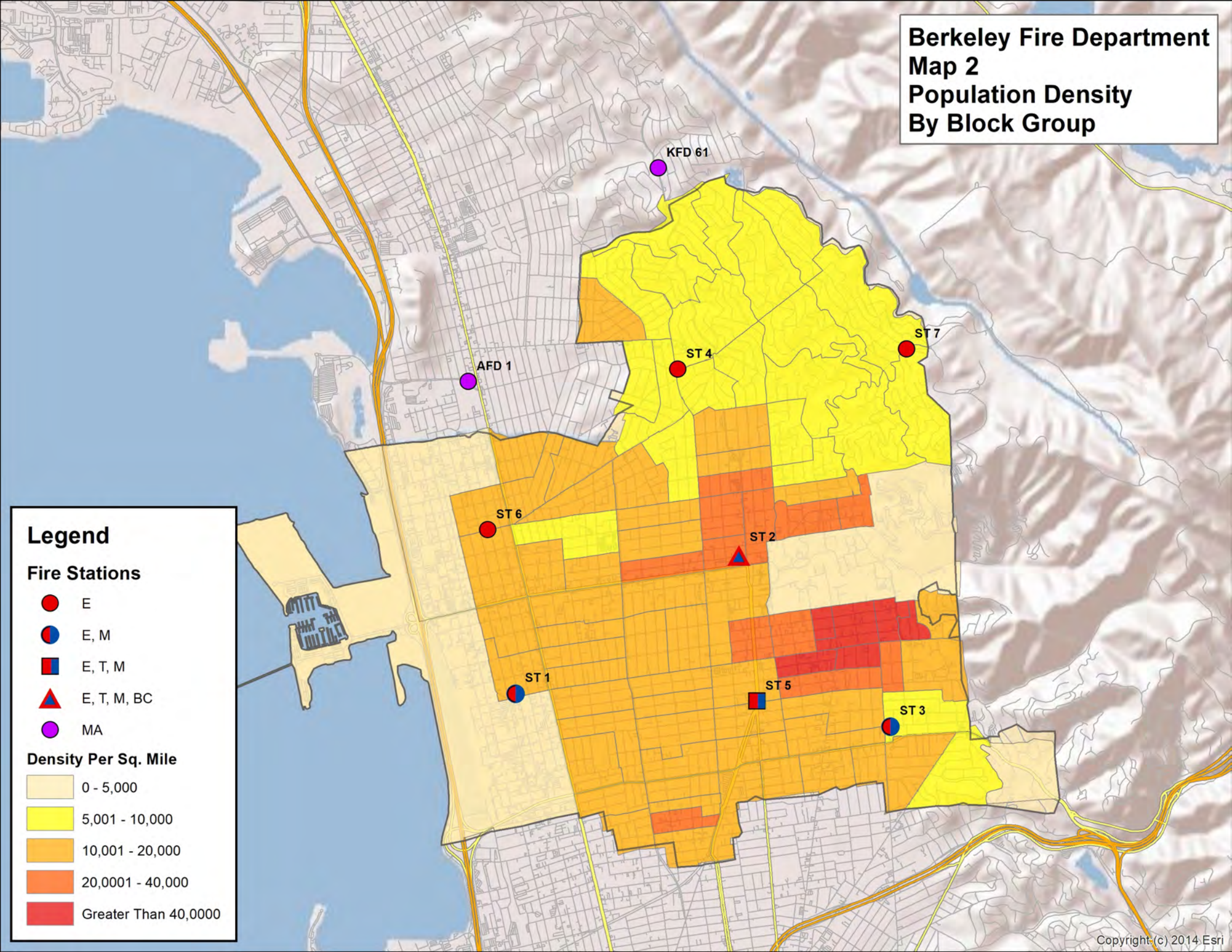
Berkeley Fire Department
Map 2
Population Density
By Block Group
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
Density Per Sq. Mile
0 - 5,000
5,001 - 10,000
10,001 - 20,000
20,0001 - 40,000
Greater Than 40,0000
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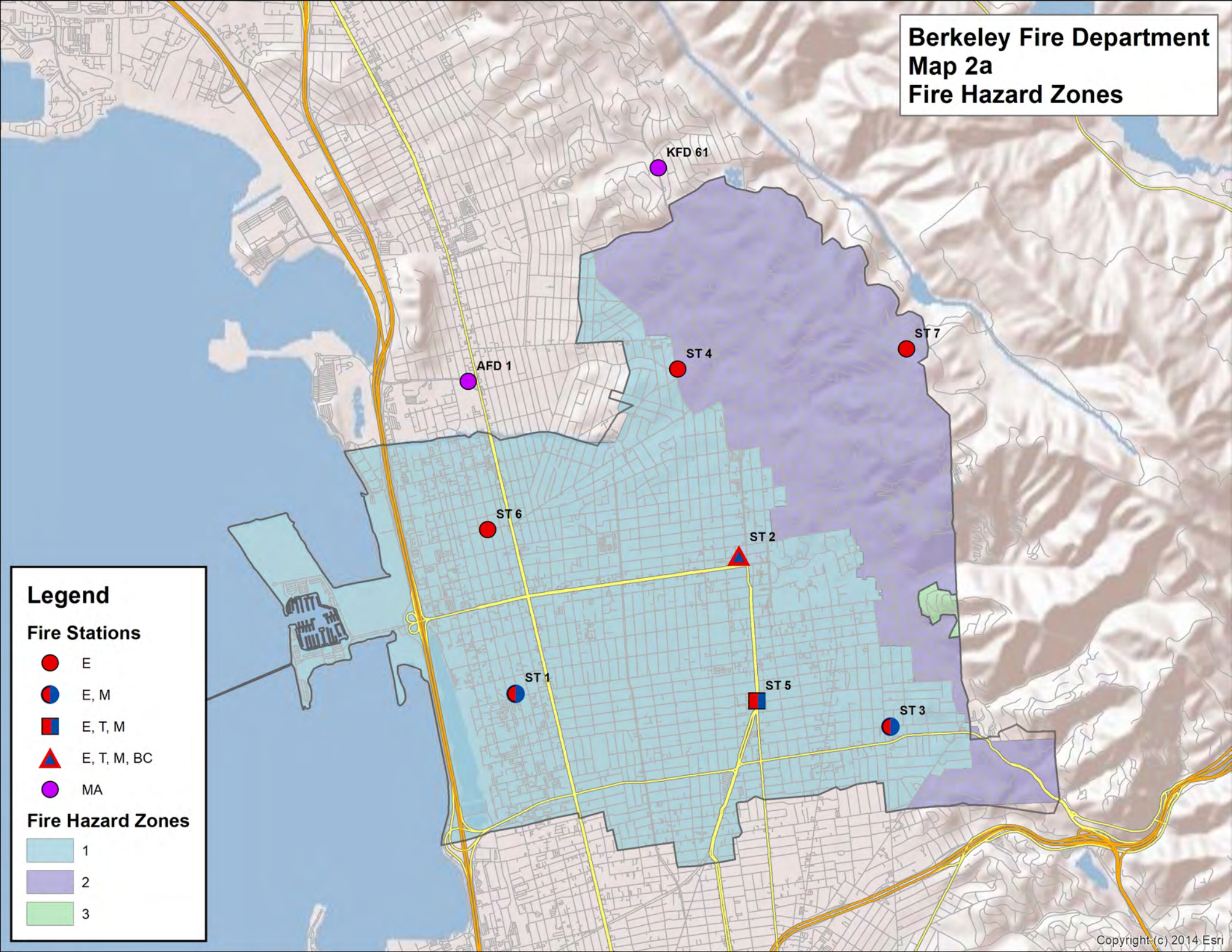
Berkeley Fire Department
Map 2a
Fire Hazard Zones
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
Fire Hazard Zones
1
2
3
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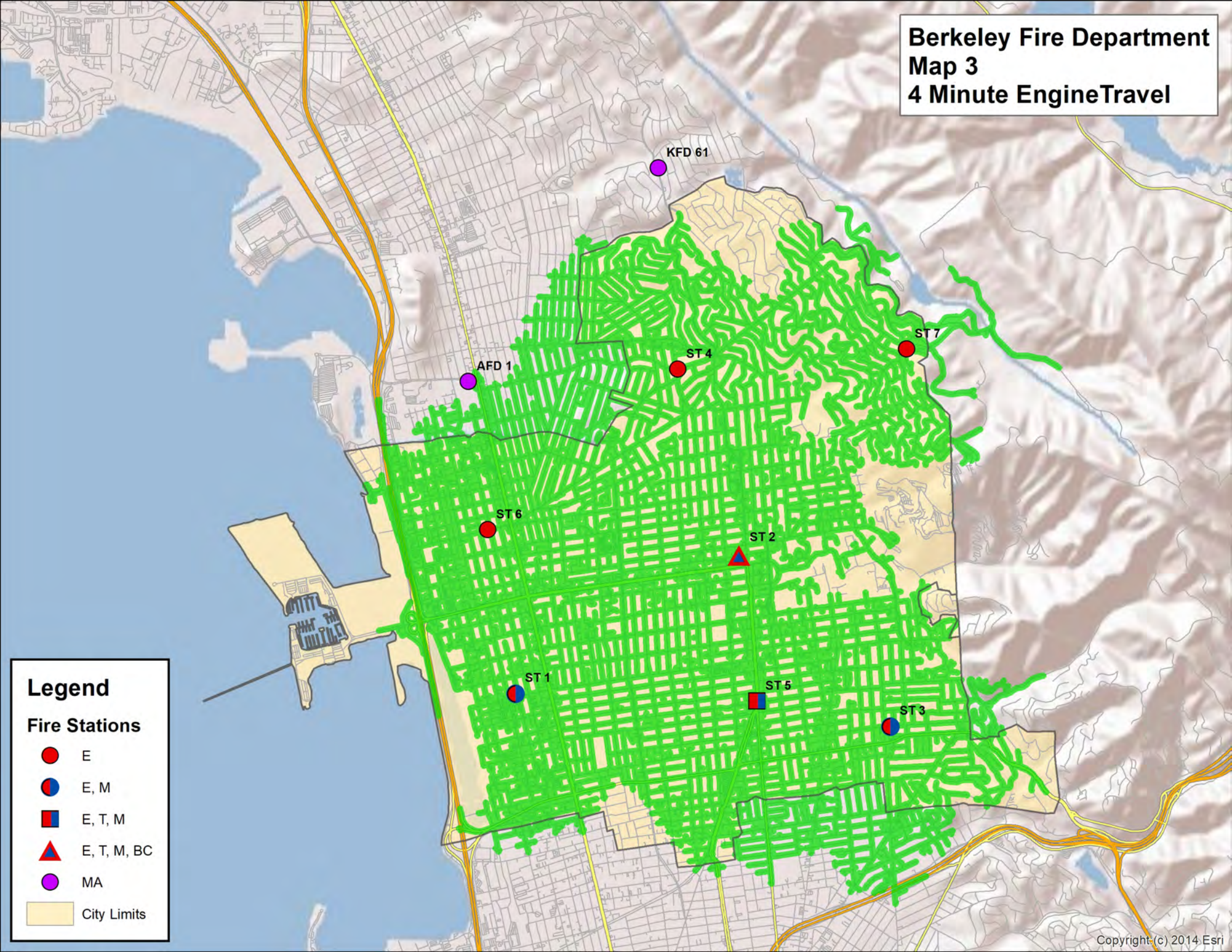
Berkeley Fire Department
Map 3
4 Minute EngineTravel
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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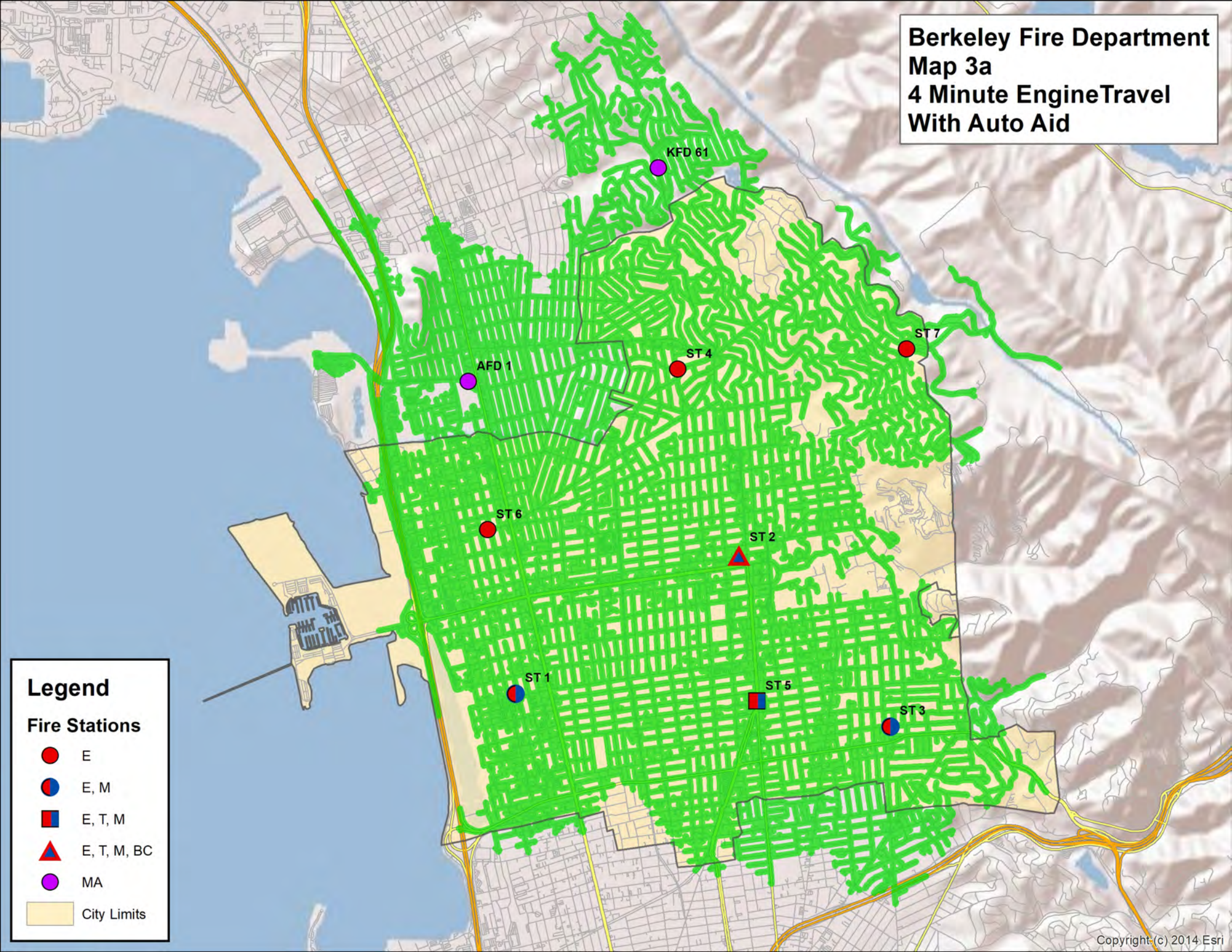
Berkeley Fire Department
Map 3a
4 Minute EngineTravel
With Auto Aid
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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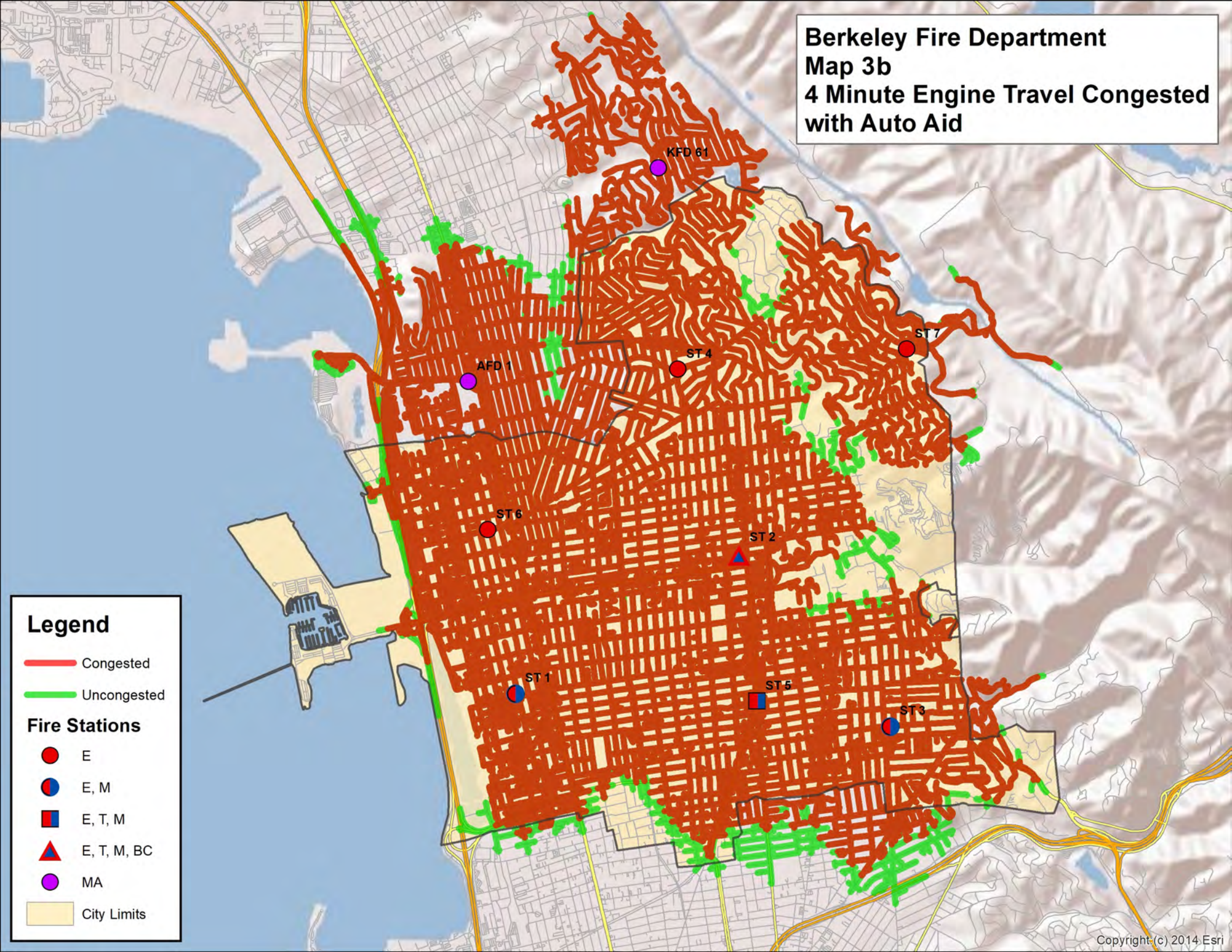
Berkeley Fire Department
Map 3b
4 Minute Engine Travel Congested
with Auto Aid
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Congested
Uncongested
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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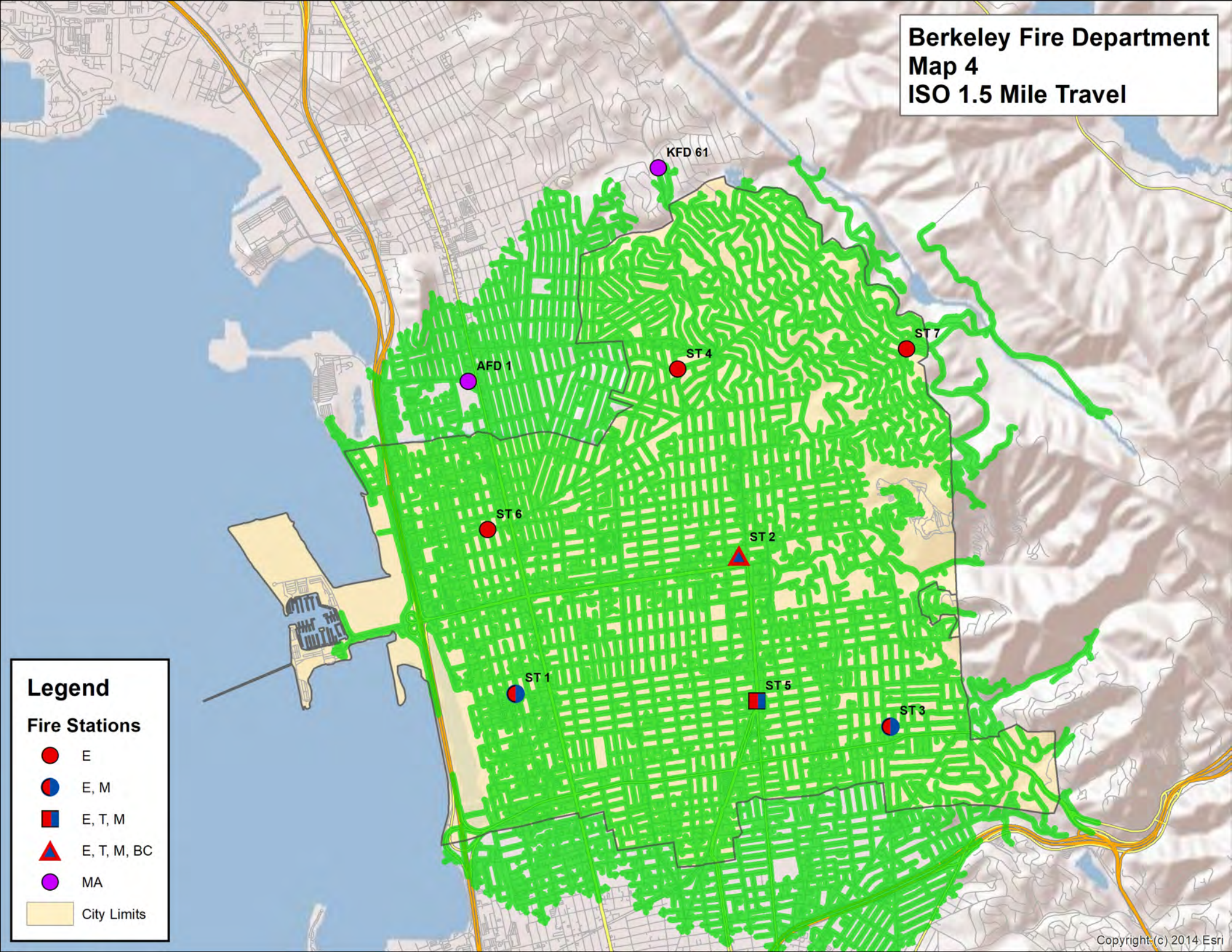
Berkeley Fire Department
Map 4
ISO 1.5 Mile Travel
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
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E, T, M
E, T, M, BC
MA
City Limits
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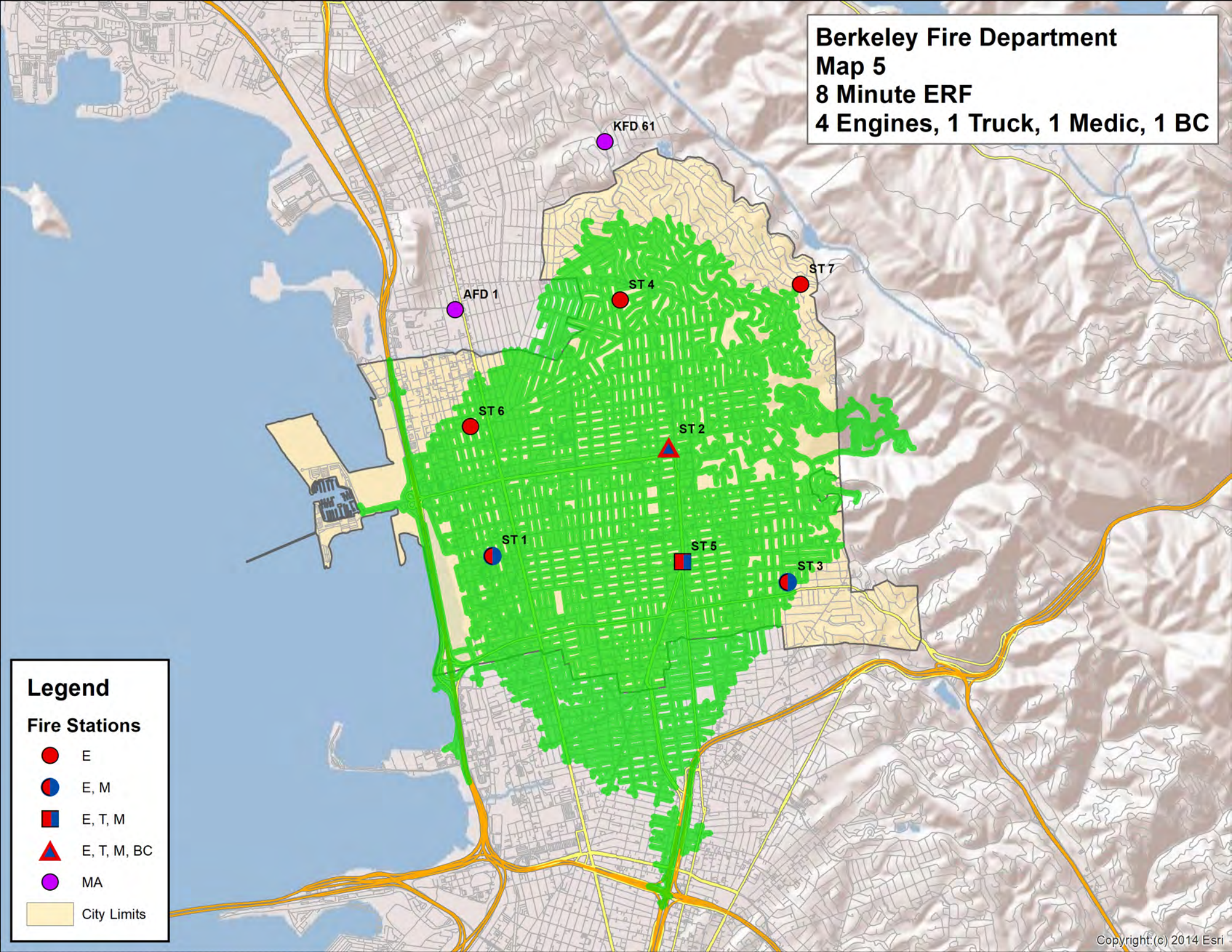
Berkeley Fire Department
Map 5
8 Minute ERF
4 Engines, 1 Truck, 1 Medic, 1 BC
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
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E, T, M
E, T, M, BC
MA
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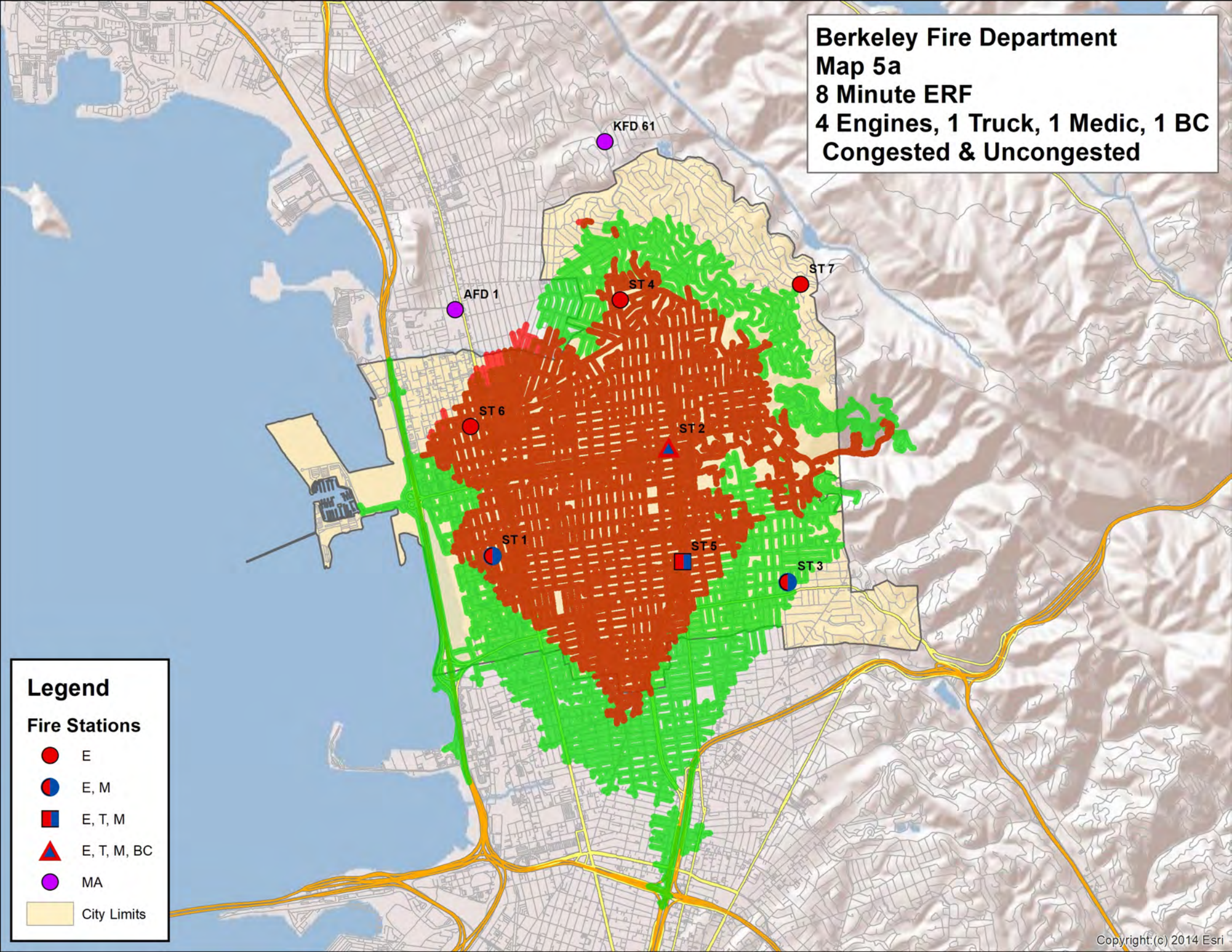
Berkeley Fire Department
Map 5a
8 Minute ERF
4 Engines, 1 Truck, 1 Medic, 1 BC
Congested & Uncongested
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
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E, T, M, BC
MA
City Limits
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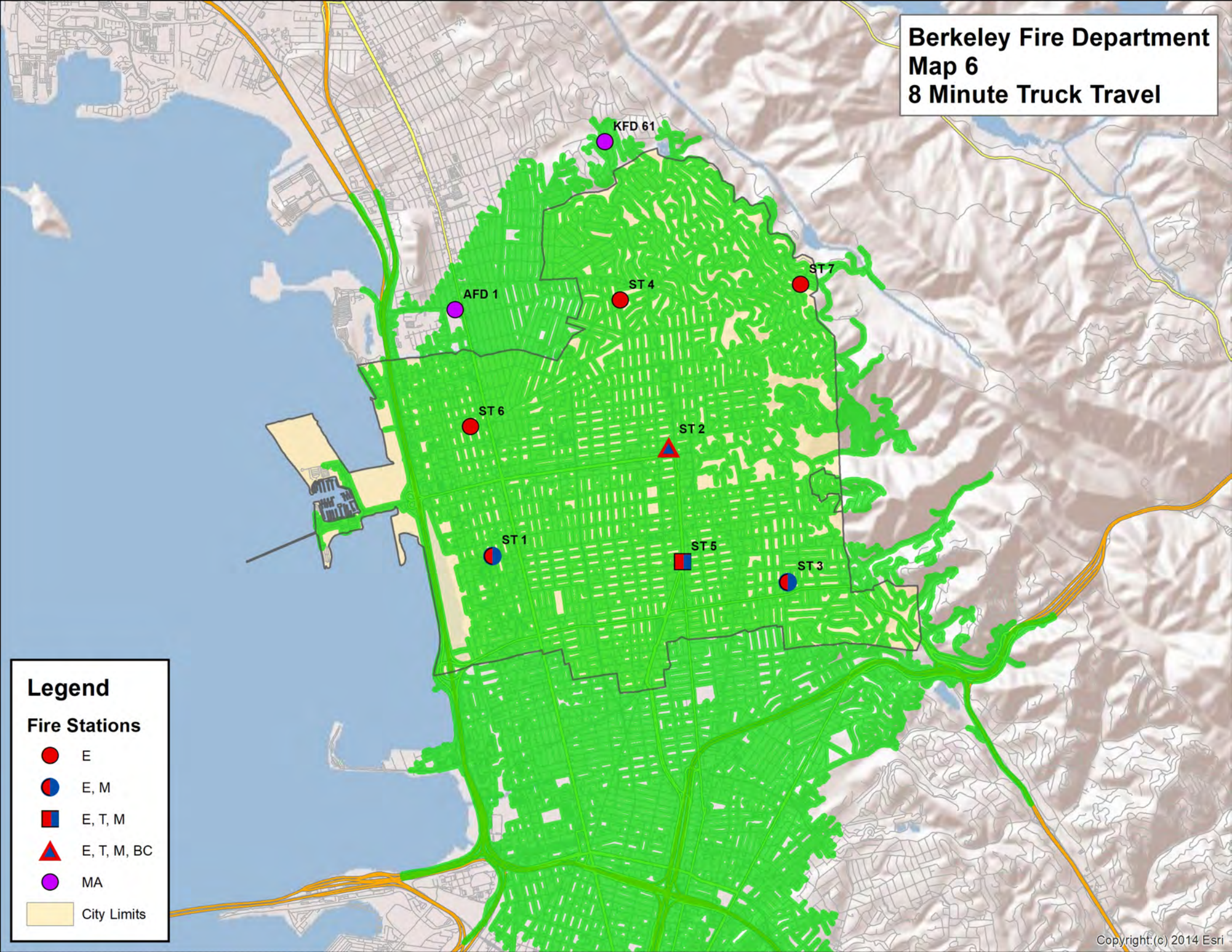
Berkeley Fire Department
Map 6
8 Minute Truck Travel
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
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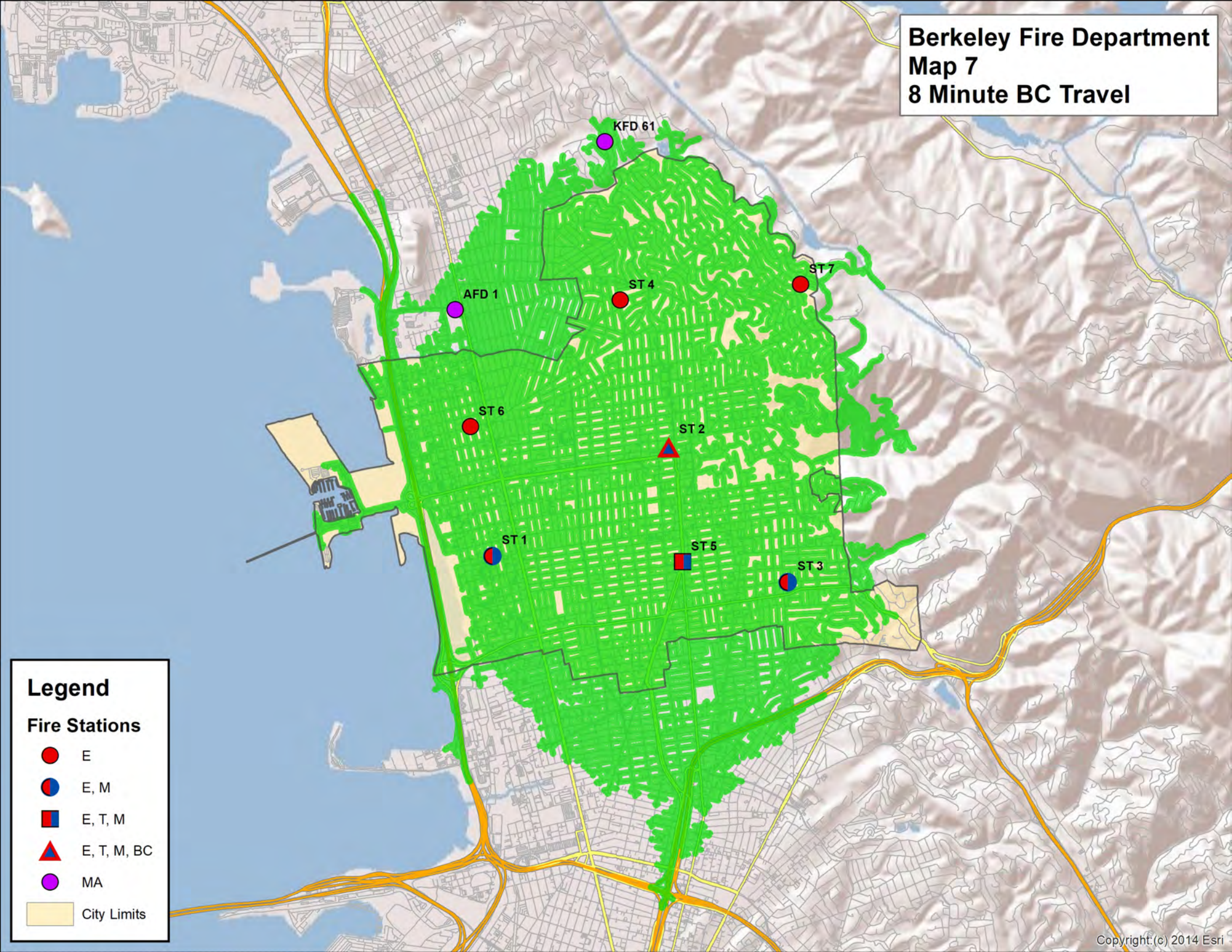
Berkeley Fire Department
Map 7
8 Minute BC Travel
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
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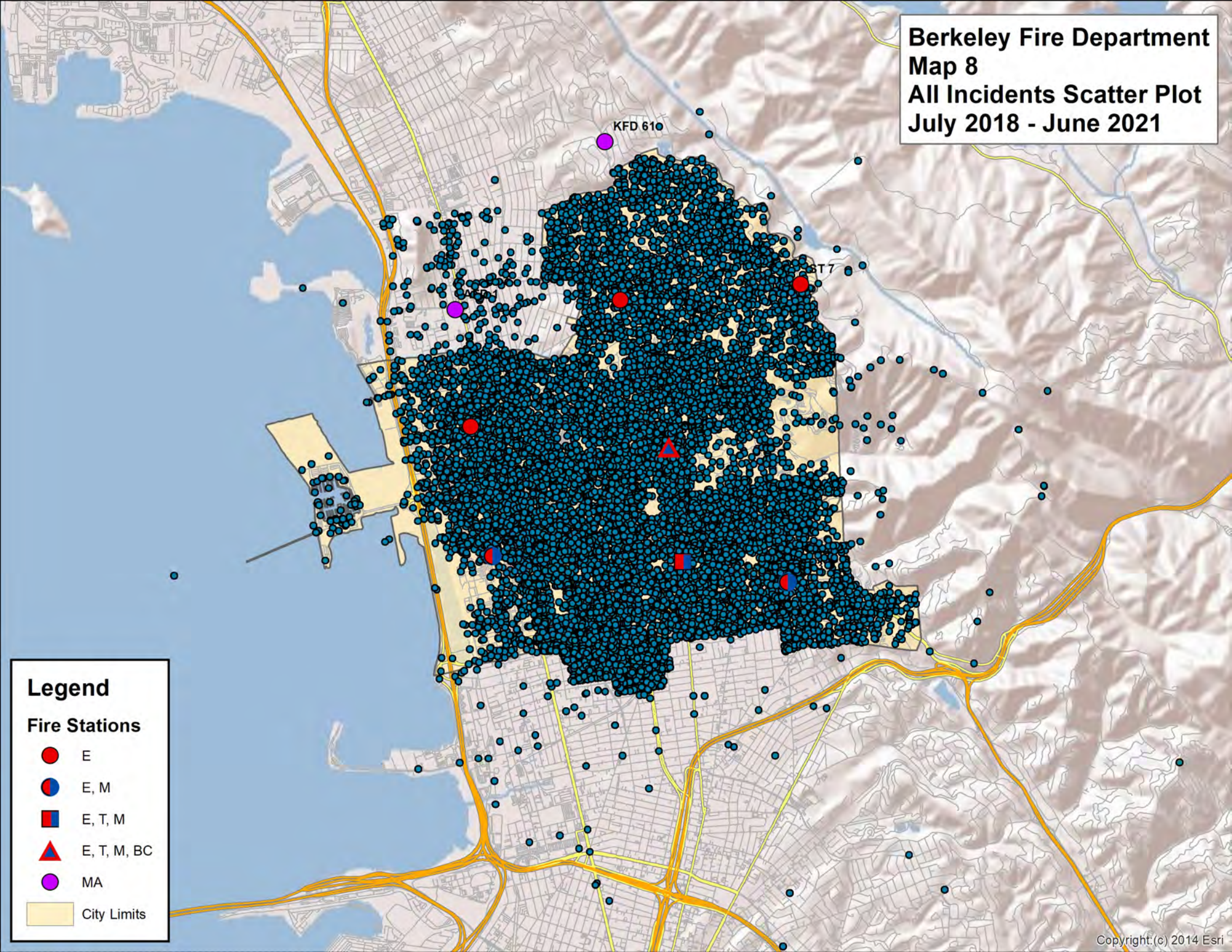
Berkeley Fire Department
Map 8
All Incidents Scatter Plot
July 2018 - June 2021
KFD 61
ST 7
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
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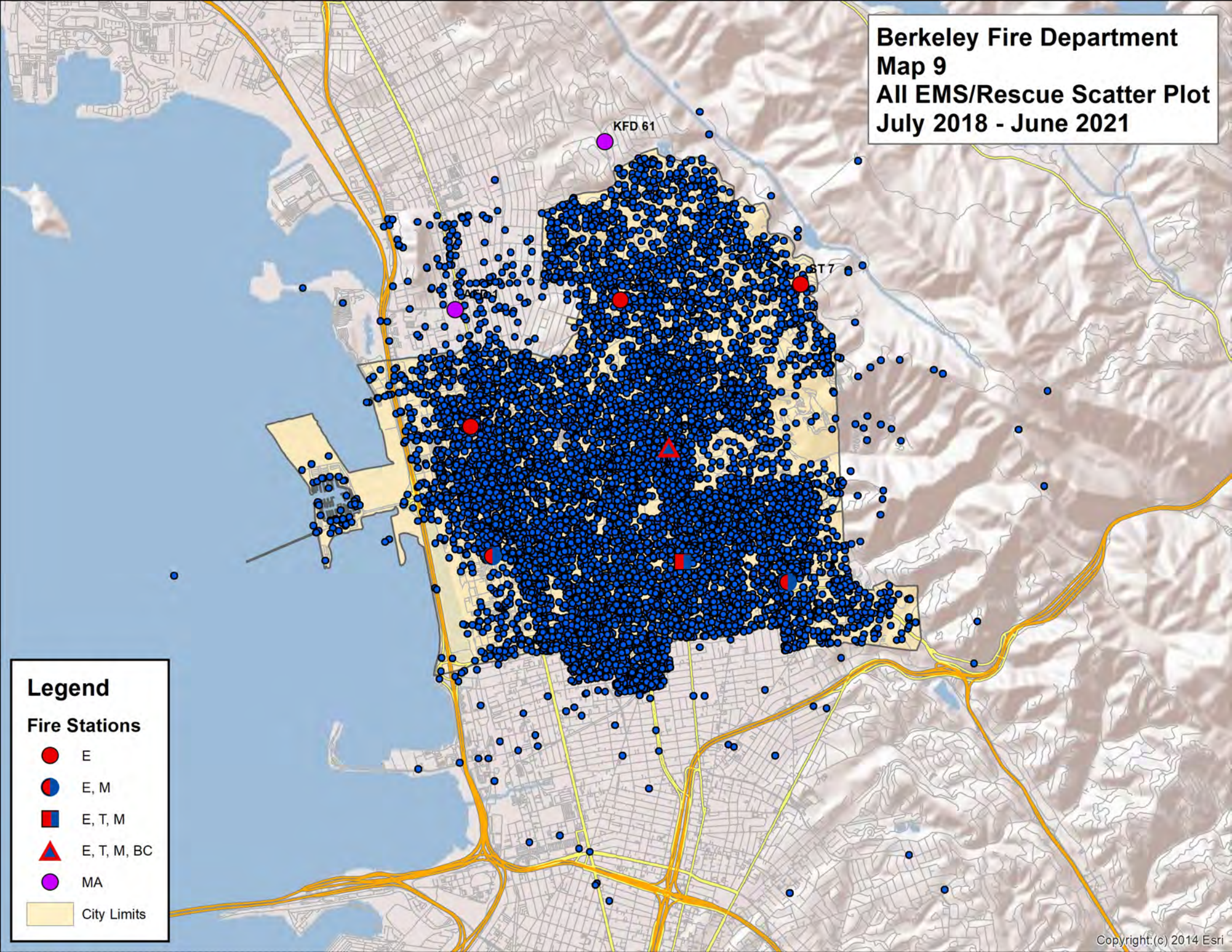
Berkeley Fire Department
Map 9
All EMS/Rescue Scatter Plot
July 2018 - June 2021
KFD 61
ST 7
AFD 1
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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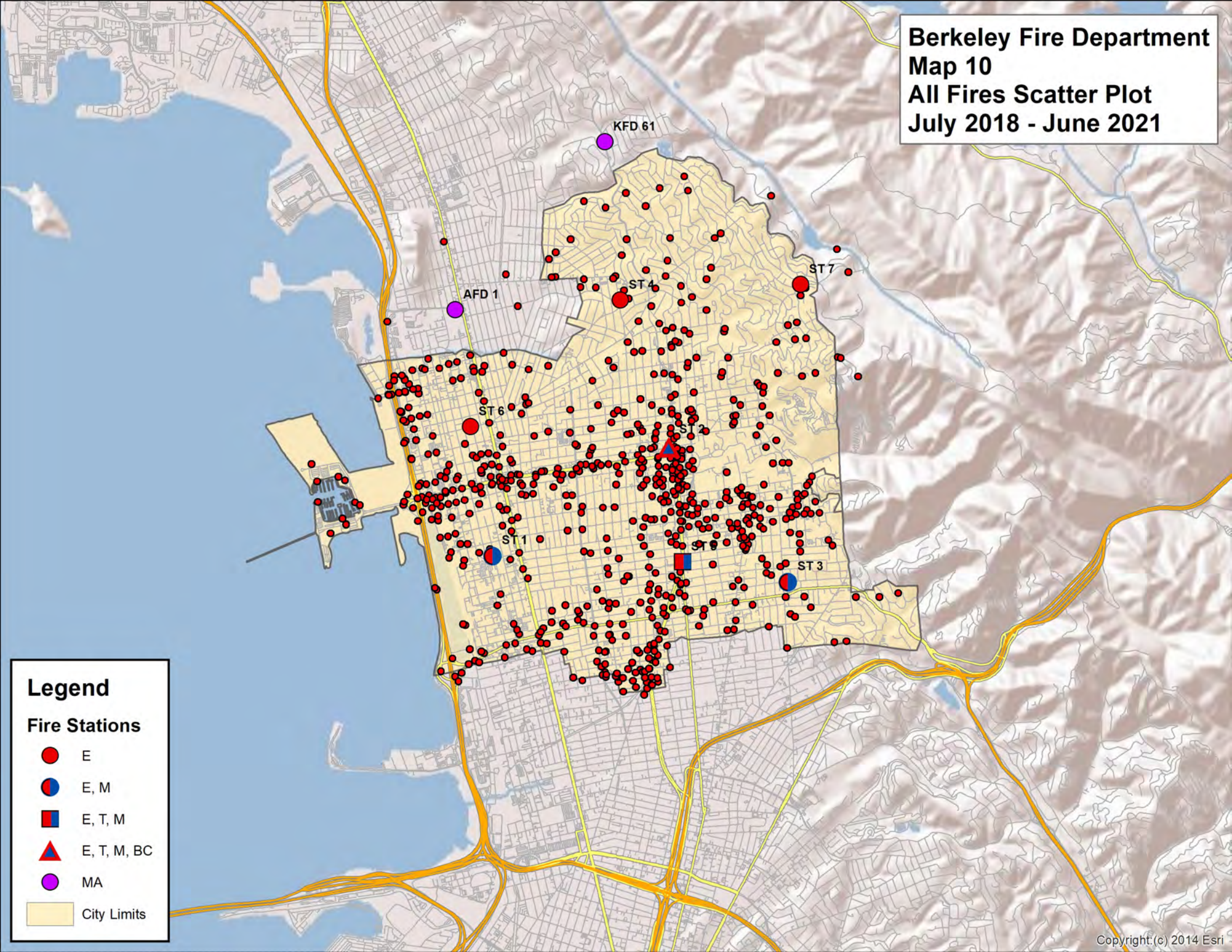
Berkeley Fire Department
Map 10
All Fires Scatter Plot
July 2018 - June 2021
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
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E, T, M, BC
MA
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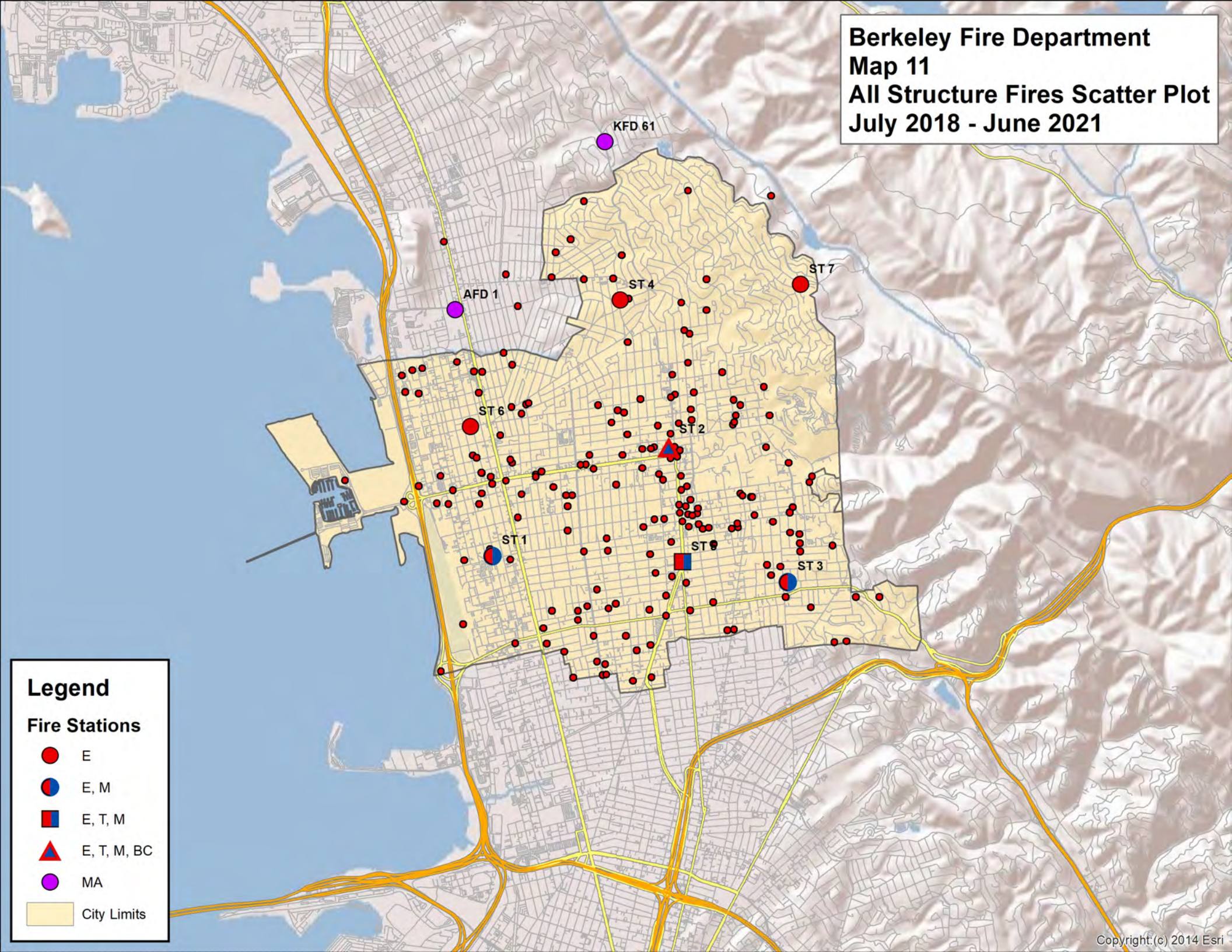
Berkeley Fire Department
Map 11
All Structure Fires Scatter Plot
July 2018 - June 2021
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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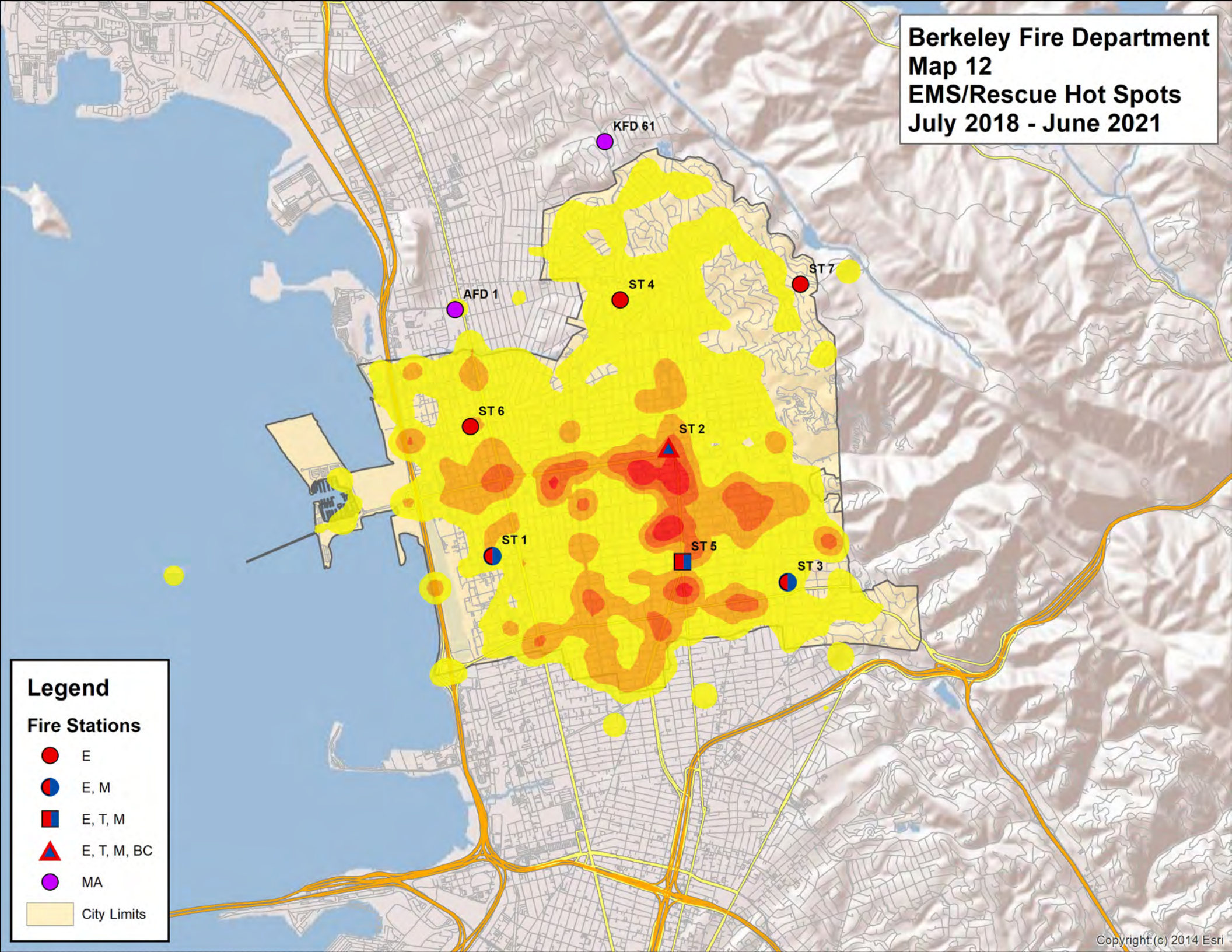
Berkeley Fire Department
Map 12
EMS/Rescue Hot Spots
July 2018 - June 2021
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
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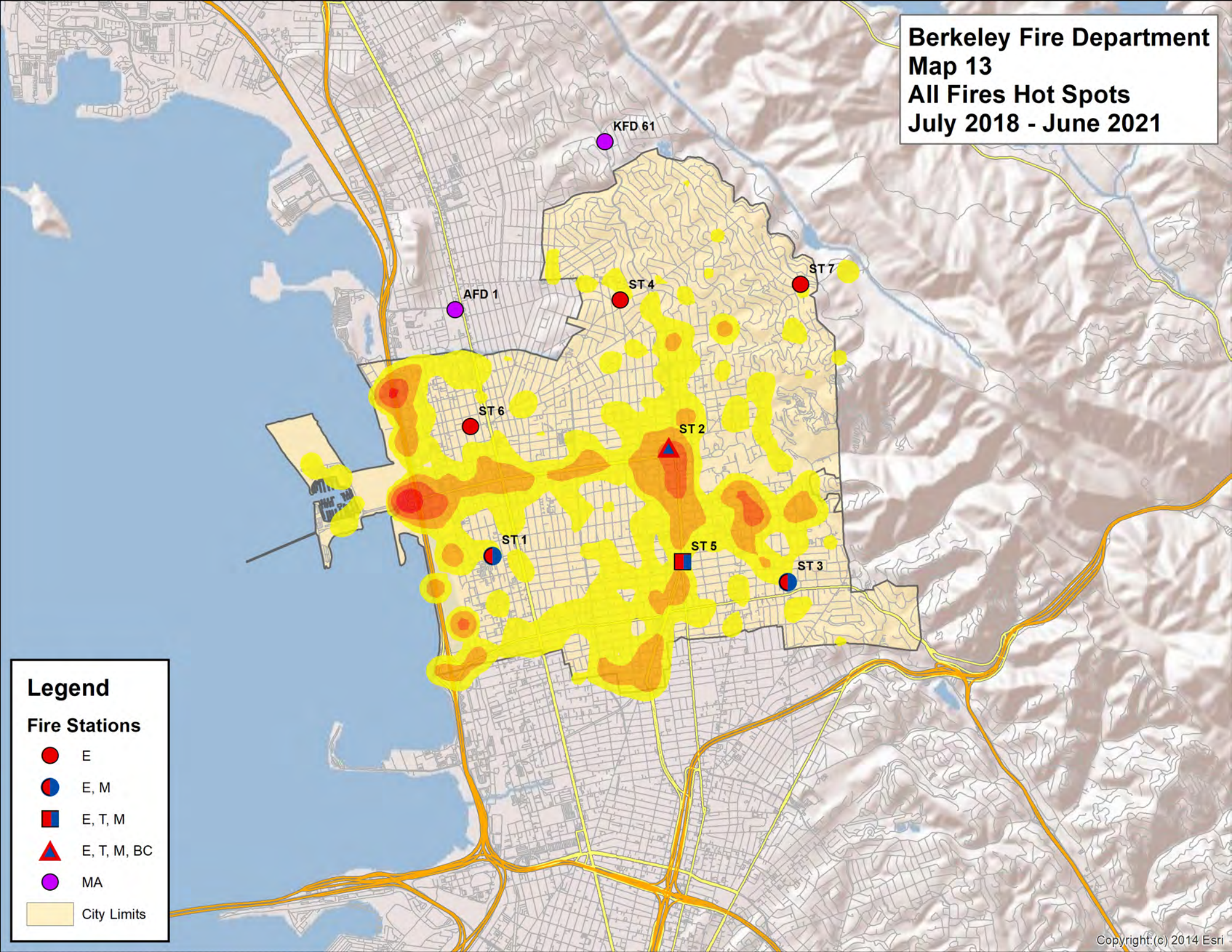
Berkeley Fire Department
Map 13
All Fires Hot Spots
July 2018 - June 2021
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
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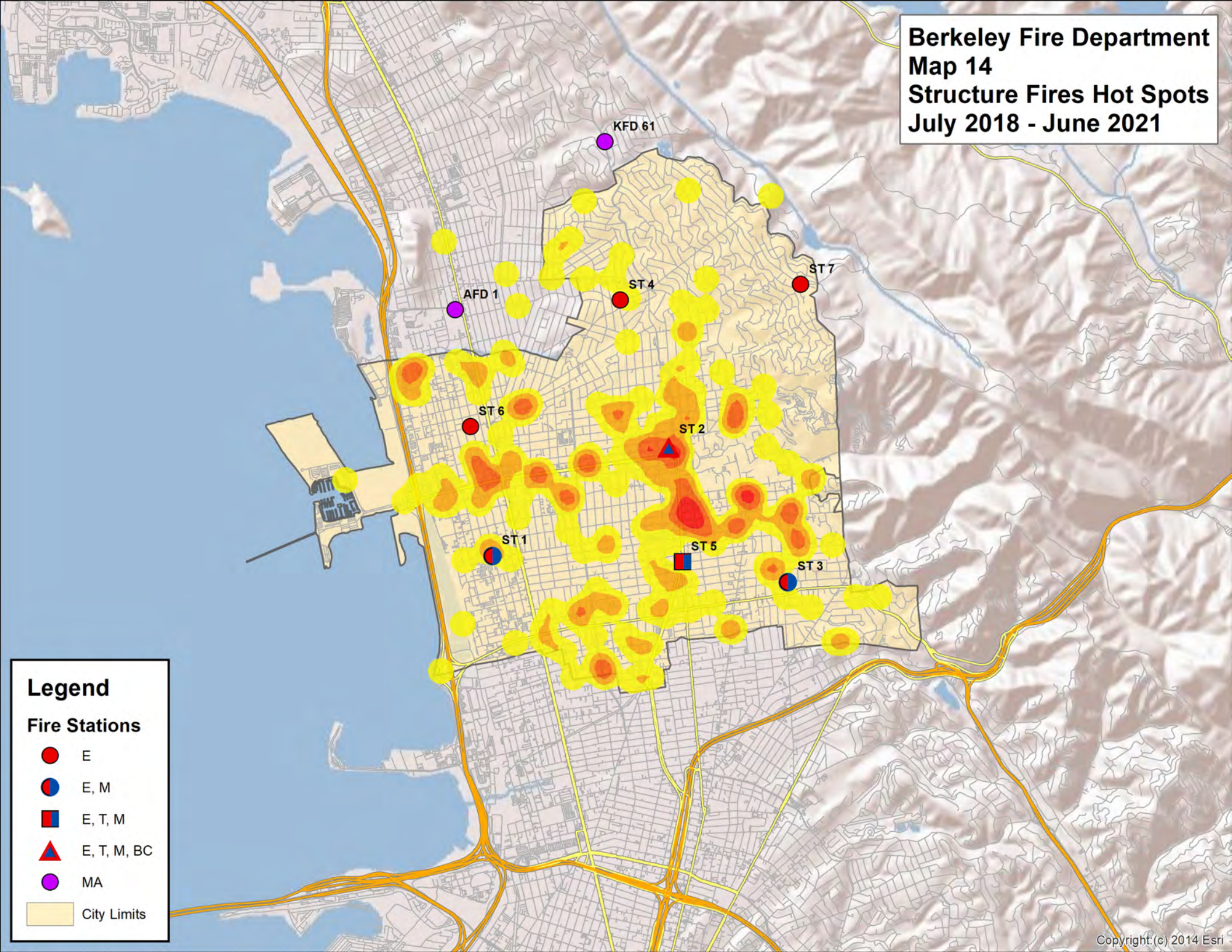
Berkeley Fire Department
Map 14
Structure Fires Hot Spots
July 2018 - June 2021
KFD 61
AFD 1
ST 4
ST 7
ST 6
ST 2
ST 1
ST 5
ST 3
Legend
Fire Stations
E
E, M
E, T, M
E, T, M, BC
MA
City Limits
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