CENTER FOR PUBLIC SAFETY MANAGEMENT, LLC

FIRE DEPARTMENT ANALYSIS REPORT

City of Haverhill, MA

Final Report-January 2023

CPSM®

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Exclusive Provider of Public Safety Technical Services for
International City/County Management Association

THE ASSOCIATION & THE COMPANY

The International City/County Management Association is a 109-year old, nonprofit professional association of local government administrators and managers, with approximately 13,000 members located in 32 countries.

Since its inception in 1914, ICMA has been dedicated to assisting local governments and their managers in providing services to its citizens in an efficient and effective manner. ICMA advances the knowledge of local government best practices with its website (www.icma.org), publications, research, professional development, and membership. The ICMA Center for Public Safety Management (ICMA/CPSM) was launched by ICMA to provide support to local governments in the areas of police, fire, and emergency medical services.

ICMA also represents local governments at the federal level and has been involved in numerous projects with the Department of Justice and the Department of Homeland Security.

In 2014, as part of a restructuring at ICMA, the Center for Public Safety Management (CPSM) was spun out as a separate company. It is now the exclusive provider of public safety technical assistance for ICMA. CPSM provides training and research for the Association's members and represents ICMA in its dealings with the federal government and other public safety professional associations such as CALEA, PERF, IACP, IFCA, IPMA-HR, DOJ, BJA, COPS, NFPA, and others.

The Center for Public Safety Management, LLC, maintains the same team of individuals performing the same level of service as when it was a component of ICMA. CPSM's local government technical assistance experience includes workload and deployment analysis using our unique methodology and subject matter experts to examine department organizational structure and culture, identify workload and staffing needs, and align department operations with industry best practices. We have conducted 341 such studies in 42 states and provinces and 246 communities ranging in population from 8,000 (Boone, Iowa) to 800,000 (Indianapolis, Ind.).

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SECTION 1. INTRODUCTION

The Center for Public Safety Management LLC (CPSM) contracted with the City of Haverhill to complete an operational and administrative analysis of the city's Fire Department.

The service demands and challenges generated by the community are numerous for the fire department and include EMS first response, fire, technical rescue, hazardous materials, density and topography challenges, river traffic and emergencies; transportation emergencies to include vehicle traffic, a mass transit system utilizing bus and commuter rail transportation, and an interstate highway; three bridges; and other non-emergency responses typical of urban and suburban fire departments.

A significant component of this report is the completion of an All-Hazards Risk Assessment of the Community. The All-Hazards Risk Assessment of the Community contemplates many factors that cause, create, facilitate, extend, and enhance risk in and to a community. The All-Hazards Risk Assessment of the Community is an important component of this report as it links directly to staffing and deploying fire and rescue assets in the community.

The response time and staffing components discussion of this report are designed to examine the current level of service provided by the Haverhill Fire Department (HFD) compared to national best practices. As well, these components provide incident data and relevant information to be utilized for future planning and self-review of service levels for continued improvement which is designed to meet community expectations and mitigate emergencies effectively and efficiently.

Other significant components of this report are an analysis of the current deployment of resources and the performance of these resources in terms of response times and the HFD fire management zones; a comprehensive review of the current ISO Public Protection Classification report; current staffing levels and patterns; department resiliency (ability to handle more than one incident); critical tasking elements for specific incident responses and assembling an effective response force; fire prevention and training; 911-dispatch; fleet; and an overtime analysis.

Based upon CPSM's detailed assessment of the HFD, it is our conclusion that the department, overall, provides quality fire, EMS, and rescue services. The HFD staff are professional and dedicated to the mission of the department, were transparent during our discussions, and were quite focused on creating a positive future for the agency.

The comprehensive risk assessment and review of deployable assets, which are critical aspects of a fire department's operation, will first assist the HFD in quantifying the risks that it faces. Second, the HFD will be better equipped to determine if the current response resources are sufficiently staffed, equipped, trained, and positioned. The factors that drive the service needs are examined and then link directly to discussions regarding the assembling of an effective response force and when contemplating the response capabilities needed to adequately address the existing risks, which encompasses the component of critical tasking.

This report also contains a series of observations, planning objectives, and recommendations that are intended to help the HFD deliver services more efficiently and effectively. Recommendations and considerations for continuous improvement of services are presented here. CPSM recognizes there may be recommendations and considerations offered that first must be budgeted and/or bargained, or for which processes must be developed prior to implementation

RECOMMENDATIONS

Fiscal Resources

(See pp. 12-13.)

1. CPSM recommends the city consider designating a finance liaison to work with the HFD grants committee on any future grants the HFD is considering. This liaison effort should include initial review of the grant opportunity, establishment of matching grant funds, assistance/review with the grant application from a finance perspective, and assistance with grant set-up and expenditures should the grant be awarded. ***There is no cost to this recommendation.***

ISO Analysis

(See pp. 14-17.)

2. CPSM recommends the HFD review the deficiencies in the Fire Department section of the 2015 ISO-Public Protection Classification report as outlined in this analysis and determine if improvements have been made. If improvements have not been made, CPSM further recommends the HFD develop a plan that addresses deficiencies that remain.
3. CPSM recommends the Department of Public Works continues to ensure fire hydrants are flow tested and inspected to a level commensurate with achieving maximum scoring possible which is a frequency of inspections every 1 to 2 years, and a frequency of flow testing every 5 to 6 years.
4. As the current ISO-PPC report is seven years old, CPSM recommends the HFD contact the ISO and schedule and prepare for a community fire protection review.

Community Risk Reduction

(See pp. 17-19.)

5. Over the near-term (1 to 3 years), CPSM recommends the city consider addressing the Fire Prevention Division staffing indirectly through the addition of an Assistant Chief position, which would relieve the current Deputy Chief who oversees the Fire Prevention Division of considerable and needed administrative support to the Fire Chief. The Deputy Chief of Fire Prevention position could then focus all efforts on the important function of community risk reduction through fire prevention and public life-safety education.

   The Assistant Chief position would be a direct report to the Fire Chief and operate in the command structure overseeing the major functions and assigned departmental committees, work groups, and programs as deemed appropriate by the Fire Chief. This position can be either a collective bargaining unit position or not and can be included in the civil service or not, as deemed appropriate by the city. ***New position cost estimate (external hire): $144,657 (Deputy Chief salary+ cba+ benefits+15%, no overtime).*** Another alternative is to promote a current Deputy Chief to this position. ***Estimated costs for this alternative (internal promotion): Deputy Chief to Assistant Chief promotion at 15% ($18,869); Captain to Deputy Chief ($12,947); Lieutenant to Captain ($12,275); Firefighter to Lieutenant ($15,896) (salary+ cba+ benefits, no overtime); 1 new firefighter to backfill vacated promotion from Firefighter to Lieutenant ($112,593) (salary+ cba+ benefits+ overtime). Total alternative cost: $172,580*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, February 2022).***
6. Over the near-term (next 24 months), CPSM recommends the city consider adding a life-safety public education specialist (civilian position) for the purpose of expanding the S.A.F.E program to the city's vulnerable residential population (the aged and those needing assistance). The position should focus on those residents living in multstory housing units and teach this population through education ad interactive programs how to prevent and

respond to fire incidents, and how to prevent unintentional injury and death. ***New position cost estimate: $60,007 (Firefighter salary + benefits, no overtime (Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, February 2022). This cost is potentially lower based on civilian benefit costs and on-boarding salary.***

Training and Education

(See pp. 20-22.)

7. CPSM recommends that due to the importance of training as outlined herein, the city consider funding a training officer at the lieutenant level over the mid-term (2 to 5 years) to develop, coordinate, manage, and deliver consistent training and education programs for new hires and incumbent personnel of the HFD. This position should have primary responsibility to ensure HFD staff are proficiently trained to perform assigned tasks, maintain state fire and EMS training, and ISO standards, and that required certifications and annual coursework is current and properly documented. ***Estimated costs: Firefighter to Lieutenant ($15,896) (salary+ cba+ benefits, no overtime); 1 new firefighter to backfill vacated promotion from Firefighter to Lieutenant ($112,593) (salary+ cba+ benefits+ overtime). Total costs $128,489 (Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***
8. CPSM recommends the HFD, to the extent possible with current staff or through an external firm, develop an officer training program that is continuous and includes at a minimum the following areas: leadership, command and control of emergency incidents, employee relations, management of a diverse workforce, oral and written communication, mentoring and coaching, crew management, fire incident safety, health and safety concepts of a contemporary fire department, community outreach, organizational risk management, professional ethics, and information management.

Fire Alarm Division

(See pp. 23-26.)

9. In the near-term (next 24 months), the HFD should work to implement performance measures and compliance methodologies for call processing times in the 911-dispatch center to address the current long call processing times. There should be a focus on closing the gap between national standards and the current time to process and dispatch all calls for service. ***There are no recommended positions to gain compliance.***
10. CPSM recommends prior to any transition from uniform to civilian disptachers, both the city and the HFD should consider all Fair Labor Standards implications for civialinizing these postions. The city and the department should research regional and state trends for vacancy rates, and evaluate any issues for recruitment and retention of 911 telecommunicators (workforce impact review). CPSM further recommends that should the transition from uniform to civilian telecommunicators occur, that the department's overall uniform firefighter position count not be reduced, and the uniform telecommunicators be reassigned to field operations to address staffing needs.

Fleet

(See pp. 34-38.)

11. CPSM recommends the HFD develop, over a one-year period, a fire apparatus replacement plan that includes, to the extent possible and funding availability, replacement that aligns more closely to recommendations with NFPA 1901, *Standard for Automotive Fire Apparatus*.

    Planning objectives should include:

12. Apparatus should not exceed 15 years of service on the front line. Once an apparatus reaches this age, one alternative is the apparatus undergoes a Level 1 refurbishing in

accordance with NFPA 1912, *Standard for Fire Apparatus Refurbishing* (current standard), or the apparatus is replaced if maintenance records and wear and tear warrant replacement.

13. All apparatus at the 25-year mark should be considered for replacement. Apparatus greater than 25 years old should be removed from service.

14. Apparatus and major apparatus components such as the motor, fire pump, aerial ladder assembly and hydraulics, chassis, and chassis components such as brakes, wheels, and steering equipment should be maintained in accordance with manufacturer and industry specifications and standards. All testing records should be maintained in a common records management system for continuous review and analysis.

15. Apparatus components requiring annualized testing either fixed or portable such as fire pumps, aerial ladder and aerial ladder assemblies, ground ladders, self-contained breathing apparatus to include personnel fit-testing, and fire hose should be tested in accordance with manufacturer and industry specifications and standards. All testing records should be maintained in a common records management system for continuous review and analysis.

Facilities and Response Times

(See pp. 39-55.)

16. Due to the age of the HFD facilities, CPSM recommends the city continue to fund the HFD facility maintenance lines at or above current levels so that facility maintenance can continue at the current scope and regularity.

17. CPSM recommends, for a more efficient deployment of resources, the rescue company be relocated to the High Street Station if practical, and if not, the city considers constructing a new facility at Broadway and I-495. This new station could house the rescue company, the HFD fleet maintenance shop, the Ayers Village call-unit and crew, reserve apparatus, and ancillary department functions that lack office and workspace. ***This recommendation does not require new positions. Facility costs based on construction and materials costs at time of design and build. This facility would need 3-4 apparatus bays that are long enough to stack two Engine apparatus (at least 70'); living/office space for the Rescue Company; office space for the call company; office and storage space for the Master Mechanic; office space for other department functions needed at time of design and construction.***

ERF and Critical Tasking

(See pp. 94-112.)

18. CPSM recommends the HFD review all current mutual aid agreements. The review should include current assets, training, and staffing available to the city from mutual aid departments. The HFD should strengthen mutual aid agreements to include standard and acceptable training of crew members responding to Haverhill, and minimum staffing levels (minimum of three personnel per apparatus responding in). In order to minimize response time, CPSM further recommends the HFD Fire Alarm Division automatically request mutual aid companies for station backfills or on-scene assistance when multiple HFD units will be committed to an incident for projected extended periods.

Due to the community risks outlined in this report, specifically:

- *Building risks (to include multi-level residential) and topography of the city,*
- *Workload of the High Street and Water Street stations, which also affects the resiliency of the fire department,*
- *Long response times in certain areas of the city for first due and assisting companies on multicompany responses,*

- *The inability to assemble an Effective Response Force for all scenarios as outlined in NFPA 1710,*
- *Lack of reliable mutual aid from surrounding communities, and*
- *Inconsistent availability of the current HFD call-firefighter force,*

CPSM recommends the City consider:

19. In the near-term (next 24 months), the city considers assigning one additional firefighter per shift to the High Street Station engine company (4 total). ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***
20. In the mid-term (3 to 5 years), the city considers assigning one additional firefighter to the Water Street engine company (4 total) (could be four firefighters transitioned from the Fire Alarm Division to operations if the implementation of civilian telecommunicators becomes reality. ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***
21. In the long-term (5 to 8 years), the city considers implementing an additional ladder company at Bradford Station to be utilized in the Bradford district and as well in the core downtown area as a second ladder response where the majority of multilevel structures are located.

- This could be a new company (12 personnel and utilize the HFD's second ladder truck). ***Estimated costs: $1,351,116 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***
- This could be a new company but utilize the fourth person from High Street and Water Street engine companies and add an officer position (four new personnel at firefighter level). CPSM recommends this if the additional station is built at I-495 and Broadway and the rescue company is moved to this location to evenly spread out specialty ladder/service companies. ***Estimated costs: Firefighter to Lieutenant promotions: $63,584 (salary + benefits+ cba, no overtime), 4 Firefighter positions: $450,372 (salary + benefits+ cba+ overtime) depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022. The cost of a ladder truck is estimated to be $1.3 -$1.6 million depending on year of purchase.***
- This could be a quint apparatus (aerial ladder, fire pump, water tank, fire hose, tools and equipment). CPSM only recommends this alternative if the city upstaffs the unit to four personnel. CPSM recognizes that this recommendation in a smaller fire department such as the HFD limits the amount of true engine apparatus, since the quint is designed to be more of a ladder apparatus than engine apparatus. In the case of the HFD where mutual aid is not reliable or automatic with staffed and trained engine companies, this will limit the engine apparatus to three but does increase the ladder apparatus capabilities to two. CPSM also recognizes that in smaller departments such as the HFD these apparatus when deployed and arrive on scene of a fire incident must commit to either engine or ladder company tasks and not both due to the limited staffing. A staffing complement of five increases the opportunity to function as a ladder and engine simultaneously, particularly if there is a need to fly the aerial device. All of these conditions should be contemplated prior to making this commitment. ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime for 4 firefighters to upstaff to four/shift) depending on implementation year*** ***(Salary ordinance 2020-***

Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022. ***The cost of a Quint apparatus is $1.0-$1.3 million depending on year of purchase.***

Specialized Response

(See pp. 109-112.)

22. Over the near term planning process, CPSM recommends the city continue with its commitment to acquire a fire boat capable of firefighting and water rescue capabilities, due to the current and potential future marine vessel, docks and slips, marinas with fueling capabilities, and other related water risks along the Merrimac River. CPSM further recommends the vessel be located in the water behind the Water Street Station for immediate response (weather permitting), ***that no additional staffing be added*** to deploy this asset, and that the crews at the Water Street Station be cross-trained in water rescue and fire boat operations and firefighting.

Basiliere Bridge Project

(See pp. 113-117.)

23. Ladder 4 is currently housed at Bradford station but is not in service due to staffing. One recommendation is for the city to consider staffing Ladder 4 temporarily during the construction of the bridge so critical resources can be available that would otherwise be impacted by the bridge construction and traffic flows.

    If Ladder 4 needs to be utilized to fill in for the ladder at Water Street, due to maintenance, then a reserve engine can be placed at the Bradford station in its place. Temporary staffing for the additional apparatus at Bradford during bridge construction can be accomplished with on-duty resources and/or overtime personnel.

    CPSM further recommends as a temporary solution to potential bridge construction closures, the City work with the private ambulance service to establish a temporary site in the Bradford area capable of housing one ambulance crew and parking one ambulance under cover and out of the environmental elements.

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SECTION 2. ANALYSIS METHODOLOGY

Data Analysis

The CPSM Fire and EMS Team used numerous sources of data to support our conclusions and recommendations for the Haverhill Fire Department (HFD). Information was obtained from the city and department along with numerous sources of internal information garnered from a CPSM document/information request. Internal sources included data from the computer-aided dispatch (CAD) system for response time and workload information, and the department's National Incident Reporting System (NFIRS) records management system for calls for service.

Interviews

This study relied extensively on intensive interviews and interaction with department personnel and the city. On-site and in-person interviews to include virtual meetings were conducted with the Mayor's office, all senior fire department staff, the collective bargaining unit, middle managers, and company personnel regarding the administration and operations of the department.

Document Review

CPSM Fire Team consultants were furnished with numerous reports and summary documents by the HFD. Information on department planning; staffing and deployment of resources; overtime; mutual aid; policies and procedures; community risk, fire code enforcement, and public education; fleet and facilities; training; and additional performance information were reviewed by fire project team staff. Follow-up phone calls, emails, and virtual meetings were used to clarify information as needed.

Operational/Administrative Observations

Over the course of the evaluation period, numerous observations were conducted. These included observations of fire and EMS operations; community risk reduction; fleet replacement schedules and overall facility usefulness in a contemporary fire department; administrative functions; deployment of apparatus from a coverage perspective as benchmarked against national standards; and operational staffing benchmarked against national standards as it relates to assembling an effective response force. The CPSM Fire and EMS Team engaged all facets of department operations from a ground floor perspective and as well from a management perspective.

Staffing Analysis

In virtually all CPSM Fire and EMS studies, we are asked to identify appropriate staffing and resource deployment levels, as well as the use of overtime. This is the case in this study as well. In this report we discuss operational workload; critical tasking; assembling an effective response force; operational deployment, station locations, and the feasibility of relocating deployable assets to improve response coverage; and other factors to be considered in establishing appropriate staffing levels. Staffing recommendations are based upon our comprehensive evaluation of all relevant factors and are benchmarked against national standards such as the National Fire Protection Association (NFPA) 1710 Standard, ISO Public Protection Classification rating system, and the Center for Public Safety Excellence, Standards of Cover.

SECTION 3. AGENCY REVIEW AND CHARACTERISTICS

The Haverhill Fire Department (HFD) is a full-time career fire department that includes senior leadership, community risk reduction (fire prevention), training, fire alarm and 911-dispatch, and support staff that includes a master mechanic and mechanic who maintain the fleet.

When fully staffed, the HFD deploys four engine companies, one ladder company, and one heavy rescue. The deployment model also includes an on-duty shift commander (Deputy Chief). This deployment model requires a minimum company level staffing of 19 personnel each day. Additional deployment resources that are only staffed (unmanned) when needed by available station personnel include forestry (wildland) units, an air cart (breathing air), light marine unit, and a water tanker for areas that do not have fire hydrants. The HFD operates with four operational shifts or groups that work a schedule that averages 42 hours a week. This schedule is 24-hours on, 48-hours off, then 24-hours on, 96-hours off.

The HFD also has two stations that are northeast and northwest, respectively, of the more urban/suburban areas served by the main fire stations. These stations, Ayers Village and Rocks Village, are staffed with call firefighters. The information provided at the time of our analysis indicates there are nine call firefighters which staff the stations. Apparatus deployed from these stations includes one engine at each.

The HFD is led by a Fire Chief who has overall responsibility for the management and leadership of the department to include assisting in the emergency management function. The Fire Chief is directly assisted by a Deputy Chief who is assigned to the community risk reduction function (fire prevention), a captain who is assigned to the training function, and civilian support staff that includes an executive assistant and head clerk. Additionally, the Fire Chief has direct oversight of the fleet maintenance shop that includes a master Mechanic (head of fleet) and mechanic, as well as the Fire Alarm Division that includes a fire alarm supervisor, a signal maintenance position, and 911 telecommunicators.

The Deputy Chief of Fire Prevention Division (Community Risk Reduction) is responsible for fire prevention code enforcement, fire protection plans review, fire investigations, and fire and life safety education. During the site visit, CPSM learned that the Deputy Chief of Fire Prevention assists the Fire Chief with many administrative duties such as oversight of the apparatus committee; fire I.D. cards (access control); community events; overtime committee; zoning issues that have fire code implications; street acceptance (hydrant placement and street width); recruitment committee; grants writing committee; and HFD policy development. While a few of these activities are related to community risk reduction, many are not. The Deputy Chief undertakes these responsibilities to assist the Fire Chief with administrative duties. There are no positions in fire administration to provide oversight for activities such as these, which is a situation common in fire departments studied by CPSM.

The training component is responsible for all new-hire training, incumbent training, and professional development. The Captain assigned to training is also the department safety officer;

medical supply officer; EMS training and medical supply officer; and coordinates and manages the annual testing of all hose utilized by the HFD.

The shift Deputy Chiefs manage the day-to-day operational components of the HFD. This includes response to emergency incidents and acting as the incident commander; managing all shift leave and backfill of vacant positions; coordinates facility and fleet issues as well as managing employee relations.

The overall EMS function for the HFD is handled by the Fire Department EMS Coordinator-Infectious Control Officer. This position is not a full-time position, but rather assigned to an HFD operational staff member as a stipend position (not overtime funded). Key duties include:

- Oversees the EMS contract with the private ambulance provider. This includes ensuring the private contractor fulfills all aspects of the contract.
- Acting as the city's EMS Committee head with responsibility for constructing RFP requirements for the EMS ground transport service.
- Liaison between the private EMS contractor and HFD with any issues/complaints that arise from either party. Ensures quality of care provided.
- Manages all aspects of vaccinations for HFD members to include OSHA recommended TB testing.
- Manages all aspects of medical and fire response employee exposures. Includes tracking all positive COVID cases.
- Manages annual OSHA fit testing for N95 masks.
- Manages the state EMS certification program for each piece of apparatus.
- Manages the development of the Safety Zone Plan for the City of Haverhill as required by OEMS.

Another position not designated as a full-time regular position, but one with multiple workload assignments, is the department's information technology (IT) staff member. This is also a stipend position. Fire departments are heavy users of technology, and demand for IT services continues to increase as digitalization of programs and records management forges ahead. Station computers, printers, mobile data terminals (MDCs), radios, and various other software programs are intrinsic in departments today and can be quite complex to operate. The threat of viruses and malware are also considerations why IT professionals should be assigned this work. The city has personnel assigned to its IT division but provides little support to HFD in terms of the aforementioned projects due to other internal demands, which is why the HFD established this position. The complexities and amount of work that is needed by the department are outpacing its ability to maintain acceptable service levels.

This HFD IT stipend position manages all of the HFD's IT needs, including:

- Management of the HFD's web domain and subdomain and share point pages.
- Management of all aspects of the HFD webpage.
- Assists HFD training officer with all training-related data that is inputted into the local records management system.

- Assists the HFD Fire Prevention Office with all fire prevention-related data inputs into local records management system.
- Assists the Fire Alarm Division with all fire incident reporting issues with state system, CAD system updates and changes, reconciliation of records management system/CAD data; maintains all fire alarm document control and backup systems.
- Works with the Haverhill Water Department on hydrant records to ensure this data reconciles between fire department and water department software systems.
- Manages HFD primary fire incident reporting system software, Crewsense staff scheduling software, and pre-plan software.
- Manages/troubleshoots issues with CAD software.
- Manages HFD network hardware, iPads, and computer hardware.

In addition to fire suppression and first response EMS, the HFD is trained to certain specialized levels of technical rescue such as vehicle extrication, rope rescue, and building collapse. However, the HFD would require additional response assets and capabilities to mitigate a complex specialized or technical rescue incident, as these call types are complex and require many human and technical/specialty resources. When needed, these assets are obtained through mutual aid regional and state resources. Hazardous materials responses are handled in the same manner. The HFD can handle operational-level hazardous materials incidents and relies on regional and state resources for higher-level entry and mitigation incidents.

Logistically the HFD has in-house programs for:

- Personal protective gear (structural firefighting ensemble). An operational Deputy Chief manages this program. This program includes the selection, purchase, and distribution to all HFD members (career and call); a repair unit that is capable of minor repair; a third-party vendor for repair work the in-house unit cannot perform; training members on proper donning of gear as well as cleaning and use of department extractors and dryers for cleaning; inspection of gear; and maintenance and inspection of reserve gear.
- Hose repair. This program is managed by the hose team and consists of two firefighters and a senior firefighter as the team lead. These are stipend positions. The hose team maintains the hose inventory, repairs hose, and manages replacement of hose carried on HFD fire apparatus. Currently the HFD has more than 26,000 feet of hose assigned to fire apparatus or in storage as reserve. The hose team has been instrumental in replacing hose that was 45-plus years old with contemporary firefighting hose. The hose team also performs the required annual hose testing. Additionally, the hose team has taken on the responsibility for nozzle maintenance. This includes repair, maintenance, and replacement.
- Self-contained breathing apparatus (SCBA) repair and maintenance. This program is set up to train and certify fire staff to repair, test, and maintain breathing apparatus and masks worn and used by firefighters. Technicians perform all repairs, and maintain and test SCBA harnesses, regulators, cylinders, masks, and associated components. Technicians also conduct annual mask fit testing for all operational personnel. As with any program such as this, the SCBA program staff maintain an inventory of all SCBA components, masks, and parts. This position also maintains gas/flammable/air quality meters for the fire department.

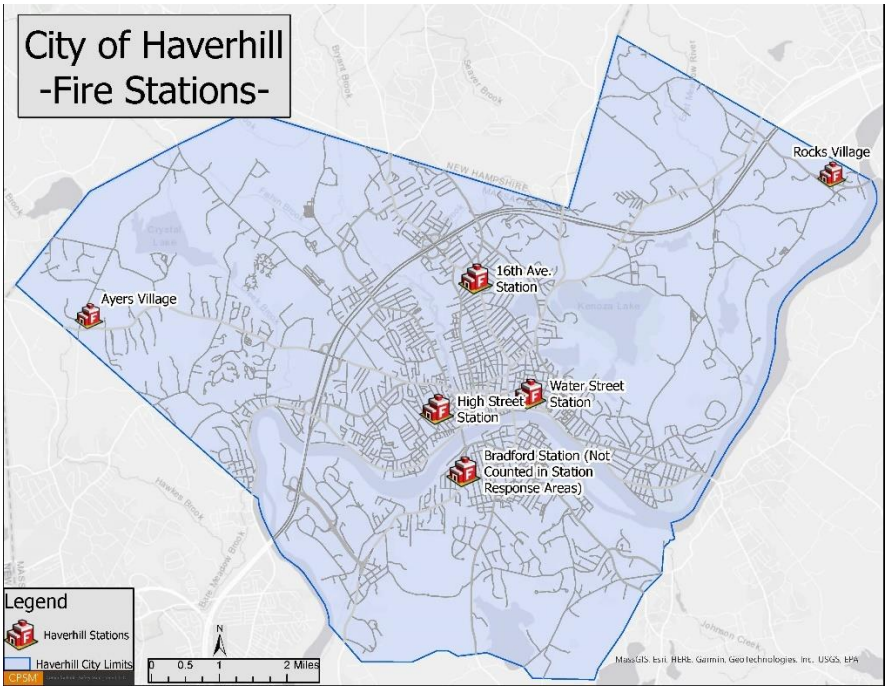
SERVICE AREA

The City of Haverhill is located approximately 35 miles north of Boston in northeastern Massachusetts. The city boundaries encompass 35.6 total square miles of which 33 square miles are land area (the remainder is water area). Haverhill is bordered to the north by New Hampshire (Salem, Atkinson, Plaistow), to the northeast by Merrimac, to the east by West Newberry and Groveland, and to the south and southwest by North Andover and Methuen. The Merrimack River in the southern portion of the city separates the Bradford section of the city from the rest of the city.

The HFD service area includes urban and suburban density which is concentrated in the southern half of the city; less densified residential north and west of the downtown area; commuter rail that includes MBTA and Amtrak; three bridges that cross the Merrimack River; multistory residential buildings; hills and elevation changes that create grade challenges for fire suppression efforts; commercial and industrial buildings and businesses; multistory business/office buildings; large footprint/square footage vacant buildings; and medical, educational, places of worship, small retail, strip malls, and restaurants that are common to cities.

The following figure illustrates the municipal boundaries and fire districts with corresponding fire apparatus assigned to each station.

FIGURE 3-1: City of Haverhill Jurisdictional Boundaries with Fire Stations



Primary Response Units

Water Street Station
Shift Deputy Chief
Engine
Ladder
Rescue
Reserve Air Cart
Reserve Water Tanker
Inflatable Rescue Boat

High Street Station
Engine

16th Ave. Station
Engine
Forestry Truck

Bradford Station
Engine 4
Forestry Truck

Ayers Village
Reserve Engine

Rocks Village

- Apparatus highlighted in blue are primary response units.
- Apparatus not highlighted are cross staffed when needed.
- Apparatus in green is staffed by call personnel when they are available and are not considered first due response units.

Emergency medical service (EMS) ground transport in Haverhill is provided through a contracted ambulance provider, Pridestar Trinity E.M.S. Inc. EMS ground transport is provided 24 hours a day. The HFD provides medical first response (MFR) in support of ambulance services (ground transport). Fire department first response personnel are certified as either Emergency Medical Technicians (the majority) or Medical Fire Response.

Mutual aid is an essential resource for fire department operations across the country. Mutual aid involves shared services between communities when their normal day-to-day operational fire, rescue, and EMS calls for service have exceeded their resources for continued emergency response. The mutual aid system ensures that calls for service are answered even when local resources are overwhelmed. The HFD has established mutual aid with contiguous and non-contiguous municipalities**.** Most mutual aid consists of station back-fills when HFD units are committed to an emergency incident. This maintains coverage in the city. The use of mutual aid for initial response is limited as most surrounding communities utilize a mix of career and call personnel, or all call/volunteer personnel.

HFD FISCAL RESOURCES

HFD operating expenses are funded through the city's general fund budget, which is supported largely through real and personal property tax revenue. The city's FY 2023 general fund budget is $231,102,946 (6.51 percent increase from 2022); this budget covers city services, the school department, debt service, employee benefits, city reserves, state assessment, and liability insurance. The following figure is a snapshot of 2023 city expenses.

FIGURE 3-2: City of Haverhill FY 2023 Expense Summary

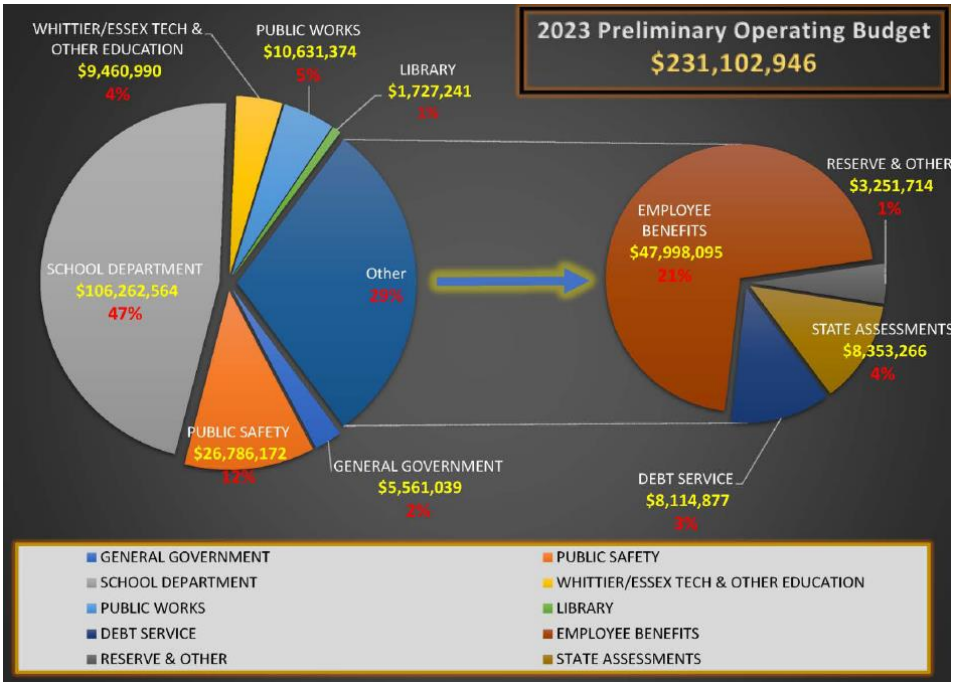


Figure source: City of Haverhill FY 2023 Final Budget Book.

The next table outlines the HFD budget for FYs 2021 through 2023.

TABLE 3-1: HFD Budget: 2021, 2022, and 2023

FY 2021Actual	FY 2022 Budget	FY 2023 Mayor Budget
$11,316,544	$11,554,780	$11,984,677

5.9% growth from 2021 actual to 2023 Mayor's Budget

Our review of the HFD budget shows that it is similar to fire department budgets CPSM has reviewed, in that the largest percentage of the budget is dedicated to personnel services. The FY 2023 HFD budget is broken down as follows:

- Personnel Services $11,076,259 92% of overall budget
- Maintenance, Equipment, Supplies $908,418 8% of overall budget

Total $11,984,677 100%

Personnel services includes salaries and wages (largest percent of this budget category); overtime (second largest percent of this category and same as previous budget); stipends, pay differentials, on-call pay; uniforms; and other related personnel expenses. There are four civilian dispatchers added to the FT 2023 budget as well as reserves for four firefighters since the current SAFER grant application is not yet approved.

Other expenses, generally known in the industry as operating and maintenance include radio and maintenance, computer equipment and service; supplies and maintenance of equipment; EMS and fire supplies, hose, and equipment; small hand and power tools; protective gear; furniture and fixtures; self-contained breathing apparatus; and all other necessary supplies, small equipment, and maintenance required for a fire department to operate.

The HFD does have a grants committee that prepares and submits grants. Recent successful grants include two FEMA Assistance to Firefighters Grants (COVID-related) for personal protective equipment totaling $56,000; and Massachusetts state fire equipment grants totaling $73,000 for firefighting gear cleaning (extractors) and dryers and fire hose.

The HFD is finding the overall grant process—writing, submitting, receiving the award, ensuring the correct account(s) are utilized if there is a grant match, expending the awarded funds, ensuring the correct accounting of spent funds, and proper reporting of the grant use and expenditures to the grantor—is time-consuming and requires constant monitoring.

This should not discourage the HFD grants committee or fire administration, as there are many grants annually that are designated to assist fire departments. The HFD should continue to be aggressive with its applications, as significant funds are available. In FY 2023, for instance, the combined FEMA Assistance to Firefighters Grants (AFG) and Staffing for Adequate Fire and Emergency Response Grants (SAFER) programs will award a total of $740 million.

Fiscal Resources Recommendation:

- CPSM recommends the city consider designating a finance liaison to work with the HFD grants committee on any future grants the HFD is considering. This liaison effort should include initial review of the grant opportunity, establishment of matching grant funds, assistance/review with the grant application from a finance perspective, and assistance with grant set-up and expenditures should the grant be awarded. ***There is no cost to this recommendation.*** (Recommendation No. 1.)

ISO-PPC ANALYSIS

The ISO is a national, not-for-profit organization that collects and evaluates information from communities across the United States regarding their capabilities to combat building fires.

ISO conducts field evaluations in an effort to rate communities and their relative ability to provide fire protection and mitigate fire risk. This evaluation allows ISO to determine and publish the Public Protection Classification (PPC). The data collected from a community is analyzed and applied to ISO's Fire Suppression Rating Schedule (FSRS) from which a Public Protection Classification (PPC) grade is assigned to a community (1 to 10). This is an analysis of the structural fire suppression delivery system in a community.

Class 1 (highest classification/lowest numerical score) represents an exemplary community fire suppression program that includes all of the components outlined below. A Class 10 indicates that the community's fire suppression program does not meet ISO's minimum criteria. It is important to understand the PPC is not just a fire department classification, but a compilation of community services that include the fire department, the emergency communications center, and the community's potable water supply system operator.[1]

A lower PPC numerical rating indicates a more favorable rating, which potentially may translate into lower insurance premiums for business owners and homeowners. This more favorable classification makes the community more attractive from an insurance risk perspective. How the PPC for each community affects business and homeowners can be complicated because each insurance underwriter is free to utilize the information as they deem appropriate. Overall, many factors feed into the compilation of an insurance premium, not just the PPC.

A community's PPC grade depends on:

- **Needed Fire Flows** (building locations used to determine the theoretical amount of water necessary for fire suppression purposes). The needed fire flow in Haverhill is 3,500 gallons per minute. This is based on the fifth-largest needed fire flow in the city.
- **Emergency Communications** (10 percent of the evaluation).
- **Fire Department** (50 percent of the evaluation).
- **Water Supply** (40 percent of the evaluation).

The City of Haverhill has an ISO rating of ***Class 03/3x***. The first number indicates a fire suppression system is present that includes a creditable dispatch center, fire department, and water supply (fire hydrants). The second number is the class that applies to properties within 5-road miles of a fire station but beyond 1,000 feet of a creditable water supply (fire hydrant). The city's ISO rating was effective in December 2015.

The City of Haverhill's 2015 report included the following credit points by major category:

- **Emergency Communications**: 8.45 earned credit points/10.00 credit points available.
- **Fire Department**: 33.41 earned credit points/50.00 credit points available.
- **Water Supply**: 26.87 earned credit points/40.00 credit points available.

1. HFD ISO PPC report Effective December 2015.

- **Community Risk Reduction** (Fire Prevention/Inspection, Public Education, and Fire Investigation activities): 3.86 earned credit points/5.50 credit points available.

Overall, the community PPC rating yielded 72.52 earned credit points out of 105.50 credit points available. There was a 0.07 point diversion reduction assessed as well, which is automatically calculated based on the relative difference between the fire department and water supply scores. **70.00 points or more qualify a community for a rating of 3.**

The next table outlines the scoring for HFD's ISO-FSRS components.

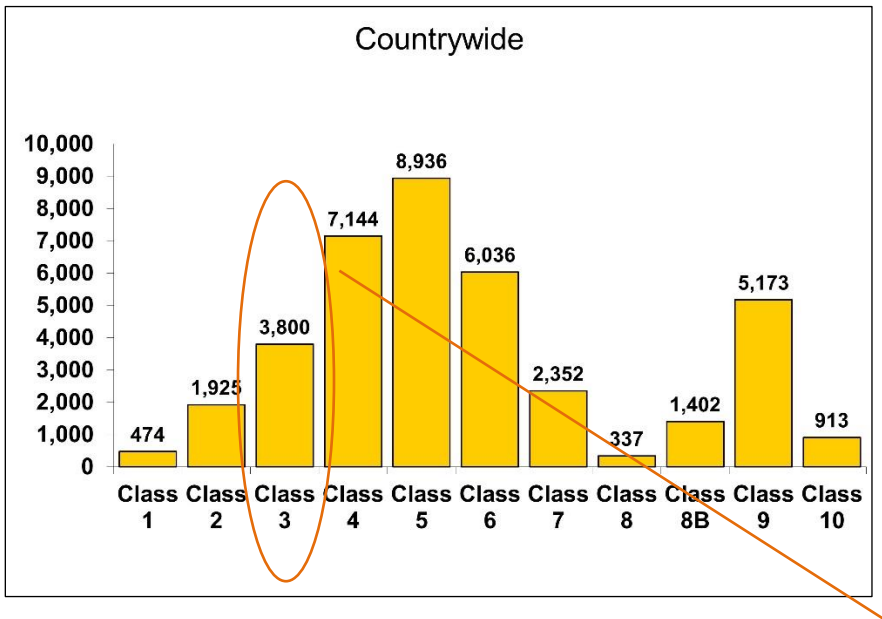
TABLE 3-2: Haverhill ISO Earned Credit Overview

FSRS Component	Earned Credit	Credit Available
414. Credit for Emergency Reporting	2.40	3
422. Credit for Telecommunicators	3.20	4
4.32. Credit for Dispatch Circuits	2.85	3
440. Credit for Emergency Communications	**8.45**	**10**
513. Credit for Engine Companies	5.95	6
523. Credit for Reserve Pumpers	0.50	0.50
532. Credit for Pump Capacity	3.00	3
549. Credit for Ladder Service	3.98	4
553. Credit for Reserve Ladder and Service Trucks	0.46	0.50
561. Credit for Deployment Analysis	5.78	10
571. Credit for Company Personnel	7.27	15
581. Credit for Training	4.47	9
730. Credit for Operational Considerations	2.00	2
590. Credit for Fire Department	**33.41**	**50**
616. Credit for Supply System	21.47	30
621. Credit for Fire Hydrants	3.00	3
631. Credit for Inspection and Flow Testing	2.40	7
640. Credit for Water Supply	**26.87**	**40**
Divergence	**-0.07**	-
1050. Community Risk Reduction	**3.86**	5.50
Total Credit	**72.52**	**105.50**

This ISO-PPC report is seven years old and should be renewed in the near term so that the HFD can adequately assess where improvements have/can be made.

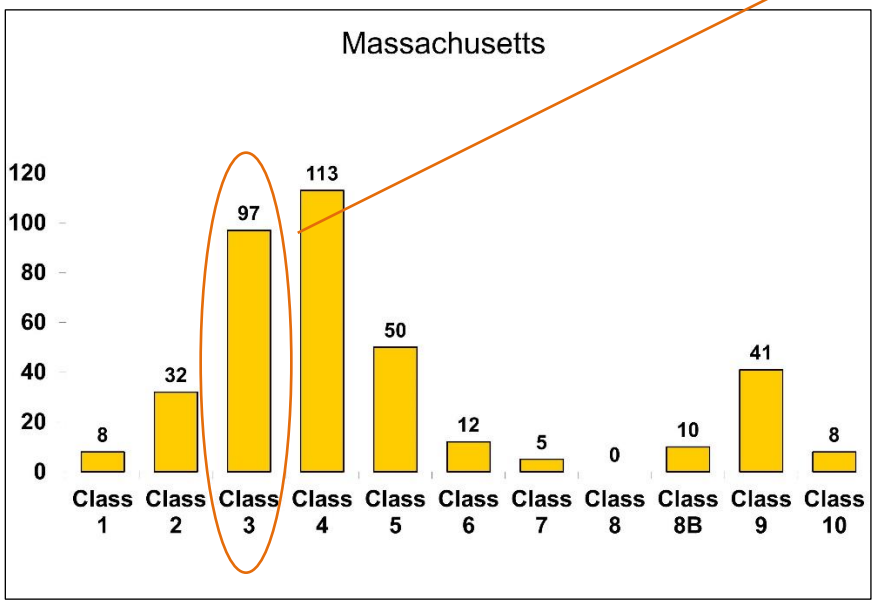
The next figures illustrate ISO-PPC ratings countrywide and in the Commonwealth of Massachusetts.

FIGURE 3-3: PPC Ratings in the United States[2]



City of Haverhill

FIGURE 3-4: PPC Ratings in Massachusetts[3]



Although the current ISO-PPC is dated, areas of scoring that should be reviewed further internally by the city and the HFD to ensure improvement has been made, and which can have the most impact on service delivery include:[4]

- Training: #581 (A) Facilities and Use (0.00/35 credits).

2. https://www.isomitigation.com/ppc/program-works/facts-and-figures-about-ppc-codes-around-the-country/
3. Ibid.
4. Public Protection Classification Summary Report, Haverhill, MA, 2015.

- For maximum credit each firefighter should receive 18 hours per year in structure fire-related subjects as outlined in the NFPA 1001 standard at a training facility where props and fire simulation buildings can be used. The HFD is not meeting this section to its fullest potential.

- New Driver and Operator Training (0.00/5 credits).
  - For maximum credit new drivers and operators should receive 60 hours of driver/operator training per year in accordance with NFPA 1002 and NFPA 1451.

- Water Supply: #631

  This item reviews the fire hydrant inspection frequency, and the completeness of the inspections in accordance with the AWWA M-17 standard. This item also reviews the frequency of flow testing of hydrants. Because the current ISO review is dated, CPSM recommends the Department of Public Works continues to ensure fire hydrants are flow tested and inspected to a level commensurate with achieving maximum scoring possible.

- Credit for company personnel (7.27/15) and deployment analysis (5.78/10) are analyzed later in this report.

ISO Analysis Recommendations:

- CPSM recommends the HFD review the deficiencies in the Fire Department section of the 2015 ISO-Public Protection Classification report as outlined in this analysis and determine if improvements have been made. If improvements have not been made, CPSM further recommends the HFD develop a plan that addresses deficiencies that remain. (Recommendation No. 2.)

- CPSM recommends the Department of Public Works continues to ensure fire hydrants are flow tested and inspected to a level commensurate with achieving maximum scoring possible, which is a frequency of inspections every 1 to 2 years, and a frequency of flow testing every 5 to 6 years. (Recommendation No. 3.)

- As the current ISO-PPC report is seven years old, CPSM recommends the HFD contact the ISO and schedule and prepare for a community fire protection review. (Recommendation No. 4.)

COMMUNITY RISK REDUCTION

Community Risk Reduction activities are important undertakings of a modern-day fire department. A comprehensive community risk reduction/fire prevention program in every jurisdiction should include, at a minimum, the key functions of fire prevention, code enforcement, inspections, and public education. Preventing fires before they occur, and limiting the impact of those that do, should be priority objectives of every fire department. Fire investigation is a mission-important function of fire departments, as this function serves to determine how a fire started and why the fire behaved the way it did, providing information that plays a significant role in future fire prevention efforts. Educating the public about fire safety and teaching them appropriate behaviors on how to react should they be confronted with a fire is also an important life safety responsibility of the fire department.

Fire suppression and response, although necessary to protect property, have negligible impact on preventing fire. Rather, it is public fire education, fire prevention, and built-in fire protection systems that are essential elements in protecting citizens from death and injury due to fire, smoke inhalation, and carbon monoxide poisoning. The fire prevention mission is of utmost importance,

as it is the only area of service delivery that dedicates 100 percent of its effort to the reduction of the incidence of fire.

The Fire Prevention Division in the HFD is commanded by a Deputy Chief who serves as the de facto Fire Marshal. In addition to the Deputy Chief, the office is staffed with a lieutenant and three firefighter positions who serve as fire inspectors/investigators/life safety educators. In addition to overall management of the Fire Prevention Division, the Deputy Chief also assists the Fire Chief in routine day-to-day administrative duties as described earlier. Together these five positions administer the fire code inspection program, fire permitting functions, plans and developmental review, public education, fire investigation, special event plan review, and associated risk reduction programs.

Associated duties of the division include occupancy load review, demolition plans review and inspection, hazardous process review and inspection, propane installation review and inspection, fireworks permitting and inspection, community risk reduction consultation, life safety public education, public information requests, outdoor dining management, and departmental interoperability.

At the time of this analysis the division was utilizing the following fire and building codes:

- Fire Prevention Code: Massachusetts Comprehensive Fire Safety Code (527 CMR 1.00).
  - NFPA 1 Fire Code with Massachusetts amendments.
- International Building Code, Massachusetts 780 CMR, 2015 edition.
- International Residential Code, 2015.
- International Existing Building Code, 2015.
- International Energy Conservation Code.
- International Mechanical Code, 2015.

The HFD Fire Prevention Division is responsible for 19,263 inspectable properties. For 2020, and 2021 the Fire Prevention Division conducted the inspections shown in the following table.

TABLE 3-3: HFD Completed Fire Inspections, 2020–2021

Year	2020	2021
Inspections	2,391	2,922

Aggregately for 2019, 2020, and 2021 the Fire Prevention Division conducted 1,228 plan reviews. These included sprinkler and fire alarm systems, fire foundation, underground and aboveground storage tank systems, LPG tank installs, commercial cooking hood systems, outdoor dining, tent or membrane structure installs, and regular developmental and preliminary project reviews. It should be noted that many plan reviews, particularly those involving fire protection systems, require a final fire inspection, which is coordinated and conducted by the Fire Prevention Division staff.

The Fire Prevention Division is responsible for issuing permits in accordance with the Fire Prevention Code for certain processes, mechanical systems, certain storage, fire alarm systems, fire foundations, certificate of inspections for residential occupancies (rental and permanent), open burning, sprinkler system repair and installation, explosive blasting operations, transport of combustible liquids, fire business inspections, above- and below-ground tanks, hot work, and

demolition. The HFD Fire Prevention Division issues and conducts follow-up inspections for 2,500 permits annually.

Public education is the area where the fire service can make the greatest impact on preventing fires and subsequently reducing the accompanying loss of life, injuries, and property damage through adjusting people's attitudes and behaviors regarding fires and fire safety. The HFD conducts public education programs focused on the school-age population. The Student Awareness of Fire Education (S.A.F.E.) program is aimed at elementary, intermediate, and high school students to help them recognize the dangers of fire, the need for and importance of working smoke detectors, the dangers of smoking, and the importance of exit drills in the home. This and other public fire education presentations and community interaction through phone and email make up this important function. Aggregately the HFD (Fire Prevention Division and Suppression Companies) completed 86 S.A.F.E. presentations from 2019 through 2022.

The investigation of the cause and origin of fires is also an important part of a comprehensive fire prevention system. Determining the cause of fires can help with future prevention efforts. Battalion Chiefs and company officers initiate the fire origin and cause determination process. When possible, they can and should make the origin and cause determination. When needed, particularly when the on-scene officers cannot determine the origin and cause of the fire, a Fire Prevention Division member responds for fire and arson investigation. Aggregately for 2019, 2020, and 2021, the HFD staff conducted 267 fire investigations.

Community Risk Reduction Recommendations:

- Over the near-term (1 to 3 years), CPSM recommends the city consider addressing Fire Prevention Division staffing through the addition of an Assistant Chief position, which would relieve the current Deputy Chief who oversees the Fire Prevention Division of considerable and needed administrative support to the Fire Chief. The Deputy Chief of Fire Prevention position could then focus all efforts on the important function of community risk reduction through fire prevention and public life-safety education.

  The Assistant Chief position would be a direct report to the Fire Chief and operate in the command structure overseeing the major functions and assigned departmental committees, work groups, and programs as deemed appropriate by the Fire Chief. This position can be either a collective bargaining unit position or not and can be included in the civil service or not, as deemed appropriate by the city. ***New position cost estimate (external hire): $144,657 (Deputy Chief salary+ cba+ benefits+15%, no overtime).*** Another alternative is to promote a current Deputy Chief to this position. ***Estimated costs for this alternative (internal promotion) (salary+ cba+ benefits, no overtime): Deputy Chief to Assistant Chief promotion at 15% ($18,869); Captain to Deputy Chief ($12,947); Lieutenant to Captain ($12,275); Firefighter to Lieutenant ($15,896); 1 new firefighter to backfill vacated promotion from Firefighter to Lieutenant ($112,593). Total alternative cost: $172,580*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, February 2022).*** (Recommendation No. 5.)

- Over the near-term (next 24 months), CPSM recommends the city consider adding a life-safety public education specialist (civilian position) for the purpose of expanding the S.A.F.E program to the city's vulnerable residential population (the aged and those needing assistance). The position should focus on those residents living in multistory housing units and teach this population through education ad interactive programs how to prevent and respond to fire incidents, and how to prevent unintentional injury and death. ***New position cost estimate: $60,007 (Firefighter salary + benefits, no overtime (Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, February 2022). This cost is potentially lower based on civilian benefit costs and on-boarding salary.*** (Recommendation No. 6.)

TRAINING AND EDUCATION

Training is, without question, one of the most essential functions that a fire department should be performing on a regular basis. One could even make a credible argument that training is, in some ways, as important as emergency responses because a department that is not well trained, prepared, and operationally ready will be unable to fulfill its emergency response obligations and mission. Education and training are vital at all levels of fire service operations to ensure that all necessary functions are completed correctly, safely, and effectively. A comprehensive, diverse, and ongoing training program is critical to the fire department's level of success.

An effective fire department training program must cover all the essential elements of that department's core missions and responsibilities. The level of training or education required for a set of tasks varies with the jobs to be performed. The program must include an appropriate combination of technical/classroom training, manipulative or hands-on/practical evolutions, and training assessment to gauge the effectiveness of these efforts. Much of the training, and particularly the practical, standardized, hands-on training evolutions should be developed based upon the department's own operating procedures and operations while remaining cognizant of widely accepted practices and standards that could be used as a benchmark to judge the department's operations for any number of reasons.

Certain Occupational Safety and Health Administration (OSHA) regulations dictate that minimum training must be completed on an annual basis. This training covers various topics that include:

- A review of the respiratory protection standard, self-contained breathing apparatus (SCBA) refresher and user competency training, SCBA fit testing (29 CFR 1910.134).
- Blood Borne Pathogens Training (29 CFR 1910.1030).
- Hazardous Materials Training (29 CFR 1910.120).
- Confined Space Training (29 CFR 1910.146).
- Structural Firefighting Training (29 CFR 1910.156).

Additionally, the ISO requires certain training to be conducted and recorded annually in areas of live facility-based training that includes live-fire and multicompany training; structural firefighting; officer development; driver-operator/pump and aerial; hazardous materials; and building familiarization.

The Training Division in the HFD is managed by a captain. There are no other full-time staff resources dedicated to this division (at one time there were as many as five assigned). A firefighter is assigned on an as-needed basis utilizing overtime. As discussed above, this Captain is also the department safety officer, medical supply officer, EMS training coordinator, and coordinates and manages the annual testing of all hose utilized by the HFD.

Training for HFD operational staff includes:

- Medical First Responder.
- Emergency Medical Technician.
- Cardiopulmonary Resuscitation.

- Recruit Training at the Massachusetts Fire Academy (Firefighter 1 and II Certification).
- Haz-Mat Operations Level.
- Officer Training.

Training for HFD personnel is delivered through a variety of methods and locations that include:

- Water Street Station (training props are located here for company use).
- Haverhill Trinity Ambulance Base.
- Computer Drive parking lot (driver/operator and practical training).
- Plugs Pond (drafting, pump ops, water training).
- Granite Street parking deck (practical training).
- Department of Public Works.
- Various buildings/businesses in the city.
- Prodigy EMS Training Platform.
- One-Stop EMS Compliance and Training Platform.
- Recreational Off-Highway Vehicle (RHOVA) training for department off-road units.
- Massachusetts Fire Academy.
- New/existing building pre-fire plan training.

Overall, the HFD training program for operational personnel is quite extensive and includes monthly, annual, and bi/tri annual (EMR and EMT) training requirements. This training covers all subject matter related to fire operations, wildland, haz-mat, EMS response, incident command, emergency vehicle operations, and technical rescue. Overall annualized training requirements are:

- Company Training: 192 Hours (16 Hours per month).
- Hazardous Materials Training: 6 Hours.
- Driver Training: 12 Hours.
- New Driver Training: 60 Hours.
- Officer Training: 12 Hours.
- Recruit Training: 240 Hours.
- Facility Training: 18 Hours.
- Pre-Planning Review: One review per year.

The Training captain organizes and coordinates much of the training for HFD operational personnel. Trinity Ambulance and the Haverhill Police Department also assist in training with their subject matter experts as needed. Additionally, several HFD members are certified instructors in basic and specialty subject matter, including haz-mat, fire prevention, computer software and

hardware, rope rescue, building collapse, pump ops, basic firefighting, and other specialty subjects.

There is no specific certification required for a new hire in the HFD. New hires attend the Massachusetts Fire Academy where they receive training and certification on completion of Firefighter I and II, as well as Haz-Mat Operations Level Responder. Additionally, new hires receive a two-week orientation and do not ride on apparatus until they receive the certifications from the academy as described here.

Incumbents receive daily company training through a task book that outlines the drill and objectives to be accomplished. Training is recorded in the department's records management system. There currently is not a specific officer training program, although officers or aspiring officers can avail themselves of state fire academy training as well as regional officer-related offered training opportunities.

As mentioned previously, the HFD had some deficiencies in the 2015 ISO-PPC review. These included live training at a training facility, which is 18 hours/year per firefighter and officer. This training includes live-fire training, multicompany training, aerial operations training, search and rescue training, ground ladder and hose training, and the like. While the HFD is an active fire department, not every member experiences repetitive fire runs where they are utilizing all structural fire skills. Annualized live facility training for all members is important, hones underutilized skills, and builds preparedness for any situation.

Recommendations:

- CPSM recommends that due to the importance of training as outlined herein, the city consider funding a training officer at the lieutenant level over the mid-term (2 to 5 years) to develop, coordinate, manage, and deliver consistent training and education programs for new hires and incumbent personnel of the HFD. This position should have primary responsibility to ensure HFD staff are proficiently trained to perform assigned tasks, maintain state fire and EMS training, and ISO standards, and that required certifications and annual coursework is current and properly documented. ***Estimated costs: Firefighter to Lieutenant ($15,896) (salary+ cba+ benefits, no overtime); 1 new firefighter to backfill vacated promotion from Firefighter to Lieutenant ($112,593) (salary+ cba+ benefits+ overtime). Total costs $128,489*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).*** (Recommendation No. 7.)
- CPSM recommends the HFD, to the extent possible with current staff or through an external firm, develop an officer training program that is continuous and includes at a minimum the following areas: leadership, command and control of emergency incidents, employee relations, management of a diverse workforce, oral and written communication, mentoring and coaching, crew management, fire incident safety, health and safety concepts of a contemporary fire department, community outreach, organizational risk management, professional ethics, and information management. (Recommendation No. 8.)

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FIRE ALARM DIVISION

The Fire Alarm Division in the HFD is responsible for 911 call taking and dispatch of fire, EMS, and non-emergency-public service calls in the city. The division is also responsible for the maintenance of the street and master fire alarm boxes located in the city, as well as all traffic control devices in the city. The fire alarm dispatch center is located in the Public Safety Complex.

The division is staffed with one Fire Alarm Supervisor, which is currently a uniform fire lieutenant grade position (budgeted as a captain); eight fire alarm telecommunicators (uniform firefighter positions); and one signal technician (civilian position compensated at the firefighter level). Daily staffing includes one lead operator/telecommunicator and one telecommunicator.

Duties for fire alarm telecommunicators include:

- With the aid of a computer-aided dispatch (CAD) system, dispatch the correct fire department apparatus as outlined in response protocols.
- Utilize the mutual aid ten-alarm card system to request resources from the surrounding communities to ensure coverage in the city during a second alarm fire.
- Through the use of *Crew Sense* software, call back additional firefighters and Safety Officer during a working fire or other situations that may dictate additional resources, and call back staff as needed during a shift when emergency, sick, or injury leave occurs. This is done with the Crew Sense software to send out a ready alert for assistance to all available personnel.
- Monitor simultaneous radio transmissions on the primary channel and fireground channel during a working fire, for any urgent radio traffic to include May-Day situations.
- Monitor the Municipal Fire Alarm Gamewell Master Box System throughout the city.
- Primary dispatch for Pridestar/Trinity EMS ambulances for emergency medical calls and interfacility transfer requests.
- Receive public phone calls for non-emergency fire-related assistance to include fire prevention questions such as burn permits for outside burning.

Training for HFD fire alarm dispatch staff includes:

- Emergency Fire Dispatch (Fire Priority Dispatch System).
- Priority Medical Dispatch.
- Next Generation 911.
- APCO Public Safety Telecommunicator 1.
- Cardiopulmonary Resuscitation.
- Acuity Computer-Aided Dispatch System Training.
- Motorola Radio Equipment Training.
- Zetron Station Alerting System Training.

During the CPSM one-year workload study period, the Fire Alarm Office dispatched 8,364 calls for service to the HFD. This call count does not count calls dispatched or transferred to

Pridestar/Trinity ambulances, which is several thousand calls per year. The following table outlines the dispatches by call type.

TABLE 3-4: Calls by Type Dispatched by the Fire Alarm Office

Call Type	Total Calls	Calls per Day
General medical	4,350	11.9
MVA	544	1.5
EMS Total	**4,894**	**13.4**
False alarm	1,427	3.9
Good intent	377	1.0
Hazard	321	0.9
Outside fire	88	0.2
Public service	765	2.1
Structure fire	163	0.4
Technical rescue	40	0.1
Fire Total	**3,181**	**8.7**
Canceled	268	0.7
Mutual aid	21	0.1
Total	**8,364**	**22.9**

The next table outlines the call processing time by the Fire Alarm Office during the one-year study period for 6,828 calls involving the arrival of a first due unit.

TABLE 3-5: Call Processing Time: Fire Alarm Office

Call Type	Average Call Processing Time, Minutes	90th Percentile Call Processing Time, Minutes
General medical	3.1	4.8
MVA	2.6	4.4
EMS Total	**3.1**	**4.7**
False alarm	2.2	3.9
Good intent	2.8	4.7
Hazard	2.6	3.9
Outside fire	2.7	4.3
Public service	3.1	4.5
Structure fire	2.4	3.8
Technical rescue	2.5	4.3
Fire Total	**2.6**	**4.2**

National Fire Protection Association (NFPA) Standard 1710, *Standard for Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, 2020 edition, includes national consensus standards for emergency communication Public Safety Answering Points (PSAPs) and dispatch centers. These standards apply to the HFD PSAP, which also serves as the communications

center. Section 4.1.2.3 of this standard outlines several benchmarks for communications center operations for fire and EMS events. For the HFD, this measurement is applied to the HFD dispatch center and includes:

Call answering time: The call arrives at the PSAP and communications center by phone and is processed as outlined in the standard as follows:

- Ninety percent of events received on emergency lines shall be answered within 15 seconds, 95 percent of alarms shall be answered in 20 seconds, and no more than 40 seconds 99 percent of the time.

Alarm processing time: Event processing times at the HFD shall be completed in 64 seconds 90 percent of the time and not more than 106 seconds 95 percent of the time.

Alarm processing time for the following call types shall be completed within 90 seconds 90 percent of the time and within 120 seconds 99 percent of the time:

- *Calls requiring Emergency Medical Dispatch.*
- *Calls requiring language translation.*
- *Calls requiring TTY/TTD receipt of events.*
- *Calls of criminal activity that require information vital to emergency responder safety prior to dispatching units.*
- *Haz-mat incidents.*
- *Technical rescue incidents.*
- *Incomplete location.*
- *Calls received by text message to the communications center.*

The 90th percentile dispatch times recorded during the one-year data analysis CPSM performed (the time to process calls for service) were:

- EMS: 4.7 minutes.
- Fire: 4.2 minutes.

Both of these time elements exceed the NFPA standard.

Fire Alarm Office Recommendation:

- In the near-term (next 24 months), the HFD should work to implement performance measures and compliance methodologies for call processing times in the 911-dispatch center to address the current long call processing times. There should be a focus on closing the gap between national standards and the current time to process and dispatch all calls for service. ***There are no recommended positions to gain compliance.*** (Recommendation No. 9.)

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City leadership is considering transitioning away from uniform firefighters serving as dispatchers to hiring civilian dispatchers. The potential savings in salary and benefits (civilian vs uniform firefighter) are attractive, and as well as the uniform positions can be transitioned to fire operations to bolster staffing needs.

Haverhill fire leadership and officers support the current emergency dispatch concept of operations. Their perspective on this includes these thoughts:

- Placing firefighters in dispatch provides an opportunity to expose them to the breadth and depth of fire and EMS operations from a higher but more focused perspective.
- They are engaged in the entire life cycle of every emergency incident, thus further providing knowledge and experience with the concept of operations for emergency incidents.
- They contend it saves staffing costs as these personnel work 24-hour shifts, which is the same work period concept as operational personnel.

Considerations that must be considered for such a transition include but are not limited to the following:

- Recruiting and retaining 911 telecommunicators is a nationwide challenge. Many 911 centers run with constant turnover and vacancies.
- E911 Emergency Dispatch is a profession. Emergency calls depend on telecommunicators to have the highest levels of training, professional certifications, equipment, and experience.
- If uniform staff is replaced one-for-one by civilians, and civilians are assigned to a 24-hour schedule, this schedule may create overtime issues since the civilian staff would not be eligible for the special 7k overtime work period exemption (29 USC §207(k). By law, overtime would be paid after 40 hours in the workweek and not as established in a work period.
- Alternative and common shifts for civilian telecommunicators are twelve hours, which reduces overtime liability. Under this scenario, it would still require eight civilian fire telecommunicators to replace eight uniform positions. However, a twelve-hour shift typically is 12 hours one week and 48 hours the second.

Fire Alarm Division Recommendation:

- CPSM recommends prior to any transition from uniform to civilian dispatchers, both the city and the HFD should consider all Fair Labor Standards implications for civilianizing these positions. The city and the department should research regional and state trends for vacancy rates, and evaluate any issues for recruitment and retention of 911 telecommunicators (workforce impact review). CPSM further recommends that should the transition from uniform to civilian telecommunicators occur, that the department's overall uniform firefighter position count not be reduced, and the uniform telecommunicators be reassigned to field operations to address staffing needs. (Recommendation No. 10.)

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OVERTIME ANALYSIS

The Haverhill Fire Department has four fire stations that are staffed based on the minimum staffing levels listed below. The collective bargaining agreement (CBA) between Local 1011, International Association of Firefighters AFL-CIO and the City of Haverhill states that there should be no fewer than 19 fire suppression personnel on duty each shift.

- Water Street Station
  - Command Car – one Deputy Chief.
  - Rescue Truck – one captain and two firefighters.
  - Ladder Truck – one lieutenant and two firefighters.
  - Engine – one lieutenant and two firefighters.
- Bradford Station
  - Engine – one lieutenant and two firefighters.
- 16th Ave. Station
  - Engine – one lieutenant and two firefighters.
- High Street Station
  - Engine – one lieutenant and two firefighters.

Minimum staffing levels for dispatching have also been established. Those requirements are two per work group (four work groups) for a total of eight personnel.

The CBA between Local 1011 and the City of Haverhill establishes that personnel follow an eight-week cycle that operates on a 24 hours on/48 hours off, then 24 hours on/96 hours off schedule, which translates to an average workweek of 42 hours. The employee's pay is based on a step schedule that can be supplemented with multiple qualifying incentives. The overtime rate for personnel is also referenced in the CBA. For employees on a 24-hour shift, overtime is figured at 1.5 times the employee's hourly pay rate. The hourly rate of pay is based upon 1/42 of the regular weekly compensation. Employees on duty who are held beyond their scheduled tour shall receive a minimum of two hours of pay at the overtime rate. Employees called back to work when off duty shall receive a minimum of four hours of pay at the overtime rate.

The HFD staffs all suppression units and fire alarm on a "constant" basis. This means that if a position is vacant for a shift (e.g., someone calls in sick or is on vacation), then another employee is called in to work overtime to fill that vacant shift. Although vacation and sick time are a large part of leave usage, there are multiple reasons that an employee may be missing from their assigned shift and would require the vacancy to be covered by an employee on overtime. In the HFD, those reasons could include: bargaining leave, union leave, other union leave, overtime callback, personal leave, attendance bonus, bereavement leave, injury leave, military leave, Family Medical and Leave Act (FMLA), and humanitarian leave. Leave procedures for sick time are covered in HFD Policy #3.6, which includes how to return to work from sick leave. HFD policy 3.7 discusses the types of leave other than sick leave and applicable governance.

Overtime

Over the past three years, the Haverhill fire department has spent between $1.9 million and $2.1 million a year, or 19.66 percent to 19.80 percent of its personal services budget, on overtime. Overtime costs in relation to the overall personal services costs are shown in the following table.

TABLE 3-6: Personal Services Actual Costs by Category with Percentages: FYs 2019, 2020, 2021

	FY 19 Actual	FY 19 %	FY 20 Actual	FY 20 %	FY 21 Actual	FY 21 %
Salaries and Wages	5,921,739	59.40%	5,994,314	59.43%	6,384,743	59.94%
Holiday Pay	433,414	4.35%	438,912	4.35%	484,200	4.55%
Overtime	1,974,306	19.80%	1,982,662	19.66%	2,099,973	19.72%
Incentives	1,639,389	16.45%	1,670,765	16.56%	1,682,392	15.80%
Total Personal Services	**9,968,848**	**100.00%**	**10,086,653**	**100.00%**	**10,651,308**	**100.00%**

Based on the total number of personnel in the department, aggregately overtime equals approximately 47,800 hours to 48,500 hours or 131 to 133 overtime hours per day as outlined in the next table.

TABLE 3-7: Three-Year Average Overtime Rate and Hours

	FY 19 Actual	FY 20 Actual	FY 21 Actual
Number of Personnel	100	100	100
Average Weekly Salary (without incentives)	$1,138.80	$1,152.75	$1,227.84
Average Hourly Rate (without incentives)	$27.11	$27.45	$29.23
Average Overtime Rate (without incentives)	$40.67	$41.17	$43.85
Total Yearly Overtime Hours	48,543	48,158	47,889
Average Daily Overtime Hours	132.99	131.94	131.20

Staffing Factor

An alternative to constant staffing is upstaffing with shift relief personnel. This model considers anticipated vacancies due to leave usage (vacation, sick, etc.), by hiring more employees than are necessary to fill the daily minimum staffing levels. So as employees use vacation and sick time, the additional personnel fill in the gaps, fulfilling the minimum staffing requirements without having to call in employees on overtime.

The leave usage in calendar year 2021 was broken down into five categories: vacation, personal day, sick, family sick leave and other. Vacation made up 58% of the leave usage for the fire suppression and dispatch personnel. The next table depicts the percentages of each of the leave usage for fire suppression and dispatch personnel.

TABLE 3-8: Calendar Year 2021 Leave Usage

Type of Leave	Percentage of Total Leave
Vacation	58.28%
Personal Day	15.36%
Sick	13.06%
Family Sick	3.22%
Other	10.08%

Largest % of Leave Usage is Vacation and Personal Day

Sick, Family Sick, and Other Aggregately Make Up 26.36% of Leave Usage

The calculation to determine the staffing factor for the number of shift relief positions needed requires a few data points. The data points include how many current employees there are, the minimum number of employees required daily and a leave usage calculation. The use of this information can determine the staffing factor, which will calculate how many employees are needed to meet the minimum staffing levels without having to rely on calling in employees on overtime. The next two figures illustrate the staffing factor for the HFD based on 2021 leave usage.

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FIGURE 3-5: Staffing Factor Formula for HFD Fire Suppression and the Fire Alarm Office

Fire Suppression	
Minimum Number of Personnel/Day	19
Minimum Number of Hours Needed/Year	**165,984**
Number of employees	76
Total Hours Scheduled/Year	**165,984**
Average Number of Leave Hours/employee/year	345
Leave Hours Used for 2021	**26,220**
Minimum Number of Hours Needed (165,984) *divided by* **Scheduled Hours** (165,984) **minus Leave Hours** (26,220)	**= Staffing Factor (1.19)**
Staffing Factor	**1.19**
Fire Alarm Office	
Minimum Number of Personnel/Day	2
Minimum Number of Hours Needed/Year	**17,472**
Number of employees	8
Total Hours Scheduled/Year	**17,472**
Average Number of Leave Hours/employee/year	345
Leave Hours Used for 2021	**2,651**
Minimum Number of Hours Needed (17,472) *divided by* **Scheduled Hours** (17,472) minus **Leave Hours** (2,651)	**= Staffing Factor (1.18)**
Staffing Factor	**1.18**

Once the staffing factor is calculated the number of shift relief personnel or "floaters" can be determined by multiplying the total hours scheduled for the year by the staffing factor. This calculation identifies the total number of hours needed to meet minimum staffing requirements while also considering the amount of leave time the department typically uses. The difference between the two numbers is the number of employee hours needed to cover the leave usage. This number is then divided by the number of hours an employee works. The final calculation shows the number of additional employees that are needed to cover leave usage without using overtime.

TABLE 3-9: HFD Fire Suppression Staffing Factor: Relief Personnel

Staffing Factor	1.19
Total Hours Needed for Minimum Staffing and to Cover Leave Usage = Staffing Factor (1.19) x Minimum Hours Needed (16,984)	197,122
Total Hours Scheduled/Year	165,984
Difference (Hours Needed to Cover Leave Usage)	31,138
Working Hours/Employee	1,839
Number of Additional Employees Needed	**16.93**

Once the staffing factor is established, the actual number of shift relief employees can be calculated. The staffing factor (1.19) is multiplied by the minimum number of hours (165,984 hours) needed for fire suppression. This will determine the total number of hours needed to cover leave usage.

1.19 staffing factor (times) 165,984 minimum staffing hours = 197,122 needed hours

The scheduled hours (165,984 hours) are subtracted from the needed hours (197,122 hours) to determine the total number of additional hours needed to cover leave usage (31,138 hours).

197,122 needed hours (minus) 165,984 scheduled hours = 31,138 missing hours

Once the missing hours are calculated, the next step is to convert the hours into the number of employees needed. For example, a fire suppression employee works an average of 1,839 hours/year. This is calculated by taking the employee's scheduled hours (42 hours/week x 52 weeks/year = 2,184 hours) (minus) the average leave usage for the year (345 hours), this equals the employee's working hours (1,839 hours).

2,184 scheduled hours (minus) 345 leave hours = 1,839 working hours

Using the calculations above, the total number of additional employees needed is 17 to cover all leave usage in fire suppression. A total of 31,138 additional hours are needed to meet the minimum staffing requirements and the anticipated leave usage. This number is divided by the number of working hours for one employee (1,839 hours). This final calculation produces 16.93, which is the number of employees needed.

31,138 missing hours (divided by) 1,839 working hours per employee = 16.93 employees needed

The next discussion focuses on Fire Alarm Office staffing.

TABLE 3-10: HFD Fire Alarm Office Staffing Factor: Relief Personnel

Staffing Factor	1.18
Total Hours Needed for Minimum Staffing and to Cover Leave Usage = Staffing Factor (1.18) x Minimum Hours Needed (17,472)	20,597
Total Hours Scheduled/Year	17,472
Difference (Hours Needed to Cover Leave Usage)	3,125
Number of Additional Employees Needed	**1.70**

The same calculation can be done for the dispatch personnel. The staffing factor (1.18) is multiplied by the minimum number of hours (17,472 hours) needed for fire suppression. This will determine the total number of hours needed to cover leave usage.

1.19 staffing factor (times) 17,472 minimum staffing hours = 20,597 needed hours

The scheduled hours (17,472 hours) are subtracted from the needed hours (20,597 hours) to determine the total number of additional hours needed to cover leave usage (3,125 hours).

20,597 needed hours (minus) 17,472 scheduled hours = 3,125 missing hours

Once the missing hours are calculated, the next step is to convert the hours into the number of employees needed. For example, a dispatch employee works an average of 1,839 hours/year. This is calculated by taking the employee's scheduled hours (42 hours/week x 52 weeks/year = 2,184 hours) (minus) average leave usage for the year (345 hours); this equals the employee's working hours (1,839 hours).

2,184 scheduled hours (minus) 345 leave hours = 1,839 working hours

Using the calculations above, the total number of additional employees needed for the Fire Alarm Office is 2. A total of 3,125 additional hours are needed to meet the minimum staffing requirements and the anticipated leave usage. This number is divided by the number of working hours for one employee (1,839 hours). This final calculation produces 1.70, which is the number of employees needed.

3,125 missing hours (divided by) 1,839 working hours per employee = 1.7 employees needed

This staffing factor calculation is used to cover the amount of leave usage that is typical for a year. Additional overtime may still be required depending on the needs of the department. For instance, vacancies, operational needs, training, and injuries will create overtime because the number of personnel is not at the calculated levels. During fiscal year 2021, the Haverhill fire department used approximately 14,000 additional hours of overtime beyond the number of overtime hours that was used for leave usage. These hours of overtime were based on the needs of the department to include: training, operational coverage, vacancy coverage and coverage for injured employees. The table below provides a comprehensive list of the department-wide overtime for fiscal year 2021 based on departmental need.

Table 3-11: Fiscal Year 2021 Overtime Based on Departmental Need

Reason	Hours
Administrative Needs	603
Coverage for Disciplined Employees	148
Maintenance Needs	1,188
Operational Needs	1,878
Other	1,789
Coverage for Employees at School	207
Training	1,232
Union Leave Coverage	132
Vacancy	3,264
Coverage for Injured Employee	3,410
Coverage for Employees on Light Duty	408

Total FY 2021 Overtime Hours Based on Department Need 14,257 Hours

As previously stated, constant staffing requires overtime to fill in the staffing gaps for leave usage. In addition to leave usage, overtime would also be necessary for any assignment required to fulfill departmental needs. By using the staffing factor formula, the HFD can better manage some of the overtime based on departmental needs through hiring additional personnel for shift relief. See the table below for the number of shift relief personnel that would need to be hired to cover the overtime for department need.

Table 3-12: Staffing Relief for Overtime Based on Departmental Need

Staffing Factor	1.19
Number of hours needed to cover overtime based on departmental needs	14,257
Hours each person works	1,839
Number of additional people needed	**7.75**

Based on the previous calculations for the staffing factor and the hours each person works, the number of additional employees needed to cover the overtime for department need is 8. A total of 14,257 additional hours are needed to cover the department need overtime. This number is divided by the number of working hours for one employee (1,839 hours). This final calculation produces 7.75, which is the number of employees needed.

14,257 overtime hours / 1,839 working hours per employee = 7.75 employees needed

Overtime in the fire department can be very fluid and costly when a constant staffing model is used. By utilizing a staffing factor formula, fire departments can better manage how to fund additional personnel to staff vacant positions created by leave (scheduled and unscheduled) or to cover overtime that is created based on the needs of the department. Additionally, this knowledge can better assist those fire departments in determining a more accurate overtime budget or developing future budgetary alternatives for additional FTE staffing to fill vacancies caused by scheduled and unscheduled leave to reduce overtime costs. ***That being said, even with a robust number of shift relief personnel, it is very unlikely that the cost of overtime will ever be completely eliminated.*** Shift relief provides the department options on how to train its personnel and manages vacancies due to long term vacancies due to injury etc., but sometimes logistically and operationally it is more advantageous to utilize personnel that are off duty. It is these instances that generate overtime costs, despite the number of shift relief personnel in the organization.

FLEET ANALYSIS

An operationally ready and strategically located fleet of mission-essential fire-rescue vehicles is fundamental to the ability of a fire-rescue department to deliver reliable and efficient public safety within a community.

The HFD currently operates a fleet of frontline fire and rescue apparatus that includes:

- Four engine apparatus.
  - 2021 engine.
  - 2021 engine.
  - 2018 engine.
  - 2016 engine.
- One ladder apparatus.
  - 2009 aerial tower.
- One rescue apparatus.
  - 2021, heavy rescue (specialty rescue, vehicle extrication, high-angle rope rescue, confined space rescue, trench rescue equipment).
- Tanker apparatus.
  - 1992 (3,000 gallons).
- Call station apparatus.
  - 2000 engine (Rocks Village).
  - 1987 Hahn (Ayers Village).
- Reserve apparatus.
  - 2006 engine (stored at the maintenance shop).
  - 2006 engine (stored at the maintenance shop).
  - 2005 ladder (tiller-straight ladder) (stored at the Bradford Street Station).

The HFD also has an assortment of command and light response vehicles to include watercraft and special equipment trailers.

The procurement, maintenance, and eventual replacement of response vehicles is one of the largest expenses incurred in sustaining a community's fire-rescue department. While it is the personnel of the HFD who provide emergency services within the community, the department's fleet of response vehicles is essential to operational success. Reliable vehicles are needed to deliver responders and the equipment/materials they use at the scene of dispatched emergencies within the city.

HFD apparatus maintenance is performed by the department's vehicle maintenance shop, which is in a shared city fleet facility and is under the command of the fire master mechanic. Assisting the master mechanic is one fire mechanic. When needed, the maintenance shop

utilizes a private vendor that specializes in fire apparatus-specific maintenance. This combination of maintenance and repair work is common practice across the country.

CPSM visited the fire apparatus shop. CPSM found a dedicated master mechanic who has considerable knowledge of pumps, hydraulics, and all chassis components of fire apparatus. CPSM toured the shop, the parts room, spoke with both the master mechanic and mechanic, and observed the fleet maintenance operation. CPSM found the shop and mechanics to be prepared for all routine and emergency maintenance.

Concerns raised by the master mechanic include excessive wear and tear, high mileage, and corrosion impacting the fire apparatus. Another concern the master mechanic raised was the lack of shop space, which CPSM observed. The shop has limited space for fleet repairs (one to two apparatus dependent on apparatus size and number of apparatus needing repair). Additionally, two reserve engines are stored in the fire fleet bay and have to be moved outside when frontline apparatus is under repair and service.

Replacement of fire-rescue response vehicles is a necessary, albeit expensive, element of fire department budgeting that should reflect careful planning. A well-planned and documented emergency vehicle replacement plan ensures ongoing preservation of a safe, reliable, and operationally capable response fleet.

NFPA 1901, *Standard for Automotive Fire Apparatus*, serves as a guide to the manufacturers that build fire apparatus and the fire departments that purchase them. The document is updated every five years using input from the public/stakeholders through a formal review process. The committee that updates this standard is made up of representatives from the fire service, manufacturers, consultants, and special interest groups. The committee monitors various issues and problems that occur with fire apparatus and attempts to develop standards that address those issues. A primary interest of the committee over the years has been improving firefighter safety and reducing fire apparatus crashes.

The Annex Material in NFPA 1901 (2016) contains recommendations and work sheets to assist in decision making in vehicle purchasing. With respect to recommended vehicle service life, the following excerpt is noteworthy:

> *"It is recommended that apparatus greater than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status and upgraded in accordance with NFPA 1912, Standard for Fire Apparatus Refurbishing (2016), to incorporate as many features as possible of the current fire apparatus standard. This will ensure that, while the apparatus might not totally comply with the current edition of the automotive fire apparatus standards, many improvements and upgrades required by the recent versions of the standards are available to the firefighters who use the apparatus."*

A primary impetus for these recommended service life thresholds is continual advances in occupant safety. Despite good stewardship and maintenance of emergency vehicles in sound operating condition, there are many advances in occupant safety, such as fully enclosed cabs, enhanced rollover protection and air bags, three-point restraints, antilock brakes, higher visibility, cab noise abatement/hearing protection, and a host of other improvements as reflected in each revision of NFPA 1901. These improvements provide safer response vehicles for those providing emergency services within the community, as well those "sharing the road" with these responders.

Many departments use a 10-5 rule (10 years frontline service, then 5 years of reserve service) when programming replacement of fire apparatus such as engines, ladders, water tenders,

heavy rescues, and heavy squad type haz-mat vehicles. Annex D of the current NFPA 1912 edition states:

> *To maximize fire fighter capabilities and minimize risk of injuries, it is important that fire apparatus be equipped with the latest safety features and operating capabilities. In the last 10 to 15 years, much progress has been made in upgrading functional capabilities and improving the safety features of fire apparatus. Apparatus more than 15 years old might include only a few of the safety upgrades required by the recent editions of the NFPA fire department apparatus standards or the equivalent Underwriters Laboratories of Canada (ULC) standards. Because the changes, upgrades, and fine tuning to NFPA 1901, Standard for Automotive Fire Apparatus have been truly significant, especially in the area of safety, fire departments should seriously consider the value (or risk) to firefighters of keeping fire apparatus more than 15 years old in first-line service.*
>
> *It is recommended that apparatus more than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status, be upgraded in accordance with NFPA 1912, and incorporate as many features as possible of the current fire apparatus standard. This will ensure that, while the apparatus might not totally comply with the current editions of the automotive fire apparatus standards, many of the improvements and upgrades required by the current editions of the standards are available for firefighters who use the apparatus.*

Under the NFPA1912 standard there are two types of refurbishments a fire department can choose. These are Level 1 and Level 2 refurbishments. According to NFPA 1912, a Level 1 refurbishment includes *the assembly of a new fire apparatus by the use of a new chassis frame, driving and crew compartment, front axle, steering and suspension components, and the use of either new components or components from existing apparatus for the remainder of the apparatus.* A Level 2 refurbishment includes *the upgrade of major components or systems of a fire apparatus with components or systems of a fire apparatus that comply with the applicable standards in effect at the time the original apparatus was manufactured.*

A few important points to note regarding the NFPA 1912 standard regarding the refurbishment of heavy fire apparatus. These are:[5]

- Apparatus that was not manufactured to applicable NFPA fire apparatus standards or that is 25 years old should be replaced. The HFD has apparatus that exceeds 25 years of age. These apparatus include one engine at a call station and one water tanker. Some departments will utilize vehicles such as this (frontline but not regularly utilized) for longer than 25 years. CPSM does not recommend this practice; however, we understand the financial burden of replacing heavy fire apparatus. It is up to the department and municipality regarding the management of older fire apparatus and the risks these may pose to firefighters and the public who share the road with them.
- A vehicle that undergoes a Level 1 refurbishing receives a new make and model designation and a new Certificate of Origin for the current calendar year. Apparatus receiving a Level 1 refurbishing are intended to meet the current edition of the NFPA automotive fire apparatus standard. *This is the optimal level of refurbishing*.

5. NFPA 1912 Standard for Fire Apparatus Refurbishing, 2016 Edition.

- A vehicle that has undergone a Level 2 refurbishing retains its original make and model identification as well as its original title and year of manufacture designation. Apparatus receiving Level 2 refurbishing are intended to meet the NFPA automotive fire apparatus standard in effect when the apparatus was manufactured.

The HFD has a fleet replacement plan for heavy fire apparatus that is broken down as follows:

- Engines: Replacement based on workload, road miles, and engine hours. A planned HFD lifespan plan is 24 years.
  - HFD engine lifespan:
    - Initial front line service in one of the two busiest stations (Water Street, High Street) for 6 years or 60, 000 miles.
    - Engine reassigned to either 16th Street Station or Bradford Station for 6 years.
      - Refurb work at the 6 to 8 year period.
    - After 12 years of frontline service, engine then placed in reserve status for 6 years.
    - After 6 years of reserve status, engine reassigned to one of the two call stations (Ayers Village or Rocks Village) for 6 years.
    - At the 24-year mark the HFD engine is replaced (retired).
- Ladders: Replacement based on workload and longevity (maintenance requirements). A planned HFD lifespan plan is 20 years.
  - HFD ladder lifespan:
    - Initial frontline service of 10 years.
    - Assigned to reserve status for 10 years.
      - Refurb work at the 12-year mark.
- Rescue: Replacement based on workload and longevity (maintenance requirements). A planned HFD lifespan plan is 16 to 18 years.
  - HFD rescue lifespan:
    - Initial frontline service of 16 to 18 years.
    - No reserve status.
      - Refurb work at the 10-year period.
- Tanker: Replacement based on workload and longevity (maintenance requirements). A planned HFD lifespan plan is 25 years.
  - HFD tanker lifespan:
    - Initial frontline service of 25 years.
    - No reserve status.
      - Refurb work at the 12-year period.

Fleet Recommendations:

- CPSM recommends the HFD develop, over a one-year period, a fire apparatus replacement plan that includes, to the extent possible and funding availability, replacement that aligns more closely to recommendations with NFPA 1901, *Standard for Automotive Fire Apparatus*. (Recommendation No. 11.)

Planning objectives should include:

- Apparatus should not exceed 15 years of service on the front line. Once an apparatus reaches this age, one alternative is the apparatus undergoes a Level 1 refurbishing in accordance with NFPA 1912, *Standard for Fire Apparatus Refurbishing* (current standard), or the apparatus is replaced if maintenance records and wear and tear warrant replacement. (Recommendation No. 12.)
- All apparatus at the 25-year mark should be considered for replacement. Apparatus greater than 25 years old should be removed from service. (Recommendation No. 13.)
- Apparatus and major apparatus components such as the motor, fire pump, aerial ladder assembly and hydraulics, chassis, and chassis components such as brakes, wheels, and steering equipment should be maintained in accordance with manufacturer and industry specifications and standards. All testing records should be maintained in a common records management system for continuous review and analysis. (Recommendation No. 14.)
- Apparatus components requiring annualized testing either fixed or portable such as fire pumps, aerial ladder and aerial ladder assemblies, ground ladders, self-contained breathing apparatus to include personnel fit-testing, and fire hose should be tested in accordance with manufacturer and industry specifications and standards. All testing records should be maintained in a common records management system for continuous review and analysis. (Recommendation No. 15.)

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FACILITY AND RESPONSE TIME ANALYSIS

Sound community fire protection and first-response EMS requires the strategic distribution of an adequate number of station facilities to ensure that effective service area coverage is achieved, that predicted response travel times satisfy prevailing community goals and national best practices, and that the facilities are capable of supporting mission-critical personnel and vehicle-oriented requirements and needs.

The HFD responds from four primary fire facilities. An additional two facilities are also under the control of the HFD and house on-call assets for response when these resources are available. Fire administration offices are located in city hall. The following table profiles the HFD's facilities.

TABLE 3-13: HFD Facilities

Station Identifier	Address	# of Bays
Water Street	131 Water St.	3 Non-drive through
High Street	123 High St.	2 Non-drive through
16th Avenue	13 16th Ave.	2 Non-drive through
Bradford	148 S. Main St.	2 Non-drive through
Ayers Village (Call Station)	1420 Broadway	1 Non-drive through
Rocks Village (Call Station)	10 Merrimack Rd.	2 Non-drive through

Fire facilities must be designed and constructed to accommodate both current and forecast trends in fire service vehicle type and manufactured dimensions. A facility must have sufficiently sized bay doors, circulation space between garaged vehicles, and departure and return aprons of adequate length and turn geometry to ensure safe response.

Fire department facilities are exposed to some of the most intense and demanding uses of any public local government facility, as they are operational 24 hours a day. Personnel-oriented needs in fire facilities must enable performance of daily duties in support of response operations. For personnel, fire facilities must have provisions for vehicle maintenance and repair; storage areas for essential equipment and supplies; and space and amenities for administrative work, training, physical fitness, laundering, meal preparation, and personal hygiene/comfort.

HFD facilities have considerable age, which drives higher upkeep and maintenance costs. Facility maintenance is managed by the Fire Chief. The FY 2023 budget includes an approved facility maintenance staff member to assist with this program work.

Costs to operate and maintain the fire facilities include utilities (water, electric, heating and cooling) as well as regular upkeep and maintenance. The FY 2023 budget includes $74,968 for utility costs and $92,000 for upkeep and maintenance. This represents 18 percent of the non-personnel services FY 2023 HFD budget.

CPSM found the Ayers Village facility interesting as it has a wooden apparatus floor, a wooden apparatus ramp, and limited space for contemporary fire apparatus. Although bolstered in the basement with support columns, the floor has separated from the walls (engineering report as reported by HFD staff). Continuing to use this facility to store and respond heavy fire apparatus should be given serious review by the city and HFD.

As stated, HFD facilities have considerable age and therefore were not constructed according to contemporary benchmarks such as NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, which offers certain health and safety measures for fire facilities. Overall, the fire facilities lack gender-friendly accommodations for staff; separation of contaminated tools, personal protective gear, and clothing from the living space; and storage space. It is noted that the HFD makes the most of all available space.

By relying on external vendors and on-duty station crews to assist with upkeep and on-going maintenance, the HFD has accomplished much. The HFD provided CPSM with a summary of completed facility projects. Each of the primary response facilities and the Rocks Village call-station have received multiple repairs, replacement of fixtures and equipment, and the installation of new equipment. This includes items such as the replacement/repair of ceiling tiles, stair treads, windows, sinks and faucets, HVAC systems, floors, cooking equipment, wiring (some stations still have knob and tube wiring), and roofs and gutters; several painting projects; remodel of kitchens and bathrooms; replace/repair doors; apparatus ramp repair; and the installation of fire gear washer/dryer systems; flammable liquid cabinets; exercise equipment upgrades and the renovation of space to accommodate this equipment; and the installation of facility generator (Rocks Village).

There is still important upkeep and upgrades needed in HFD facilities, including replacement of basement stairs; wall repair and painting; apparatus ramp repairs/replacement; apparatus floor repair; bathroom repairs/renovations; ceiling repair (living and apparatus areas); repair/replace living area floors; replacement of parking lots; and exterior painting. ***Due to the age of the HFD facilities, CPSM recommends the city continue to fund the HFD facility maintenance lines at or above current levels so that facility maintenance can continue at the current scope and regularity.***

The location of responding units is one key factor in response time; reducing response times, which is typically a key performance measure in determining the efficiency of department operations, often depends on this factor. The goal of the placement of a single fire station or a network of responding fire stations in a single community is to optimize coverage with short travel distances, when possible, while giving special attention to natural and manmade barriers, and response routes that can create response-time problems.[6]

An additional benchmark is the ISO Public Protection Classification rating system. Under this system, one element a jurisdiction is graded on is the distribution within built-upon areas of engine companies and ladder companies (deployment analysis). For full credit in the Fire Suppression Rating Schedule (FSRS), a jurisdiction's fire protection area with residential and commercial properties should have a first-due engine company within 1.5 road miles and a

6. NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments*, 2020 Edition.

ladder service company within 2.5 road miles.[7] As engine and ladder companies both respond from fire facilities, and because engine companies are the more prevalent fire suppression company, fire facilities are predictably sited based on the response needs of engine companies.

Finally, the current and potential for future demand for service is a consideration for the siting of fire facilities. Demand is the number and types of calls for services provided by the entire fire department. When demand is evaluated, it is important the number of incidents is not confused with the number of unit responses. An emergency call may require the response of more than one unit, but only one incident number is generated. This is a direct accelerator of demand. CPSM measures a call as a single event, which may be handled by a single unit, and a run as a response made by a unit to a call that involves more than one unit. ***Overall, the HFD is a very busy fire department in terms of calls for service and runs.***

Response times are typically the primary measurement for evaluating fire and EMS services. Response times can be used as a benchmark to determine how well a fire department is currently performing, to help identify response trends, and to predict future operational needs. Achieving the quickest and safest response times possible should be a fundamental goal of every fire department.

However, the actual impact of a speedy response time is limited to very few incidents. For example, in a full cardiac arrest, analysis shows that successful outcomes are rarely achieved if basic life support (CPR) is not initiated within four to six minutes of the onset. However, cardiac arrests occur very infrequently on the whole of EMS incidents. There are also other EMS incidents that are truly life-threatening, and the time of response can clearly impact the outcome. These involve cardiac and respiratory emergencies, full drownings, obstetrical emergencies, allergic reactions, electrocutions, and severe trauma (often caused by gunshot wounds, stabbings, and severe motor vehicle accidents, etc.). Again, the frequency of these types of calls is limited.

An important factor in the whole response time question is what we term "**detection time**." This is the time it takes to detect a fire or a medical situation and notify 911 to initiate the response. In many instances, particularly at night or when automatic detection systems (fire sprinklers and smoke detectors) are not present or inoperable, the detection process can be extended. Fires that go undetected and are allowed to expand in size become more destructive and are difficult to extinguish.

For the purpose of this analysis, ***response time*** is a product of three components: ***dispatch time***, ***turnout time***, and ***travel time***.

Dispatch time (alarm processing time) is the difference between the time a call is received and the time a unit is dispatched. Dispatch time includes call processing time, which is the time required to determine the nature of the emergency and types of resources to dispatch.

The NFPA 1710 standard for these components of response times is as follows. The event is processed and dispatched in:

- ≤ 64 seconds 90 percent of the time.
- ≤ 106 seconds 95 percent of the time.
- Special call types:
  - ≤ 90 seconds 90 percent of the time.

7. Insurance Services Office, ISO Mitigation, Deployment Analysis.

- ≤ 120 seconds 99 percent of the time.

The next component of response time is **turnout time**, an aspect of response which is controlled by the responding fire department. NFPA 1710 states that turnout time shall be:

- ≤ 80 seconds for fire and special operations 90 percent of the time.
- ≤ 60 seconds for EMS responses.

The last component of response time is **travel time,** an aspect of response time that is affected by factors such as station location, road conditions, weather, and traffic control systems. NFPA 1710 states that travel time for the first arriving fire suppression unit to a fire incident shall be:

- ≤ 240 seconds for the first arriving engine company to a fire suppression incident 90 percent of the time.
- ≤ 360 seconds for the second company 90 percent of the time.
- ≤ 480 seconds to assemble the initial first alarm assignment on scene 90 percent of the time for low/medium hazards, and 610 seconds for high-rise fire incidents 90 percent of the time.

For EMS incidents the standard NFPA 1710 standard establishes a travel time of:

- ≤ 240 seconds for the first arriving engine company with automated external defibrillator (AED) or higher level capability.
- ≤ 480 seconds or less travel time of an Advanced Life Support (ALS) unit at an EMS incident where the service is provided by the fire department provided a first responder with an AED or basic life support unit arrived in 240 seconds or less travel time.

The next figure provides an overview of the fire department incident cascade of events and further describes the total cascade of events and their relationship to the total response time of a fire incident.

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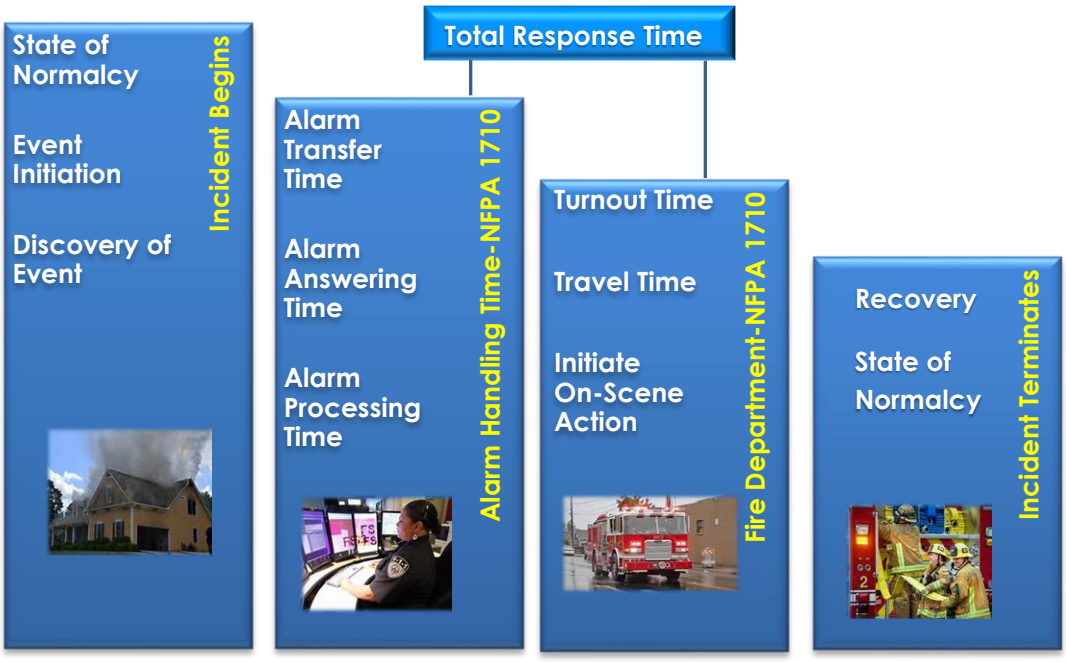
FIGURE 3-6: Incident Cascade of Events



Travel time is key to understanding how fire and EMS station location influences a community's aggregate response time performance. Travel time can be mapped when existing and proposed station locations are known. The location of responding units is one key factor in reducing response times, which is typically a key performance measure in determining the efficiency of department operations.

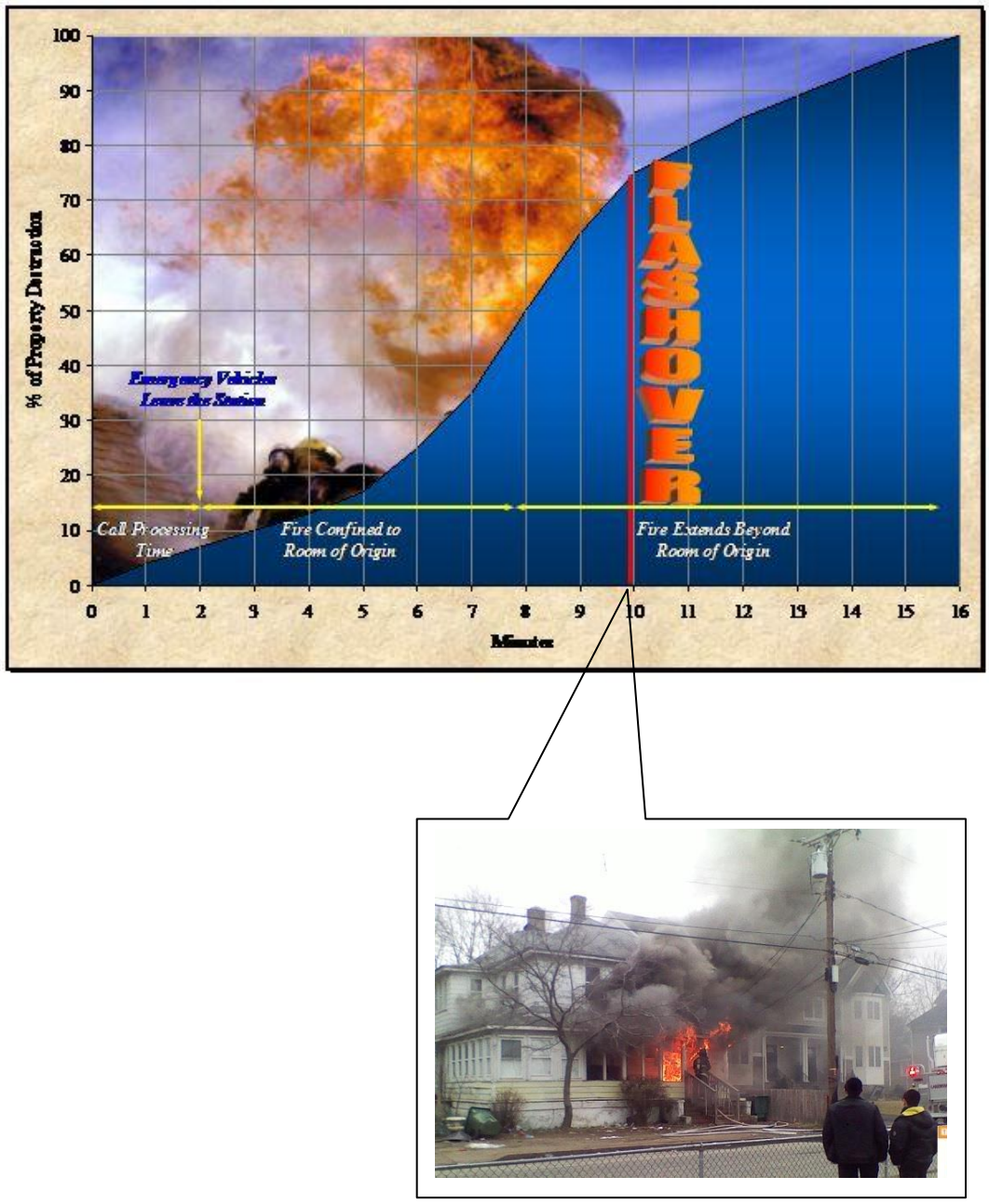
When discussing response times for fire incidents, established criterion is linked to the concept of "flashover." This is the state at which super-heated gases from a fire are released rapidly, causing the fire to burn freely, and become so volatile that the fire reaches an explosive state (simultaneous ignition of all the combustible materials in a room). In this situation, usually after an extended period (often eight to twelve minutes after ignition but at times as quickly as five to seven minutes), and a combination of the right conditions (fuel and oxygen), the fire expands rapidly and is much more difficult to contain.

When the fire does reach this extremely hazardous state, initial firefighting forces are often overwhelmed, larger and more destructive fire occurs, the fire escapes the room and possibly even the building of origin, and significantly more resources are required to affect fire control and extinguishment.

Flashover occurs more quickly and more frequently today and is caused at least in part by the introduction of significant quantities of plastic- and foam-based products into homes and businesses (e.g., furnishings, mattresses, bedding, plumbing and electrical components, home and business electronics, decorative materials, insulation, and structural components). These materials ignite and burn quickly and produce extreme heat and toxic smoke.

The following figure shows the fire propagation curve relative to fire being confined to the room of origin or spreading beyond it and the percentage of destruction of property by the fire. As described in the figure, at approximately the ten-minute mark of fire progression, the fire flashes over (due to superheating of room contents and other combustibles) and extends beyond the room of origin.

FIGURE 3-7: Fire Propagation Curve



The ability to quickly deploy adequate fire staff prior to flashover thus limits the fire's extension beyond the room or area of origin. The fire propagation curve science establishes that temperature rise and time within in a room on fire corresponds with property destruction and potential loss of life if present.[8]

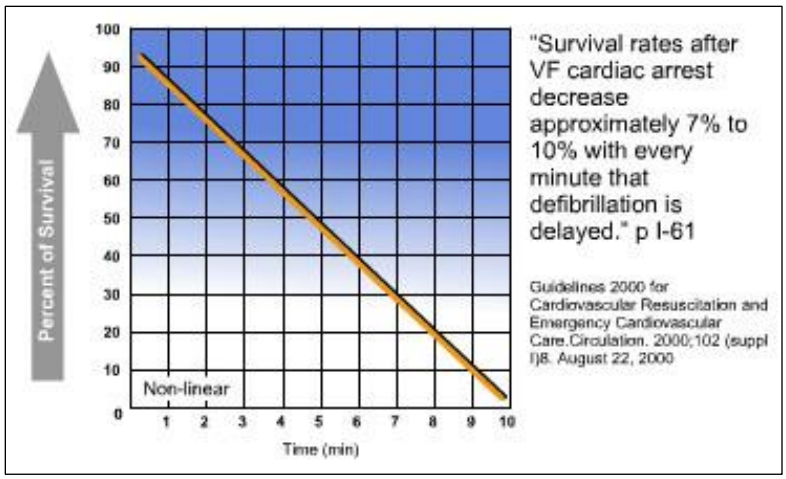
EMS response times are measured differently than fire service response times. Where the fire service uses NFPA 1710 and 1720 as response time benchmarking documents, the focus for EMS is and should be directed to the evidence-based research relationship between clinical

8. Clinton Smoke, Company Officer, 2nd ed. (Clifton Park, NY: Delmar, 2005).

outcomes and response times. Much of the current research suggests response times have little impact on clinical outcomes outside of a small segment of call types. These include cerebrovascular accidents (stroke), injury or illness compromising the respiratory system, injury or illness compromising the cardiovascular system to include S-T segment elevation emergencies, and certain obstetrical emergencies. Each requires rapid response times, rapid on-scene treatment, and rapid transport to the hospital.

The next figure illustrates the chance of survival from the onset of cardiac arrest, largely due to ventricular fibrillation in terms of minutes without emergency defibrillation delivered by the public or emergency responders. The graphic has not changed over time since first published by the American Heart Association in 2000.

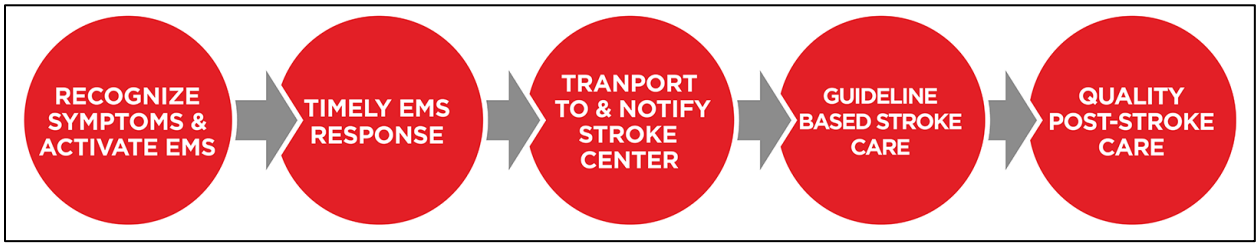
FIGURE 3-8: Cardiac Arrest Survival Probability by Minute



Typically, a low percentage of 911 patients have time-sensitive and advanced life support (ALS) needs. But, for those patients that do, time can be a critical issue of morbidity and mortality. For the remainder of those calling 911 for a medical emergency, though they may not have a medical necessity, they still expect rapid customer service. Regardless of the service delivery model, appropriate response times are more than a clinical issue; they are also a customer service issue and should not be ignored.

The next figure illustrates the out-of-hospital chain of survival for a stroke emergency, which is a series of actions that, when put in motion, reduce the mortality of a stroke emergency.

FIGURE 3-9: Cerebrovascular Emergency (Stroke) Chain of Survival



Source: https://nhcps.com/lesson/acls-acute-stroke-care/

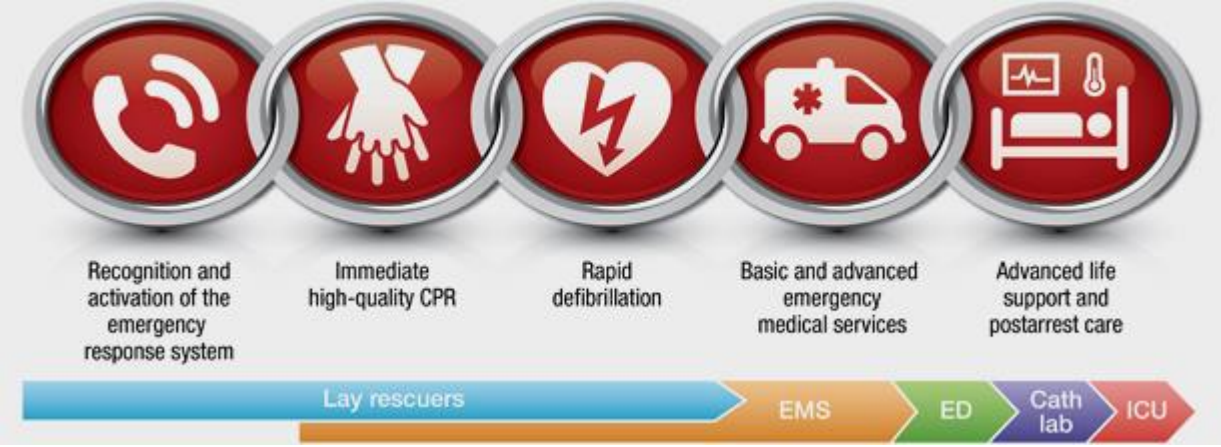
If a person is experiencing severe pain, that is also an indicator of an emergency. Again, the frequency of these types of calls is limited as compared to the routine, low-priority EMS incident

responses. In some cases, these emergencies often make up no more than 5 percent of all EMS calls.[9]

Cardiac arrest is one emergency for which EMS response times were initially built around. Science tells us that the brain begins to die without oxygenated blood flow at the four- to six-minute mark. Without immediate cardiopulmonary resuscitation (CPR) and rapid defibrillation, the chances of survival diminish rapidly at the cessation of breathing and heart pumping activity. For every minute without CPR and/or defibrillation, chances of survival decrease 7 to 10 percent. Further, only 10 percent of victims who suffer cardiac arrest outside of the hospital survive.[10]

The following figure illustrates the out of hospital chain of survival, which is a series of actions that, when put in motion, reduce the mortality of sudden cardiac arrest. Adequate EMS response times coupled with community and public access defibrillator programs potentially can impact the survival rate of sudden cardiac arrest victims by deploying early CPR, early defibrillation, and early advanced life support care provided in the prehospital setting.

FIGURE 3-10: Sudden Cardiac Arrest Chain of Survival



From: "Out of Hospital Chain of Survival," http://cpr.heart.org/AHAECC/CPRAndECC/AboutCPRFirstAid/CPRFactsAndStats/UCM_475731_Out-of-hospital-Chain-of-Survival.jsp

The next table depicts the HFD's turnout, travel, and total response times as an average and at the 90th percentile as benchmarked against the NFPA 1710 standard.

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9. www.firehouse.com/apparatus/article/10545016/operations-back-to-basics-true-emergency-and-due-regard
10. American Heart Association. *A Race Against the Clock, Out of Hospital Cardiac Arrest*. 2014

TABLE 3-14: Response Time of First Arriving Unit, by Call Type

Call Type	Average Response Time, Min.				90th Percentile Response Time, Min.				Number of Calls
	Dispatch	Turnout	Travel	Total	Dispatch	Turnout	Travel	Total	
General medical	3.1	2.3	3.1	8.5	4.8	3.7	5.8	12.2	3,923
MVA	2.6	2.2	3.3	8.2	4.3	3.4	6.6	12.2	442
EMS Total	**3.1**	**2.3**	**3.1**	**8.5**	**4.7**	**3.6**	**5.9**	**12.2**	**4,365**
False alarm	2.2	2.6	2.9	7.7	3.9	3.9	5.8	11.3	1,043
Good intent	2.8	2.6	3.4	8.8	4.7	4.1	6.5	13.0	303
Hazard	2.6	2.6	3.5	8.7	3.9	4.4	7.0	12.9	271
Outside fire	2.7	2.5	4.2	9.3	4.3	5.0	11.7	15.2	57
Public service	3.1	2.5	3.4	9.0	4.5	4.2	7.1	13.4	635
Structure fire	2.4	2.3	2.5	7.2	3.8	3.6	4.5	9.8	121
Technical rescue	2.5	2.1	3.9	8.4	4.3	3.3	6.3	12.8	33
Fire Total	**2.6**	**2.5**	**3.2**	**8.3**	**4.2**	**4.0**	**6.2**	**12.4**	**2,463**
Total	**2.9**	**2.4**	**3.1**	**8.4**	**4.6**	**3.8**	**6.0**	**12.2**	**6,828**

This table tells us that at the 90th percentile:

- Dispatch time was 4.6 minutes, which does not meet the NFPA 1710 standard.
- Turnout time was 3.8 minutes (EMS-4.7 minutes; Fire-4.2 minutes). Neither time meets the NFPA 1710 standard of 1 minute for EMS calls and 1 minute 20 seconds for fire calls).
- The 90th percentile travel time for structure fires was 4.5 minutes. This does not meet the NFPA 1710 standard.

The next figures and tables outline the HFD's current stations as benchmarked against the NFPA 1710 standard, the ISO standard for engine company and ladder company placement, and how the response coverage changes with some stations relocated. Data and GIS observations tell us:

- At 240 seconds there are gaps in travel time from HFD stations in certain parts of the city. Some of these are due to the road network while others are due to the concentration of stations in the more densified downtown and central areas of the city.
- There is built-upon land that is beyond the reach of the 240 seconds travel time standard where fire and EMS demand is occurring. The most concentrated demand, however, is served within 240 seconds of travel time from HFD stations.
- At 360 seconds, the standard for the second arriving fire suppression unit, response gaps are reduced but still present some challenges for the HFD in terms of response capabilities and the arrival of the second fire suppression unit.
- At 480 seconds, the standard for the arrival of the first alarm assignment, response coverage is widely improved.
- The HFD's deficiencies in the NFPA 1710 240 seconds first due fire unit travel time and the ISO 1.5-mile engine company placement benchmark are closely related and should be considered in any current and future station placement planning.

The next table outlines the workload of each station and primary response unit in terms of runs and the overall call workload of the city and the relationship to the importance of all components of response times.

TABLE 3-15: Workload by Unit

Station	Unit	Unit Type	Total Runs	Runs per Day
16th Avenue	E2	Engine	2,059	5.6
Bradford	E4	Engine	1,467	4.0
High Street	E1	Engine	3,118	8.5
Water Street	E3	Engine	2,611	7.2
	L1	Ladder	1,058	2.9
	R1	Rescue	1,681	4.6
	T1	Tanker	5	0.0

Highest Workload by Individual Unit 3,118 Runs

Water Street Station aggregately between three units/crews has the highest station location workload with 5,350 runs.

Call Type	Total Calls
General medical	4,350
MVA	544
EMS total	**4,894**
False alarm	1,427
Good intent	377
Hazard	321
Outside fire	88
Public service	765
Structure fire	163
Technical rescue	40
Fire total	**3,181**
Canceled	268
Mutual aid	21
Total	**8,364**

The greater fire and EMS demand is concentrated in the High Street and Water Street districts, with moderate demand in the north and northwest response districts as well as the Bradford and 16th Street districts.

FIGURE 3-11: Travel Time of 240 Seconds and ISO 1.5-Mile Benchmark

HFD 240 Seconds Travel Time

ISO 1.5-Mile Engine Co. Benchmark

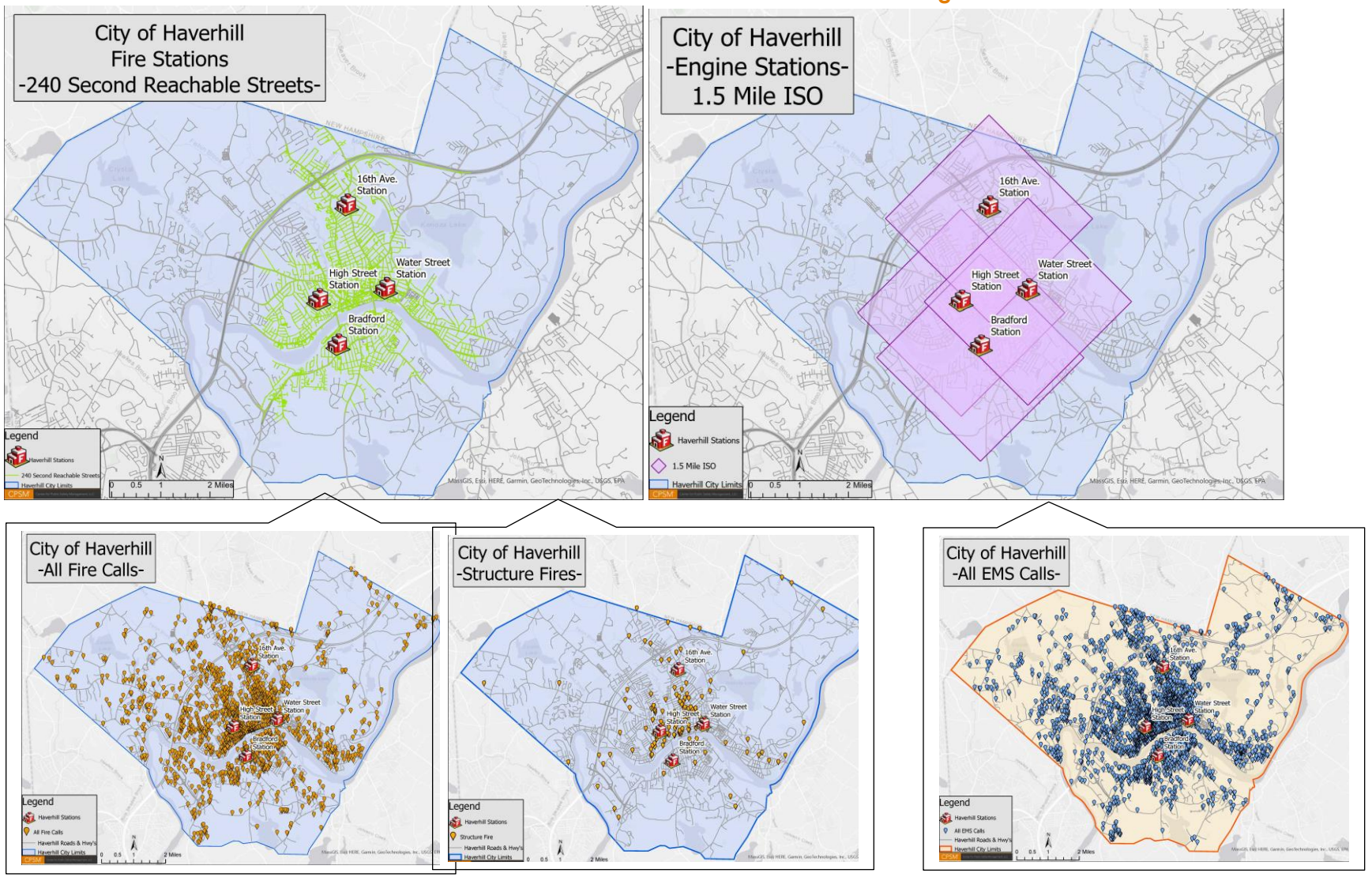
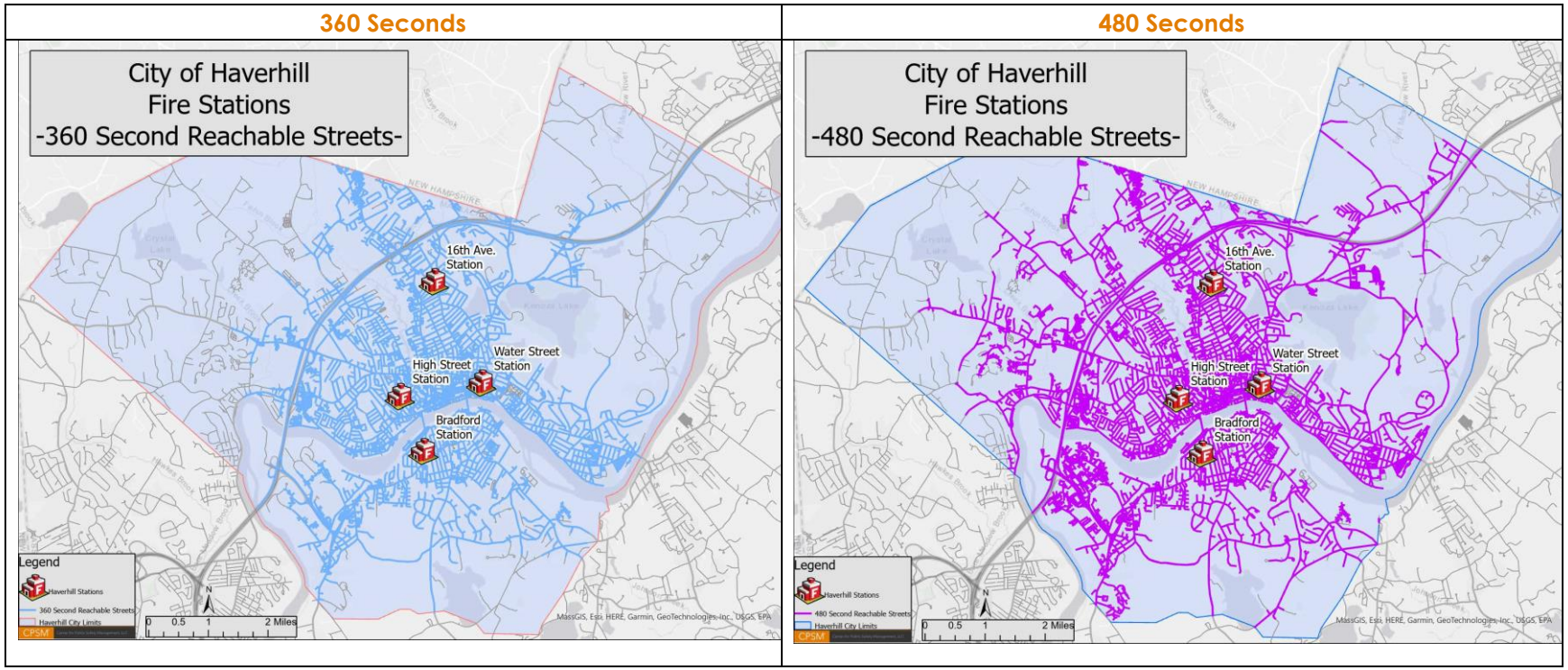


FIGURE 3-12: Travel Times of 360 and 480 Seconds



Not every street in Haverhill can be covered by the NFPA or ISO benchmarks. Specifically, the NFPA benchmark by the standard is at the 90th percentile. The ISO benchmark is difficult for some communities as well to meet due to the geography and size of the community. Established communities as well tend to concentrate resources in the core areas, much as Haverhill has done. In short, there is no perfect scenario. However, communities are encouraged to follow to the extent possible the NFPA and ISO standards, as they do represent dependable and scientifically backed reasoning for their response time and coverage standards.

An additional observation of CPSM is that the HFD ladder company and rescue company are located in the same station, which is not ideal as these are specialty companies. Ladder coverage when benchmarked against the ISO-PPC rating schedule (ladder company distribution every 2.5 miles of built-upon land) is deficient in the north, northwest, and southeast areas of the city. Relocation of the rescue company and utilizing this apparatus and crew as a *Service Company* (performing ladder company tasks such as forcible entry, search and rescue, and ventilation to name the primary critical tasks on fire responses) as well as a technical rescue company will enhance the ISO and overall deployment analysis and spread out the two specialty companies currently deployed by the HFD. Ideally, this apparatus and crew should be close to Interstate 495 (north/northwest area of the city) and the accessible city road network to provide effective and efficient service company and technical rescue resources to the interstate system and the remaining part of the city.

In a conversation with the Fire Chief, CPSM discussed the relocation of the rescue company to the High Street Station for better response coverage. The Fire Chief discussed space issues at High Street that likely prevent this alternative; as well there is little footprint to work with for expansion.

An additional alternative was presented during our discussion that includes land in the northwest area of the city located at Broadway and I-495 on the south side of I-495 across from the Ford dealership. This land may be available for the construction of a fire facility. Given this information CPSM urges strong consideration to this location as an alternative site for the rescue company (satisfies splitting up the two specialty companies), the Ayers Village call-unit and crew (satisfies concerns with the practicality of the current structure as a fire station), as well as the relocation of the master mechanic and the fleet shop, which would expand the space of this operation, and provision of storage space for reserve engine apparatus (satisfies space issues in the HFD fleet area and storage for reserve apparatus).

This location is also mapped in the next series of illustrations beginning with 240 seconds of travel time and progressing to travel times of 360 and 480 seconds travel times from this location only. Included also is ISO deployment improvement with the rescue company serving as a service company from this location.

For EMS calls, there is improvement in the northwest response area (High Street Station district), as well as at the 360- and 480-seconds NFPA standard and the ISO standard for service company/ladder company response.

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FIGURE 3-13: Rescue Located at Broadway and I-495: 240 Seconds of Travel Time

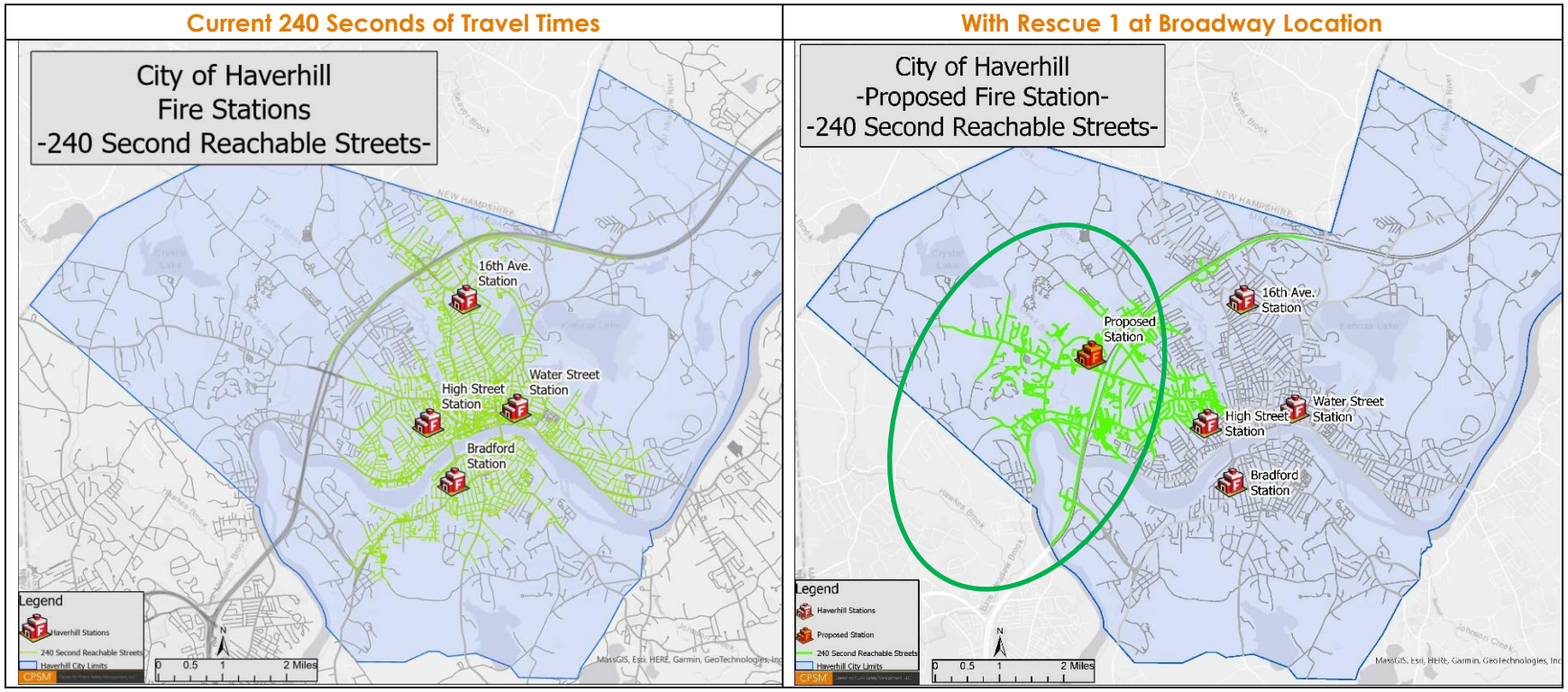
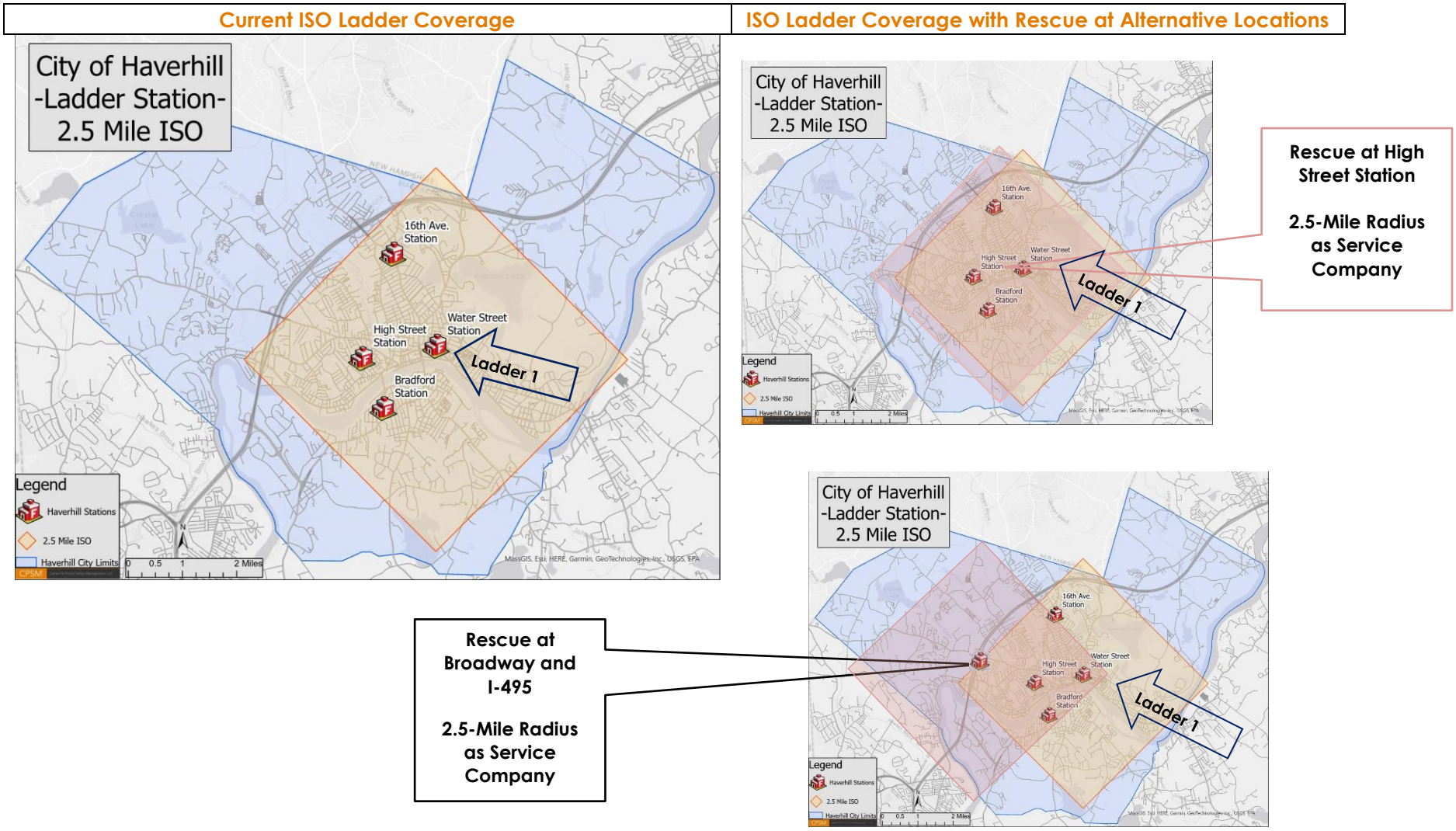


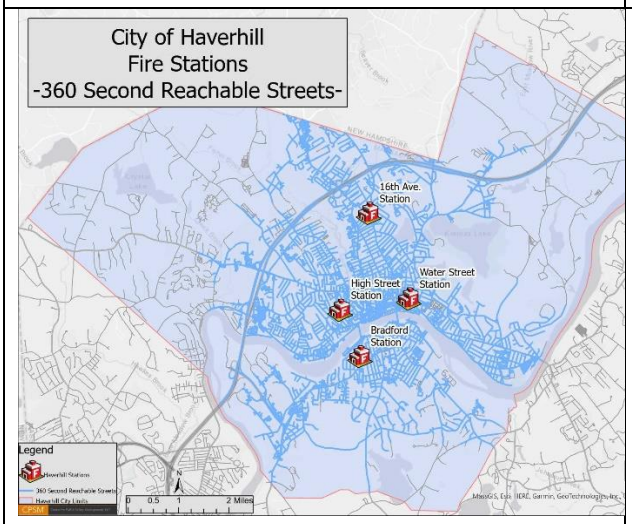
FIGURE 3-14: ISO 2.5-Mile Coverage by Ladder Company and Alternatives for the Rescue Company



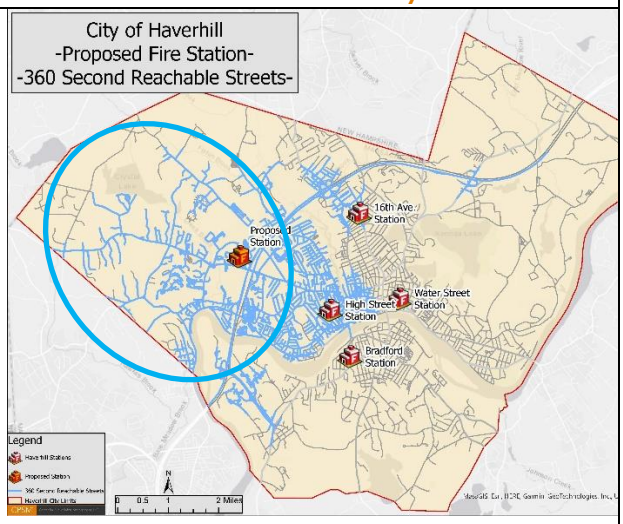
The final map shows the Rescue at Broadway and I-495 and the travel time coverage improvements at 360 seconds and 480 seconds.

FIGURE 3-15: Rescue Located at Broadway and I-495: 360 and 480 Seconds of Travel Time

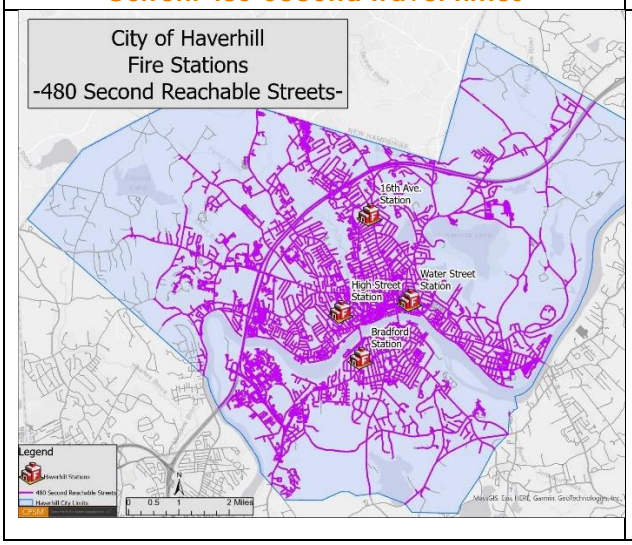
Current 360-Second Travel Times



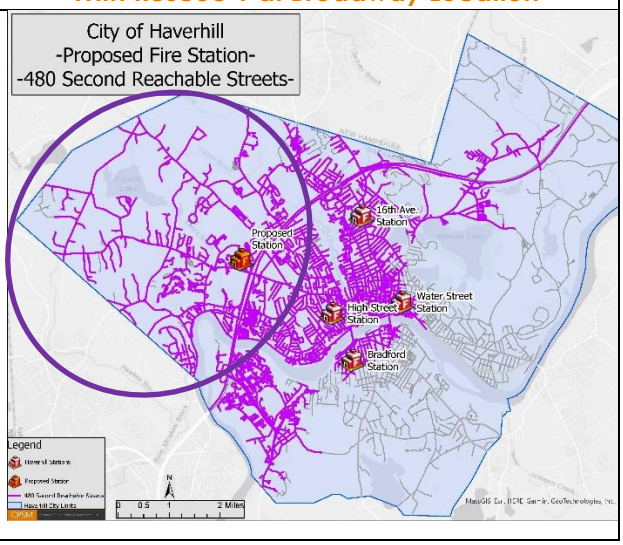
With Rescue 1 at Broadway Location



Current 480-Second Travel Times



With Rescue 1 at Broadway Location



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Facilities and Response Times Recommendations:

- Due to the age of the HFD facilities, CPSM recommends the city continue to fund the HFD facility maintenance lines at or above current levels so that facility maintenance can continue at the current scope and regularity. (Recommendation No. 16.)
- CPSM recommends, for a more efficient deployment of resources, the rescue company be relocated to the High Street Station if practical, and if not, the city consider constructing a new facility at Broadway and I-495. This new station could house the rescue company, the HFD fleet maintenance shop, the Ayers Village call-unit and crew, reserve apparatus, and ancillary department functions that lack office and workspace. ***This recommendation does not require new positions. Facility costs based on construction costs at time of design and build. This facility would need 3-4 apparatus bays that are long enough to stack two Engine apparatus (at least 70'); living/office space for the Rescue Company; office space for the call company; office and storage space for the Master Mechanic; office space for other department functions needed at time of design and construction.*** (Recommendation No. 17.)

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SECTION 4. ALL-HAZARDS RISK ASSESSMENT OF THE COMMUNITY

POPULATION AND COMMUNITY GROWTH

The U.S. Census Bureau indicates the population of the City of Haverhill in 2020 was 67,787. This is an 11.3 percent increase in population since the 2010 census of 60,879. The city has 35.7 square miles of land mass. The population density is 1,883 per square mile. This is an increase of 192 people per square mile over the 2010 census numbers. There are 27,927 housing units, of which 1,231 units are vacant.

Census Bureau data shows that Haverhill's population remained stagnant from about 1940 through 1980. In more recent decades the city has experienced methodical population growth:

- 1990 51,418 +9.7%
- 2000 58,969 +4.7%
- 2010 60,879 +3.2%
- 2020 67,787 +11.3%

In terms of fire and EMS risk, the age and socio-economic profiles of the population can have an impact on the number of requests for fire and EMS services. Evaluation of the number of seniors and children by fire management zones can provide insight into trends in service delivery and quantitate the probability of future service requests. In a 2021 National Fire Protection Association (NFPA) report on residential fires, the following key findings were identified for the period 2015–2019:[11]

- Males were more likely to be killed or injured in home fires than females and accounted for larger percentages of victims (57 percent of the deaths and 55 percent of the injuries).
- The largest number of deaths (19 percent) in a single age group was among people ages 55 to 65.
- 59 percent of the victims of fatal home fires were between the ages of 39 and 74, and three of every five (62 percent) of the non-fatally injured were between the ages of 25 and 64.
- Slightly over one-third (36 percent) of the fatalities were age 65 or older; only 17 percent of the non-fatally injured were in that age group.
- Children under the age of 15 accounted for 11 percent of the home fire fatalities and 10 percent of the injuries. Children under the age of 5 accounted for 5 percent of the deaths and 4 percent of the injuries.
- Adults of all ages had higher rates of non-fatal fire injuries than children.
- Smoking materials were the leading cause of home fire deaths overall (23 percent) with cooking ranking a close second (20 percent).

11. M. Ahrens, R. Maheshwari "Home Fire Victims by Age and Gender," Quincy, MA: NFPA, 2021.

- The highest percentage of fire fatalities occurred while the person was asleep or physically disabled and not in the area of fire origin, key factors to vulnerable populations.

In Haverhill, the following age and socioeconomic factors are considered herein when assessing and determining risk for fire and EMS preparedness and response:[12]

- Children under the age of five represent 5 percent of the population.
- Persons under the age of 18 represent 21.9 percent of the population.
- Persons over the age of 65 represent 14.5 percent of the population.
- Female persons represent 52.6 percent of the population.
- There are 2.51 persons per household in Haverhill.
- The median household income in 2020 dollars was $69,237.
- People living in poverty make up 12 percent of the population.
- 19.6 percent of children under the age of 18 live in poverty.

Black or African-American alone represents 0.4 percent of the population. The remaining percentage of population by race includes White alone at 70.3 percent, American Indian or Alaska Native alone at 0.3 percent, Asian alone at 1.6 percent, two or more races at 9.8 percent, and Hispanic or Latino at 14.5 percent.

The demographics in Haverhill overall pose a moderate risk in totality. While not a high risk, a single call involving vulnerable population (fire or EMS) poses a higher risk on that particular response. Through pre-fire planning and response district knowledge of residential and other structures housing a vulnerable population as identified above, the HFD will have the necessary situational awareness and be better prepared on arrival at the incident.

The city's recently completed master plan, Vision Haverhill 2035, identifies the importance of the downtown and the riverfront areas to the city's growth. To facilitate development, zoning will offer bonus provisions for dense development that enhances public access and open space in concert with new uses. The downtown/riverfront area is being targeted for uses such as distinctive retail, offices and restaurants, and housing (multistory).

The Vision Haverhill 2035 Master Plan outlines several key findings related to the city's land use, which are relevant to the growth discussion here:

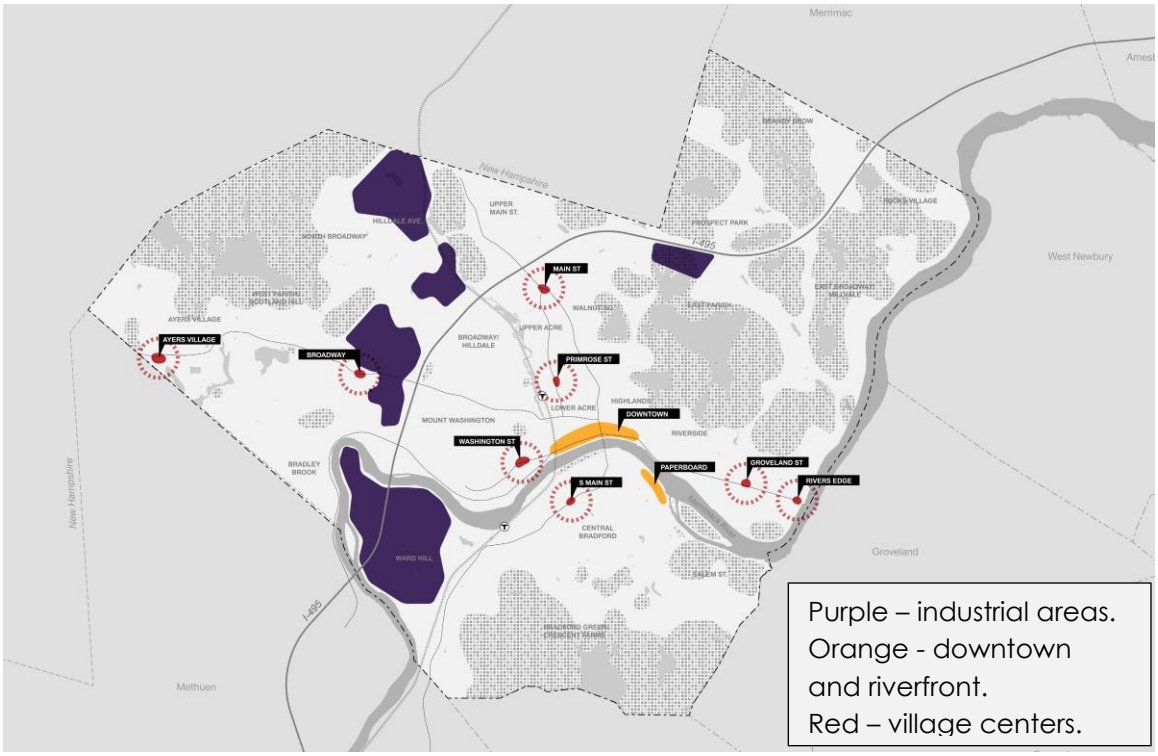
- Land use.
- Economy.
- Population and housing.
- Mobility.
- Cultural and historic resources.
- Environment and open space.

12. U.S. Census Bureau QuickFacts: Haverhill City, Massachusetts

The city also has underdeveloped areas and is looking at these areas as opportunities for redevelopment projects. There are no identified opportunities for the city to expand its boundaries that the plan recognizes.

Vision Haverhill 2035 identifies the city's current and future planned development, which will increase population in a thoughtful manner. Community growth also impacts all facets of the local infrastructure including, but not limited to, roads, schools, utilities, and public safety services.

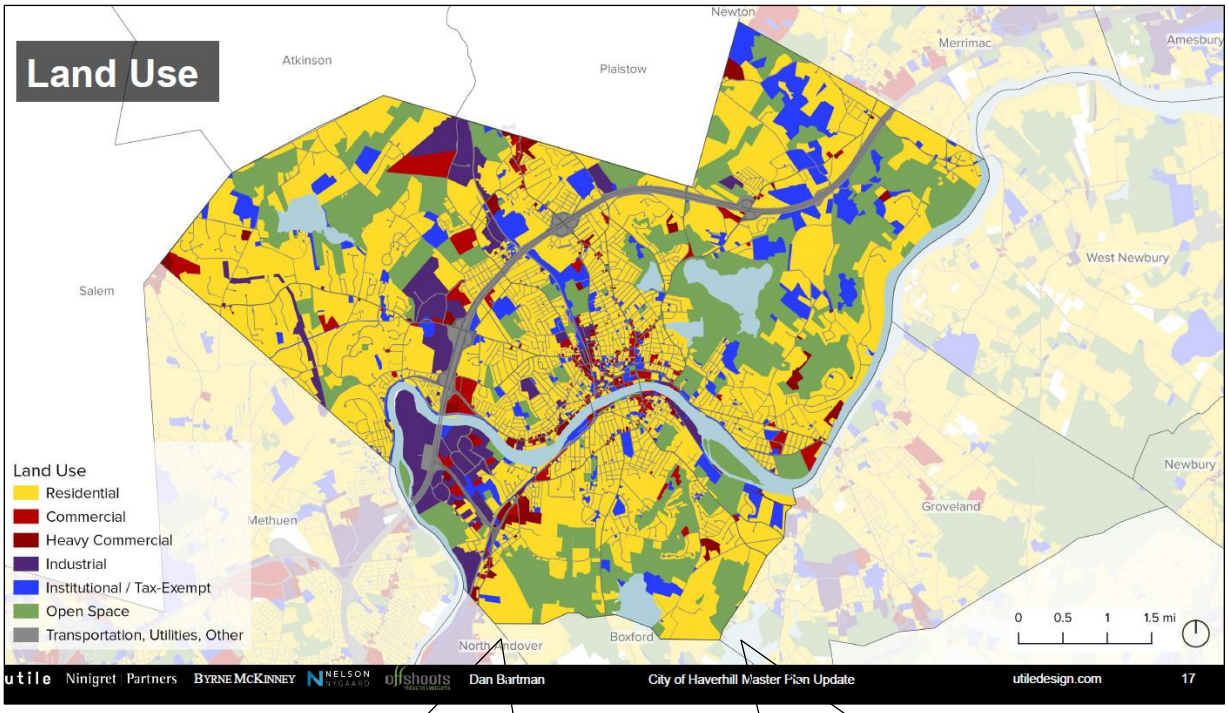
FIGURE 4-1: Vision Haverhil 2035 Areas Targeted for Growth



Envisioned projects include vertical density to include residential over parking and commercial space, which brings tactical challenges for fire and EMS services. An example of such projects include those listed here and are illustrated in the following figures:

- Merrimack Street Redevelopment Project
  - True mixed-use with 50,000 square feet plus creative commercial space.
  - Attractive food hall, in conjunction with Northern Essex Institute of Culinary Arts.
  - Pedestrian connectivity from Bailey Boulevard to the riverfront.
  - New precast parking garage to replace existing deck.
  - Multi-use, four-season public open space to host farmers' markets, minstrels, food carts, and community events.
  - Multistory mixed-use buildings on Merrimack St., Bailey Blvd., and Park Way.

FIGURE 4-2: Haverhill Land Use Map



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ENVIRONMENTAL FACTORS

The City of Haverhill is prone to and will continue to be exposed to certain environmental hazards that may impact the community. The most common natural hazards prevalent to the region, according to the City of Haverhill Emergency Management Plan, include:[13]

High-probability Event

- **Hazardous Materials**. A hazardous materials release can create environmental risks as a liquid, gas, or vapor cloud and has the potential for evacuation of buildings, and small, medium, and large geographic areas depending on the product released and the ability to control the release.

Moderate-probability Events

- **Tornado/Severe Storms**. Severe storms include heavy rain, lightning, hail, and strong winds and wind gusts. Tornadoes are included in this category.
- **Winter Storms**. Winter storms include ice, snow, strong winds, and extreme low temperatures. These storms create transportation hazards, increase the risk of carbon monoxide exposure and illness, frostbite and hypothermia, property damage, and increase in fire risk as there is an increase in alternative heating devices.

Low-Probability Events

- **Massive Urban Fires**. Urban fire occurs primarily in cities or towns with the potential to rapidly spread to adjoining structures. These fires damage and destroy homes, schools, commercial buildings, and vehicles.
- **Pandemics**. While rare, pandemics do occur and can cause mass loss of life, can negatively impact all aspects of society, and can severely damage the economy. Preparedness training, education, and drills are critical to reduce the risks associated with pandemics.
- **Flooding**. Potential flooding includes urban flooding during heavy rain downpours or prolonged rain, and along the Merrimack River.
- **Drought and Water Shortage**. Prolonged drought potentially has an effect on vegetation (increase in brush and wild fires) and water supply. Water shortage could also result from mechanical, contamination, system failure, or breach of water supply lines.

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13. City of Haverhill Incident Management Plan.

BUILDING AND TARGET HAZARD FACTORS

The purpose of a community risk and vulnerability assessment is to evaluate the community, and regarding buildings, it will review all buildings and the risks associated with each property and then classify the property as either a high, medium, or low hazard depending on factors such as the life and building content hazard and the potential fire flow and staffing required to mitigate an emergency in the specific property. According to the NFPA *Fire Protection Handbook*, these hazards are defined as:

High-hazard occupancies: Schools, hospitals, nursing homes, explosives plants, refineries, high-rise buildings, and other high life-hazard (vulnerable population) or large fire-potential occupancies.

Medium-hazard occupancies: Apartments (includes townhomes, condos, residential over commercial), single-family housing units with basements, offices, and mercantile and industrial occupancies not normally requiring extensive rescue by firefighting forces.

Low-hazard occupancies: One-, two- or three-family dwellings and scattered small business and industrial occupancies.[14]

Haverhill has the following building types.

- Single-family housing units (predominate building risk).
- Townhomes/condos (varying number of vertical floors).
- Apartment building units (traditional and center stair designs with varying number of vertical floors).
- Residential over commercial housing units (varying number of vertical floors).
- Assisted living/nursing homes.
- Commercial/industrial structures.
- Strip malls.
- High-rise buildings.

In terms of identifying target hazards, consideration must be given to the activities that take place (public assembly, life-safety vulnerability, manufacturing, processing, etc.), the number and types of occupants (elderly, youth, handicapped etc.), and other specific aspects related to the construction of the structure.

Haverhill has a variety of target hazards that meet an established hazard class:

Medium Hazard

- Multifamily dwelling buildings.
- Commercial and industrial facilities and sites.

14. Cote, Grant, Hall & Solomon, eds., *Fire Protection Handbook* (Quincy, MA: National Fire Protection Association, 2008), 12.

High Hazard

- Assisted living/nursing facilities.
- Hospital/healthcare facilities.
- Educational facilities.
- Detention/correctional facility.
- Existing high-rise buildings under construction and approved and planned for construction.
- Mixed-use, multistory buildings with commercial and residential occupants.
- Multistory residential buildings whereby the fire department access is restricted during response and deploying resources.

HAVERHILL GROWTH POTENTIAL

Vision Haverhill 2035 has the potential to drive greater sustainable growth than in the past years as the demand for affordable housing, increased safety, and less travel to worksites expands outwards from the Boston center. Haverhill's plan is and will attract major projects that subsequently will attract new citizens. The downstream impact will impact all facets of Haverhill's infrastructure as well as increasing the public safety risks. Increased population growth demand necessarily drives the need for:

- Housing to include single-family, apartments, and other multifamily structures.
- Roads/road improvements.
- Water and utilities.
- Schools.
- Retail and restaurants.
- Public safety (Fire, EMS, and Law Enforcement).
- Parks, recreation, and community activities.

More traffic on a road system that is already stressed leads to more accidents. A larger population also increases fire and EMS service demand. The downstream impact of the increased emergency service demand includes but is not limited to the Unit Hour Utilization (UHU) of medic units (ambulances) that may approach or exceed the industry benchmark of a maximum performance metric of 0.30 UHU during the peak call periods of 7:00 a.m. to 8:00 p.m. In practical terms, if there is a UHU rate of 0.40 for an EMS vehicle (ambulance or fire engine), there is a 40 percent chance that unit will not be available for emergency response within certain time frames.

Successful economic development that attracts distribution centers, manufacturing facilities, and other large buildings and businesses provides a stronger tax base for the city. This development also means greater risk target hazards due to the size of the buildings, the height of the buildings, and the hazards associated with the operations and processes within the buildings.

As an example, the ground ladders carried on Haverhill engine companies are limited to access to second floor windows and roof line on relatively flat ground. The current trend is the

construction of four-story apartments to increase capacity. Many cities such as Haverhill construct projects with commercial occupancies on the ground floor and residential condominiums or apartments above, with buildings several stories high.

Twenty-four or twenty-eight foot ground ladders are an ineffective tool for elevated rescue situations (greater than the second floor window or two-story home roof) such as people fleeing a fire and cut off from the normal means of egress. This risk is reduced by building and fire prevention codes requiring fire alarm systems and sprinkler systems to provide early warning of a fire and early activation of sprinkler heads to limit the growth of the fire in its incipient phase.

The success of these systems depends on regular maintenance and inspection in accordance with fire prevention codes. Another risk occurs when there is a change of occupancy without going through the proper permitting process.

The next figure illustrates the city's multilevel buildings (more than six levels). The NFPA 1710 travel time performance standard for high-rise buildings (in Massachusetts these are defined as 70 feet above grade level) is the ability to deploy the initial effective response force to a high rise for a fire suppression incident in 610 seconds or less. The next figure illustrates the HFD's ability to meet the travel time performance standard by station location. The ability to meet the effective response force capability is discussed later in this report.

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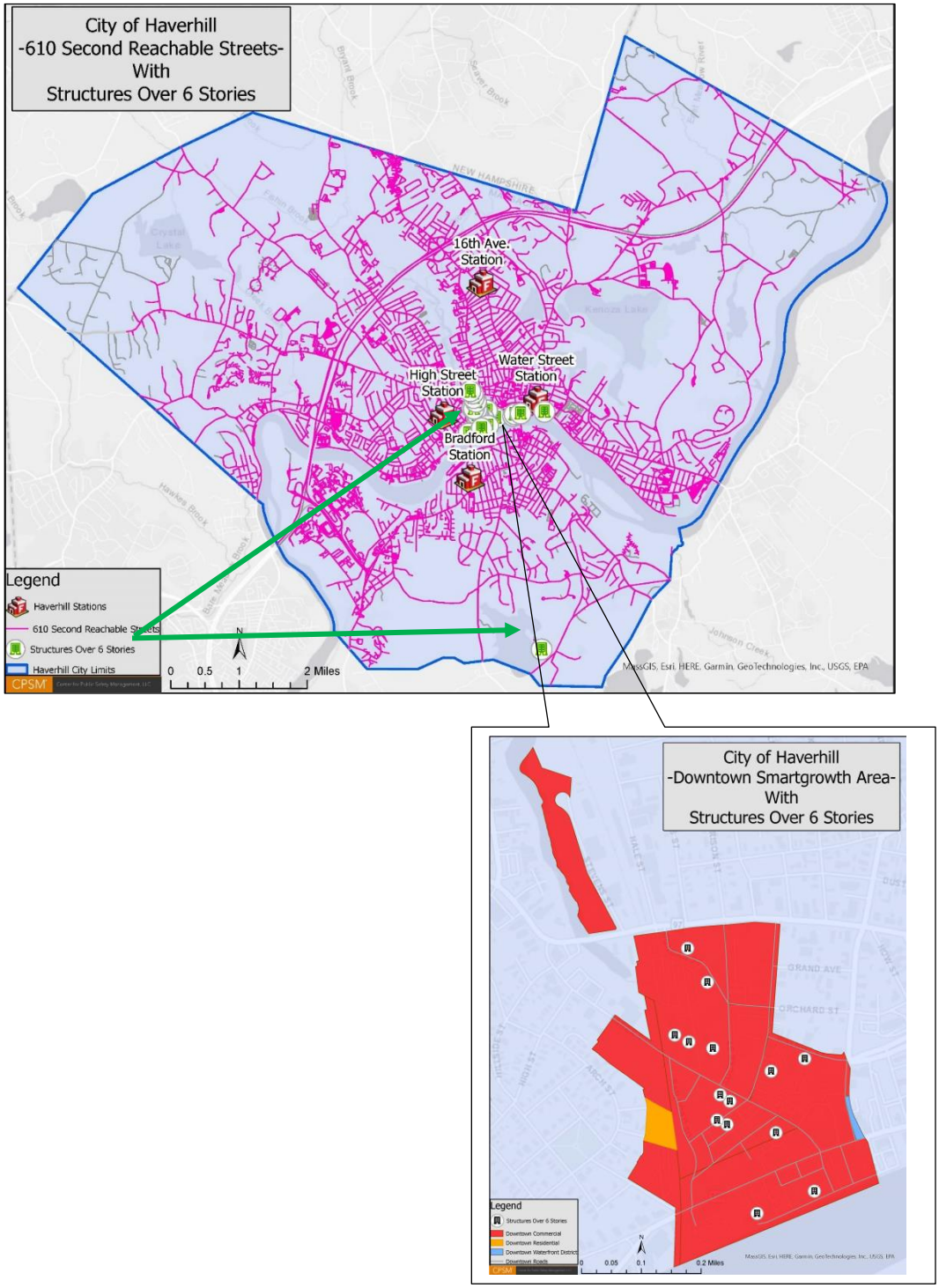
FIGURE 4-3: 610 Seconds Reachable Streets with Structures Over Six Stories



There is public and firefighter risk that exists with multistory residential homes and apartments on sloping lots in close proximity to other dwellings, which hampers access by fire apparatus as well as the firefighters. This risk is prevalent in Haverhill. The close proximity of the residential buildings also means a greater chance for fire to spread to exposed buildings.

These types of emergency situations involve high risk to the public and the property as well as to the firefighters. An effective firefighting force, including staffed aerial ladders which have reasonable response time capabilities to provide elevated access and firefighting critical tasks, is an opportunity for future improvement for Haverhill as the city grows. The locations of said "truck companies" should be thoughtfully planned based on target hazards and emergency response times to those targets.

The highest level of risk, due to the relatively higher demands for personnel and apparatus required in fire events, is in structures that have a large square footage, higher elevation (stories), and specific types of occupancy and construction risks. However, the building code requirement of a fire alarm and/or an automatic sprinkler system assists to some extent to reduce that risk. The fact is that 96 percent of fires are controlled with sprinkler activation, if these systems are properly maintained.

Other fire-related risks that Haverhill is prepared for include:

- Mobile/transportation risks (including vehicle and firefighter access to structures).
- Wildland risks.
- Single- and multifamily residential fire risks.

The totality of these fire and life safety risks increases the need for additional NFPA 1710 compliant first-alarm staffing and response times for elevated firefighting operations to slow or stop the spread of fire in large commercial, mixed-use, commercial, and residential buildings horizontally or vertically. This is a topic that a community has to address as to the level of risks that that it is willing to accept. NFPA 1710 provides industry standards and best practices. It is up to the community leadership to set fire and EMS performance metrics and thoughtfully align annual budgeting to meet community goals within sound fiscal capabilities.

The City of Haverhill's commitment to thoughtfully assess and improve preparedness for the city's highest risks will also strengthen the department's capabilities to respond to all emergencies requiring similar expertise, personnel, and apparatus. To this end, the Haverhill Emergency Management website provides the following guidance as to the chain of command and decision-making authority during significant emergency events:

> *Although the response to any emergency or disaster is a cooperative effort of all city departments along with outside agencies, the City of Haverhill Emergency Operations Center and our response to an incident follows a basic command structure. The declaration of a State of Emergency is governed by City Ordinance. The head of all emergency operations within the City of Haverhill is Mayor James J. Fiorentini. Mayor Fiorentini has assigned Haverhill Police Chief Alan DeNaro as the director of the EOC during activations. Officer Paul Malone is tasked with the management of the Emergency Operations Center during activations and EOC preparedness when the EOC is not activated.*

TRANSPORTATION FACTORS

The existing public street network within the city consists primarily of city-maintained roadways. Haverhill's street network totals more than 424 curb miles within its 34 square-mile area, with about 1,400 streets.[15] Lane-miles include the length of travel lanes in both directions along a street and as well as accounts for multilane roads.

Crossing through Haverhill is Interstate 495, which has five exits in the city. The city is crossed by five state routes, including Routes 97, 108, 110, 113, and 125. MBTA Commuter Rail provides service from Boston's North Station with the Haverhill and Bradford stations on its Haverhill/Reading Line. Amtrak provides service north to Maine and south to Boston's North Station from the same Haverhill station. Additionally, MVRTA provides local bus service to Haverhill and beyond.

Vision Haverhill 2035 articulates the city's vision as to transportation. It provides the following:

> *Haverhill is well-served by transit and the interstate highway system, but these assets could be better integrated with economic development priorities and the actions of the plan that seek to make Haverhill a more livable and walkable community. These include an increased prioritization of pedestrian and bicycle safety and mobility and an acknowledgement that public works projects should also consider place-making opportunities.*
>
> *The location and level of service of Haverhill's two rail stations has influenced several plan recommendations, including the identification of priority growth areas. Likewise, the automobile-focused corridors that connect I-495 to downtown should be the focus of future planning efforts, to both improve their visual appeal and increase their appeal to people walking from adjacent neighborhoods.*
>
> *The commuter rail is a valuable but underutilized asset in Haverhill. Enhancing access to this resource has the potential to unlock employment and recreational opportunities for residents throughout the Greater Boston region.*

The following figure illustrates the principal road network in Haverhill.

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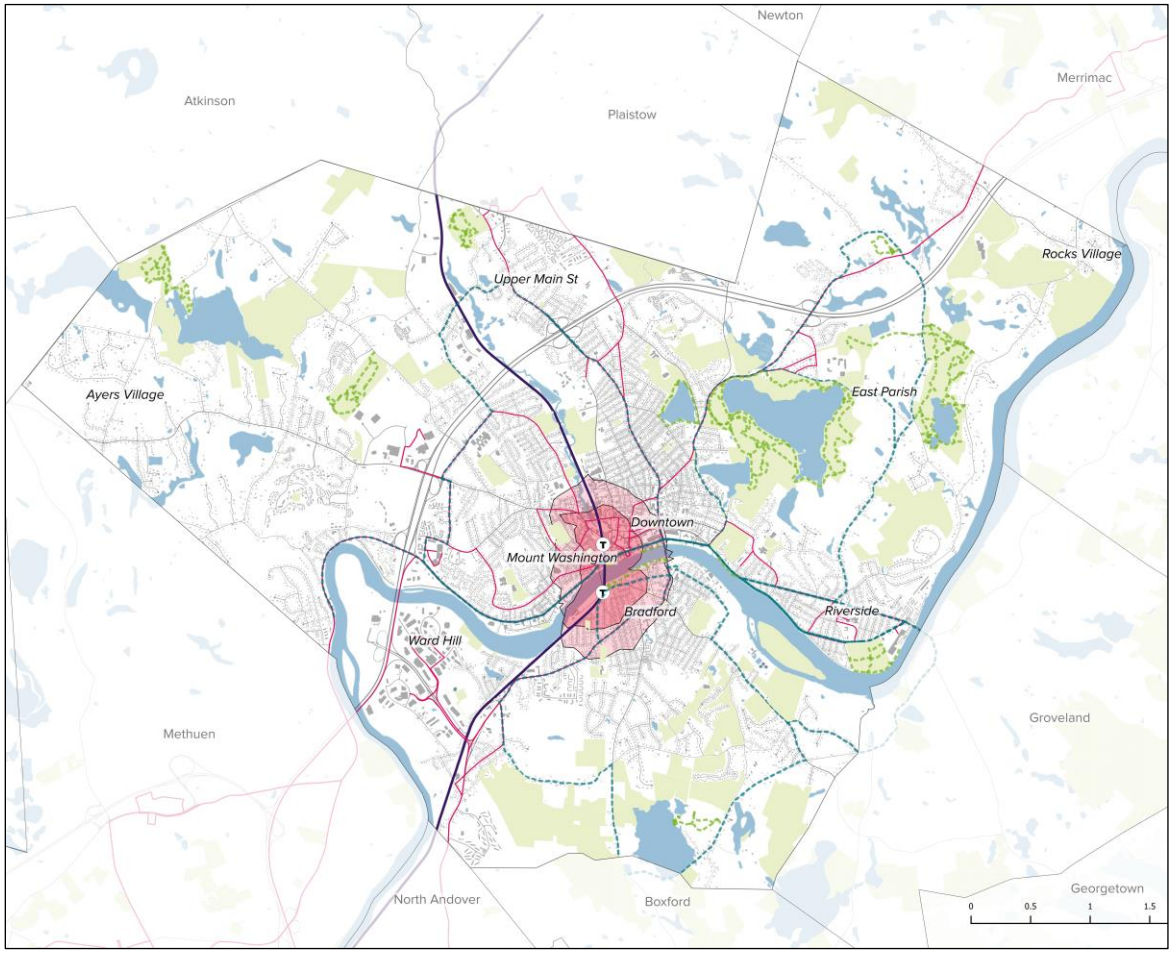
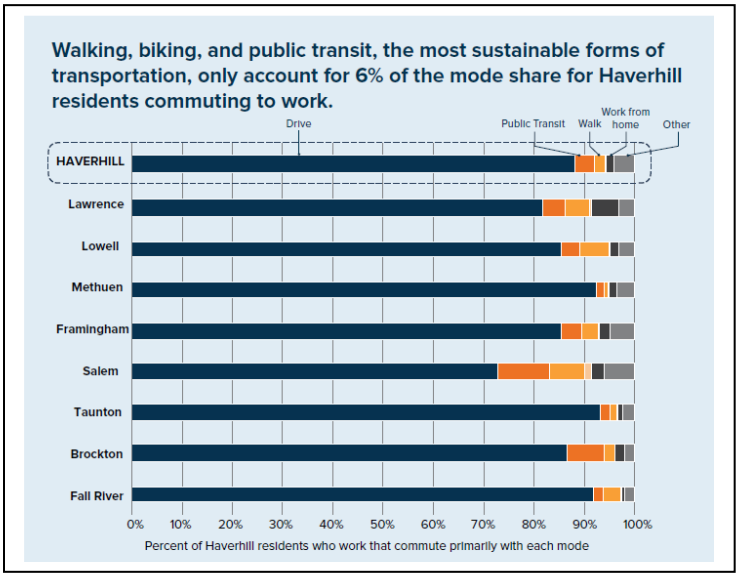
[15]. City of Haverhill Website 2022.

FIGURE 4-4: Haverhill Road Network[16]





In an effort to manage attractive community growth within the confines of a finite road system, Haverhill's leaders are working to transition to more sustainable transportation options and have identified opportunities for improvement in this area as iillustrated to the left.

16. Vision Haverhill 2035

The Merrimack Valley Regional Transit Authority (MVRTA) operates several routes in Haverhill that include:

- Route 13 – Main Street / North Avenue.
- Route 14 – Bradford / Ward Hill.
- Route 15 – Hilldale Avenue / Haverhill Commons.
- Route 16 – Washington Street / Westgate Plaza.
- Route 18 – Riverside.
- Route 51 – Haverhill / Amesbury.

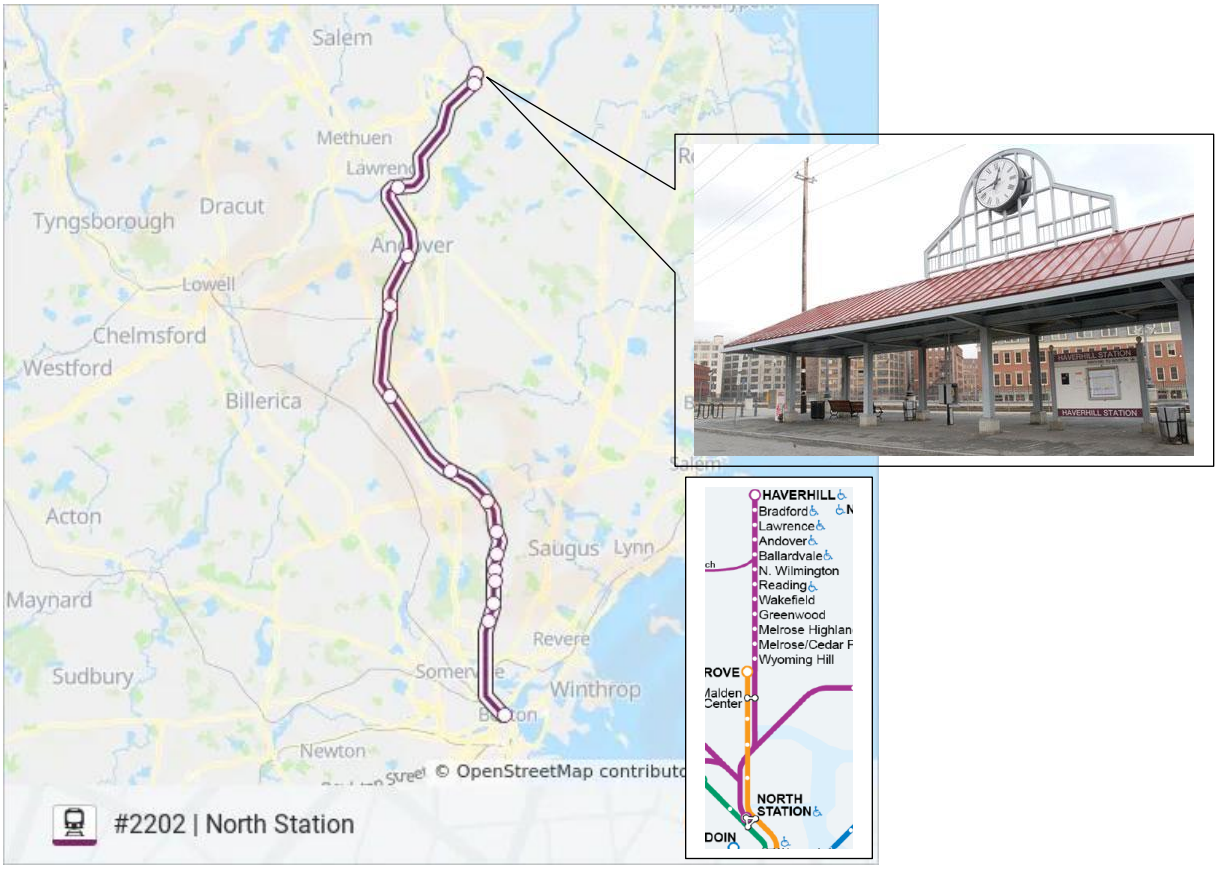
The next figure illustrates the MVRTA system and stops in Haverhill.

FIGURE 4-5: MVRTA Bus Routes With Stops

Map Source: MVRTA.Com

The Massachusetts Bay Transportation Authority (MBTA) provides mass transit via commuter rail inbound and outbound seven days a week passing through and stopping in Haverhill at various times of the day from just before 5:00 a.m. until after midnight, connecting Haverhill with the City of Boston. There are 13 stops between the Haverhill station located at 1 Washington street and North Station in Boston.

FIGURE 4-6: MBTA Haverhill Line Train Stops



Map Source: moovitapp.com MBTA.com

Additional passenger rail utilizing track that passes through Haverhill includes Amtrak's Downeaster, which stops in Haverhill and runs north to Brunswick, Maine, and south to Boston where a connection to the Northeast Corridor line can be made.

In addition to the passenger rail service, the city also has a freight rail service that utilizes the main track rail line. Primary commodities handled by Pan Am Railways (subsidiary of CSX Rail) include grain, sand and gravel, food products, lumber, paper and pulp, chemicals and plastics, petroleum, processed minerals, metals, scrap metal, and intermodal trailers and containers. Fire involving these products can produce smoke and other products of combustion that may be hazardous to health. Hazardous materials create hazardous to health conditions as well as fire, smoke and vapor plumes, containment, and related public safety concerns. Rail lines in Haverhill utilize at-grade crossings, which pose a transportation risk.

MassDOT is managing the replacement of the I-495 Bridge that crosses the Merrimack River in Haverhill. The Real Time Traffic Management (RTTM) System is in place and active along I-495 and adjacent roadways to warn of ongoing construction and current traffic conditions. The MassDOT website reminds those traveling through the area to obey posted speed limits and use

caution. All the project work is weather dependent. This project has potential impacts on the provision of emergency services by limiting emergency response times and apparatus access. This should be monitored by the HFD.

The road and transportation network described herein poses risks for a vehicular accident, some at medium to greater than medium speeds, as well as vehicular-versus-pedestrian-bicycle risks. There are additional transportation risks since tractor-trailer and other commercial vehicles traverse the roadways of Haverhill to deliver mixed commodities to business locations. Fires or releases of product involving these products can produce vapors, smoke and other products of combustion that may be hazardous to health. Additionally, there is risk for a mass casualty incident involving mass-transit buses either on specific bus routes/roads in the city or utilizing the road network in the city for stops in jurisdictions external to Haverhill.

FIRE AND EMS INCIDENT RISK

An indication of the community's fire risk is the type and number of fire-related incidents the fire department responds to. CPSM conducted a data analysis for this project that analyzed the fire department's incident responses and workload.

The following table details the call types and call type totals for these types of fire-related risks between July 1, 2021, and June 30, 2022. During this time period HFD responded to 8,364 calls. Of these, 164 were structure fire calls and 88 were outside fire calls within the City of Haverhill.

TABLE 4-1: Calls by Type

Call Type	Total Calls	Calls per Day	Call Percentage
General medical	4,350	11.9	52.0
MVA	544	1.5	6.5
EMS Total	**4,894**	**13.4**	**58.5**
False alarm	1,427	3.9	17.1
Good intent	377	1.0	4.5
Hazard	321	0.9	3.8
Outside fire	88	0.2	1.1
Public service	765	2.1	9.1
Structure fire	163	0.4	1.9
Technical rescue	40	0.1	0.5
Fire Total	**3,181**	**8.7**	**38.0**
Canceled	268	0.7	3.2
Mutual aid	21	0.1	0.3
Total	**8,364**	**22.9**	**100.0**

Analysis of this table tells us that the highest percentage of HFD calls are EMS first response (58.5 percent of overall calls). False alarms (typically fire alarms) represent the highest percentage of fire-related calls (39.2 percent). Structure and outside fires are further broken down in the next table as coded by HFD staff when completing fire reports.

TABLE 4-2: Structure and Outside Fire Breakdown

Code	Description	Number
Structure Fire Breakdown		
111	Building fire. Excludes confined fires. (113–118).	40
112	Fire in structure, other than in a building. Included are fires on or in piers, quays, or pilings: tunnels or under-ground connecting structures; bridges, trestles, or overhead elevated structures; transformers, power or utility vaults or equipment; fences; and tents.	6
113	Cooking fire involving the contents of a cooking vessel without fire extension beyond the vessel.	102
114	Chimney or flue fire originating in and confined to a chimney or flue. Excludes fires that extend beyond the chimney (111 or 112).	5
116	Fuel burner/boiler, delayed ignition or malfunction, where flames cause no damage outside the fire box.	5
118	Trash or rubbish fire in a structure, with no flame damage to structure or its contents.	4
Outside Fire Breakdown		
100	Fire, other	8
131	Passenger vehicle fire. Includes any motorized passenger vehicle, other than a motor home (136) (e.g., pickup trucks, sport utility vehicles, buses).	14
140	Natural vegetation fire, other.	21
141	Forest, woods, or wildland fire. includes fires involving vegetative fuels, other than prescribed fire (632), that occur in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and the like.	3
142	Brush or brush-and-grass mixture fire.	29
150	Outside rubbish fire, other.	3
151	Outside rubbish, trash, or waste fire not included in 152–155. Excludes outside rubbish fires in a container or receptacle (154).	1
154	Dumpster or other outside trash receptacle fire.	3
160	Special outside fire, other.	3
162	Outside equipment fire. Excludes special structures and mobile construction equipment (130 series).	3

Fire and EMS Incident Demand

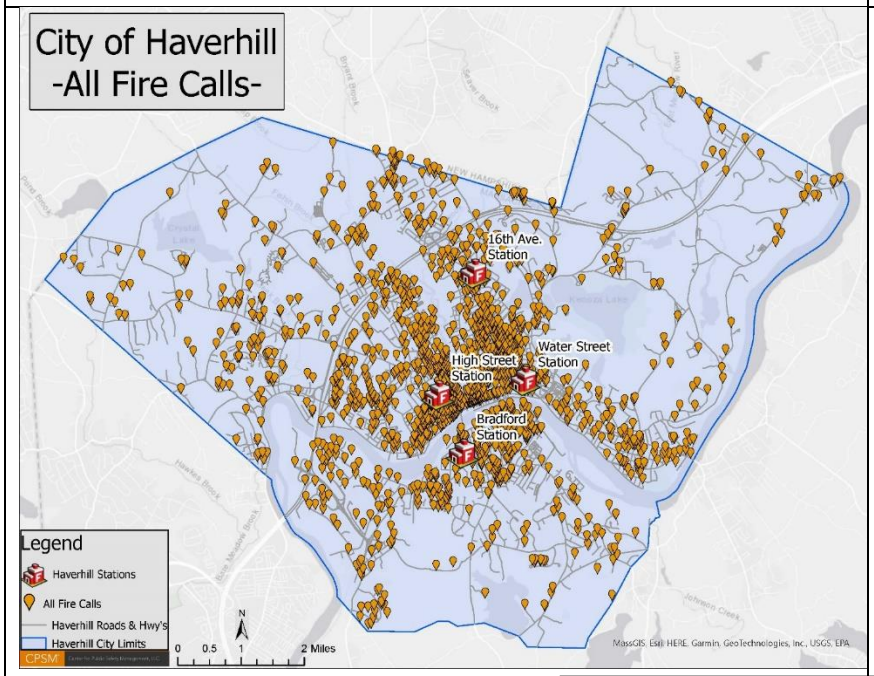
Analyzing where the fire and EMS incidents occur, and the demand density of fire and EMS incidents, helps to determine adequate fire management zone resource assignment and deployment. It is also a prime indicator for sustaining EMS ground transport resources.

The following figures illustrate overall fire and EMS demand in a more defined manner by specific call types. These include a breakout of structural fire incidents; false alarms (typically fire alarms); and EMS incident demand that also breaks out motor vehicle accidents.

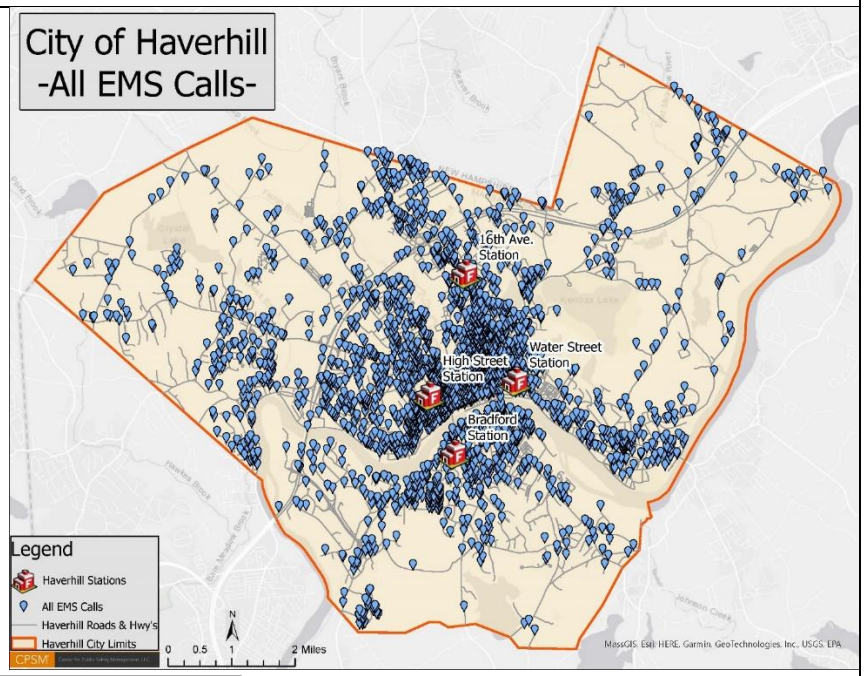
The heaviest demand is central to the downtown, riverfront, north and northwest, and the core Bradford areas of the city. This is predictable as these are the densified areas of the city. Motor vehicle accidents are along major and local streets, and limited access highway on-off ramps, which again is predictable as these roads are heavily traveled.

FIGURE 4-7: Overall Fire and EMS Demand

Fire Demand



EMS Demand



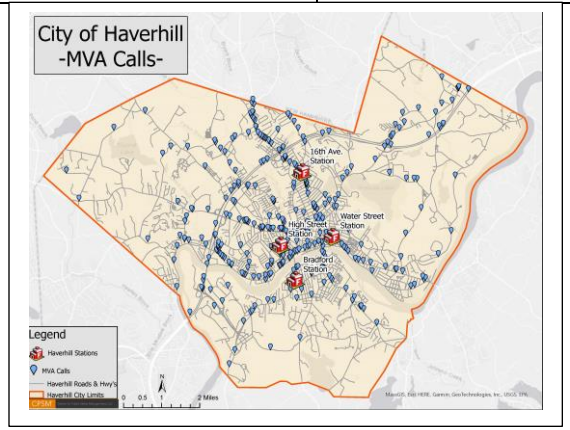
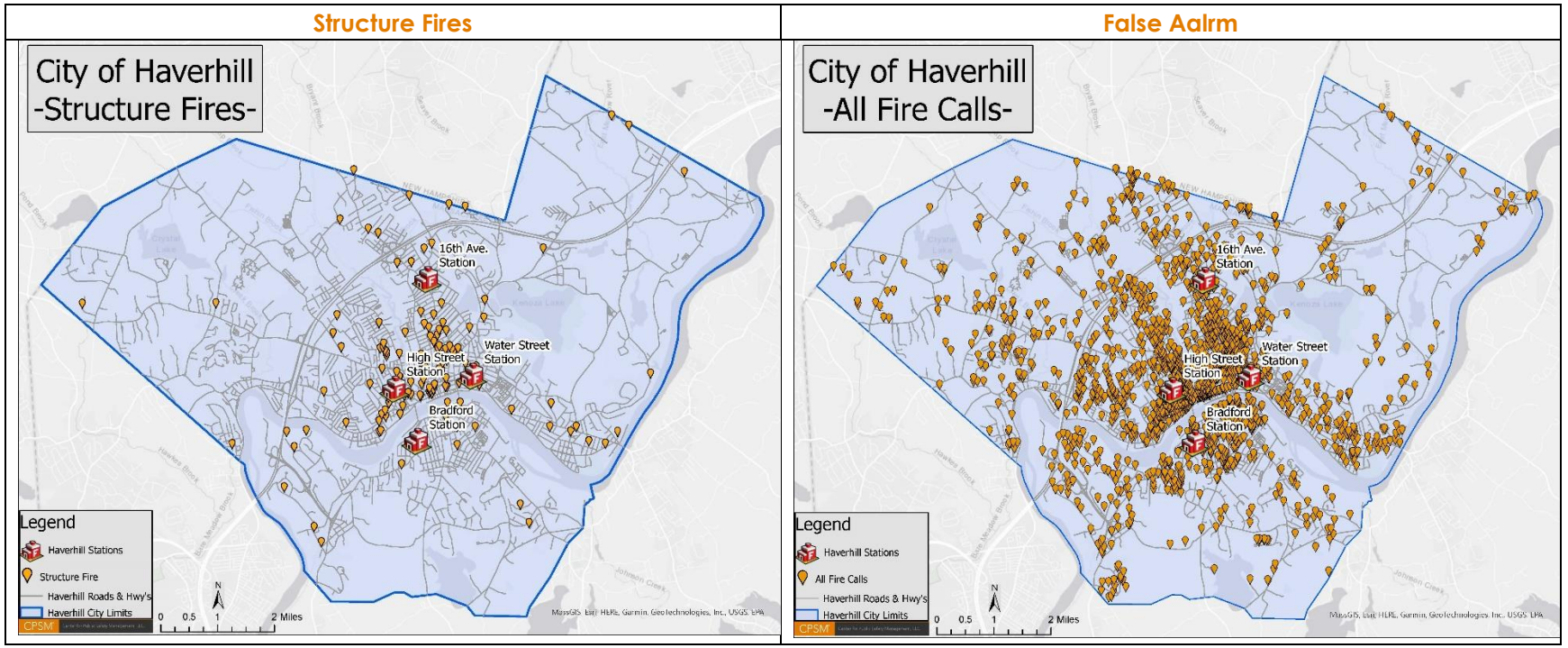
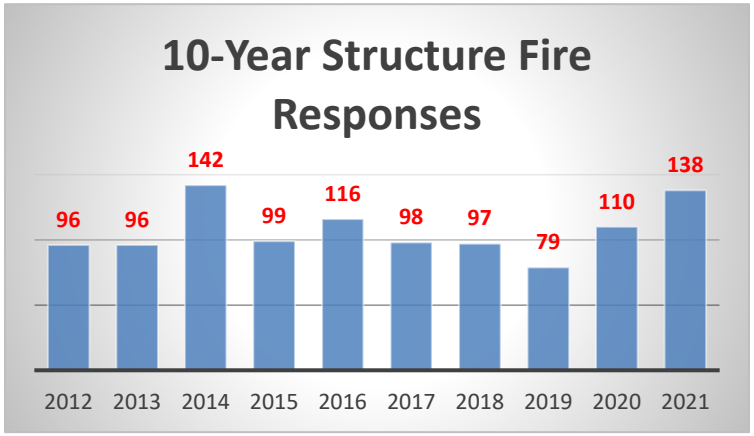


FIGURE 4-8: Structure Fire, False Alarm, and MVA Demand





National Fire Incident Reporting System Codes: Structure Fires

111	Building fire. Excludes confined fires. (113–118).
112	Fire in structure, other than in a building. Included are fires on or in piers, quays, or pilings: tunnels or under-ground connecting structures; bridges, trestles, or overhead elevated structures; transformers, power or utility vaults or equipment; fences; and tents.
113	Cooking fire involving the contents of a cooking vessel without fire extension beyond the vessel.
114	Chimney or flue fire originating in and confined to a chimney or flue. Excludes fires that extend beyond the chimney (111 or 112).
116	Fuel burner/boiler, delayed ignition or malfunction, where flames cause no damage outside the fire box.
118	Trash or rubbish fire in a structure, with no flame damage to structure or its contents.

Community Loss and Save Information

Fire loss is an estimation of the loss from a fire to the structure and contents in terms of replacement. Fire loss includes contents damaged by fire, smoke, water, and overhaul. Fire loss does not include indirect loss, such as business interruption.

In a 2021 report published by the National Fire Protection Association on trends and patterns of U.S. fire losses, it was determined that home fires still cause the majority of all civilian fire deaths, civilian injuries, and property loss due to fire. Key findings from this report include:[17]

- Public fire departments responded to 1,338,500 fires in 2020, a 7.5-percent increase from the previous year.
- 490,500 fires occurred in structures (37 percent). Of these fires, 379,500 occurred in residential structures and 86,000 occurred in apartments or multifamily structures.
- 2,230 civilian fire deaths occurred in residential fires, and 350 deaths occurred in apartments or multifamily structures.
- Home fires were responsible for 11,500 civilian injuries.
- An estimated $21.9 billion in direct property damage occurred as a result of fire in 2020 (includes fires in the California wildland-urban interface and a large-loss naval ship fire in California).

The following table shows overall fire loss in Haverhill in terms of dollars for the years indicated. This information should be reviewed regularly and discussed in accordance with response times to actual fire incidents, company level training, effectiveness on the fireground, and effectiveness of incident command. Property loss information should also be included in any strategic planning discussions regarding response times, training, incident command, staffing, and deployment of resources.

TABLE 4-3: Property and Contents Loss in Haverhill, 2017–2021

2017	2018	2019	2020	2021
$4,184,645	$1,003,460	$3,923,004	$3,168,756	$6,534,274

Source: HFD NFIRS reporting: NFIRS codes 100, 111, 112, 113, 116, 118, 123, 130, 131, 150,162, 440, 522

Resiliency

Resiliency as defined by the Center for Public Safety Excellence (CPSE) in the *Fire and Emergency Service Self-Assessment Manual* (FESSAM) 9th edition is: "an organization's ability to quickly recover from an incident or events, or to adjust easily to changing needs or requirements." Greater resiliency can be achieved by constant review and analysis of the response system and focuses on three key components:

- Resistance: The ability to deploy only resources necessary to control an incident and bring it to termination safely and effectively.
- Absorption: The ability of the agency to quickly add or duplicate resources necessary to maintain service levels during heavy call volume or incidents of high resource demand.

17. *Fire Loss in the United States During 2020*, National Fire Protection Association.

- Restoration: The agency's ability to quickly return to a state of normalcy.

Resistance is controlled by the HFD through staffing and response protocol, and with HFD resources dependent on the level of staffing and units available at the time of the alarm.

Absorption is accomplished through availability to respond by HFD units and through regional mutual aid resources. This is aided through the computer-aided dispatch at the fire dispatch center.

Restoration is managed by HFD unit availability as simultaneous calls occur, the availability of regional mutual aid resources, recall of staff to staff fire units during campaign events when warranted, and backfilling HFD stations when needed through the computer-aided dispatch at the fire dispatch center.

Between July 1, 2021, and June 30, 2022, HFD's fire units responded to 8,364 calls. The following tables and figure analyze HFD resiliency. In this analysis, CPSM included all calls that occurred inside and outside Haverhill. We did this because responses outside of the city (although few) impact the resiliency of the department to respond to calls inside of the city.

The first table examines the workload in terms of runs for each station. High Street Station has the highest individual unit workload. Aggregately, Water Street Station has the highest total of runs, but has three deployable assets. Each station's availability to respond to calls in their first due area is examined in the second table. The lower the percentage the less resilient the entire station's fire management zone (district) is. The 16th Avenue and High Street Stations have less resiliency than Bradford and Water Street. Water Street Station is the most resilient as there are three first-line units deployed from this station.

TABLE 4-4: Station Workload (Runs)

Station	Unit	Unit Type	Total Runs	Runs per Day
16th Avenue	E2	Engine	2,059	5.6
Bradford	E4	Engine	1,467	4.0
High Street	E1	Engine	3,118	8.5
Water Street	E3	Engine	2,611	7.2
	L1	Ladder	1,058	2.9
	R1	Rescue	1,681	4.6
	T1	Tanker	5	0.0

TABLE 4-5: Station Availability to Respond to Calls

Station	Calls in Area	First Due Responded	First Due Arrived	First Due First	Percent Responded	Percent Arrived	Percent First
16th Ave.	1,786	1,601	1,588	1,476	89.6	88.9	**82.6**
Bradford	1,301	1,220	1,206	1,132	93.8	92.7	**87.0**
High St.	3,098	2,709	2,683	2,514	87.4	86.6	**81.1**
Water St.	1,913	1,817	1,813	1,791	95.0	94.8	**93.6**
Total	**8,098**	**7,347**	**7,290**	**6,913**	**90.7**	**90.0**	**85.4**

Note: For each station, we count the number of calls occurring within its first due area. Then, we count the number of calls to where at least one unit arrived. Next, we focus on units from HFD's first due station to see if any of its units responded, arrived, or arrived first.

The next resiliency measure is the frequency distribution of calls, or how many calls are occurring in an hour. The next table tells us that calls overlap 25 percent of the time with two to four calls overlapping citywide about 24 percent of the time.

TABLE 4-6: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	3,644	41.6
1	2,919	33.3
2	1,453	16.6
3	524	6.0
4	155	1.8
5	48	0.5
6+	17	0.2
Total	**8,760**	**100.0**

The next table looks at frequency of overlapping calls in each fire management zone. The High Street Station has the highest frequency of overlapping calls (11 percent).

TABLE 4-7: Frequency of Overlapping Calls for Each Station

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
16th Ave.	No overlapped call	1,702	93.0	605.2
	Overlapped with one call	124	6.8	22.4
	Overlapped with two calls	4	0.2	0.4
Bradford	No overlapped call	1,267	95.5	409.4
	Overlapped with one call	60	4.5	11.5
High St.	No overlapped call	2,812	89.3	903.9
	Overlapped with one call	317	10.1	49.8
	Overlapped with two calls	20	0.6	1.8
Water St.	No overlapped call	1,825	93.2	588
	Overlapped with one call	129	6.6	19.8
	Overlapped with two calls	3	0.2	0.4
	Overlapped with three calls	1	0.1	0.1

The next table looks at the duration of calls, a measure that contributes to overlapping calls in a fire management zone, particularly those that last one or more hours. In Haverhill, 87 percent of all calls were handled in 30 minutes or less.

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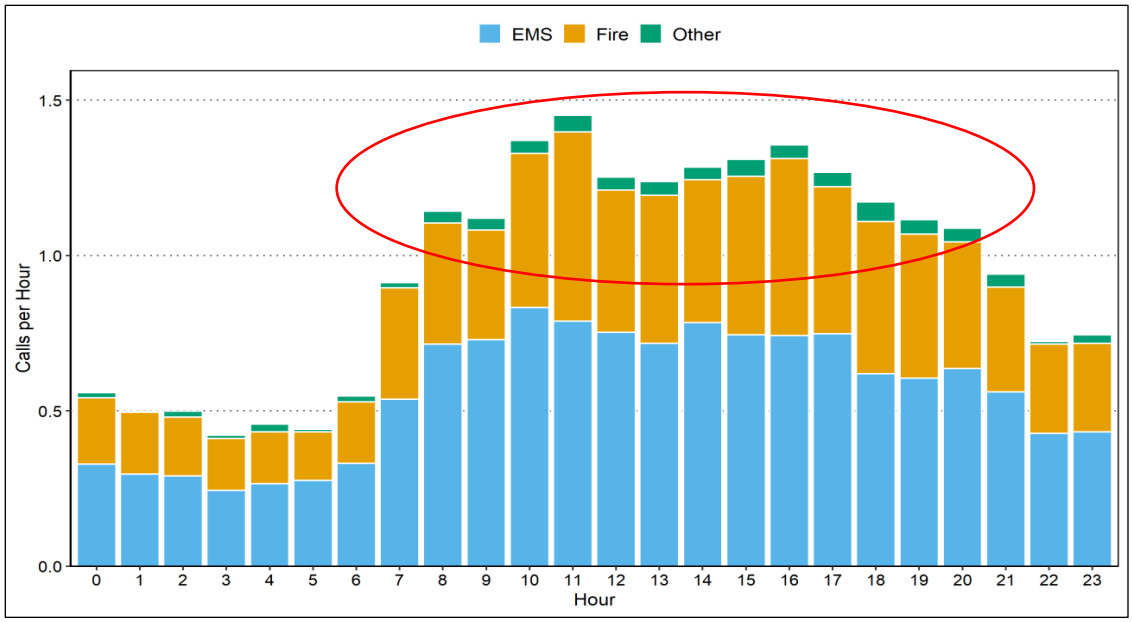
TABLE 4-8: Calls by Type and Duration

Call Type	Less than 30 Minutes	30 Minutes to One Hour	One to Two Hours	Two or More Hours	Total
EMS	4,027	288	29	6	4,350
MVA	341	175	24	4	544
EMS Total	**4,368**	**463**	**53**	**10**	**4,894**
False alarm	1,288	121	17	1	1,427
Good intent	347	28	1	1	377
Hazard	149	113	50	9	321
Outside fire	54	23	8	3	88
Public service	659	79	19	8	765
Structure fire	102	30	20	11	163
Technical rescue	27	10	3	0	40
Fire Total	**2,626**	**404**	**118**	**33**	**3,181**
Canceled	265	3	0	0	268
Mutual aid	0	1	11	9	21
Total	**7,259**	**871**	**182**	**52**	**8,364**

Finally, when we analyze resiliency, we look at when calls are occurring over a 24-hour period. In Haverhill, the peak time for calls is between the hours of 8:00 a.m. and 8:00 pm. The next figure illustrates this.

FIGURE 4-9: Average Calls by Hour of Day



The HFD does have moderate resistance issues based on the reposnse matrix. Overall, 15 percent of calls where units arrived included two or more HFD units. More specifically, false alrams (primarily fire alrams), structure fires, and hazrd calls made up 11 percent of calls with two or more units.

TABLE 4-9: Calls by Call Type and Number of Arriving HFD Units

Call Type	Number of Units			Total Calls
	One	Two	Three or More	
General medical	4,291	25	16	4,332
MVA	394	72	75	541
EMS Total	**4,685**	**97**	**91**	**4,873**
False alarm	785	117	519	1,421
Good intent	307	14	54	375
Hazard	192	22	107	321
Outside fire	63	7	18	88
Public service	699	33	31	763
Structure fire	34	16	113	163
Technical rescue	30	4	6	40
Fire Total	**2,110**	**213**	**848**	**3,171**
Canceled	119	3	8	130
Mutual aid	20	1	0	21
Total	**6,934**	**314**	**947**	**8,195**
Total Percentage	**84.6**	**3.8**	**11.6**	**100**

Overall, the HFD has only moderate resilliency issues at the High Street and Water Street stations in terms of workload. Both High Street and 16th Avenue Stations have moderate resiliency issues when analyzing their ability to arrive first in their fire management zone (81.1 and 82.6 percent, respectively). Although there can be more than one call in an hour in all stations, the percentage overall is low. The highest percentage at High Street (11 percent of the time an overlapped call occurs) would have absorption impacts in the northwest area of the fire management zone due to long travel distance from other stations. The workload of all companies in terms of runs (calls where there are more than one unit responding) will have an effect on resilliency, as there are limited resources available.

The HFD's ability to absorb multiple calls and restore response capabilities to a state of normal can be challenging at certain times such as during working structural fires and other multi-company responses (runs). High Street, 16th Avenue, and Bradford stations should be monitored as they are below the 90th percentile of arriving first in their fire management zone.

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THREE-AXIS RISK ANALYSIS

A comprehensive risk assessment is a critical aspect of creating standards of cover and can assist the HFD in quantifying the risks that it faces. Once those risks are known, the department is better equipped to determine if the current response resources are sufficiently staffed, equipped, trained, and positioned.

In this component, the factors that drive the service needs are examined and then link directly to discussions regarding the assembling of an effective response force (ERF) and when contemplating the response capabilities needed to adequately address the existing risks, which encompasses the component of critical tasking.

The risks that the department faces can be natural or manufactured and may be affected by the changing demographics of the community. With the information available from the CPSM data and operational analysis, the HFD, the city, and public research, the HFD can begin an analysis of the city's risks and can begin working towards recommendations and strategies to mitigate and minimize their effects. This section contains an analysis of the various risks considered within the HFD service area.

Risk is often categorized in three ways: consequence of the event on the community, the probability the event will occur in the community, and the impact on the fire department. The following three tables look at the probability of the event occurring, which ranges from unlikely to frequent; consequence to the community, which is categorized as ranging from insignificant to catastrophic; and the impact to the organization, which ranges from insignificant to catastrophic.

TABLE 4-10: Event Probability

Probability	Chance of Occurrence	Description	Risk Score
Unlikely	2%-25%	Event may occur only in exceptional circumstances.	**2**
Possible	26%-50%	Event could occur at some time and/or no recorded incidents. Little opportunity, reason, or means to occur.	**4**
Probable	51%-75%	Event should occur at some time and/or few, infrequent, random recorded incidents, or little anecdotal evidence. Some opportunity, reason, or means to occur; may occur.	**6**
Highly Probable	76%-90%	Event will probably occur and/or regular recorded incidents and strong anecdotal evidence. Considerable opportunity, means, reason to occur.	**8**
Frequent	90%-100%	Event is expected to occur. High level of recorded incidents and/or very strong anecdotal evidence.	**10**

TABLE 4-11: Impact on HFD

Impact	Impact Categories	Description	Risk Score
Insignificant	Personnel and Resources	One apparatus out of service for period not to exceed one hour.	**2**
Minor	Personnel and Resources	More than one but not more than two apparatus out of service for a period not to exceed one hour.	**4**
Moderate	Personnel and Resources	More than 50 percent of available resources committed to incident for over 30 minutes.	**6**
Significant	Personnel and Resources	More than 75 percent of available resources committed to an incident for over 30 minutes.	**8**
Catastrophic	Personnel, Resources, and Facilities	More than 90 percent of available resources committed to incident for more than two hours or event which limits the ability of resources to respond.	**10**

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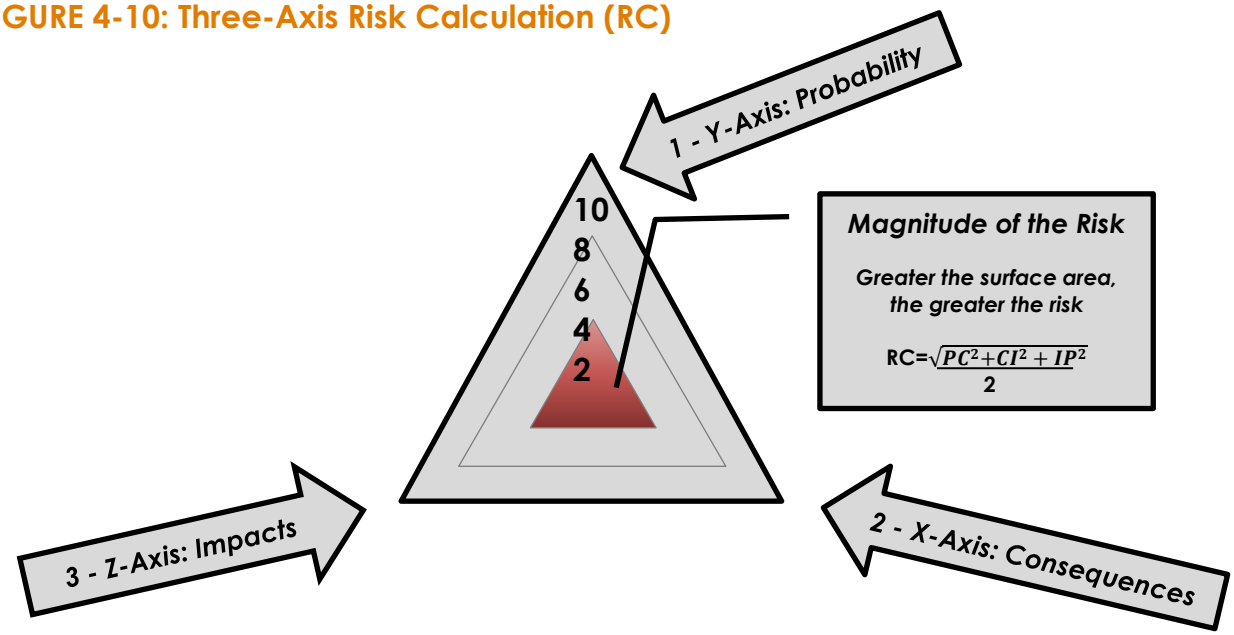
TABLE 4-12: Consequence to Community Matrix

Impact	Consequence Categories	Description	Risk Score
Insignificant	Life Safety	■ 1 or 2 people affected, minor injuries, minor property damage, and no environmental impact.	**2**
Minor	Life Safety Economic and Infrastructure Environmental	■ Small number of people affected, no fatalities, and small number of minor injuries with first aid treatment. Minor displacement of people for <6 hours and minor personal support required. ■ Minor localized disruption to community services or infrastructure for <6 hours. Minor impact on environment with no lasting effects.	**4**
Moderate	Life Safety Economic and Infrastructure Environmental	■ Limited number of people affected (11 to 25), no fatalities, but some hospitalization and medical treatment required. Localized displacement of small number of people for 6 to 24 hours. Personal support satisfied through local arrangements. Localized damage is rectified by routine arrangements. ■ Normal community functioning with some inconvenience. Some impact on environment with short-term effects or small impact on environment with long-term effects.	**6**
Significant	Life Safety Economic and Infrastructure Environmental	■ Significant number of people (>25) in affected area impacted with multiple fatalities, multiple serious or extensive injuries, and significant hospitalization. ■ Large number of people displaced for 6 to 24 hours or possibly beyond. External resources required for personal support. Significant damage that requires external resources. Community only partially functioning, some services unavailable. Significant impact on environment with medium- to long-term effects.	**8**
Catastrophic	Life Safety Economic and Infrastructure Environmental	■ Very large number of people in affected area(s) impacted with significant numbers of fatalities, large number of people requiring hospitalization; serious injuries with long-term effects. General and wide-spread displacement for prolonged duration; extensive personal support required. Extensive damage to properties in affected area requiring major demolition. ■ Serious damage to infrastructure. Significant disruption to, or loss of, key services for prolonged period. ■ Community unable to function without significant support. ■ Significant long-term impact on environment and/or permanent damage.	**10**

This section also contains an analysis of the various risks considered in the city. In this analysis, information presented and reviewed in this section (All-Hazards Risk Assessment of the Community) have been considered. Risk is categorized as Low, Moderate, High, or Special.

Prior risk analysis has only attempted to evaluate two factors of risk: probability and consequence. Contemporary risk analysis considers the impact of each risk to the organization, thus creating a three-axis approach to evaluating risk as depicted in the following figure. A contemporary risk analysis now includes probability, consequences to the community, and impact on the organization, in this case the HFD.

FIGURE 4-10: Three-Axis Risk Calculation (RC)



The following factors/hazards were identified and considered:

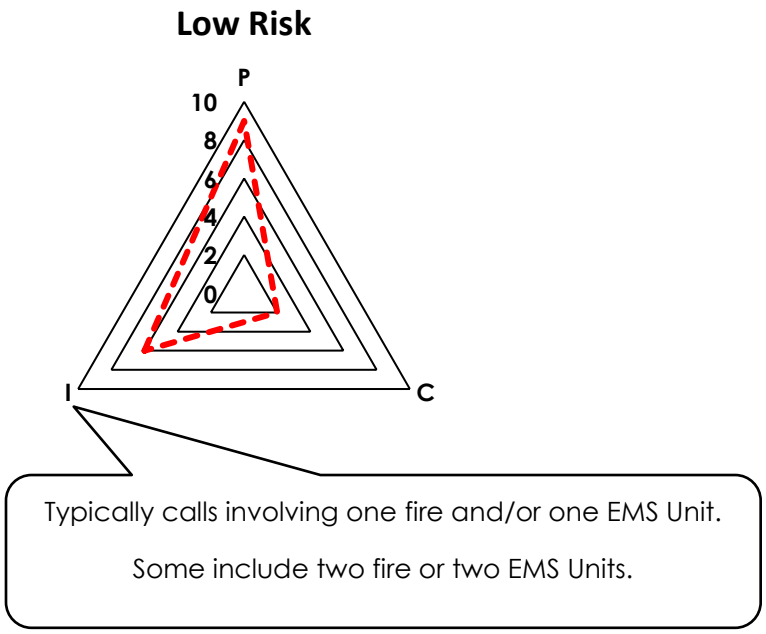
- **Demographic factors** such as age, socio-economic, vulnerability.
- **Natural hazards** such as flooding, snow and ice events, wind events, wild land fires.
- **Manufactured hazards** such as rail lines, roads and intersections, target hazards.
- **Structural/building risks**.
- **Fire and EMS incident numbers and density**.
- **Resiliency.**

The assessment of each factor and hazard as listed below took into consideration the likelihood of the event, the impact on the city itself, and the impact on HFD's ability to deliver emergency services, which includes HFD resiliency and mutual aid capabilities as well. The list is not all inclusive but includes categories most common or that may present to the city and the HFD.

Low Risk

- Automatic fire/false alarms.
- Low-acuity BLS EMS Incidents.
- Low-risk environmental event.
- Motor vehicle accident (MVA).
- Good intent/hazard/public service fire incidents with no life-safety exposure.
- Outside fires such as grass, rubbish, dumpster, vehicle with no structural/life-safety exposure.

FIGURE 4-11: Low Risk



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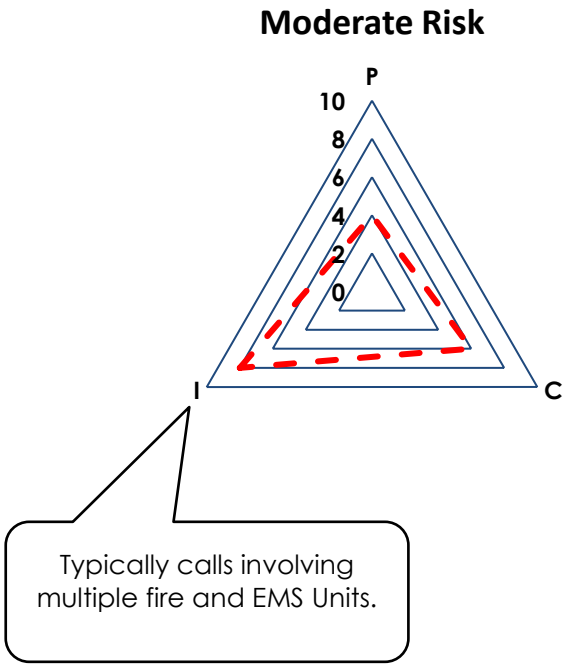
Moderate Risk

- Fire incident in a single-family dwelling where fire and smoke or smoke is visible, indicating a working fire.
- Suspicious substance investigation involving multiple fire companies and law enforcement agencies.
- ALS EMS incident.
- MVA with entrapment of passengers.
- Grass/brush fire with structural endangerment/exposure.
- Low-angle rescue involving ropes and rope rescue equipment and resources.
- Surface water rescue.
- Good intent/hazard/public service fire incidents with life-safety exposure.
- Rail event with no release of product or fire, and no threat to life safety

FIGURE 4-12: Moderate Risk



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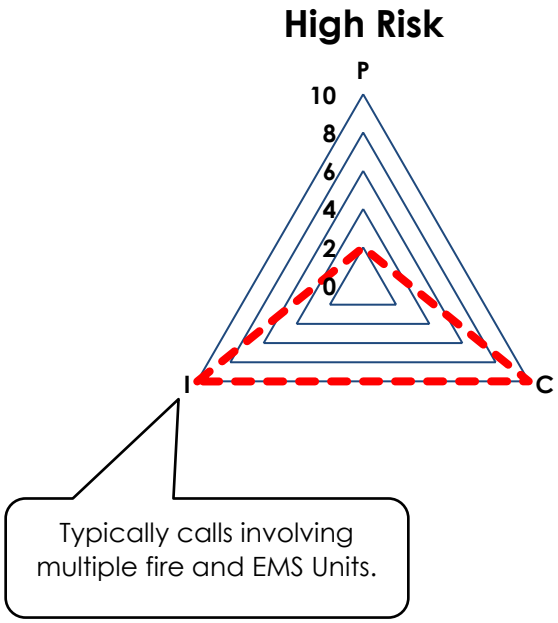
High Risk

- Working fire in a target hazard.
- Cardiac arrest.
- Mass casualty incident of more than 10 patients but fewer than 25 patients.
- Confined space rescue.
- Structural collapse involving life-safety exposure.
- High-angle rescue involving ropes and rope rescue equipment.
- Trench rescue.
- Suspicious substance incident with multiple injuries.
- Industrial leak of hazardous materials that causes exposure to persons or threatens life safety.
- Weather event that creates widespread flooding, heavy snow, heavy winds, building damage, and/or life-safety exposure.

FIGURE 4-13: High Risk



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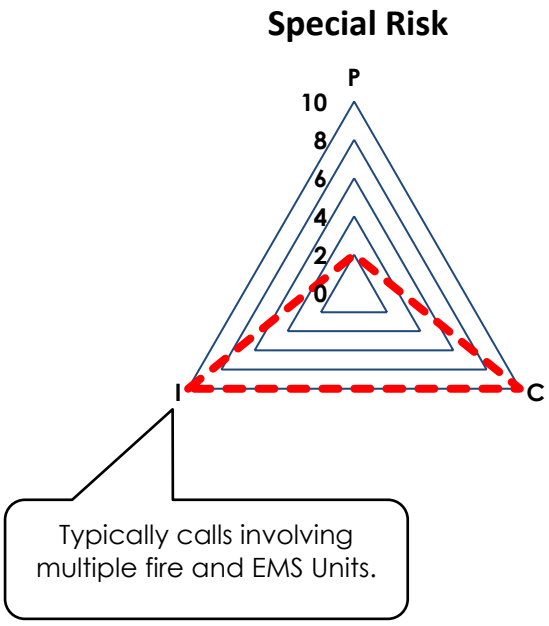
Special Risk

- Working fire in a structure of more than three floors.
- Fire at an industrial building or complex with hazardous materials.
- Fire in an occupied targeted hazard with special life-safety risks such as age, medical condition, or other identified vulnerabilities.
- Mass casualty incident of more than 25 patients.
- Rail or transportation incident that causes life-safety exposure or threatens life safety through the release of hazardous smoke or materials and evacuation of residential and business occupancies.
- Explosion in a building that causes exposure to persons or threatens life safety or outside of a building that creates exposure to occupied buildings or threatens life safety.
- Massive river/estuary flooding, fire in a correctional or medical institution, high-impact environmental event, pandemic.
- Mass gathering with threat fire and threat to life safety or other civil unrest, weapons of mass destruction release.

FIGURE 4-14: Special Risk



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SECTION 5. EMERGENCY DEPLOYMENT

STAFFING AND DEPLOYMENT OF RESOURCES

When exploring staffing and deployment of fire departments it is prudent to design an operational strategy around the actual circumstances that exist in the community and the fire and risk problems that are identified. The strategic and tactical challenges presented by the widely varied hazards that a department protects against need to be identified and planned for through a community risk analysis planning and management process as completed in this report.

There are real budgetary factors that must be considered when deciding on the level of staffing against the level of risk in a community.

Effectively managing a fire department requires an understanding of and an ability to demonstrate how changes to resources will affect community outcomes. It is imperative that fire department leaders, as well as policy makers, know how fire department resource deployment in their local community affects community outcomes in three important areas: firefighter injury and death; civilian injury and death; and property loss. If fire department resources (both mobile and personnel) are deployed to match the risk levels inherent to hazards in the community, it has been scientifically demonstrated that the community will be far less vulnerable to negative outcomes in all three areas.[18]

Even with a thorough risk evaluation, staffing fire and EMS companies continues to remain a hotly debated topic among firefighters and governmental leadership since risk assessment models include high risk / low frequency situations. While there are situations that may be low frequency, they can and do occur and thus require operational readiness to mitigate.

The federal government recognizes staffing issues for local municipal fire departments as well. In response to concerns over the adequacy of firefighter staffing, the Staffing for Adequate Fire and Emergency Response Act, known as the SAFER Act, was enacted by the 108th Congress as Section 1057 of the FY2004 National Defense Authorization Act (P.L. 108-136). The SAFER Act authorizes grants to career, volunteer, and combination local fire departments for the purpose of increasing the number of firefighters to help communities meet industry-minimum standards such as NFPA 1710 and 1720 and attain 24-hour staffing to provide adequate protection from fire and fire-related hazards. Also authorized are grants to volunteer fire departments for recruitment and retention of volunteers. SAFER is administered by the Federal Emergency Management Agency (FEMA) of the Department of Homeland Security (DHS).[19]

While NFPA 1710 and OSHA provide guidelines as to the level of staffing and response of personnel, the acceptance of these guidelines varies from state to state and department to department. NFPA 1710 addresses recommended staffing in terms of four types of occupancies. The needed staffing to accomplish the critical tasks for each specific occupancy are determined to be the *Effective Response Force* (ERF). The ERF for each of these occupancies is detailed in NFPA 1710 (2020 edition), Section 5.2.4, Deployment.

18. Fire Service Deployment, Assessing Community Vulnerability, Metropolitan Chiefs, 2011.
19. Congressional Budget Research Service, informing the legislative debate since 1914. *Staffing for Adequate Fire and Emergency Response:* The SAFER Grant Program, updated April 25, 2019.

One of the factors that has helped the fire service in terms of staffing is technology. The fire service continues to incorporate technological advances that help firefighters extinguish fires more effectively. More advanced equipment in terms of nozzles, thermal imaging systems, advancements in self-contained breathing apparatus, incident command strategies, and devices used to track personnel air supply are some of the advancements of technologies and techniques that help firefighters extinguish fires faster and manage the fireground more effectively. While some of these technologies do not reduce the staffing or workforce required, they can have an impact on workload capacity, property loss, and crew fatigue.

One such technology that can assist in the rapid extinguishment of fires is a foam agent such as a Class A and Compressed Air Foam System (CAFS). Foam has an extinguishing capability that is superior to water because of its ability to cool a fire and to suppress combustion vapor. The increased surface area of foam bubbles increases foam's capability to absorb heat, and makes a dramatic difference compared to plain water.

The foam suppresses vapors because it covers and coats burned or partially burned fuels, thereby trapping escaping vapors.[20] Class A foam increases wetting effectiveness, which enables greater penetration into Class A fuels such as ordinary combustibles. It also gives water a foaming ability, which allows it to remain and cling to vertical and horizontal surfaces without run-off and allows water to absorb more heat. By adding a small quantity of a Class A foam concentrate into a water stream, the effectiveness of the water can be increased by up to five times.[21]

A CAFS offers other advantages vs. water-only systems. CAFS has been shown to reduce water use, provide for less extinguishment time, and reduce firefighter fatigue.[22]

Even with many advances in technology and equipment, the fireground is an unforgiving and dynamic environment where firefighters must complete critical tasks. Providing adequate staffing (Effective Response Force) for these environments utilizes many factors. A community fire risk assessment and the expectations of the community are factors that will drive the critical tasks needed to be completed on the fireground.

Staffing and deployment of fire services are not exact sciences. While there are many benchmarks that communities and management utilize in justifying certain staffing levels, there are certain considerations that are data driven and reached through national consensus that serve this purpose as well. CPSM has developed metrics it follows and recommends that communities consider when making recommendations regarding staffing and deployment of fire resources.

In addition to metrics, staffing is also linked to station location, what type of apparatus is responding, whether engine, ladder, or specialty piece such as a rescue company. These combined factors help to determine what level of fire and EMS service is going to be delivered in terms of manpower, response time, and resources. Linked to these components of staffing and deployment are 11 critical factors that drive various levels and models from which fire and EMS departments staff and deploy. These factors are:

20. www.chemguard.com
21. www.chemguard.com
22. *Fire Engineering*, 2013, Compressed Air Foam and Firefighting Research, Dicus et al

Fire Risk and Vulnerability of the Community: The community risk and vulnerability assessment are used to evaluate the community. With regard to individual property, the assessment is used to measure all property and the risk associated with that property and then segregate the property as either a high-, medium-, or low-hazard depending on factors such as the life and building content hazard and the potential fire flow and the staffing and apparatus types required to mitigate an emergency in the specific property. Factors such as fire protection systems are considered in each building evaluation. Included in this assessment should be both a structural and nonstructural (weather, wildland-urban interface, transportation routes, etc.) analysis.

Population, Demographics, and Socioeconomics of a Community: Population and population density drive calls for local government service, particularly public safety. The risk from fire is not the same for everyone, with studies telling us age, gender, race, economic factors, and what region in the country one might live all contribute to the risk of death from fire. Studies also tell us these same factors affect demand for EMS, particularly population increase and the use of hospital emergency departments. Many uninsured or underinsured patients rely on emergency departments for their primary and emergent care, utilizing a pre-hospital EMS transport system as their entry point.

Call Demand: Demand is made up of the types of calls to which units are responding and the location of the calls. This drives workload and station staffing considerations. *Higher population centers with increased demand require greater resources.*

Workload of Units: The types of calls to which units are responding and the workload of each unit in the deployment model. This tells us what resources are needed and where; it links to demand and station location, or in a dynamic deployed system, the area(s) in which to post units.

Travel Times from Fire Stations: Looks at the ability to cover the response area in a reasonable and acceptable travel time when measured against national benchmarks. Links to demand and risk assessment.

NFPA Standards, ISO, OSHA Requirements (and other national benchmarking). CPSM considers national benchmarks, standards, and applicable laws when making recommendations or alternatives regarding the staffing and deployment of fire and EMS resources.

EMS Demand: Community demand; demand on available units and crews; demand on non-EMS units responding to calls for service (fire/police units); availability of crews in departments that utilize cross-trained EMS staff to perform fire suppression.

Critical Tasking: The ability of a fire and EMS department to collect an effective response force as benchmarked against national standards when confronted with the need to perform required critical tasks on a fire or EMS incident scene defines its capability to provide adequate resources to mitigate each event. Department-developed and measured against national benchmarks. Links to risk and vulnerability analysis.

Innovations in Staffing and Deployable Apparatus: The fire department's ability and willingness to develop and deploy innovative apparatus. Compressed air foam systems, deploying quick response vehicles (light vehicles equipped with medical equipment and some light fire suppression capabilities) on those calls (typically the largest percentage) that do not require heavy fire apparatus.

Community Expectations: Measuring, understanding, and meeting community expectations.

Ability to Fund: The community's ability and willingness to fund all local government services and understanding how the revenues are divided up to meet the community's expectations.

While each component presents its own metrics of data, consensus opinion, and/or discussion points, aggregately they form the foundation for informed decision making geared toward the implementation of sustainable, data- and theory-supported, effective fire and EMS staffing and deployment models that fit the community's profile, risk, and expectations.

Deployable Resources

The HFD service area has a mix of commercial areas, professional office buildings, multifamily and single-family residential structures (low and moderate density), and healthcare facilities. The service area has a diverse mix of buildings ranging from new to older construction with single and/or mixed occupancy types with multiple stories and access issues in the winter months given the topography. There are also urban, suburban, and more rural areas of the city that are built upon.

As discussed, the HFD responds with fire suppression apparatus with crews from four fire station locations and utilizes a private ambulance service for ALS/BLS Transport. HFD relies on mutual aid companies for working fires when backfill of HFD stations are needed. Mutual aid companies can be called to the scene if needed but have extended response times from a variety of paid, paid on call, combination, and volunteer departments. The HFD primary deployable resources include:

Engine Companies, which are primarily designed for firefighting operations, the transport of crew members, hose (fire attack and larger supply), tank water, ground ladders, self-contained breathing apparatus, and storage of an assortment of hand tools used for a broad spectrum of fire operational tasks. As engines are often utilized as first response units on EMS calls, they also carry an assortment of EMS gear to treat patients and provide life-saving measures prior to the arrival of EMS transport units. The HFD engines are set up for this as well and are staffed with advanced emergency medical technicians. Staffing complements for engine apparatus are discussed below. HFD currently responds to emergencies with an inventory of four engines.

Ladder Company, which is also primarily designed for firefighting operations but differs from engines in that it also has a hydraulically operated aerial device designed to reach above grade floors to transport crew members, effect rescues, and provide an elevated water stream. Ladder trucks also transport crew members, ground ladders, self-contained breathing apparatus, various forcible entry tools, ventilation equipment, and hydraulic rescue tools as well as other equipment to deal with an assortment of fires and technical rescues. The HFD currently responds to emergencies with an inventory of one ladder truck. When needed, the unit responds with a crew capable of performing ladder company functions such as ventilation, utility control, above-grade firefighting tasks, and elevated master stream application.

Rescue Company, which is also primarily designed for firefighting operations and transports crew members, self-contained breathing apparatus, various hand and forcible entry tools, ventilation equipment, hydraulic rescue tools as well as other specialty equipment such as rope and rope equipment, vehicle stabilization devices, various mechanical cutting and burning tools, water rescue, and other specialty tools and equipment to deal with an assortment of fire and technical rescue incidents. The HFD currently responds to emergencies with an inventory of one rescue truck. When needed, the unit responds with a crew capable of performing ladder and engine company functions, as well as vehicle and technical rescue functions.

Forestry Truck, is a combination of an all-terrain vehicle, mini-pumper, and a wilderness rescue vehicle, used to fight wildfires. It is sometimes also known as a brush truck. This type of vehicle is designed to assist in fighting wildfires by transporting firefighters to the scene and providing them with access to the fire, along with water or other brush/wild land firefighting equipment.

Water Tender, which is a type of firefighting apparatus that specializes in the transport of water utilizing a large on-vehicle tank and from a water source to a fire scene.

Command Vehicles, which are typically SUV-type vehicles with command centers built into the cargo compartment, are designed to carry a command level officer to the scene and equipped with radio and command boards as well scene personnel-tracking equipment and associated gear. HFD has one command vehicle assigned to the Fire Chief and one to the Deputy Chiefs. These personnel are responsible for responding to fire and EMS incidents and establishing command and control of the incident.

Fire, rescue, and emergency medical system (EMS) incidents, and the fire department's ability to respond to, manage, and mitigate, them effectively, efficiently, and safely, are mission-critical components of the emergency services delivery system. In fact, fire, rescue, and EMS operations provide the primary, and certainly most important, basis for the very existence of the fire department.

The HFD operational division aggregately consists of 48 firefighters, 4 captains, 20 lieutenants, and 4 Deputy Chiefs, who are assigned to four work groups. Each group operates four engines, one ladder truck, one rescue truck, and one command car out of four stations. Each group is staffed daily with a minimum of 19 members. The next table details primary response apparatus and staffing for each work group.

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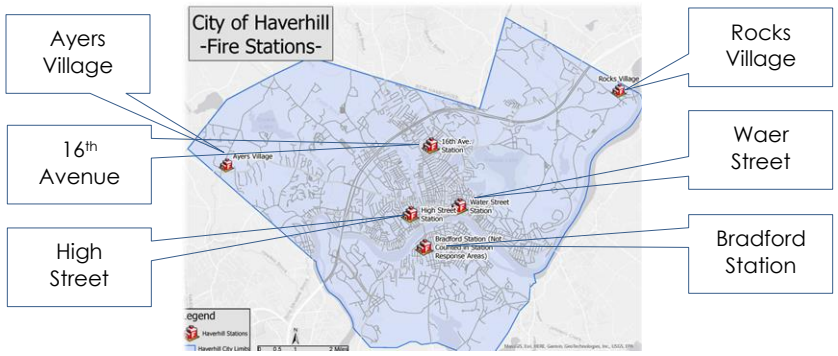
TABLE 5-1: HFD Shift Matrix: Apparatus and Staffing

<table>
<tr><th>Water Street Station</th><th>Bradford Station</th><th>16th Ave. Station</th><th>High Street Station</th></tr>
<tr><td>Command Car
1 Deputy Chief
Engine
1 Lieutenant
2 Firefighters
Rescue Truck
1 Captain
2 Firefighters
Ladder Truck
1 Lieutenant
2 Firefighters

Reserve Air Cart
Reserve Tanker Truck
Cross-staffed with available crew

Trinity Ambulance Base</td><td>Engine
1 Lieutenant
2 Firefighters

Forestry Truck
Cross-staffed with available crew</td><td>Engine
1 Lieutenant
2 Firefighters
Forestry Truck
Cross-staffed with available crew</td><td>Engine
1 Lieutenant
2 Firefighters</td></tr>
<tr><td colspan="4"> 
</td></tr>
<tr><td colspan="4">Village Call Fire Stations</td></tr>
<tr><td colspan="2">Ayers Village Call Station
Reserve Engine 8
Unstaffed</td><td colspan="2">Rocks Village Call Station
Reserve Engine 9
Unstaffed</td></tr>
</table>

Nationwide, fire departments are responding to more EMS calls and fewer fire calls, particularly fire calls that result in active firefighting operations by responders. This is well documented in both national statistical data as well as CPSM fire studies. HFD is consistent with these trends, with 58.5 percent of its responses being EMS-related and 38.0 percent being fire-related.

CPSM monitors national data (as well as CPSM historical project data) as questions often arise from fire departments as they track EMS vs. fire Calls to see how to distribute resources according to call-type demand. ESO, a leading data and software company serving emergency medical services (EMS), fire departments, hospitals, and state EMS/trauma offices, gathered data in 2019 from its fire clients and partners to look at the distribution of fire and EMS calls.[23] From this data, five key topics were researched, including a deeper look into the most common type of responses overall. The results of the analysis (*2019 ESO Fire Trends Report*), compiled from 638,979 calls during the period of January 1, 2019, to June 30, 2019, showed that fire departments respond to more EMS calls than fire calls. In fact, in the sampling of data, more than 70 percent of calls were EMS calls.[24]

Emergency medical services (EMS) ground transport in Haverhill is provided through a contracted ambulance provider, Pridestar Trinity E.M.S. Inc. The HFD response matrix sends an

23. ESO *Acquires Emergency Reporting, Leading Fire Records Management System (RMS),* August 26, 2021, press release. eso.com
24. eso.com staff report, 2019. Fire Trends Report: *Number of EMS calls vs. Fire Calls.*

engine and/or ladder company to EMS incidents to assist Pridestar Trinity Ambulance; the department's focus is on ensuring rapid scene and patient contact. HFD firefighters assist ambulance crew by assessing, treating, stabilizing, and packaging the patient for transport, thereby decreasing on-scene times. In regard to EMS staffing, HFD does not provide ALS/BLS EMS transport or staff any ALS engines. With a few exceptions, all HFD employees are certified to the EMT level. All HFD frontline apparatus are staffed with an officer and two firefighters; at least two of these three are at the EMT level. Each frontline piece carries a first-in medical bag stocked with medical equipment necessary to perform emergency first responder duties. There are no special response units in the HFD for EMS.[25]

Trinity staffs two Advanced Life Support (ALS) ambulances with two ALS medics and three Basic Life Support Ambulances with Emergency Medical Technicians. HFD EMS is coordinated by the Training Captain who is responsible for maintaining the Narcan and oxygen inventory as well as coordinating all certifications and continuing education for the department. The Training Captain is also the liaison to Holy Family Hospital in Haverhill.

Holy Family Hospital Haverhill is a normal operating hospital that has a 24-hour emergency department as well as inpatient hospital beds and 24-hour psychiatric facilities for the older adult (ABU). The hospital also provides regular services on a daily basis that a standard hospital would provide. Haverhill Fire is the first response agency for any emergencies that occur at this facility as well.

Trinity is dispatched by the HFD Fire Alarm Division utilizing Emergency Medical Dispatch (EMD), but the division does not have "closest to" capabilities. "Closest to" vehicle dispatch enables a communication center to dispatch the closest fire or EMS unit to the incident regardless of what district the call for service may be coming from. This process provides the fastest possible response to the incident.

On a national level, improved building construction, code enforcement, automatic sprinkler systems, and aggressive public education programs have contributed to a decrease in serious fires and, more importantly, fire deaths among civilians. These trends and improvements in the overall fire protection system notwithstanding, fires still do occur, and the largest percentage of those occur in residential occupancies where they place the civilian population at risk. Although they occur with less frequency than they did several decades ago, when they occur today, they grow much quicker and burn more intensely than they did in the past due to newer construction features and interior finishes. In the case of a locality such as Haverhill, its older buildings, road access challenges, and severe winter weather with icy streets and terrain make emergency response at times difficult. In addition, multiple renovations to structures that contain hidden voids and spaces that act as channels for fire and smoke can present significant firefighting challenges.

As will be discussed later in this section, ***it is imperative that the fire department is able to assemble an Effective Response Force (ERF) within a reasonable time period in order to successfully mitigate these incidents with the least amount of loss possible***.

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, outlines organization and deployment of operations by career, and primarily career fire and rescue organizations. It serves as a benchmark to measure staffing and deployment of resources to certain structures and emergencies. Questions of legal responsibilities are often discussed in terms of compliance with NFPA standards. NFPA

25. HFD Report to CPSM, 2022.

standards are consensus standards and not the law. Many cities and counties strive to achieve these standards to the extent possible without an adverse financial impact on the community. Cities and communities must decide on the level of service and compliance they can deliver based on budgetary constraints and operational capabilities.

NFPA 1710 details staffing levels for fire departments in terms of fire, EMS, and special operation incidents. According to NFPA 1710, fire departments should base their capabilities on a formal community risk assessment, as discussed in this report, and taking into consideration:[26]

- Life hazard to the population protected.
- Provisions for safe and effective firefighting performance conditions for the firefighters.
- Potential property loss.
- Nature, configuration, hazards, and internal protection of the properties involved.
- Types of fireground tactics and evolutions employed as standard procedure, type of apparatus used, and results expected to be obtained at the fire scene.

Cities and communities must decide on the level of service and compliance they can deliver based on budgetary constraints and operational capabilities. Questions of legal responsibilities are often discussed in terms of compliance with NFPA standards. NFPA 1710 was the first organized approach to defining levels of service, deployment capabilities, and staffing levels for substantially career departments. Research work and empirical studies in North America were used by the standard's committee for the basis of developing response times and resource capabilities for those services as identified by the fire department.[27]

EFFECTIVE RESPONSE FORCE AND CRITICAL TASKING

NFPA 1710 addresses standards for an *Effective Response Force* across several types of occupancies. An effective response force (ERF) is defined as the minimum number of firefighters and equipment that must reach a specific emergency incident location within a maximum prescribed travel [driving] time. The maximum prescribed travel time acts as one indicator of resource deployment efficiency.

NFPA 1710 provides a staffing deployment model and critical tasking guidelines for four specific occupancies. These occupancies are:

- Single-Family Dwelling.
- Open-Air Strip Mall/Commercial Building.
- Garden Style Apartment.
- High Rise.

The Center for Public Safety Excellence (CPSE) has also established benchmarks regarding staffing and deployment. CPSE sets standards for agencies desiring accreditation through the Commission on Fire Accreditation International (CFAI). CFAI uses standards set forth in the

26. NFPA 1710, 5.2.1.1, 5.2.2.2
27. NFPA 1710 Origin and Development of the NFPA 1710, 1710-1

Community Risk Assessment Manual: Standards of Cover, 10th edition, to provide guidance in staffing and deployment to agencies desiring accreditation through Core Competencies.

Critical Tasking as Defined by CPSE and NFPA

Both CPSE and the NFPA have defined *critical tasking*. CPSE defines critical tasking as the application of tasks assigned to the human and physical resources that are minimally required to effectively mitigate pain, suffering, and loss of life and/or property. Critical tasking is relevant to risk classifications and risk categories.[28]

There are 93 Core Competencies required for a department to achieve accreditation status as defined by CPSE. Competency 2C.4 is under the heading of Current Deployment and Performance and addresses critical tasking.

> ***Criterion 2C: Current Deployment and Performance***
>
> *The agency identifies and documents the nature and magnitude of the service and deployment demands within its jurisdiction. Based on risk categorization and service impact considerations, the agency's deployment practices are consistent jurisdictional expectations and with industry research. Efficiency and effectiveness are documented through quality response measurements that consider overall response, consistency, reliability, resiliency, and outcomes throughout all service areas. The agency develops procedures, practices, and programs to appropriately guide its resource deployment.*[29]
>
> ***Core Competency 2C.4***
>
> *A critical task analysis of each category and risk class is conducted to determine the first due and effective response force capabilities, and a process is in place to validate and document the results.*
>
> *Core competency 2C.4 requires that the agency conduct a critical task analysis of each risk category and risk class to determine the first-due and effective response force capabilities, and to have a process in place to validate and document the results. The process considers the number of personnel needed to perform the necessary emergency scene operations. Completion of the process also helps to identify any gaps in the agency's emergency scene practices*

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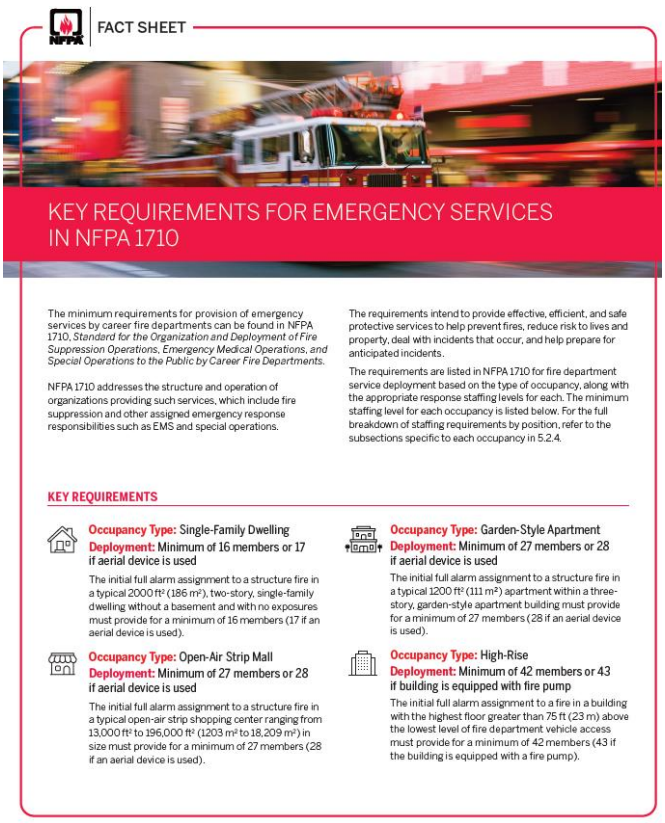
28. Center for Public Safety Excellence, Quality Improvement for the Fire and Emergency Services, 2020
29. Center for Public Safety Excellence, Quality Improvement for the Fire and Emergency Services, 2020



FACT SHEET

KEY REQUIREMENTS FOR EMERGENCY SERVICES IN NFPA 1710

The minimum requirements for provision of emergency services by career fire departments can be found in 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.*

NFPA 1710 addresses the structure and operation of organizations providing such services, which include fire suppression and other assigned emergency response responsibilities such as EMS and special operations.

The requirements intend to provide effective, efficient, and safe protective services to help prevent fires, reduce risk to lives and property, deal with incidents that occur, and help prepare for anticipated incidents.

The requirements are listed in NFPA 1710 for fire department service deployment based on the type of occupancy, along with the appropriate response staffing levels for each. The minimum staffing level for each occupancy is listed below. For the full breakdown of staffing requirements by position, refer to the subsections specific to each occupancy in 5.2.4.

KEY REQUIREMENTS

Occupancy Type: Single-Family Dwelling
Deployment: Minimum of 16 members or 17 if aerial device is used

The initial full alarm assignment to a structure fire in a typical 2000 ft² (186 m²), two-story, single-family dwelling without a basement and with no exposures must provide for a minimum of 16 members (17 if an aerial device is used).

Occupancy Type: Garden-Style Apartment
Deployment: Minimum of 27 members or 28 if aerial device is used

The initial full alarm assignment to a structure fire in a typical 1200 ft² (111 m²) apartment within a three-story, garden-style apartment building must provide for a minimum of 27 members (28 if an aerial device is used).

Occupancy Type: Open-Air Strip Mall
Deployment: Minimum of 27 members or 28 if aerial device is used

The initial full alarm assignment to a structure fire in a typical open-air strip shopping center ranging from 13,000 ft² to 196,000 ft² (1203 m² to 18,209 m²) in size must provide for a minimum of 27 members (28 if an aerial device is used).

Occupancy Type: High-Rise
Deployment: Minimum of 42 members or 43 if building is equipped with fire pump

The initial full alarm assignment to a fire in a building with the highest floor greater than 75 ft (23 m) above the lowest level of fire department vehicle access must provide for a minimum of 42 members (43 if the building is equipped with a fire pump).

Critical tasks as defined by NFPA 1710 are those activities that must be conducted on time by responders at emergency incidents to control the situation and stop loss. Critical tasking for fire operations is the minimum number of personnel needed to perform the tasks needed to effectively control and mitigate a fire or other emergency. To be effective, critical tasking must assign enough personnel so that all identified functions can be performed simultaneously. However, it is important to note that initial response personnel may manage secondary support functions once they have completed their primary assignment. Thus, while an incident may end up requiring a greater commitment of resources or a specialized response, a properly executed critical tasking assignment will provide adequate resources to immediately begin bringing the incident under control.

The specific number of people required to perform all the critical tasks associated with an identified risk or incident type is referred to as an Effective Response Force (ERF). The goal is to deliver an ERF within a prescribed period.

The HFD has a response matrix for structure fires that includes:

- 1 Deputy Chief (1 staff).
- 3 engines (3 officers; 6 firefighters).
- 1 ladder (1 officer; 2 firefighters).
- 1 rescue (1 officer; 2 firefighters).

Mutual Aid and Call Personnel

Haverhill does not currently have automatic aid agreements with any of the surrounding municipalities. Automatic aid involves an agreement whereby fire, rescue and EMS units respond automatically into another jurisdiction based on closeness of resources. Mutual aid involves an agreement whereby adjacent or surrounding communities provide fire, rescue, and EMS resources to a community upon a specific request (not automatically). In an automatic aid scenario, resources from neighboring jurisdictions are built into run cards in the home jurisdiction for an automatic response; these response resources are intended to supplement and bolster the effective response force of the home jurisdiction.

The current HFD mutual aid response is based on a ten-alarm run CAD system that can escalate as the incident grows or additional help is needed. ***However, the reliability of mutual aid varies***

among the HFD mutual aid departments as there is a mix of career staffed (full time), paid-on-call staffed during the day, and all-volunteer fire departments in neighboring jurisdictions.

HFD relies on mutual aid companies primarily to backfill Haverhill fire stations in the event of a working incident involving multiple HFD units such as a structural fire or technical rescue event. It is difficult to determine the level of staffing that may come from some of the mutual aid companies. As stated above, these communities have varying staffing capabilities during different times of the day and evening. The level of certification of the firefighters at these companies is also unknown to the HFD, which can affect critical staffing assignments on the fireground.

In addition to the utilization of mutual aid companies during extended incidents where multiple or all HFD units are committed, HFD will tone out off-duty career/and HFD call personnel to respond back to the city and staff the village stations apparatus (Ayers and Rocks) for deployment in the city as needed. HFD does have some reliance on call backs and volunteer firefighters.

A decline in volunteer firefighter participation is being seen nationally; today, departments struggle with recruiting and retaining volunteers. A drop in participation is being seen in Haverhill as the HFD is down to nine volunteer firefighters between the two village stations. The rate of participation in the HFD call-personnel concept varies from incident to incident and has provided little staffing over the past few years. Currently only nine call firefighters are rostered between the two village stations.

Typically, automatic aid is reciprocal from community to community, and almost certainly between contiguous communities. Mutual aid is requested when needed and does not respond automatically. The departments that Haverhill receives mutual aid from are listed in the following table. The next table includes the staffing arrangements for each mutual aid partner. Groveland, North Andover, and Salem (NH) provide the greatest mutual aid assistance to Haverhill.

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TABLE 5-2: Ten-Alarm Run Cards: Mutual Aid Departments Assisting Haverhill and Staffing Status

Department	Staffing Status	Department	Staffing Status
Lawrence	Full Time	Newbury	Full Time
Methuen	Full Time	Merrimac	Paid on Call
Salem, NH	Full Time	Middleton	Full time
Groveland	Paid on Call	Newton, NH	Paid on Call
Merrimac	Paid on Call	Lowell	Full Time
North Andover	Full Time	Topsfield	Paid on call
Georgetown	Paid on Call	Rowley	Paid on Call-Daytime
West Newbury	Paid on Call	Salisbury	Full Time
Plaistow, NH	Paid on Call-Daytime	Ipswich	EMS Daytime
DFS Rehab	Support Services Only	Newburyport	Paid on Call
Boxford	Paid on Call	Amesbury	Paid on Call
Atkinson	Paid on Call	Seabrook, NH	Full Time
Amesbury	Full Time	North Reading	Full Time
Andover	Full Time	Hampton, NH	Full Time
Hampstead, NH	Paid on Call	Kingston, NH	Paid on Call

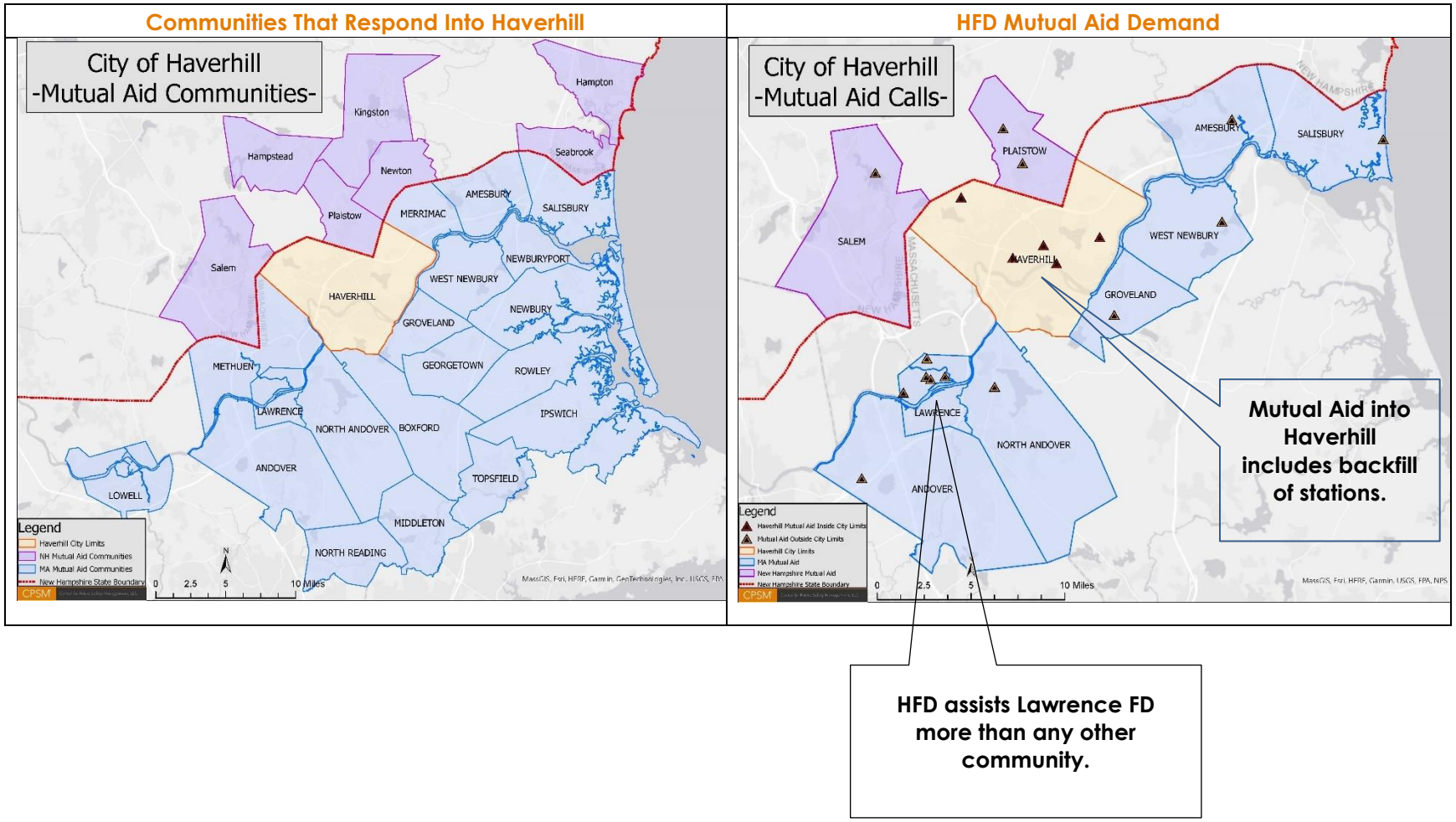
The next table illustrates the departments that HFD assists with mutual aid and on what alarm the HFD is requested.

TABLE 5-3: Communities to which HFD Provides Mutual Aid

Municipality	Alarm When Requested
Amesbury	4TH Alarm
Andover	4TH Alarm
Boxford	3RD Alarm
Byfield	6TH Alarm
Georgetown	3RD Alarm
Groveland	1ST Alarm (sent to backfill)
Lawrence	2ND Alarm
Merrimac	4TH Alarm
Methuen	4TH Alarm
Newbury	5TH Alarm
Newburyport	4TH Alarm
North Andover	2ND Alarm
Rowley	6TH Alarm
Salisbury	3RD Alarm
West Newbury	3RD Alarm

The next figure illustrates the communities that provide aid to Haverhill and those the HFD provides mutual aid to.

FIGURE 5-1: Mutual Aid Communities



Observations regarding mutual aid include:

- While HFD does receive mutual aid assistance, the companies are dispatched after the on-scene crews have determined a working fire or working incident situation. While NFPA 1710 does allow these mutual aid companies to be counted towards the overall effective response force it is clear that the travel time and availability of on-duty/in-station staff from most mutual aid communities may affect the critical tasking functions on the fireground.

  It is generally accepted in the fire service that the first five minutes of a firefight sets the stage for risk and outcomes. If we do it smart and correct, the risk to firefighters will be low and the outcome will be better. If we do it wrong, without caution or much thought, the outcome can be tragic.[30]

- HFD should continue to utilize mutual aid companies; the HFD should ensure agreements are up to date and should identify the staffing levels and response capabilities that each surrounding community provides. HFD should ensure that additional alarm fire departments are automatically requested by CAD to minimize response time into Haverhill. HFD should also explore training opportunities when available with several neighboring jurisdictions to improve collaboration of fire operations.

ERF and Critical Tasking Recommendation:

- CPSM recommends the HFD review all current mutual aid agreements. The review should include current assets, training, and staffing available to the city from mutual aid departments. The HFD should strengthen mutual aid agreements to include standard and acceptable training of crew members responding to Haverhill, and minimum staffing levels (minimum of three personnel per apparatus responding in). In order to minimize response time, CPSM further recommends the HFD Fire Alarm Division automatically request mutual aid companies for station backfills or on-scene assistance when multiple HFD units will be committed to an incident for projected extended periods. (Recommendation No. 18.)

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30. First 5 Minutes Determine Risk and Outcome, 2016. Gary Morris, Fire Chief, Director at Large IAFC, Safety, Health & Survival.

BUILDING THE EFFECTIVE RESPONSE FORCE

The following discussion and tables will outline how critical tasking and assembling an effective response force is first measured in NFPA 1710, and how the HFD is benchmarked against this standard for the building types existing in Haverhill. This discussion will cover single-family dwelling buildings, open-air strip mall buildings, apartment buildings, and high-rise buildings as outlined in the NFPA standard. As mentioned already in this report, the HFD relies on mutual aid to assemble an Effective Response Force.

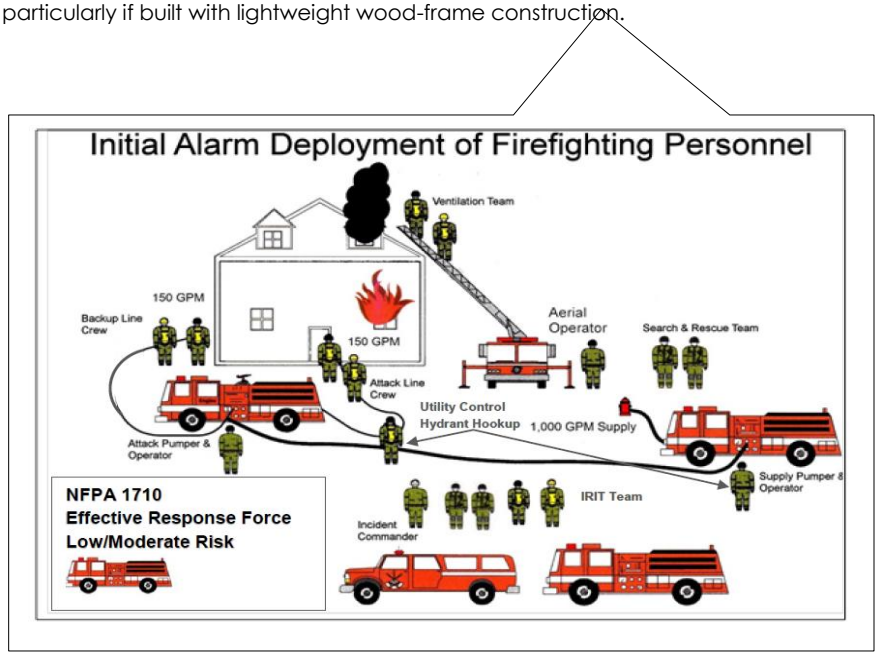
Single-Family Dwelling: NFPA 1710, 5.2.4.1

The initial full alarm assignment (ERF) to a structural fire in a typical 2,000 square-foot, two-story, single-family dwelling without a basement and with no exposures must provide for a minimum of 16 members (17 if an aerial device is used). The next table outlines the critical task matrix.

TABLE 5-4: Effective Response Force for Single-Family Dwelling Building

Critical Tasks	Personnel
Incident Command	1
Continuous Water Supply	1
Fire Attack via Two Handlines	4
Hydrant Hook Up - Forcible Entry - Utilities	2
Primary Search and Rescue	2
Ground Ladders and Ventilation	2
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew)	4
Total Effective Response Force	**16 (17 If aerial is used)**

Note: Single-family dwellings in Haverhill greater than 2,000 square feet with a basement should be considered a more moderate risk, particularly if built with lightweight wood-frame construction.



The next table outlines how the HFD assembles staffing and deployable resources as measured against NFPA 1710 benchmarking for an effective response force for a single-family dwelling fire.

TABLE 5-5: HFD Effective Response Force for Single-Family Dwelling Building

Apparatus	Personnel
HFD Deputy Chief	1
HFD Engine	3
HFD Engine	3
HFD Engine	3
HFD Ladder	3
HFD Rescue	3
Total HFD Effective Response Force	**14**

As a single responding agency, HFD does not meet the minimum benchmarks of NFPA 1710 for an effective response force for a single-family dwelling fire. With the addition of a fourth HFD pump or response of mutual aid, the HFD can achieve this criterion. NFPA 1710 permits fire departments to use established automatic/mutual aid agreements to comply with section 5.2 of this standard.

An auto/mutual aid rapid intervention crew (RIC) is not part of the initial attack due to time and distance involved in providing this aid and therefore can serve as a rapid intervention crew (RIC), not an immediate rapid intervention crew (IRIC) as established in the NFPA 1710 criteria.

HFD's fourth pumper if dispatched would be considered for an IRIC assignment and through this additional assignment the HFD would meet the ERF criteria.

Open-Air Strip Mall/Commercial Building, NFPA 5.4.2

The initial full alarm assignment (ERF) to a structural fire in a typical open-air strip center/commercial building ranging from 13,000 square feet to 196,000 square feet in size must provide for a minimum of 27 members (28 if an aerial device is used). The following table outlines the critical tasking matrix for these building types.

TABLE 5-6: Effective Response Force for Open-Air Strip Mall/Commercial Building

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	2
Fire Attack via Two Handlines	6
Hydrant Hook Up - Forcible Entry - Utilities	3
Primary Search and Rescue	4
Ground Ladders and Ventilation	4
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew)	4
Medical Care Team	2
Total Effective Response Force	**27 (28 If aerial is used)**

The next table outlines how the HFD assembles staffing and deployable resources as measured against NFPA 1710 benchmarking for an effective response force for an open-air strip mall and commercial building fires.

TABLE 5-7: HFD Effective Response Force for Open-Air Strip Mall/Commercial Building

Apparatus	Personnel
HFD Deputy Chief	1
HFD Engine	3
HFD Engine	3
HFD Engine	3
HFD Ladder	3
HFD Rescue	3
**HFD Engine	3
Lawrence Engine	3
Methuen Engine	3
Salem, NH Ladder	3
Total HFD ERF	**28**

As a single responding agency, HFD does not meet the minimum benchmarks of NFPA 1710 for an effective response force for an open-air strip mall/commercial building. With HFD's fourth engine and mutual aid, the HFD does meet this benchmark. NFPA 1710 permits fire departments to use established automatic aid and mutual aid agreements to comply with section 5.2 of this standard.

An auto/mutual aid rapid intervention crew (RIC) is not part of the initial attack due to time and distance involved in providing this aid and therefore can serve as a rapid intervention crew (RIC), not an immediate rapid intervention crew (IRIC) as established in the NFPA 1710 criteria.

HFD's fourth pump if dispatched would be considered for an IRIC assignment.

Apartment Building, NFPA 1710, 5.2.4.3

The initial full alarm assignment (ERF) to a structural fire in a typical 1,200 square-foot apartment within a three-story, garden-style apartment building must provide for a minimum effective response force (ERF) of 27 members (28 if an aerial device is used).

The next table outlines the critical tasking matrix for this type of building fire.

TABLE 5-8: Effective Response Force for Apartment Building

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	2
Fire Attack via Two Handlines	6
Hydrant Hook Up - Forcible Entry - Utilities	3
Primary Search and Rescue	4
Ground Ladders and Ventilation	4
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew	4
Medical Care Team	2
Total Effective Response Force	**27 (28 If aerial is used)**

The next table outlines how the HFD assembles staffing and deployable resources as measured against NFPA 1710 benchmarking for an effective response force for an apartment building or other multi-unit housing type building fire.

TABLE 5-9: HFD Effective Response Force for Apartment Building Fire

Apparatus	Personnel
HFD Deputy Chief	1
HFD Engine	3
HFD Engine	3
HFD Engine	3
HFD Ladder	3
HFD Rescue	3
**HFD Engine	3
Lawrence Engine	3
Methuen Engine	3
Salem, NH Ladder	3
Total HFD ERF	**28**

As a single responding agency, HFD does not meet the minimum benchmarks of NFPA 1710 for an Effective Response Force for an apartment building fire. With HFD's fourth engine and mutual aid, the HFD does meet this benchmark. NFPA 1710 permits fire departments to use established automatic aid and mutual aid agreements to comply with section 5.2 of this standard.

An auto/mutual aid rapid intervention crew (RIC) is not part of the initial attack due to time and distance involved in providing this aid and therefore can serve as a rapid intervention crew (RIC), not an immediate rapid intervention crew (IRIC) as established in the NFPA 1710 criteria.

HFD's fourth pumper if dispatched would be considered for an IRIC assignment.

High Rise, NFPA 5.2.4.4

The initial full alarm assignment to a fire in a building where the highest floor is greater than 75 feet (70 feet from grade level in Massachusetts) above the lowest level of fire department vehicle access must provide for a minimum of 42 members (43 if the building is equipped with a fire pump). The following table outlines the critical tasking matrix for this type of building fire.

TABLE 5-10: Effective Response Force for High-Rise Building

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	1/1 1 FF for continuous water. If fire pump exists an additional 1 FF will be required for a total of 2
Fire Attack via Two Handlines	4
One Handline above the Fire Floor	2
Establishment of IRIC (Initial Rapid Intervention Crew	4
Primary Search and Rescue Teams	4
Entry Level Officer with Aide near entry point of Fire Floor	2
Entry Level Officer with Aide near the entry point above the Fire Floor	2
Two Evacuation Teams	4
Elevation Operations	1
Safety Officer	1
FF Two floors below Fire to coordinate Staging	1
Rehabilitation Management	2
Officer and FFs to Manage vertical Ventilation	4
Lobby Operations	1
Transportation of Equipment below Fire Floor	2
Officer to Management Base Operations	1
Two ALS Medical Care Team	4
Total Effective Response Force	**42 (43) If building is Equipped with Pump**

The following table outlines how the HFD assembles staffing and deployable resources as measured against NFPA 1710 benchmarking for an effective response force for a high-rise building.

TABLE 5-11: HFD Effective Response Force for High-Rise Building

Apparatus	Personnel
HFD Deputy Chief	1
HFD Engine	3
HFD Engine	3
HFD Engine	3
HFD Ladder	3
HFD Rescue	3
**HFD Engine	3
Lawrence Engine	3
Methuen Engine	3
Salem, NH Ladder	3
Groveland Engine	2
Merrimac Engine	3
North Andover Engine	3
Georgetown Ladder	3
Plaistow Engine	3
W Newbury	3
Total HFD ERF	**45**

As a single responding agency, HFD does not meet the minimum benchmarks of NFPA 1710 for an effective response force for a high-rise building. With HFD's fourth engine and mutual aid, the HFD does meet this benchmark. NFPA 1710 permits fire departments to use established automatic aid and mutual aid agreements to comply with section 5.2 of this standard.

An auto/mutual aid rapid intervention crew (RIC) is not part of the initial attack due to time and distance involved in providing this aid and therefore can serve as a rapid intervention crew (RIC), not an immediate rapid intervention crew (IRIC) as established in the NFPA 1710 criteria.

HFD's fourth pumper if dispatched would be considered for an IRIC assignment.

Conclusion

HFD does not meet the *Effective Response Force* (ERF) standard for a single-family dwelling, open-air strip shopping center, apartment, and high-rise structure as a single response agency; however, it does meet the standard with the assistance of HFD's fourth engine and mutual aid companies.

It is important to note that five of the mutual aid companies listed in the open-air/commercial, apartment, and high-rise building responses are "Paid-on-Call" (POC) resources. These personnel will respond to their stations via an alert and initiate the response request. The POC status of these agencies likely creates a delay in their response to the scene in Haverhill. While NFPA 1710 does allow for mutual aid assistance to satisfy 5.2.1.3, it is clear that time and distance involved for these mutual aid companies to respond could impact fire/rescue operations in terms of initiating and completing critical tasking.

EMS Critical Staffing

EMS is a vital component of the comprehensive emergency services delivery system in any community. Together with the delivery of police and fire services, it forms the backbone of the community's overall public safety net.

In terms of overall incidents responded to by the emergency agencies in most communities, it could be argued that EMS incidents constitute the greatest number of "true" emergencies, where intervention by trained personnel makes a difference, sometimes literally between life and death. Heart attack and stroke victims require rapid intervention, care, and transport to a medical facility. The longer the time duration without care, the less likely the patient is to fully recover. Contemporary pre-hospital clinical care deploys many clinical treatments one will receive in the emergency department, truly matching the long-time EMS saying, "we bring the emergency room to you."

Critical tasks by specific call type in EMS-only agencies assisted by fire departments are not as well-defined as those in the fire discipline. Notwithstanding, *Critical Tasking* in EMS is typical of that in the fire service in that there are certain critical tasks that need to be completed either in succession or simultaneously. EMS on-scene service delivery is based primarily on a focused scene assessment, patient assessment, and then followed by the appropriate basic and advanced clinical care through established medical protocols. EMS critical tasking is typically developed (in fire-based EMS Standards of Cover documents) in accord with the U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services (CMS), as:

- Basic Life Support (BLS), *which is an emergency response by a ground transport unit (and crew) and the provision of medically necessary supplies and services occurs*.
- Advanced Life Support, Level 1 (ALS1), which is *the transportation by ground ambulance vehicle and the provision of medically necessary supplies and services including the provision of an ALS assessment or at least <u>one</u> ALS intervention*.
- Advanced Life Support, Level 2 (ALS2), which is *the transportation by ground ambulance vehicle and the provision of medically necessary supplies and services including:*
  - *(1) at least three separate administrations of one or more medications by intravenous push/bolus or by continuous infusion (excluding crystalloid fluids) or*
  - *(2) ground ambulance transport, medically necessary supplies and services, and the provision of at least one of the ALS2 procedures listed below:*
    - *a. Manual defibrillation/cardioversion.*
    - *b. Endotracheal intubation.*
    - *c. Central venous line.*
    - *d. Cardiac pacing.*
    - *e. Chest decompression.*
    - *f. Surgical airway.*
    - *g. Intraosseous line.*

The next set of tables provides recommended critical tasking for the HFD continuum of care. As indicated above, the critical tasking is based on the current CMS ground transport definition of ambulance services.

TABLE 5-12: BLS Critical Tasking

Critical Task	# Responders
Primary Patient Care Incident Command	1
Secondary Patient Care Vehicle Operations	1
Effective Response Force	**2**

Resource Deployment

1 Transport Ambulance

TABLE 5-13: ALS1Critical Tasking

Critical Task	# Responders
Incident Command	1
Primary Patient Care	1
Secondary Patient Care Vehicle Operations	2 1
Effective Response Force	**5**

Resource Deployment

1 Transport Ambulance
1 HFD Fire Crew

TABLE 5-14: ALS2 Critical Tasking

Critical Task	# Responders
Incident Command	1
Primary Patient Care	1
Secondary Patient Care	1
Tertiary Patient Care Provider	2
Vehicle Operations	1
Effective Response Force	**6**

Resource Deployment

1 Transport Ambulance
1 EMS Supervisor
1 HFD Fire Unit

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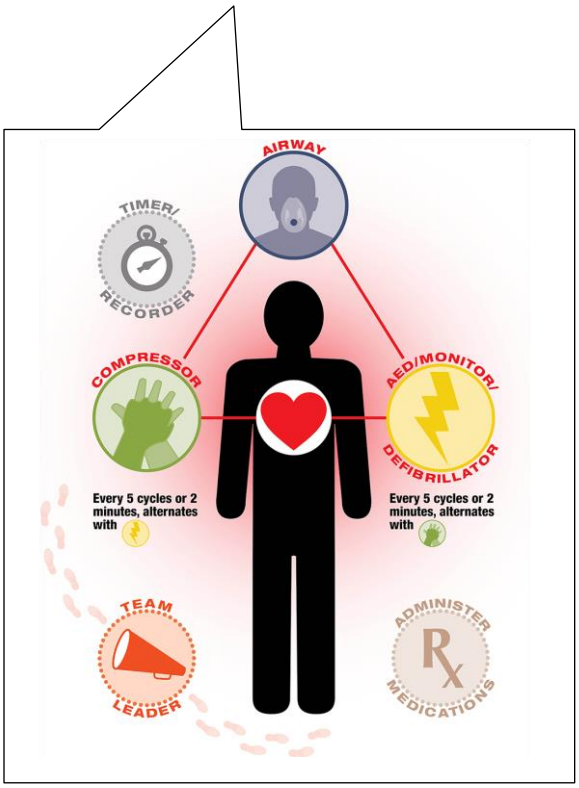
TABLE 5-15: Pulseless/Non-Breathing Critical Tasking

Critical Task	# Responders
Incident Command	1
Primary Patient Care	1
Secondary Patient Care	1
Tertiary Patient Care Provider	2
Vehicle Operations	1
Effective Response Force	**6**

Resource Deployment

1 Transport Ambulance
1 EMS Supervisor
1 HFD Fire Unit



Code of Federal Regulations, NFPA 1500, and Two-In/Two-Out

Another consideration, and one that links to critical tasking and assembling an Effective Response Force, is that of two-in/two-out regulations. Essentially, prior to starting any fire attack in an immediately dangerous to life and health (IDLH) environment [with no confirmed rescue in progress], the initial two-person entry team shall ensure that there are sufficient resources on-scene to establish a two-person initial rapid intervention team (IRIT) located outside of the building.

This critical tasking model has its genesis with the Occupational Safety and Health Administration, specifically 29 CFR 1910.134(g)(4). The Massachusetts State Administrative Procedure Act (State APA) incorporates the standards set forth under OSHA (29 CFR 1910.134(g)(4)). The Massachusetts State Plan applies to state and local government employers.

The federal rule (29 CFR 1910.134(g)(4)) applies to the HFD under the State of Massachusetts Administrative Procedure.[31]

The HFD responds to structural fires with three engines, one rescue, one ladder, and a Deputy Chief, which is equivalent to 16 on-duty fire staff. HFD also dispatches additional mutual aid companies to backfill their stations on working incidents and which can be sent to the incident scene if necessary. Under this response model, the HFD provides the minimum number of firefighters on the initial response in order to comply with CFR 1910.134(g)(4), regarding two-in/two-out rules and an initial rapid intervention team (IRIT). Specifics to 1910.134)g)(4) are:

CFR 1910.134(g)(4): Procedures for interior structural firefighting. In addition to the requirements as set forth under paragraph (g)(3), interior structural fires, the employer shall ensure that:

- 1910.134(g)(4)(i)
  - At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;
- 1910.134(g)(4)(ii)
  - At least two employees are located outside the IDLH atmosphere; and
- 1910.134(g)(4)(iii)
  - All employees engaged in interior structural firefighting use SCBAs.

Note 1 to paragraph (g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

Note 2 to paragraph (g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

According to the standard, one of the two individuals (standby members) shall be permitted to perform other duties outside of the hazard area, such as apparatus operator, incident commander, or technician or aid, provided constant communication is maintained between the standby member and the members of the crew. [32]

NFPA 1500, *Standard on Fire Department Occupational Health, Safety, and Wellness,* 2018 Edition, has similar language as CFR 1910.134(g)(4) to address the issue of two-in/two-out, stating *the initial stages of the incident where only one crew is operating in the hazardous area of a working structural fire, a minimum of four individuals shall be required consisting of two members working as a crew in the hazardous area and two standby members present outside this hazard area available for assistance or rescue at emergency operations where entry into the danger area is required.*[33]

NFPA 1500 also speaks to the utilization of the two-out personnel in the context of the health and safety of the firefighters working at the incident. *The assignment of any personnel including the incident commander, the safety officer, or operations of fire apparatus, shall not be permitted*

31. Massachusetts State Plan for State and Local Government Employers; Initial Approval Determination. A Rule by the Occupational Safety and Health Administration on 8/18/2022
32. NFPA 1500, 2018, 8.8.2.4
33. NFPA 1500, 2018, 8.8.2.

as standby personnel if by abandoning their critical task(s) to assist, or if necessary, perform rescue, this clearly jeopardizes the safety and health of any firefighter working at the incident.[34]

In order to meet CFR 1910.134(g)(4), and NFPA 1500, the HFD must utilize two personnel to commit to interior fire attack while two firefighters remain out of the hazardous area or immediately dangerous to life and health (IDLH) area to form the Initial Rapid Intervention Team (IRIT), while attack lines are charged, and a continuous water supply is established. This takes two companies on scene, which links to the NFPA 1710 standard for second arriving fire unit in 360 seconds at the 90th percentile.

However, NFPA 1500 allows for fewer than four personnel under specific circumstances. It states, *Initial attack operations shall be organized to ensure that if on arrival at the emergency scene, initial attack personnel find an imminent life-threatening situation where immediate action could prevent the loss of life or serious injury, such action shall be permitted with fewer than four personnel*.[35]

It is also important to note that the OSHA standard (and NFPA 1710) specifically references "interior firefighting." Firefighting activities that are performed from the exterior of the building are not regulated by this portion of the OSHA standard. However, in the end, the ability to assemble adequate personnel, along with appropriate apparatus, on the scene of a structure fire, is critical to operational success and firefighter safety.

Given the distance, availability, and resiliency of response, mutual aid fire Departments to HFD may at times serve as a rapid intervention crew (RIC) if deployed early in the event; however, several mutual aid companies cannot serve as an initial rapid intervention crew (IRIC) given their distance and time of response. Therefore, interior vs. exterior attacks that do not involve life safety have to be considered.

ERF and Critical Tasking Recommendations:

- Due to the community risks outlined in this report, specifically:
  - Building risks (to include multi-level residential) and topography of the city,
  - Workload of the High Street and Water Street stations, which also affects the resiliency of the fire department,
  - Long response times in certain areas of the city for first due and assisting companies on multicompany responses,

34. NFPA 1500, 2018, 8.8.2.5.
35. NFPA 1500, 2018 8.8.2.10.

- The inability to assemble an Effective Response Force for all scenarios as outlined in NFPA 1710,
- Lack of reliable mutual aid from surrounding communities, and
- Inconsistent availability of the current HFD call-firefighter force,

CPSM recommends for operational staffing planning:

In the near-term (next 24 months), the city considers assigning one additional firefighter per shift to the High Street Station engine company (4 total). ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).*** (Recommendation No. 19.)

- In the mid-term (3 to 5 years), the city considers assigning one additional firefighter to the Water Street engine company (4 total) (could be four firefighters transitioned from the Fire Alarm Division to operations if the implementation of civilian telecommunicators becomes reality. ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).*** (Recommendation No. 20.)
- In the long-term (5 to 8 years), the city considers implementing an additional ladder company at Bradford Station to be utilized in the Bradford district and as well in the core downtown area as a second ladder response where the majority of multilevel structures are located. (Recommendation No. 21.)
  - This could be a new company (12 personnel and utilize the HFD's second ladder truck). ***Estimated costs: $1,351,116 (salary + benefits+ cba+ overtime), depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***
  - This could be a new company but utilize the fourth person from High Street and Water Street engine companies and add an officer position (four new personnel). CPSM recommends this if the additional station is built at I-495 and Broadway and the rescue company is moved to this location to evenly spread out specialty ladder/service companies. ***Estimated costs: Firefighter to Lieutenant promotions (4): $63,584 (salary + benefits+ cba, no overtime), 4 Firefighter positions: $450,372 (salary + benefits+ cba+ overtime) depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022.***
  - This could be a quint apparatus (aerial ladder, fire pump, water tank, fire hose, tools and equipment). CPSM only recommends this alternative if the city upstaffs the unit to four personnel. CPSM recognizes that this recommendation in a smaller fire department such as the HFD limits the amount of true engine apparatus, since the quint is designed to be more of a ladder apparatus than engine apparatus. In the case of the HFD where mutual aid is not reliable or automatic with staffed and trained engine companies, this will limit the engine apparatus to three but does increase the ladder apparatus capabilities to two. CPSM also recognizes that in smaller departments such as the HFD these apparatus when deployed and arrive on scene of a fire incident must commit to either engine or ladder company tasks and not both due to the limited staffing. A staffing complement of five increases the opportunity to function as a ladder and engine simultaneously, particularly if there is a need to fly the aerial device. All of these conditions should be contemplated prior to making this commitment. ***Estimated costs: $450,372 (salary + benefits+ cba+ overtime for 4 firefighters to upstaff to four/shift) depending on implementation year*** ***(Salary ordinance 2020-Local #1011; City of Haverhill annual salary and benefits cost summary, March 2022).***

SPECIALIZED AND TECHNICAL RESPONSE CAPABILITIES

Specialized response capabilities include hazardous materials (haz-mat), high-angle rope rescue, trench collapse, building collapse, complicated heavy auto extrication, elevated rescue with an aerial platform, and confined space rescue. The HFD, although trained to certain specialized levels, does not have the response assets and capabilities to mitigate a complex specialized or technical rescue incident. This requires a properly trained and equipped response force in special operations. When needed, these assets are obtained through partnerships and agreements with surrounding mutual aid departments that have these resources in place.

There is nothing in NFPA 1710, ISO-FSRS, or other national benchmarks, that requires a fire department to deliver any or all of these special services. What is included in the NFPA standard is *an organizational statement that sets forth the criteria for the various types of special operations response and mitigation activities to which the fire department is required to respond.*

Large municipal fire departments build these special assets into their day-to-day staffing and deployable resources. In some cases, separate companies are tasked to manage the haz-mat and technical rescue service deliverables. Some jurisdictions assign these functions to ladder, squad, or rescue companies to include auto extrication. In some communities, such as Haverhill, the rescue and ladder companies carry a complement of tools and maintain the required training to handle most calls at the awareness and operations level. More involved complex incidents require the assistance of local and state resources where personnel respond to the scene or specific locations to make up specialized teams to mitigate the emergency.

Hazardous Materials Response and Mitigation

In Massachusetts, the Hazardous Materials Emergency Response Division, based in Stow, coordinates six regional haz-mat teams that are strategically located to be able to respond anywhere in the state in less than one hour. Haverhill's team responds from Leominster.

These specialized teams support local fire departments with technical information, expertise, and specialized equipment. The program was originally created to respond to industrial or transportation incidents like a tanker truck roll-over or a manufacturing process incident involving hazardous chemicals. A haz-mat incident can also be a broken mercury thermometer or unintentional mix of drain cleaners or pool chemicals. A team can be requested for suspicious powder calls, to assess possible clandestine laboratory situations, and to initiate the multi-agency Clandestine Laboratory Enforcement Team (CLET). ***HFD has two members on the Regional Haz-Mat Team.***

Typical haz-mat incidents are categorized by tier based on the required level of response. All teams work at the request of and under the command of the local incident commander. These include:

- JHIRT – Joint Hazard Incident Response Team – Contained Suspicious Powder Calls, Assessment of Clandestine Laboratories, and/or Activation of Clandestine Lab Enforcement Team (CLET).
- Tier 1 – Hazardous & Risk Assessment – Suspicious Substances, Open or Loose Suspicious Powders.
- Tier 2 – Short-term Operation – Limited Release.
- Tier 3 – Long-Term Operation – Full Team – Large Release.
- Tier 4 – Multidistrict Response – Multi-Operational Period.
- Tier 5 – WMD/Mass Contamination – Full System (6 teams) Response.[36]

Technical Rescue Response

Special Operations response personnel are assigned to four state groups: north, south, central, and west with specialized technical response. Equipment is housed in each district. These services are organized and directed by the Massachusetts Technical Rescue Coordinating Council and include assets and personnel in five state regions.

For a technical rescue response event in Haverhill, North Redding houses the Spec Ops Trailer carrying specialized equipment for technical rescue. Once deployed, this is a 20-minute response to Haverhill. The cities of Ipswich and Peabody are also partner cities that assist North Redding, and their personnel respond to the scene. The HFD participates in these responses as well with on-duty personnel.
There are four state response tiers for Special Operations (Spec Ops) that include:

- Tier One Response: includes a driver, equipment, and a maximum of three to four technicians.
- Tier Two Response: applies to a more complex operation and requires the remainder of the staff from the district and the technical support staff.
- Tier Three Response: all team members statewide are placed on alert that an incident has grown and is expected to exceed 14 hours and it is probable that other teams may be activated within 24 hours.
- Tier Four Response: entails multiple-team activation for long-term operations.

Support staff personnel are on call for response to include these specialties:

- Communications.
- Technology.
- Critical incident stress management and chaplain services.
- Public information.

Overall, should a complex technical rescue incident occur in Haverhill, the HFD responds and initiates immediate size-up, operational level response, and establishes the operational response

36. mass.gov/service-details.hazardous-materials-emergency-response-division-hazmat

structure for the specialized teams and equipment responding in to assist in the mitigation of the emergency.

Fire-Rescue Boat

The Merrimack River begins in central New Hampshire and winds 115 miles south to the Atlantic Ocean in Newburyport, Massachusetts. The Merrimack River watershed is the fourth largest watershed in New England, encompassing 5,010 square miles. It includes all or parts of approximately 200 communities, home to almost 2.6 million people.[37]

The Merrimac River runs through Haverhill and is important to tourism and economic development in the city. As recreation activities continue to increase along the river, the demand for rescue services as well as fire protection to marinas, vessels, and structures along the river create risks that require the proper assets to mitigate emergencies. There are a number of boat slips, marinas (where fueling occurs), and a yacht club along the river in Haverhill that present potential fire and rescue responses and emergencies that require mitigation from the shore and potentially from the river.

Marine vessel emergencies can occur while docked, fueling, trailering and launching, and while on the open water. These emergencies can include fire, fuel leaks, medical emergencies, mechanical malfunctions, taking on water, swimmers in distress, and the like. Fires that occur on boats or in marinas typically spread quickly due to the fuel load and materials some boats are made from, and those docked present with response challenges, hazardous conditions, and limited access. Fires on the open water have firefighting access issues unless a fire boat is available to respond. Both boat fire incident types and those involving trailering and launching involve life safety concerns that are of primary importance. Water rescue is a specialized rescue of victims from water or water-related environments where responders utilize various specialized equipment based on the type of situation (surface or underwater) and environmental conditions. The above risks are potentialities in Haverhill.

The ability to respond to fire, rescue, and water-related emergencies along the Merrimac with marine assets could prove beneficial. Fire related responses are not limited to just marine vessel and dock structures on the water, but also buildings located on the waterfront when a fire attack from the water side is advantageous when land-based firefighting may have limited access to the building.

Currently, there is an Inflatable Rescue Boat (IRB) at the High Street Station. The boat is on a trailer; it does not have direct access to the river and must be trailered to a dock located on the south side of the river. This boat is utilized for water rescue emergencies and does not have firefighting capabilities.

Recognizing the risks on the river, the HFD has requested a fire boat capable of firefighting capabilities as well as response on the river for water rescue and EMS responses. Such a fireboat could potentially be docked at the Water Street Station for quick access that would enable a timely response to fire and water-related emergencies. The Water Street Station would serve this purpose well as there are multiple crews assigned to this station for marine cross-training; no increase in staffing for this operation would be necessary.

37. Epa.gov/merrimackriver/about-merrimack

Specialized Response Recommendation:

- Over the midterm planning process (3 to 5 years), CPSM recommends CPSM recommends the city continue with its commitment to acquire a fire boat capable of firefighting and water rescue capabilities, due to the current and potential future marine vessel, docks and slips, marinas with fueling capabilities, and other related water risks along the Merrimac River. CPSM further recommends the vessel be located in the water behind the Water Street Station for immediate response (weather permitting), ***that no additional staffing be added*** to deploy this asset, and that the crews at the Water Street Station be cross-trained in water rescue and fire boat operations and firefighting. (Recommendation No. 22.)

BASILIERE BRIDGE CONSTRUCTION ANALYSIS

A major transportation project scheduled to begin in Haverhill in 2025 is the replacement of the Basiliere Bridge. The Basiliere Bridge, which connects downtown Haverhill with Bradford, was constructed in 1925 using deck-plate girder construction and open spandrel deck arch approach spans. The total length of the bridge is 804.2 ft. and it has a deck width of 45.9 ft.[38] This bridge is vital to emergency services response, particularly fire assets since they serve as the Effective Response Force that bolsters the single engine response from the Bradford station on multi-unit incident responses.

The closing of the bridge for repairs/replacement presents issues for the HFD in terms of response of heavy apparatus. As the Basiliere Bridge is used to get companies to the southern area of the city (Bradford) and to enable the Bradford Station to access the northern part of Haverhill for incident response, any delays from partial or total bridge closure will affect response times.

Given the current condition of the bridge and the weight of the HFD ladder truck that is positioned at Water Street Station, the ladder truck cannot utilize the Basiliere Bridge. The HFD must alter the response of the ladder truck to the Comeau Bridge to reach the Bradford section of the city.

While the ladder cannot currently pass over the bridge, engines from Water Street, High Street, and 16th Avenue can utilize the bridge for responses into Bradford, and the Bradford engine can respond over the bridge to the northern part of the city. The utilization of both the Basiliere and Comeau Bridges "is extremely important," according to HFD Fire Chief Robert O'Brien.

Given the potential construction and closure and/or partial closure of the Basiliere bridge, we performed an analysis on the effect on response times into Bradford in relation to response times of 240 seconds, 360 seconds, and 480 seconds. Although the state does not anticipate full closure of the bridge while construction is

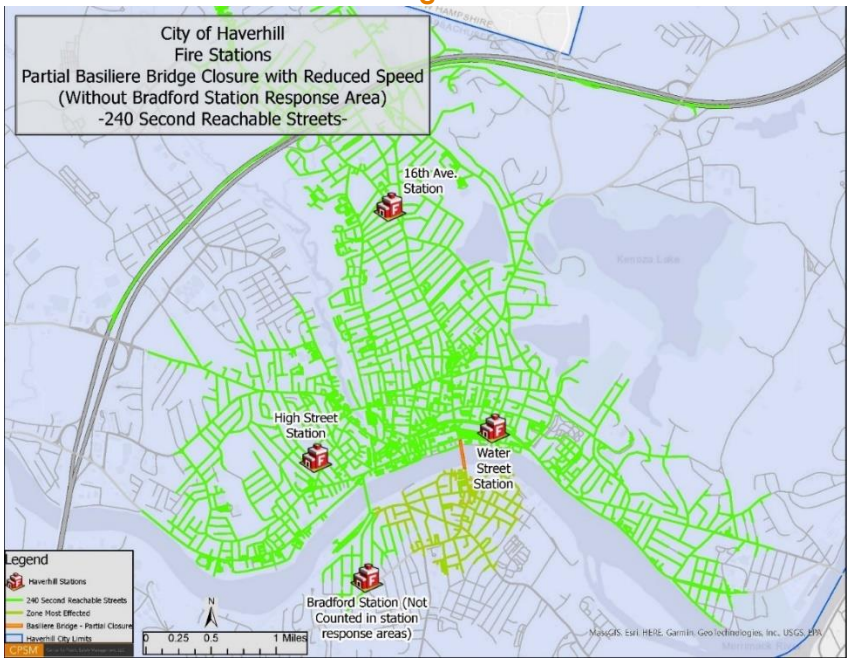
38. Bridgehunter.com

underway, CPSM feels it is prudent to analyze the effects on a closure as there may be brief times when full closure occurs.

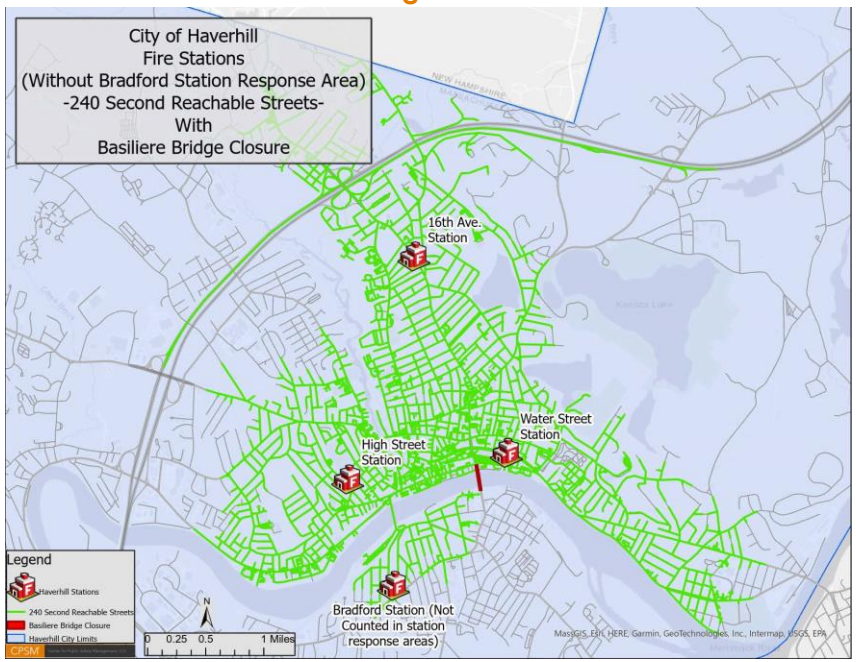
First, we look at partial and full closure of the bridge and ≤ 240 seconds response, which is the NFPA 1710 standard for the first arriving engine company to a fire suppression incident at the 90th percentile.

FIGURE 5-2: 240 Seconds Response Time with Basiliere Bridge Construction

Partial Bridge Closure



Full Bridge Closure



Observations on 240 Seconds Response

(Bradford Station not included in travel time bleed analysis)

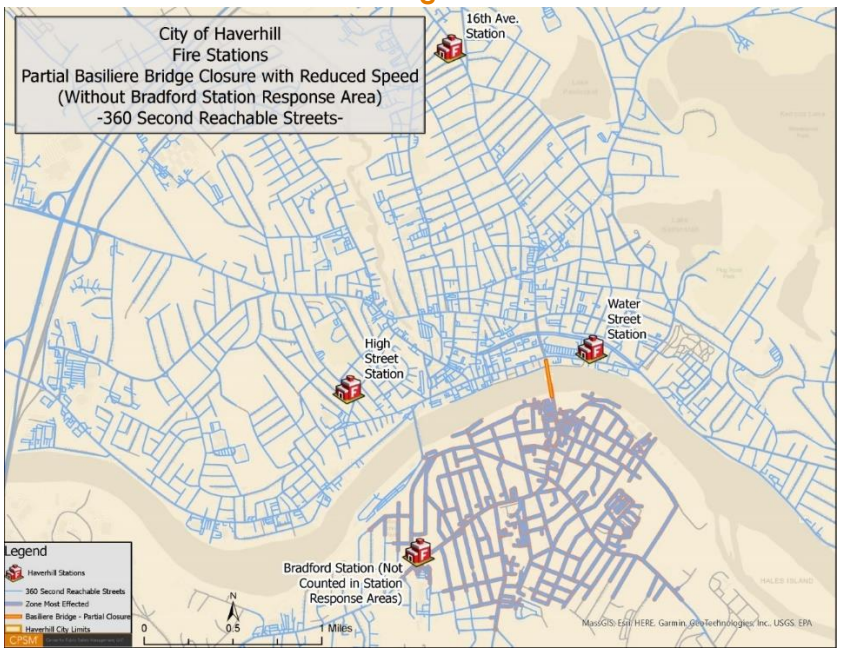
When comparing the streets reachable in 240 seconds (without the Bradford Station) with bridge closure, areas of the south central, southwest, northeast, and southeast show considerable areas of non-coverage regarding asset deployment when the Bradford Station may be assigned to another incident. Most of the access would appear to be coming from the High Street Station utilizing the Comeau bridge.

The partial closure of the bridge affects coverage to the northeast area of Bradford (primarily from Water Street) and causes limited coverage to the south central, southwest, and southeast areas of the city in terms of 240 seconds response time.

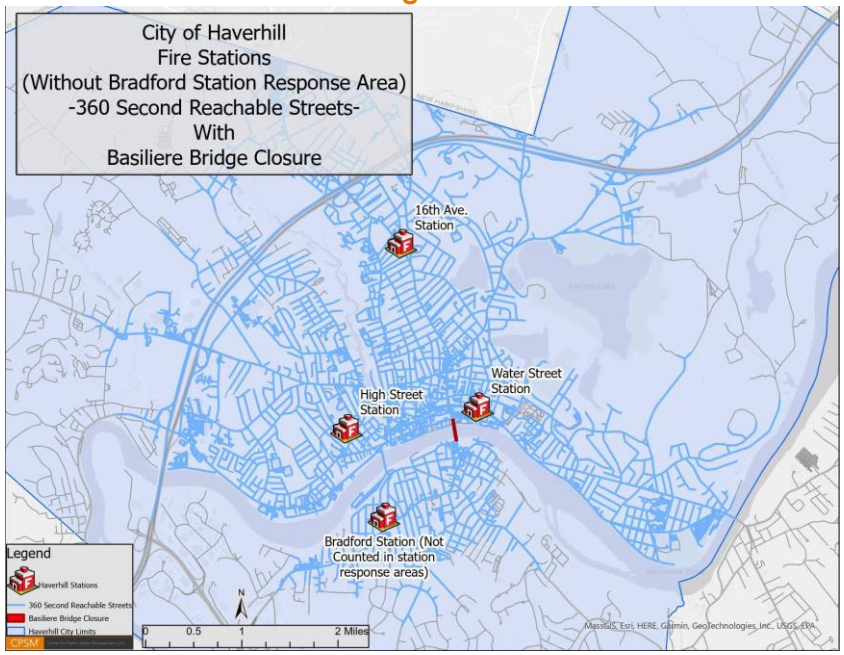
Next, we look at partial and full closure of the bridge and ≤ 360 second response, which is the NFPA 1710 standard for the arrival of the second company to a fire suppression incident at the 90th percentile.

FIGURE 5-3: 360 Second Response Time with Basiliere Bridge Construction

Partial Bridge Closure



Full Bridge Closure



Observations on 360 Seconds Response

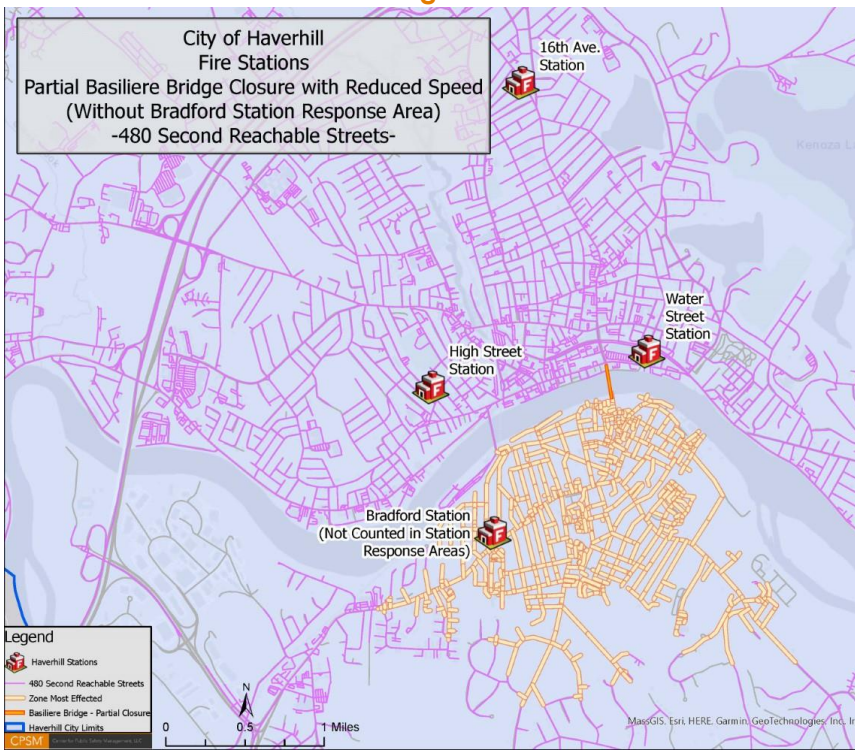
(Bradford Station not included in travel time bleed analysis)

When comparing the streets reachable in 360 seconds (without the Bradford Station) with bridge closure, areas of the south central, southwest, and southeast show considerable areas of non-coverage regarding asset deployment to the Bradford Station for multi-unit incident response. The partial closure of the bridge affects coverage to the northeast area of Bradford (primarily from Water Street) and causes limited coverage to the southwest and southeast areas of the city in terms of 360 seconds response time. Delays in the response of second due companies limits the ability to begin the formation of an Effective Response Force and hampers critical tasking completion.

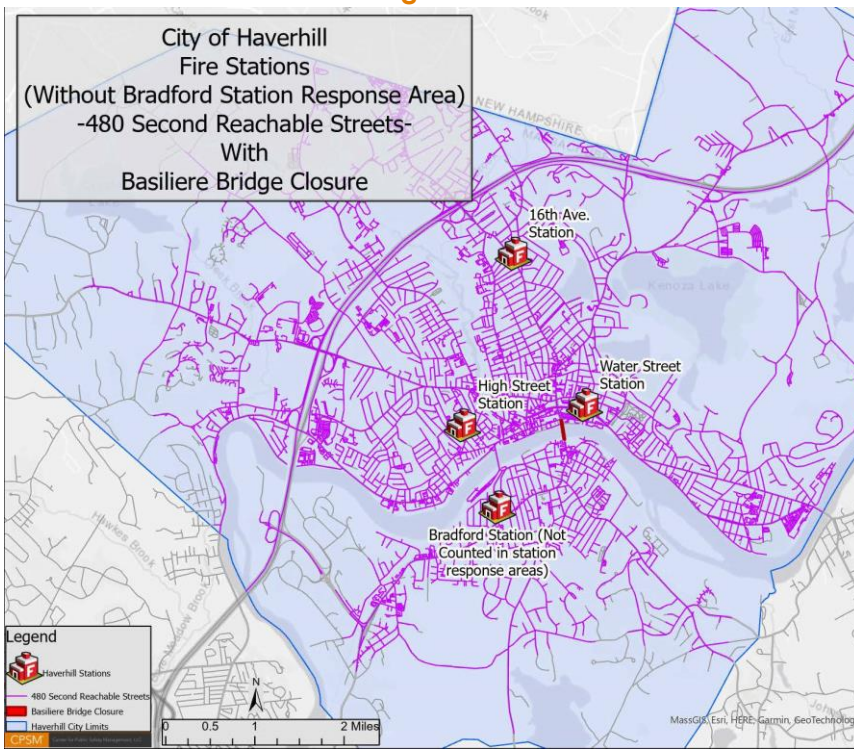
Finally, we analyzed the partial and full closure effects of the bridge for 480 seconds response times, which is the NFPA 1710 standard for the arrival of the initial first alarm assignment to a fire suppression incident at the 90th percentile.

FIGURE 5-4: 480 Seconds Response Time with Basiliere Bridge Construction

Partial Bridge Closure



Full Bridge Closure



Observations on 480 Second Response

(Bradford Station not included in travel time bleed analysis)

With partial and full bridge closure, and without Bradford Station the analysis indicates that the Water, High Street, and 16th Avenue Stations can access Bradford utilizing the Comeau Bridge access or Basiliere if partial closure is available.

While the data shows that the majority of the first alarm area is covered during a full bridge closure regarding 480 seconds, there are several variables that will affect this model. As previously discussed, the availability of units to quickly recover from an event and be available for service is known as resiliency. The model assumes that all stations are in-house and available for response (resiliency).

We know from the data that this is not always the case, and some resources will not be available as they will be assigned to previous calls for service. Engine 1 and Engine 3's resiliency is currently under 90 percent when in their respective stations. The resiliency of HFD units is a considerable factor in response during bridge construction.

Basiliere Bridge Project Recommendation:

A temporary solution should be considered at Bradford Station during construction of the new Basiliere Bridge.

- Ladder 4 is currently housed at Bradford station but is not in service due to staffing. One recommendation is for the city to consider staffing Ladder 4 temporarily during the construction of the bridge so critical resources can be available that would otherwise be impacted by the bridge construction and traffic flows.
- If Ladder 4 needs to be utilized to fill in for the ladder at Water Street, due to maintenance, then a reserve engine can be placed at the Bradford station in its place. Temporary staffing for the additional apparatus at Bradford during bridge construction can be accomplished with on-duty resources and/or overtime personnel. (Recommendation No. 23.)
- CPSM further recommends as a temporary solution to potential bridge construction closures, the City work with the private ambulance service to establish a temporary site in the Bradford area capable of housing one ambulance crew and parking one ambulance under cover and out of the environmental elements.

§ § §

SECTION 6. DATA ANALYSIS

This data analysis examines all calls for service between July 1, 2021, and June 30, 2022, as recorded in HFD's computer-aided dispatch (CAD) system and its National Fire Incident Reporting System (NFIRS).

This analysis is made up of four parts. The first part focuses on call types and dispatches. The second part explores the time spent and the workload of individual units. The third part presents an analysis of the busiest hours in the year studied. The fourth part provides a response time analysis.

Between July 1, 2021, and June 30, 2022, the HFD responded to 8,364 calls, of which 59 percent were EMS calls. The total combined workload (deployed time) for HFD units was 3,980.0 hours. In responding to calls that involved the fire department, the average dispatch time was 2.9 minutes, and the average response time was 8.4 minutes. The 90th percentile dispatch time was 4.6 minutes and the 90th percentile response time was 12.2 minutes.

METHODOLOGY

In this study, CPSM analyzes calls and runs. A call is an emergency service request or incident. A run is a dispatch of a unit (i.e., a unit responding to a call). Thus, a call may include multiple runs.

To begin, we linked the CAD and NFIRS data sets. Then, we classified the calls in a series of steps. We first used the NFIRS incident type to identify canceled calls, motor vehicle accidents (MVA), and fire category call types. Calls identified by NFIRS as EMS calls along with any calls that lacked a matching NFIRS record were categorized using the CAD system's incident descriptions. We describe the method of call categorization in Attachment IV. As HFD's primary service area is the City of Haverhill, all HFD responses beyond the city were identified as aid given.

We received records for a total of 8,450 calls that were responded to by HFD units during the study period. We removed all runs without en route and arrival timestamps. As a result, 82 calls were removed. Finally, four incidents to which administrative units were the sole responders are not included in the analysis sections of the report. However, the workload of administrative units is documented in Attachment I.

CALL TOTALS AND RUNS

Between July 1, 2021, and June 30, 2022, HFD responded to 8,364 calls. Of these, 163 were structure fire calls and 88 were outside fire calls within the City of Haverhill.

Calls by Type

Table 6-1 shows the number of calls that HFD responded to by call type, average calls per day, and the percentage of calls that fall into each call type category. Figures 6-1 and 6-2 show the percentage of calls that fall into each EMS (Figure 6-1) and fire (Figure 6-2) type category.

TABLE 6-1: Calls by Type

Call Type	Total Calls	Calls per Day	Call Percentage
General medical	4,350	11.9	52.0
MVA	544	1.5	6.5
EMS Total	**4,894**	**13.4**	**58.5**
False alarm	1,427	3.9	17.1
Good intent	377	1.0	4.5
Hazard	321	0.9	3.8
Outside fire	88	0.2	1.1
Public service	765	2.1	9.1
Structure fire	163	0.4	1.9
Technical rescue	40	0.1	0.5
Fire Total	**3,181**	**8.7**	**38.0**
Canceled	268	0.7	3.2
Mutual aid	21	0.1	0.3
Total	**8,364**	**22.9**	**100.0**

FIGURE 6-1: EMS Calls by Type

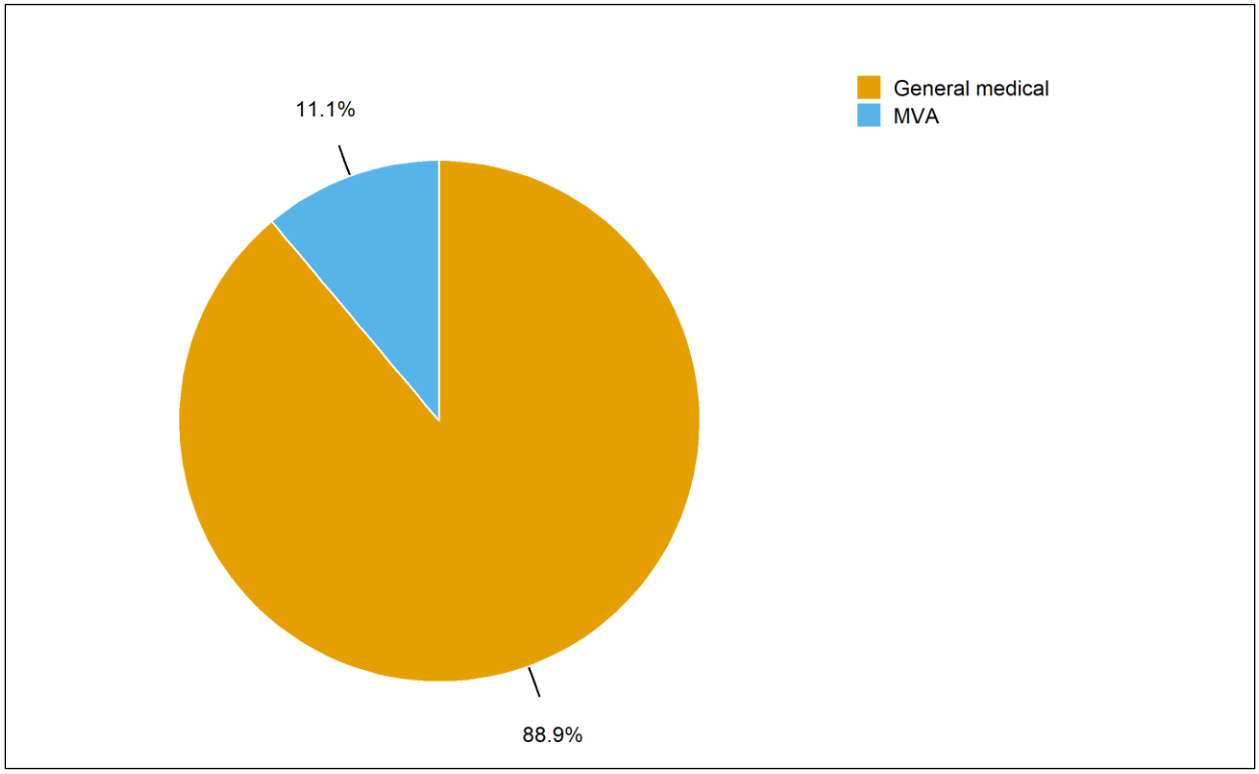
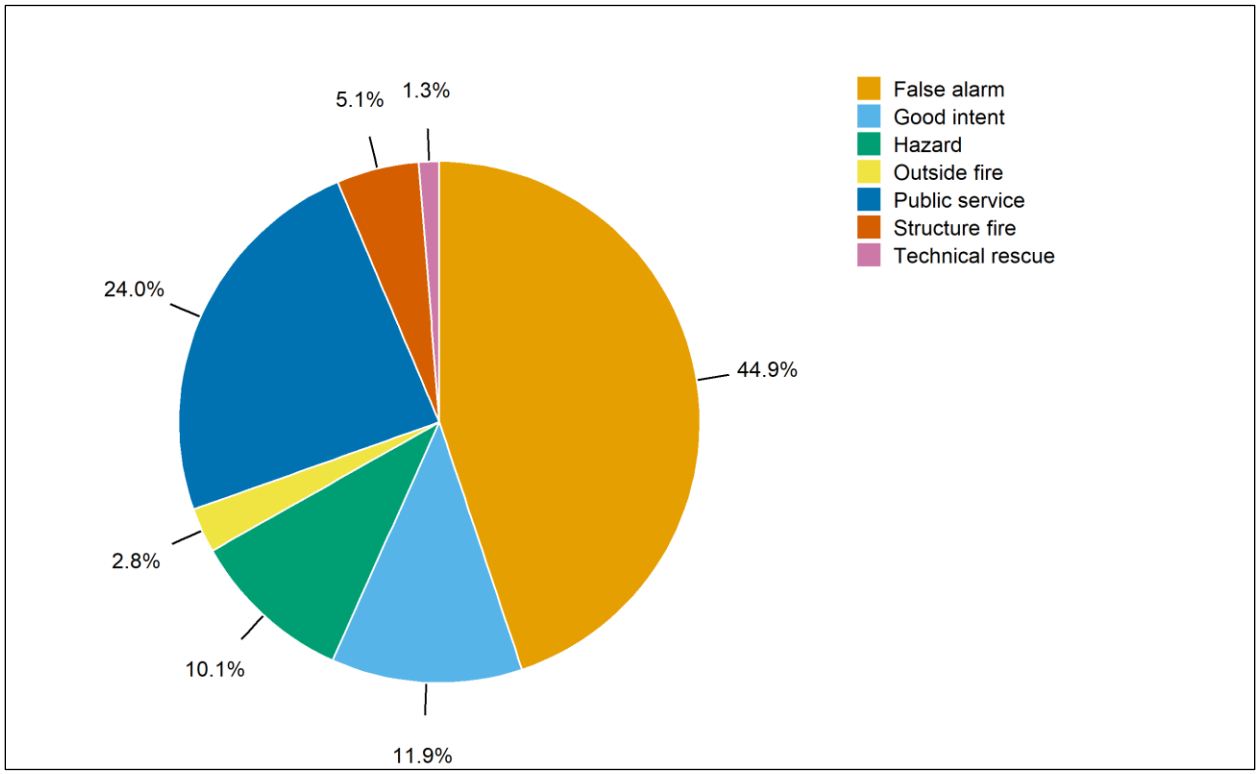


FIGURE 6-2: Fire Calls by Type



Observations:

- HFD responded to an average of 22.9 calls per day, which includes 0.7 canceled and 0.1 mutual aid calls.
- EMS calls for the year totaled 4,894 (59 percent of all calls), an average of 13.4 calls per day.
  - Motor vehicle accidents made up 11 percent of EMS calls, an average of 1.5 calls per day.
- Fire calls for the year totaled 3,181 (38 percent of all calls), an average of 8.7 per day.
  - False alarm calls were the largest category of fire calls at 45 percent of fire calls, an average of 3.9 calls per day.
  - Structure and outside fire calls combined made up 8 percent of fire calls, an average of 0.7 calls per day, or one call every 1.5 days.

Calls by Type and Duration

The following table shows the duration of calls by type using four duration categories: less than 30 minutes, 30 minutes to one hour, one to two hours, and two or more hours.

TABLE 6-2: Calls by Type and Duration

Call Type	Less than 30 Minutes	30 Minutes to One Hour	One to Two Hours	Two or More Hours	Total
General medical	4,027	288	29	6	4,350
MVA	341	175	24	4	544
EMS Total	**4,368**	**463**	**53**	**10**	**4,894**
False alarm	1,288	121	17	1	1,427
Good intent	347	28	1	1	377
Hazard	149	113	50	9	321
Outside fire	54	23	8	3	88
Public service	659	79	19	8	765
Structure fire	102	30	20	11	163
Technical rescue	27	10	3	0	40
Fire Total	**2,626**	**404**	**118**	**33**	**3,181**
Canceled	265	3	0	0	268
Mutual aid	0	1	11	9	21
Total	**7,259**	**871**	**182**	**52**	**8,364**

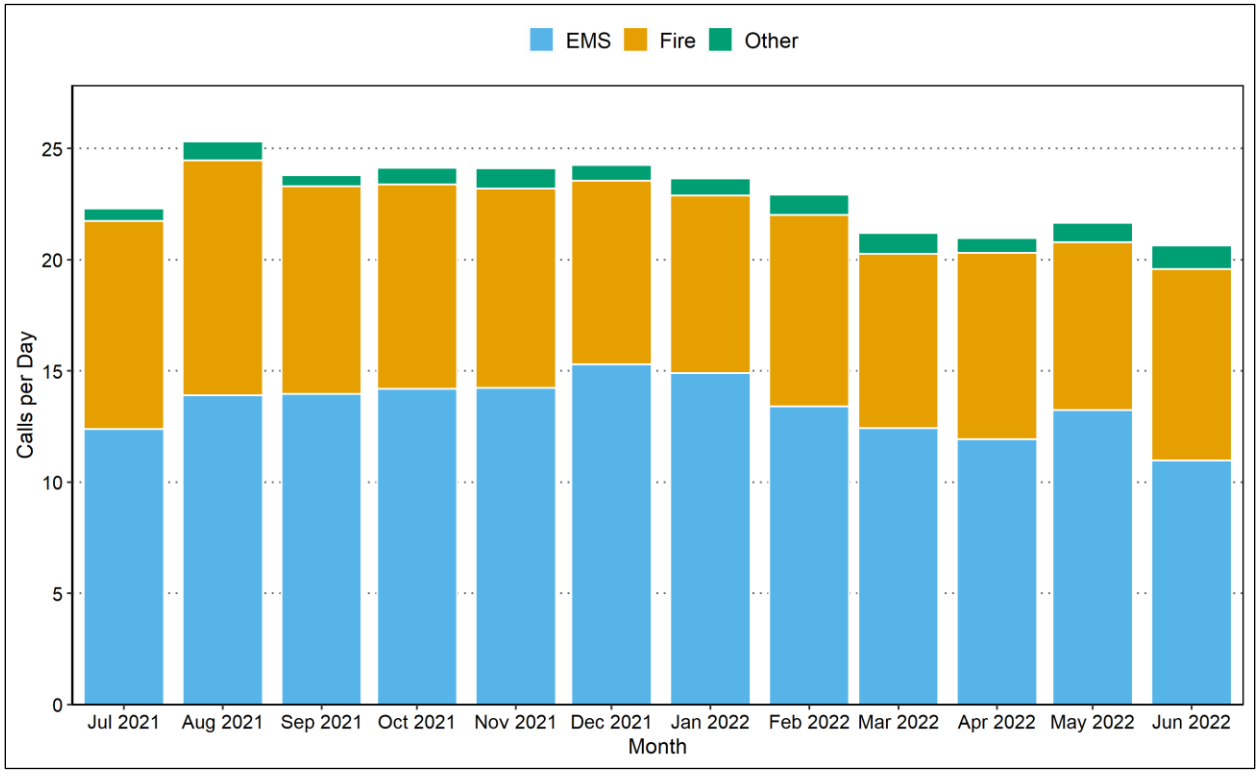
Observations:

- A total of 4,831 EMS calls (99 percent) lasted less than one hour, 53 EMS calls (1 percent) lasted one to two hours, and 10 EMS calls (less than 1 percent) lasted two or more hours.
  - On average, there were 0.2 EMS calls per day that lasted more than one hour.
  - A total of 516 motor vehicle accidents (95 percent) lasted less than one hour, 24 motor vehicle accidents (4 percent) lasted one to two hours, and 4 motor vehicle accidents (1 percent) lasted two or more hours.
- A total of 3,030 fire calls (95 percent) lasted less than one hour, 118 fire calls (4 percent) lasted one to two hours, and 33 fire calls (1 percent) lasted two or more hours.
  - On average, there were 0.4 fire calls per day that lasted more than one hour.
  - A total of 1,409 false alarm calls (99 percent) lasted less than one hour, 17 false alarm calls (1 percent) lasted one to two hours, and 1 false alarm call (less than 1 percent) lasted two or more hours.
  - A total of 77 outside fire calls (88 percent) lasted less than one hour, 8 outside fire calls (9 percent) lasted one to two hours, and 3 outside fire calls (3 percent) lasted two or more hours.
  - A total of 132 structure fire calls (81 percent) lasted less than one hour, 20 structure fire calls (12 percent) lasted one to two hours, and 11 structure fire calls (7 percent) lasted two or more hours.

Calls by Month and Hour of Day

Figure 6-3 shows the monthly variation in the average daily number of calls handled by HFD between July 1, 2021, and June 30, 2022. Similarly, Figure 6-4 illustrates the average number of calls received each hour of the day.

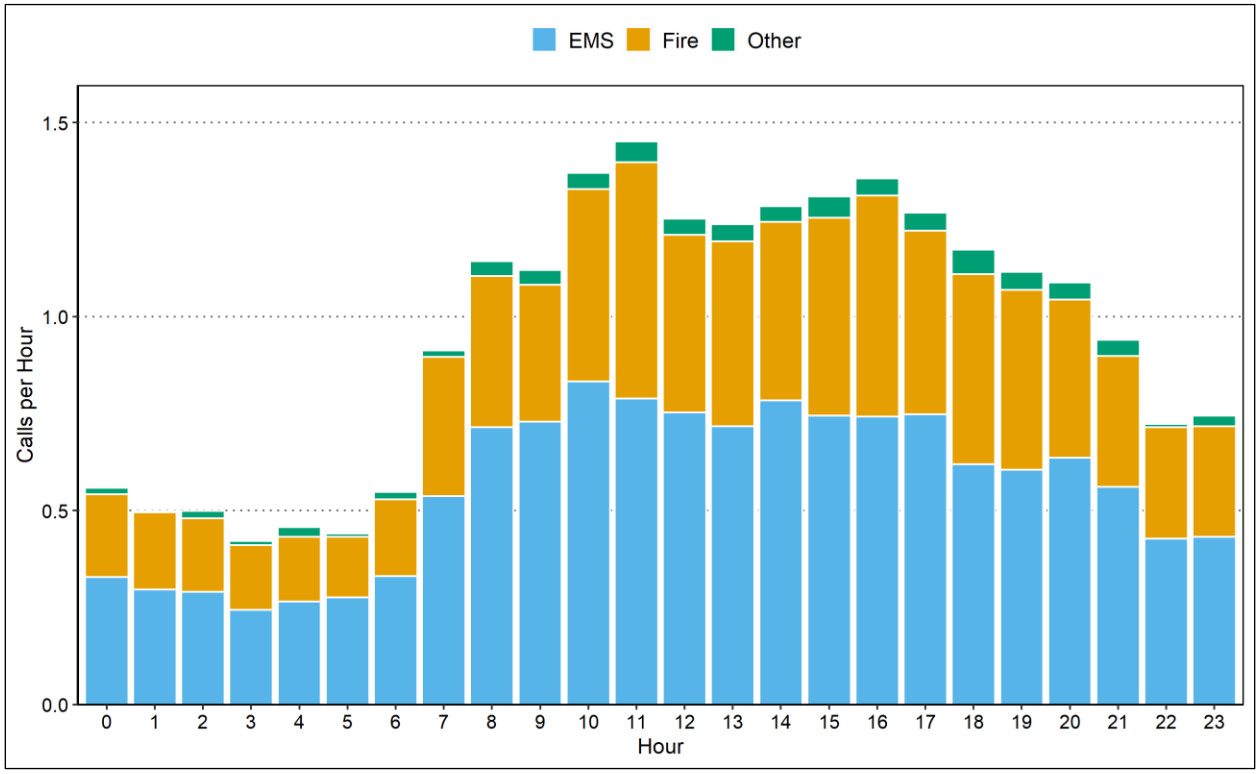
FIGURE 6-3: Calls per Day by Month



Observations:

- Average EMS calls per day ranged from 11.0 in June 2022 to 15.3 in December 2021.
- Average fire calls per day ranged from 7.5 in May 2022 to 10.5 in August 2021.
- Average other calls per day ranged from 0.5 in September 2021 to 1.1 in June 2022.
- Average calls per day overall ranged from 20.6 in June 2022 to 25.3 in August 2021.

FIGURE 6-4: Average Calls by Hour of Day



Observations:

- Average EMS calls per hour ranged from 0.2 between 3:00 a.m. and 4:00 a.m. to 0.8 between 10:00 a.m. and 11:00 a.m.
- Average fire calls per hour ranged from 0.2 between 5:00 a.m. and 6:00 a.m. to 0.6 between 11:00 a.m. and noon.
- Average other calls per hour stayed below 0.06 throughout the day.
- Average calls per hour overall ranged from 0.4 between 3:00 a.m. and 4:00 a.m. to 1.5 between 11:00 a.m. and noon.

Units Arriving at Calls

In this section, we limit ourselves to calls where a unit from HFD arrived. For this reason, there are fewer calls in Table 6-3 than in Table 6-2. Table 6-3, along with Figures 6-5 and 6-6, detail the number of calls with one, two, and three or more HFD units arriving at a call, broken down by call type.

TABLE 6-3: Calls by Call Type and Number of Arriving HFD Units

Call Type	Number of Units			Total Calls
	One	Two	Three or More	
General medical	4,291	25	16	4,332
MVA	394	72	75	541
EMS Total	**4,685**	**97**	**91**	**4,873**
False alarm	785	117	519	1,421
Good intent	307	14	54	375
Hazard	192	22	107	321
Outside fire	63	7	18	88
Public service	699	33	31	763
Structure fire	34	16	113	163
Technical rescue	30	4	6	40
Fire Total	**2,110**	**213**	**848**	**3,171**
Canceled	119	3	8	130
Mutual aid	20	1	0	21
Total	**6,934**	**314**	**947**	**8,195**
Total Percentage	**84.6**	**3.8**	**11.6**	**100**

FIGURE 6-5: Number of Arriving HFD Units for EMS Calls

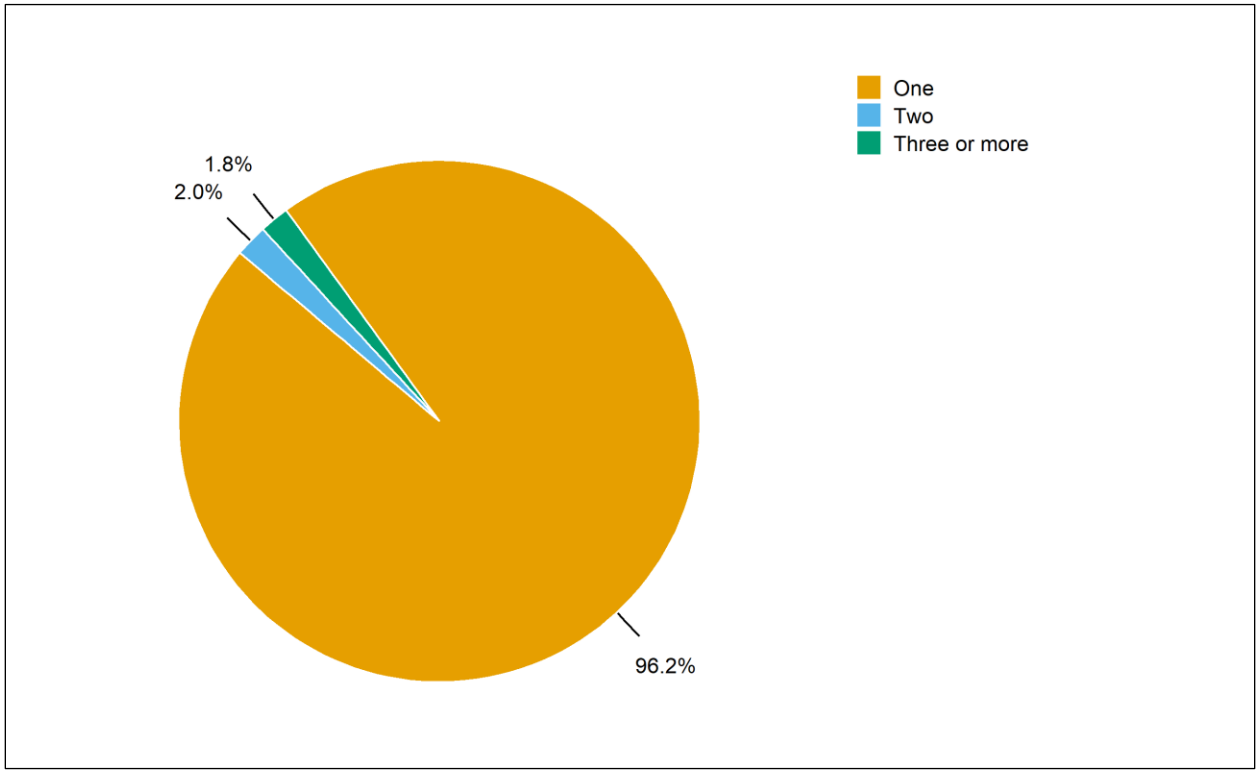
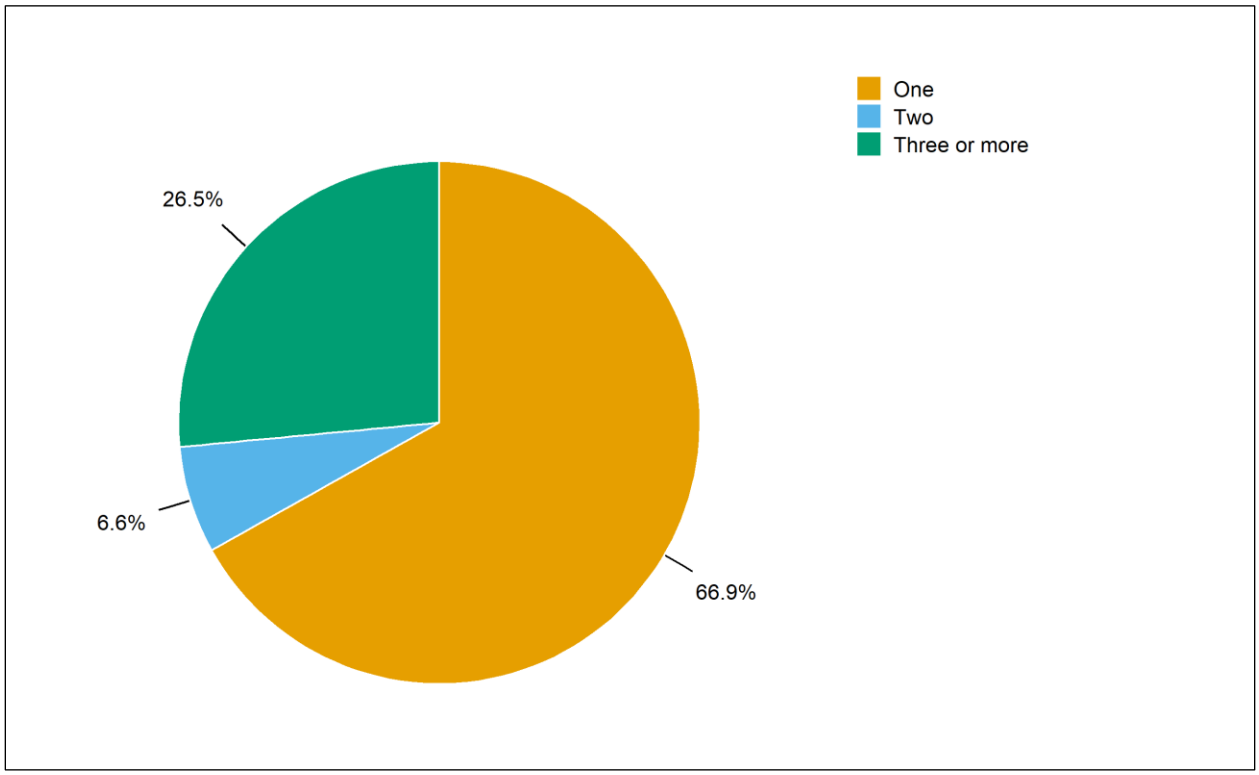


FIGURE 6-6: Number of Arriving HFD Units for Fire Calls



Observations:

Overall

- On average, 1.5 units arrived per call; for 85 percent of calls, only one unit arrived.
- Overall, three or more units arrived at 12 percent of calls.

EMS

- On average, 1.1 units arrived per EMS call.
- For EMS calls, one unit arrived 96 percent of the time, two units arrived 2 percent of the time, and three or more units arrived 2 percent of the time.

Fire

- On average, 2.1 units arrived per fire call.
- For fire calls, one unit arrived 67 percent of the time, two units arrived 7 percent of the time, and three or more units arrived 27 percent of the time.
- For outside fire calls, three or more units arrived 20 percent of the time.
- For structure fire calls, three or more units arrived 69 percent of the time.

WORKLOAD: RUNS AND TOTAL TIME SPENT

The workload of HFD's units is measured in two ways: runs and deployed time. The deployed time of a run is measured from the time a unit is dispatched through the time the unit is cleared. Because multiple units respond to some calls, there are more runs (13,317) than calls (8,364) and the average deployed time per run varies from the average duration per call.

Runs and Deployed Time

Deployed time, also referred to as deployed hours, is the total deployment time of HFD units deployed on all runs. Table 6-4 shows the total deployed time, both overall and broken down by type of run, for all non-administrative HFD units. Table 6-5 and Figure 6-7 present the average deployed minutes by hour of day.

TABLE 6-4: Annual Runs and Deployed Time by Run Type

Run Type	Minutes per Run	Annual Hours	Percent of Hours	Minutes per Day	Annual Runs	Runs per Day
General medical	17.9	1,328.3	33.4	218.4	4,461	12.2
MVA	24.0	348.8	8.8	57.3	871	2.4
EMS Total	**18.9**	**1,677.2**	**42.1**	**275.7**	**5,332**	**14.6**
False alarm	13.0	892.3	22.4	146.7	4,105	11.2
Good intent	13.3	155.2	3.9	25.5	701	1.9
Hazard	26.1	378.7	9.5	62.3	871	2.4
Outside fire	31.8	95.4	2.4	15.7	180	0.5
Public service	20.6	323.3	8.1	53.1	942	2.6
Structure fire	26.1	331.9	8.3	54.6	764	2.1
Technical rescue	30.7	30.2	0.8	5.0	59	0.2
Fire Total	**17.4**	**2,207.0**	**55.5**	**362.8**	**7,622**	**20.9**
Canceled	8.2	46.4	1.2	7.6	341	0.9
Mutual aid	134.5	49.3	1.2	8.1	22	0.1
Other Total	**15.8**	**95.8**	**2.4**	**15.7**	**363**	**1.0**
Total	**17.9**	**3,980.0**	**100.0**	**654.2**	**13,317**	**36.5**

Observations:

Overall

- The total deployed time for the year was 3,980.0 hours. The daily average was 10.9 hours for all units combined.
- There were 13,317 runs, including 341 runs dispatched for canceled calls and 22 runs dispatched for mutual aid calls. The daily average was 36.5 runs.

EMS

- EMS runs accounted for 42 percent of the total workload.
- The average deployed time for EMS runs was 18.9 minutes. The deployed time for all EMS runs averaged 4.6 hours per day.

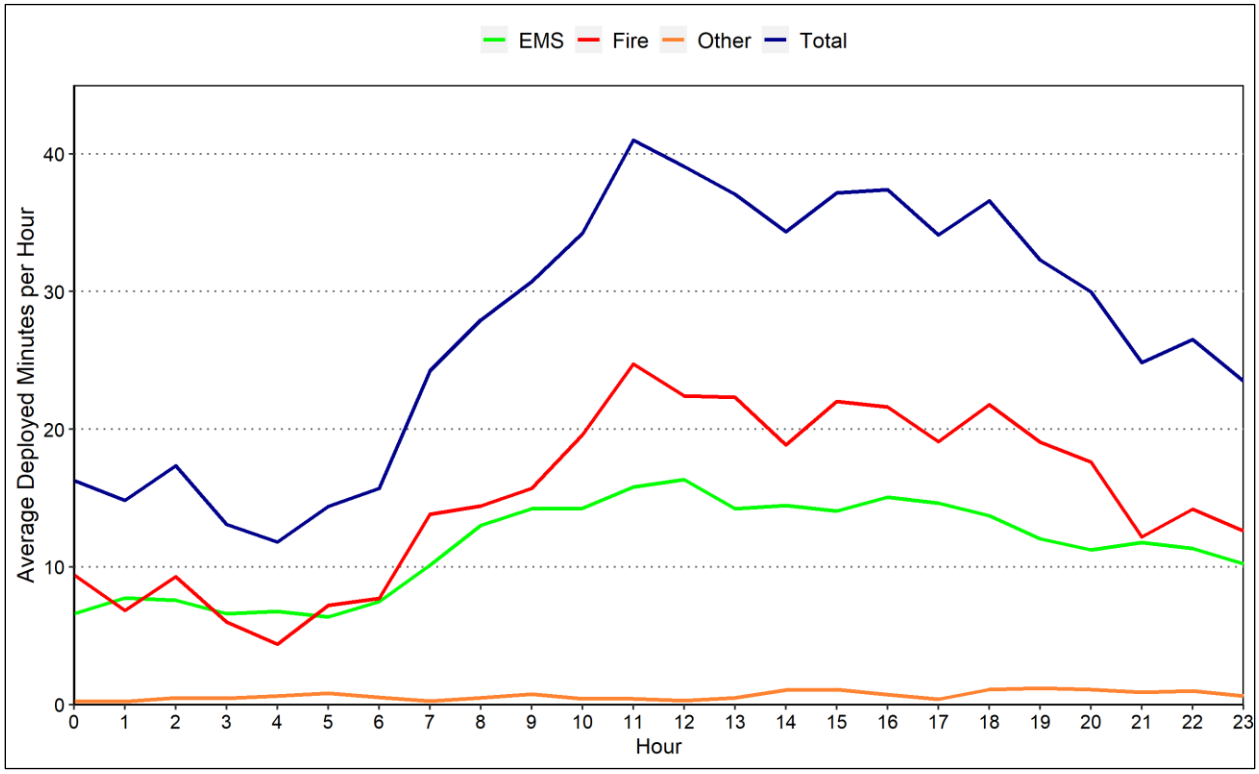
Fire

- Fire runs accounted for 55 percent of the total workload.
- The average deployed time for fire runs was 17.4 minutes. The deployed time for all fire runs averaged 6.0 hours per day.
- There were 944 runs for structure and outside fire calls combined, with a total workload of 427.3 hours. This accounted for 11 percent of the total workload.
- The average deployed time for outside fire runs was 31.8 minutes per run, and the average deployed time for structure fire runs was 26.1 minutes per run.

TABLE 6-5: Deployed Minutes by Hour of Day

Hour	EMS	Fire	Other	Total
0	6.6	9.4	0.3	16.3
1	7.8	6.8	0.2	14.8
2	7.6	9.3	0.5	17.4
3	6.6	6.0	0.5	13.1
4	6.8	4.4	0.6	11.8
5	6.4	7.2	0.8	14.4
6	7.5	7.7	0.5	15.7
7	10.1	13.8	0.3	24.2
8	13.0	14.4	0.5	27.9
9	14.2	15.7	0.8	30.7
10	14.2	19.6	0.4	34.3
11	15.8	24.7	0.4	41.0
12	16.4	22.4	0.3	39.1
13	14.2	22.3	0.5	37.1
14	14.5	18.8	1.1	34.4
15	14.0	22.0	1.1	37.2
16	15.1	21.6	0.7	37.4
17	14.6	19.1	0.4	34.1
18	13.7	21.8	1.1	36.6
19	12.0	19.1	1.2	32.3
20	11.2	17.6	1.1	30.0
21	11.8	12.2	0.9	24.9
22	11.3	14.2	1.0	26.5
23	10.2	12.6	0.6	23.5
Daily Avg.	**275.8**	**363.0**	**15.8**	**654.5**

FIGURE 6-7: Average Deployed Minutes by Hour of Day



Observations:

- Hourly deployed time was highest during the day from 11:00 a.m. to 7:00 p.m., averaging between 34 minutes and 41 minutes.
- The average deployed time peaked between 11:00 a.m. and noon, averaging 41 minutes.
- The average deployed time was lowest between 4:00 a.m. and 5:00 a.m., averaging 12 minutes.

Workload by Unit

Table 6-6 provides a summary of each HFD unit's workload for the period between July 1, 2021, and June 30, 2022. Tables 6-7 and 6-8 provide a more detailed view of the workload, showing each unit's runs broken out by run type (Table 6-7) and its daily average deployed time by run type (Table 6-8).

TABLE 6-6: Workload by Unit

Station	Unit	Unit Type	Minutes per Run	Total Hours	Total Percent	Minutes per Day	Total Runs	Runs per Day
16th Ave.	COMBO2	Brush	54.4	7.3	0.2	1.2	8	0.0
	E2	Engine	20.2	692.5	17.4	113.8	2,059	5.6
	Total		**20.3**	**699.7**	**17.6**	**115.0**	**2,067**	**5.7**
Bradford	COMBO4	Brush	98.7	6.6	0.2	1.1	4	0.0
	E4	Engine	18.8	460.9	11.6	75.8	1,467	4.0
	L4	Ladder	125.2	2.1	0.1	0.3	1	0.0
	Total		**19.1**	**469.5**	**11.8**	**77.2**	**1,472**	**4.0**
High St.	E1	Engine	18.1	941.6	23.7	154.8	3,118	8.5
	Total		**18.1**	**941.6**	**23.7**	**154.8**	**3,118**	**8.5**
Reserve	E5	Engine	13.1	0.9	0.0	0.1	4	0.0
	E6	Engine	34.5	2.3	0.1	0.4	4	0.0
	E8	Engine	31.1	1.0	0.0	0.2	2	0.0
	E9	Engine	44.8	6.0	0.2	1.0	8	0.0
	Total		**33.9**	**10.2**	**0.3**	**1.7**	**18**	**0.0**
Water St.	C2	Deputy chief	18.7	400.1	10.1	65.8	1,287	3.5
	E3	Engine	18.0	784.3	19.7	128.9	2,611	7.2
	L1	Ladder	14.4	253.8	6.4	41.7	1,058	2.9
	R1	Rescue	14.8	414.4	10.4	68.1	1,681	4.6
	T1	Tanker	76.5	6.4	0.2	1.0	5	0.0
	Total		**16.8**	**1,858.9**	**46.7**	**305.6**	**6,642**	**18.2**
Total			**17.9**	**3,980.0**	**100.0**	**654.2**	**13,317**	**36.5**

Note: Brush indicates a brush truck. Engines 8 and 9 are reserve engines staffed by volunteers. Car 2 is either the deputy chief or a shift supervisor.

TABLE 6-7: Total Runs by Run Type and Unit

Station	Unit	EMS	Technical Rescue	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
16th Ave.	COMBO2	0	0	0	0	0	4	3	1	0	0	8
	E2	1,074	3	446	115	96	27	136	92	65	5	2,059
	Total	**1,074**	**3**	**446**	**115**	**96**	**31**	**139**	**93**	**65**	**5**	**2,067**
Bradford	COMBO4	0	0	0	0	0	3	0	0	0	1	4
	E4	761	5	298	88	102	15	111	50	35	2	1,467
	L4	1	0	0	0	0	0	0	0	0	0	1
	Total	**762**	**5**	**298**	**88**	**102**	**18**	**111**	**50**	**35**	**3**	**1,472**
High St.	E1	1,735	4	582	151	142	37	280	105	73	9	3,118
	Total	**1,735**	**4**	**582**	**151**	**142**	**37**	**280**	**105**	**73**	**9**	**3,118**
Reserve	E5	3	0	1	0	0	0	0	0	0	0	4
	E6	1	0	1	0	0	0	1	1	0	0	4
	E8	2	0	0	0	0	0	0	0	0	0	2
	E9	1	0	1	0	0	1	2	3	0	0	8
	Total	**7**	**0**	**3**	**0**	**0**	**1**	**3**	**4**	**0**	**0**	**18**
Water St.	C2	176	8	690	69	122	22	44	130	26	0	1,287
	E3	1,058	2	769	126	183	43	220	126	82	2	2,611
	L1	17	2	656	65	110	11	55	130	9	3	1,058
	R1	502	35	661	87	115	14	90	126	51	0	1,681
	T1	1	0	0	0	1	3	0	0	0	0	5
	Total	**1,754**	**47**	**2,776**	**347**	**531**	**93**	**409**	**512**	**168**	**5**	**6,642**
Total		**5,332**	**59**	**4,105**	**701**	**871**	**180**	**942**	**764**	**341**	**22**	**13,317**

Note: See Table 6-6 for unit type.

TABLE 6-8: Deployed Minutes per Day by Run Type and Unit

Station	Unit Id	EMS	Technical Rescue	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
16th Ave.	COMBO2	0.0	0.0	0.0	0.0	0.0	0.7	0.3	0.3	0.0	0.0	1.2
	E2	63.1	0.1	18.1	4.6	7.1	2.9	8.7	6.2	1.4	1.7	113.8
	Total	**63.1**	**0.1**	**18.1**	**4.6**	**7.1**	**3.5**	**9.0**	**6.5**	**1.4**	**1.7**	**115.0**
Bradford	COMBO4	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.5	1.1
	E4	39.5	0.3	11.7	3.0	8.6	1.3	5.7	3.9	0.9	1.0	75.8
	L4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	Total	**39.9**	**0.3**	**11.7**	**3.0**	**8.6**	**1.9**	**5.7**	**3.9**	**0.9**	**1.5**	**77.2**
High St.	E1	85.1	0.4	22.9	5.3	9.8	2.3	15.6	8.7	1.6	3.0	154.8
	Total	**85.1**	**0.4**	**22.9**	**5.3**	**9.8**	**2.3**	**15.6**	**8.7**	**1.6**	**3.0**	**154.8**
Reserve	E5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	E6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.4
	E8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	E9	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.8	0.0	0.0	1.0
	Total	**0.4**	**0.0**	**0.1**	**0.0**	**0.0**	**0.1**	**0.1**	**1.0**	**0.0**	**0.0**	**1.7**
Water St.	C2	10.1	0.7	25.7	3.0	10.0	1.6	3.7	10.3	0.7	0.0	65.8
	E3	53.9	0.4	27.8	4.9	16.7	3.7	11.0	7.9	1.7	0.8	128.9
	L1	0.5	0.1	19.1	2.0	4.6	0.6	4.2	9.1	0.2	1.2	41.7
	R1	22.7	2.9	21.3	2.7	5.5	1.0	3.9	7.1	1.1	0.0	68.1
	T1	0.0	0.0	0.0	0.0	0.1	1.0	0.0	0.0	0.0	0.0	1.0
	Total	**87.3**	**4.1**	**93.9**	**12.6**	**36.8**	**7.9**	**22.8**	**34.5**	**3.8**	**2.0**	**305.6**
Total		**275.7**	**5.0**	**146.7**	**25.5**	**62.3**	**15.7**	**53.1**	**54.6**	**7.6**	**8.1**	**654.2**

Note: See Table 6-6 for unit type.

Observations:

- The Water Street station made the most runs (6,642, or an average of 18.2 runs per day) and had the highest total annual deployed time (1,858.9, or an average of 5.1 hours per day).
  - EMS calls accounted for 26 percent of runs and 29 percent of total deployed time.
  - Outside and structure fire calls accounted for 9 percent of runs and 14 percent of total deployed time.
- The High Street station made the second most runs (3,118, or an average of 8.5 runs per day) and had the second-highest total annual deployed time (941.6, or an average of 2.6 hours per day).
  - EMS calls accounted for 56 percent of runs and 55 percent of total deployed time.
  - Outside and structure fire calls accounted for 5 percent of runs and 7 percent of total deployed time.
- Among all engines, E1 made the most runs (3,118, or an average of 8.5 runs per day) and had the highest total annual deployed time (941.6, or an average of 2.6 hours per day)
  - EMS calls accounted for 56 percent of runs and 55 percent of total deployed time.
  - Outside and structure fire calls accounted for 5 percent of runs and 7 percent of total deployed time.

ANALYSIS OF BUSIEST HOURS

In this analysis, we included all 8,364 calls given in Table 6-2. There is significant variability in the number of calls from hour to hour. One special concern relates to the resources available for hours with the heaviest workload. We tabulated the data for each of the 8,760 hours between July 1, 2021, and June 30, 2022. Table 6-9 shows the number of hours in which there were zero to six and more calls during the hour. Table 6-10 shows the ten one-hour intervals which had the most calls during the studied period. Table 6-11 examines the number of times a call overlapped with another call in each station area.

TABLE 6-9: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	3,644	41.6
1	2,919	33.3
2	1,453	16.6
3	524	6.0
4	155	1.8
5	48	0.5
6+	17	0.2
Total	**8,760**	**100.0**

TABLE 6-10: Top Ten Hours with the Most Calls Received

Hour	Number of Calls	Number of Runs	Total Deployed Hours
11/12/2021, 3:00 p.m. to 4:00 p.m.	8	16	9.5
9/1/2021, 10:00 a.m. to 11:00 a.m.	8	8	1.5
10/15/2021, 3:00 p.m. to 4:00 p.m.	7	8	3.5
1/7/2022, 8:00 a.m. to 9:00 a.m.	6	16	3.8
1/20/2022, 3:00 p.m. to 4:00 p.m.	6	15	3.7
9/20/2021, 5:00 p.m. to 6:00 p.m.	6	14	3.0
9/1/2021, 11:00 a.m. to noon	6	14	1.9
11/9/2021, 9:00 a.m. to 10:00 a.m.	6	12	3.5
9/28/2021, 4:00 p.m. to 5:00 p.m.	6	9	2.8
8/6/2021, 11:00 a.m. to noon	6	8	1.4

Note: Total deployed hours are a measure of the total time spent responding to calls received in the hour. The deployed time from these calls may extend into the next hour or hours.

TABLE 6-11: Frequency of Overlapping Calls

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
16th Ave.	No overlapped call	1,702	93.0	605.2
	Overlapped with one call	124	6.8	22.4
	Overlapped with two calls	4	0.2	0.4
Bradford	No overlapped call	1,267	95.5	409.4
	Overlapped with one call	60	4.5	11.5
High St.	No overlapped call	2,812	89.3	903.9
	Overlapped with one call	317	10.1	49.8
	Overlapped with two calls	20	0.6	1.8
Water St.	No overlapped call	1,825	93.2	588
	Overlapped with one call	129	6.6	19.8
	Overlapped with two calls	3	0.2	0.4
	Overlapped with three calls	1	0.1	0.1

Table 6-12 examines each HFD station's availability to respond to calls within its first due area. At the same time, it focuses on calls where at least one unit eventually arrived and ignores calls where no non-administrative unit arrived. While there were 8,364 calls within HFD jurisdiction (See Table 6-3), there were 167 calls without an arriving unit and 100 calls without first-due area information.

TABLE 6-12: Station Availability to Respond to Calls

Station	Calls in Area	First Due Responded	First Due Arrived	First Due First	Percent Responded	Percent Arrived	Percent First
16th Ave.	1,786	1,601	1,588	1,476	89.6	88.9	82.6
Bradford	1,301	1,220	1,206	1,132	93.8	92.7	87.0
High St.	3,098	2,709	2,683	2,514	87.4	86.6	81.1
Water St.	1,913	1,817	1,813	1,791	95.0	94.8	93.6
Total	**8,098**	**7,347**	**7,290**	**6,913**	**90.7**	**90.0**	**85.4**

Note: For each station, we count the number of calls occurring within its first due area. Then, we count the number of calls to where at least one unit arrived. Next, we focus on units from HFD's first due station to see if any of its units responded, arrived, or arrived first.

Observations:

- During 17 hours (0.2 percent of all hours), six or more calls occurred; in other words, the department responded to six or more calls in an hour roughly once every 21 days.
  - The highest number of calls to occur in an hour was 8, which happened 2 times.
- One hour with 8 calls was 10:00 a.m. to 11:00 a.m. on September 1, 2021.
  - The hour's 8 calls involved 8 individual dispatches resulting in 1.5 hours of deployed time. These 8 calls included six general medical calls and two motor vehicle accident calls.

RESPONSE TIME

In this part of the analysis, we present response time statistics for different call types. We separate response time into its identifiable components. Dispatch time is the difference between the time a call is received and the time a unit is dispatched. Dispatch time includes call processing time, which is the time required to determine the nature of the emergency and the types of resources to dispatch. Turnout time is the difference between dispatch time and the time a unit is en route to a call's location. Travel time is the difference between the time en route and arrival on scene. Response time is the total time elapsed between receiving a call to arriving on scene.

In this analysis, we included all calls within the City of Haverhill to which at least one non-administrative unit arrived. In addition, calls with a total response time exceeding 30 minutes were excluded. Finally, we focused on units that had complete time stamps, that is, units with all components recorded, so that we could calculate each segment of response time.

Based on the methodology above, of the 8,364 calls in the study period, we excluded 180 calls without valid arrival times, 21 aid-given calls, 130 canceled calls, 20 calls with a total response time exceeding 30 minutes, and 1,185 calls where one or more segments of the first arriving unit's response time could not be calculated due to missing or faulty data. As a result, in this section, a total of 6,828 calls are included in the analysis.

Response Time by Type of Call

Table 6-13 breaks down the average and 90th percentile dispatch, turnout, travel, and total response times by call type. A 90th percentile means that 90 percent of calls had response times at or below that number. For example, Table 6-13 shows an overall 90th percentile response time of 12.2 minutes, which means that 90 percent of the time a call had a response time of no more than 12.2 minutes. Figures 6-8 and 6-9 illustrate the same information. Table 6-14 compares the average and 90th percentile response times to calls that occurred in Haverhill, broken out by grand call type (i.e., EMS and fire).

TABLE 6-13: Response Time of First Arriving Unit, by Call Type

Call Type	Average Response Time, Min.				90th Percentile Response Time, Min.				Number of Calls
	Dispatch	Turnout	Travel	Total	Dispatch	Turnout	Travel	Total	
General medical	3.1	2.3	3.1	8.5	4.8	3.7	5.8	12.2	3,923
MVA	2.6	2.2	3.3	8.2	4.3	3.4	6.6	12.2	442
EMS Total	**3.1**	**2.3**	**3.1**	**8.5**	**4.7**	**3.6**	**5.9**	**12.2**	**4,365**
False alarm	2.2	2.6	2.9	7.7	3.9	3.9	5.8	11.3	1,043
Good intent	2.8	2.6	3.4	8.8	4.7	4.1	6.5	13.0	303
Hazard	2.6	2.6	3.5	8.7	3.9	4.4	7.0	12.9	271
Outside fire	2.7	2.5	4.2	9.3	4.3	5.0	11.7	15.2	57
Public service	3.1	2.5	3.4	9.0	4.5	4.2	7.1	13.4	635
Structure fire	2.4	2.3	2.5	7.2	3.8	3.6	4.5	9.8	121
Technical rescue	2.5	2.1	3.9	8.4	4.3	3.3	6.3	12.8	33
Fire Total	**2.6**	**2.5**	**3.2**	**8.3**	**4.2**	**4.0**	**6.2**	**12.4**	**2,463**
Total	**2.9**	**2.4**	**3.1**	**8.4**	**4.6**	**3.8**	**6.0**	**12.2**	**6,828**

FIGURE 6-8: Average Response Time of First Arriving Unit, by EMS Call Type

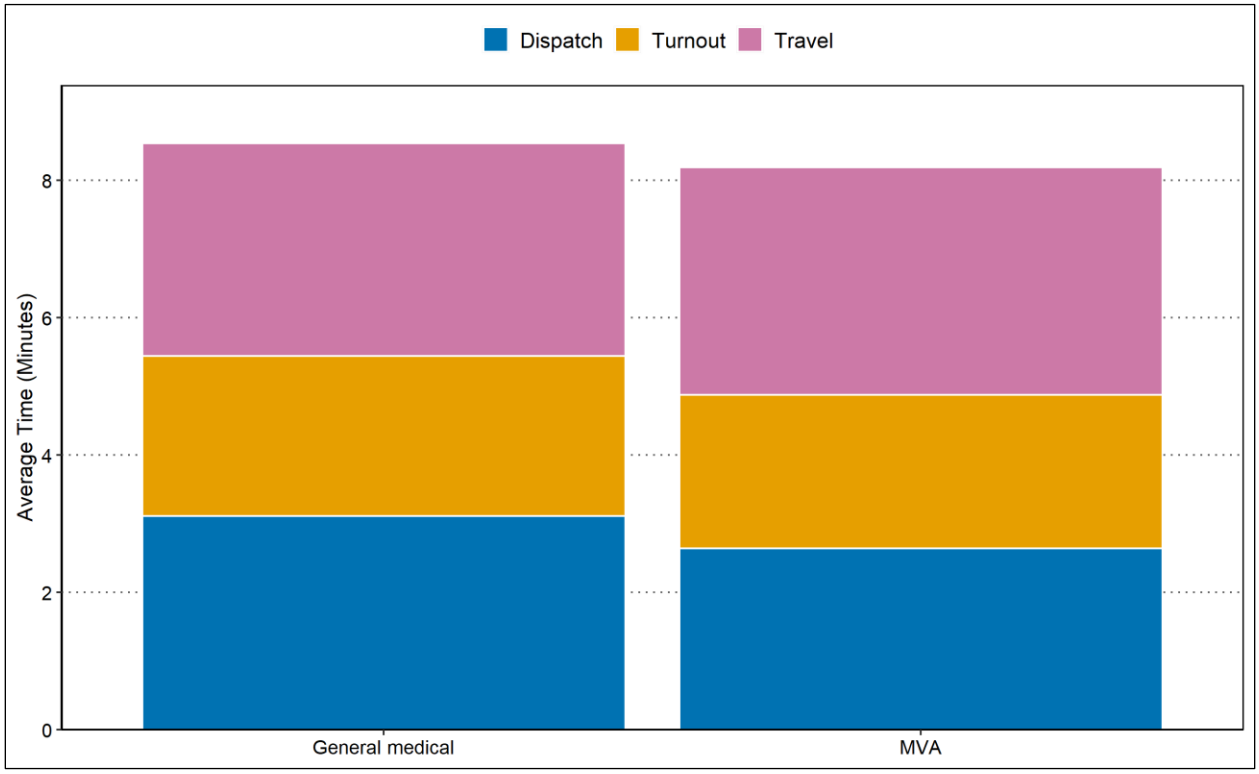
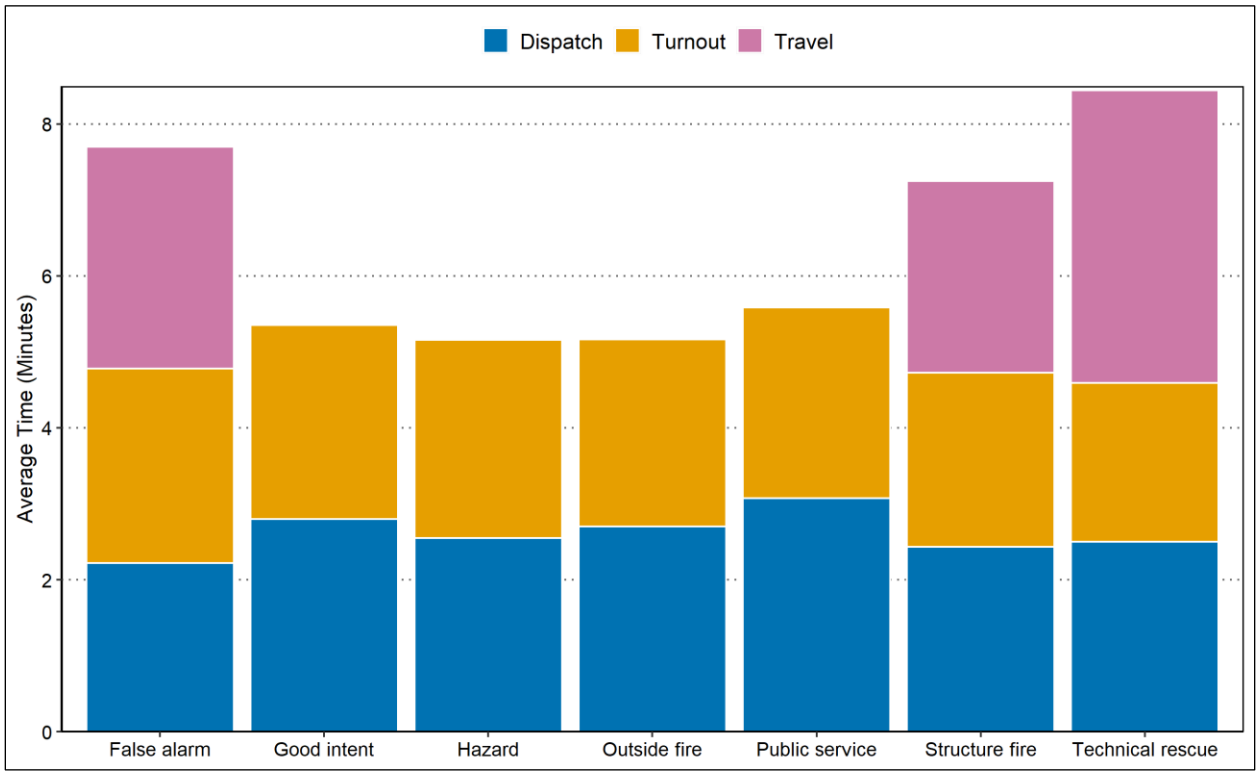


FIGURE 6-9: Average Response Time of First Arriving Unit, by Fire Call Type



Observations:

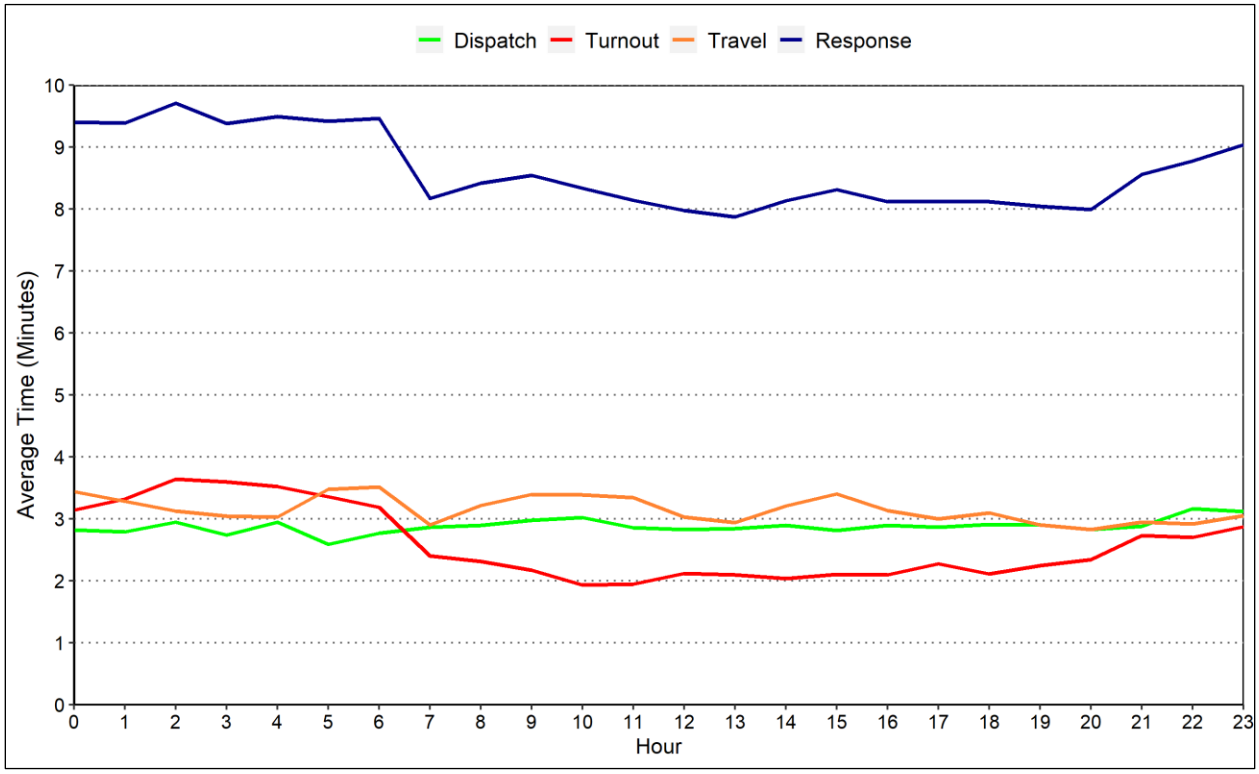
- The average dispatch time was 2.9 minutes.
- The average turnout time was 2.4 minutes.
- The average travel time was 3.1 minutes.
- The average total response time was 8.4 minutes.
- The average response time was 8.5 minutes for EMS calls and 8.3 minutes for fire calls.
- The average response time was 9.3 minutes for outside fires and 7.2 minutes for structure fires.
- The 90th percentile dispatch time was 4.6 minutes.
- The 90th percentile turnout time was 3.8 minutes.
- The 90th percentile travel time was 6.0 minutes.
- The 90th percentile total response time was 12.2 minutes.
- The 90th percentile response time was 12.2 minutes for EMS calls and 12.4 minutes for fire calls.
- The 90th percentile response time was 15.2 minutes for outside fires and 9.8 minutes for structure fires.

Table 6-14 shows the average response time by the time of day. The table also shows 90th percentile response times. Figure 6-10 shows the average response time by the time of day.

TABLE 6-14: Average and 90th Percentile Response Time of First Arriving Unit, by Hour of Day

Hour	Minutes					Number of Calls
	Dispatch	Turnout	Travel	Response Time	90th Percentile Response Time	
0	2.8	3.1	3.4	9.4	12.6	157
1	2.8	3.3	3.3	9.4	12.9	158
2	2.9	3.6	3.1	9.7	13.2	152
3	2.7	3.6	3.0	9.4	12.4	131
4	2.9	3.5	3.0	9.5	12.5	137
5	2.6	3.4	3.5	9.4	13.6	149
6	2.8	3.2	3.5	9.5	14.1	172
7	2.9	2.4	2.9	8.2	11.6	273
8	2.9	2.3	3.2	8.4	11.6	351
9	3.0	2.2	3.4	8.5	12.4	351
10	3.0	1.9	3.4	8.3	12.0	413
11	2.9	1.9	3.3	8.1	11.6	432
12	2.8	2.1	3.0	8.0	11.6	379
13	2.8	2.1	2.9	7.9	11.5	369
14	2.9	2.0	3.2	8.1	11.8	394
15	2.8	2.1	3.4	8.3	12.4	376
6	2.9	2.1	3.1	8.1	12.1	412
17	2.9	2.3	3.0	8.1	12.1	372
18	2.9	2.1	3.1	8.1	11.2	341
19	2.9	2.2	2.9	8.0	11.1	314
20	2.8	2.3	2.8	8.0	11.3	306
21	2.9	2.7	2.9	8.6	12.0	266
22	3.2	2.7	2.9	8.8	13.0	211
23	3.1	2.9	3.0	9.0	13.1	212
Total	**2.9**	**2.4**	**3.1**	**8.4**	**12.2**	**6,828**

FIGURE 6-10: Average Response Time of First Arriving Unit, by Hour of Day



Observations:

- Average dispatch time was between 2.6 minutes (5:00 a.m. to 6:00 a.m.) and 3.2 minutes (10:00 p.m. to 11:00 p.m.).
- Average turnout time was between 1.9 minutes (10:00 a.m. to 11:00 a.m.) and 3.6 minutes (2:00 a.m. to 3:00 a.m.).
- Average travel time was between 2.8 minutes (8:00 p.m. to 9:00 p.m.) and 3.5 minutes (6:00 a.m. to 7:00 a.m.).
- Average response time was between 7.9 minutes (1:00 p.m. to 2:00 p.m.) and 9.7 minutes (2:00 a.m. to 3:00 a.m.).
- The 90th percentile response time was between 11.1 minutes (7:00 p.m. to 8:00 p.m.) and 14.1 minutes (6:00 a.m. to 7:00 a.m.).

Response Time Distribution

Here, we present a more detailed look at how response times to calls are distributed. The cumulative distribution of total response time for the first arriving unit to EMS calls is shown in Figure 6-11 and Table 6-15. Figure 6-11 shows response times for the first arriving unit to EMS calls as a frequency distribution in whole-minute increments, and Figure 6-12 shows the same for the first arriving unit to outside and structure fire calls.

The cumulative percentages here are read in the same way as a percentile. In Figure 6-11, the 90th percentile of 12.2 minutes means that 90 percent of EMS calls had a response time of 12.2 minutes or less. In Table 6-15, the cumulative percentage of 47.0, for example, means that 47.0 percent of EMS calls had a response time under 8 minutes.

FIGURE 6-11: Cumulative Distribution of Response Time, First Arriving Unit, EMS

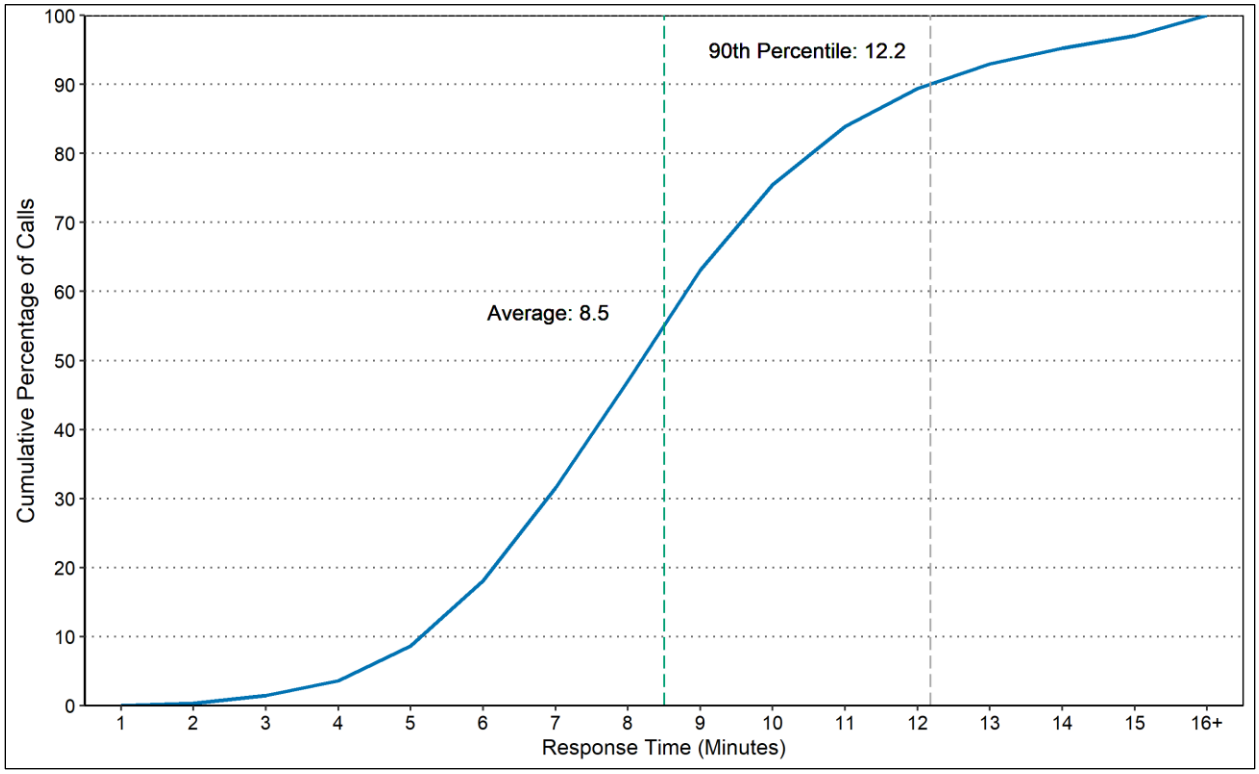


TABLE 6-15: Cumulative Distribution of Response Time, First Arriving Unit, EMS

Response Time (minute)	Frequency	Cumulative Percentage
1	0	0.0
2	14	0.3
3	48	1.4
4	95	3.6
5	218	8.6
6	413	18.1
7	593	31.6
8	673	47.1
9	703	63.2
10	537	75.5
11	370	83.9
12	239	89.4
13	157	93.0
14	97	95.2
15	78	97.0
16+	130	100.0

FIGURE 6-12: Cumulative Distribution of Response Time, First Arriving Unit, Outside and Structure Fires

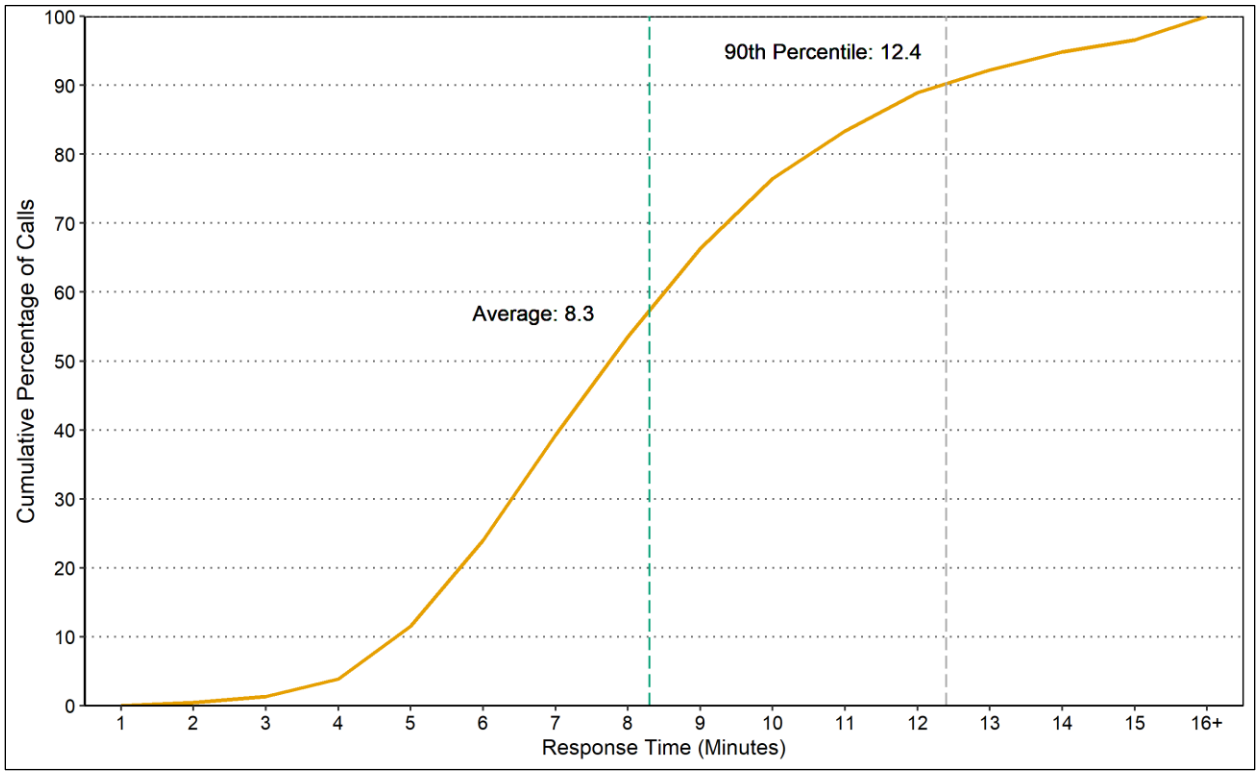


TABLE 6-16: Cumulative Distribution of Response Time, First Arriving Unit, Outside and Structure Fires

Response Time (minute)	Frequency	Cumulative Percentage
1	0	0.0
2	12	0.5
3	21	1.3
4	64	3.9
5	189	11.6
6	308	24.1
7	375	39.3
8	349	53.5
9	314	66.3
10	250	76.4
11	171	83.4
12	138	89.0
13	80	92.2
14	66	94.9
15	44	96.7
16+	82	100.0

Observations:

- For 47.1 percent of EMS calls, the response time of the first arriving unit was less than 8 minutes.
- For 53.5 percent of outside and structure fire calls, the response time of the first arriving unit was less than 8 minutes.

ATTACHMENT I: ADDITIONAL PERSONNEL

Table 6-17 illustrates the workload of HFD's administrative units between July 1, 2021, and June 30, 2022.

TABLE 6-17: Workload of Administrative Units

Unit ID	Type	Hours	Runs
C1	Fire chief	13.5	10
C3	Fire chief	30.9	23
C5	Fire prevention / inspection	2.0	2
C6	Fire prevention / inspection	39.4	27
C7	Fire prevention / inspection	52.1	33
C8	Fire prevention / inspection	26.1	16
C9	Fire prevention / inspection	8.0	5
C10	Training	24.3	11
Total		**196.3**	**127**

ATTACHMENT II: ACTIONS TAKEN

TABLE 6-18: Actions Taken Analysis for Structure and Outside Fire Calls

Action Description	Outside Fire	Structure Fire
Extinguishment by fire service personnel	66	26
Fire control or extinguishment, other	4	15
Fires, rescues & hazardous conditions, other	0	1
Hazardous materials spill control and confinement	2	0
Incident command	24	61
Information, investigation & enforcement, other	0	3
Investigate	19	99
Investigate fire out on arrival	1	13
Notify other agencies.	0	1
Provide basic life support (bls)	1	0
Provide equipment	1	0
Provide first aid & check for injuries	0	1
Provide manpower	1	3
Provide water	1	0
Refer to proper authority	0	1
Rescue, remove from harm	0	1
Restore fire alarm system	1	30
Restore municipal services	0	2
Salvage & overhaul	3	15
Shut down system	0	1
Standby	0	3
Ventilate	3	32

Note: Totals are higher than the total number of structure and outside fire calls because some calls recorded multiple actions taken.

Observations:

- Out of 88 outside fires, 66 were extinguished by fire service personnel, which accounted for 75 percent of outside fires.
- Out of 163 structure fires, 26 were extinguished by fire service personnel, which accounted for 16 percent of structure fires.

ATTACHMENT III: FIRE LOSS

Table 6-19 presents the number of outside and structure fires, broken out by levels of fire loss. Table 6-20 shows the amount of property and content loss for outside and structure fires inside Haverhill and Perry Township between July 1, 2021, and June 30, 2022.

TABLE 6-19: Total Fire Loss Above and Below $25,000

Call Type	No Loss	Under $25,000	$25,000 plus	Total
Outside fire	64	22	2	88
Structure fire	108	47	8	163
Total	**172**	**69**	**10**	**251**

TABLE 6-20: Content and Property Loss, Structure and Outside Fires

Call Type	Property Loss		Content Loss	
	Loss Value	Number of Calls	Loss Value	Number of Calls
Outside fire	$164,900	23	$27,200	17
Structure fire	$2,456,010	52	$350,440	33
Total	**$2,620,910**	**75**	**$377,640**	**50**

Note: The table includes only fire calls with a recorded loss greater than 0.

Observations:

- 64 outside fires and 108 structure fires had no recorded loss.
- 2 outside fires and 8 structure fires had $25,000 or more in losses.
- Structure fires:
  - The highest total loss for a structure fire was $730,000.
  - The average total loss for a structure fire was $17,217.
  - 33 structure fires recorded content losses with a combined $350,440 in losses.
  - The average total loss for a structure fire with loss was $51,026.
  - Out of 163 structure fires, 52 had recorded property losses, with a combined $2,456,010 in losses.
- Outside fires:
  - The highest total loss for an outside fire was $45,000.
  - 17 outside fires recorded content losses with a combined $27,200 in losses.
  - Out of 88 outside fires, 23 had recorded property losses, with a combined $164,900 in losses.

ATTACHMENT IV: CALL TYPE IDENTIFICATION

When available, NFIRS data serves as our primary source for assigning call categories. In this analysis, NFIRS incident type codes were used to assign call types for 8,297 fire category calls, motor vehicle accidents, and canceled calls. Finally, the remaining 7 calls were categorized using the nature description from the computer-aided dispatch (CAD) data to assign a call category.

Tables 6-21 and 6-22 illustrate the method used to identify the category of calls based on NFIRS type code and CAD nature, respectively. We identified 39 calls as EMS that lacked both NFIRS incident type codes and adequate descriptions from the computer-aided dispatch (CAD) data to assign a call category. We identified 21 aid-given calls (Table 6-2) independently and thus excluded them from these tables.

TABLE 6-21: EMS, Fire, MVA, and Canceled Call Types by NFIRS Incident Type Code and Description

Call Type	Incident Type Code	Incident Type Description	Count
Canceled	611	Dispatched and canceled en route. Incident cleared or canceled prior to arrival of the responding unit. If a unit arrives on the scene, fill out the applicable code.	193
	621	Wrong location. Excludes malicious false alarms (710 series).	3
	622	No incident found on arrival at dispatch address.	72
General Medical	300	Rescue and EMS incident, other.	29
	311	Medical assist. Includes incidents where medical assistance is provided to another group/agency that has primary EMS responsibility. (example, providing assistance to another agency-assisting EMS with moving a heavy patient.)	4,052
	320	Emergency medical service incident, other.	165
	321	Ems call. Includes calls when the patient refuses treatment. Excludes vehicle accident with injury (322) and pedestrian struck (323).	64
	331	Lock-in. Includes opening locked vehicles and gaining entry to locked areas for access by caretakers or rescuers, such as a child locked in a bathroom. Excludes lockouts (511).	1
False Alarm	700	False alarm or false call, other.	88
	710	Malicious, mischievous false alarm, other.	33
	711	Municipal alarm system, malicious false alarm. Includes alarms transmitted on street fire alarm boxes.	20

Call Type	Incident Type Code	Incident Type Description	Count
	712	Direct tie to fire department, malicious false alarm. Includes malicious alarms transmitted via fire alarm system directly tied to the fire department, not via dialed telephone.	4
	714	Central station, malicious false alarm. Includes malicious false alarms via a central-station-monitored fire alarm system.	4
	715	Local alarm system, malicious false alarm. Includes malicious false alarms reported via telephone or other means as a result of activation of a local fire alarm system.	3
	730	System or detector malfunction, other.	44
	731	Sprinkler activated due to the failure or malfunction of the sprinkler system. Includes any failure of sprinkler equipment that leads to sprinkler activation with no fire present. Excludes unintentional operation caused by damage to the sprinkler system (740 series).	27
	732	Extinguishing system activation due to malfunction.	2
	733	Smoke detector activation due to malfunction.	222
	734	Heat detector activation due to malfunction.	9
	735	Alarm system activation due to malfunction.	79
	736	Carbon monoxide detector activation due to malfunction.	47
	740	Unintentional transmission of alarm, other.	83
	741	Sprinkler activation (no fire), unintentional. Includes testing the sprinkler system without fire department notification.	15
	743	Smoke detector activation (no fire), unintentional. Includes proper system responses to environmental stimuli such as non-hostile smoke.	355
	744	Detector activation (no fire), unintentional. A result of a proper system response to environmental stimuli such as high heat conditions.	177
	745	Alarm system activation (no fire), unintentional.	163
	746	Carbon monoxide detector activation (no carbon monoxide detected). Excludes carbon monoxide detector malfunction.	51
Good Intent	600	Good intent call, other.	343
	650	Steam, other gas mistaken for smoke, other.	1

Call Type	Incident Type Code	Incident Type Description	Count
	651	Smoke scare, odor of smoke, not steam (652). Excludes gas scares or odors of gas (671).	22
	652	Steam, vapor, fog, or dust thought to be smoke.	6
	653	Smoke from barbecue or tar kettle (no hostile fire).	1
	661	Ems call where injured party has been transported by a non-fire service agency or left the scene prior to arrival.	2
Hazard	210	Overpressure rupture from steam, other.	1
	211	Overpressure rupture of steam pipe or pipeline.	1
	221	Overpressure rupture of air or gas pipe or pipeline.	1
	251	Excessive heat, overheat scorch burns with no ignition. Excludes lightning strikes with no ensuing fire (814).	4
	400	Hazardous condition (no fire), other.	14
	410	Combustible and flammable gas or liquid spills or leaks, other.	8
	411	Gasoline or other flammable liquid spill (flash point below 100 degrees f at standard temperature and pressure (class i)).	17
	412	Gas leak (natural gas or LPG). Excludes gas odors with no source found (671).	90
	413	Oil or other combustible liquid spill (flash point at or above 100 degrees f at standard temperature and pressure (class ii or iii)).	7
	420	Toxic chemical condition, other.	1
	422	Chemical spill or leak. Includes unstable, reactive, explosive material.	2
	424	Carbon monoxide incident. Excludes incidents with nothing found (736 or 746).	65
	440	Electrical wiring/equipment problem, other.	25
	441	Heat from short circuit (wiring), defective or worn insulation.	3
	442	Overheated motor or wiring.	5
	444	Power line down. Excludes people trapped by downed power lines (372).	16
	445	Arcing, shorted electrical equipment.	16
	461	Building or structure weakened or collapsed. Excludes incidents where people are trapped (351).	1

Call Type	Incident Type Code	Incident Type Description	Count
	462	Aircraft standby. Includes routine standby for takeoff and landing as well as emergency alerts at airports.	39
	463	Vehicle accident, general cleanup. Includes incidents where FD is dispatched after the accident to clear away debris. Excludes extrication from vehicle (352) and flammable liquid spills (411 or 413).	5
Motor Vehicle Accident	322	Motor vehicle accident with injuries. Includes collision with other vehicle, fixed objects, or loss of control resulting in leaving the roadway.	156
	323	Motor vehicle/pedestrian accident (mv ped). Includes any motor vehicle accident involving a pedestrian injury.	23
	324	Motor vehicle accident with no injuries.	362
Outside Fire	100	Fire, other	8
	131	Passenger vehicle fire. Includes any motorized passenger vehicle, other than a motor home (136) (e.g., pickup trucks, sport utility vehicles, buses).	14
	140	Natural vegetation fire, other.	21
	141	Forest, woods, or wildland fire. Includes fires involving vegetative fuels, other than prescribed fire (632), that occur in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and the like. Also includes forests managed for lumber production and fires involving elevated fuels such as tree branches and crowns. Excludes areas in cultivation for agricultural purposes such as tree farms or crops (17x series).	3
	142	Brush or brush-and-grass mixture fire. Includes ground fuels lying on or immediately above the ground such as duff, roots, dead leaves, fine dead wood, and downed logs.	29
	150	Outside rubbish fire, other.	3
	151	Outside rubbish, trash, or waste fire not included in 152–155. Excludes outside rubbish fires in a container or receptacle (154).	1
	154	Dumpster or other outside trash receptacle fire. Includes waste material from manufacturing or other production processes. Excludes materials that are not rubbish or have salvage value (161 or 162).	3

Call Type	Incident Type Code	Incident Type Description	Count
	160	Special outside fire, other.	3
	162	Outside equipment fire. Includes outside trash compactors, outside HVAC units, and irrigation pumps. Excludes special structures (110 series) and mobile construction equipment (130 series).	3
Public Service	500	Service call, other.	10
	510	Person in distress, other.	20
	511	Lock-out. Includes efforts to remove keys from locked vehicles. Excludes lock-ins (331).	10
	520	Water problem, other.	65
	521	Water (not people) evacuation. Includes the removal of water from basements. Excludes water rescues (360 series).	2
	522	Water or steam leak. Includes open hydrant. Excludes overpressure ruptures (211).	26
	531	Smoke or odor removal. Excludes the removal of any hazardous materials.	23
	540	Animal problem or rescue, other.	1
	542	Animal rescue.	1
	550	Public service assistance, other.	90
	551	Assist police or other governmental agency. Includes forcible entry and the provision of lighting.	79
	552	Police matter. Includes incidents where FD is called to a scene that should be handled by the police.	5
	553	Public service. Excludes service to governmental agencies (551 or 552).	48
	554	Assist invalid. Includes incidents where the invalid calls the FD for routine help, such as assisting a person in returning to bed or chair, with no transport or medical treatment given.	278
	555	Defective elevator, no occupants.	1
	561	Unauthorized burning. Includes fires under control and not endangering property.	98
	571	Cover assignment, assist other fire agency such as standby at a fire station or move-up.	6
	900	Special type of incident, other.	2
Structure Fire	111	Building fire. Excludes confined fires (113–118).	40
	112	Fire in structure, other than in a building. Included are fires on or in piers, quays, or pilings: tunnels or under-ground connecting structures; bridges, trestles, or overhead	6

Call Type	Incident Type Code	Incident Type Description	Count
		elevated structures; transformers, power or utility vaults or equipment; fences; and tents.	
	113	Cooking fire involving the contents of a cooking vessel without fire extension beyond the vessel.	102
	114	Chimney or flue fire originating in, confined to a chimney or flue. Excludes fires that extend beyond the chimney (111 or 112).	5
	116	Fuel burner/boiler, delayed ignition, or malfunction, where flames cause no damage outside the fire box.	5
	118	Trash or rubbish fire in a structure, with no flame damage to structure or its contents.	4
Technical Rescue	350	Extrication, rescue, other.	2
	352	Extrication of victim(s) from vehicle. Includes rescues from vehicles hanging off bridge or cliff.	4
	353	Removal of victim(s) from stalled elevator.	27
	354	Trench/below-grade rescue.	1
	355	Confined space rescue. Includes rescues from the interiors of tanks, including areas with potential for hazardous atmospheres such as silos, wells, and tunnels.	1
	357	Extrication of victim(s) from machinery. Includes extrication from farm or industrial equipment.	2
	360	Water and ice-related rescue, other.	1
	361	Swimming/recreational water areas rescue. Includes pools and ponds. Excludes ice rescue (362).	1
	362	Ice rescue. Includes only cases where victim is stranded on ice or has fallen through ice.	1
Total			**8,297**

TABLE 6-22: Call Types by CAD Nature

Call Type	Nature	Count
False Alarm	Check alarms	1
Good Intent	Investigate	2
Motor Vehicle Accident	MVA	3
Structure Fire	Struc fire dwel	1
Total		**7**

- END -