CENTER FOR PUBLIC SAFETY MANAGEMENT, LLC

FIRE DEPARTMENT AND EMS ANALYSIS

Plymouth, Massachusetts

Final Report – January 2023

CPSM®

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ICMA

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 Town of Plymouth contracted the Center for Public Safety Management LLC (CPSM) to complete an analysis of the town's Fire Department and private EMS provider.

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 challenges, transportation emergencies to include vehicle traffic, a mass transit system utilizing bus transportation, wildland fires, and other non-emergency responses typical of coastal 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 PFD 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. This analysis and self-review are intended to help the department 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 PFD 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; the fire alarm office; fleet; and the EMS ground transport system and how the PFD integrates in this system.

Based upon CPSM's detailed assessment of the PFD, it is our conclusion that the department, overall, provides quality fire, EMS, and rescue services. The PFD staff are professional and dedicated to the mission of the department; which was apparent 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 and EMS department's operation will first assist the PFD in quantifying the risks that it faces. Second, the PFD 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 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 and planning objectives and recommendations provided by CPSM. These are intended to help PFD 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

Emergency Management

(See pp. 10-11.)

1. CPSM recommends the PFD Emergency Preparedness Director establish a planning schedule where the town's Comprehensive Emergency Management Plan is reviewed and revised on a bi-annual basis, which is the recommended review and revision schedule established by FEMA through its Comprehensive Preparedness Guide.
2. CPSM recommends the Emergency Management office begin the process of preparing and implementing a Continuity of Operations Plan (COOP) so that the effects of any interruption in a Town office, system, operation, and staffing before or during an event are successfully managed and the Town is able to perform all essential functions.

Technology and Procedures

(See p. 12.)

3. CPSM recommends the PFD develop planning strategies for the procurement and implementation of technology solutions that support: staff scheduling; email addresses for all PFD employees; staff training and education; records management system that integrates all PFD divisions to include fleet services; contemporary policies and guidelines that are easily accessible by all PFD members.

ISO Analysis

(See pp. 17-20.)

4. CPSM recommends the PFD review and address, to the extent possible, deficiencies in the Fire Department section of the current ISO-Public Protection Classification report as outlined in this report. Special attention should be given to developing methods and opportunities for members to achieve the training as required in the ISO analysis, as it is focused on firefighter safety, improved competencies, and overall improved fireground effectiveness and functionality. This includes, given the identified building risks in the town, ensuring company personnel conduct (and document for future ISO reviews) live fire, multi-company, and training facility hands-on training as required; and developing an officer training program targeted at ensuring officers have opportunities for the various levels of officer certification and that they receive structured annualized officer training.

Community Risk Reduction

(See pp. 21-23.)

5. CPSM recommends the PFD address Community Risk Reduction staffing and adjust staffing as necessary to ensure current (and future) inspectable properties are receiving annualized (where required) inspections, and those not requiring annualized inspections receive timely inspections in accordance with applicable laws and standards, and as established by the Fire Marshal. Addressing this deficiency in Community Risk Reduction will require additional staffing to the extent possible with available funding and should be addressed over the near to mid-term (1 to 5 years) with an additional fire prevention inspector, or at a minimum, a part-time inspector whose focus would be on those inspections that are required on an annualized cycle.

Training and Education

(See pp. 23-27.)

6. CPSM recommends that, due to the importance of training as outlined herein, the town consider funding a training officer at the lieutenant level to develop, coordinate, manage, and deliver consistent training and education programs for new hires and incumbent

personnel of the PFD. This position will have primary responsibility to ensure PFD staff are proficiently trained to perform assigned tasks; that they maintain state, national, and ISO standards; and that required certifications and annual coursework are current and properly documented.

7. CPSM recommends the PFD pursue, based on available funding, a digital platform for training and training compliance to be used as a didactic/virtual platform for department training.

CPSM further recommends:

8. The PFD should make a concerted effort to send as many officers as possible to the National Fire Academy (NFA). Any officer who meets the admissions criteria should be encouraged to enroll in the academy's Executive Fire Officer Program.
9. CPSM recommends the PFD develop task books for firefighter, driver, company officer, and Battalion Chief. Firefighters should be required to complete their book as part of their probationary period. For other ranks, all personnel aspiring for promotion to a higher rank should be required to successfully complete all elements of that rank's task book to be eligible to participate in the formal promotional testing process.
10. CPSM recommends the PFD develop and institute annualized practical skills proficiency evaluations as part of the department's comprehensive fire training program.
11. The PFD should provide all companies and personnel with high-intensity training on various subjects, including multicompany drills and periodic live fire training on at least an annual basis (to the extent possible) at an appropriate location where appropriate training facilities, structures, and props are available.
12. CPSM recommends that the town develop a mid- to long-term plan to provide funding for the PFD to develop and construct an appropriate training facility where it can safely perform live training evolutions for all personnel.

911-Dispatch Recommendations

(See pp. 27-31.)

13. In the near term, the PFD should work to implement performance measures and compliance methodologies for call processing times in the 911-dispatch center to address the long call processing times and should include all primary Public Safety Answering Points and the transfer time of emergency calls to the PFD. There should be a focus on closing the gap between the national standard and the current time in Plymouth to process and dispatch all calls for service.
14. In the mid to long term, given the multiple PSAP configurations outlined in this report, and the cost for CAD, radio system, and console upgrades in the PFD 911-dispatch center, the PFD should begin to explore other opportunities for 911-dispatch services to include participating in the Plymouth County Sherriff's Department communications center. This exploration should include enhanced management of Public Safety Answering Point incoming calls to include a centralized Public Safety Answering Point for all town emergency services, which should have a focus on minimizing call processing times for fire and EMS calls for service. Should the PFD decide to transition this function to another agency, CPSM recommends the PFD retain the uniform firefighters assigned to the 911- dispatch center and utilize their knowledge, skills, and abilities either in fire suppression, fire administration, or any other division where there is a need in the PFD.

Fire Alarm Division

(See pp. 31-32.)

15. CPSM recommends, that because of the criticality of the fire alarm, station alerting, and radio systems, and because the Fire Alarm Division has only one staff member to maintain all of the components of these systems, the PFD consider budgeting (as funding is available) for a full-time fire alarm technician or at a minimum a part-time position (technician level). This position would assist the Fire Alarm Superintendent with the maintenance of the components of the municipal fire alarm, station alerting, and radio systems, and other fire department electrical and mechanical systems assigned to the Fire Alarm Division to maintain.

Fleet

(See pp. 32-38.)

16. CPSM recommends the PFD develop, over a one-year period, a fire apparatus replacement plan that includes, to the extent possible and funding availability, replacement according to recommendations in accordance with NFPA 1901, *Standard for Automotive Fire Apparatus*.

Planning objectives should include:

17. Apparatus should not exceed 15 years of service on the front line. Once an apparatus reaches this age, one alternative is for the apparatus to undergo 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.

18. Apparatus in active/reserve status and which is between 20 and 25 years old should comply with NFPA 1901 and undergo a Level 1 refurbishing in accordance with NFPA 1912 as an immediate planning objective if the department plans to continue to use this apparatus. All apparatus at the 25-year-old mark should be considered for replacement. Apparatus greater than 25 years old should be removed from service.

19. 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.

20. Apparatus components that are either fixed or portable and which require annualized testing, 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.

21. CPSM recommends the PFD acquire a fleet records management system or fleet module to an existing PFD records management system that integrates fleet records with other departmental records so that hours of work, cost for repairs, and new and recurrent apparatus issues are readily available for review by fire administrative staff and shop personnel and as well that is designed so that feedback on apparatus issues and repairs is readily available to line personnel for review, process improvement, and training.

22. CPSM recommends the PFD develop a grading scale for the remaining light vehicle and marine fleet to help determine each vehicle's service life to ensure these vehicles and trailers remain in a safe operating condition and meet industry standards based on their condition or usage.

23. If the PFD continues to operate a marine firefighting vessel, then proper cross-staffing, maintenance, operating guidelines, and storage are required to ensure safe operations.

Succession Planning

(See pp. 38-39.)

24. CPSM recommends the PFD work with the collective bargaining unit and the town's Human Resources department to develop a succession plan that is diverse, includes the entire organization, and has a focus on preparing current and future members to take on additional roles and responsibilities, and as well as prepares members for advancement and promotion into key roles in the organization.

Staffing and Deployment Recommendations and Alternatives

(See pp. 71-106.)

25. To increase the ability to assemble an Effective Response Force in all response areas of the town and increase the PFD's ability to meet the NFPA travel time standard of 240 seconds for the first arriving fire suppression unit to fires and EMS calls for service, which is the intent of the 2018 SAFER grant to fund positions for a rescue apparatus, CPSM recommends the PFD adjust the daily staffing matrix and staff Rescue 1 at Station 3 with one officer and two firefighters on a daily basis. CPSM further recommends Rescue 1 be dispatched on all structure fire calls in the town in order to increase the initial Effective Response Force, and to also assume service/ladder company responsibilities in the central and southern areas of the town's response areas. (Near-term recommendation: 1 year).

26. As an alternative deployment model, CPSM recommends that Ladder 2 at Station 5 be deployed as the first-out unit on all structure fires to which Station 5 is dispatched. This will ensure a faster ladder apparatus response to the eastern fire management zones in the town. (Near-term recommendation:1 year.)

27. CPSM recommends the town continue with the current PFD facility plan which is to relocate and construct a new Station 1 with adequate space, equipment, and fixtures to house two staffed fire suppression units and the operational field Battalion Chief, as well as Fire Administration staff (Station 1 to remain Fire Headquarters); relocate and construct a new Station 4 with a design that involves adequate space for two staffed fire suppression pieces; and renovation of Station 5. CPSM further recommends that care be taken in any relocation of Station 1 as substantial movement east or south of the current location will have an impact on response travel time as measured against the NFPA 1710 benchmark standard.

28. As Station 4's fire management zone will be experiencing increasing growth to include multifamily residential, and due to the location and longer response time for assisting companies on structural fire and other multi-unit calls, CPSM recommends increasing staffing to 4 per shift (or a total of 4 additional personnel). (Mid-term recommendation: 3 to 5 years.)

29. Since Ladder 3 at Station 7 covers both the Station 7 and Station 2 fire management zones, and because Stations 1, 2, and 7 have significant residential and commercial building risks, and to increase the ability to assemble an Effective Response Force in the northwest areas of the town, CPSM recommends as an alternative staffing model to staff the ladder apparatus at Station 7 with one officer and two firefighters (twelve personnel total) on a daily basis in tandem with a staffed Engine 7. An alternative is to staff the ladder apparatus (Ladder 3) at Station 2 with one officer and two firefighters (twelve personnel total) on a daily basis in tandem with a staffed Engine 2. (Long-term alternative: 5 to 8 years.)

30. As Station 4's fire management zone will be seeing increasing growth to include multifamily, multilevel residential, and due to the location and long response for a ladder apparatus on structural fire and other multi-unit calls, combined with the lack of this resource in the southern

areas of the town, CPSM recommends the staffing of a ladder apparatus at Station 4 with one officer and two firefighters (twelve personnel total and purchase of one ladder apparatus) on a daily basis in tandem with a staffed Engine 4. (Long-term recommendation: 5 to 8 years.).

EMS

(See pp. 107-130.)

31. The PFD should seek to upgrade the EMS training for PFD field response personnel to the EMT-Basic level.
32. PFD should review internal procedures and processes in order to reduce EMS dispatch and turnout times to meet the NFPA 1710 standard at the 90th percentile reliability measure.
33. The PFD, by working with the EMS Medical Director and other stakeholders, should limit its Medical First Responses to less than 50 percent of the overall EMS response by only responding to ECHO, DELTA, and BRAVO EMD determinants.
34. BAS and PFD should investigate methods for alternative delivery models in order to reduce ambulance demand, which will help to maintain response times for high-acuity medical responses.
35. PFD and the other agencies that are part of the dispatch process should work with the leadership the PFD and BAS to immediately end the process of BAS responding to all EMS calls HOT and take full clinical and safety advantage of using the MPDS system for response prioritization, response mode, and clinical level of response.
36. PFD and BAS should work with their Medical Directors and other community stakeholders to determine the role that an MIH/CP program could play in working with high utilizers and other patients within Plymouth who would benefit from this type of service model.
37. PFD and BAS, working with their Medical Director, should develop and publish clinical dashboards to evaluate and improve the clinical measures for the EMS system and identify quality improvement opportunities.
38. PFD and BAS should consider and implement a process to independently evaluate and publish patient experience scores as a key metric in evaluating overall service delivery quality.
39. The Town of Plymouth and BAS should revise or amend the current 'Level of Effort' agreement to a 'Performance-Based' agreement that specifies desired clinical, experiential, and response time performance levels, and as well provides for financial evaluations that offer the town ample notice in the event financial conditions may cause service delivery challenges.
40. CPSM does not recommend the town initiate a fire-based ambulance service unless there are compelling reasons due to chronic and repeated service delivery failures on the part of BAS.

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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 Plymouth Fire Department (PFD). Information was obtained from the PFD, Brewster Ambulance Service, the Town, and 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. On-site and in-person interviews as well as virtual meetings were conducted with 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 and EMS Team consultants were furnished with numerous reports and summary documents by the PFD. Information on department planning; staffing and deployment of resources; EMS ground transport; mutual and automatic aid; policies and procedures; community risk, fire code enforcement, and public education; investigation records; 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 to include the Brewster Ambulance; community risk reduction; fleet 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. 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's (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

DEPARTMENT OVERVIEW AND ORGANIZATIONAL STRUCTURE

The Plymouth Fire Department (PFD) is a career fire department that employs full-time uniform administrative, community risk reduction, training, fire alarm, 911-dispatch, emergency management and support staff, as well as operational command and company level officers and firefighters.

When fully staffed, the PFD deploys seven engine companies, one ladder company, and one heavy rescue. The deployment model also includes two ladder apparatus that are cross staffed as needed by engine crews, as well an array of brush truck (brush breakers), water tenders, and support vehicles and equipment. The PFD has one Battalion Chief (shift commander) on duty 24/7. This deployment model requires a minimum company level staffing of 25 personnel each day. Total on-duty shift personnel when fully staffed is31 (four firefighter-level staff are used daily to cover vacancies in all companies created by scheduled and unscheduled leave). The PFD operates on a typical 24-hour shift. There are four operational shifts or platoons.

The PFD is led by a Fire Chief who has overall responsibility for the management and leadership of the department. The Fire Chief is assisted by two Deputy Chiefs who are direct reports. Also, the Emergency Preparedness Director and administrative staff report directly to the Fire Chief.

The Deputy Chief of Operations manages the four operational shifts as described above as well as the Fire Alarm Division, which maintains the fire alarm box system in the Town, and the Apparatus Maintenance Division, which maintains the department's fleet and small equipment. The operational shift management includes all operational components such as staffing, facilities, and equipment. Each of the four operational shift Battalion Chiefs as well as the Apparatus Maintenance Division Chief Master Mechanic and Fire Alarm Superintendent report directly to the Deputy Chief of Operations.

The Deputy Chief of Administration manages the Fire Prevention Division (Community Risk Reduction) and Training Division. The community risk reduction component is responsible for fire prevention code enforcement, fire protection plans review, and fire and life safety education. The training component is responsible for all new-hire and incumbent training and professional development. Each of these divisions is commanded by a Battalion Chief.

Administrative support includes a business manager and administrative assistant that assists fire administration directly, and administrative assistants assigned to fire prevention and emergency management (one each).

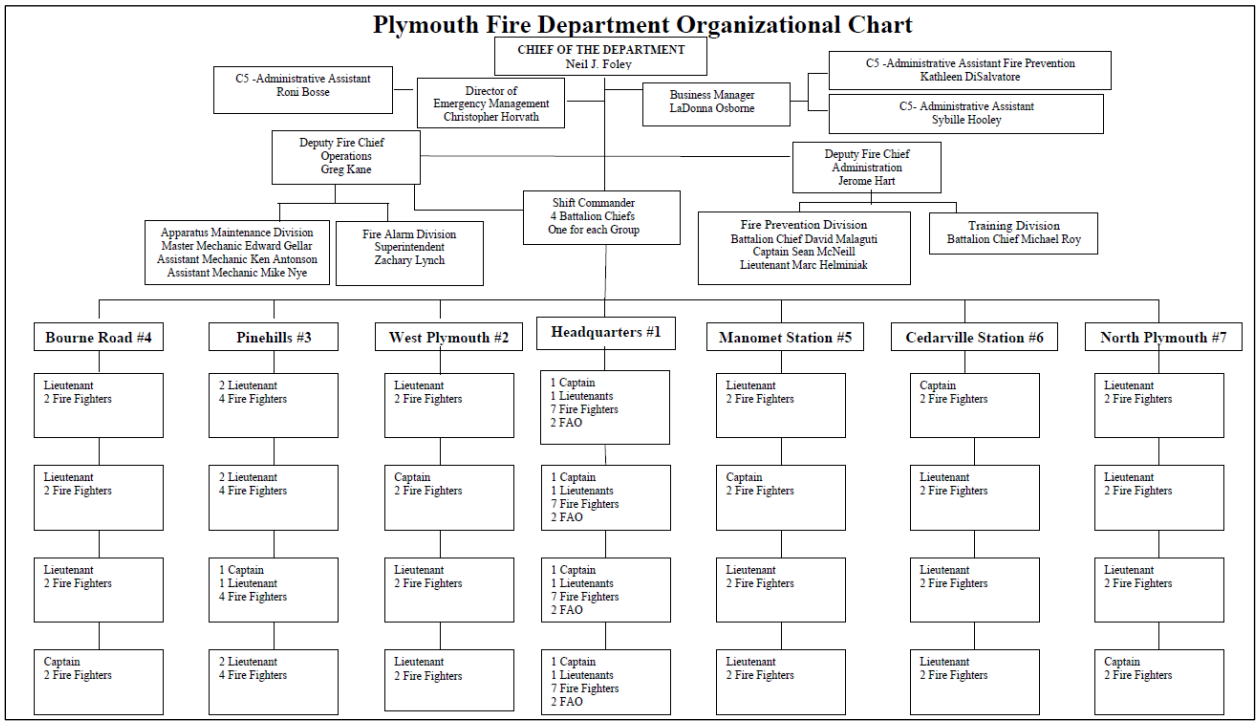
The key elements of the PFD include:

- Fire protective services.
- EMS first-tier response.
- Fire prevention, fire code enforcement, fire protection plans review.
- Fire cause and origin investigation.

- Emergency management operations and preparation.
- Technical rescue response and mitigation.
- Hazardous materials response and mitigation.
- Community outreach and life safety education.
- Employee training and education.
- Fleet, facility, and logistical support and management.

Specialty response limited to available on-duty staffing and state and regional support.

FIGURE 3-1: PFD Organizational Chart



In addition to fire suppression and first response EMS, the PFD is trained to certain specialized levels of technical rescue such as vehicle extrication, rope rescue, and building collapse. However, the PFD 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. When needed, these assets are obtained through partnerships and agreements with the county which has these resources. The same service level exists for hazardous materials response. The PFD can handle operational-level hazardous materials incidents but requires state assets for more complex incidents requiring high-level entry and mitigation. The PFD does have a dive team trained in underwater vehicle rescue and extrication as well as other underwater rescue responses.

EMERGENCY MANAGEMENT

Emergency management is the discipline of planning for, mitigating, and responding to natural and manufactured risks. Its role in the community is to assess and prepare for current risk conditions, to proactively take steps to mitigate those risks, and to respond/recover should an emergency situation occur. Further, through the crucial roles of planning and preparedness and the coordination of response and management of resources, emergency management plays a major role in mitigating the impacts of disasters.

Emergency management for the Town of Plymouth is handled by an office under the PFD and is led by a full-time Emergency Preparedness Director who reports directly to the Fire Chief. CPSM reviewed the Town's existing 2017 Comprehensive Emergency Operations Plan (CEOP) and found the content valid.[1] The CEOP is an Emergency Support Function (ESF)-based plan and is compliant with the Federal Emergency Management Agency's Comprehensive Preparedness Guide and Commonwealth of Massachusetts standards. Also, all tenets of emergency management are discussed within the CEOP. Lastly, the CEOP meets or exceeds the five areas of emergency management in the content of the [respective] plan.

Another important document the Town's Emergency Management office should maintain is a Continuity of Operations Plan (COOP). A COOP is important to any organization, especially local governments that operate financial and human resources systems, facilities, public operations, and vital community services. A COOP is developed to serve as a roadmap that builds the organization's plan to prepare for, react to, and respond to any event that disrupts one or more operation, facility, service, or line of succession. COOP planning includes:

- Essential Functions – The critical activities performed by organizations, especially after a disruption of normal activities.
- Orders of Succession – Provisions for the assumption of senior agency offices during an emergency if any of those officials are unavailable to execute their duties.
- Delegations of Authority – Identification, by position, of the authorities for making policy determinations and decisions at the executive, middle management, and operational levels, and all other organizational locations. Generally, pre-determined delegations of authority will take effect when normal channels of direction have been disrupted and will lapse when these channels have been reestablished.
- Continuity of Facilities – Locations, other than the primary facility, used to carry out essential functions, particularly in a continuity event. Continuity facilities, or "Alternate facilities," refers to not only other locations, but also nontraditional options such as working at home, ("teleworking"), telecommuting, and mobile-office concepts.
- Continuity of Communications – Communications that provide the capability to perform essential functions, in conjunction with other agencies, under all conditions.
- Vital Records Management – The identification, protection, and ready availability of electronic and hard-copy documents, references, records, information systems, and data management software and equipment needed to support essential functions during a continuity situation.
- Human Capital – During a continuity event, emergency employees and other special categories of employees are activated by an agency to perform assigned response duties.

1. Hazard Mitigation Plan developed by the Western Connecticut Council of Governments.

- Devolution of Control and Direction – Capability to transfer statutory authority and responsibility for essential functions from an agency's primary operating staff and facilities to other agency employees and facilities.
- Reconstitution – The process by which agency personnel resume normal agency operations from the original or replacement primary operating facility.[2]

Emergency Operations Center (EOC)

During an emergency, particularly one that involves multiple agencies and where a central command and control in accordance with the Emergency Operations Plan is established and implemented, a functional area (operations room) is required for the assembling of Emergency Support Function (ESF) personnel. This area requires enough room so that individual ESFs can plan and direct their sections and includes communication via telephone and computer software available at each ESF, functioning utilities with uninterrupted power supply and emergency generator, and located in a facility that is accessible to staff and with adequate parking. Ideally an EOC is set up and functional at a moment's notice. Additional areas for consideration include planning areas, facilities to include support for 24-hour operations, and a break area away from the operations room.

The Town Emergency Operations Center (EOC) is located at PFD Station 6. The EOC consists of an operations room, breakout rooms/offices and support space. The EOC has technology in place to support emergency activation. The operations room can also serve as a classroom, which makes for excellent dual-purpose use of this space.

Emergency Management Recommendations:

- CPSM recommends the PFD Emergency Preparedness Director establish a planning schedule where the town's Comprehensive Emergency Management Plan is reviewed and revised on a bi-annual basis, which is the recommended review and revision schedule established by FEMA through its Comprehensive Preparedness Guide. (Recommendation No. 1.)
- CPSM recommends the Emergency Management office begin the process of preparing and implementing a Continuity of Operations Plan (COOP) so that the effects of any interruption in a Town office, system, operation, and staffing before or during an event are successfully managed and the Town is able to perform all essential functions. (Recommendation No. 2.)

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2. coop_brochure.pdf (fema.gov)

TECHNOLOGY AND PROCEDURES

During the CPSM site visit and while speaking with PFD internal stakeholders, CPSM learned the PFD does not have certain technology/software solutions in place that many contemporary fire departments have and have implemented. These include:

- Automated scheduling software. The PFD currently utilizes a system of books and a digital calendar to schedule staff to fill vacancies created by scheduled and unscheduled leave. There are workforce scheduling solutions available that also link with payroll systems and that automate scheduling, leave, and overtime; such systems also incorporate local rules and polices and ensure equitable staffing of overtime and approval of leave.
- Email addresses for all members. CPSM learned that not all members of the PFD have email addresses. Email is important since department staff need to stay informed and have access to readily communicate with other department members as well as other Town agencies. Email is a first line communication medium particularly in a decentralized department such as the PFD (7 stations; 4 shifts).
- Training solution. The PFD does not have a training/training compliance solution. The use of such a solution will help to ensure that there is a reliable and accurate database for tracking and retrieval of all department-level training and for recording and tracking the status of certifications for all personnel.
- Fleet services records management system. An issue raised by the Chief Master Mechanic is the shop's lack of a contemporary records management system (RMS) that integrates with other departmental records systems. Recording hours of work, cost for repairs, new and recurrent apparatus issues that are readily available for review by fire administrative staff and shop personnel, as well as feedback on issues for line personnel to review are essential components of a contemporary fleet maintenance program.
- Contemporary health and safety in fire and EMS operations (such as cancer prevention, on-scene firefighter rehab, after an incident decontamination, injury prevention, apparatus safety) to include incident safety officer, training/certification for all staff levels, and operating emergency apparatus protocols, polices, and guidelines. Guidelines and polices form the base for all operations in public safety agencies. It is essential to have policies and guidelines that reflect current practices and that do not contradict one another.

Technology and Procedures Recommendation:

- CPSM recommends the PFD develop planning strategies for the procurement and implementation of technology solutions that support: staff scheduling; email addresses for all PFD employees; staff training and education; records management system that integrates all PFD divisions to include fleet services; contemporary policies and guidelines that are easily accessible by all PFD members. (Recommendation No. 3.)

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SERVICE AREA

The Town of Plymouth is located approximately 40 miles south of Boston in southeastern Massachusetts. Plymouth is a coastal community with approximately 20-miles of coastline (almost 26 if you include the barrier beach). The Town's boundaries encompass 134 total square miles of which 103 square miles are land area (the remainder is water area). Contiguous jurisdictions include Bourne to the southeast, Wareham to the southwest, Carver to the west, and Kingston to the north. Plymouth and Cape Cod Bay make up the eastern boundaries.

Plymouth has the largest land area of any municipality in the commonwealth. Clark's Island, located in Plymouth Bay, is accessed by water only and is within the Town of Plymouth. Clark's Island has a small number of homes and is populated during the summer months. Saquish and Gurnet are accessed from the towns of Duxbury and Marshfield.

Situated inside the town is the Myles Standish State Forest. This natural area is 26 square miles in area and is comprised of pitch pine and scrub oak forests. As it is a large recreational area, it does create emergency responses for brush and wildland fires as well as EMS calls for service.

The following figure illustrates Plymouth's municipal boundaries, fire station locations, and fire districts, along with the fire apparatus assigned to each station.

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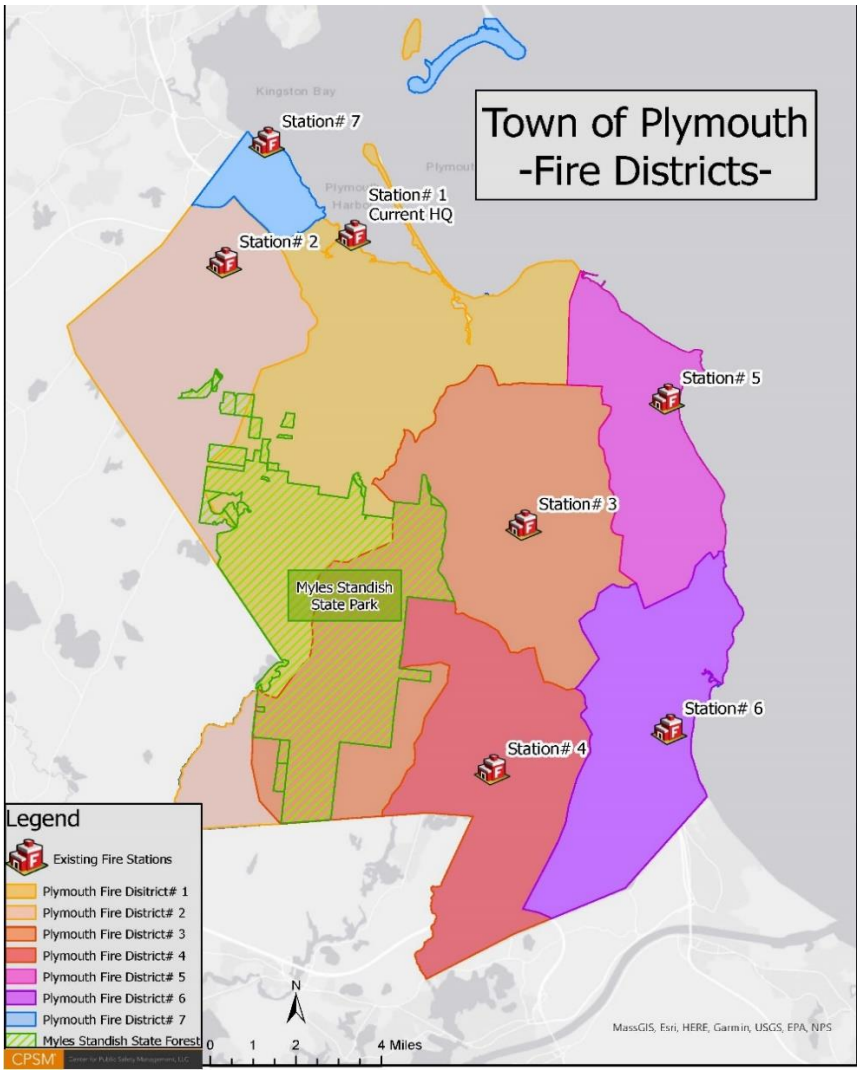
FIGURE 3-2: Town of Plymouth Jurisdictional Boundaries with Fire Stations



Primary Response Units

Station 1
Engine 1
Tower 1
33' Fire Boat
Brush Breaker

Station 2
Engine 2
16' Boat
Brush Breaker
2,100 Gallon Tanker

Station 3
Engine 3
Rescue 1
14-foot Boat
Brush Breaker
2,500 Gallon Tanker

Station 4
Engine 4
14-foot Boat
Brush Breaker

Station 5
Engine 5
Ladder 2 — Cross-Staffed
13-foot Zodiac Boat
Brush Breaker

Station 6
Engine 6
14-foot Boat
Brush Breaker
2,100 Gallon Tanker

Station 7
Engine 7
Ladder 3 — Cross-Staffed
Brush Breaker

- Apparatus highlighted in blue are primary response units.
- Apparatus highlighted in orange are cross staffed with the engine by a single crew.
- Apparatus not highlighted are cross staffed when needed.

Emergency medical services (EMS) ground transport in Plymouth is provided through a contracted ambulance provider, Brewster Ambulance Service (BAS). The PFD provides medical first response (MFR) through fire suppression units. The BAS provides Basic Life Support (BLS) and Advanced Life Support (ALS) ambulance services (ground transport) based on clinical need of the patient requiring the EMS response. EMS service delivery is analyzed later in this report.

Mutual aid is an essential component of almost every fire department's operations. Except for the largest cities, no municipal fire department can, or should, be expected to have adequate resources to respond to and safely, effectively, and efficiently mitigate large-scale and complex incidents. Mutual aid is shared between communities when their day-to-day operational fire,

rescue, and EMS capabilities have been exceeded. A mutual aid system ensures that the citizens of the communities are protected even when local resources are overwhelmed. **PFD has established mutual aid assistance through Plymouth County Control.**

PFD FISCAL RESOURCES

The PFD's operating expenses are funded through the Town's General Fund Budget, which is funded largely through property tax revenue. The FY 2023 Town Meeting approved budget is $274,673,314, which includes all town services, enterprise departments, and the Plymouth Schools. [3]

The next table outlines the PFD budgets for 2021 through 2023.

TABLE 3-1: PFD Budget: 2021, 2022, 2023

2021 Actual Expenditures	2022 Revised	2023 Town Meeting Approved
$12,361,287	$14,266,468	$15,028,622

22% growth from 2021 actual to 2023 Town Meeting-Approved Budget

The PFD also manages the Emergency Management function. The next table outlines the Emergency Management budgets for 2021 through 2023.

TABLE 3-2: Emergency Management Budget: 2021, 2022, 2023

2021 Actual Expenditures	2022 Revised	2023 Town Meeting Approved
$2,420	$59,900	$119,988

The 2021 and 2022 FY budgets did not include personnel costs. Personnel costs of $59,988 are added in the FY 2023 budget.

Review of the PFD budget tells us it is similar to other fire department budgets that CPSM has reviewed, in that the largest percentage of the budget is dedicated to personnel services. The FY 2023 PFD budget is broken down as follows:

- Personnel Services $14,396,261 96% of overall budget
- All Other Expenses $434,629 3% of overall budget
- Equipment $197,732 1% of overall budget

Total $15,028,622 100%

3. Finance Department | Town of Plymouth MA (plymouth-ma.gov)

Personnel services includes salaries and wages (largest percent of this budget category); overtime (second largest percent of this category and 7 percent lower than the previous year revised budget); uniform allowance; and other related personnel expenses. There is one new administrative personnel initiative that is budgeted at $43,685. This budget category shows a 6 percent increase from the FY 2022 revised budget.

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; training; 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. This budget category has a 31 percent increase from the FY 2022 revised budget.

Departmental equipment includes funding for

There are FY 2023 PFD expenditures that are charged against other budget categories in other departments such as:

- Building maintenance, heat and electric: Building Maintenance.
- Fuel: Fleet Maintenance Budget.
- Fire Truck Vehicle Replacement: Long-term Principal & Interest Budget.
- Emergency Management Facility: Long-term Principal & Interest Budget.
- Employee Benefits and Retirement.

CPSM has no recommendations on the PFD budget, as expenses are proportioned consistently with other Town departments as well as with other fire departments across the country. There are recommendations in this analysis that, if adopted, may have an impact on the budget.

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ISO 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 (score from 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.[4]

A favorable PPC numerical rating 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). Plymouth's needed fire flow is 3,500 gallons per minute. This is based on the fifth-largest needed fire flow in the town.
- **Emergency Communications** (10 percent of the evaluation).
- **Fire Department** (50 percent of the evaluation).
- **Water Supply** (40 percent of the evaluation).

The Town of Plymouth has an ISO rating of ***Class 03/3y***. 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 five road miles of a fire station but beyond 1,000 feet of a creditable water supply (fire hydrant). The town's ISO rating was effective October 1, 2019.

The following figures illustrate the PPC ratings across the United States and in Massachusetts.

4. PFD ISO PPC report Effective October 1, 2019.

FIGURE 3-3: PPC Ratings in the United States[5]

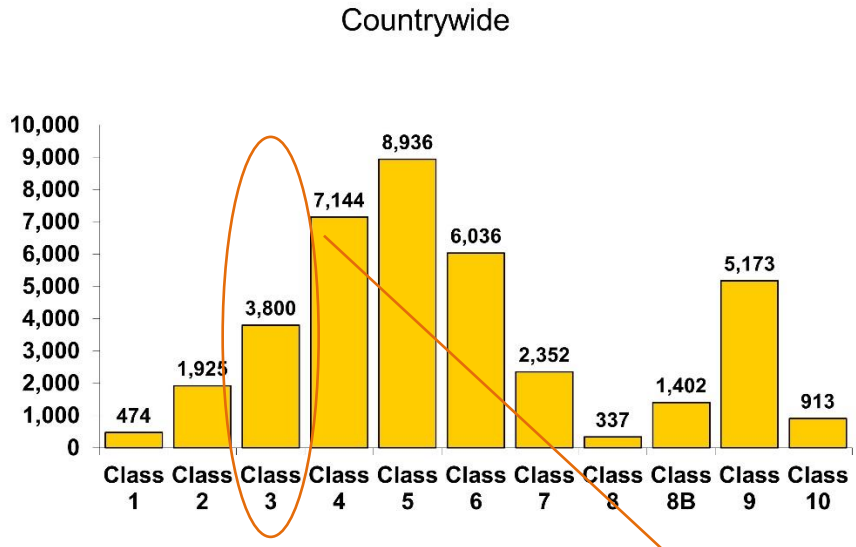
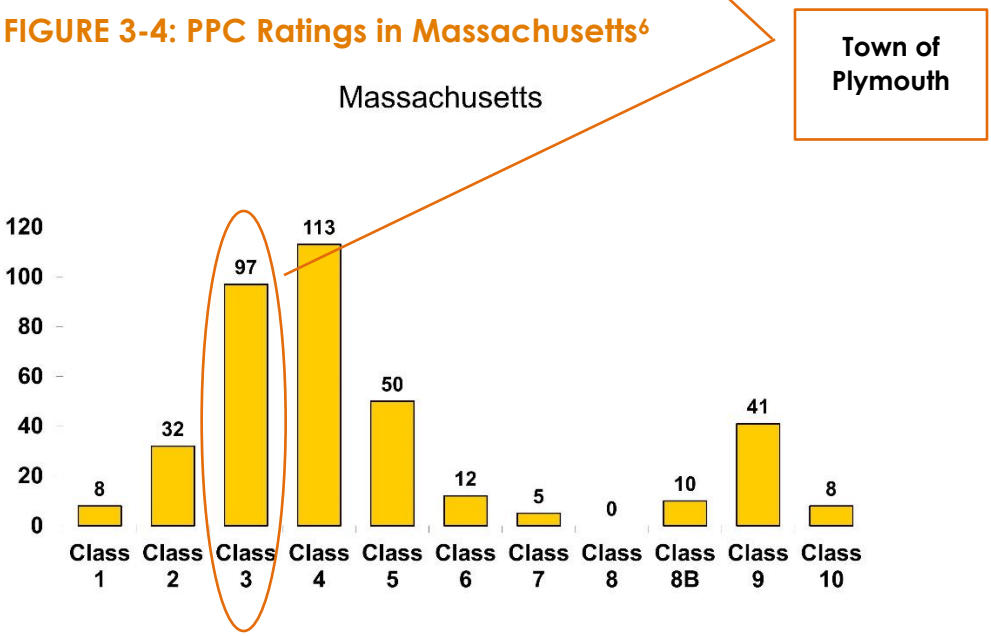


FIGURE 3-4: PPC Ratings in Massachusetts[6]



The Town of Plymouth's 2019 ISO report included the following credit points by major category:

- **Emergency Communications**: 9.91 earned credit points/10.00 credit points available.
- **Fire Department**: 30.42 earned credit points/50.00 credit points available.
- **Water Supply:** 29.35 earned credit points/40.00 credit points available.

5. https://www.isomitigation.com/ppc/program-works/facts-and-figures-about-ppc-codes-around-the-country/
6. Ibid.

- **Community Risk Reduction** (Fire Prevention/Inspection, Public Education, and Fire Investigation activities): 4.47 earned credit points/5.50 credit points available.

Overall, the community PPC rating yielded 71.64 earned credit points/105.50 credit points available. There was a -2.30 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 3/3y.**

The following table outlines the scoring for the three Town of Plymouth ISO-FSRS components.

TABLE 3-3: Plymouth ISO Earned Credit Overview

FSRS Component	Earned Credit	Credit Available
414. Credit for Emergency Reporting	3.00	3
422. Credit for Telecommunicators	4.00	4
4.32. Credit for Dispatch Circuits	2.91	3
440. Credit for Emergency Communications	**9.91**	**10**
513. Credit for Engine Companies	5.13	6
523. Credit for Reserve Pumpers	0.50	0.50
532. Credit for Pump Capacity	3.00	3
549. Credit for Ladder Service	2.24	4
553. Credit for Reserve Ladder and Service Trucks	0.19	0.50
561. Credit for Deployment Analysis	5.12	10
571. Credit for Company Personnel	7.62	15
581. Credit for Training	4.62	9
730. Credit for Operational Considerations	2.00	2
590. Credit for Fire Department	**30.42**	**50**
616. Credit for Supply System	22.95	30
621. Credit for Fire Hydrants	3.0	3
631. Credit for Inspection and Flow Testing	3.40	7
640. Credit for Water Supply	**29.35**	**40**
Divergence	**-2.51**	-
1050. Community Risk Reduction	**4.47**	5.50
Total Credit	**71.64**	**105.50**

Areas of scoring that should be reviewed further internally by the town and the PFD, and which can have the most impact on individual areas evaluated and scored that connect to total section scoring include:[7]

- Deployment analysis: #561 (5.12/10 credits).
  - This category contemplates the percentage of built-upon area that first due engines cover (1.5 miles) and first due ladders cover (2.5 miles). The analysis shows that just over 50-percent of the built upon area of the town is within 1.5 miles of engine apparatus and 2.5 miles of ladder apparatus. *This category has an expanded discussion later in this report.*

7. Public Protection Classification Summary Report, Plymouth, MA, 2019.

- Credit for Company Personnel: #571 (7.62/15 credits).
  - This category reviews the average number of existing firefighters and company officers available to respond to first alarm structure fires. The ISO report gives credit for 32 on-duty personnel and considers any mutual aid companies available to respond as well. On-duty strength and subsequent credit takes into account the yearly average of total firefighters and company officers on-duty after considering scheduled and unscheduled leave.
- Training: #581 (A) Facilities and Use (7.12/35 credits).
  - 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 PFD is not meeting this section to its fullest potential.
- Training: #581 (B) Company Training (14.06/25 credits).
  - For maximum credit, each firefighter should receive 16 hours per month in structure fire-related subjects as outlined in the NFPA 1001 standard. The PFD is not meeting this section to its fullest potential.
- Training: #581 (C) Classes for Officers (7.48/12 credits).
  - For maximum credit each officer should be certified in accordance with the general criteria of NFPA 1021 standard. In addition to this benchmark, each officer should receive 12 hours of continuing education on- or off-site annually. The PFD is not meeting this section to its fullest potential.
- Water Supply: #630. #631 (3.40/7)
  - This item reviews the fire hydrant inspection frequency, and the completeness of the inspections in accordance with the AWWA M-17 standard. The credits received (3.40) means fire hydrants have not been inspected in five years or more.
  - This item also reviews the frequency of flow testing of hydrants. The credits received (0.00) means the hydrants have not been flow tested for ten or more years.

ISO Analysis Recommendation:

- CPSM recommends the PFD review and address, to the extent possible, deficiencies in the Fire Department section of the current ISO-Public Protection Classification report as outlined in this report. Special attention should be given to developing methods and opportunities for members to achieve the training as required in the ISO analysis, as it is focused on firefighter safety, improved competencies, and overall improved fireground effectiveness and functionality. This includes, given the identified building risks in the town, ensuring company personnel conduct (and document for future ISO reviews) live fire, multi-company, and training facility hands-on training as required; and developing an officer training program targeted at ensuring officers have opportunities for the various levels of officer certification and that they receive structured annualized officer training. (Recommendation No. 4.)

COMMUNITY RISK REDUCTION

Community Risk Reduction activities are important undertakings of a modern-day fire department. A comprehensive fire protection system 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 occur, 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.

Fire prevention should be approached in a systematic manner, and many community stakeholders have a personal stake and/or responsibility in these endeavors. It has been estimated that a significant percentage of all the requirements found in building/construction and related codes are related in some way to fire protection and safety. Various activities such as plan reviews, permits, and inspections are often spread among different departments in the municipal government and are often not coordinated nearly as effectively as they should be. Every effort should be made to ensure these activities are managed effectively between departments.

The Fire Prevention Division in the PFD is commanded by the Fire Marshal. In addition to the Fire Marshal, the office is staffed with a captain and one lieutenant. In addition to overall management of the Fire Prevention Division, the Battalion Chief also focuses on building plans review that link to the fire prevention code and also conducts inspections. The captain as well is involved in plans review as well as permitting and fire prevention code enforcement. The lieutenant position focuses on residential inspections, inspections turned over by engine companies, and multifamily building inspections. Together these three positions administer the fire code inspection program, fire permitting functions, plan review, public education, fire investigation, and associated risk reduction programs.

In addition to Fire Prevention personnel conducting fire inspections, engine companies participate in this endeavor as well. ***This is a national best practice.*** Engine companies are assigned *Business Occupancy* classification inspections (B-Group). This group includes occupancies in stand-alone buildings or those in a portion of a building and generally used as offices and professional or service type transactions.

At the time of this analysis the PFD Community Risk Reduction 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, 9th edition.

For 2019, 2020, and 2021 the Fire Prevention Division and engine companies conducted the inspections shown in the following table.

TABLE 3-4: PFD Completed Fire Inspections, 2019–2021

2019	2020	2021
4,072	3,049	3,963

Note: 2019, 2020, 2021 fire inspections completed affected by the COVID pandemic.

For 2019, 2020, and 2021 the Fire Prevention Division conducted the plans review shown in the following table.

It should be noted that many plan reviews, particularly those involving fire protection systems, site plan review, and fire department ingress and egress require a final fire inspection, which is coordinated and conducted by the Fire Marshal's Office.

TABLE 3-5: PFD Completed Plans Review, 2019–2021

2019	2020	2021
242	378	126

Note: 2019, 2020, 2021 plan reviews completed affected by the COVID pandemic.

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 PFD does have a public education program in place, which is coordinated by the Fire Prevention Division in partnership with fire operations and suppression companies. The PFD provides the following programs for public education:

- General fire training for businesses.
- Trip & fall safety, cooking safety, smoke detector checks for seniors and the aged.
- School programs (pre-school through high school) that include stop, drop, and roll.
- What to do after you call 911.
- Touch a truck events for children.
- Egress training (how to exit in the event of a fire or smoke).

For 2019, 2020, and 2021 the Fire Prevention Division coordinated public education programs shown in the following table. Fire suppression companies routinely participate in these programs as well.

TABLE 3-6: Public Education Programs, 2019–2021

2019	2020	2021
35 events	6 events; 4 Zoom	17 events; 6 Zoom

Note: 2019, 2020, 2021 public education programs completed affected by the COVID pandemic.

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, or

they believe a crime has been committed, a Fire Prevention Division member responds for fire and arson investigation.

For 2019, 2020, and 2021 the PFD staff conducted the following number of fire investigations.

TABLE 3-7: PFD Fire Investigations, 2019–2021

2019	2020	2021
22	26	27

The Fire Prevention Division manages an extensive workload when considering the number of fire code inspections and plans review completed. Included in fire prevention inspections are those inspections that are required by law to be conducted annually, such as schools (required four times/year), public assemblies, institutional class occupancies that include day care centers, assisted living and nursing homes, and businesses holding a liquor license. Aside from these there are occupancies that require inspections such as those that receive a permit issued by the Fire Prevention Division, new construction or new rebuild that includes fire protection systems such as sprinkler systems (residential and commercial), new businesses, and residential structures that change ownership. Fire suppression companies assist with the overall workload; however the remaining inspections are conducted by the three personnel in the Fire Prevention Division.

Community Risk Reduction Recommendation:

- CPSM recommends the PFD address Community Risk Reduction staffing and adjust staffing as necessary to ensure current (and future) inspectable properties are receiving annualized (where required) inspections, and those not requiring annualized inspections receive timely inspections in accordance with applicable laws and standards, and as established by the Fire Marshal. Addressing this deficiency in Community Risk Reduction will require additional staffing to the extent possible with available funding and should be addressed over the near to mid-term (1 to 5 years) with an additional fire prevention inspector, or at a minimum, a part-time inspector whose focus would be on those inspections that are required on an annualized cycle. (Recommendation No. 5.)

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 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, covering 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 multi-company training; structural firefighting; officer development; driver-operator/pump and aerial; hazardous materials; and building familiarization.

The training division in the PFD is managed by a Battalion Chief. There are no other staff resources dedicated to this division. The Battalion Chief also serves as the PFD safety officer.

The PFD does not have a documented training program for new and incumbent personnel *per se* that focuses on all components as outlined above. The department has a standard it follows for new employees and does have directed training at the company level for certain training, but not as a standardized practice. Training typically occurs at each station as the PFD does not have a training facility. This includes:

- Basic firefighter training for new employees. This is an eight-week program new employees attend prior to being assigned to an operations company on shift and that covers basic firefighting such as fireground safety; proper wearing of protective ensemble gear; fire behavior; fire control and fire streams; donning and operating with self-contained breathing apparatus; ground ladder placement and climbing; search and rescue; ventilation; use of fire department hand tools; ropes and knots; forcible entry; rescue and extrication; and live fire training.
- State certification in Firefighter I and II. Employees attend the Massachusetts Firefighting Academy for this training and attend when a slot can be secured for those needing this certification. Not all staff assigned to operational companies have this training when assigned.
- Company-level training led/assigned by the company officer. This includes firefighting and EMS training; fire management zone training such as street locations, fire alarm box locations in the zone, hydrant locations and/or drafting locations in non-hydrated areas, and familiarization of buildings in the zone.
- Staff are encouraged to attend specific courses at the Massachusetts Firefighting Academy to gain ProBoard certifications (National Professional Qualifications System Standards certification training). Through the collective bargaining agreement staff are provided with 20 hours annually to attend these courses.

Because so much depends upon the ability of the emergency responder to effectively deal with an emergency, education and training must have a prominent position within an emergency responder's schedule of activities when on duty. Education and training programs also help to

create the character of a fire service organization. Agencies that place a real emphasis on their training tend to be more proficient in carrying out day-to-day duties. The prioritization of training also fosters an image of professionalism and instills pride in the organization.

Overall, the PFD lacks a comprehensive training program.

This is validated in the 2019 ISO-PPC report as the department received 4.62/9 points for training overall. A deeper dive into the ISO-PPC report tells us the PFD was deficient in company level training as it received just 7.12 out of 35 credits available for annualized live structural fire training at a facility and 14.06/25 credits for monthly training in structural firefighting.

During the CPSM on-site visit, staff advised CPSM that they rarely participate in multicompany, hands-on training drills and that there is no standardized training. Further discussion did outline that company level training does occur and company officers do receive a monthly syllabus for training. It is clearly reasonable that some days it will be difficult to complete the required training as various time demands throughout the duty day, including emergency responses, pose a competing demand for training time. Yet, in many fire departments less-than-efficient time management and even past practice can hinder attempts to provide training for on-duty personnel. We believe that this is at least partially true in Plymouth. ***Every effort should be made to continue to make completion of the daily training task a priority and include live, hands on training as frequently as possible.***

Additional daily opportunities for training can be found during related activities such as daily/weekly apparatus and equipment inspections and building pre-planning activities. Annual inspection and testing requirements such as for hose, pumps, hydrant flow testing, etc. can also provide additional training credits for personnel who participate. Training can and should also be conducted during evening hours and on weekends.

On the EMS side of operations, the training programs and requirements are primarily driven by the mandatory nature of continuing education and recertification requirements for various levels of practitioners. If individual personnel or the agency were to not keep up with required training and/or certification requirements, they could lose the ability to practice or provide the prescribed levels of service.

As mentioned previously, the PFD does not have a digital/software training/training compliance solution. Vector Solutions (formerly Target Solutions) is one such solution that is widely used by fire departments. It has a robust course catalog system for fire and EMS training (among other disciplines in need of continuing education) that can be utilized to meet all federal, state, and local public safety training mandates. Its inventory is comprised of more than 450 hours of fire department training, as well as 250 hours of accredited EMS training.[8]

Using this solution, the Battalion Chief of Training or other designated personnel could post training and information materials online for personnel to reference. A training schedule can be posted prominently on Vector Solutions and be accessible to all personnel. Vector Solutions also provides the platform for managing all training records and reports for compliance. The use of a solution such as this will help to ensure that there is a reliable and accurate database for tracking and retrieval of all department-level training and for recording and tracking the status of certifications for all personnel.

Professional development for fire department personnel, especially officers, is also an important part of overall training. There are numerous, excellent opportunities for firefighters and officers to attend training on a wide range of topics outside of Plymouth, including those offered at various

[8] https://www.vectorsolutions.com

state firefighting academies and at the National Fire Academy in Emmitsburg, Maryland. Beyond the practical benefits to be gained from personnel participating in outside training, encouraging personnel to earn and/or maintain various specialized certifications such as Fire Instructor, or Fire Officer increases the positive professional perception of the organization and can help to demonstrate a commitment to continued excellence.

As of the time of this analysis the PFD has no formal professional development program in place. While many department officers have earned various professional certifications, some perhaps as the result of mandatory training, it has primarily been through their own pursuit of professional development. Supervisors are not required to hold fire officer certifications and there is no system for professional development in anticipation of promotion.

PFD officers typically should provide feedback to personnel regarding their performance, but there is no formal testing or skills assessments for fire training in the department. Training is a required activity in the fire service and the ability to incorporate a formal testing process as part of the learning effort is essential. Traditionally, fire departments are reluctant to incorporate skills testing into their fire training components. However, an increasingly common way to evaluate a department's training program is through annual skills proficiency evaluations where all members of the department are required to successfully perform certain skills and/or complete standardized evolutions, either individually, or as part of a team.

The ability to monitor and record training test scores is beneficial from an overall proficiency standpoint. In addition, training scores should be incorporated into the annual performance appraisal process for both the employee, his or her supervisor, and the training staff. In addition, the concept of adding a testing process to each training evolution adds to the importance and seriousness in which these activities are carried out.

The PFD does not currently utilize a formal task book process to provide training guidance and new rank orientation. A growing number of fire departments are employing task books for personnel who aspire to (or in some cases have already been promoted to) higher rank. For the PFD, task books would be appropriate for firefighter, driver, company officer, and Battalion Chief. The successful completion of any task book can be considered as a prerequisite for promotion to higher rank including company officer or Battalion Chief, or alternatively, can be a required element of the post-promotional evaluation process.

Beyond the establishment of requirements to achieve certain levels of certification for promotion, the department should consider the implementation of a formal professional development program for all department personnel. The program should attempt to strike an appropriate balance between technical/practical task books, simulator training, formal certifications, mentor relationship, and outside influences. Where practical, best practices identified by the NFPA, ISO, IFSTA, IFSAC, and the Center for Public Safety Excellence (CPSE) should be incorporated.

Training and Education Recommendations:

- CPSM recommends that, due to the importance of training as outlined herein, the town consider funding a training officer at the lieutenant level to develop, coordinate, manage, and deliver consistent training and education programs for new hires and incumbent personnel of the PFD. This position will have primary responsibility to ensure PFD staff are proficiently trained to perform assigned tasks; that they maintain state, national, and ISO standards; and that required certifications and annual coursework are current and properly documented. (Recommendation No. 6.)

- CPSM recommends the PFD pursue, based on available funding, a digital platform for training and training compliance to be used as a didactic/virtual platform for department training. (Recommendation No. 7.)

CPSM further recommends:

- The PFD should make a concerted effort to send as many officers as possible to the National Fire Academy (NFA). Any officer who meets the admissions criteria should be encouraged to enroll in the academy's Executive Fire Officer Program. (Recommendation No. 8.)
- CPSM recommends the PFD develop task books for firefighter, driver, company officer, and Battalion Chief. Firefighters should be required to complete their book as part of their probationary period. For other ranks, all personnel aspiring for promotion to a higher rank should be required to successfully complete all elements of that rank's task book to be eligible to participate in the formal promotional testing process. (Recommendation No. 9.)
- CPSM recommends the PFD develop and institute annualized practical skills proficiency evaluations as part of the department's comprehensive fire training program. (Recommendation No. 10.)
- The PFD should provide all companies and personnel with high-intensity training on various subjects, including multicompany drills and periodic live fire training on at least an annual basis (to the extent possible) at an appropriate location where appropriate training facilities, structures, and props are available. (Recommendation No. 11.)
- CPSM recommends that the town develop a mid- to long-term plan to provide funding for the PFD to develop and construct an appropriate training facility where it can safely perform live training evolutions for all personnel. (Recommendation No. 12.)

911-DISPATCH SERVICES

Primary 911-dispatch services for the PFD are handled by the PFD fire dispatch center located on the first floor of PFD Station 1. Typical staffing for this center are two telecommunicators who are also uniform firefighters.

The radio system for the PFD consists of two UHF channels and two VHF channels. There are also two citywide UHF channels available for use by the PFD if needed. Use of the radio channels further breaks down as follows:

- Primary PFD operations occur on the two UHF channels.
  - Channel 1 is the primary operations channel.
  - Channel 2 is the multicompany response channel.
    - The PFD dispatch center dispatches on and monitors both channels.
- The two VHF channels are used primarily for station alerting.
  - Station alerting is completed with the Zetron alerting system.
  - Medical calls from Brewster Ambulance are received over the VHF system.
  - Fire alarm boxes are transmitted over the VHF system.

The PFD dispatch center serves as a secondary Public Safety Answering Point (PSAP), meaning the center receives the actual call from another primary PSAP, which is either the Plymouth Police Department (PPD) dispatch center, or Brewster Ambulance Service (BAS). The following outlines how the calls are processed:

- 911 calls originating in the town via landline go to the PPD PSAP, which in turn processes the call as either police, fire, or EMS. Once processed the caller is transferred by phone (phone to phone) to the PFD dispatch center for fire calls or the BAS dispatch center for EMS calls. The BAS dispatch center then transfers the call to the PFD dispatch center over the VHF primary channel (radio to radio) for fire EMS assist dispatching of the appropriate unit(s) when fire units are needed to respond.
- 911 calls originating as EMS from direct calls into the BAS dispatch center are transferred to the PFD dispatch center over the VHF primary channel (radio to radio) for fire EMS assist dispatching of the appropriate unit(s) when fire units are needed to respond.
- 911 calls originating through cellular service go to the state 911 center, which in turn processes the call as either police, fire, or EMS. Once processed the caller is transferred to the PPD dispatch, which then transfers the caller, after confirming the call as either police, fire, or EMS, to the PFD dispatch center for fire calls or the BAS dispatch center for EMS calls. The BAS dispatch center then transfers the call to the PFD dispatch center over the VHF primary channel (radio to radio) for fire EMS assist dispatching of the appropriate unit(s) when fire units are needed to respond.

None of the above methods for call processing are efficient. Ideally, emergency service calls are received by a primary PSAP that is also responsible for the dispatch of units and personnel, or go through a primary PSAP that quickly and efficiently transfers the call either phone-to-phone, radio-to-radio, or CAD-to-CAD.

NFPA Standard 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, and NFPA 1710 identify call arrival and transfer times at the primary PSAP (State, PPD, BAS) as well. ***The standard for the State 911, PPD, and/or BAS dispatch centers is:***

- The call arrives at the primary PSAP, is processed as to fire or EMS, and is transferred in 30 seconds or less 95 percent of the time.

From a fire and EMS perspective, the communications center is measured on three critical points in the overall cascade of events linking the event to the incident response force. These are ***how the call is routed through the public safety network and its capabilities*** (wireline phone, wireless phone, E911capabilities, Voice over Internet Protocol (VoIP), mobile satellite services, telematics, and Text Telephone Devices (TTYs)), ***time to answer*** (the time it takes to answer an incoming call on the emergency phone line), ***and alarm processing time*** (the time it takes to process and create the event and then notify the emergency response unit(s)).

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 PSAPS and dispatch centers. For the PFD, this refers to the PFD 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 PFD, this measurement is applied to the PFD 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 PFD 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.*
- *HazMat incidents.*
- *Technical rescue incidents.*
- *Incomplete location.*
- *Calls received by text message to the communications center.*

The 90th percentile dispatch times (the time to process calls for service) as recorded during the one-year period analyzed by CPSM are:

- EMS: 2.2 minutes.
- Fire: 2.5 minutes.

Both of these time elements exceed the NFPA standard. The time the actual call is received and then transferred from a primary PSAP to the PFD dispatch center adds to this time and exacerbates the total call processing time, further delaying the arrival of emergency service units.

The next figure illustrates the event timeline when the primary PSAP (State 911, PPD, and/or BAS dispatch centers) is other than the communications center, which in this case is the PFD.

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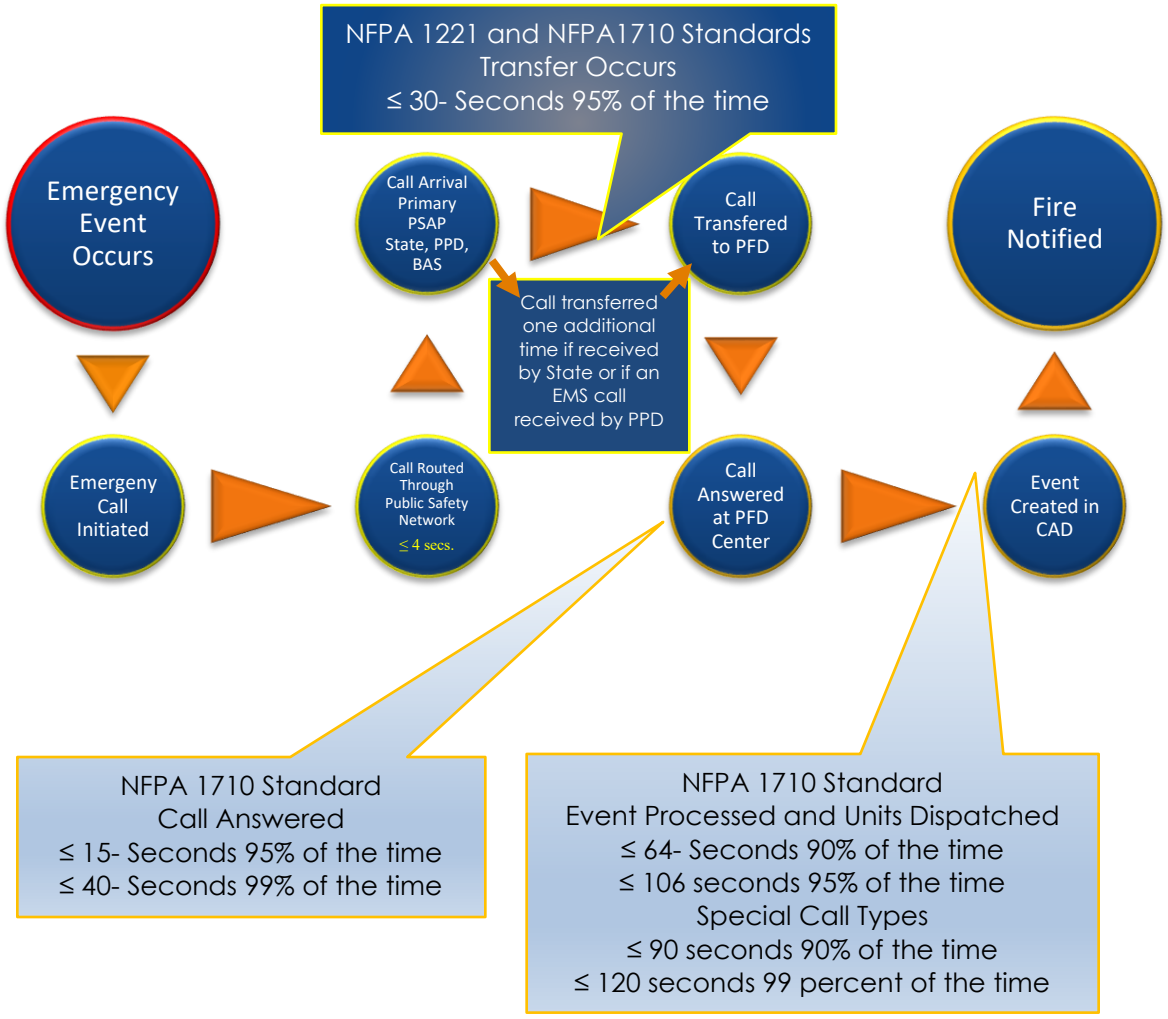
FIGURE 3-5: Event Timeline for 911 Call Receipt, Transfer, and Processing



During the CPSM on-site visit, CPSM observed the PFD communications staff answer, process, and dispatch calls for service (fire and EMS). Not mentioned above, but as important, the town has a number of fire alarm boxes (this includes 120 street boxes) that transmit to the PFD dispatch center (which are *efficient in the sense the call is transmitted directly to the dispatch center; however, the true nature of the call is unknown*).

CPSM observed the communications staff receive a radio message from BAS regarding an EMS call, which was received and dispatched quickly and efficiently. As a note, the BAS utilizes a medical priority dispatch system that prioritizes calls for service. Information received through this call processing is not transferred to the PFD dispatcher receiving the radio call for assistance but is transferred to the BAS medic unit when they are dispatched. The PFD dispatches EMS calls to fire units based on very little information received either as Level 1 (no lights and siren); Level 2 and Level 3 (lights and siren with Level 3 a higher priority).

CPSM also observed the communications staff receive and process a fire alarm box quickly and efficiently, as well as take several phone calls and one phone alarm for a single unit fire response, which was processed and quickly dispatched.

Also, during the-site visit, the Fire Chief advised CPSM that the CAD and work-station system is due for replacement in the near term. CAD system replacements or upgrades as well radio equipment components and systems are costly. Given the multiple PSAP configurations outlined above, and the near-term cost for radio system upgrades in the PFD 911 dispatch center, the PFD should consider other alternatives for 911 dispatch services.

911-Dispatch Recommendations:

- In the near term, the PFD should work to implement performance measures and compliance methodologies for call processing times in the 911-dispatch center to address the long call processing times and should include all primary Public Safety Answering Points and the transfer time of emergency calls to the PFD. There should be a focus on closing the gap between the national standard and the current time in Plymouth to process and dispatch all calls for service. (Recommendation No. 13.)
- In the mid to long term, given the multiple PSAP configurations outlined in this report, and the cost for CAD, radio system, and console upgrades in the PFD 911-dispatch center, the PFD should begin to explore other opportunities for 911-dispatch services to include participating in the Plymouth County Sherriff's Department communications center. This exploration should include enhanced management of Public Safety Answering Point incoming calls to include a centralized Public Safety Answering Point for all town emergency services, which should have a focus on minimizing call processing times for fire and EMS calls for service. Should the PFD decide to transition this function to another agency, CPSM recommends the PFD retain the uniform firefighters assigned to the 911- dispatch center and utilize their knowledge, skills, and abilities either in fire suppression, fire administration, or any other division where there is a need in the PFD. (Recommendation No. 14.)

FIRE ALARM DIVISION

The Fire Alarm Division is responsible for maintaining the the town's municipal fire alarm system, fire department radios, and station alerting systems. This division is staffed by a single Fire Alarm Superintendent.

The municipal fire alarm system is a complex system that includes 120 street boxes; 215 local energy master boxes; 4 shunt trip master boxes; 7 electronic master boxes; 59 radio master boxes; 1 LW Bills Form 4 type power supply-all circuits supervised; 1 digitized Form 4 at Station 5; 2 signal communications Vision-21 alarm receivers; 10 Punch registers distributed among all fire stations; 20 single-stroke bell- distributed among all fire stations; 17.4 miles of underground cable; and 34.7 miles of aerial cable. The Fire Alarm Superintendent maintains, repairs, and replaces all of these components except underground cable, which is contracted out to a vendor who specializes in this work.

The Fire Alarm Superintendent also performs the following tasks, which reduces reliance on external vendors and provides budget savings: designs, builds, and maintains light timers for fire stations; designs, builds, and maintain decoders for the two-tone fire station alerting system; maintains all audible alerting devices in the fire stations; maintains in-house fire alarm systems; maintains fire station watch desk controls; fire station electrical troubleshooting and repair; maintains fire station vehicle exhaust systems; and maintains fire fleet electronic sirens.

During our discussions with the Fire Alarm Superintendent, we found there are times when he is tasked with replacing aerial cable, which is scheduled annually, or repairing other components of the fire alarm system; meanwhile, work orders come in for the many other tasks, components, and systems he is responsible for. Many such requests require attention in the immediate or near term due to their importance in the overall fire alarm, station alerting, and radio systems.

Fire Alarm Division Recommendation:

- CPSM recommends, that because of the criticality of the fire alarm, station alerting, and radio systems, and because the Fire Alarm Division has only one staff member to maintain all of the components of these systems, the PFD consider budgeting (as funding is available) for a full-time fire alarm technician or at a minimum a part-time position (technician level). This position would assist the Fire Alarm Superintendent with the maintenance of the components of the municipal fire alarm, station alerting, and radio systems, and other fire department electrical and mechanical systems assigned to the Fire Alarm Division to maintain. (Recommendation No. 15.)

FLEET

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

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 PFD who provide emergency services within the community, the department's fleet of response vehicles is essential to operational success. Modern, reliable vehicles are needed to deliver responders and the equipment/materials they employ to the scene of dispatched emergencies within the city.

PFD apparatus maintenance is performed by the department's vehicle maintenance shop under the command of a Chief Master Mechanic. Assisting the Chief Master Mechanic are two assistant fire mechanics. When needed the maintenance shop utilizes a private vendor that specializes in apparatus-specific maintenance. This combination of maintenance and repair work is common practice across the country. The intricacies and scope of fire pumps and fire pump controls, aerial ladder hydraulic systems and controls, and apparatus electrical control systems (the main components outside of the motor, chassis, and drive train) are best left in the hands of specialists such as the Chief Master Mechanic and his personnel and third-party vendors when needed for diagnosis, maintenance, and repair of fire apparatus and apparatus systems.

While on-site the CPSM consultants visited the fire apparatus shop, which is adjoined to Station 2. CPSM found a very active shop with repairs of several apparatus ongoing, and a dedicated team working on apparatus and small equipment. CPSM toured the shop, the parts room, spoke with mechanics, and observed the operation. Regarding the fleet maintenance and repair, CPSM found the shop and personnel to be prepared for all routine and emergency maintenance. Shop personnel were quite knowledgeable about fire apparatus and apparatus systems. As previously discussed, one item that was prominently discussed is the shop's lack of a records management system (RMS) that integrates with other departmental records systems. Recording hours of work, cost for repairs, new and recurrent apparatus issues that are readily available for review by fire administrative staff and shop personnel, as well as feedback on issues

for line personnel to review are essential components of a contemporary fleet maintenance program.

Another issue raised by the Chief Master Mechanic is the wear and tear on apparatus due to the overall heavy PFD workload (Fire and EMS responses). Plymouth, like other northeast U.S., suburban-based communities, has a road network that is demanding on heavy fire apparatus. Stop-and-go responses, and winter weather conditions that create asphalt and concrete road degradation, create wear and tear on apparatus chassis systems, brake systems, and the apparatus power train. A review of EMS responses and an alternative response matrix is discussed in the EMS section later in this report.

The PFD currently operates a fleet of fire apparatus as outlined in the following tables.

TABLE 3-8: PFD Fire Apparatus

Unit Number	Unit Type	Unit Description	Unit Age (In Years)
Engine 8	Reserve Engine	1999 Pierce Dash	**23**
Engine 10	Reserve Engine	2007 Pierce	**15**
Engine 9	Reserve Engine	2007 Pierce	**15**
Engine 2	Frontline Engine	2008 E- One	**14**
Engine 5	Frontline Engine	2008 E- One	**14**
Engine 1	Frontline Engine	2011 E-One Cyclone	**11**
Engine 7	Frontline Engine	2013 E-One Cyclone	**9**
Engine 6	Frontline Engine	2017 E-One Cyclone	**5**
Engine 3	Frontline Engine	2019 E-One Cyclone	**3**
Engine 4	Frontline Engine	2021 E- One Cyclone	**1**

TABLE 3-9: PFD Ladder and Rescue/Service Company Apparatus

Unit Number	Unit Type	Unit Description	Unit Age (In Years)
Ladder 2	Ladder–Frontline	1996 75-foot Aerial	**26**
Tower 1	Ladder–Frontline	2006 Pierce Tower	**16**
Rescue 1	Rescue–Frontline	2014 E-One Emax	**8**
Ladder 3	Ladder–Frontline	2019 E-One 100'	**3**

TABLE 3-10: PFD Tanker Apparatus

Unit Number	Unit Type	Unit Description	Unit Age (In Years)
Tanker 1	Tanker–Frontline	1989 Mack AWD	**33**
Tanker 3	Tanker–Frontline	1990 Ford F900	**32**
Tanker 2	Tanker–Frontline	2017 Kenworth E-One	**5**

TABLE 3-11: PFD Forest Fire Apparatus

Unit Number	Unit Type	Unit Description	Unit Age (In Years)
FF 177	Forest Fire	1990 I.H. EJ Murphy	**32**
FF 375	Forest Fire	1991 I.H. E.J. Murphy	**31**
FF 174	Forest Fire	1992 I.H. E.J. Murphy	**30**
FF 176	Forest Fire	1993 I.H. E.J. Murphy	**29**
FF 179	Forest Fire	1993 I.H. E.J. Murphy	**29**
FF 173	Forest Fire	1998 I.H. E.J. Murphy	**24**
FF 172	Forest Fire	2003 Freightliner/EJ	**19**
FF 175	Forest Fire	2005 Freightliner	**17**
8-1	Forest Fire	2015 International	**7**

Replacement of fire-rescue response vehicles is a necessary, albeit expensive, element of fire department budgeting which should reflect careful planning. A well-planned and documented emergency vehicle replacement plan ensures ongoing preservation of a safe, dependable, and operationally capable response fleet. A plan must also include a schedule for future capital outlay in a manner that is affordable to the community.

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 membership 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 fire fighters 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 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:[9]

- Apparatus that was not manufactured to applicable NFPA fire apparatus standards or that is 25 years old should be replaced. The PFD has frontline apparatus that exceeds 25 years of age. These apparatus include one ladder truck, water tankers, and heavy brush firefighting apparatus. 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, CPSM understands 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 they may pose to firefighters and the public who shares 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 in which it is refurbished. 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*.

9. 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.

While the PFD Chief Master Mechanic does an annual grading schedule for apparatus and command cars, which assists in the decision-making process for apparatus replacement and/or refurbishment, the PFD does not have an established fleet replacement plan that follows the NFPA recommendations for apparatus replacement as such: 10 years of frontline service then 5 years of reserve service, or 15 years of frontline service and then upgrading to the NFPA 1912 standard.

The second option is reasonable considering the cost of new fire apparatus today. The PFD operates an active status fleet of heavy fire apparatus (10 engines; 3 ladders; 1 rescue; 3 tankers). Five of the apparatus are beyond the 15-year frontline/reserve age for active status as recommended in the current edition of NFPA 1901. PFD apparatus, particularly those that are older than 20 years, although seemingly road- and response-worthy, lack contemporary road, motor, chassis and chassis systems, and emergency response operational and safety features included in apparatus constructed during the last two to three cycles of NFPA 1901 (2003, 2009, 2016), as noted above.

Fleet Recommendations:

- CPSM recommends the PFD develop, over a one-year period, a fire apparatus replacement plan that includes, to the extent possible and funding availability, replacement according to recommendations in accordance with NFPA 1901, *Standard for Automotive Fire Apparatus*. (Recommendation No. 16.)

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 for the apparatus to undergo 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. 17.)
- Apparatus in active/reserve status and which is between 20 and 25 years old should comply with NFPA 1901 and undergo a Level 1 refurbishing in accordance with NFPA 1912 as an immediate planning objective if the department plans to continue to use this apparatus. All apparatus at the 25-year-old mark should be considered for replacement. Apparatus greater than 25 years old should be removed from service. (Recommendation No. 18.)
- 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. 19.)
- Apparatus components that are either fixed or portable and which require annualized testing, 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. 20.)

- CPSM recommends the PFD acquire a fleet records management system or fleet module to an existing PFD records management system that integrates fleet records with other departmental records so that hours of work, cost for repairs, and new and recurrent apparatus issues are readily available for review by fire administrative staff and shop personnel and as well that is designed so that feedback on apparatus issues and repairs is readily available to line personnel for review, process improvement, and training. (Recommendation No. 21.)

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The PFD also has an assortment of command and light-response vehicles to include watercraft and special equipment trailers. There are no specific NFPA recommendations on these types of vehicles but there are fleet industry standards that PFD can use to determine service life for budgeting purposes.

The remaining PFD fleet of specialty units such as trailers, boats and ATVs have a service life based on their maintenance and condition. Trailers, non-firefighting boats, and ATVs do not have an NFPA recommendation on service life that is applicable.

TABLE 3-12: PFD Command and Light Vehicles

Unit Number	Unit Type	Unit Description	Unit Age
C15	Utility	2001 Ford F250 4WD	**21**
C8	Utility Car	2002 FORD F-350 4	**20**
C10	Utility Car	2003 Ford Fire Alarm	**19**
C6	Utility Car	2006 Ford Sedan	**16**
C14	Chief Officers	2008 Tahoe Utility Car	**14**
C13	Utility Car	2008 Tahoe Utility Car	**14**
C17	Utility Car	2010 Ford Expedition	**12**
C11	Utility Car	2012 Ford 4X4 pick	**10**
C4	Utility Car	2013 Ford Utility	**9**
C5	Utility Car	2013 Ford Utility	**9**
C3	Chief Officers	2016 Suburban	**6**
C2	Chief Officers	2017 Ford Expedition	**5**
C12	Utility Car	2017 Ford Expedition	**5**
C1	Chief Officers	2019 Suburban Chief	**3**
C9	Utility	2020 Ford F350 4X4	**2**
C7	Chief Officers	2021 Ford Expedition	**1**

The PFD does have a 2012 33-foot fire boat that is based on NFPA 1925 *Standard on Marine Fire-Fighting Vessels*. This standard details requirements for the construction of new marine firefighting vessels, the conversion of existing vessels for firefighting purposes, as well as testing and maintenance. This fire boat is an important deployable service for service to the town.

Fleet Recommendations:

- CPSM recommends the PFD develop a grading scale for the remaining light vehicle and marine fleet to help determine each vehicle's service life to ensure these vehicles and trailers remain in a safe operating condition and meet industry standards based on their condition or usage. (Recommendation No. 22.)
- IF PFD continues to operate a marine firefighting vessel, then proper cross-staffing, maintenance, operating guidelines, and storage are required to ensure safe operations. (Recommendation No. 23.)

SUCCESSION PLANNING

During our analysis, CPSM was not able to identify a clear organizational succession plan. Additionally, there is not a career path program that outlines expectations and helps to prepare staff for advancement to various levels in the organization, to include middle and senior management. One important element for the organization is to implement programs that identify the future leaders of the organization; that is, programs that go beyond the technical courses for career advancement preparation. A key to this is to develop and implement a formal succession plan, focused on developing potential successors to ensure organizational leadership stability. This type of planning is typically designed to identify, develop, and nurture potential future leaders.

There are a few examples of succession planning that work well in fire departments. These are:

- **Development-based Processes**: A succession planning model that equips an employee or group of employees for future roles and responsibilities through diverse organizational program exposure and assignments.
- **Replacement Planning**: A process of identifying replacement staff for key positions and functions and developing these employees over the short term.
- **Career Path Training**: A program that identifies technical and organizational development courses and/or formal education that must be completed as employees prepare to elevate responsibility or position in the organization. Ideally a candidate for any officer level in the department is experienced and has the foundational technical and formal education and training to be successful with each new level promoted to. To ensure this and to ensure the PFD is preparing future officers, a formal program that identifies those foundational technical and organizational courses germane to each level in the organization should be selected and implemented. A growing number of fire departments are employing task books for personnel who aspire to (or in some cases have already been promoted to) higher rank. For the PFD, task books would be appropriate for firefighters, lieutenants, and captains. The successful completion of any task book can be considered as a prerequisite for promotion to higher rank including captain, or alternatively, can be a required element of the post hire/promotional evaluation process.
- **Succession Planning**: A more future-focused process of categorizing the knowledge, skills, and abilities needed to perform organizational functions. Linked to this is the development of a plan that has the intent of preparing multiple employees to potentially perform those functions and which creates opportunity for advancement in the organization.

Critical to the success of succession planning is the engagement and commitment of the senior leaders to the program, as well as the commitment of other members of the organization to their

own personal and professional development. To be a part of the succession plan, one must commit to one's own professional development process to be able to compete for and fill critical organizational leadership roles.

Succession Planning Recommendation:

- CPSM recommends the PFD work with the collective bargaining unit and the town's Human Resources department to develop a succession plan that is diverse, includes the entire organization, and has a focus on preparing current and future members to take on additional roles and responsibilities, and as well as prepares members for advancement and promotion into key roles in the organization. (Recommendation No. 24.)

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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 Plymouth was 61,190 in 2020. This is an 8.41 percent increase in population since the 2010 census of 56,468. This averages 0.841 percent for each year over the ten-year period. From 2020 to 2021 the same U.S. Census Bureau report shows that Plymouth increased its population by 1.5 percent, with a population of 62,131 as of July 2021. The population density in 2020 was 634.8 per square mile. This is an increase of 49 people per square mile over the 2010 Census numbers.

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 national findings were identified for the period 2015–2019:[10]

- Males were more likely to be killed or injured in home fires than females and accounted for a larger percentages of victims (57 percent of the deaths and 55 percent of the injuries).
- The largest percentage 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 aged 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 incidents ranking a close second (20 percent).
- 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 Plymouth, the following age, and socioeconomic factors (using 2020 U.S. Census figures) are considered herein when assessing and determining risk for fire and EMS preparedness and response:[11]

- Children under the age of five represent 4.2 percent of the population.

10. M. Ahrens, R. Maheshwari "Home Fire Victims by Age and Gender," Quincy, MA: NFPA, 2021.
11. U.S. Census Bureau QuickFacts: Town of Plymouth, Massachusetts

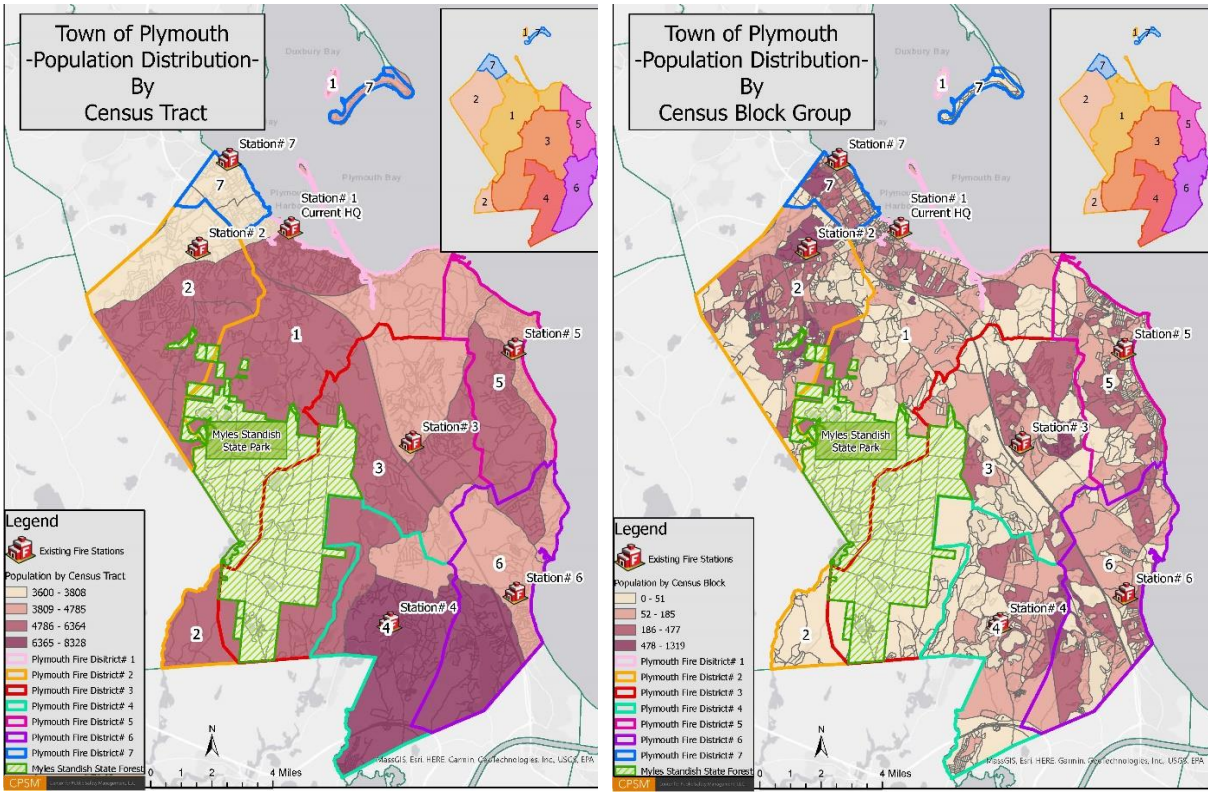
- Persons under the age of 18 represent 17.5 percent of the population.
- Persons over the age of 65 represent 23.4 percent of the population.
- Female persons represent 51.8 percent of the population.
- There are 2.43 people per household in Plymouth.
- The median household income in 2020 dollars was $92,757.
- People living in poverty make up 5 percent of the population.

Black or African American alone represents 1.7 percent of the population. The remaining percentage of population by race includes White alone at 93.8 percent, American Indian or Alaska Native alone at 0.1 percent, Asian alone at 0.8 percent, two or more races at 2.6 percent, and Hispanic or Latino at 3.1 percent.

The next figure illustrates population density in Plymouth.

FIGURE 4-1: Population Density with Fire Station Locations

Density by Census Tract | **Density by Census Block Group**



As Plymouth has a growth plan that includes a village concept outside of the established downtown and coastal areas, it makes sense that population density is more concentrated in these areas. This does have an impact on the response of fire and EMS staff and equipment, as the village development coupled with the state park and forest land area centralizes fire stations to a village but separates assisting fire companies due to distance.

The Town of Plymouth's Comprehensive Emergency Operations Plan (CEOP) outlines several key findings related to the Town's land use, which are relevant to a growth discussion here.

> *The Town of Plymouth is in southeastern Massachusetts within the Old Colony Region. Plymouth spans an area of approximately 103 square miles with 37 miles of coastline. The Town's distinguishing natural features are its ocean coastline, the Myles Standish State Forest, Pine Hills Country, and over 450 ponds, of which 83 are classified as great ponds.*
>
> *Plymouth remains attractive to both residents and businesses because it still possesses large tracts of undeveloped land, limited regulations, a rural character, and proximity to the Boston metropolitan area. There are many transportation options including new high-volume highways, buses, and trains that enable commuter access to the entire region and beyond. Plymouth's most notable transportation resources include Routes 3 and 44, Plymouth Municipal Airport, as well as three public transit options such as the Greater Attleboro Taunton Regional Transit Authority (GATRA) regional bus lines, the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail, and the Plymouth & Brockton Bus Line.*
>
> ***Myles Standish State Forest and Pine Hills***
>
> *The Myles Standish State Forest is located in the central part of Plymouth and includes 14,635 acres of forest composed of pitch pine and scrub oak. The forest is classified as a "pine barren" because the soil was historically considered too poor or barren to support agriculture. The soil in this type of environment is both extremely dry and strongly acidic, which limits the decomposition of pine needles, sticks, and leaves. Accumulation of these flammable materials increases the favorable conditions necessary for wildfire. The Pine Hills are sparsely populated and hilly. It is the most dominant landscape feature in the Town of Plymouth. The region consists of hills that rise from the coastline to an elevation of nearly 400 feet. The vegetation present in the Pine Hills is considered flammable.*
>
> ***Atlantic Coastline***
>
> *Plymouth's eastern border spans 37 miles of the Atlantic seaboard. The Town's prominent position on the coast is a major aspect of its history and standing as a popular residential community. The coastline is vulnerable to threats such as coastal erosion, flooding, hurricanes/tropical storms, landslides, and tsunamis. These hazards each represent dual threats to the Town of Plymouth in that they pose their own inherent risk while also contributing to coastal erosion and the continuous changes to the shoreline. In particular, coastal erosion along the bluffs in the southern part of Plymouth has degraded the condition of several existing structures, including occupied homes. The buildings continue to be at greater risk; however, hard, and soft mitigation solutions are both incorporated into the landscape to stabilize the slope and protect the structures.*
>
> ***Historical Downtown Area***
>
> *Downtown Plymouth is a dense 12 to 15 block area generally bounded by Court Street (Route 3A) and Water Street, which is near both Plymouth Rock and the Mayflower. This area houses several shops, restaurants, hotels, museums, and private residences, which are some of the oldest structures in America. The area consists of minimum spacing between buildings, wood structures, and some*

facilities built prior to standard building codes. The entire area is susceptible to fires that could rapidly engulf the entire historic downtown.

The next figure illustrates the city's land use and developable land as recorded in the Economic Development Strategy Plymouth, Massachusetts 2018.

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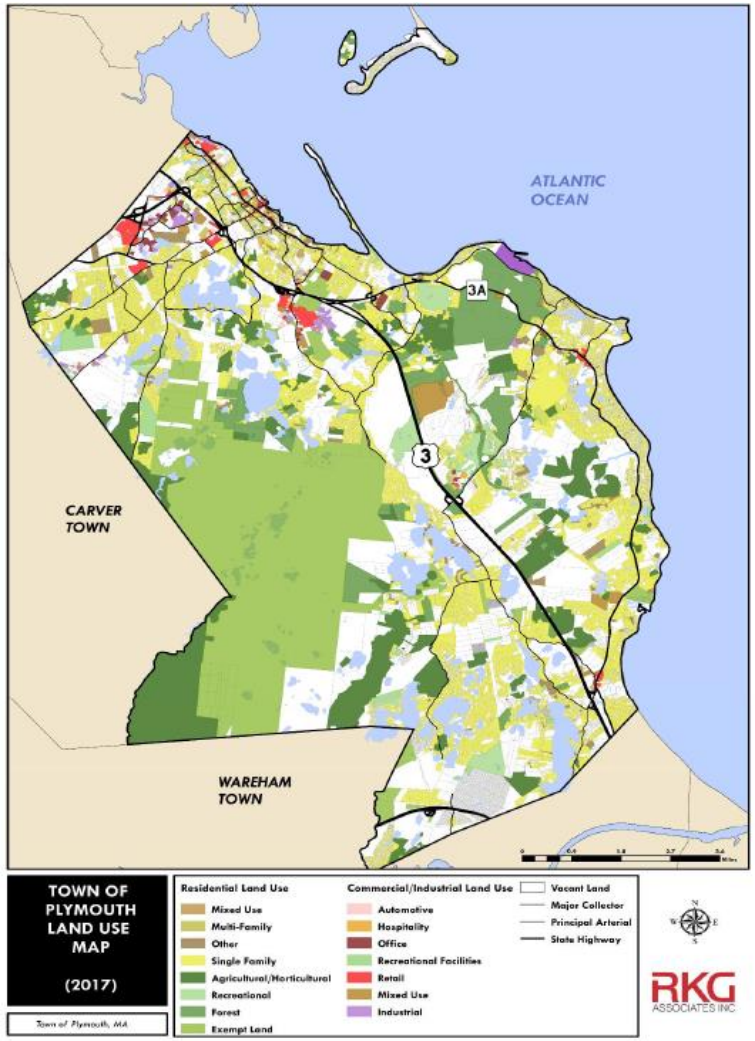
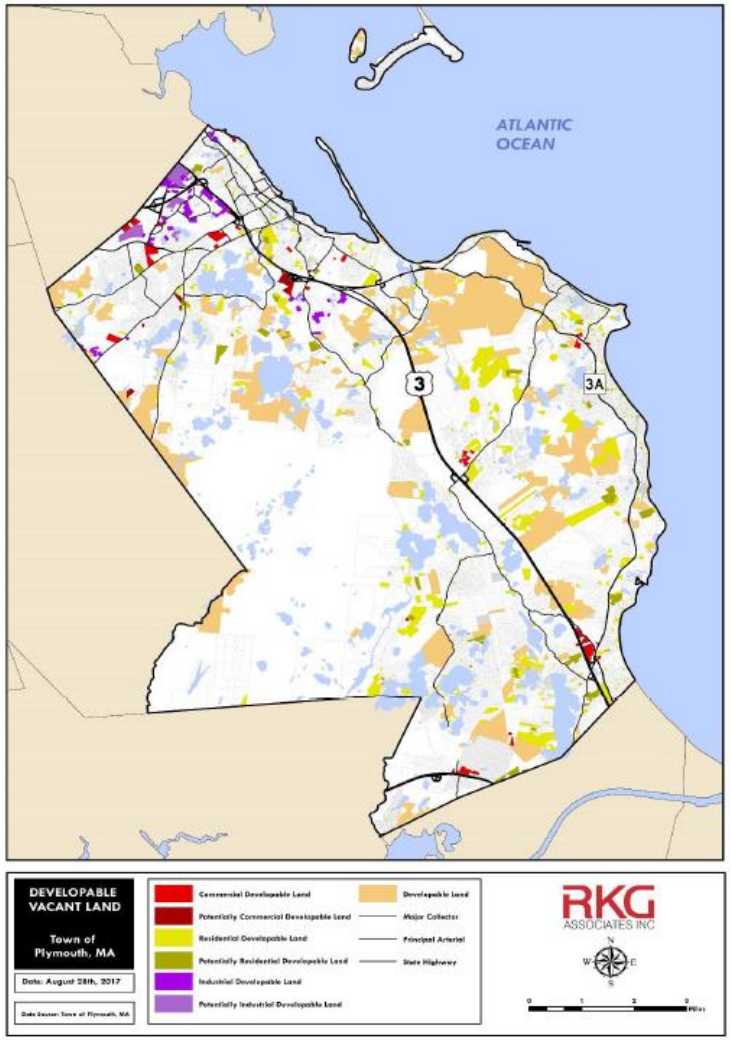
FIGURE 4-2: Town of Plymouth Land Use[12]

Land Use Map



Developable Land Map



12. Economic Development Strategy Plymouth, Massachusetts 2018

ENVIRONMENTAL FACTORS

The Town of Plymouth 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 Plymouth Massachusetts Hazard Mitigation Plan 2021, are shown in the following table.[13]

TABLE 4-1: Natural Hazards Probability in Plymouth

Hazard	Frequency	Severity
Flood-Related Hazards	High	Extensive/Serious
Winter-Related Hazards	High	Extensive/Serious
Wind-Related Hazards	High	Extensive
Geologic-Related Hazards	Very Low	Serious
Drought	High	Minor
Urban Fire/Wildfire	Medium	Minor
Invasive Species	Medium	Minor

Criteria for Frequency Categorization

- Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% / year).
- Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1.0% / year).
- Medium: Events that occur from once in 10 years to once in 100 years (1.0% to 10% / year)
- High: Events that occur more frequently than once in 10 years (greater than 10% / year)

Criteria for Severity Categorization (Based on Past Hazard Events)

- Minor: Limited and scattered property damage; no damage to public infrastructure; contained geographic area; essential services not interrupted; no injuries or fatalities.
- Serious: Scattered major property damage; some minor infrastructure damage; wider geographic area; essential services are briefly interrupted; some injuries/fatalities.
- Extensive: Consistent major property damage; major damage to public infrastructure; essential services are interrupted for several hours to several days; many injuries and fatalities.
- Catastrophic: Property and public infrastructure destroyed; essential services stopped; thousands of injuries and fatalities.

The Wildland-Urban Interface (WUI) in Plymouth is within the third most hazardous wildfire-interface area in the country, with fires able to spread across 40 acres in a minute. Specifically, the town is highly susceptible to wildfires due to the presence of flammable vegetation, prevailing offshore winds, and increasing development near woodlands. Historically, up to 15,000 acres have been affected within a single wildfire incident.[14]

The geographic landscape that exists in and around Plymouth and its vulnerability to varied hazards commonly draws numerous emergency responders for search and rescue activities. With more than 37 miles of ocean coastline, 450 ponds, and one of the largest contiguous forests

13. Plymouth Massachusetts Hazard Mitigation Plan 2021.
14. Town of Plymouth | Comprehensive Emergency Operations Plan (CEOP) May 2017.

north of Long Island, the potential for displaced, stranded, lost, or trapped individuals needing prompt rescue from an emergency or disaster exists.

BUILDING AND TARGET HAZARD FACTORS

A community risk and vulnerability assessment will 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), 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.[15]

Plymouth has the following building types.

- Single-family homes, 19,439 total (highest total building count).
- Townhomes/condos, 3,693 total (varying number of vertical floors).
- Mobile home and properties with more than one house, 143 total.
- Two-family, total 521.
- Three-family, total 76.
- Apartment building units and assisted living, total 151.
- Commercial structures (includes vacant lots), total 744
- Industrial structures (includes vacant lots), total 291.
- Chapter 61,61A,61B properties, total 196.
- Mixed-use property, total 159.
- There are no current high-rise structures.
- Strip malls, total 19.

The predominant building type/building risk in Plymouth is single-family detached dwellings (a low-hazard occupancy). The primary construction type for residential structures in Plymouth is Type V-B, which does not require a fire resistance rating for any of the building elements (typically wood frame).

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

Multifamily buildings and apartments also exist in Plymouth. Typical construction includes non-fire resistive, wood frame with one-hour fire rating, and protected combustible construction. Some apartment complexes include a multibuilding footprint. The town does have an assortment of manufactured homes as well, which are typically made of light metal/wood construction with various exterior coverings.

The strip mall inventory consists of non-fire resistive, fire resistive (one-hour fire rating), and protected combustible construction (one-hour fire rating). The commercial/industrial structure building inventory is ordinary (block/brick) construction, wood frame with composite siding, and masonry non-combustible construction.

According to the Town of Plymouth's "Housing Production Plan, January 2019," Housing Stock Analysis, was as follows:

- The number of housing units in Plymouth is expected to increase 26.87 percent by 2030.
- Single-family detached structures make up 72.1 percent of all housing units in Plymouth.
- Plymouth's housing stock is relatively young, with approximately 54.4 percent of Plymouth's housing stock built after 1969 and 39.6 percent of those units built between 1980 and 2009.
- Most Plymouth residents own their own home; 78.01 percent of housing units are owner-occupied.

Plymouth's zoning bylaws restrict multifamily development to one residential zoning district by special permit. Cordage Park 40R, Downtown Harbor (DH), Open Space Mixed-Use Development (OSMUD), Traditional Rural Village Development (TRVD), Waterfront (WF) and Transitional Commercial (TC) also allow for multifamily by special permit. Much of the multifamily housing stock in North Plymouth today has evolved from mill housing that was originally built for the Cordage workers.

As noted above, Plymouth's housing stock primarily consists of single-family detached homes. This type of housing accounts for 72.1 percent of the homes in Plymouth. The remaining 27.9 percent of the housing stock consists of single-family attached homes (6.9 percent), two unit homes (5.10 percent), three to four unit homes (3.9 percent), complexes of 10 to 19 units (3.7 percent), smaller complexes of 5 to 9 units (3.0 percent), complexes of more than 20 units (2.8 percent), and mobile homes (2.5 percent).

The most frequent causes for structural fires are related to food preparation, heating equipment malfunctions, electrical distribution and lighting equipment, arson, and smoking. The town conducts extensive preparedness training for both professionals and the public. It maintains seven well-equipped fire stations across Plymouth and integrates mitigation through enforcement of building codes and other best practices. The Town of Plymouth is the home of a variety of historic buildings located along the downtown harbor district. Due to age, many structures pre-date contemporary code, which elevates the risk of structural fires throughout this area, which has high actual and intrinsic value.

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.

The Town of Plymouth has a variety of target hazards that have been assigned meet an established hazard class:

High Hazard

- Assisted living/nursing facilities.
- Educational facilities.

Medium Hazard

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

The greatest building risk by number of buildings in Plymouth are of a low to moderate hazard. **(Single family dwellings, predominately of wood frame construction, are low hazard. Those with basements and more than 2,000 square feet should be considered moderate hazards.)** Plymouth does have high risk/vulnerable population risks (nursing/assisted living facilities), detention/correctional centers, places of public assembly, schools, and multifamily residential structures (apartments/condos), All of these building risks present the PFD with life-safety concerns and challenges of direct access and density. Industrial and mercantile building risk are generally a higher hazard risk based on processes, storage, and overall occupancy type. Those with high numbers of staff and workers at any given time of the day (some operate around the clock) would present with a higher life-safety risk.

The following figure illustrates designated target hazards in the town.

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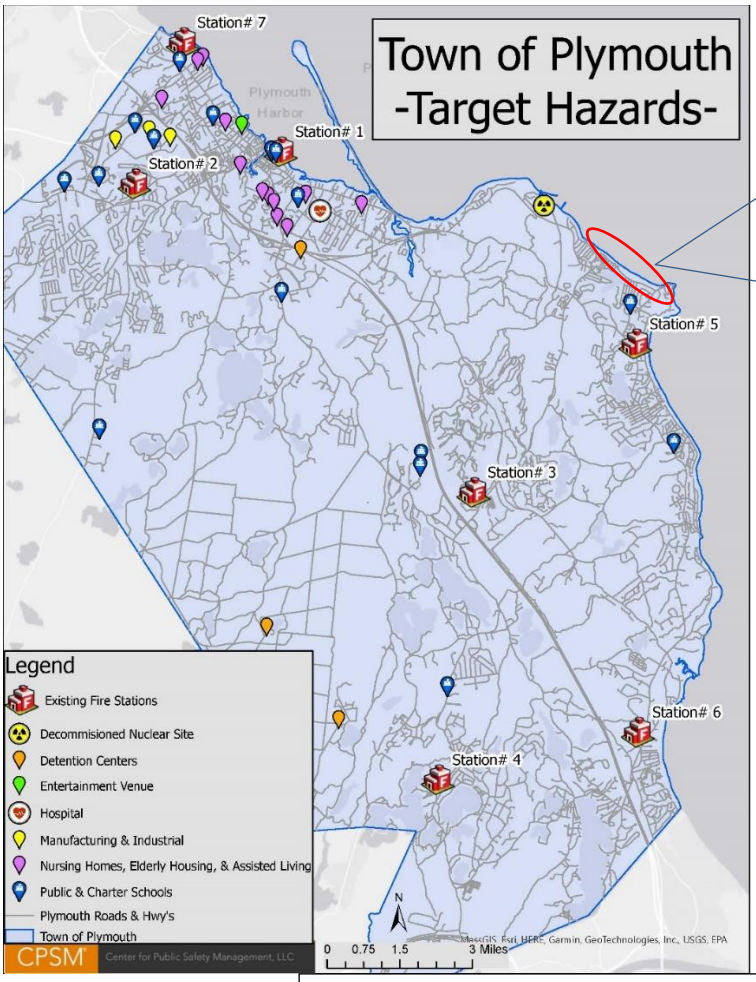
FIGURE 4-3: PFD Designated Target Hazard Locations



This area includes houses that are sited in rows and are not accessible by road. To combat fires in these structures, firefighters will have to hand lay attack lines, several hundred feet dependent on the distance of the structure from the road and apparatus. Additional hazards include exposure distance from structure to structure and prevailing coastal winds.

TRANSPORTATION FACTORS

Plymouth, like most Massachusetts communities, is largely dependent on the automobile for basic transportation. The town's 103-square mile area, its dispersed population, and the separation of residential and commercial areas contribute significantly to the reliance on private automobiles. Naturally, as Plymouth's population has grown and its commercial base has expanded, the number of cars on the town's roads has also increased. Over the next 20 years, traffic volume increases may strain the capacity of local roads. Already, there is growing congestion at key intersections, especially during peak travel hours in the morning and evening. There are currently alternatives to the private automobile; however, these are limited. Limited bus service does connect the major points in the community. The commuter rail service extends from Kingston through North Plymouth. However, bus and rail have relatively low ridership, and much of Plymouth is not served by any form of public transit.

The Town of Plymouth contains 530 miles of roadways. Most road segments and intersections in the town function very well under current traffic loads. In fact, many miles of rural roadway experience limited traffic volumes. However, several arterial and collector streets and related intersections experience significant congestion and safety problems, such as:

- Samoset Street.
- Route 3A (Court Street/Main Street/Main Street Extension/Sandwich Street).
- Route 3A (Warren Avenue/State Road).
- Long Pond Road.
- South Street.

Congestion on these roads has impacts on emergency response vehicles.

The next figure illustrates the road transportation network in Plymouth.

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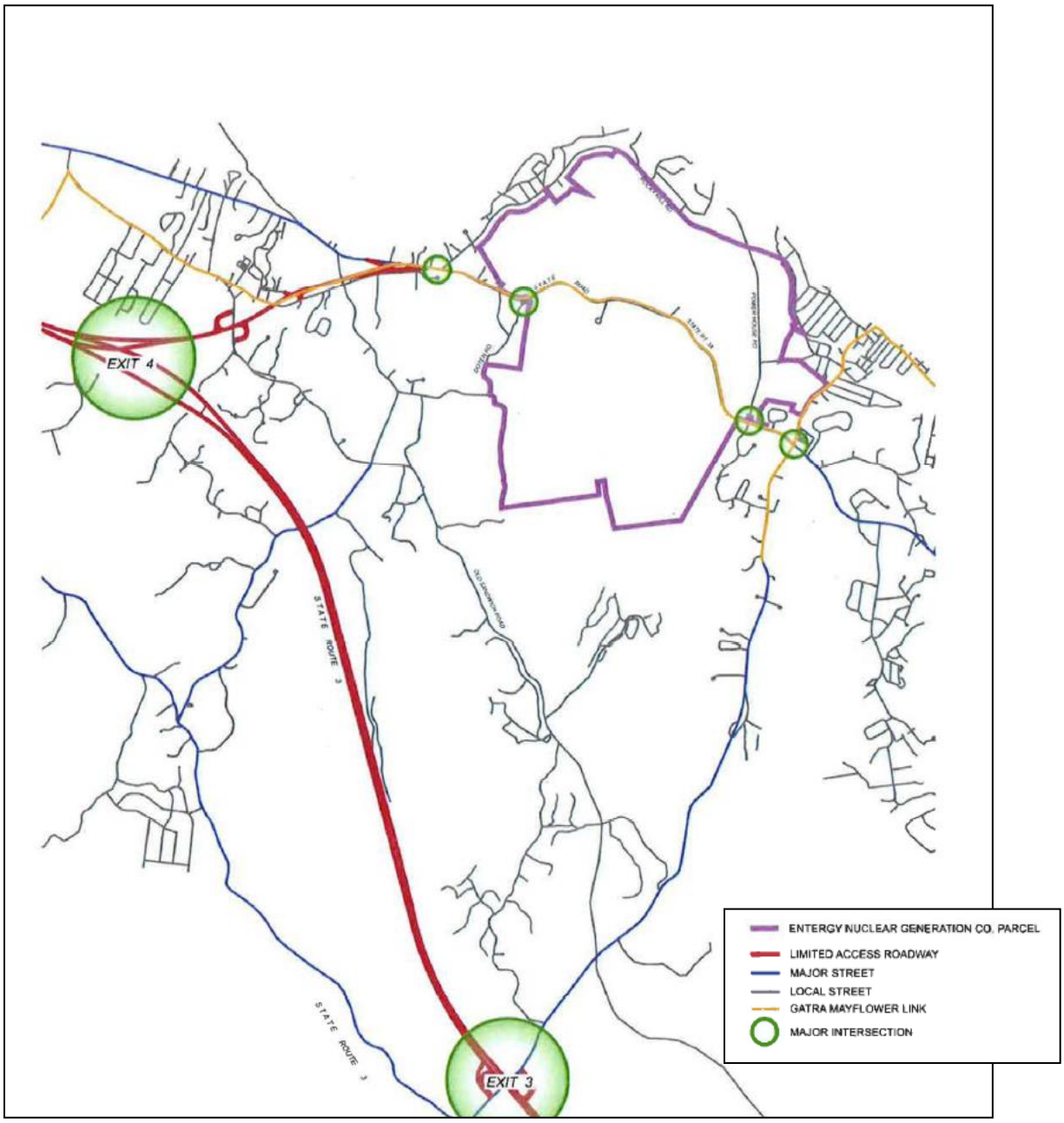
FIGURE 4-4: Principal Road Network in Plymouth



The Plymouth Municipal Airport on South Meadow Road consists of approximately 755 acres. The airport is an active general aviation airport serving both business and recreation aviation needs in Plymouth and southeastern Massachusetts. Plymouth Municipal Airport is home to several types of private and business aircraft, several hangars, and several aviation and non-aviation businesses. The airport does have a capital improvement program that has a focus on improving the infrastructure to aviation and non-aviation activities. The airport has continued to develop available acreage to expand aviation and industrial activity.[16]

16. 2005 Airport Development Master Plan

The Greater Attleboro and Taunton Regional Transit Authority (GATRA) serves as the regional mass-transit provider in Plymouth through fixed bus routes, paratransit, senior transportation, and similar forms of public transportation. Specifically, GATRA East serves the Town of Plymouth with two fixed bus routes with connections to others in the overall system as illustrated. P&B Bus Lines also has a hub and maintenance center in Plymouth.

Due to limited ridership and service, MBTA commuter rail serving Plymouth station was closed for an indefinite period in April 2021.

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-trailers and other commercial vehicles traverse the roadways of Plymouth to deliver mixed commodities to business locations. Fires or releases of product involving these commodities 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 town or utilizing the road network in the town for stops in jurisdictions external to Plymouth.

FIRE AND FIRE-RELATED 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 to analyze the Plymouth 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 April 1, 2021, and March 31, 2022.

TABLE 4-2: Fire Call Types, One-year Study Period

Call Type	Total Calls	Calls per Day
False alarm	1,441	3.9
Good intent	141	0.4
Hazard	432	1.2
Outside fire	109	0.3
Public service	841	2.3
Structure fire	68	0.2
Technical Rescue	20	0.1
Canceled	612	1.7
Mutual Aid	10	0.0
Fire Total	**3,674**	**10.1**

This table tells us:

- Fire calls totaled 3,674 (35 percent of all calls that include EMS, canceled, and mutual aid), or an average of 10.1 calls per day.
- False alarm calls made up 39 percent of fire calls.
- Structure and outside fire calls combined made up two percent of total calls (five percent of fire calls), or an average of 0.5 calls per day, or about one call every two days.
- Overall, there are 10.1 fire responses/day made by the PFD.

EMS RISK

As with fire risks, an indication of the community's pre-hospital emergency medical risk is the type and number of EMS calls to which the fire department responds.

The following table outlines the call types and call type totals for these types of EMS risks between April 1, 2021, and March 31, 2022.

TABLE 4-3: EMS Call Types, One-year Study Period

Call Type	Total Calls	Calls per Day
Breathing difficulty	786	2.2
Cardiac and stroke	886	2.4
Fall and injury	1,337	3.7
Illness and other	2,267	6.2
MVA	580	1.6
Overdose and psychiatric	288	0.8
Seizure and unconsciousness	740	2.0
EMS Total	**6,884**	**18.9**

This tables tells us:

- EMS calls totaled 6,884 (65 percent of all calls that include fire, canceled, and mutual aid), an average of 18.9 calls per day.
  - Illness and other calls were the largest category of EMS calls at 33 percent of EMS calls.
  - Motor vehicle accidents (MVA) made up eight percent of EMS calls.
  - Cardiac and stroke calls made up 13 percent of EMS calls.
  - On average, eight calls/day per day were higher-acuity calls for service, with some illness or other call types reaching a higher acuity call after initial assessment by PFD crews.

COMMUNITY LOSS AND SAVE INFORMATION

Fire loss is an estimation of the total 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 predominant building type/building risk in Plymouth is single-family detached dwellings (a low-hazard occupancy).

The following table shows overall fire loss in Plymouth in terms of dollars for the year 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 4-4 : Historical Property and Content Loss in Plymouth

2017	2018	2019	2020	2021
$2,107599	$3,602,665	$1,331,881	$2,639,243	$2,195,885

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

FIRE INCIDENT DEMAND 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 the overall fire incident and EMS ground transport demand in a more defined manner by specific call types. These include a breakout of structural and outside fire incidents; false alarms (typically fire alarms); and EMS incident demand that breaks out motor vehicle accidents.

The heaviest demand is central to the developed villages, downtown and northwest, and along the coast east and southeast. This is predictable as these are the most dense areas of the town and where the PFD has initial response resources. 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.

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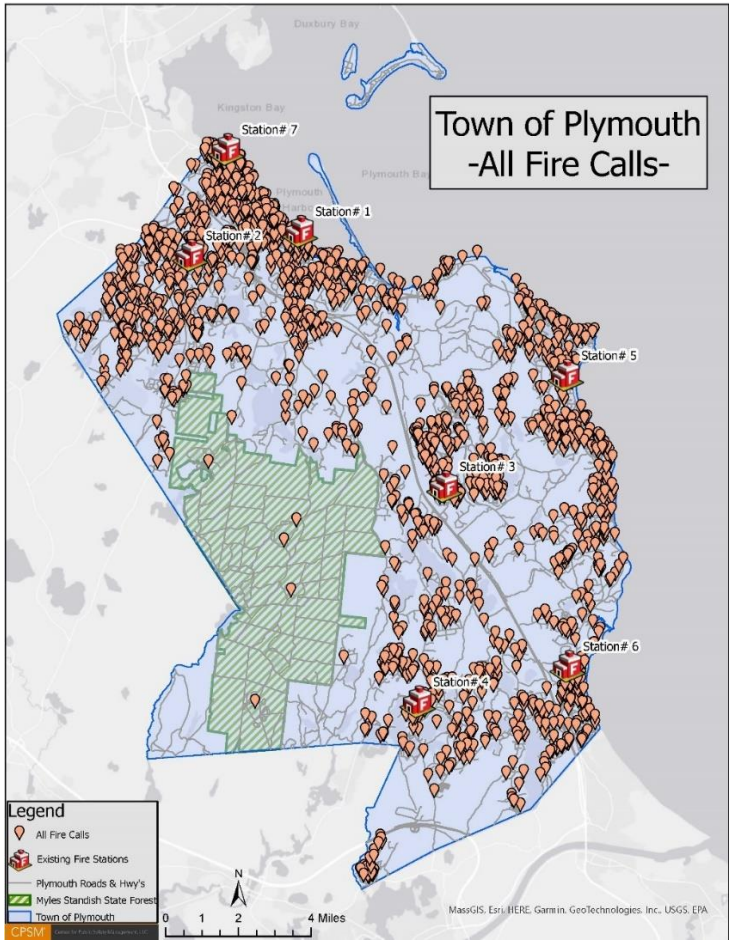
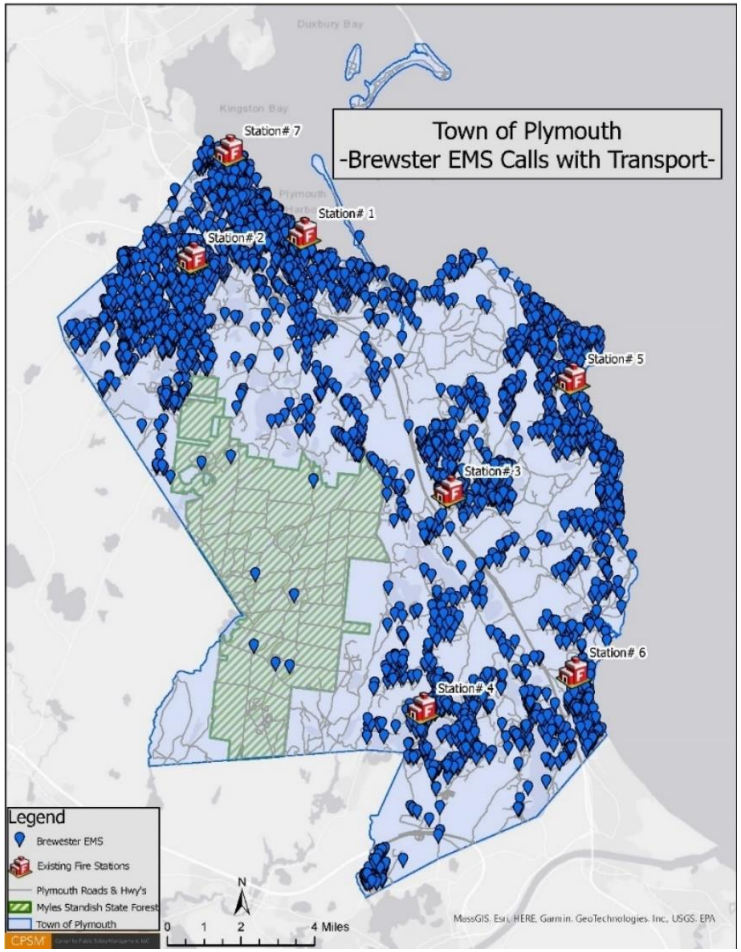
FIGURE 4-5: All Fire Demand; All EMS Transport Demand

All Call Types: Fire Demand



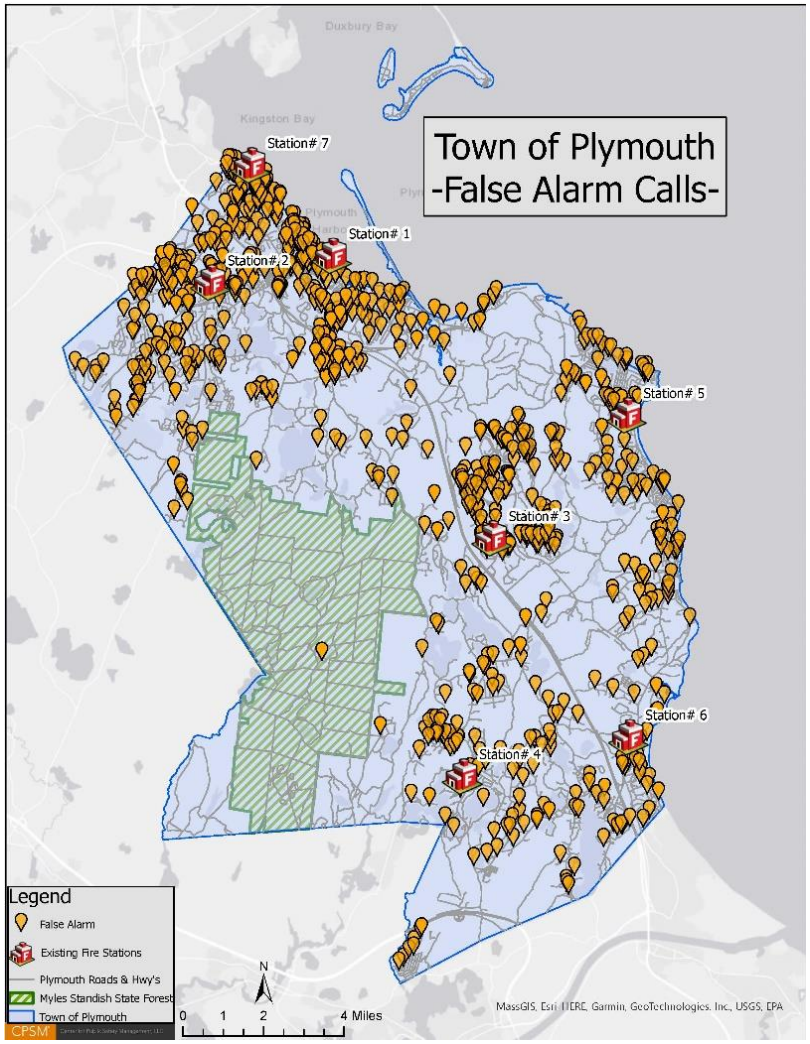
EMS Demand-Brewster EMS Transport



Note that the PFD responds to all EMS incidents along with Brewster Ambulance Services.

FIGURE 4-6: Fire Demand: False Alarm Calls; Structure & Outside Fire Calls

False Alarm Calls



Structure & Outside Fire Calls

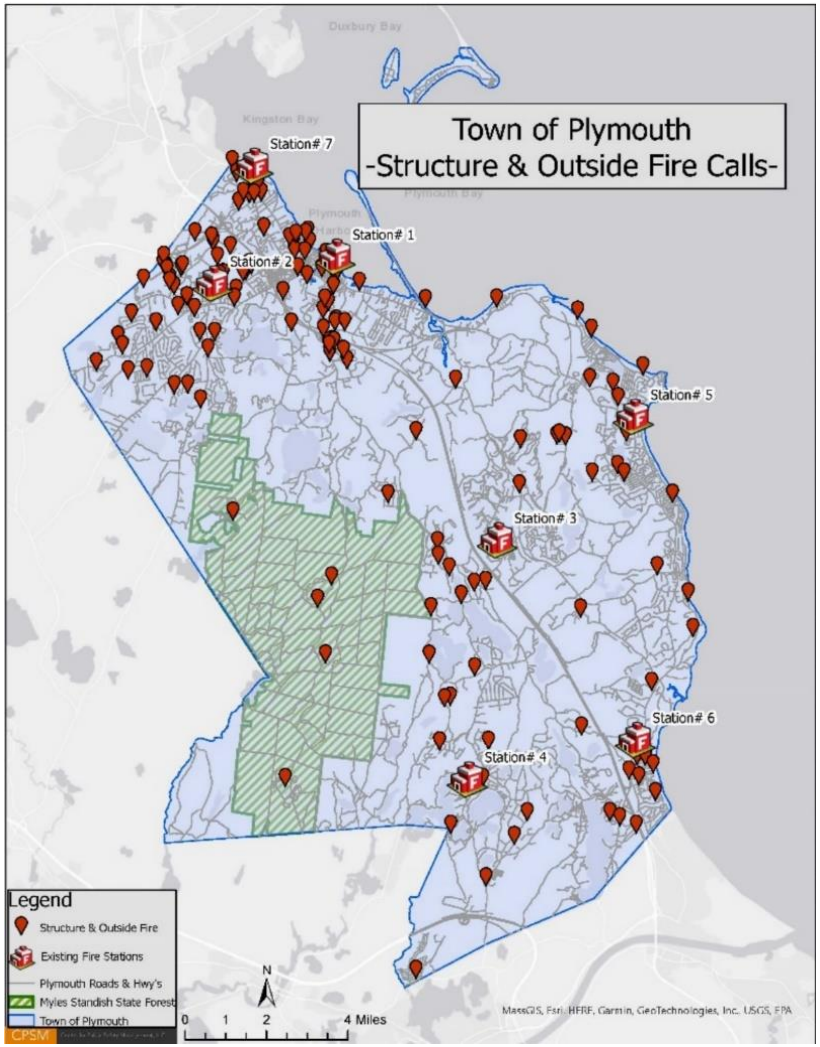
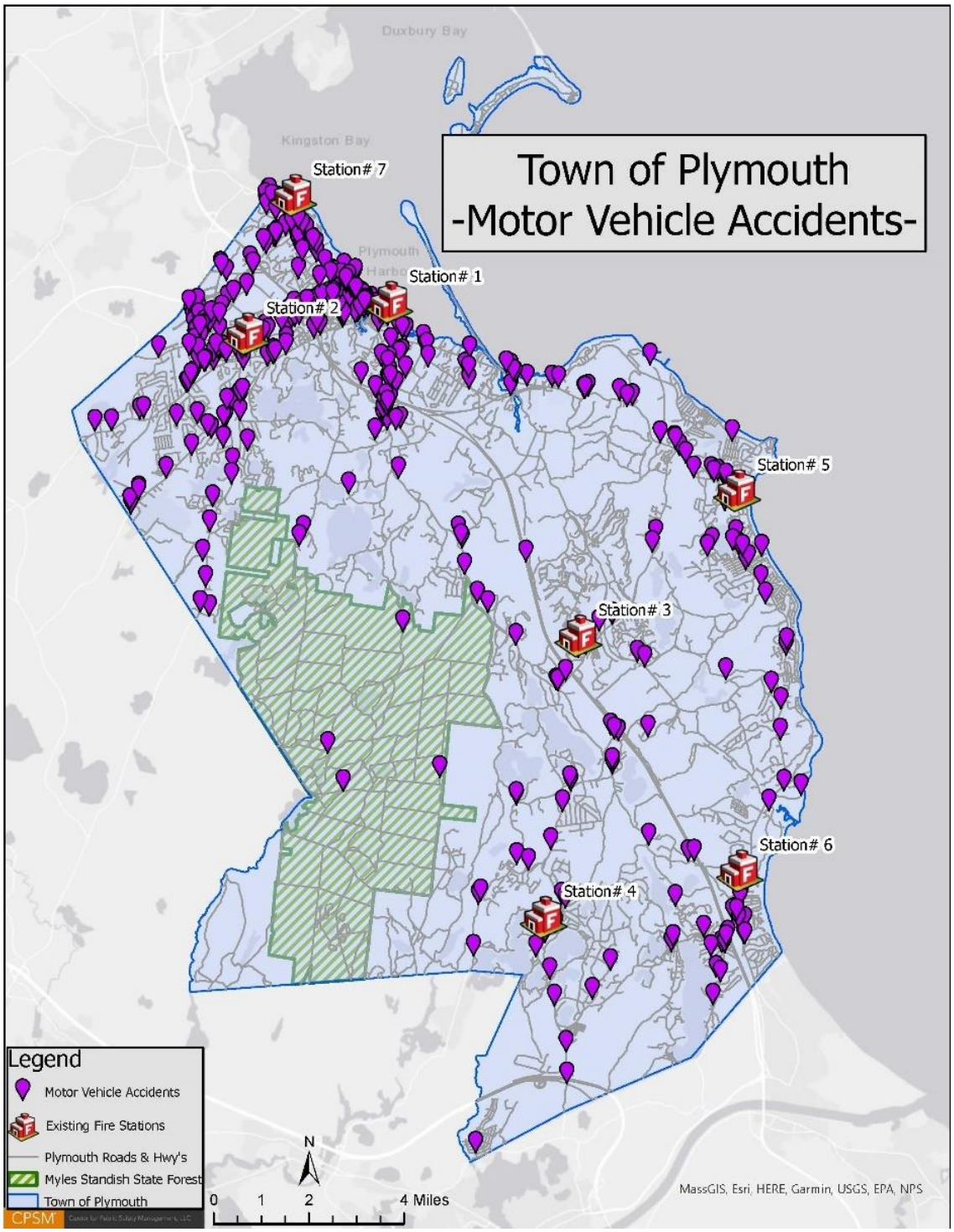


FIGURE 4-7: MVA Incident Demand



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

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

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

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

Between April 1, 2021, and March 31, 2022, PFD's fire units responded to 10,316 calls. The following tables and figure analyze PFD resiliency. In this analysis, CPSM included all calls that occurred inside and outside Plymouth. We did this because responses outside of the town (although few) impact the resiliency of the department to respond to calls inside of the town.

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
1	2,805	2,749	98.0	2,746	97.9	2,746	97.9
2	2,104	1,948	92.6	1,944	92.4	1,939	92.2
3	1,432	1,374	95.9	1,372	95.8	1,369	95.6
4	732	707	96.6	707	96.6	707	96.6
5	1,202	1,152	95.8	1,151	95.8	1,150	95.7
6	651	626	96.2	625	96.0	625	96.0
7	1,390	1,315	94.6	1,311	94.3	1,297	93.3
Total	**10,316**	**9,871**	**95.7**	**9,856**	**95.5**	**9,833**	**95.3**

TABLE 4-6: PFD Workload by Station and Unit

Station	Unit	Unit Type	Minutes per Run	Total Hours	Total Pct.	Minutes per Day	Total Runs	Runs per Day
1	BC	Battalion Chief	35.0	201.9	5.1	33.2	346	0.9
	E1	Engine	19.2	831.3	20.8	136.7	2,592	7.1
	E8	Reserve Engine	20.8	375.6	9.4	61.8	1,083	3.0
	TWR1	Ladder	18.6	151.2	3.8	24.9	488	1.3
	Other	Other	45.8	32.0	0.8	5.3	42	0.1
	Total		**21.0**	**1,592.1**	**39.9**	**261.7**	**4,551**	**12.5**
2	E2	Engine	20.5	321.8	8.1	52.9	943	2.6
	E10	Reserve Engine	19.6	68.7	1.7	11.3	210	0.6
	Other	Other	36.8	23.9	0.6	3.9	39	0.1
	Total		**20.9**	**414.4**	**10.4**	**68.1**	**1,192**	**3.3**
3	E3	Engine	19.8	436.1	10.9	71.7	1,322	3.6
	RES1	Rescue	24.9	59.4	1.5	9.8	143	0.4
	Other	Other	59.9	24.9	0.6	4.1	25	0.1
	Total		**21.0**	**520.5**	**13.0**	**85.6**	**1,490**	**4.1**
4	E4	Engine	24.7	292.2	7.3	48.0	711	1.9
	Other	Other	54.4	15.4	0.4	2.5	17	0.0
	Total		**25.3**	**307.6**	**7.7**	**50.6**	**728**	**2.0**
5	E5	Engine	19.6	326.8	8.2	53.7	1,001	2.7
	L2	Ladder	25.2	16.0	0.4	2.6	38	0.1
	Other	Other	25.2	5.5	0.1	0.9	13	0.0
	Total		**19.9**	**348.2**	**8.7**	**57.2**	**1,052**	**2.9**
6	E6	Engine	20.4	211.6	5.3	34.8	623	1.7
	E9	Reserve Engine	21.7	109.0	2.7	17.9	301	0.8
	Other	Other	64.1	12.8	0.3	2.1	12	0.0
	Total		**21.4**	**333.4**	**8.3**	**54.8**	**936**	**2.6**
7	E7	Engine	18.0	396.5	9.9	65.2	1,325	3.6
	L3	Ladder	17.9	53.9	1.3	8.9	181	0.5
	Other	Other	25.2	11.3	0.3	1.9	27	0.1
	Total		**18.1**	**461.8**	**11.6**	**75.9**	**1,533**	**4.2**
Other Units*			**53.3**	**16.0**	**0.4**	**2.6**	**18**	**0.0**
Total			**20.8**	**3,993.8**	**100.0**	**656.5**	**11,500**	**31.5**

Note: *Additional units that were not assigned to a specific station.

TABLE 4-7: Frequency Distribution of the Number of Calls Responded by PFD Units

Calls in an Hour	Frequency	Percentage
0	3,059	34.9
1	2,838	32.4
2	1,651	18.8
3	758	8.7
4	278	3.2
5	121	1.4
6	32	0.4
7+	23	0.3
Total	**8,760**	**100.0**

FIGURE 4-8: Average Calls by Hour of Day, PFD

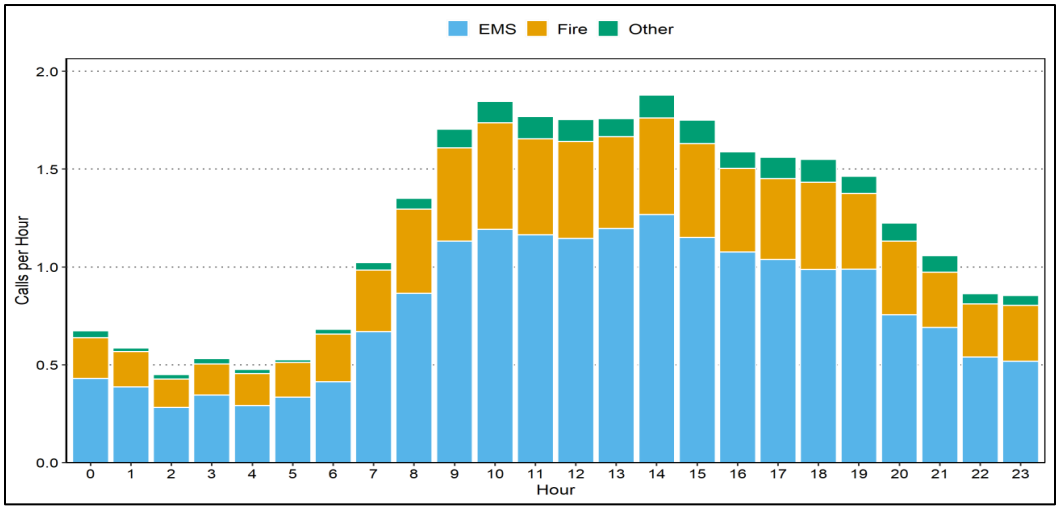


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TABLE 4-8: Frequency of Overlapping PFD Calls by Station

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
1	No overlapped call	2,529	88.3	810.4
	Overlapped with one call	305	10.6	53.7
	Overlapped with two calls	22	0.8	2.6
	Overlapped with three calls	5	0.2	0.8
	Overlapped with four calls	4	0.1	0.2
2	No overlapped call	1,946	91.1	701.2
	Overlapped with one call	169	7.9	36.3
	Overlapped with two calls	18	0.8	2.3
	Overlapped with three calls	3	0.1	0.2
3	No overlapped call	1,377	93.6	469.7
	Overlapped with one call	88	6.0	20.3
	Overlapped with two calls	3	0.2	0.1
	Overlapped with three calls	2	0.1	0.3
	Overlapped with four calls	1	0.1	0.2
4	No overlapped call	722	96.4	313.3
	Overlapped with one call	27	3.6	6.2
5	No overlapped call	1,167	95.3	384.0
	Overlapped with one call	53	4.3	11.1
	Overlapped with two calls	4	0.3	0.6
	Overlapped with three calls	1	0.1	0.0
6	No overlapped call	632	94.2	222.0
	Overlapped with one call	34	5.1	7.4
	Overlapped with two calls	3	0.4	0.4
	Overlapped with three calls	2	0.3	0.1
7	No overlapped call	1,353	94.5	408.2
	Overlapped with one call	76	5.3	12.5
	Overlapped with two calls	2	0.1	0.3

This analysis of the PFD's resiliency to respond to calls tells us:

- The overall peak call time is 7:00 a.m. to 9:00 p.m., with a concentrated peak time between the hours of 9:00 a.m. and 6:00 p.m.
- Station 1 has the highest workload in terms of runs for fire units, followed by Station 7, which corresponds with the demand analysis maps.
- Overall, all primary fire units (including the BC) aggregately averaged 31.5 runs per day.
- Each fire zone experiences overlapped calls. Station 1 experiences overlap the most (11.7 percent of the time) followed by Station 2 (8.9 percent of the time). The greatest percentage of the time each zone is overlapped with one call. This corresponds with the demand analysis maps.

- There were 612 canceled calls to which PFD units responded (almost 6 percent of all calls). Units were canceled either en route to the incident or after arrival on scene. While this is common nationally, it is important to note here that whether canceled en route or after arrival on scene, the unit(s) is/are still unavailable for another call in the town.
- All stations arrive first in their fire management zones over 90 percent of the time. This links to the low percentage of overlapping calls.

The PFD overall does not have issues with resiliency. Although there can be more than one call in an hour for any station, the percentage overall is low. The highest percentage at Station 1 (11.7 percent of the time an overlapped call occurs) is absorbed better as there are two staffed units deployed from this station. The workload of all companies in terms of runs (calls where there are more than one unit responding) can have an effect on resiliency; however, that does not appear in the data. Affecting resiliency are the calls that require more than one unit in the southern half of the town. These calls involve longer travel distances for assisting companies, which can affect resiliency as well.

The PFD'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 winter/summer storm events. However, the data shows the department's ability to absorb these peak call periods, as noted in the data, is positive. Station 2 and Station 3 should, however, be monitored as they are on the low end of the 90th percentile of arriving first in their fire management zones.

RISK CATEGORIZATION

A comprehensive risk assessment is a critical aspect of creating standards of cover and can assist the PFD 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) 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 served. With the information available from the CPSM data and operational analysis, the PFD, the town, and public research, the PFD can begin an analysis of the town'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 PFD 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 4-9: 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 4-10: Impact on PFD

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 an incident for more than two hours or event which limits the ability of resources to respond.	**10**

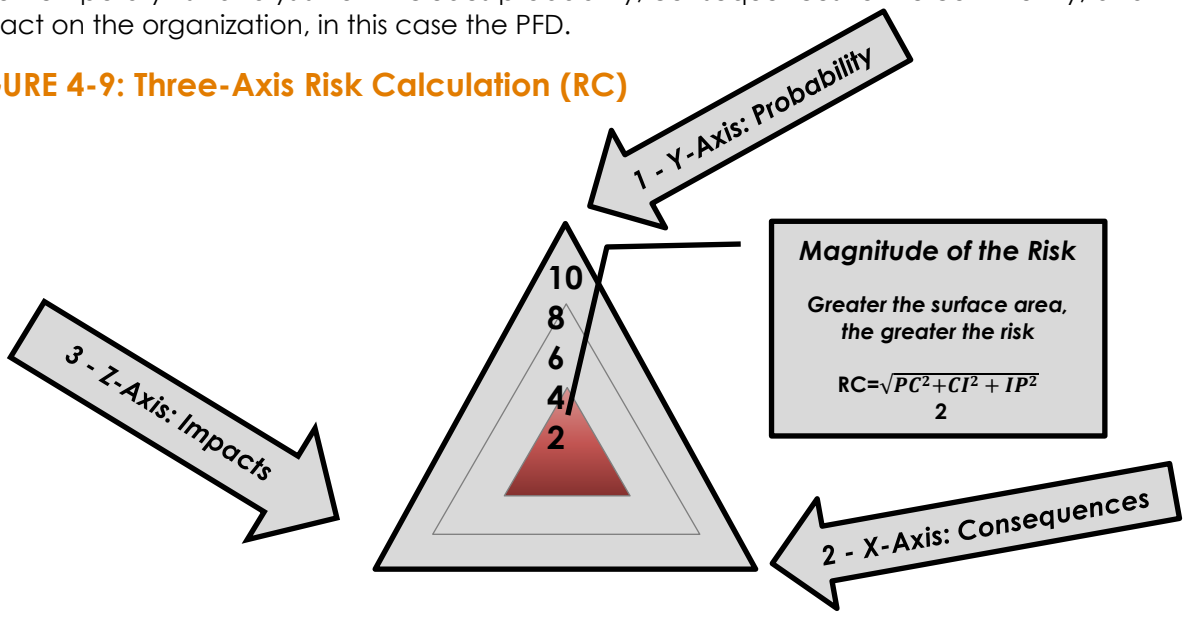
TABLE 4-11: Consequence to Community Matrix

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	■ A 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. ■ A 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	■ A 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 widespread 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 periods. ■ 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 town. 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 PFD.

FIGURE 4-9: Three-Axis Risk Calculation (RC)



The following factors/hazards were identified and considered:

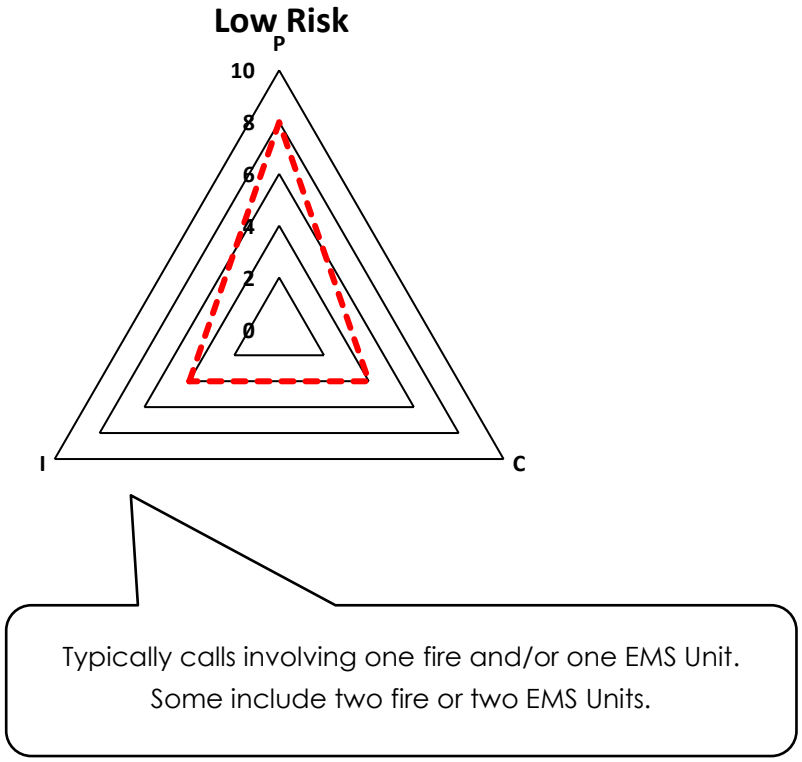
- **Demographic factors** such as age, socio-economic, vulnerability.
- **Natural hazards** such as coastal flooding, snow and ice events, wind events, wild land fires.
- **Manufactured hazards** such as rail lines, roads and intersections, target hazards.
- Structural/building risks.
- Fire and EMS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

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

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.

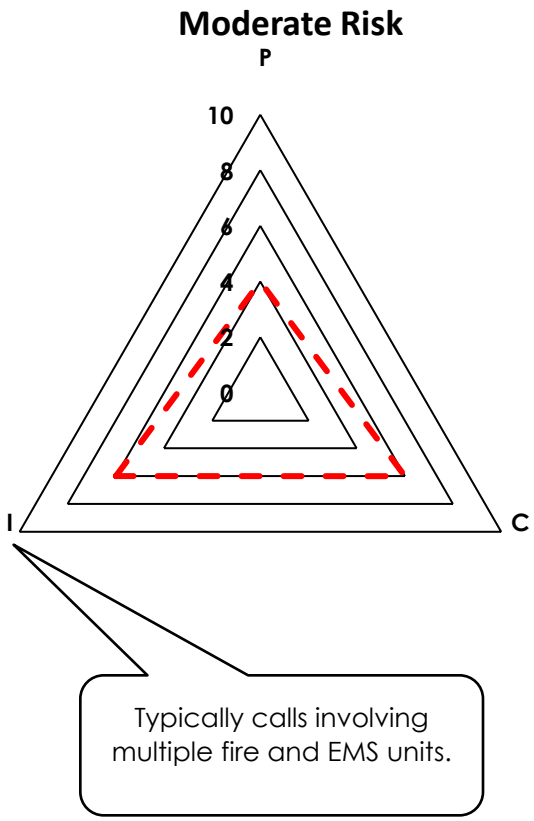
FIGURE 4-10: Low Risk



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.

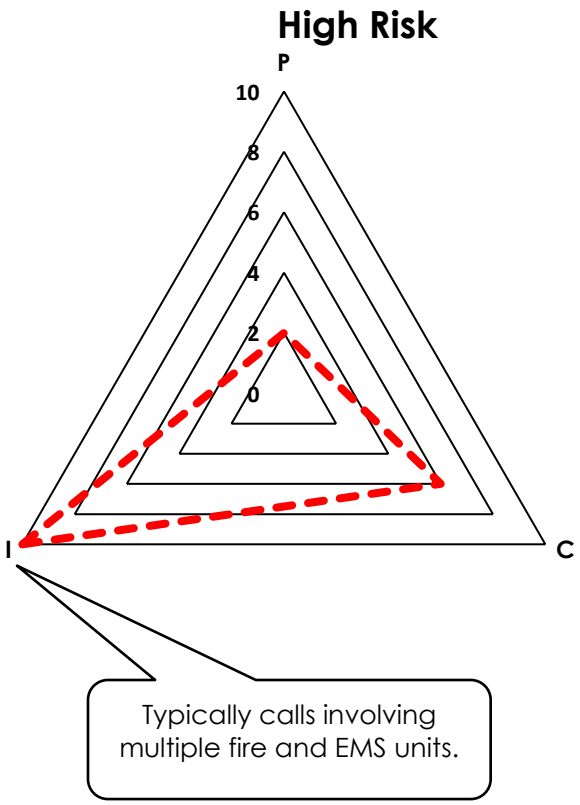
FIGURE 4-11: Moderate Risk



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.

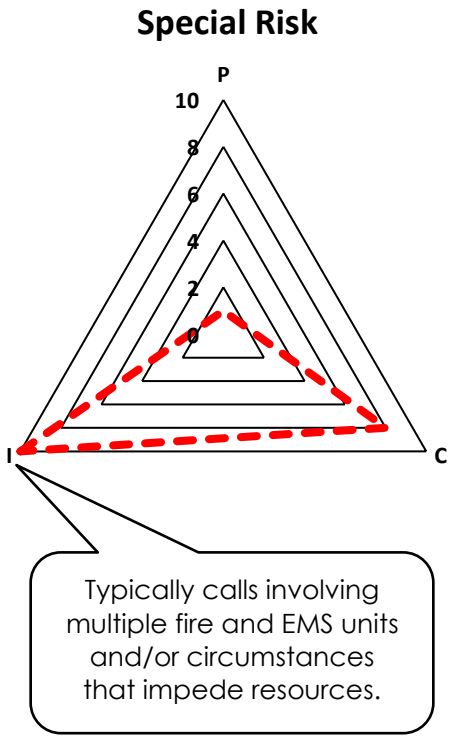
FIGURE 4-12: High Risk



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 of fire and threat to life safety or other civil unrest, weapons of mass destruction release.
- Working fire in a structure on the coast with little to no street access for apparatus.

FIGURE 4-13: Special Risk



SECTION 5. EMERGENCY DEPLOYMENT AND PERFORMANCE

STAFFING LEVELS AND STAFFING PATTERNS

In the course of examining staffing and deployment of a fire department, 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. It is ultimately the responsibility of elected officials to decide the level of risk that is acceptable to their community. Once the acceptable level of risk has been decided, then operational service goals can be established. Whether looking at acceptable risk, or level of service goals, it would be imprudent, and probably very costly, to build a deployment strategy that is based solely on response times and emotion.

The staffing of fire and EMS companies is a never-ending focus of attention among fire service and governmental leadership. While NFPA 1710 and OSHA provide guidelines (and to some extent the law, specifically OSHA in OSHA states) as to the level of staffing and response of personnel, the adoption of these documents varies from state to state and department to department. NFPA 1710 addresses the recommended staffing in terms of specific types of occupancies and risks. The needed staffing to conduct the critical tasks for each specific occupancy and risk 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.

The fire service has experienced tremendous technological advances in equipment, procedures, and training over the past 50 years. Better personal protective equipment (PPE), the widespread use of self-contained breathing apparatus (SCBA), large diameter hose, better and lighter hand lines and nozzles, and thermal imaging cameras are just a few of the numerous advances in equipment and procedures that have allowed firefighters to perform their duties more effectively, efficiently, safely, and with fewer personnel. However, the fact remains that the emergency scene in general, and the fireground involving a structure fire, is a dynamic, dangerous, frequently unpredictable, and rapidly changing environment where conditions can deteriorate very quickly and can place firefighters in extreme personal danger, particularly if there are not enough on scene to handle all the critical tasks.

Even with the many advances in technology and equipment, the fireground is an unforgiving and dynamic environment where firefighters must complete critical tasks simultaneously. Lightweight wood construction, truss roofs, dwellings and buildings with basements, increased setbacks making accessibility to the building difficult, and large footprint commercial buildings and estate homes are examples of the challenges that firefighting forces are met with when mitigating structural fires. Newly constructed homes are larger than much of the older home stock in a community. Newer homes tend to incorporate open floor plans, with large spaces that contribute to rapid fire spread. The challenge of rapid fire spread is exacerbated by the use of lightweight roof trusses, vinyl siding, and combustible sheathing. The result is that more personnel are required to mitigate the incidents safely and effectively in these structures. Providing adequate staffing through an Effective Response Force for these environments depends on many factors.

The operations necessary to successfully extinguish a structure fire, and do so effectively, efficiently, and safely, requires a carefully coordinated and controlled plan of action where certain operations such as venting ahead of the advancing interior hose line(s) must be carried out with a high degree of precision and timing. Multiple operations, frequently where seconds count, such as search and rescue operations and trying to cut off a rapidly advancing fire, must also be conducted simultaneously. If there are not enough personnel on the incident initially to perform all the critical tasks, some tasks will, out of necessity, be delayed. This can result in an increased risk of serious injury, or death, to building occupants and firefighters, as well as increased property damage.

Staffing and deployment of fire services is not an exact science. 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. CPSM has developed metrics it follows and recommends that communities consider when making recommendations regarding staffing and deployment of fire resources.

Critical Factors

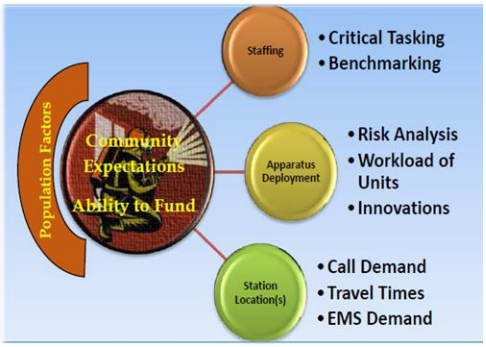
Staffing is one component and the type of apparatus the personnel are deployed on and from where (station locations) are the other two components that determine how fire and EMS services are delivered. Linked to these components of staffing and deployment are eleven critical factors that drive various levels and models from which fire and EMS departments staff and deploy. These factors are discussed below.

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. The Town of Plymouth had not completed a comprehensive analysis of these elements prior to this study. However, part of CPSM's analysis involved the completion of a community fire risk and target hazard analysis.

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-safety and building content hazard, 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 emergency care, utilizing pre-hospital EMS transport systems 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.

PFD Response Components

PFD responds with fire suppression apparatus with crews from seven fire station locations. Emergency response units 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 PFD engines are set up for this as well and are staffed with

advanced emergency medical technicians. Staffing complements for engine apparatus are discussed below.

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 PFD 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 transporting 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 PFD 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.

Brush Trucks, which are a combination of an all-terrain vehicle, mini-pumper, and a wilderness rescue vehicle, and which are used to fight wildfires. These are sometimes also known as a brush breaker or breaker. 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/wildland firefighting equipment.

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. They are equipped with radio and command boards as well scene personnel-tracking equipment and associated gear. PFD has one command vehicle assigned to the Battalion Chief (shift commander). These personnel are responsible for responding to fire and EMS incidents and establishing command and control of the incident.

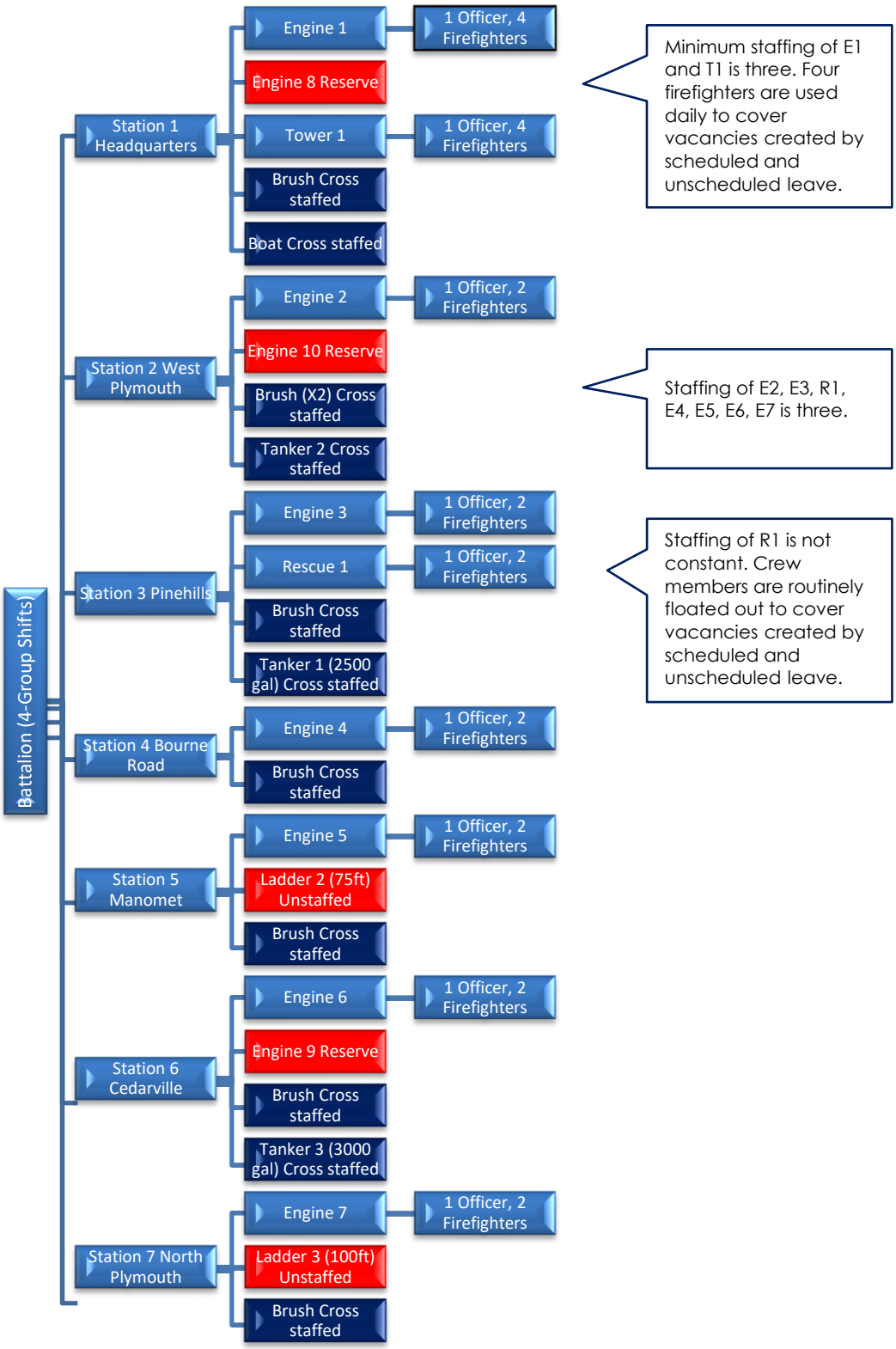
The department delivers field operations and emergency response services through a clearly defined division of labor that includes middle managers (battalion chiefs), first-line operational supervisors (captains, lieutenants), technical specific staff (fire apparatus drivers/operators), and firefighters. Field personnel work a four-platoon, 42-hour work week that is comprised of 24-hour long duty days.

The PFD operates out of seven stations, staffing seven engines, one ladder, one rescue, and one command vehicle. The department also has several specialty units such as boats, three tankers, eight brush units, and several other staff and utility vehicles. In addition, the department maintains three reserve engines and two unstaffed ladders.

When fully staffed, and with the current resource deployment, each of the department's four shifts should optimally have a minimum of 31 personnel on duty each day. This would consist of one battalion chief, nine officers (captains and lieutenants), and 22 firefighters. The engines are staffed with three personnel, the tower (ladder) is staffed with five, and the rescue is staffed with three (PFD received a staffing grant for 12 FTEs to place the rescue in service). All members of the department are entitled to various types of leave, including vacation, personal, sick, injured on duty, and military (if applicable).

The following figure illustrates how on-duty staffing is normally deployed.

FIGURE 5-1: PFD Staffing/Deployment Model



FIRE AND EMS OPERATIONS AND RESPONSE METRICS

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.

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. Improved building construction, code enforcement, automatic sprinkler systems, and aggressive public education programs have contributed to a decrease in serious fires in many communities and, more importantly, fire deaths among civilians. However, these trends are not as evident in older, densely developed northeastern cities, particularly those that struggle with a high percentage of their population comprised of at-risk socio-economic groups.

These trends and improvements in the overall fire protection system notwithstanding, fires still do occur, occur with greater frequency in older, poorer urban areas, 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. As will be discussed next, it is imperative that the fire department is able to assemble an *effective response force* (ERF) within a reasonable time 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 (National Fire Protection Association, Quincy, MA) outlines organization and deployment of operations by career, and primarily career, fire, and rescue organizations.[18] It serves as a benchmark to measure staffing and deployment of resources to certain structures and emergencies. Further, NFPA standards are consensus standards and not the law. Many local governments and special fire districts strive to achieve these standards to the extent possible without having an adverse fiscal 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. 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 substantial career departments. Research work and empirical studies in North America were used by the standard's committee for the basis for developing response times and resource capabilities for those services as identified by the fire department.[19]

18. NFPA 1710 is a nationally recognized standard, but it has not been adopted as a mandatory regulation by the federal government or the State of Massachusetts. It is a valuable resource for establishing and measuring performance objectives for the Town of Plymouth but should not be the only determining factor when making local decisions about the town's fire services.
19. NFPA 1710 Origin and Development of the NFPA 1710, 1710-1.

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:[20]

- 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.

According to NFPA 1710, if a community follows this standard, engine and ladder companies shall be staffed with a minimum of four on-duty members.[21] Additional staffing parameters in this standard for engine and ladder companies is based on geographical isolation and tactical hazards, and increases each to five or six as a minimum.[22] This staffing configuration is designed to ensure a fire department can efficiently assemble an effective response force for each risk the department may encounter and complete the critical tasking necessary to combat building fires and other emergency incidents simultaneously to the extent possible.

CRITICAL TASKING

To effectively respond to and mitigate requests for emergency services, an agency must have a thorough understanding of its community's risk factors, both fire and EMS. Once identified and understood, each category or level of risk is associated with the necessary resources and actions required to mitigate it. This is accomplished through a critical task analysis. The exercise of matching operational asset deployments to risk, or critical tasking, considers multiple factors including national standards, performance measures, and the safety of responders.

Critical tasks are those activities that must be conducted in a timely manner 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 required to effectively control a fire. The same is true for EMS as there are specific patient care tasks that must be completed in succession and often together to support positive prehospital care. The specific number of people required to perform all the critical tasks associated with an identified risk is referred to as an ***Effective Response Force*** (**ERF**). The goal is to deliver an ERF within a prescribed time frame. NFPA 1710, as a nationally recognized consensus standard on staffing and deployment for career fire departments, provides a benchmark for ERF.

To be effective during fire incidents, 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 handle 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 task analysis will provide adequate resources to immediately begin bringing the incident under control.

20. NFPA 1710, 5.2.1.1, 5.2.2.2
21. NFPA 1710, 5.2.3.1.1, 5.2.3.2.1
22. NFPA 1710, 5.2.3.1.2, 5.2.3.1.2.1., 5.2.3.2.2., 5.3.2.3.2.2.1

Regarding the implementation of an ERF and its aggregate effect on fireground operations, there has been much research done by fire departments on the effects of various staffing levels. These studies have consistently confirmed that company efficiency and effectiveness decrease substantially, and injuries increase, when company staffing falls below four personnel. A comprehensive yet scientifically conducted, verified, and validated study titled *Multiphase Study on Firefighter Safety and the Deployment of Resources* was performed by the National Institute of Standards and Technology (NIST) and Worcester Polytechnic Institute (WPI), in conjunction with the International Association of Fire Chiefs, the International Association of Fire Fighters, and the Center for Public Safety Excellence. For the first time, quantitative evidence was produced regarding the impact of crew size on accomplishing critical tasks. Additionally, continual research from UL has provided tactical insights that shed further light on the needs related to crew size and firefighter safety. This body of research includes:

- An April 2010 report on *Residential Fireground Field Experiments* from the National Institute of Standards and Technology (NIST).
- An April 2013 report on *High-Rise Fireground Field Experiments* from the National Institute of Standards and Technology (NIST-HR).
- A December 2010 report on the *Impact of Ventilation on Fire Behavior in Legacy and Contemporary Residential Construction* (UL).

As stated, some of these studies' findings have a direct impact on the exercise of critical tasking. For example, as UL studied the impact of ventilation on fire behavior, it was able to obtain empirical data about the effect of water application on fire spread and occupant tenability. The research clearly indicates that the external application of a fire stream, especially a straight stream, does not "push fire" or decrease tenability in any adjacent rooms. Therefore, during the deployment of resources for the critical task of fire attack, consideration must be given to the option of applying water to the fire from the exterior when able. This approach enables a fire attack that can begin prior to the establishment of an IRIT (Initial Rapid Intervention Team) as well as decreases the time to get water on the fire, which has the greatest impact on occupant survivability.

The NIST studies examined the impact of crew size and stagger on the timing of fireground task initiation, duration, and completion. Although each study showed crew size as having an impact on time-to-task, consideration must be given to what tasks were affected and to what extent. For example, four-person crews operating at a low-hazard structure fire completed all fireground tasks (on average) 5.1 minutes or 25 percent faster than three-person crews.

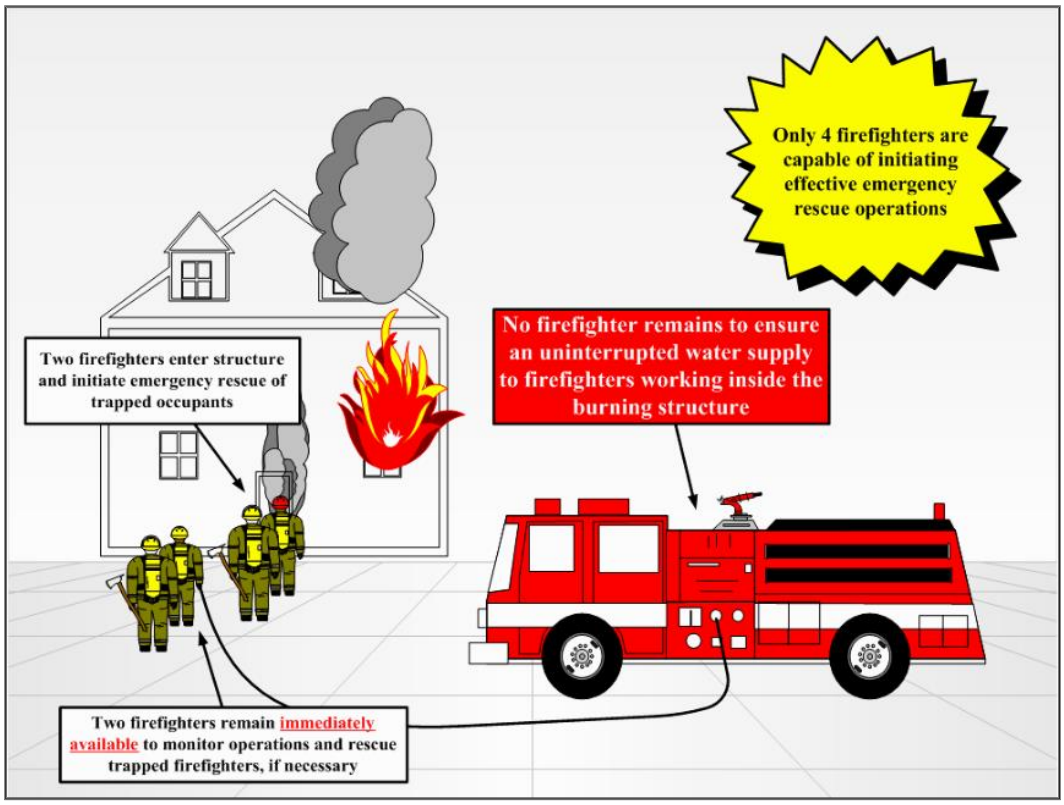
- Four-person firefighting crews were able to complete 22 essential firefighting and rescue tasks in a typical residential structure 30 percent faster than two-person crews and 25 percent faster than three-person crews.
- The four-person crews were able to deliver water to a similar sized fire 15 percent faster than the two-person crews and 6 percent faster than three-person crews, steps that help to reduce property damage and reduce danger/risks to firefighters. The latter time represents a 34-second difference.
- Four-person crews were able to complete critical search and rescue operations 30 percent faster than two-person crews and 6 percent faster than three-person crews. The latter time represents a 23-second difference. The "rescue time" difference from a four-person to a three-person crew is seven seconds.

When considering critical tasking for the deployment of an ERF for fire suppression operations, the PFD will not be able to handle most incidents with just its own resources. For larger, more significant, or complex incidents, the department will need to consider resources from surrounding and mutual aid partners. It is also unlikely that the department would be capable of handling two simultaneous or significantly overlapping structure fires. It is also important to note that the impact of crew size as it relates to high-risk categories is greater than for low-risk categories and should be considered when staffing units that cover a greater amount of risk. As PFD's engine companies are staffed with just three personnel, and the Rescue at Station 3 is not staffed on a consistent basis, this will ultimately present some significant operational challenges and concerns (as it does in many other communities that utilize similar staffing models).

There is no Massachusetts or federal requirement that specifies staffing levels on fire apparatus. The closest thing that approaches a requirement for staffing levels is the OSHA 29 CFR 1910.134 standard, often referred to as the ***"Two-in/Two-out"*** guideline. This standard, which is a safety mandate that has application to municipal firefighting, requires the use of four personnel (two inside the structure and two outside the structure) when conducting interior firefighting activities in a hazardous work environment (that is, an environment that is immediately dangerous to life or health, or IDLH). **It is important to note that the potential for an IDLH atmosphere to exist is not just limited to structure fires. They can exist on natural gas leaks, carbon monoxide incidents, confined space emergencies, chemical spills, and even automatic fire alarm activations where there is an actual fire in progress.**

The following figure illustrates one example of how this standard is intended to be implemented.

FIGURE 5-2: OSHA "Two-in/Two-out" Rule Illustrated



The OSHA requirement has two key provisions that allow considerable flexibility regarding staffing:

- One provision specifies that the four personnel who engage in interior firefighting are required at the incident (assembled) and are not a staffing requirement for the individual responding unit.
- The second provision is that an exception is provided when crews are performing rescue operations where there is the potential for serious injury or death of the occupants. In this case the standard allows the entry of two personnel to conduct the rescue activity without two firefighters outside immediately available to monitor operations and rescue trapped firefighters, if necessary.

In addition, the 2018 edition of NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness*, section 8.8.2, states: "In the initial stages of an incident where only one crew is operating in the hazardous area at a working structure fire, a minimum of four individuals shall be required, consisting of two individuals working as a crew in the hazardous area and two individuals present outside this hazardous area available for assistance or rescue at emergency operations where entry into the danger area required." This standard also stipulates the utilization of a stand-by crew member assigned another task (i.e., apparatus operator) is allowable so long as abandoning his/her task does not jeopardize the operating crews.

As with the OSHA standard, NFPA 1500 does support entry into a hazardous area with less than four personnel assembled if initial attack personnel find an imminent life-threatening situation where the immediate action could prevent loss of life or serious injury.

The Center for Public Safety Excellence (CPSE) has also established benchmarks regarding staffing and deployment. CPSE sets standards for agencies seeking and achieving accreditation through the Commission on Fire Accreditation International (CFAI). CFAI uses standards set forth in the *Community Risk Assessment Manual: Standards of Cover*, 6th edition, to provide guidance in staffing and deployment to agencies desiring accreditation through Core Competencies.

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.

From a practical standpoint, staffing engines with three personnel rather than four forces the company officer to be actively involved in hands-on tasks such as stretching a line, rather than performing size-up and other important initial fireground actions. Company officers are working supervisors. They form an integral part of their company, and it is often necessary for them to assume hands-on involvement in operations, particularly with companies that are minimally staffed, while simultaneously providing oversight and direction to their personnel. During structure fires and other dangerous technical operations, it is imperative that these officers accompany, and operate with, their crew to monitor conditions, provide situation reports, and assess progress toward incident mitigation. During structure fires they operate inside of the fire building. Company officers need to be able to focus on the completion of specific tasks that have been assigned to their respective companies, such as interior fire attack, rescue, ventilation, and/or water supply.

When companies are staffed with three rather than four personnel, the company officer often needs to either function as the nozzle person while the other firefighter backs him/her up and

helps with advancing the line, or, if the roles are reversed and the captain is assisting with line advancement they cannot monitor the conditions at the nozzle—and closest to the fire—as they should. Ideally, one firefighter should be the nozzle operator, the company officer should be right alongside of, or behind the nozzle, providing direction and evaluating conditions, and the third firefighter can be further back assisting with advancing the line. This is particularly important for fires on the second and third floors of buildings where the lines must frequently be advanced up narrow and winding stairways. When short staffed in fire conditions such as this, two companies often must be deployed to get a single line in service, which can then impact the completion of additional critical tasks.

CPSM advocates for structural fire tactics and strategies that are both safe and effective, but sometimes staffing levels can make that dual goal difficult to achieve. Initiating offensive operations with fewer than four firefighters or the ability to place four or more on scene within the prescribed timelines outlined in national standards such as NFPA 1710 will place firefighters at a high level of risk; delaying operations until additional staffing arrives places occupants in greater danger and can increase property damage.

Ultimately, on-duty fire department staffing is a local government decision. It is also important to note that the OSHA standard (and NFPA 1500/1710/1720) 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 to the scene of a structure fire, is critical to operational success and firefighter safety**. How and where personnel and resources are located, and how quickly they can arrive on scene, play major roles also.

All these factors must be taken into consideration as Plymouth reaches consensus on the acceptable community fire safety risk level, affordable levels of expenditure for fire protection, and appropriate levels of staffing. The town will need to consider the cost-benefit of various deployment strategies, such as continuing the current staffing and deployment model, or adopting a different one based upon recommendations contained within this report.

For the PFD, emergency responses are based on caller information provided to dispatchers at the Plymouth Fire Department dispatch center; responses depend on the nature and type of call for service. PFD details out its response procedures through a response plan in the dispatch center. This response plan covers both high- and low-frequency incidents that range from low to high risk. Structure fire responses represent the type of high-risk/low-frequency incidents that present the greatest challenges to a fire organization.

For any given emergency to which PFD responds, there are critical tasks that must be completed. These tasks can range from the immediate rescue of trapped occupants within a burning structure to vehicle or water rescue when needed. A set of critical tasks have been developed to identify what resources are needed for each incident type. PFD has developed response matrices detailing the initial levels of response for varying incident types. The following critical task analysis was performed independent of these policies; however, a comparison is provided.

The intent of the risk management process is for the department to develop a standard level of safety while strategically aligning its resources with requests for service. Thus, the critical tasking presented herein will consider the Effective Response Force in relation to either a low-, moderate-, or high-risk classification.

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 Effective Response Force within the prescribed period. NFPA 1710 provides the benchmarks for effective response forces.

The PFD has a response matrix for structure fires as follows:

- 1 Battalion Chief.
- 2 Engines (2 Officers; 4 Firefighters).
- 1 Ladder (1 Officer; 2 Firefighters).

Because Stations 5 and 7 have ladder apparatus as well as engine apparatus, crews may cross-staff each and take the most appropriate apparatus based on the type of incident and knowledge of the response district. At Station 7 this is the preferred action rather than an option given the response district and the building risks. Regardless of the response configuration of engines and ladders, the total complement of personnel is ten on the initial alarm.

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 PFD is benchmarked against this standard for the building types existing in Plymouth. This discussion will cover single-family dwellings, open-air strip mall buildings, and apartment buildings as outlined in the NFPA standard.

Some of the key provisions of NFPA 1710 related to an Effective Response Force are as follows: As a benchmark, NFPA 1710 states that the initial full alarm to a typical 2,000 square-foot residential structure shall provide for the following critical tasks:

- Incident command.
- Continuous water supply.
- Hydrant hookup.
- Forcible entry.
- Fire attack via two handlines.
- Primary search and rescue.
- Establishment of an IRIT (initial rapid intervention team).

These tasks meet the minimum requirements of NFPA 1710 for the initial full alarm assignment to a typical low-risk, 2,000 square-foot, two-story residential structure. These are the proverbial "bread and butter" structural fire incidents that fire departments respond to, and which are, by far, the most common type of structure fire. Personnel requirements for fires involving large, more complex structures such as commercial or industrial facilities or multifamily residential occupancies will require a significantly greater commitment of personnel.

Thus, according to NFPA 1710, the ERF for a single-family dwelling fire would be a minimum of 16 personnel (17 if aerial apparatus is used) deployed to the scene.

The next set of tables outlines the critical tasking standard as outlined in the NFPA 1710 standard and how the PFD currently benchmarks against this standard. This discussion includes:

- Single Family Dwellings (2,000 square-foot, two-story, single-family dwelling without a basement and with no exposures).
- Open-Air-Strip Mall/Commercial Buildings.

- Apartment Buildings.

Following this fire critical tasking/effective response force discussion, CPSM also outlines critical tasking for EMS calls. These calls are:

- Basic Life Support.
- Advanced Life Support–Level 1.
- Advanced Life Support–Level 2.
- Pulseless/Non-Breathing.

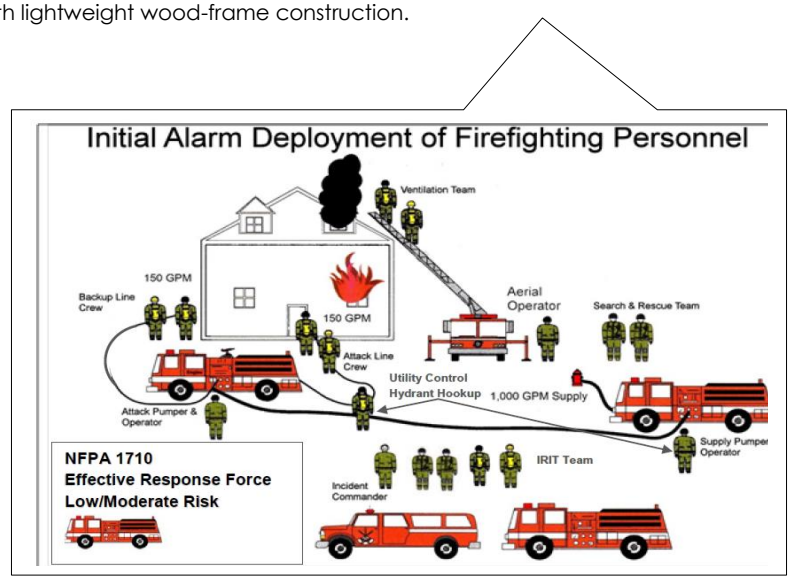
Single-Family Dwelling: NFPA 1710, 5.2.4.1

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 following table outlines the critical task matrix.

TABLE 5-1: Effective Response Force for Single-Family Dwelling Fire

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 IRIT (Initial Rapid Intervention Team)	4
Total Effective Response Force	**16 (17 if aerial used)**

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



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

TABLE 5-2: PFD Effective Response Force for Single-Family Dwelling Fire

PFD Response Matrix	Personnel
Battalion Chief	1
PFD Engine	3
PFD Engine	3
PFD Aerial	3
Total PFD Effective Response Force	**10**

As a single responding agency, PFD does not meet the minimum benchmarks of NFPA 1710 for an Effective Response Force for single-family dwelling fires. PFD units may not be fully staffed, and units may be out of service. Box alarms are sent out to bring in off-duty staff to assist in responding to structure fires. Mutual aid must be requested when needed.

NFPA 1710 permits fire departments to use established automatic aid and mutual aid agreements to comply with section 5.2 of this standard.

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 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 this type of fire. This can also be typed as a commercial building fire response.

TABLE 5-3: Effective Response Force for Open-Air Strip Mall Fire

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	2
Fire Attack via Three 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 used)**

The following table outlines how the PFD assembles staffing and deployable resources as measured against NFPA 1710 benchmarking for an Effective Response Force for an open-air strip mall or commercial building fire.

TABLE 5-4: PFD Effective Response Force for Open-Air Strip Mall/Commercial Fire

PFD Response Matrix	Personnel
Battalion Chief	1
PFD Engine	3
PFD Engine	3
PFD Aerial	3
Total PFD Effective Response Force	**10**

As a single responding agency, PFD does not meet the minimum benchmarks of NFPA 1710 for an Effective Response Force for an open-air strip mall fire. PFD units may not be fully staffed, and units may be out of service. Box alarms are sent out to bring in off duty staff to assist in responding to structure fires. Mutual aid must be requested when needed.

Apartment Buildings, NFPA 1710 5.2.4.3

The initial full alarm assignment 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 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 5-5: NFPA 1710 Effective Response Force for Apartment Building Fire

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 IRIT (Initial Rapid Intervention Team)	4
Medical Care Team	2
Total Effective Response Force	**27 (28) If Aerial is Used**

The following table outlines the how the PFD is able to assemble an Effective Response Force for an apartment building fire.

TABLE 5-6: PFD Effective Response Force for Apartment Building

PFD Response Matrix	Personnel
Battalion Chief	1
PFD Engine	3
PFD Engine	3
PFD Aerial	3
Total PFD Effective Response Force	**10**

As a single responding agency, PFD does not meet the minimum benchmarks of NFPA 1710 for an Effective Response Force for an apartment fire. PFD units may not be fully staffed, and units may be out of service. Box alarms are sent out to bring in off duty staff to assist in responding to structure fires. Mutual aid must be requested when needed.

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 critical tasks 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. Thus, 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 one 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 PFD continuum of care. As indicated above, this critical tasking is based on the current CMS ground transport definition of ambulances services.

TABLE 5-7: 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 5-8: ALS1 Critical 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 PFD Fire Crew

TABLE 5-9: 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

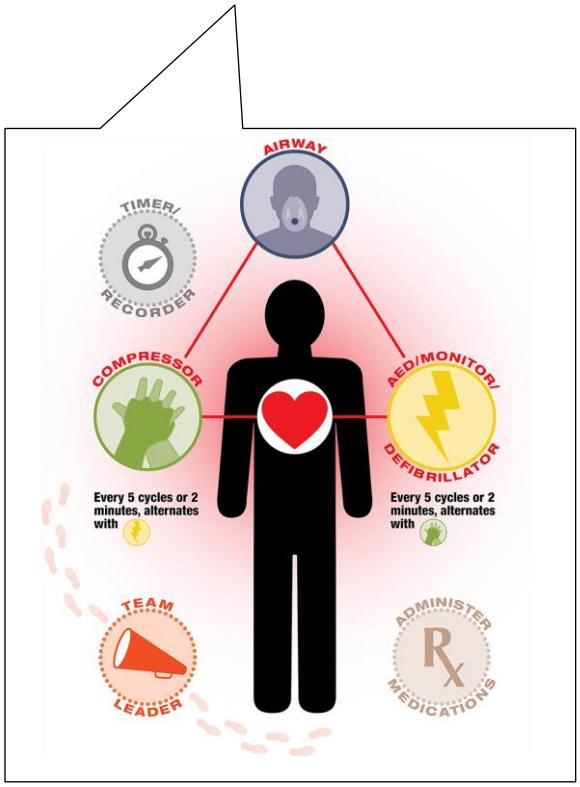
1 Transport Ambulance
1 EMS Supervisor
1 PFD Fire Unit

TABLE 5-10: 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 PFD Fire Unit



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 average, these incidents make up 1 percent to 1.5 percent of all EMS incidents.[23] 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 are inoperable, the detection time 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***.

The NFPA 1710 standard for these components of response times follows.

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.

NFPA 1710 states that the event should be 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.
  - ≤ 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 (1.33 minutes) for fire and special operations 90 percent of the time.
- ≤ 60 seconds (1.0 minute) for EMS responses.

23 Myers, Slovis, Eckstein, Goodloe et al. (2007)." Evidence-based Performance Measures for Emergency Medical Services System: A Model for Expanded EMS Benchmarking." *Pre-hospital Emergency Care*.

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:

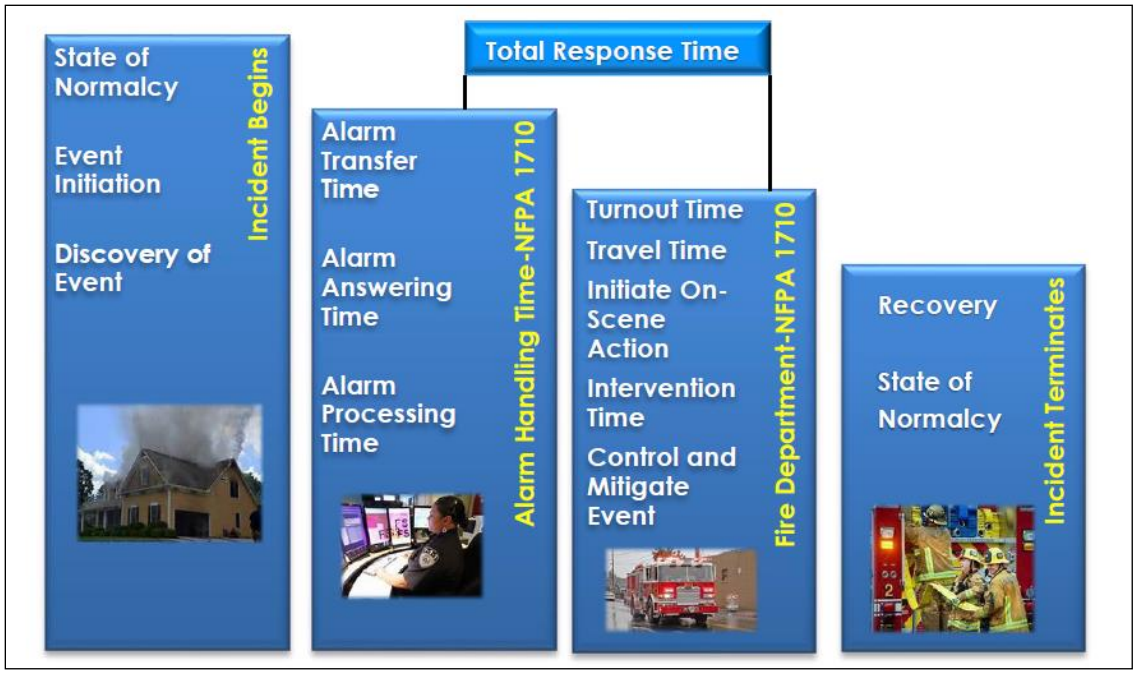
- ≤ 240 seconds for the first arriving engine company to a fire suppression incident 90 percent of the time.
- ≤ 360 seconds for the second company 90 percent of the time.
- ≤ 480 seconds to assemble the initial first alarm assignment on scene 90 percent of the time for low/medium hazards, and 610 seconds 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 complete cascade of events and their relationship to the total response time of a fire incident.

FIGURE 5-3: 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 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 placement of a single fire station or creating 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 could create response-time problems.[24] This goal is generally budget-driven and based on demand intensity of fire and EMS incidents, travel times, and identified risks.

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 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.

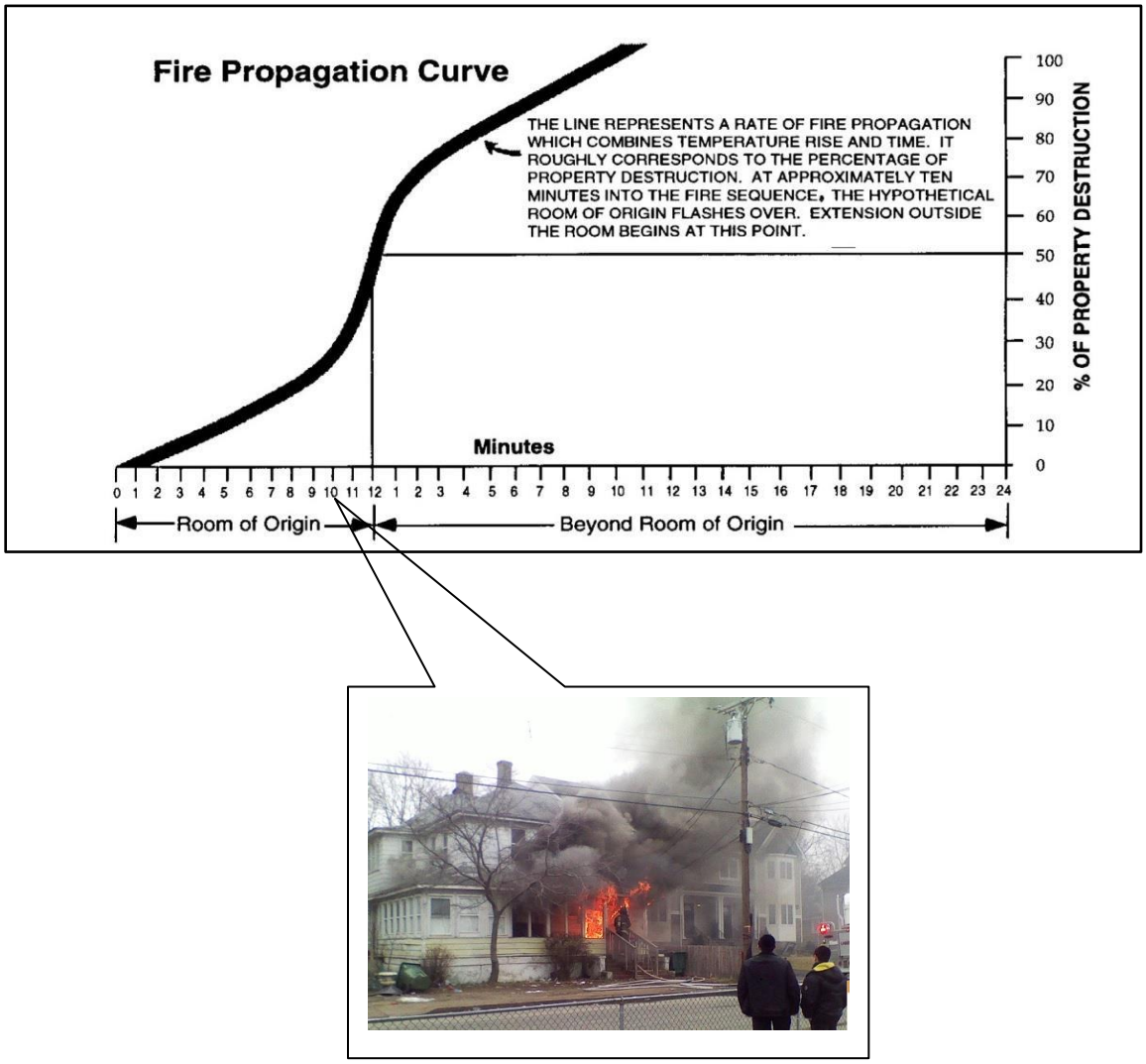
Flashover occurs more quickly and more frequently today and is caused at least in part by the introduction of significant quantities of plastic- and foam-based products into homes and businesses (e.g., furnishings, mattresses, bedding, plumbing and electrical components, home and business electronics, 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 at about the twelve-minute mark, thus increasing proportionately the destruction to property and potential endangerment of life.

The ability to quickly deploy adequate fire staff prior to flashover thus limits the fire's extension beyond the room or area of origin. 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.[25]

24. 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.
25. Clinton Smoke, *Company Officer*, 2nd ed. (Clifton Park, NY: Delmar, 2005).

FIGURE 5-4: Fire Propagation Curve[26]



Regarding the risk of flashover, the authors of an IAFF report conclude:

> *Clearly, an early aggressive and offensive initial interior attack on a working structural fire results in greatly reduced loss of life and property damage. Consequently, given that the progression of a structural fire to the point of "flashover" (the very rapid spreading of the fire due to super-heating of room contents and other combustibles) generally occurs in less than 10 minutes, two of the most important elements in limiting fire spread are the quick arrival of sufficient numbers of personnel and equipment to attack and extinguish the fire as close to the point of its origin as possible.*[27]

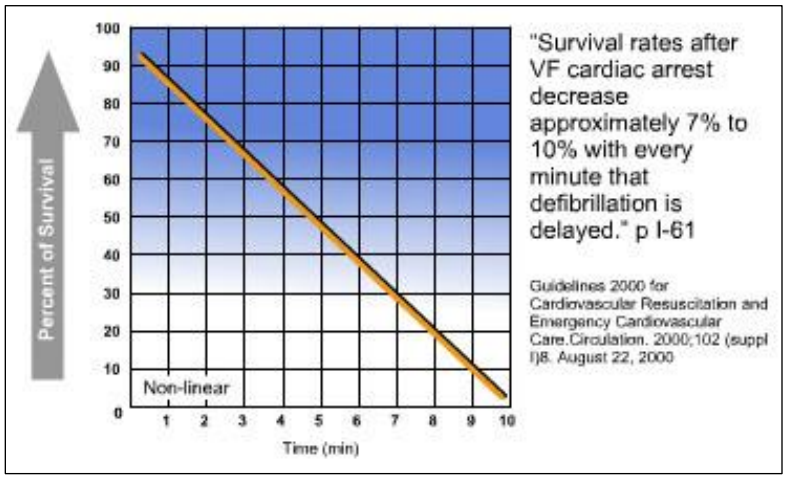
EMS response times are measured differently than fire service response times. Where the fire service uses NFPA 1710 and 1720 as response time benchmarking documents, the focus with

26. John C. Gerard and A. Terry Jacobsen, "Reduced Staffing: At What Cost?" *Fire Service Today* (September 1981), 15–21.
27. *Safe Fire Fighter Staffing: Critical Considerations*, 2nd ed. (Washington, DC: IAFF), 5.

EMS is and should be directed to the evidence-based research relationship between clinical 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 packaging for transport, 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 chance of survival has not changed over time since this graphic was first published by the American Heart Association in 2000.

FIGURE 5-5: Cardiac Arrest Survival Probability by Minute

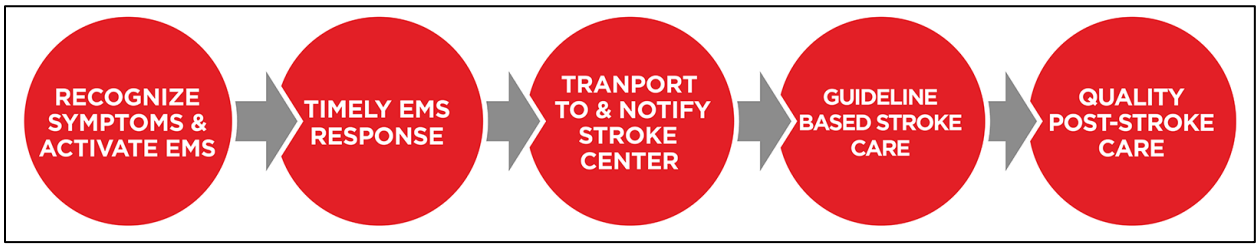


Typically, a low percentage of 911 patients have time-sensitive and advanced life support (ALS) needs. But, for those patients that do, time can be a critical issue of morbidity and mortality. For the remainder of those calling 911 for a medical emergency, though they may not have a medical necessity, they still expect rapid customer service. Response times for patients and their families are often the most important measurement of the EMS department. 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.

In addition, a true emergency is when an illness or injury places a person's health or life in serious jeopardy and treatment cannot be delayed. Examples include severe trauma with cardiovascular system compromise, difficulty breathing, chest pain with S-T segment elevation (STEMI), a head injury, or ingestion of a toxic substance.[28] 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.

28. Mills-Peninsula Health Blog, Bruce Wapen, MD.

FIGURE 5-6: Cerebrovascular Emergency (Stroke) Chain of Survival



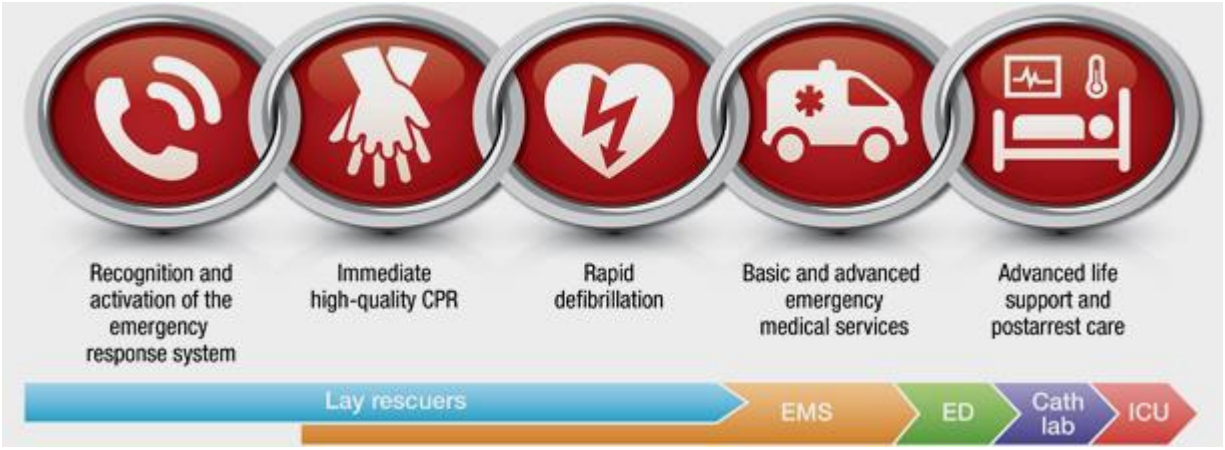
Source: https://nhcps.com/lesson/acls-acute-stroke-care/

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.[29]

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.[30]

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 5-7: 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

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

It is important to understand that measuring and analyzing response times and response time coverage are measurements of performance. When we discussed community risk, we identified that the PFD, like most other fire departments in the nation, is an all-hazards response agency. While different regions of the country respond to different environmental risks, the majority of hazards that fire departments confront remain the same. Linking response data to community risks lays the foundation for future fire department planning in terms of fire station location, the need for additional fire stations, and staffing levels whether supplied by the fire department or a combination of a jurisdiction's fire department plus automatic aid. ***The PFD does receive automatic aid for: state forest incidents; Plymouth Airport incidents; Mass Casualty Incidents; and the Gurnet and Saquish residential areas. The PFD also receives mutual aid when a request is made.***

Managing fire department response capabilities to the identified community's risk focuses on three components, which are:

- Having a full understanding of the total risk in the community and how each risk impacts the fire department in terms of resiliency, what the consequences are to the community and fire department should a specific risk or combination of two or more occur and preparing for and understanding the probability that the risk may occur.
- Linking risk to the deployment of resources to effectively manage every incident. This includes assembling an Effective Response Force for the response risk in measurable times benchmarked against NFPA standards, deploying the appropriate apparatus (engines, ladders, heavy rescues, ambulances), and having a trained response force trained to combat a specific risk.
- Understanding that each element of response times plays a role in the management of community risk. Low response times of the initial arriving engine and low time to assemble an Effective Response Force on fire and other incidents are associated with positive outcomes.

The next table depicts the average and 90th percentile dispatch, turnout, travel, and total response times in Plymouth by call type. The subsequent figures illustrate PFD station location and travel time bleeds using the town road network.

The NFPA national benchmark considers response times at the 90th percentile as:

- First arriving engine company on fire incidents and EMS incidents with an automated external defibrillator (AED) or higher level capability:
  - ≤ 240 seconds 90 percent of the time.
- Arrival of second company:
  - ≤ 360 seconds 90 percent of the time.
- Arrival of first alarm assignment on a structural fire and arrival 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:
  - ≤ 480 seconds 90 percent of the time.

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

TABLE 5-11: Average and 90th Percentile Response Time of First Arriving Unit, by Call Type

Call Type	Average Response Time. Minutes				90th Percentile Response Time, Minutes				Number of Calls
	Dispatch	Turnout	Travel	Total	Dispatch	Turnout	Travel	Total	
Breathing difficulty	1.5	0.8	3.7	6.0	1.9	1.7	6.5	9.4	776
Cardiac and stroke	1.4	0.8	3.8	6.0	1.9	1.7	7.2	9.9	939
Fall and injury	1.5	0.9	4.1	6.5	2.1	1.9	7.5	10.4	1,616
Illness and other	1.6	0.9	4.7	7.2	2.2	1.9	9.4	12.2	3,104
MVA	1.7	0.8	3.2	5.7	2.7	1.7	5.7	9.4	380
OD	1.6	1.1	5.8	8.5	2.4	2.2	10.5	13.9	1,128
Seizure and UNC	1.6	0.8	3.7	6.0	2.0	1.7	6.3	9.6	734
EMS Total	**1.5**	**0.9**	**4.4**	**6.8**	**2.2**	**1.8**	**8.7**	**11.7**	**8,677**
False alarm	1.4	1.1	4.7	7.2	2.3	1.9	9.2	12.4	164
Good intent	1.8	1.0	3.8	6.6	3.3	1.9	5.9	11.7	41
Hazard	1.6	1.3	5.1	7.9	2.4	2.3	9.7	13.9	119
Outside fire	2.4	1.5	6.1	9.9	3.7	3.3	10.9	18.1	55
Public service	1.7	1.0	4.2	6.8	2.3	1.8	7.7	12.2	371
Structure fire	2.2	1.1	3.6	6.8	3.4	1.8	6.3	10.0	47
Technical rescue	1.8	0.7	3.4	5.9	3.5	1.5	6.7	8.9	6
Fire Total	**1.7**	**1.1**	**4.5**	**7.3**	**2.5**	**2.0**	**8.8**	**12.9**	**803**
Total	**1.5**	**0.9**	**4.4**	**6.9**	**2.2**	**1.9**	**8.7**	**11.8**	**9,480**

Note: OD=Overdose and psychiatric; UNC=Unconsciousness.

This table tells us that at the 90th percentile:

- Dispatch time was 2.2 minutes, which does not meet the NFPA 1710 standard.
- Turnout time was 1.9 minutes (EMS-1.8 minutes; Fire-2.0 minutes). Neither meet 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 6.3 minutes. *This does not meet the NFPA 1710 standard.*

At 240 seconds there are gaps in travel time from PFD stations to all parts of the town. Some of these gaps are due to road networks and the presence of the state park and forest; however, most are due to the location of fire stations, which follows the village/public service concept of development. There is built-upon land that is beyond the reach of the 240-second travel time standard where fire and EMS demand is occurring. However, the most concentrated demand is served within 240 seconds of travel time from PFD stations. At 360 seconds, the standard for the second arriving fire suppression unit, response gaps are reduced but still present challenges for the PFD 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 improved; however, because of the distance for all assigned companies, there is a challenge in certain areas of the town to meet this standard.

FIGURE 5-8: Travel Projections at 240 Seconds from PFD Stations

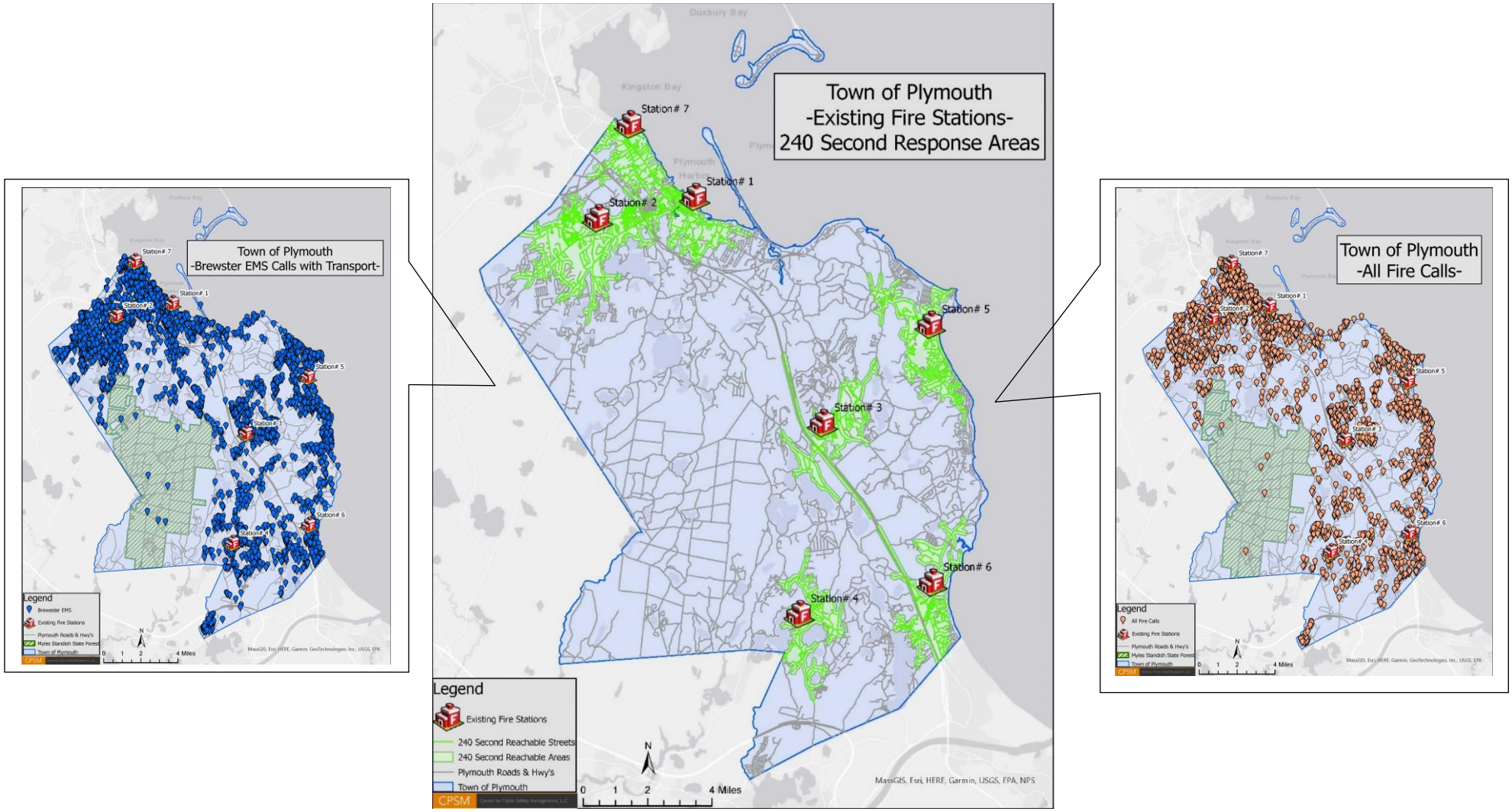
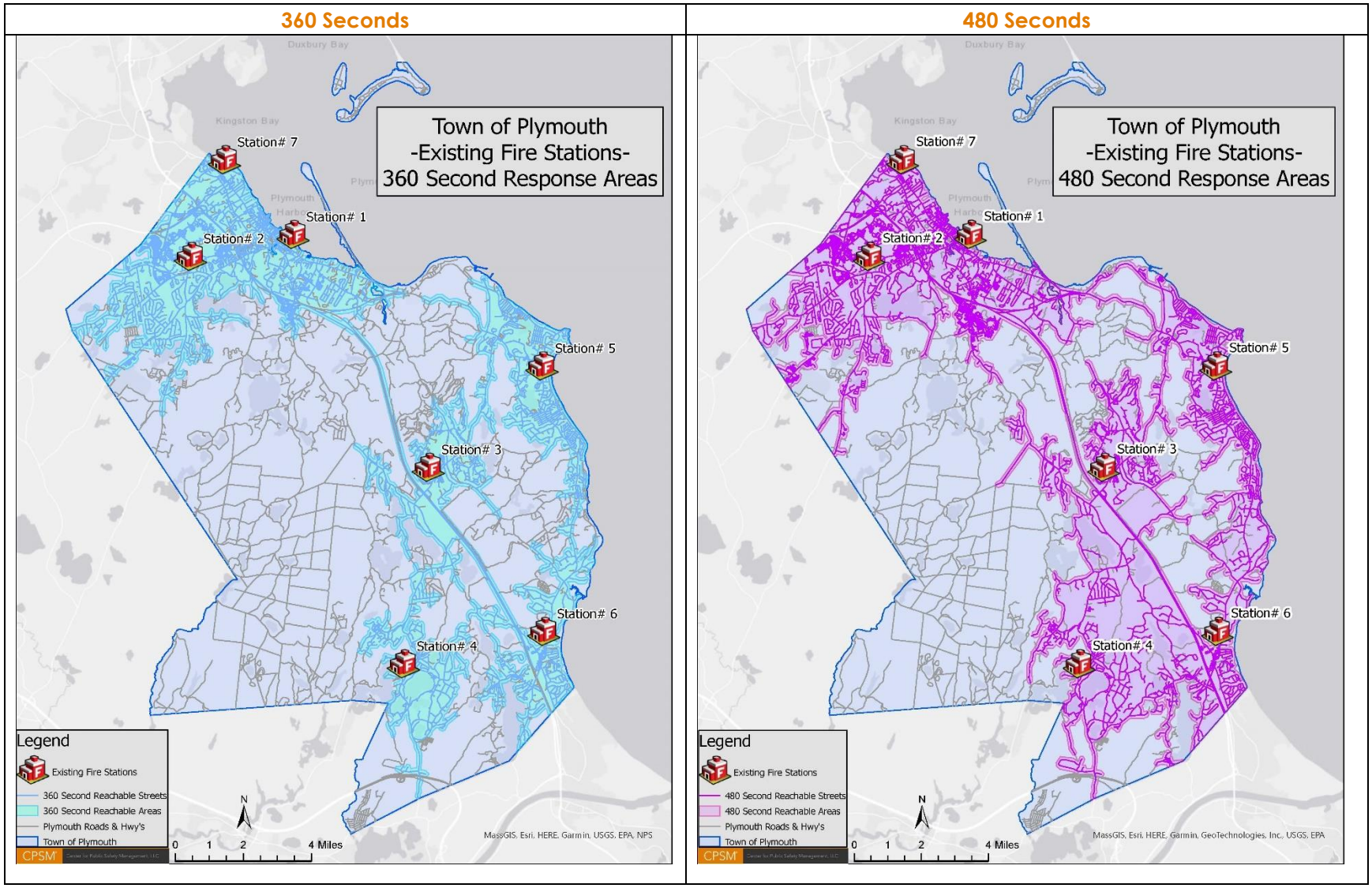


FIGURE 5-9: Travel Projections at 360 and 480 Seconds from PFD Stations



Facilities and ISO Deployment Benchmarking

Sound community fire-rescue protection 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.

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 occupied 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.

The PFD responds from seven fire facilities. Fire administration is located in shared facility space with Station 1. The following table describes each fire facility related to operational use.

TABLE 5-12: PFD Station Facilities

Station Number	Address	Year Built	Square Footage	Response Area Square Miles	Comments
1	114 Sandwich St.	1978	11,216	22.71	Includes Fire Administration and staff
2	240 Samoset St.	1975	15,520	15.89	Rehab-2022 Includes Apparatus Repair Shop
3	12 Pinehills St.	2001	8,614	26.80	
4	533 Bourne Rd.	1977	5,674	13.55	
5	827 State Rd.	1988	7,510	8.74	
6	2209 State Rd.	1996	22,715	12.21	Includes Emergency Operations Center
7	15 Hedge Rd.	2019	12,563	2.82	

When siting fire stations for the most efficient response, several factors must be considered. These include the road network the assigned apparatus will use to serve the response district the station is built to serve, which directly ties to response travel time. As discussed above, and reviewed here, travel time is key to understanding how fire and EMS station location influences a community's aggregate response time performance. As reviewed above, 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, establishes benchmark travel times for first arriving fire units as:

- ≤ 240 seconds for the first arriving engine company to a fire suppression incident 90 percent of the time.
- ≤ 240 seconds for the first arriving engine company with automated external defibrillator (AED) or higher level capability.

The NFPA 1710 standard also benchmarks the travel time of the second arriving unit on a fire incident, and the travel time to assemble the first alarm assignment of apparatus and staff on low/medium hazards as:

- ≤ 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 hazard.

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 placement of a single fire station or creating 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 manufactured barriers, and response routes that could create response-time problems.[31]

In 2021 the PFD commissioned a study with a consulting firm to analyze the best locations for fire stations in the town. This study offered a list of optimal station locations for the town and PFD to consider, which they have and continue to do. Additionally, the town and the PFD have provided facility improvement and replacement planning recommendations to the town building committee and for consideration and funding at town meetings. This includes:

- Renovation and replacement/relocation of Station 1.
- Renovation of Station 2 (currently funded and on-going).
- Replacement/relocation of Station 4. The town building committee recommends the replacement of this facility, and a property search is on-going to site a new station just north of the current station on Bourne Road.
- Renovation of Station 5.

While on-site, CPSM visited each PFD facility and recommends the PFD continue with this plan and replace/relocate Station 4, either fully renovate or replace/relocate Station 1, and renovate Station 5. CPSM analyzes the relocation of Stations 1 and 4 later in this section.

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

31. 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.[32] 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.

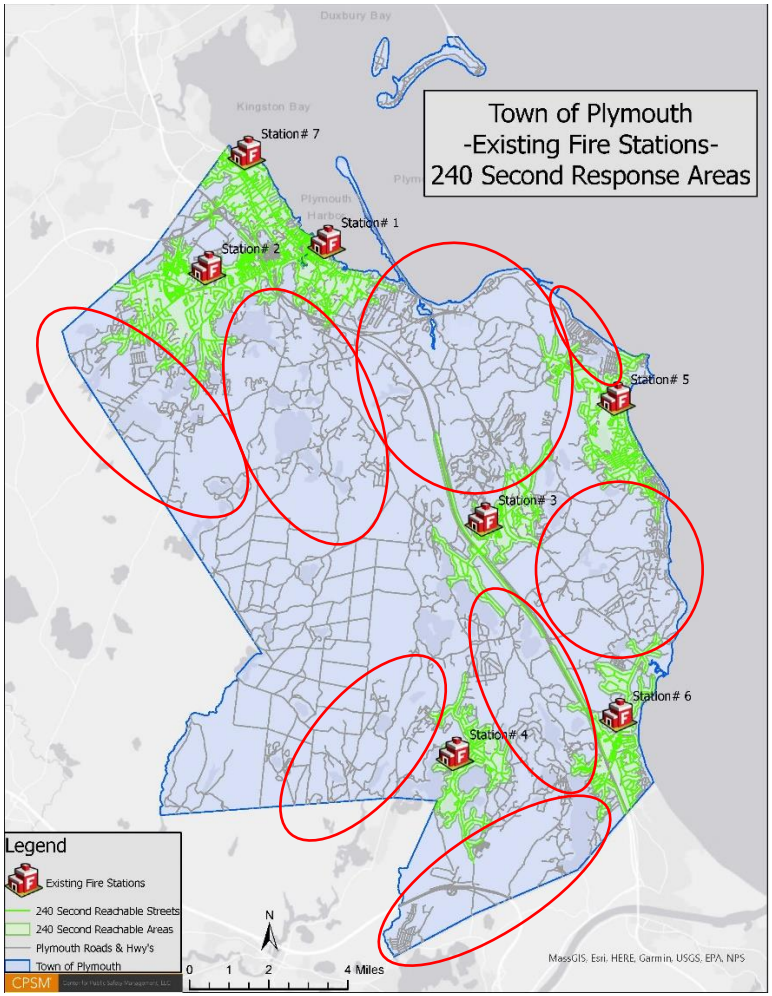
The next figures and tables outline the PFD's current stations as benchmarked against the NFPA 1710 standard, the ISO standard for engine company and ladder company placement, and how the response coverage changes with some stations relocated. These elements should be discussed and included in any strategic planning the PFD conducts in the near, mid, and long terms.

§§§

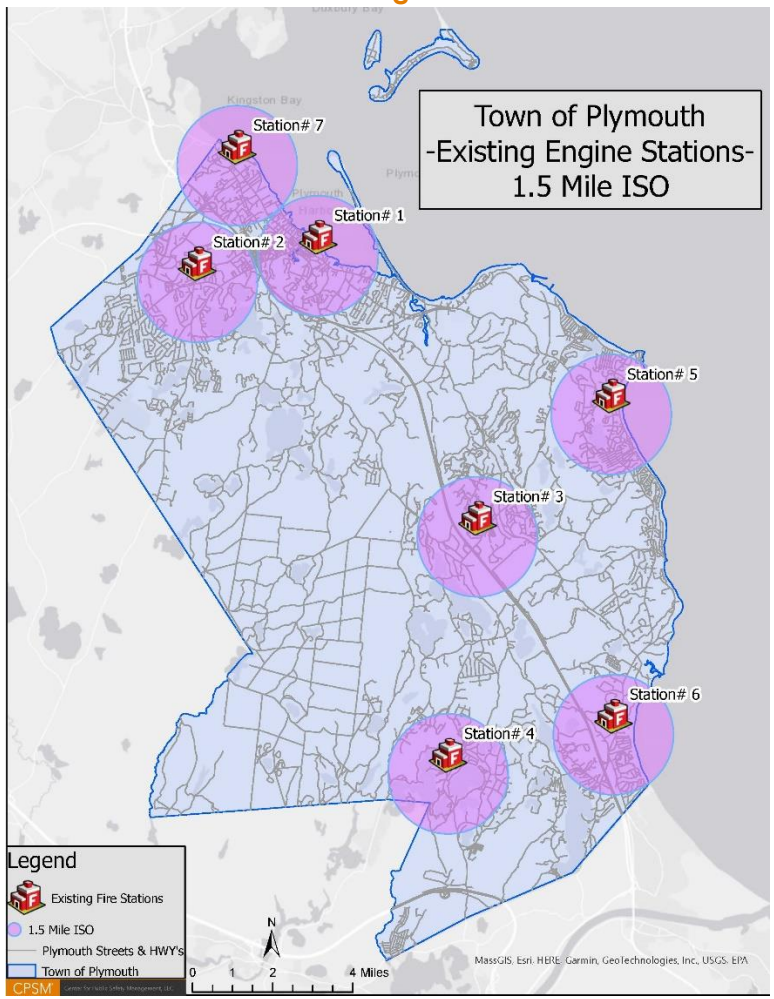
32. Insurance Services Office, ISO Mitigation, Deployment Analysis.

FIGURE 5-10: Travel Projections at 240 Seconds and ISO 1.5-Mile Benchmarks, PFD Stations

PFD 240 Seconds Travel Time



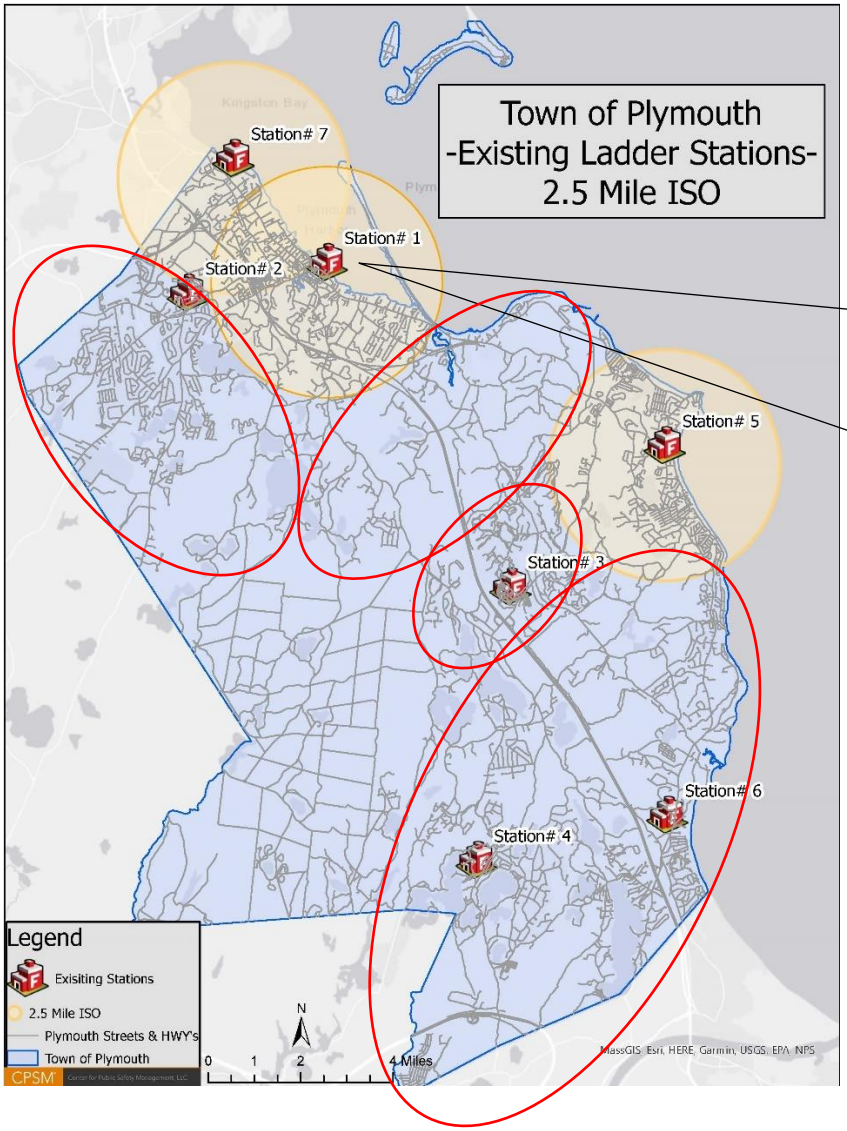
ISO 1.5-Mile Engine Co. Benchmark



The PFD's deficiencies in the NFPA 1710 240-seconds first due fire unit travel time are outlined in red. These deficiencies are closely related to the ISO 1.5-mile standard and should be considered in any current and future station placement planning.

The next figure illustrates the 2.5-mile benchmark for ladder company placement for built-upon land. The PFD ladder companies located at Stations 1, 7, and 5 are located along the coastal areas of the town, where there is the greatest need for aerial devices.

FIGURE 5-11: ISO 2.5-Mile Coverage by Ladder Companies



Station 1 is the only double company station where an Engine and Ladder apparatus is staffed. Stations 5 and 7 have ladder apparatus but this apparatus is cross staffed with the engine crew and responds as needed. Station 7 ladder response is more frequent based on the fire management zone building risk.

The PFD's deficiencies in the ISO 2.5-mile standard are noted in the Station 2, 3, 4, 5, and 6 fire management zones and should be considered in any current and future deployment planning.

While there is no need to fill all of the gaps for ladder company coverage, it is prudent to have either ladder or service company capabilities available within the 2.5 mile response area for built upon land. As noted, the PFD has ladder apparatus in those response areas that have the majority of the types of buildings that require this service (more than three floors) for the use of elevated master stream and elevated access (roof or window/balcony).

A ladder company, which is primarily designed for firefighting operations, and 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. The ladder truck also transports 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.

A service company is a staffed apparatus that carries the tools and equipment of a ladder company but does not have the elevated aerial devise. Modern day service companies/apparatus are similar to or in most cases are the heavy rescue apparatus of the fire department. These apparatus carry self-contained breathing apparatus, various forcible entry tools, ventilation equipment, and hydraulic rescue tools as well as other specialized equipment to deal with an assortment of fires and technical rescues. Many localities include a rescue apparatus in lieu of or in conjunction with (depending on alarm assignments) ladder apparatus on fire responses.

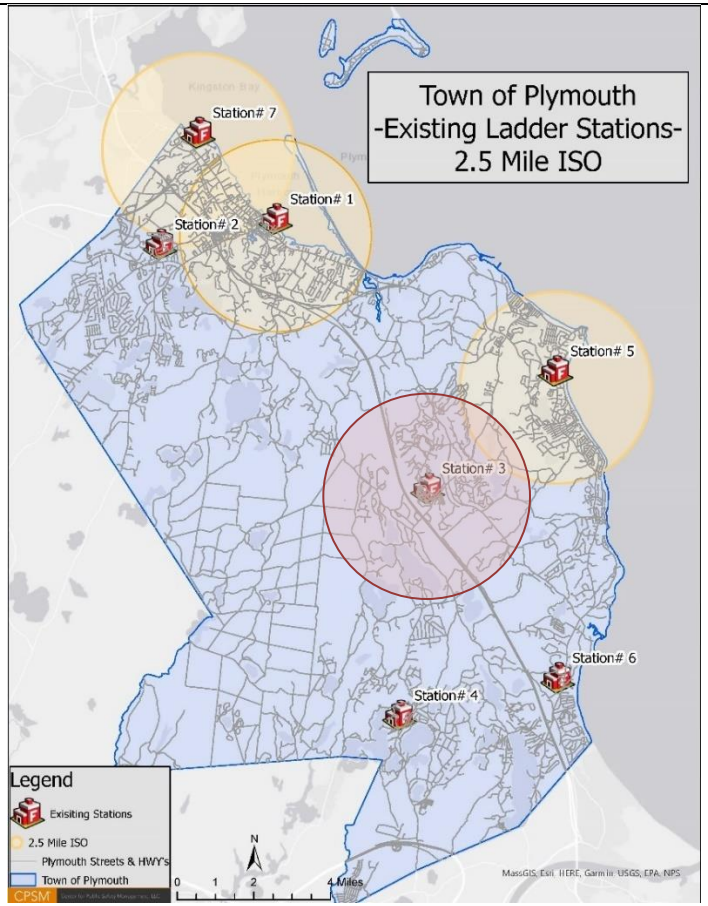
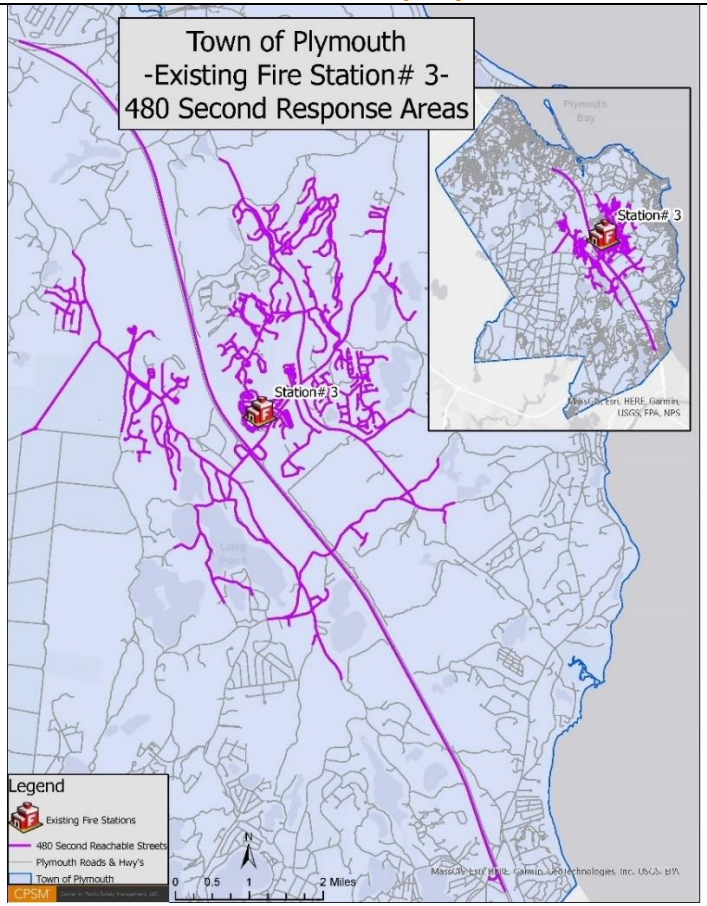
In 2018, the town was awarded a Staffing for Adequate Fire and Emergency Response (SAFER) grant specifically for the staffing of the rescue apparatus. The grant awarded funding for 12 positions (3 per shift). The goal of the grant was to have one additional engine/heavy rescue staffed with three personnel to improve the 240-second response time coverage standard. The current rescue apparatus (pictured left) was constructed as a rescue pumper, meaning it is configured and equipped with a fire pump, water tank, hose and rescue equipment and tools, which serves the purpose of the grant language.

However, the PFD rescue apparatus in service at Station 3 is not staffed consistently with budgeted positions. The three positions typically assigned to the rescue apparatus are instead used as floating positions and are assigned to other companies to cover vacancies created by scheduled and unscheduled leave. This action is used to keep overtime down. The adverse effect, however, is a reduction of three positions and a versatile response asset is not in service on a consistent basis. The rescue is cross staffed with the engine crew at Station 3 when rescue staffing is floated out. However, this methodology takes this apparatus and a consistent crew out of a normal and reliable response matrix.

An absolute staffing configuration and standard, moving forward, should be to staff the rescue apparatus more consistently and as designed through the grant award with the budgeted three positions per shift. This staffing augments the PFD's ability to assemble an Effective Response Force on multi-unit alarm assignments, ensures a more consistent crew assigned to this specialty apparatus that carries specialized tools and equipment, and provides the service company concept on structure fire and alarm assignments in the southern portion of the town.

The next figure illustrates the impact of having the rescue apparatus in service.

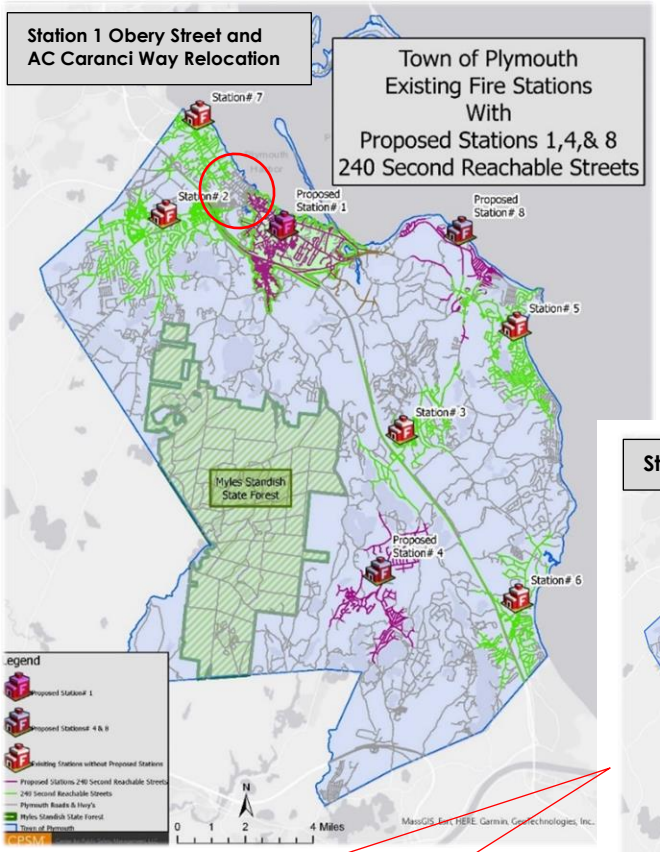
FIGURE 5-12: Performance Improvement with Rescue 1 In Service

ISO 2.5-Mile Service Standard, Service Company	NFPA 1710 480-Seconds Response as a Rescue or Service Company
	

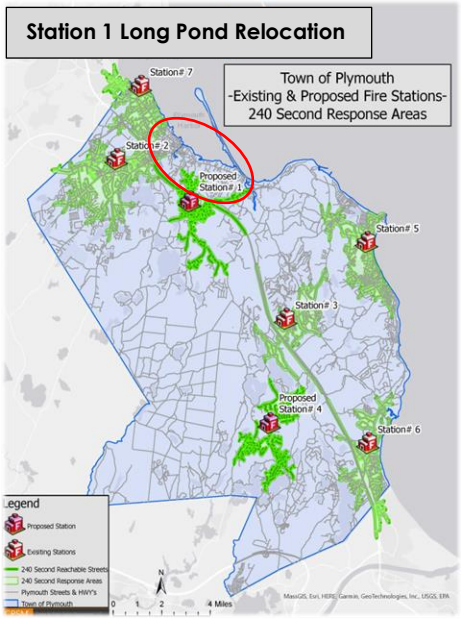
The next set of maps provides strategic planning alternatives for planned and unplanned station relocation to close response gaps. This includes moving Station 1 to Obery Street and AC Caranci Way; moving Station 4 slightly north of the existing station; and a proposed Station 8 at the PNPS site (which involves longer term planning and potential station siting).

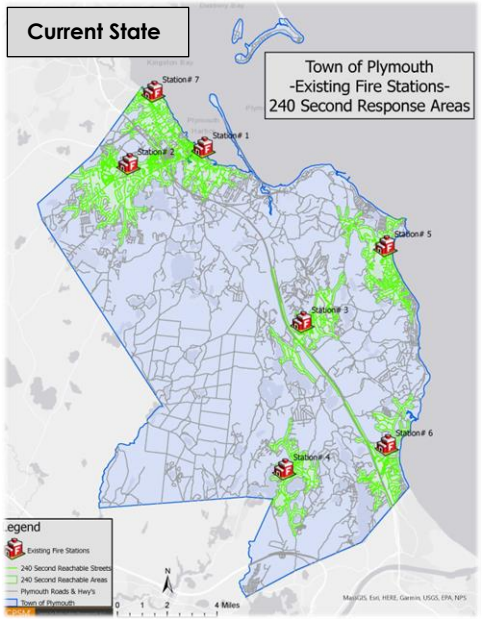
FIGURE 5-13: Station Relocation with 240 Second Benchmark

Alternate Station 1 & 4 Relocation and Additional Station 8



The Obrey Street location offers the best relocation site of Station 1 when compared to the current and the Long Pond location. The Long Pond location is suitable for future consideration as future planned growth dictates.





Outcomes

Because of the large response area and the growth plan which includes village centers, which is where fire facilities are generally located in the town, it is difficult to close the 240-seconds and ISO 1.5-mile engine company gaps. Station 1 has been identified for relocation; however, any movement south or east of the current location creates gaps in response coverage as identified in the figure to the left and below. A station at the former PNPS site is analyzed here to fill a response gap between Stations 5 and 1 along the coast and is offered over the longer term if this land is redeveloped with residential and commercial properties. The movement of Station 4 does not adversely affect the current response pattern.

Staffing and Deployment Recommendations and Alternatives:

- To increase the ability to assemble an Effective Response Force in all response areas of the town and increase the PFD's ability to meet the NFPA travel time standard of 240 seconds for the first arriving fire suppression unit to fires and EMS calls for service, which is the intent of the 2018 SAFER grant to fund positions for a rescue apparatus, CPSM recommends the PFD adjust the daily staffing matrix and staff Rescue 1 at Station 3 with one officer and two firefighters on a daily basis. CPSM further recommends Rescue 1 be dispatched on all structure fire calls in the town in order to increase the initial Effective Response Force, and to also assume service/ladder company responsibilities in the central and southern areas of the town's response areas. (Near-term recommendation: 1 year). (Recommendation No. 25.)
- As an alternative deployment model, CPSM recommends that Ladder 2 at Station 5 be deployed as the first-out unit on all structure fires to which Station 5 is dispatched. This will ensure a faster ladder apparatus response to the eastern fire management zones in the town. (Near-term recommendation:1 year.) (Recommendation No. 26.)
- CPSM recommends the town continue with the current PFD facility plan which is to relocate and construct a new Station 1 with adequate space, equipment, and fixtures to house two staffed fire suppression units and the operational field Battalion Chief, as well as Fire Administration staff (Station 1 to remain Fire Headquarters); relocate and construct a new Station 4 with a design that involves adequate space for two staffed fire suppression pieces; and renovation of Station 5. CPSM further recommends that care be taken in any relocation of Station 1 as substantial movement east or south of the current location will have an impact on response travel time as measured against the NFPA 1710 benchmark standard. (Recommendation No. 27.)
- As Station 4's fire management zone will be experiencing increasing growth to include multifamily residential, and due to the location and longer response time for assisting companies on structural fire and other multi-unit calls, CPSM recommends increasing staffing to 4 per shift (or a total of 4 additional personnel). (Mid-term recommendation: 3 to 5 years.) (Recommendation No. 28.)
- Since Ladder 3 at Station 7 covers both the Station 7 and Station 2 fire management zones, and because Stations 1, 2, and 7 have significant residential and commercial building risks, and to increase the ability to assemble an Effective Response Force in the northwest areas of the town, CPSM recommends as an alternative staffing model to staff the ladder apparatus at Station 7 with one officer and two firefighters (twelve personnel total) on a daily basis in tandem with a staffed Engine 7. An alternative is to staff the ladder apparatus (Ladder 3) at Station 2 with one officer and two firefighters (twelve personnel total) on a daily basis in tandem with a staffed Engine 2. (Long-term alternative: 5 to 8 years.) (Recommendation No. 29.)
- As Station 4's fire management zone will be seeing increasing growth to include multifamily, multilevel residential, and due to the location and long response for a ladder apparatus on structural fire and other multi-unit calls, combined with the lack of this resource in the southern areas of the town, CPSM recommends the staffing of a ladder apparatus at Station 4 with one officer and two firefighters (twelve personnel total and purchase of one ladder apparatus) on a daily basis in tandem with a staffed Engine 4. (Long-term recommendation: 5 to 8 years.). (Recommendation No. 30.)

SECTION 6. EMS ANALYSIS

PLYMOUTH PROVIDER BACKGROUND

Emergency Medical Services (EMS) in Plymouth are provided through a partnership between the Plymouth Fire Department (PFD) and a contracted ambulance provider, Brewster Ambulance Service (BAS). PFD provides Medical First Response (MFR) for some emergency medical services requests and BAS provides Basic Life Support (BLS) and Advanced Life Support (ALS) ambulance services based on clinical need of the patient requiring the EMS response.

PFD provides MFR primarily using personnel trained as Emergency First Responders. Typically, PFD co-responds with BAS on medical responses as presumptively based on the primary classification of the type of medical response. This determination does not generally appear to be based on a structured process based on a formal Emergency Medical Dispatch (EMD) process, but rather, on a general description of the primary chief complaint as described by the 911 caller. Of the PFD's total responses, 65 percent are an EMS response with BAS.

BAS is a well-established and well-respected ambulance provider throughout the region. It has been providing ambulance service for decades, including in the Town of Plymouth. The most recent service agreement between the BAS and with the Town of Plymouth was initiated in 2014 and renewed in January 2022. The agreement can be categorized as a 'Level of Effort' agreement versus a performance-based agreement as the agreement calls for a specified number of resources to be available to the town, without an expectation of performance. BAS is not paid a contract fee for its services but rather is expected to cover the costs of servicing the town through revenues generated for the services provided.

BAS has an operation base in Plymouth from which up to 15 ambulances are deployed throughout the region daily. The agreement between BAS and Plymouth calls for four dedicated ALS ambulances and two support Quick Response Vehicles (QRVs)—one operating 24 hours a day and the other operating 16 hours per day.

According to data supplied by PFD and BAS, between April 1, 2021, and March 31, 2022, PFD's fire units responded to 6,884 EMS calls, representing 65.2 percent of all PFD calls, an average of 18.9 calls per day.

Comparatively, BAS responded to a total of 10,974 calls in Plymouth, an average of 30 calls per day; thus, about 63 percent of all EMS calls in Plymouth received an MFR from the PFD.

PLYMOUTH FIRE DEPARTMENT EMS RESPONSE WORKLOAD

The workload of PFD'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 available for another assignment. Because multiple units respond to some calls, there are more runs (7,060) than calls (6,887) and the average deployed time per run may vary from the average duration per call.

Deployed time, also referred to as deployed hours, is the total deployment time of PFD units deployed on all runs. Table 7-6 in the accompanying data analysis shows that the total deployed time for PFD's 6,887 EMS responses was 2,406.9 hours, an average of 0.349 hours per EMS response, or an average of 20.5 minutes per response.

Another method for measuring workload is Unit Hour Utilization (UHU). UHU is a measure of activity; essentially, it measures the amount of on-duty time that a response unit is dispatched on a call.

A Unit Hour is defined as one unit, fully staffed, equipped and available for a response for one hour. For example, one unit that is on duty 24 hours per pay, 365 days per year equates to 8,760 unit hours (1 x 24 x 365). The UHU is derived by dividing the number of *responses* by the total number of *unit hours*.

PFD staffs seven engines that provide primary EMS response from seven stations. These seven engines responded to about 63 percent of all EMS requests in Plymouth between April 2021 and March 2022.

Using the staffed Unit Hours of PFD's seven primary engines, we derive an annual Unit Hour staffing of 61,320 hours (7 x 8,760). Dividing the number of *responses* (6,887) into the number of *Unit Hours*, we derive a *response* UHU of 0.112. This essentially means that a PFD unit responds to an EMS response 11.2 percent of the time the units are on-duty.

A limitation of the UHU calculation is that it measures activity based on the *frequency* of responses, not the *duration* of those response, and generally presumes that an EMS response will last one hour. However, as depicted in Table 7-6 in the accompanying data report, a PFD unit is typically committed on an EMS call for only an average of 20.5 minutes. Therefore, it is prudent to also use a *time* analysis to more clearly illustrate the *percentage of time* that PFD units are committed on EMS responses.

The total time that PFD units were committed on EMS calls between April 2021 and March 2022 was 2,406.9 hours. Using the 61,320 annual staffed Unit Hours for the seven primary EMS response units, we can calculate the percentage of time that PFD's primary EMS response engines were committed on EMS responses as 0.039, or 3.9 percent of their on-duty time. In other words, PFD's primary EMS first response engines maintain an overall availability percentage of 96.1%

EMS response volume is generally not evenly distributed across a 24-hour day. Typically, EMS volume peaks during times when people are engaging in activity as opposed to when they are sleeping. Figure 7-5 in the data analysis displays PFD's average deployed minutes by time of day. Average deployed time peaked between noon and 1:00 p.m., averaging 41.8 minutes. During this time, PFD typically has seven primary EMS first response units on duty (7 Unit Hours), meaning that even at peak times, only 9.95 percent of PFD's on-duty capacity is committed on responses (41.8 minutes ÷ 420 minutes = 7 Unit Hours).

From an EMS response perspective, this represents a very high degree of response capability. This is due largely to a very desirable system design in which first response units maintain a high level of availability due to short task times, while ambulance resources are committed on much longer task times due to time-consuming ambulance transport and hospital emergency department discharge times.

PLYMOUTH FIRE DEPARTMENT CLINICAL STAFFING FOR EMS RESPONSES

PFD staffs its MFR units with first responders who meet the state requirements in Massachusetts 105 CMR 171.000. This training level includes training in first aid, CPR, the use of AEDs, and in some cases, the administration of naloxone and epinephrine through an auto-injector. While this training level meets the state requirements for MFR, it may not be the most desirable training level for PFDs personnel.

Certification as an Emergency Medical Technician-Basic would be a more appropriate level of certification for PFD personnel. EMT-Basics provide basic emergency medical care for critical and emergency patients who access the emergency medical system. EMTs possess the basic knowledge and skills necessary to provide patient care, and they function as part of a comprehensive EMS response under medical oversight. The initial training course for EMT-Basics consists of Didactic (classroom) learning that follows the National EMS Education Standards published by the National Highway Traffic Safety Administration (NHTSA). This level is the entry level of training for personnel who intend to work as EMT-Basics in conjunction with an ambulance service in Massachusetts and must be taught by a DPH-accredited EMT training institution.

Recommendation:

- The PFD should seek to upgrade the EMS training for PFD field response personnel to the EMT-Basic level. (Recommendation No. 31.)

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PLYMOUTH FIRE EMS RESPONSE TIMES

As discussed in the previous section, CPSM uses two response time measures to evaluate EMS response times, *average* and *fractile*. The average time represents the response time interval at which half of the responses are SHORTER than that interval, and half are LONGER than that interval. It is an easily understood measure of performance, but not necessarily a level of reliability.

The 90th percentile measure is a measure of *reliability*. A 90th percentile analysis determines the response interval at which 90 percent of the EMS response times are less than that interval. Looked at another way, it is the response time interval at which only 10 percent of the EMS response times are longer than that 90th percentile.

PFD's EMS response times are depicted in the following tables.

TABLE 6-1: PFD EMS Average Response Times

	Dispatch	Turnout	Travel	Total
EMS Total	1.5	0.9	4.4	6.8

TABLE 6-2: PFD EMS 90th Percentile Response Times

	Dispatch	Turnout	Travel	Total
EMS Total	2.2	1.9	8.7	11.7

The EMS response time segments recommended by National Fire Protection Association (NFPA) 1710 are shown in the following table.

TABLE 6-3: NFPA 1710 Recommended EMS Response Time Segments

	Dispatch	Turnout	Travel	Total
NFPA Recommendation	1.1	1.0	4.0	6.1

Source: *NFPA 1221; 2020 Ed. https://link.nfpa.org/free-access/publications/1710/2020

Note that only PFD's *average* turnout time is within the NFPA average and fractile recommendations to the NFPA standard.

The following table illustrates the application of the NFPA recommendation compared to PFD's performance at the 90th percentile.

TABLE 6-4: PFD EMS Response Times Compared to NFPA 1710 Recommendations, 90th Percentile

Time Component	Recommended 90% Fractile	PFD Performance	Performance vs. Recommended
Dispatch	1:04	2:12	-00:42
Turnout	1:00	1:54	-00:54
Travel	4:00	8:42	-04:42
Response Time	6:34	12:48	-06:14

It is important to note that for a small sub-set of high-acuity EMS responses, patient outcomes for medical conditions such as cardiac arrest, severe airway compromise, or significant trauma, can be directly impacted by response time. A short response time for these types of EMS responses is crucial, and PFD should undertake steps to minimize response times for high-acuity EMS responses.

Based on this analysis, CPSM recommends that the PFD review internal procedures and processes in order to reduce dispatch, turnout, and travel times to meet the NFPA 1710 standard at the 90th percentile reliability measure.

Recommendation:

- PFD should review internal procedures and processes in order to reduce EMS dispatch and turnout times to meet the NFPA 1710 standard at the 90th percentile reliability measure. (Recommendation No. 32.)

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Dispatch Considerations. While an analysis of the dispatching process is more fully covered earlier in this report, the process used for dispatching EMS units to a 911 EMS response in Plymouth is highly variable, with multiple pathways for call receipt and processing which include multiple Public Safety Answering Points (PSAPs). Steps should be undertaken with PFD, Brewster Ambulance, and the PSAPs responsible for 911 call taking and dispatch to streamline the call-taking and dispatch process.

Turnout Considerations. We note in the data analysis that turnout times for PFD are shortest between the hours of 9:00 a.m. and 9:00 p.m. This seems logical, since during those hours, fire personnel are generally awake and able to assemble for an EMS response more quickly. However, to achieve the NFPA recommended 90th percentile performance level, the PFD must address turnout times both during the day, and the overnight hours through training and data feedback for crew accountability.

Travel Considerations. A 90th percentile fractile measure is a much more stringent standard, and a small number of long response times can impact fractile performance. One area PFD may be able to address is limiting overlapping responses in the same station district. The data analysis depicts the number and percent of calls occurring simultaneously by station. We note that

Stations 1 and 2, the busiest stations in the department, have a combined frequency of 23.1 percent of overlapping calls, nearly a quarter of all responses.

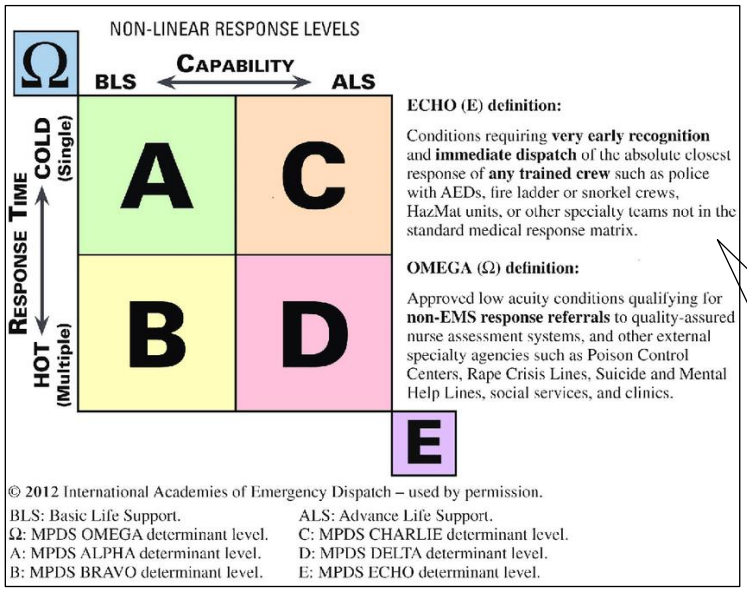
An overlapping call typically means that a response unit from a neighboring district must respond to cover the overlapping call. This will generally result in a longer response time, adversely impacting the 90th percentile fractile response time performance.

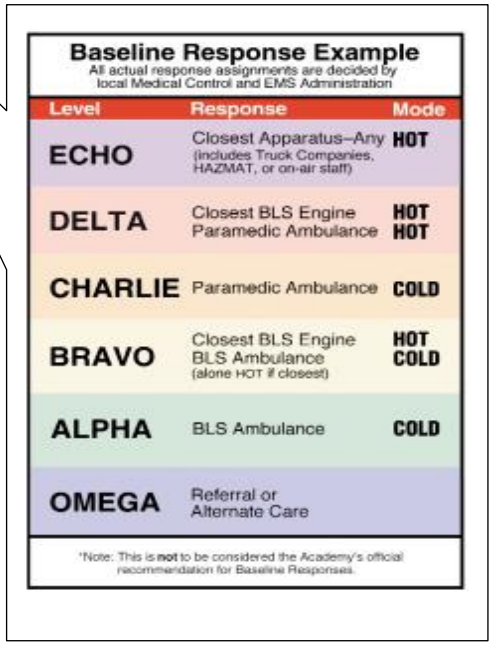
Reducing Overlapping Responses

The 911 Public Safety Answering Points (PSAPs) serving Plymouth have available to them the Priority Solutions® Medical Priority Dispatch System® for Emergency Medical Dispatch (EMD). This system is a highly respected EMD system and is used most by progressive EMS dispatch agencies.

The MPDS system facilitates the use of evidence-based clinical protocols and call-taking processes to assign a response determinant to an EMS request. These response determinants are alpha-numeric codes that help inform responding units specifically what type of medical call to which they are responding. If approved by local protocol, the MPDS system can also be used to assign *response priorities* and *modes of response*, as well as make determinations regarding the *response configuration* for the EMS response.

FIGURE 6-1: Medical Priority Dispatch System Response Algorithm





One method to prevent overlapping calls and improve fractile response time performance would be to limit Medical First Response (MFR) to only those responses that are reasonably likely to be impacted by a rapid MFR. Many EMS responses are not time-life sensitive responses and can be effectively managed by an ambulance-only response. The PFD, BAS, and their Medical Directors should undertake an analysis of patient clinical patient presentations, by EMD Determinant, to identify the types of EMS responses which truly would benefit from a response by an MFR unit and which determinants do not likely require an MFR response. This analysis may reduce the number of calls to which the PFD dispatches an MFR, thereby limiting overlapping calls and creating additional response capacity. This would reduce travel time for up to 23.1 percent of the PFD's overlapped response volume.

An analysis of BAS response data for the period of January 1 through May 31, 2022, reveals there were 3,592 EMS responses in Plymouth. Of those, only 1,781 had a complete EMD Determinant. This may indicate a low compliance by the PSAPs for completing the call-taking process and assigning an EMD determinant.

Applying the MPDS indicated response configuration for an MFR to ECHO, DELTA, and BRAVO determinants in Plymouth would look like this:

	No.	**%**
Total Responses	**3,592**	
Responses with a complete EMD Determinant	1,781	49.6%
ECHO Determinants	25	1.4%
DELTA Determinants	532	29.9%
BRAVO Determinants	223	12.5%
MFR Calls for Service	780	43.8%
MFR calls, if applied to all EMS responses	1,573	43.8%

Thus, we can see that PFD could reduce its Medical First Response to the 43.8 percent of EMS responses in which there is a reasonable likelihood that the presence of an MFR unit may have influence in patient outcome. Doing this would free up capacity and thus cut down on delayed responses due to overlapping calls.

Recommendation:

- The PFD, by working with the EMS Medical Director and other stakeholders, should limit its Medical First Responses to less than 50 percent of the overall EMS response by only responding to ECHO, DELTA, and BRAVO EMD determinants. (Recommendation No. 33.)

BREWSTER AMBULANCE RESPONSE WORKLOAD

The workload of BAS 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 (12,549) than calls (10,955) and the average deployed time per run may vary from the average duration per call.

Deployed time, also referred to as deployed hours, is the total deployment time of BAS units deployed on all runs. Table 7-24 in the accompanying data analysis shows that the total deployed time for BAS' 12,549 runs was 9,790.2 hours, an average of 0.780 hours per EMS run, or an average of 46.7 minutes per response. This is nearly double the average PFD deployed time

per run, due to the additional time typically required for patient transport and discharge at a local emergency department.

Another method for measuring BAS workload is Unit Hour Utilization (UHU), which was described earlier in this section.

To recap: A Unit Hour is defined as one unit, fully staffed, equipped, and available for a response for one hour. For example, one unit on duty 24 hours per day, 365 days per year equates to 8,760 Unit Hours (1 x 24 x 365). A UHU is derived by dividing the number of *responses* by the total number of *unit hours*.

BAS typically staffs four ambulances for Plymouth, providing primary ambulance response from four response stations co-located with PFD. It is important to note that although BAS staffs four dedicated ambulances in Plymouth, it has the capability to draw from other ambulances within the region to cover additional response volume if the four dedicated units are committed on responses.

Using the staffed Unit Hours of the four dedicated BAS ambulances, we derive an annual Unit Hour staffing of 35,040 hours (4 x 8,760). Dividing the number of *responses* (10,955) into the number of Unit Hours, we derive a *response* UHU of 0.313. This essentially means that a BAS ambulance responds to an EMS response 31.3 percent of the time it is on duty.

As we discussed earlier, a limitation of the UHU calculation is that it measures *activity* based on the *frequency* of responses, not the duration of those response, and generally presumes that an EMS response will last one hour. However, as shown in Table 7-26 in the accompanying data report, a BAS unit is typically committed on an EMS call for an average of 46.7 minutes. Therefore, it is prudent to also use a ***time*** analysis to more clearly illustrate the ***percentage of time*** that BAS units are committed on EMS responses.

The total time that BAS units were committed on EMS calls from April 2021 through March 2022 was 9,760.2 hours. Using the 35,040 annual staffed Unit Hours for the four primary ambulances, we can calculate the percentage of time the BAS primary ambulances were committed on EMS responses as 0.279, or 27.9 percent of their on-duty time.

EMS response volume is generally not evenly distributed across a 24-hour day. Typically, EMS volume peaks during times when people are engaging in activity as opposed to when they are sleeping. Figure 7-5 in the data analysis shows the average deployed minutes by time of day for the BAS. Average deployed time peaks between 2:00 p.m. and 3:00 p.m., averaging 98.7 minutes in that hour. During this time, BAS typically has four primary ambulances on duty (four Unit Hours), meaning that at peak times, only 41.1 percent of the BAS on-duty capacity is committed on responses (98.7 minutes ÷ 240 minutes).

From an EMS response perspective, the BAS commitment represents a reasonable response capability, but should be monitored for the delicate balance of operational and economic efficiencies and desired response times. EMS systems across the country are experiencing record response volumes at a time when staffing resources are dropping.

To balance ambulance workload to those responses that have a high likelihood of needing either ALS care and/or transport to an area hospital, some EMS systems have performed detailed analyses of EMD determinants that have low ALS utilization (< 3 percent of the calls), or a low transport percentage (< 25 percent). Consequently, they send only an MFR or QRV to those responses. This helps balance clinical needs and response resources for low-acuity medical calls.

An example of such an analysis is shown here:

BLS Response Report Summary - BLS Eligible Determinants

Through: **10/31/2021**

**BLS Response Determinants w/BLS Unit Response*

Determinant	Responses	Patients Assessed	Transports	Transport Ratio
01A03 - Abdominal Pain / Problems - P3	10	8	7	70.0%
04B01 - A - Assault - Assault - P2	69	60	33	47.8%
04B03 - A - Assault / Sexual Assault / Stun Gun - Assault - P2	10	9	7	70.0%
04D05 - A - Assault - Assault - P1	14	12	6	42.9%
05A01 - Back Pain (Non-Traumatic or Non-Recent Trauma) - P3	6	6	6	100.0%
16A01 - Eye Problems / Injuries - P3	4	4	3	75.0%
20B02 - H - Heat / Cold Exposure - Heat exposure - P2	24	11	5	20.8%
20O01 - H - Heat exposure - Heat exposure - P3	4	2	1	25.0%
23B01 - Overdose/Poisoning/Ingestion	1	1	1	100.0%
24B02 - Pregnancy/Childbirth/Miscarriage	0	0	0	
24C03 - Pregnancy/Childbirth/Miscarriage	2	2	2	100.0%
24D03 - Pregnancy/Childbirth/Miscarriage	3	3	3	100.0%
25A02 - Psychiatric / Abnormal Behavior / Suicide Attempt - P3	20	18	13	65.0%
25B03 - Psychiatric / Abnormal Behavior / Suicide Attempt - P2	50	40	37	74.0%
25O01 - Psychiatric / Abnormal Behavior / Suicide Attempt - P3	36	33	27	75.0%
25O02 - Psychiatric / Abnormal Behavior / Suicide Attempt - P3	28	25	23	82.1%
26A06 - Sick Person (Specific Diagnosis) - P3	14	12	10	71.4%
26A10 - Sick Person (Specific Diagnosis) - P3	68	54	43	63.2%
26C02 - C - Sick Person (Specific Diagnosis) - Suspected coronavirus illness - P2	23	20	12	52.2%
26O28 - Sick Person (Specific Diagnosis) - P3	13	12	12	92.3%
29A02 - V - Traffic Collision / Transportation Incident - Multiple patients - P3	60	21	13	21.7%
29B01 - V - Vehicle vs. vehicle - Multiple patients - P2	271	141	88	32.5%
29B02 - V - Vehicle vs. vehicle - Multiple patients - P2	4	1	1	25.0%
29B03 - V - Vehicle vs. vehicle - Multiple patients - P2	56	18	9	16.1%
29B05 - Traffic Collision / Transportation Incident - P2	322	116	82	25.5%
32B03 - Unknown Problem (Person Down) - P2	109	37	16	14.7%
Total	**1221**	**666**	**460**	**37.7%**

Recommendation:

- BAS and PFD should investigate methods for alternative delivery models in order to reduce ambulance demand, which will help to maintain response times for high-acuity medical responses. (Recommendation No. 34)

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CPSM was provided response time data from BAS for the additional period of January 2022 through May 2022. An analysis of this data reveals the BAS average and 90th percentile response time summary for the Town of Plymouth as seen in the next two tables.

TABLE 6-5: Brewster Ambulance Average Response Times

	Dispatch	Turnout	Travel	Total
Average in Minutes	2.2	2.0	6.5	10.7

TABLE 6-6: Brewster Ambulance 90th Percentile Response Times

	Dispatch	Turnout	Travel	Total
90th Percentile in Minutes	4.1	3.1	11.7	18.9

Although there is no contracted requirement between Plymouth and the BAS for response time performance, this analysis points to opportunities for improvement for BAS service delivery, specifically in dispatch time and turnout time.

Ambulance industry standards are, for the most part, that an ambulance will arrive on scene within 10 minutes at the 90th percentile reliability factor, with a 60-second dispatch time and a 60-second turnout time. If BAS is able to reduce its dispatch and turnout times to the accepted 90th percentile at 60 seconds each, its total response time would be reduced to 13.7 minutes.

Dispatch Considerations. While an analysis of the dispatching process was fully covered in an earlier part of this section, we have to emphasize that the process used for dispatching EMS units to a 911 EMS response in Plymouth is highly variable, with multiple pathways for call receipt and processing, and which includes multiple Public Safety Answering Points (PSAPs). Steps should be undertaken with PFD, BAS, and the PSAPs responsible for 911 call taking and dispatch to streamline the call-taking and dispatch process.

Turnout Considerations. The BAS turnout times are generally above industry best practice and can be reduced by considering a dynamic posting system that removes ambulances from fixed fire stations, at least during the busiest daytime hours.

Transport Time Components

The data analysis reveals an average ambulance on-scene times of 15 minutes and 12 seconds, travel time to the hospital of 11 minutes and 18 seconds, and at-hospital time of 26 minutes and 12 seconds. These time segments are relatively typical in ambulance operations. The community is benefiting from relatively short at-hospital times since some EMS systems experience at-hospital times of 90 minutes or longer.

TABLE 6-7: Brewster Ambulance Transport Analysis

Call Type	Average Time Spent per Run, Minutes				Number of Runs
	On Scene	Traveling to Hospital	At Hospital	Deployed	
EMS Total	**15.2**	**11.3**	**26.2**	**59.9**	**8,115**
Fire & Other Total	**14.7**	**10.6**	**28.3**	**59.8**	**210**
Total	**15.2**	**11.3**	**26.2**	**59.9**	**8,325**

EMERGENCY CALL TAKING

EMS 911 call taking for Plymouth is complex, and other sections of this report have highlighted the challenges with the current 911 call-taking and dispatch process. In this section we will highlight certain aspects of these processes.

Based on computer-aided dispatch (CAD) data provided by PFD, it appears that to some extent, dispatch agencies do use the Priority Solutions® Medical Priority Dispatch System®

(MPDS)[33] for Emergency Medical Dispatch (EMD). This system is a highly respected EMD system and is used most by progressive EMS dispatch agencies.

The MPDS system is an evidence-based system that uses clinical protocols and processes to assign a response determinant to the EMS request. These response determinants are alpha-numeric codes that, if approved by the EMS Medical Director, can be used to determine the *priority* of a response (lights and siren (HOT) response, or a non-lights and siren (COLD) response), and the appropriate *level of care* likely necessary to meet the patient's clinical needs. These codes facilitate the appropriate use of ALS and BLS ambulances in the ambulance response system. The response determinants also aid in informing the responding units specifically what type of medical call to which they are responding. If approved by local protocol, the MPDS system can also be used to assign response configurations for the EMS response, such as whether or not a MFR should be assigned to the response.

An example of a response matrix based on MPDS EMD response determinants was shown in Figure 6-1.

The MPDS system enables the use of an evidence-based process for the provision of pre-arrival medical instructions during the time EMS units are responding to the call.

Appropriate use of the MPDS system typically includes the active engagement of a physician Medical Director, and a robust quality assurance (QA) process, which helps assure that EMD call taking, EMD determinant assignments, and pre-arrival instructions are being conducted appropriately and reliably.

Many EMS systems across the country are using EMD, and MPDS in particular, to reduce the incidence of HOT responses. This offers two important benefits. It helps protect provider and public safety, and it preserves crucial first medical response resources for 911 medical calls that are time-sensitive (cardiac arrest, choking, heart attack, etc.). HOT responses dramatically increase the risk of crashes and injuries to responding personnel and the public. In February 2022, 14 national EMS associations, including the International Association of Fire Chiefs, and the National Association of EMS Physicians, published a joint position statement[34] ***encouraging EMS systems to reduce HOT responses to less than 30 percent of EMS calls, and less than 5 percent of ambulance transports***.

In Plymouth, BAS responds HOT to every EMS call. This is problematic; as well. It is contrary to best practices for two reasons. First, it increases the risk of a crash during the response, placing the ambulance crew and the public in unnecessary jeopardy while offering little clinical benefit to most patients. Second, it does not allow the reassignment of ambulances from lower priority call to a higher priority call. This could potentially delay the ambulance response to a more critical patient.

The MPDS system can be used effectively to determine which EMS responses are time-sensitive and on which ones the presence of a medical first response unit could make an impact on patient outcomes. The effective use of this system can preserve crucial first response medical units for those responses that are time-sensitive.

Due to the worsening EMS worker shortage, in particular paramedics, high-performance EMS systems, such as MedStar in Fort Worth, Texas; REMSA in Reno, Nev.; and EMSA in Tulsa and

33. https://www.emergencydispatch.org/what-we-do/emergency-priority-dispatch-system/medical-protocol
34. https://www.hmpgloballearningnetwork.com/site/emsworld/news/top-ems-groups-issue-joint-statement-ls-responses

Oklahoma City, Ok., have recently begun using the MPDS system as the backbone of a tiered ambulance deployment system. Specifically, these systems are using BLS ambulances staffed with EMTs to respond to low-acuity medical complaints, thereby preserving scarce ALS capacity for higher-acuity medical responses. This process has enabled those systems to dramatically enhance response capability while improving job satisfaction for the ambulance personnel.

During interviews with PFD and BAS leadership, it was shared with CPSM that although the MPDS system is used for call taking and pre-arrival instructions, it is not used very effectively. Evidence of this can be found in the dispatch data supplied to CPSM for this project. For the period of January through May 2022, BAS provided records for 3,592 EMS responses in Plymouth. Of those, only 1,781 (49.6 percent) of the responses had a complete EMD determinant.

Recommendation:

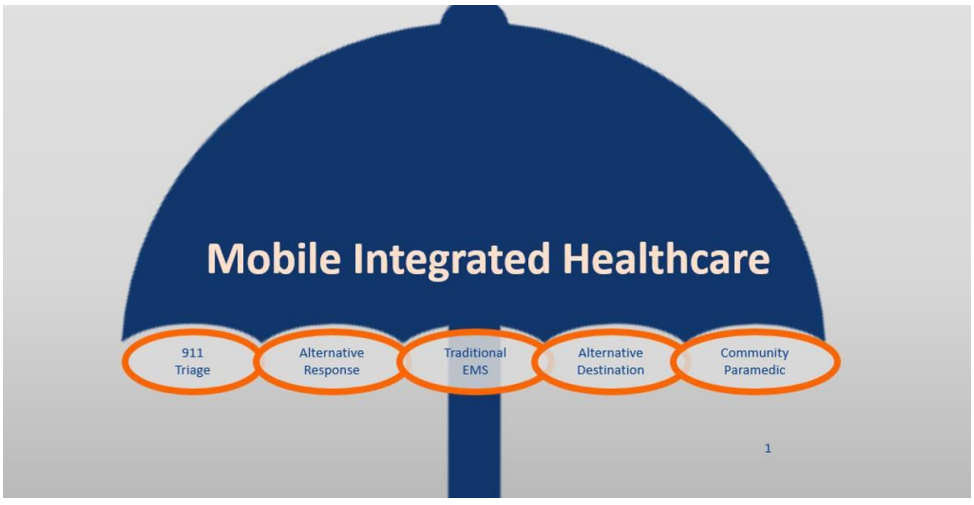
- PFD and the other agencies that are part of the dispatch process should work with the leadership the PFD and BAS to immediately end the process of BAS responding to all EMS calls HOT and take full clinical and safety advantage of using the MPDS system for response prioritization, response mode, and clinical level of response. (Recommendation No. 35.)

MOBILE INTEGRATED HEALTH/COMMUNITY PARAMEDIC PROGRAM

One of the fastest-growing value-added service enhancements in EMS is that of Mobile Integrated Healthcare/Community Paramedicine (MIH/CP) programs. An MIH/CP program is comprised of a suite of potential services that EMS could provide to fill gaps in the local healthcare delivery system. In essence, such a service is intended as a way to better manage the increasing EMS call volume and better align the types of care being provided with the needs of the patient. To be effective, an MIH/CP program is commonly accomplished through a collaborative approach with healthcare and social service agencies within the community.

In 2009, there were four such programs in the country, but a recent survey by the National Association of EMTs identified more than 250 active MIH/CP programs operating across the U.S.[35]

FIGURE 6-2: Components of a Mobile Integrated Healthcare Program



35. http://www.naemt.org/docs/default-source/2017-publication-docs/mih-cp-survey-2018-04-12-2018-web-links-1.pdf?Status=Temp&sfvrsn=a741cb92_2

During our interviews with BAS leadership, they note that BAS has developed MIH/CP programs for the communities they serve; however, the State of Massachusetts has put in place regulatory fees for MIH/CP programs which generally make it financially challenging to operate these programs.

BAS and PFD should continue to investigate options to operationalize an MIH/CP program for Plymouth. We understand that there may continue to be challenges with the way the state is regulating MIH/CP programs, but there may be workarounds that could bring this valuable service delivery model to Plymouth.

A consideration for a potential role for an MIH/CP program in Plymouth could be an expansion of the currently operated specialized response unit for behavioral health emergencies, in partnership with the Plymouth Police Department and community mental health resources. Sometimes referred to as a Crisis Intervention Team (CIT), specialized units such as these have been effective in other communities across the country to reduce the risks associated with behavioral health-related responses.[36].

Recommendation:

- PFD and BAS should work with their Medical Directors and other community stakeholders to determine the role that an MIH/CP program could play in working with high utilizers and other patients within Plymouth who would benefit from this type of service model. (Recommendation No. 36.)

EMS PERFORMANCE MEASURES & QUALITY

BAS has a very transparent management philosophy and has made its operational and clinical performance statistics, including response level detail, available to key stakeholders in the PFD. This is commendable and demonstrates a willingness to accept accountability for the service it provides.

Most communities evaluate the effectiveness of an EMS system based on response times. However, for the majority of EMS responses, time is not a critical factor in a patient's outcome.

A position statement developed in 2007 by the consortium known as the U.S. Metropolitan Municipality EMS Medical Directors[37] cited that in many jurisdictions, response-time intervals for advanced life support units and resuscitation rates for victims of cardiac arrest are the primary measures of EMS system performance, but that the association of the former with patient outcomes is not supported explicitly by the medical literature, while the latter focuses on a very small proportion of the EMS patient population and thus does not represent a sufficiently broad selection of performance measures.

As a result, although BAS provides access to clinical data, the reports provided to CPSM appear to be for specific steps in the clinical process of care. Progressive and transformative EMS systems have adopted a more robust process for evaluating EMS System performance, that is, measures based on clinical bundles and patient experience.

36. https://www.nami.org/Advocacy/Crisis-Intervention/Crisis-Intervention-Team-(CIT)-Programs
37. https://pubmed.ncbi.nlm.nih.gov/18379908/

Clinical Performance Dashboards

The use of clinical dashboards for key clinical performance indicators can significantly augment the QA process by identifying opportunities for improvement and tying these opportunities to continuing medical education.

For example, the Metropolitan Area EMS Authority (MedStar Mobile Healthcare) system in Fort Worth, Texas, publishes clinical performance dashboards for specific high-acuity medical interventions such as airway management, mechanical chest compression use, and clinical conditions such as cardiac arrest, STEMI, and trauma care.

Examples of these clinical performance dashboards are shown here.

MAEMSA Clinical Bundle Performance Dashboard

Agency:

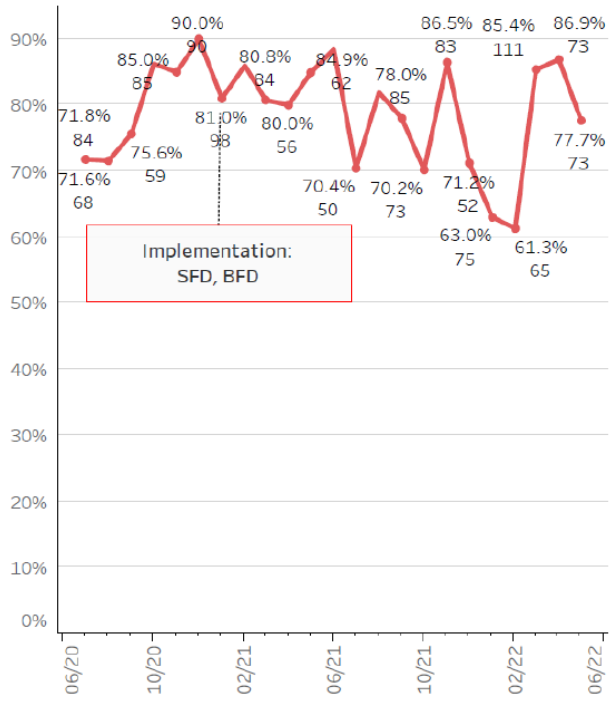
Ventilation Management	Goal	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
% of cases with etCO2 use for non-invasive ventilation management (CPAP, BVM) when equipped								
% of cases with etCO2 use for invasive ventilation management (KA, ETT, Cric)								
% of successful ventilation management as evidenced by etCO2 waveform throughout the case								
% of successful King Airway placement								
% of successful endotracheal tube placement								
System response time < 5 mins for Dispatch-presumed compromised airway								

STEMI	Goal	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
% of suspected STEMI patients correctly identified by EMS								
% of suspected STEMI patients w/ASA admin (*in the absence of contraindications)*								
% of suspected STEMI patients w/NTG admin (*in the absence of contraindications)*								
% of suspected STEMI patients with 12L acquisition within 10 minutes of patient contact								
% of suspected STEMI patients with 12L transmitted within 5 minutes of transport initiation								
% of suspected STEMI patients with PCI facility notified of suspected STEMI within 10 minutes of EMS patient contact								
% of patients with Suspected STEMI Transported to PCI Center								
% of suspected STEMI patients with EMS activation to Cath Lab intervention time < 90 minutes								

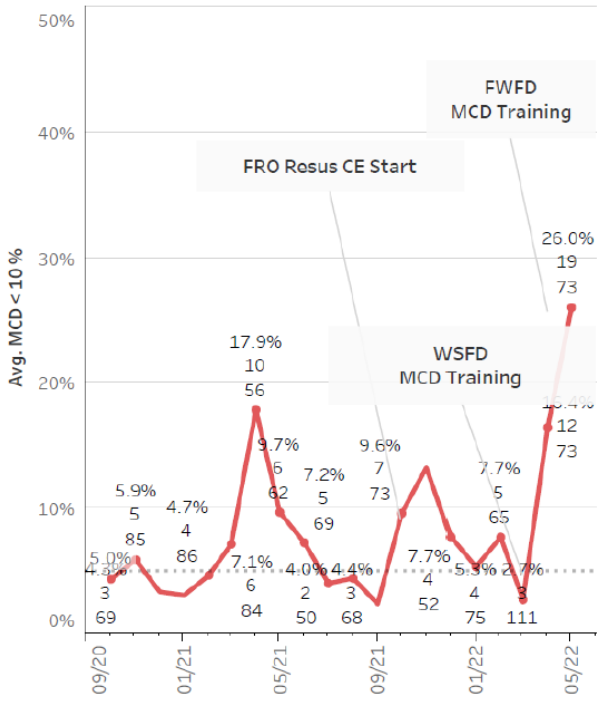
Stroke	Goal	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
% of suspected Stroke patients correctly identified by EMS								
% of suspected Stroke patients w/BGL measured								
% of suspected Stroke patients w/CSS measured								
% of suspected Stroke patients w/positive CSS scores receiving Los Angeles Motor Score (LAMS) measured								
% of suspected stroke patients with stroke facility notified of suspected stroke within 10 minutes of EMS patient contact								
% of suspected stroke patients w/LAMS scores 4 - 5 transported to Comprehensive Stroke Center								

Trauma	Goal	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
% of patients meeting Trauma Alert criteria correctly identified by EMS								
% of suspected Trauma Alert patients with trauma facility notified of trauma alert within 10 minutes of EMS patient contact								
% of suspected Trauma Alert patients with scene time < 10 minutes (*in the asbsence of extrication delay*)								

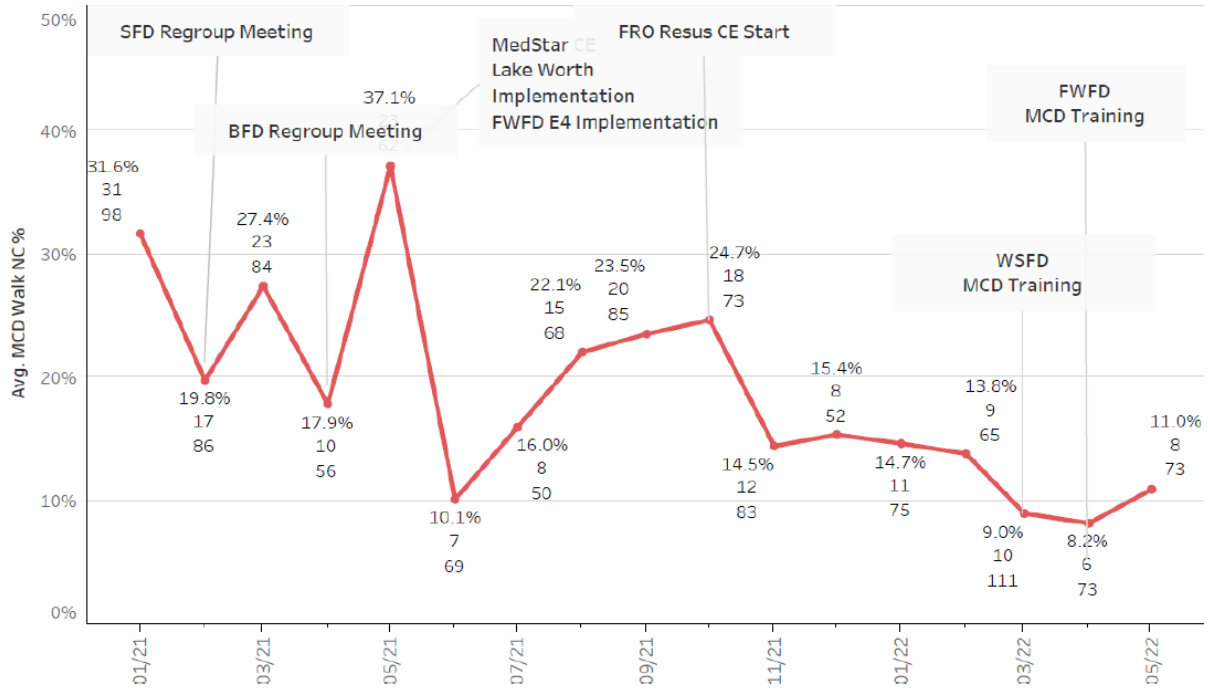
MCD Placement %



MCD Placement < 10 sec %



% of Uncorrected MCD Walk/Overall placement



Recommendation:

- PFD and BAS, working with their Medical Director, should develop and publish clinical dashboards to evaluate and improve the clinical measures for the EMS system and identify quality improvement opportunities. (Recommendation No. 37.)

Patient Experience Metrics

Medicare and other healthcare payers place more emphasis on the patient's experience in healthcare delivery. EMS is healthcare delivery. It is commendable that BAS offers a patient experience survey option on its website; however, this requires the patient to actively access the BAS website to complete a survey. Medicare and other payers do not allow providers to conduct their own surveys, due to the potential risk of skewed data. Instead, these payers require a provider to use an approved outside surveying agency, such as Press Ganey, or Gallup, to contact patients and complete an experience survey.

As a result of this trend, a growing number of progressive and transformative EMS agencies have begun evaluating patient experience scores using an outside agency to assure the assessment is objective and nonbiased. An example of this type of patient experience report follows here.

§ § §

Medstar Mobile Healthcare

Fort Worth, TX
Client 6511

1515 Center Street
Lansing, MI 48096
(517) 318-3800
support@EMSSurveyTeam.com
www.EMSSurveyTeam.com

Patient Experience Report

July 1, 2022 to July 31, 2022

Your Score
91.87

Your Patients in this Report
135

Total Patients in this Report
4,614

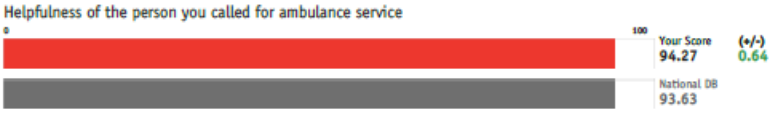
Total EMS Organizations
215

Medstar Mobile Healthcare
July 01, 2022 to July 31, 2022

Dispatch Composite

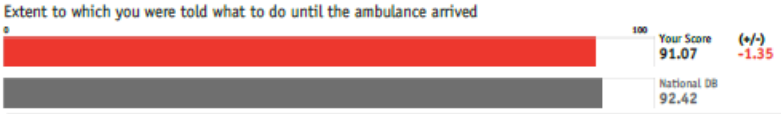
This report shows mean scores for each Dispatch survey item and the overall composite score. The first column shows your organization score with the national database score below it. The second column is the difference between your score and the database mean.

Helpfulness of the person you called for ambulance service



Concern shown by the person you called for ambulance service

Extent to which you were told what to do until the ambulance arrived



Overall Composite Score

Recommendation:

- PFD and BAS should consider and implement a process to independently evaluate and publish patient experience scores as a key metric in evaluating overall service delivery quality. (Recommendation No. 38.)

AMBULANCE SERVICE CONTRACT

BAS is currently operating under a 'Level of Effort' contract with the Town of Plymouth, contracting for a specified number of ambulance units. This agreement is in effect through December 31, 2027. The agreement does not specify any performance levels the Town expects. It is more common for ambulance providers and jurisdictions to operate under a 'Performance-Based' agreement, which would specify a desired performance levels for key clinical, experiential and response time metrics.

The current agreement also does not provide any funding to BAS for the units dedicated to the town. EMS agencies are undergoing a significant staffing crisis due to fewer people willing to enter the EMS profession because of the inherent risks (exacerbated as a result of the COVID-19 pandemic) and the low wages that some EMS agencies offer due to a poor reimbursement model. Costs for the provision of ambulance services have dramatically increased over the past 18 to 24 months due to the need to significantly increase wages to retain and recruit ambulance staff along with the ongoing supply chain issues. In the event supplemental funding may become necessary to maintain the level of service the town desires, for planning purposes the town and BAS should establish financial metrics for service delivery to the town that could indicate any future financial challenges BAS may experience.

Recommendation:

- The Town of Plymouth and BAS should revise or amend the current 'Level of Effort' agreement to a 'Performance-Based' agreement that specifies desired clinical, experiential, and response time performance levels, and as well provides for financial evaluations that offer the town ample notice in the event financial conditions may cause service delivery challenges. (Recommendation No. 39.)

AMBULANCE SERVICE DELIVERY MODEL

As part of this engagement, CPSM was requested to evaluate the risk and benefits of PFD initiating a fire-based ambulance service.

It is not likely the existing number of personnel would be sufficient to provide a fire-based ambulance service, nor would CPSM recommend using existing PFD firefighters to take on an ambulance service. Thus, all the positions needed for a fire-based ambulance service would need to be new positions within the department. Staffing four ambulances on a 24/7 basis would require hiring 24 frontline personnel (12 EMTs and 12 paramedics). It would also be necessary to add a Battalion Chief/EMS Supervisor position, for a total of 25 new hires to the department.

To demonstrate the cost to the fire department of setting up a fire-based EMS system, we built a pro forma budget for year-one ambulance operations for the PFD, with the following assumptions:

- Year 1 firefighter wage for the EMT positions of $26.2228, plus a 2 percent certification premium.
- Year 1 lieutenant wage for the paramedic positions of $37.3707, plus a 4 percent certification premium.
- Year 1 Battalion Chief/EMS supervisor at $41.0693.
- 1 EMT and 1 Paramedic floater to cover vacancies for PTO.

- A standard 24/48 work schedule, with OT pay built in for late calls and required continuing education.
- Ambulances and all capital costs amortized over the useful life of the equipment.
- A 2 percent increase in call volume from the baseline 2021-22 year.

Based on predicted revenues and expenses, a PFD-based ambulance would have expenses in excess of revenues of $943,904.

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TABLE 6-8: Fire-Based EMS, Estimated Year-One Personnel Expenditures

Personnel Expense											
Plymouth, MA											
Year 1											
Ambulance Personnel	**Rate**	**#**	**Reg. Hours**	**Regular Wages**	**Overtime Rate**	**Unsch. Overtime**	**Training Hours**	**Overtime Wages**	**Total Wages**	**Benefit %**	**Total Expense**
A-Shift Ambulance 1 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
B-Shift Ambulance 1 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
C-Shift Ambulance 1 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
A-Shift Ambulance 2 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
B-Shift Ambulance 2 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
C-Shift Ambulance 2 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
A-Shift Ambulance 3 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
B-Shift Ambulance 3 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
C-Shift Ambulance 3 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
A-Shift Ambulance 4 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
B-Shift Ambulance 4 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
C-Shift Ambulance 4 EMT	$ 26.75	1.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
EMT Floater	$ 26.75	2.00	2592	$ 69,329	$ 40.12	156	10	$ 6,660	$ 75,989	45.0%	$ 110,184
A-Shift Ambulance 1 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
B-Shift Ambulance 1 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
C-Shift Ambulance 1 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
A-Shift Ambulance 2 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
B-Shift Ambulance 2 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
C-Shift Ambulance 2 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
A-Shift Ambulance 3 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
B-Shift Ambulance 3 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
C-Shift Ambulance 3 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
A-Shift Ambulance 4 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
B-Shift Ambulance 4 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
C-Shift Ambulance 4 Paramedic	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
Paramedic Floater	$ 32.63	1.00	2592	$ 84,565	$ 48.94	156	20	$ 8,613	$ 93,179	45.0%	$ 135,109
Ambulance Supervisor/Coordinator/Bat Chief	$ 41.07	1.00	2080	$ 85,424	$ 61.60	104	20	$ 7,639	$ 93,063	45.0%	$ 134,941
Year 1 Total Personnel Expense											**$ 3,323,748**

TABLE 6-9: Fire Based EMS Estimated Vehicle Expenses

Vehicle/Capital Equipment Expense					
Plymouth, MA					
	Capital Expense	**Number Needed**	**Capital Outlay**	**Useful Life (Years)**	**Annual Expense**
Ambulance	$ 350,000	5	$ 1,750,000	5	$ 350,000
Cardiac Monitor	$ 45,000	6	$ 270,000	7	$ 38,571
Auto-Load/Stretcher	$ 35,000	5	$ 175,000	7	$ 25,000
Radios	$ 3,500	20	$ 70,000	4	$ 17,500
Mobile Computers	$ 1,750	5	$ 8,750	2	$ 4,375
Total			**$2,273,750**		**$ 435,446**

TABLE 6-10: Fire-Based EMS Estimated Operational & Maintenance Expenses

Operations Expenses					
Plymouth, MA					
Annual Responses	10,995				
Annual Transports	7,367				
Category	**Annual Miles**	**Miles Per Gallon**	**Gallons**	**Price**	**Total**
Fuel	76,965	5	15,393	$ 5.20	$ 80,044
	Annual Miles	**Cost per Mile**			**Total**
Maintenance/Tires	76,965	$ 0.41			$ 31,556
	Per Response	**Responses**	**Total**		
Medical Supplies	$ 21.00	10,995	$ 230,895		
Equipment Maintenance	$ 3.50	10,995	$ 38,483		
Total Operations Expense	$ 380,977				

TABLE 6-11: Fire-Based EMS Estimated Revenues

Revenue Analysis						
Plymouth, MA						
Year 1	**Number**	**Average Patient Charge**	**Gross Fees**	**Collection %**	**Average Collected**	**Net Collections**
Responses	10,995					
Transports	7,367	$ 1,500.00	$ 11,049,975	30.0%	$ 450.00	$ 3,314,993
Non-Transports	3,628	$ 175.75	$ 637,683	5.0%	$ 8.79	$ 31,884
Total Net Revenue			**$ 11,687,658**			**$ 3,346,877**

Payer Mix Analysis	
Plymouth, MA	
Payer	**2022**
Medicare	15.2%
Medicare MCO	25.5%
Medicaid	3.7%
Medicaid MCO	22.6%
Dual Eligible	2.2%
Commercial	15.3%
Self Pay	14.1%
Other	1.5%
Total	**100.0%**

TABLE 6-12: Fire-Based EMS Revenues & Expenses Roll-Up Analysis

Roll-Up Analysis	
Expense	**Year 1**
Personnel	$ 3,323,748
Vehicles/Equipment	$ 435,446
Operations	$ 380,977
Billing Fees	$ 150,609
Total	**$ 4,290,781**
Revenue	$ 3,346,877
Retained Earnings From Operations	**($943,904)**
Per Unit Hour	29,625
Expense	$ 144.83
Revenue	$ 112.97
Retained Earnings	**($31.86)**
Per Response	10,995
Expense per Response	$ 390.25
Revenue Per Response	$ 304.40
Retained Earnings	**($85.85)**
Per Transport	7,367
Expense per Transport	$ 582.46
Revenue Per Transport	$ 454.33
Retained Earnings	**($128.13)**

Currently, Plymouth enjoys a very good ambulance service, with no expense to the town.

Recommendation:

- CPSM does not recommend the town initiate a fire-based ambulance service unless there are compelling reasons due to chronic and repeated service delivery failures on the part of BAS. (Recommendation No. 40.)

SECTION 7. DATA ANALYSIS

This data analysis was prepared as a key component of the study of the Plymouth Fire Department (PFD). It also includes an analysis of the private ambulance service provided within Plymouth's town limits. This analysis examines all calls for service between April 1, 2021, and March 31, 2022, as recorded in PFD's Records Management System (RMS), and Emergency Medical Dispatch (EMD) records from the Brewster Ambulance Service (BAS).

This analysis is made up of three parts. The first part focuses on the Plymouth Fire Department. The second part explores the emergency medical services provided by the Brewster Ambulance Service. The third and final part presents response time statistics.

The PFD serves the Town of Plymouth and protects the community through fire prevention and suppression, technical rescue, and hazardous materials mitigation services. The town provides emergency medical services to the community through a contract with the Brewster Ambulance Service as well as through emergency medical responses by the PFD. The PFD is a full-service fire department, primarily serving 64,500 residents in 103 square miles.

The fire department operates out of seven fire stations. It utilizes seven frontline engines, three reserve engines, three ladder trucks, three tankers, eight fire boats, nine forest fire units, one rescue unit, and twelve utility units. PFD also houses four ambulances and a medical fly-car of the Brewster Ambulance Service.

Between April 1, 2021, and March 31, 2022, PFD units responded to 10,558 calls, of which 65 percent were EMS calls. The total combined workload (deployed time) was 3,993.8 hours. The BAS units responded to 10,955 calls, of which 89 percent were EMS calls. The total combined workload (deployed time) was 9,760.2 hours. The average PFD response time was 6.9 minutes and the 90th percentile response time was 11.8 minutes.

METHODOLOGY

In this report, 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.

We linked the Plymouth Fire Department and Brewster Ambulance data sets. Then, we classified the calls in a series of steps. We first used the National Fire Incident Reporting System's (NFIRS) standard incident type from the PFD system to identify canceled calls, motor vehicle accidents (MVA), and fire category call types. Calls identified within NFIRS as EMS calls along with any calls that lacked an NFIRS record were categorized using the Brewster Ambulance's Emergency Medical Dispatch (EMD) descriptions. We describe the method of call categorization in Attachment I.

The PFD's primary service area is the Town of Plymouth. All of PFD's responses beyond the town's limits were identified as mutual aid. In this analysis, we examined PFD's fire response to locations inside and outside Plymouth. We limited our analysis of BAS's responses to the Town of Plymouth.

We received records for a total of 13,729 calls that were responded to by either a PFD unit to any location or a BAS unit within Plymouth between April 1, 2021, and March 31, 2022. We removed all runs that did not have en route and arrival timestamps. As a result, 60 calls were removed. In addition, a total of eight incidents to which the administrative units were the sole responders are not included in the analysis sections of the report. However, the workload of administrative units is documented separately in the analysis.

SUMMARY OF CALLS AND WORKLOAD

In this report, we separated the analysis into two parts including (1) Plymouth Fire Department's (PFD) units and (2) Brewster Ambulance Service's (BAS) units. Tables 7-1 and 7-2 summarize the number of calls involving each agency and the combined workload, broken out by agency and service type.

TABLE 7-1: Summary of Calls by Responding Agency and Type

Agency	Service Type			Number of Calls	Percent of Calls
	EMS	Fire	Other		
PFD only	82	2,474	150	2,706	19.8
BAS only	2,997	58	48	3,103	22.7
Combined PFD and BAS	6,802	578	472	7,852	57.5
Total	**9,881**	**3,110**	**670**	**13,661**	**100.0**

TABLE 7-2: Summary of Workload by Responding Agency and Type

Agency	Runs				Work Hours			
	EMS	Fire	Other	Total	EMS	Fire	Other	Total
PFD	7,055	3,795	650	11,500	2,405.3	1,454.7	133.7	3,993.8
BAS	11,284	692	573	12,549	9,272.1	271.2	217.0	9,760.2
Total	**18,339**	**4,487**	**1,223**	**24,049**	**11,677.4**	**1,726.0**	**350.7**	**13,754.1**

Observations:

- PFD units responded to 10,558 calls. 74 percent of these calls included a responding BAS unit.
- BAS units responded to 10,974 calls. 72 percent of these calls included a responding PFD unit.

PART 1. PLYMOUTH FIRE DEPARTMENT

In this part, we examine the response and workload of PFD units. This part of the analysis is made up of three sections. The first section focuses on call types and dispatches. The second section explores the time spent and the workload of individual units. The third section presents an analysis of the busiest hours in the year studied.

AGGREGATE PFD CALL TOTALS AND RUNS

Between April 1, 2021, and March 31, 2022, PFD's fire units responded to 10,558 calls. Of these, 68 were structure fire calls and 109 were outside fire calls within Plymouth.

PFD Calls by Type

Table 7-3 shows the number of calls responded by fire response units by call type, average calls per day, and the percentage of calls that fall into each call type category. Figures 7-1 and 7-2 show the percentage of calls that fall into each EMS (Figure 7-1) and fire (Figure 7-2) type category.

TABLE 7-3: PFD Calls by Type

Call Type	Total Calls	Calls per Day	Call Percentage
Breathing difficulty	786	2.2	7.4
Cardiac and stroke	886	2.4	8.4
Fall and injury	1,337	3.7	12.7
Illness and other	2,267	6.2	21.5
MVA	580	1.6	5.5
Overdose and psychiatric	288	0.8	2.7
Seizure and unconsciousness	740	2.0	7.0
EMS Total	**6,884**	**18.9**	**65.2**
False alarm	1,441	3.9	13.6
Good intent	141	0.4	1.3
Hazard	432	1.2	4.1
Outside fire	109	0.3	1.0
Public service	841	2.3	8.0
Structure fire	68	0.2	0.6
Technical rescue	20	0.1	0.2
Fire Total	**3,052**	**8.4**	**28.9**
Canceled	612	1.7	5.8
Mutual aid	10	0.0	0.1
Total	**10,558**	**28.9**	**100.0**

Note: Four mutual aid calls were canceled.

FIGURE 7-1: EMS Calls by Type, PFD

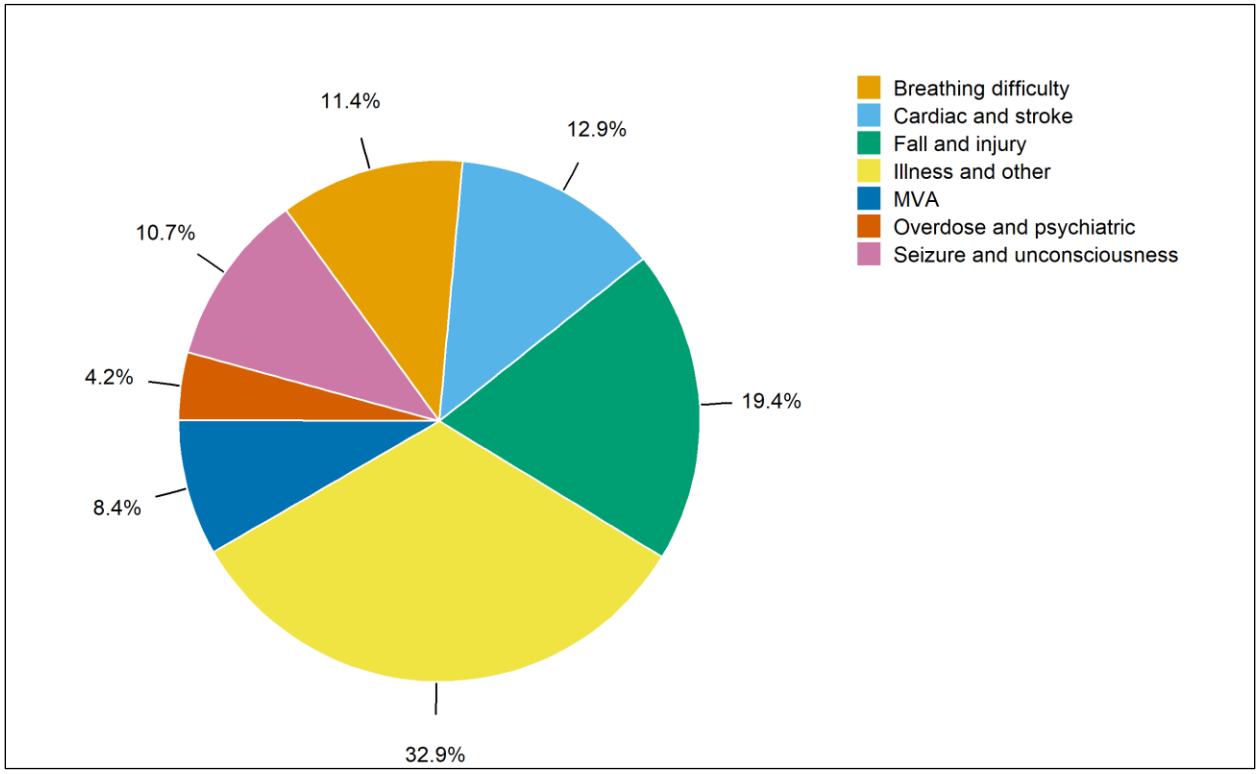
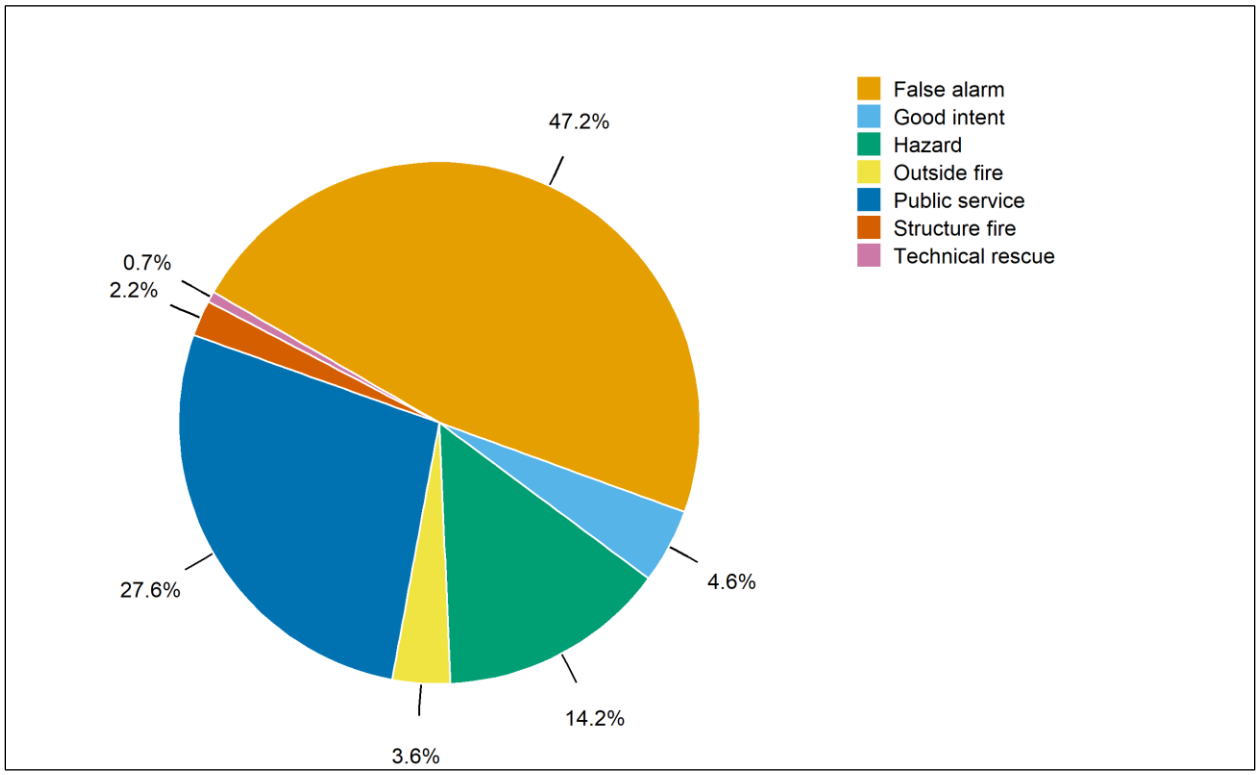


FIGURE 7-2: Fire Calls by Type, PFD



Observations:

- PFD's fire response units responded to an average of 28.9 calls per day, including 1.7 canceled (six percent) calls per day.
- EMS calls totaled 6,884 (65 percent of all calls), an average of 18.9 calls per day.
  - Illness and other calls were the largest category of EMS calls at 21 percent of total calls (33.0 percent of EMS calls).
  - Motor vehicle accidents (MVA) made up 5 percent of total calls (8 percent of EMS calls).
  - Cardiac and stroke calls made up 8 percent of total calls (13 percent of EMS calls).
- Fire calls totaled 3,052 (29 percent of all calls), or an average of 8.4 calls per day.
  - False alarm calls made up 14 percent of total calls (47 percent of fire calls).
  - Structure and outside fire calls combined made up 2 percent of total calls (6 percent of fire calls), or an average of 0.5 calls per day, or about one call every two days.

PFD Calls by Type and Duration

Table 7-4 shows the duration of calls by type using four duration categories: less than 30 minutes, 30 minutes to one hour, and one or more hours.

TABLE 7-4: PFD Calls by Type and Duration

Call Type	Less than 30 Minutes	30 Minutes to One Hour	One or More Hours	Total
Breathing difficulty	691	91	4	786
Cardiac and stroke	776	110	0	886
Fall and injury	1,189	140	8	1,337
Illness and other	2,040	225	2	2,267
MVA	464	98	18	580
Overdose and psychiatric	259	27	2	288
Seizure and unconsciousness	646	90	4	740
EMS Total	**6,065**	**781**	**38**	**6,884**
False alarm	1,297	127	17	1,441
Good intent	130	9	2	141
Hazard	267	120	45	432
Outside fire	61	26	22	109
Public service	734	79	28	841
Structure fire	25	26	17	68
Technical rescue	6	8	6	20
Fire Total	**2,520**	**395**	**137**	**3,052**
Canceled	593	16	3	612
Mutual aid	5	0	5	10
Total	**9,183**	**1,192**	**183**	**10,558**

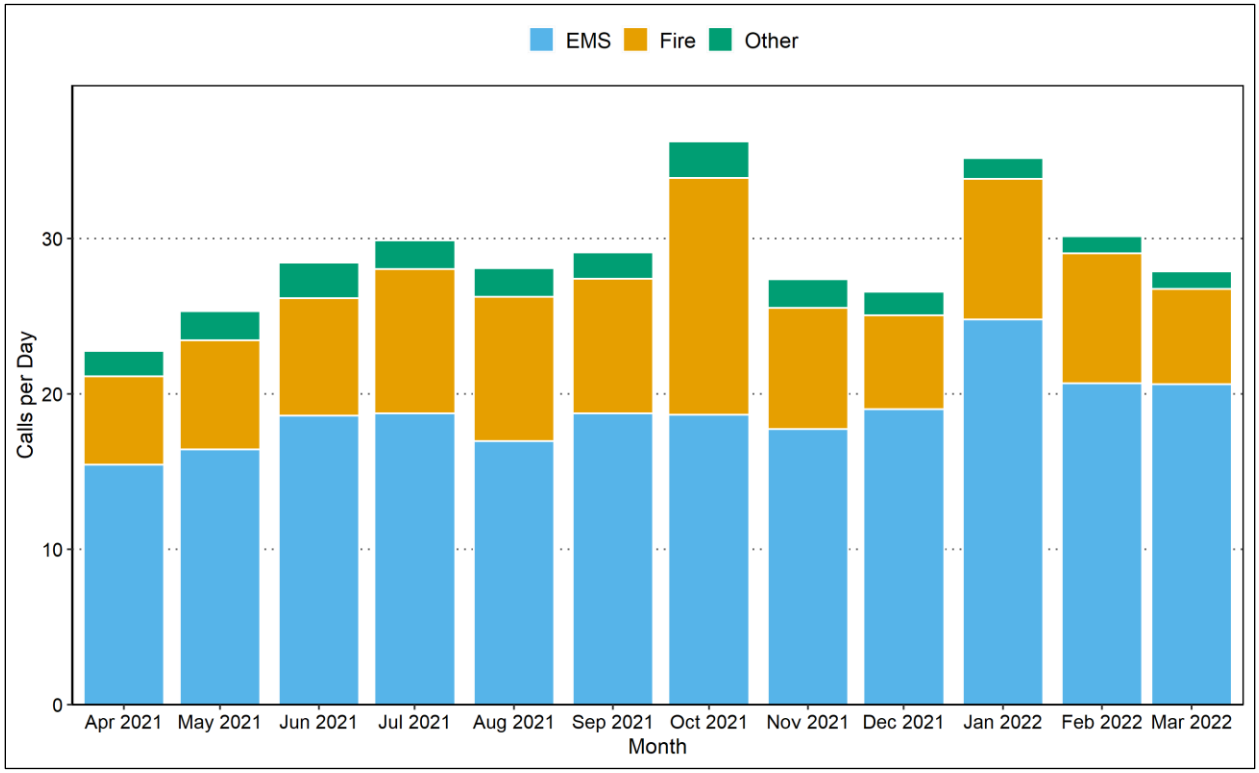
Observations:

- On average, PFD's fire units responded to 0.1 EMS calls per day that lasted more than one hour.
- On average, PFD's fire units responded to 0.4 fire calls per day that lasted more than one hour.
- A total of 6,846 EMS calls (99 percent) lasted less than one hour and 38 EMS calls (1 percent) lasted one or more hours.
- A total of 2,915 fire calls (96 percent) lasted less than one hour and 137 fire calls (4 percent) lasted one or more hours.
- A total of 87 outside fire calls (80 percent) lasted less than one hour and 22 outside fire calls (20 percent) lasted one or more hours.
- A total of 51 structure fire calls (75 percent) lasted less than one hour and 17 structure fire calls (25 percent) lasted one or more hours.

Average PFD Calls by Month and Hour of Day

Figure 7-3 shows the monthly variation in the average daily number of calls handled by PFD's fire units between April 1, 2021, and March 31, 2022. Similarly, Figure 7-4 illustrates the average number of calls received each hour of the day.

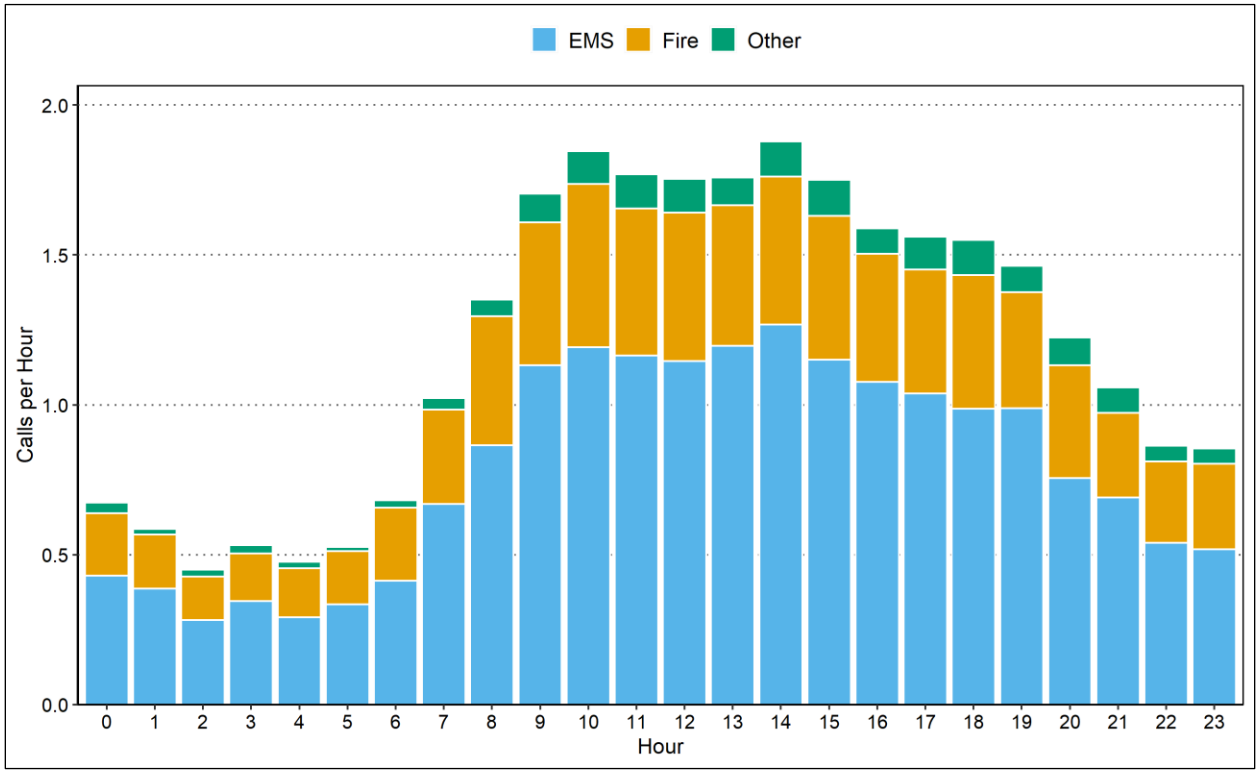
FIGURE 7-3: Calls per Day by Month, PFD



Observations:

- EMS calls responded by fire units per day ranged from 15.4 in April 2021 to 24.8 in January 2022.
- Fire calls responded to by fire units per day ranged from 5.7 in April 2021 to 15.3 in October 2021.
- Other calls responded by fire units per day ranged from 1.1 in February 2022 to 2.4 in October 2021.
- Total calls responded by fire units per day ranged from 22.8 in April 2021 to 36.3 in October 2021.
- A storm led to 204 calls on October 27, 2021. In addition, PFD responded to a total of 388 calls between October 27, 2021, and October 30, 2021.
- A snowstorm led to 75 calls on January 29, 2022.

FIGURE 7-4: Average Calls by Hour of Day, PFD



Observations:

- Average EMS calls responded to by fire units per hour ranged from 0.28 between 2:00 a.m. and 3:00 a.m. to 1.27 between 2:00 p.m. and 3:00 p.m.
- Average fire calls responded to by fire units per hour ranged from 0.15 between 2:00 a.m. and 3:00 a.m. to 0.55 between 10:00 a.m. and 11:00 a.m.
- Average other calls responded by fire units per hour ranged from 0.01 between 5:00 a.m. and 6:00 a.m. to 0.12 between 3:00 p.m. and 4:00 p.m.
- Average total calls responded to by fire units per hour ranged from 0.45 between 2:00 a.m. and 3:00 a.m. to 1.88 between 2:00 p.m. and 3:00 p.m.

PFD Units Arriving at Calls

Table 7-5 details the number of calls with one, two, three, and four or more fire units arriving at a call, broken down by call type. Here we limit ourselves to calls where a fire unit arrives. For this reason, there are fewer calls in Table 7-5 than in Table 7-3.

TABLE 7-5: PFD Calls by Call Type and Number of Arriving Units

Call Type	Number of Units				Total Calls
	One	Two	Three	Four or More	
Breathing difficulty	778	4	0	0	782
Cardiac and stroke	884	1	0	0	885
Fall and injury	1,321	15	0	0	1,336
Illness and other	2,249	12	0	0	2,261
MVA	544	24	8	0	576
Overdose and psychiatric	285	2	0	0	287
Seizure and unconsciousness	738	1	0	0	739
EMS Total	**6,799**	**59**	**8**	**0**	**6,866**
False alarm	1,313	30	22	59	1,424
Good intent	131	4	3	1	139
Hazard	376	28	7	11	422
Outside fire	84	10	6	7	107
Public service	808	14	5	0	827
Structure fire	27	9	5	27	68
Technical rescue	14	4	1	0	19
Fire Total	**2,753**	**99**	**49**	**105**	**3,006**
Canceled	437	5	0	2	444
Mutual aid	5	0	0	0	5
Total	**9,994**	**163**	**57**	**107**	**10,321**
Percentage	**96.8**	**1.6**	**0.6**	**1.0**	**100.0**

Observations:

- On average, 1.1 fire units arrived at all calls; for 97 percent of calls, only one unit arrived.
- Overall, four or more fire units arrived at 1 percent of calls.
- On average, 1.0 fire units arrived per EMS call.
- On average, 1.2 fire units arrived per fire call.
- For EMS calls, one fire unit arrived 99 percent of the time and two or more fire units arrived 1 percent of the time.
- For fire calls, one fire unit arrived 92 percent of the time, two fire units arrived 3 percent of the time, three fire units arrived 2 percent of the time, and four or more fire units arrived 4 percent of the time.
- For outside fire calls, three or more fire units arrived 12 percent of the time.
- For structure fire calls, three or more fire units arrived 47 percent of the time.

WORKLOAD: PFD RUNS AND DEPLOYED TIME

The workload of PFD's fire response 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 (11,500) than calls (10,558) and the average deployed time per run varies from the average duration per call.

PFD Runs and Deployed Time

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

TABLE 7-6: PFD 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
Breathing difficulty	20.8	276.8	6.9	45.5	797	2.2
Cardiac and stroke	20.7	309.3	7.7	50.9	898	2.5
Fall and injury	20.4	462.4	11.6	76.0	1,363	3.7
Illness and other	19.6	751.7	18.8	123.6	2,299	6.3
MVA	22.9	248.8	6.2	40.9	653	1.8
Overdose and psychiatric	19.7	96.3	2.4	15.8	294	0.8
Seizure and unconsciousness	20.8	260.0	6.5	42.7	751	2.1
EMS Subtotal	**20.5**	**2,405.3**	**60.2**	**395.4**	**7,055**	**19.3**
False alarm	17.2	508.5	12.7	83.6	1,778	4.9
Good intent	17.0	47.7	1.2	7.8	168	0.5
Hazard	30.2	271.7	6.8	44.7	539	1.5
Outside fire	48.0	132.0	3.3	21.7	165	0.5
Public service	19.2	282.9	7.1	46.5	882	2.4
Structure fire	48.6	190.2	4.8	31.3	235	0.6
Technical rescue	46.5	21.7	0.5	3.6	28	0.1
Fire Subtotal	**23.0**	**1,454.7**	**36.4**	**239.1**	**3,795**	**10.4**
Canceled	11.5	122.0	3.1	20.1	638	1.7
Mutual aid	58.5	11.7	0.3	1.9	12	0.0
Other Subtotal	**12.3**	**133.7**	**3.3**	**22.0**	**650**	**1.8**
Total	**20.8**	**3,993.8**	**100.0**	**656.5**	**11,500**	**31.5**

Observations:

Overall

- The total deployed time for the studied period was 3,993.8 hours. The daily average was 10.9 hours for all units combined.
- There were 11,500 runs, including 638 runs dispatched for canceled calls and 12 runs dispatched for mutual aid calls. The daily average was 31.5 runs.

EMS

- EMS runs accounted for 60 percent of the total workload.
- The average deployed time for EMS runs was 20.5 minutes. The deployed time for all EMS runs averaged 6.6 hours per day.

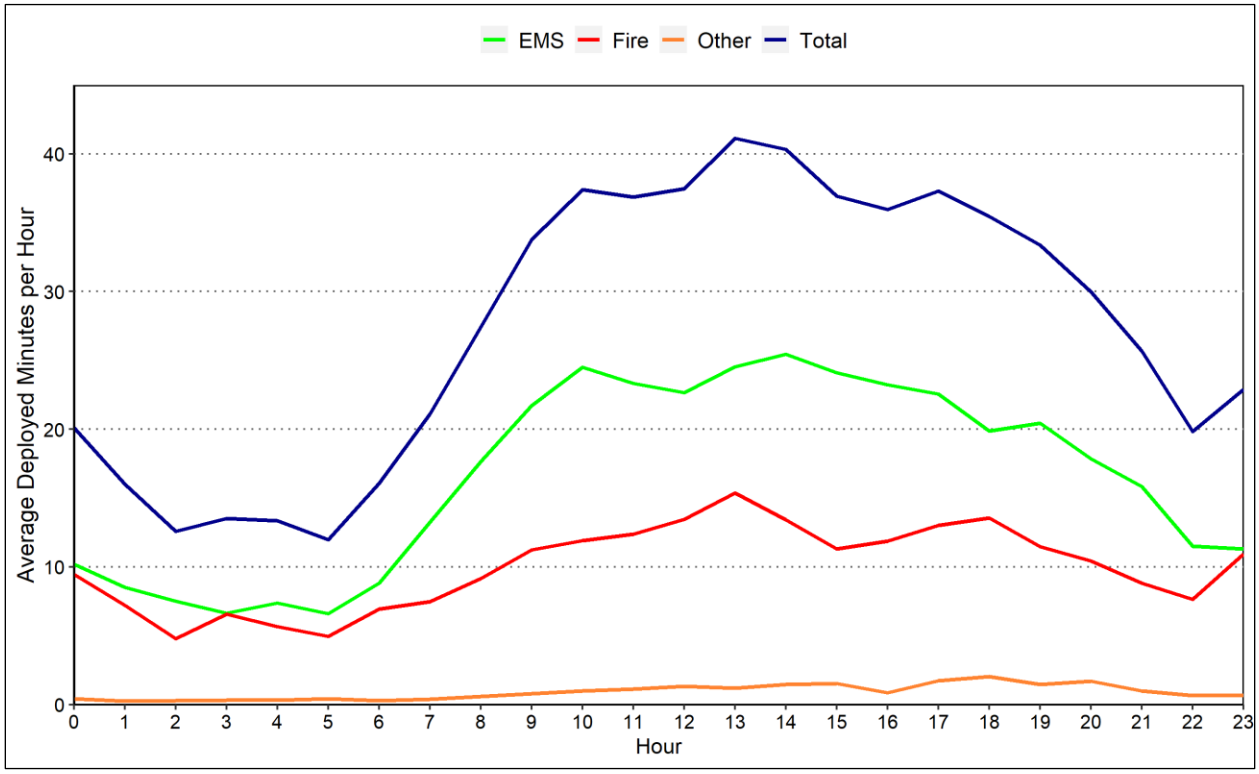
Fire

- Fire runs accounted for 36 percent of the total workload.
- The average deployed time for fire runs was 23.0 minutes. The deployed time for all fire runs averaged 4.0 hours per day.
- There were 400 runs for structure and outside fire calls combined, with a total workload of 322.2 hours. This accounted for eight percent of the total workload.
- The average deployed time for outside fire runs was 48.0 minutes per run, and the average deployed time for structure fire runs was 48.6 minutes per run.

TABLE 7-7: Deployed Minutes of PFD Units by Hour of Day

Hour	EMS	Fire	Other	Total
0	10.2	9.5	0.4	20.1
1	8.5	7.2	0.3	16.0
2	7.5	4.8	0.3	12.6
3	6.6	6.6	0.3	13.5
4	7.4	5.7	0.3	13.4
5	6.6	5.0	0.4	12.0
6	8.8	7.0	0.3	16.1
7	13.2	7.5	0.4	21.1
8	17.7	9.2	0.6	27.4
9	21.7	11.2	0.8	33.8
10	24.5	11.9	1.0	37.4
11	23.3	12.4	1.1	36.8
12	22.7	13.5	1.3	37.5
13	24.5	15.4	1.2	41.1
14	25.4	13.4	1.5	40.3
15	24.1	11.3	1.5	36.9
16	23.2	11.9	0.9	36.0
17	22.6	13.0	1.7	37.3
18	19.9	13.5	2.0	35.4
19	20.4	11.5	1.5	33.4
20	17.8	10.4	1.7	30.0
21	15.8	8.8	1.0	25.7
22	11.5	7.7	0.7	19.8
23	11.3	10.9	0.7	22.9
Daily Avg.	**395.4**	**239.1**	**22.0**	**656.5**

FIGURE 7-5: Average Deployed Minutes of PFD Units by Hour of Day



Observations:

- Hourly deployed time of fire response units was highest during the day from 10:00 a.m. to 6:00 p.m., averaging 37.6 minutes.
- Average deployed time peaked between 1:00 p.m. and 2:00 p.m., averaging 41.1 minutes.
- Average deployed time was lowest between 5:00 a.m. and 6:00 a.m., averaging 12.0 minutes.

PFD Workload by Unit

Table 7-8 summarizes each fire response unit's workload. Tables 7-9 and 7-10 detail each fire unit's runs (Table 7-9) and its daily average deployed time, broken out by run type (Table 7-10).

TABLE 7-8: PFD Workload by Station and Unit

Station	Unit	Unit Type	Minutes per Run	Total Hours	Total Pct.	Minutes per Day	Total Runs	Runs per Day
1	BC	Battalion Chief	35.0	201.9	5.1	33.2	346	0.9
	E1	Engine	19.2	831.3	20.8	136.7	2,592	7.1
	E8	Reserve Engine	20.8	375.6	9.4	61.8	1,083	3.0
	TWR1	Ladder	18.6	151.2	3.8	24.9	488	1.3
	Other	Other	45.8	32.0	0.8	5.3	42	0.1
	Total		**21.0**	**1,592.1**	**39.9**	**261.7**	**4,551**	**12.5**
2	E2	Engine	20.5	321.8	8.1	52.9	943	2.6
	E10	Reserve Engine	19.6	68.7	1.7	11.3	210	0.6
	Other	Other	36.8	23.9	0.6	3.9	39	0.1
	Total		**20.9**	**414.4**	**10.4**	**68.1**	**1,192**	**3.3**
3	E3	Engine	19.8	436.1	10.9	71.7	1,322	3.6
	RES1	Rescue	24.9	59.4	1.5	9.8	143	0.4
	Other	Other	59.9	24.9	0.6	4.1	25	0.1
	Total		**21.0**	**520.5**	**13.0**	**85.6**	**1,490**	**4.1**
4	E4	Engine	24.7	292.2	7.3	48.0	711	1.9
	Other	Other	54.4	15.4	0.4	2.5	17	0.0
	Total		**25.3**	**307.6**	**7.7**	**50.6**	**728**	**2.0**
5	E5	Engine	19.6	326.8	8.2	53.7	1,001	2.7
	L2	Ladder	25.2	16.0	0.4	2.6	38	0.1
	Other	Other	25.2	5.5	0.1	0.9	13	0.0
	Total		**19.9**	**348.2**	**8.7**	**57.2**	**1,052**	**2.9**
6	E6	Engine	20.4	211.6	5.3	34.8	623	1.7
	E9	Reserve Engine	21.7	109.0	2.7	17.9	301	0.8
	Other	Other	64.1	12.8	0.3	2.1	12	0.0
	Total		**21.4**	**333.4**	**8.3**	**54.8**	**936**	**2.6**
7	E7	Engine	18.0	396.5	9.9	65.2	1,325	3.6
	L3	Ladder	17.9	53.9	1.3	8.9	181	0.5
	Other	Other	25.2	11.3	0.3	1.9	27	0.1
	Total		**18.1**	**461.8**	**11.6**	**75.9**	**1,533**	**4.2**
Other Units*			53.3	16.0	0.4	2.6	18	0.0
Total			**20.8**	**3,993.8**	**100.0**	**656.5**	**11,500**	**31.5**

Note: *Additional units that were not assigned to a specific station.

TABLE 7-9: PFD Runs by Run Type and Unit

Station	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Tech. Rescue	Other	Total
1	BC	58	127	13	45	25	23	46	4	5	346
	E1	1,789	353	24	109	16	123	30	4	144	2,592
	E8	693	125	18	54	6	120	21	1	45	1,083
	TWR1	239	142	9	28	3	21	24	2	20	488
	Other	7	3	1	10	9	5	6	0	1	42
	Total	**2,786**	**750**	**65**	**246**	**59**	**292**	**127**	**11**	**215**	**4,551**
2	E2	601	147	18	31	17	73	14	1	41	943
	E10	132	39	3	5	5	15	4	1	6	210
	Other	3	4	4	1	8	5	6	0	8	39
	Total	**736**	**190**	**25**	**37**	**30**	**93**	**24**	**2**	**55**	**1,192**
3	E3	778	274	20	43	12	102	16	1	76	1,322
	RES1	95	14	2	9	1	6	3	3	10	143
	Other	3	0	1	2	15	1	0	0	3	25
	Total	**876**	**288**	**23**	**54**	**28**	**109**	**19**	**4**	**89**	**1,490**
4	E4	483	95	5	32	5	47	8	0	36	711
	Other	4	0	0	1	7	3	0	0	2	17
	Total	**487**	**95**	**5**	**33**	**12**	**50**	**8**	**0**	**38**	**728**
5	E5	616	115	5	45	4	119	9	0	88	1,001
	L2	12	14	2	1	0	3	6	0	0	38
	Other	2	0	1	4	0	4	0	0	2	13
	Total	**630**	**129**	**8**	**50**	**4**	**126**	**15**	**0**	**90**	**1,052**
6	E6	363	73	20	29	6	85	12	1	34	623
	E9	191	33	0	29	4	27	5	0	12	301
	Other	0	0	0	0	7	0	0	2	3	12
	Total	**554**	**106**	**20**	**58**	**17**	**112**	**17**	**3**	**49**	**936**
7	E7	859	188	17	54	10	80	20	6	91	1,325
	L3	116	23	3	5	2	13	3	0	16	181
	Other	9	8	2	2	1	2	0	0	3	27

Station	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Tech. Rescue	Other	Total
	Total	**984**	**219**	**22**	**61**	**13**	**95**	**23**	**6**	**110**	**1,533**
Other Units*		2	1	0	0	2	5	2	2	4	18
Total		**7,055**	**1,778**	**168**	**539**	**165**	**882**	**235**	**28**	**650**	**11,500**

Note: *Additional units that were not assigned to a specific station; See Table 7-8 for unit type.

TABLE 7-10: PFD Deployed Minutes per Day by Run Type and Unit

Station	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Tech. Rescue	Other	Total
1	BC	4.4	7.3	1.0	6.0	4.7	1.7	7.5	0.5	0.2	33.2
	E1	94.1	17.3	1.3	9.0	1.3	5.4	3.5	0.7	4.0	136.7
	E8	42.9	5.5	0.7	3.5	0.5	4.7	2.5	0.1	1.3	61.8
	TWR1	12.8	5.2	0.4	1.8	0.2	0.9	2.9	0.2	0.6	24.9
	Other	0.5	0.1	0.0	1.0	1.5	0.9	1.1	0.0	0.0	5.3
	Total	**154.7**	**35.4**	**3.4**	**21.3**	**8.2**	**13.6**	**17.5**	**1.4**	**6.2**	**261.7**
2	E2	34.5	6.5	0.9	3.3	0.8	3.6	2.1	0.2	1.2	52.9
	E10	7.6	1.5	0.1	0.4	0.5	0.5	0.5	0.1	0.1	11.3
	Other	0.2	0.1	0.2	0.1	1.1	1.2	0.6	0.0	0.5	3.9
	Total	**42.2**	**8.1**	**1.2**	**3.8**	**2.4**	**5.2**	**3.2**	**0.3**	**1.8**	**68.1**
3	E3	42.1	14.0	0.7	3.2	1.3	5.0	2.1	0.2	3.0	71.7
	RES1	6.2	0.8	0.0	0.8	0.0	0.3	0.4	0.4	0.7	9.8
	Other	0.3	0.0	0.0	0.1	3.5	0.0	0.0	0.0	0.2	4.1
	Total	**48.6**	**14.9**	**0.8**	**4.0**	**4.8**	**5.3**	**2.5**	**0.6**	**3.9**	**85.6**
4	E4	33.0	5.1	0.3	4.1	0.2	3.1	1.2	0.0	1.1	48.0
	Other	0.3	0.0	0.0	0.1	1.9	0.2	0.0	0.0	0.1	2.5
	Total	**33.3**	**5.1**	**0.3**	**4.1**	**2.1**	**3.3**	**1.2**	**0.0**	**1.2**	**50.6**
5	E5	34.5	5.3	0.2	3.1	0.5	6.3	0.9	0.0	2.9	53.7
	L2	0.7	0.9	0.1	0.1	0.0	0.1	0.8	0.0	0.0	2.6
	Other	0.1	0.0	0.1	0.2	0.0	0.4	0.0	0.0	0.1	0.9
	Total	**35.3**	**6.2**	**0.4**	**3.4**	**0.5**	**6.8**	**1.7**	**0.0**	**3.0**	**57.2**
6	E6	20.1	3.0	0.8	2.8	0.6	4.5	1.6	0.2	1.2	34.8
	E9	11.8	1.6	0.0	1.8	0.3	1.2	0.7	0.0	0.4	17.9
	Other	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.1	0.2	2.1
	Total	**32.0**	**4.5**	**0.8**	**4.7**	**2.7**	**5.7**	**2.3**	**0.3**	**1.8**	**54.8**
7	E7	42.9	7.9	0.6	3.0	0.6	4.8	2.0	0.7	2.9	65.2
	L3	5.7	1.1	0.2	0.3	0.0	0.6	0.6	0.0	0.3	8.9
	Other	0.6	0.4	0.0	0.1	0.1	0.2	0.0	0.0	0.5	1.9

Station	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Tech. Rescue	Other	Total
	Total	**49.2**	**9.3**	**0.8**	**3.4**	**0.7**	**5.5**	**2.6**	**0.7**	**3.8**	**75.9**
Other Units*		0.1	0.1	0.0	0.0	0.4	1.0	0.3	0.3	0.4	2.6
Total		**395.4**	**83.6**	**7.8**	**44.7**	**21.7**	**46.5**	**31.3**	**3.6**	**22.0**	**656.5**

Note: *Additional units that were not assigned to a specific station; See Table 7-8 for unit type.

Observations:

- PFD Station 1 made the most runs (4,551, or an average of 12.5 runs per day) and had the highest total annual deployed time (1,592.1 hours, or an average of 4.4 hours per day).
  - EMS calls accounted for 61 percent of runs and 59 percent of total deployed time.
  - Outside and structure fire calls accounted for 4 percent of runs and 10 percent of total deployed time.
- PFD Station 3 made the second-most runs (1,490, or an average of 4.1 runs per day) and had the second-highest total annual deployed time (520.5 hours, or an average of 1.4 hours per day).
  - EMS calls accounted for 59 percent of runs and 57 percent of total deployed time.
  - Outside and structure fire calls accounted for 3 percent of runs and 9 percent of total deployed time.
- Engine 1 (E1) made the most runs (2,592, or an average of 7.1 runs per day) and had the highest total annual deployed time (831.3 hours, or an average of 2.3 hours per day).
  - EMS calls accounted for 69 percent of runs and 69 percent of total deployed time.
  - Outside and structure fire calls accounted for 2 percent of runs and 4 percent of total deployed time.

PFD Workload by District

Table 7-11 breaks down the annual workload of fire response units by fire district. Table 7-12 provides further detail on the workload of the fire response units associated with structure and outside fire calls, broken out by district. In both tables, the fire units' responses to the Kingston fire district are mutual aid.

TABLE 7-11: Annual Workload of PFD Units by Location

Fire District	Calls	Percent Calls	Runs	Runs Per Day	Minutes Per Run	Annual Hours	Pct. Annual Work	Deployed Minutes Per Day
Plymouth	10,548	99.9	11,488	31.5	20.8	3,982.1	99.7	654.6
Kingston	10	0.1	12	0.0	58.5	11.7	0.3	1.9
Total	**10,558**	**100.0**	**11,500**	**31.5**	**20.8**	**3,993.8**	**100.0**	**656.5**

TABLE 7-12: Structure and Outside Fire Runs by Location

Fire District	Structure Fire Runs	Structure Fires Minutes per Run	Outside Fire Runs	Outside Fires Minutes per Run	Total Hours	Percent Workload
Plymouth	235	48.6	165	48.0	322.2	98.5
Kingston	1	16.1	4	71.3	5.0	1.5
Total	**236**	**48.4**	**169**	**48.6**	**327.3**	**100.0**

Note: The number of runs for structure (235) and outside (165) fires in Plymouth agree with Table 7-9.

Observations:

Plymouth

- Total deployed time was 3,982.1 hours or 99.7 percent of the total annual workload. The daily average was 10.9 hours for all units combined.
- There were 11,488 runs, including 638 runs dispatched for canceled calls. The daily average was 31.5 runs.

Kingston Fire

- Total deployed time was 11.7 hours or 0.3 percent of the total annual workload. The daily average was 1.9 minutes for all units combined.
- There were 10 runs, including four runs dispatched for canceled calls. The remaining eight mutual runs included four runs for outside fires, three runs for public service calls, and one run for a structure fire.

ANALYSIS OF BUSIEST HOURS OF PFD UNITS

In this analysis, we included all 10,565 calls given in Table 7-3. For these calls, 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 April 1, 2021, and March 31, 2022. Table 7-13 shows the number of hours in which there were zero to eight or more calls during the hour. Table 7-14 shows the ten one-hour intervals which had the most calls during the study period. Table 7-15 examines the number of times a call overlapped with another call in each station area.

TABLE 7-13: Frequency Distribution of the Number of Calls Responded by PFD Units

Calls in an Hour	Frequency	Percentage
0	3,059	34.9
1	2,838	32.4
2	1,651	18.8
3	758	8.7
4	278	3.2
5	121	1.4
6	32	0.4
7+	23	0.3
Total	**8,760**	**100.0**

TABLE 7-14: Top Ten Hours with the Most Calls Responded by PFD Units

Hour	Number of Calls	Number of Runs	Total Deployed Hours
10/27/2021, 6:00 a.m. to 7:00 a.m.	24	24	8.0
10/27/2021, 5:00 a.m. to 6:00 a.m.	19	22	8.9
10/27/2021, 8:00 a.m. to 9:00 a.m.	17	18	5.0
10/27/2021, 7:00 a.m. to 8:00 a.m.	16	16	5.2
10/27/2021, 10:00 a.m. to 11:00 a.m.	13	13	3.4
10/27/2021, 9:00 a.m. to 10:00 a.m.	12	13	3.8
10/27/2021, 4:00 a.m. to 5:00 a.m.	10	15	5.9
10/27/2021, 1:00 p.m. to 2:00 p.m.	10	14	6.3
10/27/2021, 2:00 a.m. to 3:00 a.m.	10	12	3.4
9/13/2021, 1:00 p.m. to 2:00 p.m.	10	11	2.1

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 7-15: Frequency of Overlapping PFD Calls by Station

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
1	No overlapped call	2,529	88.3	810.4
	Overlapped with one call	305	10.6	53.7
	Overlapped with two calls	22	0.8	2.6
	Overlapped with three calls	5	0.2	0.8
	Overlapped with four calls	4	0.1	0.2
2	No overlapped call	1,946	91.1	701.2
	Overlapped with one call	169	7.9	36.3
	Overlapped with two calls	18	0.8	2.3
	Overlapped with three calls	3	0.1	0.2
3	No overlapped call	1,377	93.6	469.7
	Overlapped with one call	88	6.0	20.3
	Overlapped with two calls	3	0.2	0.1
	Overlapped with three calls	2	0.1	0.3
	Overlapped with four calls	1	0.1	0.2
4	No overlapped call	722	96.4	313.3
	Overlapped with one call	27	3.6	6.2
5	No overlapped call	1,167	95.3	384.0
	Overlapped with one call	53	4.3	11.1
	Overlapped with two calls	4	0.3	0.6
	Overlapped with three calls	1	0.1	0.0
6	No overlapped call	632	94.2	222.0
	Overlapped with one call	34	5.1	7.4
	Overlapped with two calls	3	0.4	0.4
	Overlapped with three calls	2	0.3	0.1
7	No overlapped call	1,353	94.5	408.2
	Overlapped with one call	76	5.3	12.5
	Overlapped with two calls	2	0.1	0.3
Kingston Fire	No overlapped call	8	80.0	7.4
	Overlapped with one call	2	20.0	1.4

Table 7-16 examines each PFD station's availability to respond to calls within its first due area. At the same time, it focuses on calls where at least one fire response unit eventually arrived and ignores calls where no fire unit arrived. While 10,548 calls were responded to by PFD units within Plymouth (See Table 7-11), there were 232 calls without an arriving fire unit.

PFD Engines 8, 9, and 10 are reserve engines and were deployed to stations when their primary engine was unavailable. For example, Engine 8 covered Station 2 and Engine 9 was deployed to Station 5 for a good portion of time between April 1, 2021, and March 31, 2022. For this reason, in the analysis of station availability, we included the reserve engines when they responded to calls within the service area of different PFD stations.

TABLE 7-16: 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
1	2,805	2,749	98.0	2,746	97.9	2,746	97.9
2	2,104	1,948	92.6	1,944	92.4	1,939	92.2
3	1,432	1,374	95.9	1,372	95.8	1,369	95.6
4	732	707	96.6	707	96.6	707	96.6
5	1,202	1,152	95.8	1,151	95.8	1,150	95.7
6	651	626	96.2	625	96.0	625	96.0
7	1,390	1,315	94.6	1,311	94.3	1,297	93.3
Total	**10,316**	**9,871**	**95.7**	**9,856**	**95.5**	**9,833**	**95.3**

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 the first due station to see if any of its units responded, arrived, or arrived first. The response of reserve engines within the first due area of a station was included.

Observations:

- During 23 hours (0.3 percent of all hours), seven or more calls occurred. In other words, the PFD units responded to seven or more calls in an hour roughly once every 16 days.
  - The highest number of calls to occur in an hour was 24, which happened once.
  - Nine of the ten hours with the most calls occurred on October 27, 2021.
- The hour with the most calls was from 6:00 a.m. to 7:00 a.m. on October 27, 2021, when Plymouth was hit by a storm. The hour's 24 calls involved 24 individual dispatches resulting in 8.0 hours of deployed time. These 24 calls included twelve false alarm calls, six hazard calls, three public service calls, two canceled calls, and one fall and injury call.

ATTACHMENT 1.1: ADDITIONAL PFD PERSONNEL

Table 7-17 illustrates the workload of PFD's administrative units between April 1, 2021, and March 31, 2022.

TABLE 7-17: PFD Workload of Administrative Units

Unit ID	Type	Annual Hours	Annual Runs
C1	Chief	8.3	6
C2	Deputy Chief	11.6	7
C3	Deputy Chief	2.3	8
BC 5	Training Officer	18.2	20
BC 6	Fire Prevention	8.5	14

ATTACHMENT 1.2: ACTIONS TAKEN

TABLE 7-18: Actions Taken Analysis for Structure and Outside Fire Calls

Action Taken	Number of Calls	
	Outside Fire	Structure Fire
Confine fire (wildland)	1	0
Control fire (wildland)	2	0
Emergency medical services, other	0	1
Enforce codes	1	0
Extinguishment by fire service personnel	19	4
Fire control or extinguishment, other	3	0
Forcible entry	0	1
Incident command	2	0
Information, investigation & enforcement, other	1	3
Investigate	3	9
Investigate fire out on arrival	0	1
Provide equipment	1	1
Provide first aid & check for injuries	1	0
Provide workforce	1	0
Refer to proper authority	0	4
Remove hazard	1	2
Rescue, remove from harm	0	1
Restore fire alarm system	0	3
Salvage & overhaul	30	21
Search	1	1
Secure property	0	1
Shut down system	1	1
Ventilate	1	14

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

Observations:

- Of 109 outside fires, 19 were extinguished by fire service personnel, which accounted for 17 percent of outside fires.
- Of 68 structure fires, four were extinguished by fire service personnel, which accounted for 6 percent of structure fires.

ATTACHMENT 1.3: FIRE LOSS

Table 7-19 presents the number of outside and structure fires, broken out by levels of fire loss. Table 7-20 shows the amount of property and content loss for outside and structure fires inside Plymouth between April 1, 2021, and March 31, 2022.

TABLE 7-19: Total Fire Loss Above and Below $25,000

Call Type	No Loss	Under $25,000	$25,000 plus	Total
Outside fire	96	10	3	109
Structure fire	38	24	6	68
Total	**134**	**34**	**9**	**177**

TABLE 7-20: 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	$583,030	12	$10,200	3
Structure fire	$1,648,000	29	$338,605	19
Total	**$2,231,030**	**41**	**$348,805**	**22**

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

Observations:

- 96 outside fires and 38 structure fires had no recorded loss.
- Three outside fires and six structure fires had $25,000 or more in losses.
- Structure fires:
  - The highest total loss for a structure fire was $650,000.
  - The average total loss for all structure fires was $29,215.
  - 19 structure fires had content losses with a combined $338,605 in losses.
  - Of 69 structure fires, 29 had recorded property losses, with a combined $1,648,000 in losses.
- Outside fires:
  - The highest total loss for an outside fire was $350,000.
  - The average total loss for outside fires with loss was $45,633.
  - Three outside fires had content losses with a combined $10,200 in losses.
  - Of 109 outside fires, 12 had recorded property losses, with a combined $583,030 in losses.

PART 2. BREWSTER AMBULANCE SERVICE

In this part, we examine the response and workload of all Brewster Ambulance Service (BAS) units, including ALS and BLS ambulances, a medical supervisor, and fly-cars. This part of the analysis is made up of four sections. The first section focuses on call types and dispatches. The second section explores the time spent and the workload of individual medical response units. The third section presents an analysis of the busiest hours in the year studied. The fourth and final part analyzes the workload of medical transport.

AGGREGATE BAS CALL TOTALS AND RUNS

Between April 1, 2021, and March 31, 2022, the studied medical response units responded to 10,955 calls inside Plymouth. Of these, 89 percent were EMS calls and six percent were fire calls.

BAS Calls by Type

Table 7-21 shows the number of calls responded by the medical units by call type, average calls per day, and the percentage of calls that fall into each call type category. Figures 7-6 and 7-7 show the percentage of calls that fall into each EMS (Figure 7-6) and fire (Figure 7-7) type category.

TABLE 7-21: BAS Calls by Type

Call Type	Total Calls	Calls per Day	Call Percentage
Breathing difficulty	820	2.2	7.5
Cardiac and stroke	985	2.7	9.0
Fall and injury	1,709	4.7	15.6
Illness and other	3,484	9.5	31.8
Interfacility transfer	257	0.7	2.3
MVA	584	1.6	5.3
Overdose and psychiatric	1,190	3.3	10.9
Seizure and unconsciousness	770	2.1	7.0
EMS Subtotal	**9,799**	**26.8**	**89.4**
False alarm	53	0.1	0.5
Good intent	29	0.1	0.3
Hazard	28	0.1	0.3
Outside fire	4	0.0	0.0
Public service	499	1.4	4.6
Structure fire	18	0.0	0.2
Technical rescue	5	0.0	0.0
Fire Subtotal	**636**	**1.7**	**5.8**
Canceled	520	1.4	4.7
Total	**10,955**	**30.0**	**100.0**

FIGURE 7-6: EMS Calls by Type, BAS

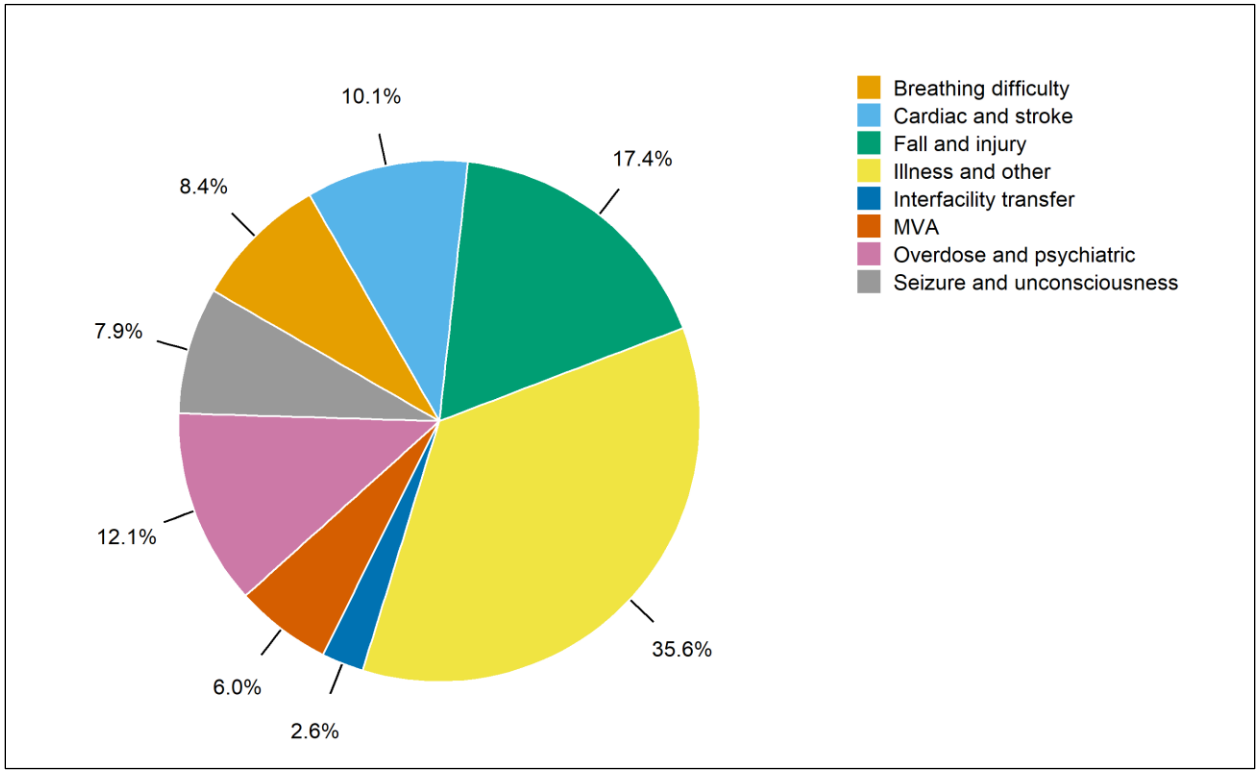
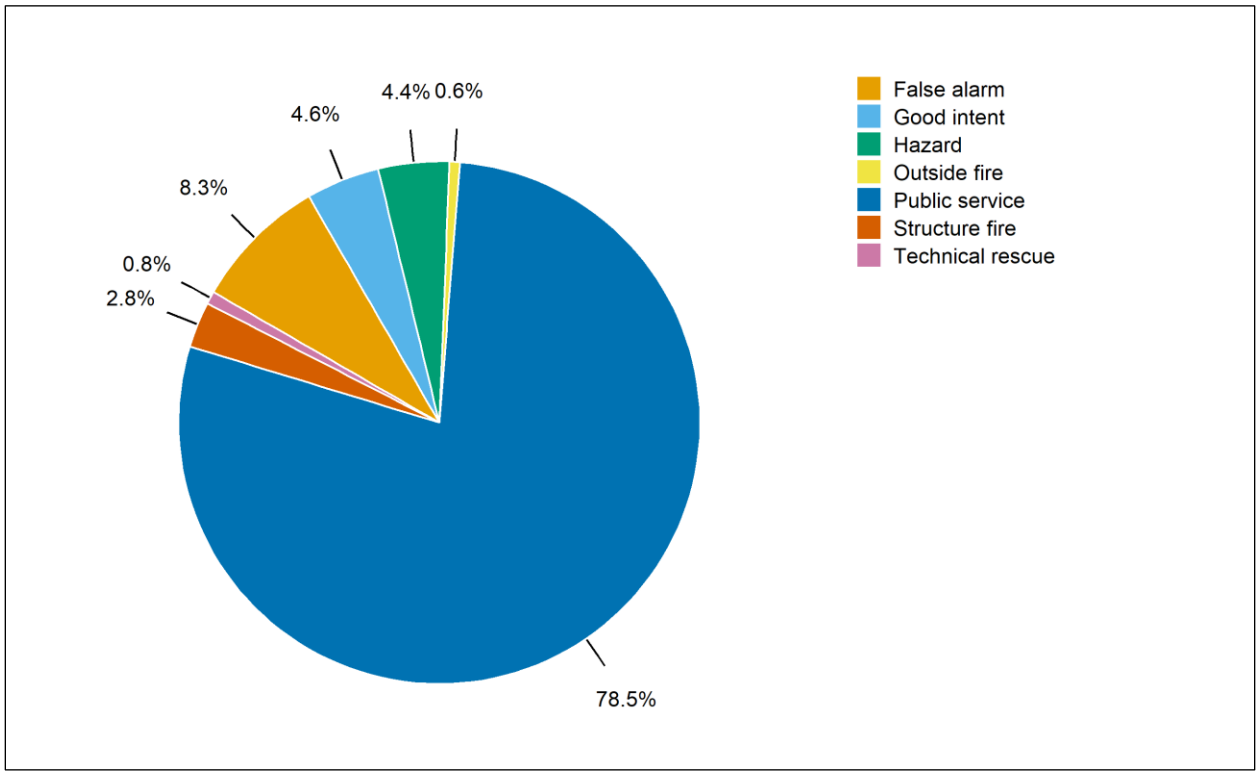


FIGURE 7-7: Fire Calls by Type, BAS



Observations:

- The medical units responded to an average of 30.0 calls per day, including 1.4 canceled calls (5 percent of daily calls).
- EMS calls totaled 9,799 (89 percent of all calls), an average of 26.8 calls per day.
  - Illness and other calls were the largest category of EMS calls at 32 percent of total calls (36 percent of EMS calls).
  - Motor vehicle accidents (MVA) made up 5 percent of total calls (6 percent of EMS calls).
  - Cardiac and stroke calls made up 9 percent of total calls (10 percent of EMS calls).
- Fire calls totaled 636 (6 percent of all calls), or an average of 1.7 calls per day.

BAS Calls by Type and Duration

Table 7-22 shows the duration of calls responded to by the medical units 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 7-22: BAS 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
Breathing difficulty	73	443	296	8	820
Cardiac and stroke	89	509	358	29	985
Fall and injury	357	880	421	51	1,709
Illness and other	562	1,949	896	77	3,484
Interfacility transfer	8	43	18	188	257
MVA	300	173	96	15	584
Overdose and psychiatric	274	656	251	9	1,190
Seizure and unconsciousness	91	415	247	17	770
EMS Total	**1,754**	**5,068**	**2,583**	**394**	**9,799**
False alarm	50	3	0	0	53
Good intent	26	3	0	0	29
Hazard	19	4	5	0	28
Outside fire	2	1	1	0	4
Public service	393	68	31	7	499
Structure fire	2	10	4	2	18
Technical rescue	2	1	1	1	5
Fire Total	**494**	**90**	**42**	**10**	**636**
Canceled	378	97	37	8	520
Total	**2,626**	**5,255**	**2,662**	**412**	**10,955**

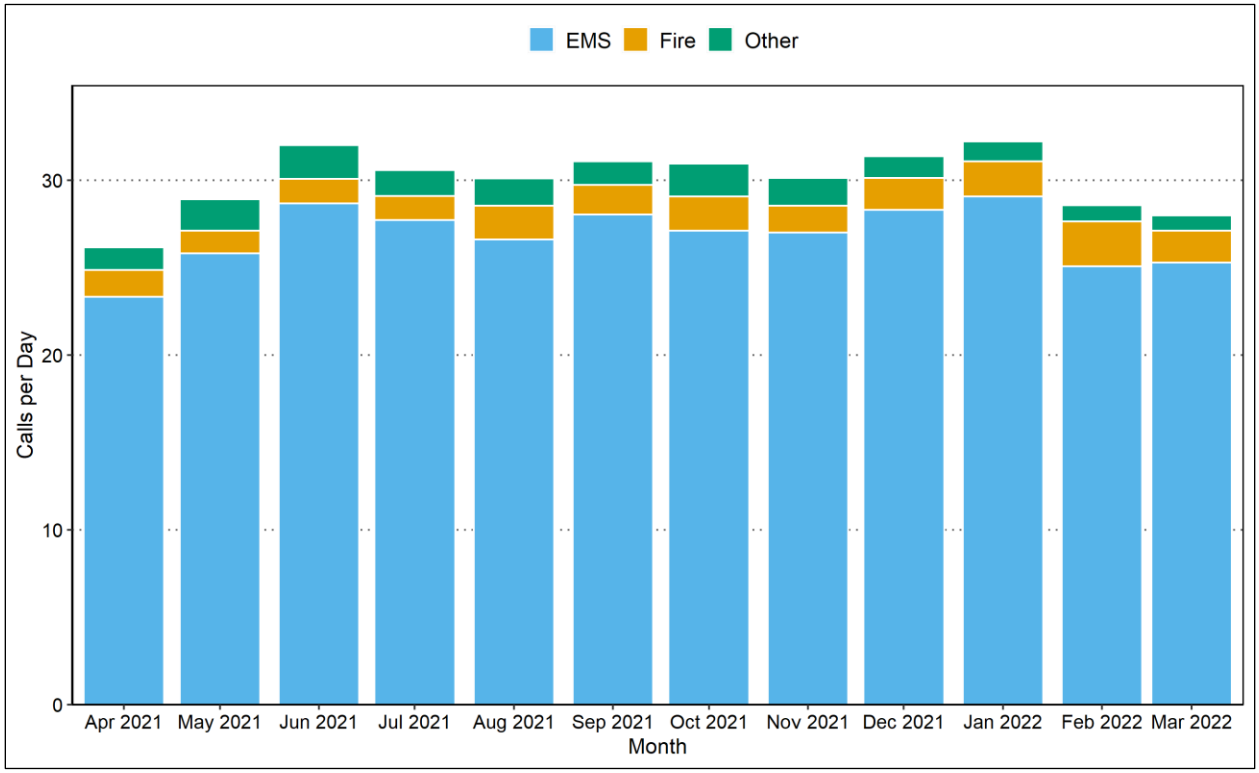
Observations:

- On average, medical units responded to 8.2 EMS calls per day that lasted more than one hour.
- On average, medical units responded to 0.1 fire calls per day that lasted more than one hour.
- A total of 6,822 EMS calls (70 percent) lasted less than one hour, 2,583 EMS calls (26 percent) lasted one to two hours, and 394 EMS calls (4 percent) lasted two or more hours.
- A total of 598 cardiac and stroke calls (61 percent) lasted less than one hour, 358 cardiac and stroke calls (36 percent) lasted one to two hours, and 29 cardiac and stroke calls (3 percent) lasted two or more hours.
- A total of 584 fire calls (92 percent) lasted less than one hour, 42 fire calls (7 percent) lasted one to two hours, and 10 fire calls (2 percent) lasted two or more hours.

Average BAS Calls by Month and Hour of Day

Figure 7-8 shows the monthly variation in the average daily number of calls handled by the medical units between April 1, 2021, and March 31, 2022. Similarly, Figure 7-9 illustrates the average number of calls received each hour of the day.

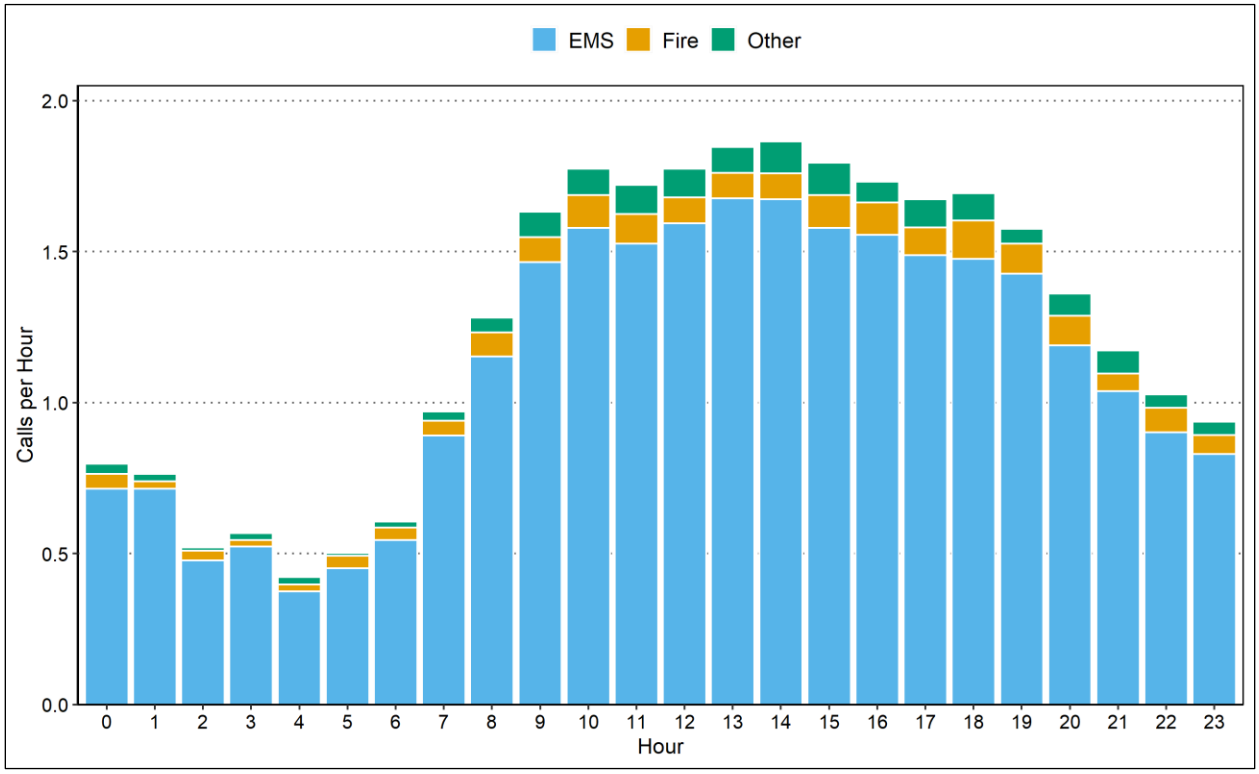
FIGURE 7-8: Calls per Day by Month, BAS



Observations:

- EMS calls per day responded by medical units ranged from 23.3 in April 2021 to 29.1 in January 2022.
- Fire calls per day responded by medical units ranged from 1.3 in May 2021 to 2.6 in February 2022.
- Other calls per day responded by medical units ranged from 0.9 in March 2022 to 1.9 in June 2021.
- Total calls per day responded by medical units ranged from 26.2 in April 2021 to 32.2 in January 2022.

FIGURE 7-9: Average Calls by Hour of Day, BAS



Observations:

- Average EMS calls per hour responded to by medical units ranged from 0.38 between 4:00 a.m. and 5:00 a.m. to 1.68 between 1:00 p.m. and 2:00 p.m.
- Average fire calls per hour responded to by medical units ranged from 0.02 between 3:00 a.m. and 4:00 a.m. to 0.13 between 6:00 p.m. and 7:00 p.m.
- Average other calls per hour responded by medical units ranged from 0.01 between 5:00 a.m. and 6:00 a.m. to 0.11 between 2:00 p.m. and 4:00 p.m.
- Average total calls per hour responded to by medical units ranged from 0.42 between 4:00 a.m. and 5:00 a.m. to 1.87 between 2:00 p.m. and 3:00 p.m.

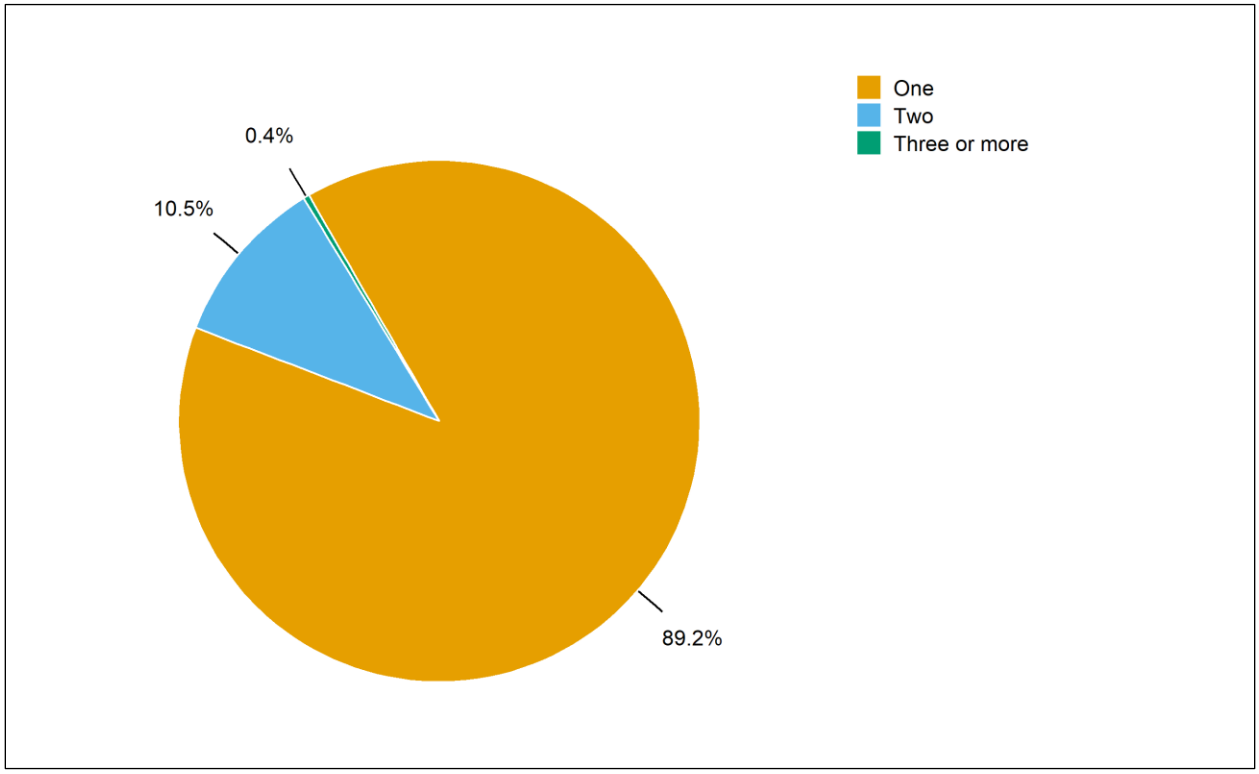
BAS Units Arriving at Calls

Table 7-23, along with Figure 7-10, detail the number of calls with one, two, and three or more medical units arriving at a call, broken down by call type. Here we limit ourselves to calls where a medical unit arrives. For this reason, there are fewer calls in Table 7-23 than in Table 7-21.

TABLE 7-23: BAS Calls by Call Type and Number of Arriving Units

Call Type	Number of Units			Total Calls
	One	Two	Three or More	
Breathing difficulty	642	173	3	818
Cardiac and stroke	809	168	5	982
Fall and injury	1,583	116	3	1,702
Illness and other	3,127	309	4	3,440
Interfacility transfer	249	6	0	255
MVA	433	98	20	551
Overdose and psychiatric	1,127	49	2	1,178
Seizure and unconsciousness	621	143	1	765
EMS Total	**8,591**	**1,062**	**38**	**9,691**
False alarm	28	0	0	28
Good intent	16	2	0	18
Hazard	21	3	0	24
Outside fire	4	0	0	4
Public service	362	15	0	377
Structure fire	15	2	1	18
Technical rescue	3	2	0	5
Fire Total	**449**	**24**	**1**	**474**
Canceled	376	21	0	397
Total	**9,416**	**1,107**	**39**	**10,562**
Percentage	**89.1**	**10.5**	**0.4**	**100.0**

FIGURE 7-10: Number of Arriving Units for EMS Calls, BAS



Observations:

Overall

- On average, 1.1 medical units arrived at all calls.
- For 89 percent of calls, only one unit arrived.
- Overall, two or more medical units arrived at 11 percent of calls.

EMS

- On average, 1.1 medical units arrived per EMS call.
- For EMS calls, one arrived 88.6 percent of the time, two arrived 11.0 percent of the time, and three or more units arrived 0.4 percent of the time.

Fire

- On average, 1.1 medical units arrived per fire call.
- For fire calls, one unit arrived 94.7 percent of the time, two units arrived 5.1 percent of the time, and three units arrived 0.2 percent of the time.

WORKLOAD: BAS RUNS AND DEPLOYED TIME

The workload of the medical units is measured in two ways: runs and deployed time. The deployed time of a run is measured from the time a medical unit is dispatched through the time the unit is cleared. Because multiple units respond to some calls, there are more runs (12,549) than calls (10,955) and the average deployed time per run varies from the average duration per call.

BAS Runs and Deployed Time

Deployed time, also referred to as deployed hours, is the total deployment time of medical units deployed on all runs. Table 7-24 shows the total deployed time, both overall and broken down by type of run, for all medical units. Table 7-25 and Figure 7-11 present the average deployed minutes by hour of day.

TABLE 7-24: BAS 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
Breathing difficulty	49.3	843.4	8.6	138.6	1,027	2.8
Cardiac and stroke	51.2	1,035.1	10.6	170.2	1,213	3.3
Fall and injury	47.9	1,496.3	15.3	246.0	1,874	5.1
Illness and other	48.0	3,136.0	32.1	515.5	3,920	10.7
Interfacility transfer	142.0	634.4	6.5	104.3	268	0.7
MVA	34.6	437.8	4.5	72.0	760	2.1
Overdose and psychiatric	43.7	926.2	9.5	152.3	1,273	3.5
Seizure and unconsciousness	48.2	762.9	7.8	125.4	949	2.6
EMS Total	**49.3**	**9,272.1**	**94.8**	**1,524.2**	**11,284**	**30.9**
False alarm	10.6	10.1	0.1	1.7	57	0.2
Good intent	12.3	7.0	0.1	1.1	34	0.1
Hazard	31.1	17.1	0.2	2.8	33	0.1
Outside fire	40.2	2.7	0.0	0.4	4	0.0
Public service	23.1	205.0	2.1	33.7	532	1.5
Structure fire	56.7	22.7	0.2	3.7	24	0.1
Technical rescue	49.8	6.6	0.1	1.1	8	0.0
Fire Total	**23.5**	**271.2**	**2.8**	**44.6**	**692**	**1.9**
Canceled	22.7	217.0	2.2	35.7	573	1.6
Total	**46.7**	**9,760.2**	**100.0**	**1,604.4**	**12,549**	**34.4**

Observations:

Overall

- The total deployed time of medical units for the studied period was 9,760.2 hours. The daily average was 26.7 hours for all medical units combined.
- There were 12,549 runs, including 573 runs dispatched for canceled calls. The daily average was 34.4 runs.

EMS

- EMS runs accounted for 95 percent of the total workload of the medical units.
- The average deployed time for EMS runs was 49.3 minutes. The deployed time for all EMS runs averaged 25.4 hours per day.

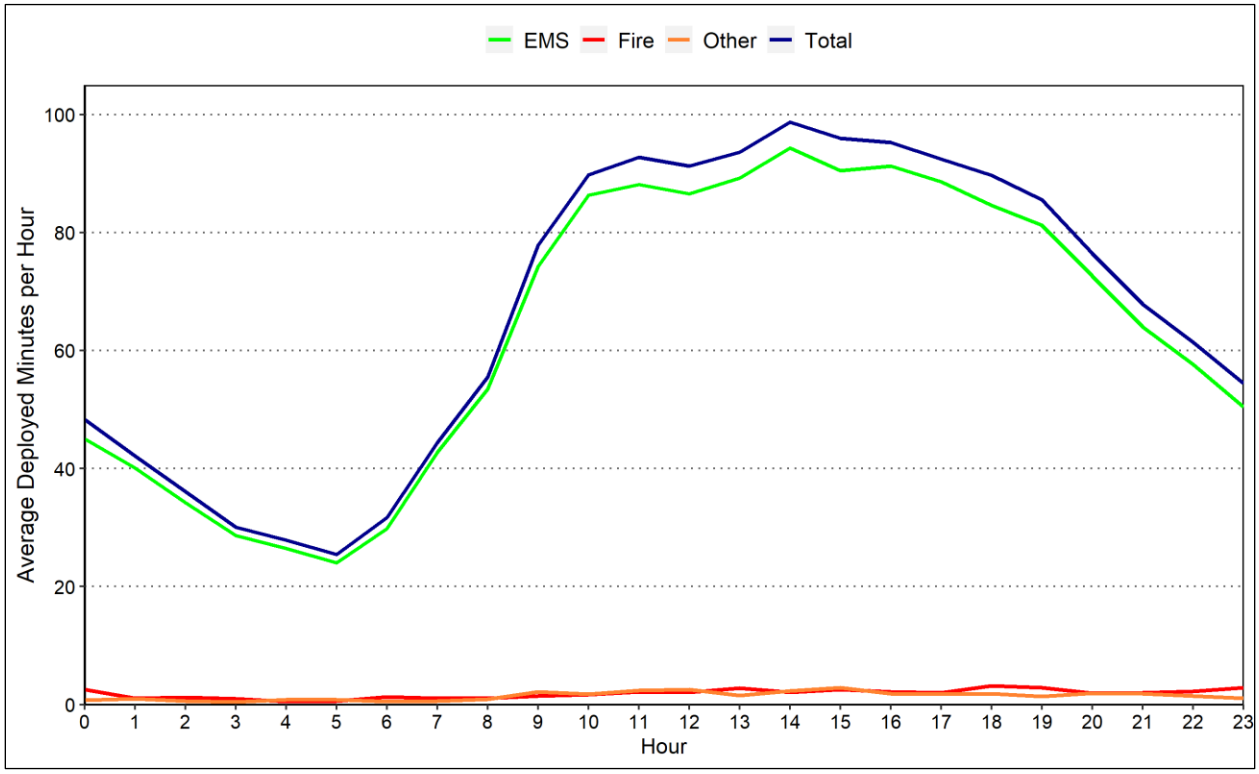
Fire

- Fire runs accounted for 3 percent of the total workload of the medical units.
- The average deployed time for fire runs was 23.5 minutes. The deployed time for all fire runs averaged 44.6 minutes per day.

TABLE 7-25: Deployed Minutes of BAS Units by Hour of Day

Hour	EMS	Fire	Other	Total
0	45.0	2.5	0.8	48.3
1	40.1	1.0	1.0	42.2
2	34.2	1.2	0.6	36.1
3	28.6	1.0	0.4	30.1
4	26.5	0.6	0.8	27.9
5	24.0	0.6	0.8	25.5
6	29.8	1.3	0.6	31.7
7	42.8	1.0	0.6	44.4
8	53.5	1.1	1.0	55.5
9	74.3	1.4	2.1	77.9
10	86.3	1.7	1.8	89.8
11	88.1	2.2	2.4	92.7
12	86.6	2.1	2.6	91.2
13	89.2	2.8	1.6	93.6
14	94.3	2.1	2.3	98.7
15	90.5	2.6	2.9	96.0
16	91.3	2.2	1.9	95.3
17	88.6	2.0	1.8	92.4
18	84.6	3.2	1.8	89.7
19	81.2	2.9	1.4	85.5
20	72.6	1.9	2.0	76.5
21	64.0	2.0	1.8	67.8
22	57.7	2.2	1.5	61.4
23	50.4	2.9	1.1	54.4
Daily Avg.	**1,524.2**	**44.6**	**35.7**	**1,604.4**

FIGURE 7-11: Average Deployed Minutes of BAS Units by Hour of Day



Observations:

- Hourly deployed time was highest during the day from 10:00 a.m. to 7:00 p.m., averaging more than 1.5 hours.
- Average deployed time peaked between 2:00 p.m. and 3:00 p.m., averaging 98.7 minutes.
- Average deployed time was lowest between 5:00 a.m. and 6:00 a.m., averaging 25.5 minutes.

BAS Workload by Unit

Table 7-26 summarizes the workload of each medical unit. Tables 7-27 and 7-28 detail each unit's runs broken out by run type (Table 7-27) and its daily average deployed time by run type (Table 7-28).

TABLE 7-26: BAS Workload by Unit

Unit	Unit Type	Minutes per Run	Total Hours	Total Pct.	Minutes per Day	Total Runs	Runs per Day
A1	Ambulance	24.2	0.4	0.0	0.1	1	0.0
A2 P38	ALS Ambulance	45.8	2,759.1	28.3	453.5	3,615	9.9
A3 P39	ALS Ambulance	50.0	2,069.1	21.2	340.1	2,484	6.8
A5 P40	ALS Ambulance	54.8	2,703.3	27.7	444.4	2,958	8.1
A6 P41	ALS Ambulance	50.7	1,395.9	14.3	229.5	1,652	4.5
A10	Ambulance	45.7	96.8	1.0	15.9	127	0.3
A11	Ambulance	28.0	0.5	0.0	0.1	1	0.0
A12	Ambulance	35.2	1.2	0.0	0.2	2	0.0
AT 1	4x4 Ambulance	23.0	16.9	0.2	2.8	44	0.1
B10	BLS Ambulance	40.4	250.1	2.6	41.1	371	1.0
B11	BLS Ambulance	38.5	41.1	0.4	6.8	64	0.2
B12	BLS Ambulance	29.9	7.0	0.1	1.1	14	0.0
B13	BLS Ambulance	40.4	4.7	0.0	0.8	7	0.0
Medic 1	Medic Supervisor	20.0	252.5	2.6	41.5*	757	2.1*
Medic 2	Medic Fly-car	21.5	161.5	1.7	26.5*	451	1.2*
Medic 3	Medic Fly-car	10.2	0.2	0.0	0.0*	1	0.0*
Total		**46.7**	**9,760.2**	**100.0**	**1,604.4**	**12,549**	**34.4**

Note: Medic 1, 2, and 3 began operation on January 2, 2022 (three months studied). Work and runs per day for these units are still recorded out of 365 days to match the overall total. When measured from January 2, 2022, Medic 1 made 8.5 runs per day with a deployed time of 170.3 minutes per day. Similarly, Medic 2 made 5.1 runs per day with a deployed time of 108.9 minutes per day.

TABLE 7-27: BAS Runs by Run Type and Unit

Unit	Breathing difficulty	Cardiac and stroke	Fall and Injury	Illness and Other	Interfacility transfer	MVA	OD	Seizure and UNC	Fire	Other	Total
A1	0	0	1	0	0	0	0	0	0	0	1
A2 P38	296	337	564	1,136	37	241	405	277	183	139	3,615
A3 P39	176	214	426	762	65	141	256	149	165	130	2,484
A5 P40	197	286	427	910	142	157	308	216	148	167	2,958
A6 P41	135	155	242	551	18	86	153	123	119	70	1,652
A10	17	14	22	35	0	6	12	12	4	5	127
A11	0	0	0	0	0	1	0	0	0	0	1
A12	0	0	0	2	0	0	0	0	0	0	2
AT 1	2	4	10	10	0	4	1	1	10	2	44
B10	15	12	53	134	1	33	80	12	16	15	371
B11	4	1	16	28	0	5	7	3	0	0	64
B12	4	0	3	3	0	1	1	0	2	0	14
B13	0	0	2	2	0	1	1	0	0	1	7
Medic 1	106	128	71	200	4	64	28	104	23	29	757
Medic 2	75	62	37	147	1	20	21	52	21	15	451
Medic 3	0	0	0	0	0	0	0	0	1	0	1
Total	**1,027**	**1,213**	**1,874**	**3,920**	**268**	**760**	**1,273**	**949**	**692**	**573**	**12,549**

Note: See Table 7-26 for unit type; OD=Overdose and psychiatric; UNC=Unconsciousness. Medic 1, 2, and 3 entered operation in 2022 (three months studied).

TABLE 7-28: BAS Deployed Minutes per Day by Run Type and Unit

Unit	Breathing difficulty	Cardiac and stroke	Fall and Injury	Illness and Other	Interfacility transfer	MVA	OD	Seizure and UNC	Fire	Other	Total
A1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
A2 P38	43.6	50.1	75.1	146.8	9.4	22.8	45.5	40.2	12.5	7.7	453.5
A3 P39	27.0	32.7	57.8	106.2	27.3	15.1	33.7	21.7	10.1	8.6	340.1
A5 P40	30.3	47.2	60.2	136.0	61.5	17.9	36.0	32.4	10.3	12.7	444.4
A6 P41	22.6	24.0	35.2	81.2	5.7	8.6	21.6	18.4	7.7	4.4	229.5
A10	2.4	2.1	3.1	4.1	0.0	0.4	1.6	1.5	0.4	0.3	15.9
A11	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
A12	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
AT 1	0.1	0.2	0.8	0.6	0.0	0.2	0.1	0.0	0.7	0.0	2.8
B10	1.6	1.7	5.3	17.1	0.1	2.5	9.9	1.1	0.8	0.9	41.1
B11	0.4	0.1	1.7	3.1	0.0	0.4	0.9	0.2	0.0	0.0	6.8
B12	0.4	0.0	0.2	0.3	0.0	0.1	0.1	0.0	0.1	0.0	1.1
B13	0.0	0.0	0.3	0.1	0.0	0.1	0.3	0.0	0.0	0.0	0.8
Medic 1	5.5	8.2	4.1	10.3	0.3	2.8	1.5	6.9	1.2	0.7	41.5
Medic 2	4.8	3.9	2.1	9.5	0.0	1.0	1.1	3.0	0.8	0.3	26.5
Medic 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**138.6**	**170.2**	**246.0**	**515.5**	**104.3**	**72.0**	**152.3**	**125.4**	**44.6**	**35.7**	**1,604.4**

Note: See Table 7-26 for unit type; OD=Overdose and psychiatric; UNC=Unconsciousness. Medic 1, 2, and 3 entered operation in 2022 (three months studied).

Observations:

- A2 P38 made the most runs (3,615, or an average of 9.9 runs per day) and had the highest total annual deployed time (2,759.1 hours, or an average of 7.6 hours per day).
  - EMS calls accounted for 91 percent of runs and 96 percent of total deployed time.
  - Fire calls accounted for 5 percent of runs and 3 percent of total deployed time.

ANALYSIS OF BUSIEST HOURS OF BAS UNITS

In this analysis, we included all 10,955 calls given in Table 7-21 that were responded to by the BAS units. For these calls, 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 April 1, 2021, and March 31, 2022. Table 7-29 shows the number of hours in which there were zero to seven or more calls during the hour. Table 7-30 shows the ten one-hour intervals which had the most calls during the study period. Table 7-31 examines the number of times a medical response call overlapped with another medical response call in each PFD station area.

TABLE 7-29: Frequency Distribution of the Number of BAS Calls

Calls in an Hour	Frequency	Percentage
0	2,747	31.4
1	2,953	33.7
2	1,788	20.4
3	829	9.5
4	316	3.6
5	96	1.1
6	22	0.3
7+	9	0.1
Total	**8,760**	**100.0**

TABLE 7-30: Top Ten Hours with the Most BAS Calls

Hour	Number of Calls	Number of Runs	Total Deployed Hours
2/1/2022, 3:00 p.m. to 4:00 p.m.	7	11	7.7
1/6/2022, 2:00 p.m. to 3:00 p.m.	7	10	9.9
12/7/2021, 9:00 a.m. to 10:00 a.m.	7	10	7.4
12/30/2021, 10:00 a.m. to 11:00 a.m.	7	9	7.4
3/29/2022, 5:00 p.m. to 6:00 p.m.	7	9	5.9
3/25/2022, 1:00 p.m. to 2:00 p.m.	7	8	5.4
12/29/2021, 9:00 a.m. to 10:00 a.m.	7	7	6.0
12/17/2021, 11:00 p.m. to midnight	7	7	4.7
8/13/2021, 10:00 a.m. to 11:00 a.m.	7	7	2.8
2/16/2022, 9:00 a.m. to 10:00 a.m.	6	10	6.3

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 7-31: Frequency of Overlapping BAS Calls

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
1	No overlapped call	2,393	70.0	2,187.7
	Overlapped with one call	875	25.6	423.0
	Overlapped with two calls	140	4.1	40.7
	Overlapped with three calls	9	0.3	2.2
2	No overlapped call	1,697	80.4	1,348.9
	Overlapped with one call	364	17.2	154.1
	Overlapped with two calls	50	2.4	11.7
	Overlapped with three calls	1	0.0	0.2
3	No overlapped call	1,178	85.5	949.3
	Overlapped with one call	182	13.2	83.0
	Overlapped with two calls	16	1.2	3.5
	Overlapped with three calls	2	0.1	0.5
4	No overlapped call	627	92.1	610.7
	Overlapped with one call	50	7.3	25.7
	Overlapped with two calls	4	0.6	1.4
5	No overlapped call	1,101	88.4	894.0
	Overlapped with one call	134	10.8	53.4
	Overlapped with two calls	11	0.9	2.7
6	No overlapped call	615	94.5	478.4
	Overlapped with one call	34	5.2	15.7
	Overlapped with two calls	2	0.3	0.4
7	No overlapped call	1,287	87.6	942.1
	Overlapped with one call	172	11.7	63.7
	Overlapped with two calls	11	0.7	2.6

Observations:

- During nine hours (0.1 percent of all hours), seven or more calls occurred; in other words, the studied medical response units responded to seven or more calls in an hour roughly once every 41 days.
  - The highest number of calls responded by medical units in an hour was eight, which happened once.
- The hour with the most calls was 3:00 p.m. to 4:00 p.m. on February 1, 2022. The hour's 7 calls involved 11 individual dispatches resulting in 7.7 hours of deployed time. These 7 calls included four overdose and psychiatric calls, two illness and other calls, and one breathing difficulty call.

TRANSPORT CALL ANALYSIS

In this section, we present an analysis of the medical units' activity that involved transporting patients, the variations by hour of day, and the average time for each stage of transport service. We identified transport calls by requiring that at least one responding medical unit had recorded both a "beginning to transport" time and an "arriving at the hospital" time. Based on these criteria, we note that 206 non-EMS (fire & other) calls that resulted in transport are included in this analysis.

Transport Calls by Type

Table 7-32 shows the number of calls by call type broken out by transport and non-transport calls.

TABLE 7-32: Transport Calls by Call Type

Call Type	Number of Calls			Conversion Rate
	Non-transport	Transport	Total	
Breathing difficulty	77	743	820	90.6
Cardiac and stroke	146	839	985	85.2
Fall and injury	382	1,327	1,709	77.6
Illness and other	553	2,931	3,484	84.1
Interfacility transfer	19	238	257	92.6
MVA	311	273	584	46.7
Overdose and psychiatric	256	934	1,190	78.5
Seizure and unconsciousness	109	661	770	85.8
EMS Total	**1,853**	**7,946**	**9,799**	**81.1**
Fire & Other Total	**950**	**206**	**1,156**	**17.8**
Total	**2,803**	**8,152**	**10,955**	**74.4**

Observations:

- 81 percent of EMS calls involved transporting one or more patients.
- On average, 21.8 EMS calls per day involved transporting one or more patients.

Average Transport Calls per Hour

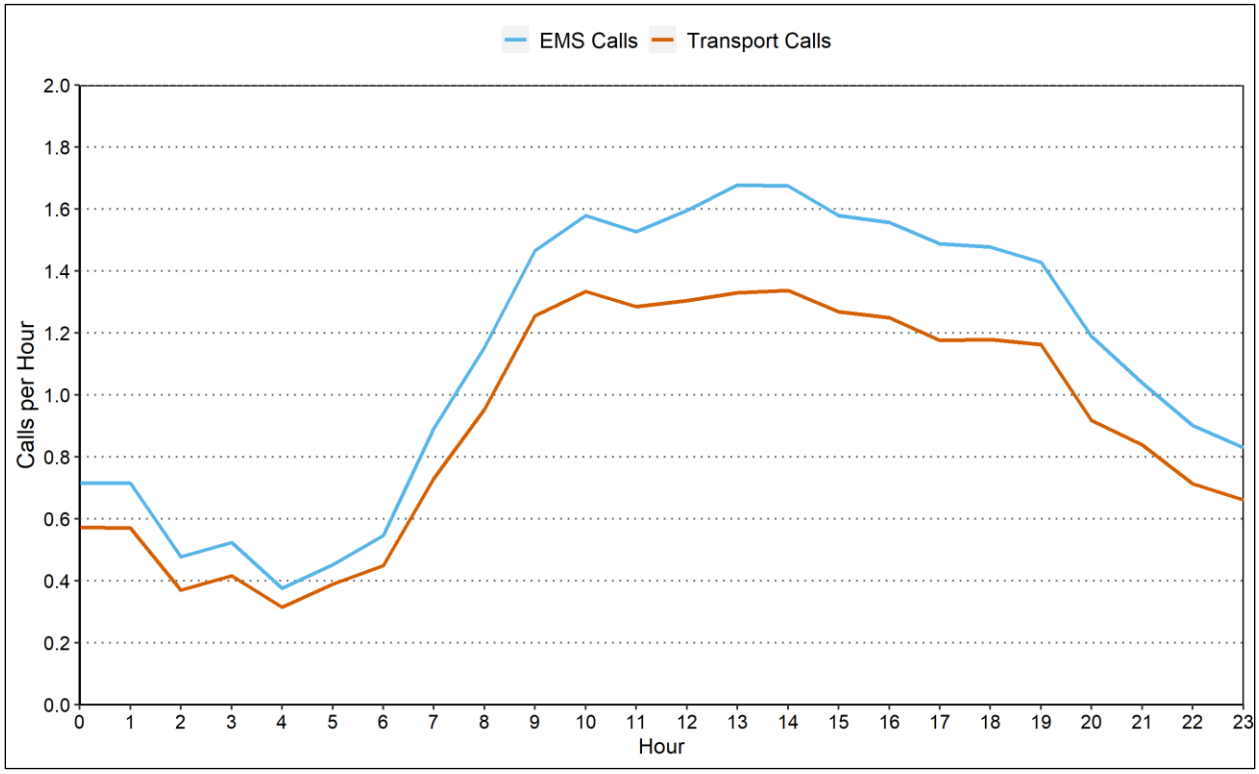
Table 7-33 and Figure 7-12 show the average number of EMS calls received each hour of the day over the study period. In Table 7-33, the conversion rate measures the percentage of EMS calls that transported one or more patients.

TABLE 7-33: EMS Transport Calls per Hour, by Time of Day

Hour	EMS Calls	Transport	EMS Calls per Day	Transport per Day	Conversion Rate
0	261	209	0.7	0.6	80.1
1	261	208	0.7	0.6	79.7
2	174	135	0.5	0.4	77.6
3	191	152	0.5	0.4	79.6
4	137	115	0.4	0.3	83.9
5	165	142	0.5	0.4	86.1
6	199	164	0.5	0.4	82.4
7	325	266	0.9	0.7	81.8
8	421	348	1.2	1.0	82.7
9	535	458	1.5	1.3	85.6
10	576	487	1.6	1.3	84.5
11	557	469	1.5	1.3	84.2
12	582	476	1.6	1.3	81.8
13	612	485	1.7	1.3	79.2
14	611	488	1.7	1.3	79.9
15	576	463	1.6	1.3	80.4
16	568	456	1.6	1.2	80.3
17	543	429	1.5	1.2	79.0
18	539	430	1.5	1.2	79.8
19	521	424	1.4	1.2	81.4
20	434	335	1.2	0.9	77.2
21	379	306	1.0	0.8	80.7
22	329	260	0.9	0.7	79.0
23	303	241	0.8	0.7	79.5
Total	**9,799**	**7,946**	**26.8**	**21.8**	**81.1**

Note: The conversion rate is measured by dividing the number of EMS transports by the number of EMS calls. For example, between midnight and 1:00 a.m., there were 209 EMS transports out of 261 EMS calls. This gives a conversion rate of 209 / 261 = 0. 801, or 80.1 percent.

FIGURE 7-12: Average Transport Calls by Hour



Observations:

- Hourly EMS calls per day were highest during the day from 10:00 a.m. to 5:00 p.m., averaging between 1.5 calls per day and 1.7 calls per day.
- Average hourly EMS calls per day peaked between 1:00 p.m. and 2:00 p.m., averaging 1.7 calls per day.
- Average hourly EMS calls per day was lowest between 4:00 a.m. and 5:00 a.m., averaging 0.4 calls per day.
- Hourly transport calls per day were highest during the day from 10:00 a.m. to 5:00 p.m., averaging between 1.2 calls per day and 1.3 calls per day.
- Average hourly transport calls per day peaked between 2:00 p.m. and 3:00 p.m., averaging 1.3 calls per day.
- Average hourly transport calls per day was lowest between 4:00 a.m. and 5:00 a.m., averaging 0.3 calls per day.
- Average hourly transport conversion rates per day peaked between 5:00 a.m. and 6:00 a.m., averaging 86 percent per day.
- Average hourly transport conversion rates per day was lowest between 8:00 p.m. and 9:00 p.m., averaging 77 percent per day.

Calls by Transport, Type, and Duration

Table 7-34 shows the average duration of transport and non-transport EMS calls by call type.

TABLE 7-34: Call Duration by Call Type and Transport (in Minutes)

Call Type	Non-transport		Transport	
	Average Duration	Number of Calls	Average Duration	Number of Calls
Breathing difficulty	26.4	77	59.7	743
Cardiac and stroke	47.5	146	60.0	839
Fall and injury	23.6	382	58.6	1,327
Illness and other	27.0	553	56.4	2,931
Interfacility transfer	86.1	19	152.5	238
MVA	16.6	311	62.6	273
Overdose and psychiatric	22.8	256	51.8	934
Seizure and unconsciousness	25.7	109	59.1	661
EMS Total	**26.1**	**1,853**	**60.2**	**7,946**
Fire & Other Total	**16.5**	**950**	**60.2**	**206**
Total	**22.8**	**2,803**	**60.2**	**8,152**

Note: The duration of a call is defined as the longest deployed time of any of the units responding to the same call.

Observations:

- The average duration was 26.1 minutes for non-transport EMS calls.
- The average duration was 60.2 minutes for EMS calls where one or more patients were transported to a hospital.

Transport Time Components

Table 7-35 gives the average deployed time for an ambulance on a transport call, along with three major components of the deployed time: on-scene time, travel to hospital time, and at-hospital time.

The on-scene time is the interval from the unit arriving on-scene time through the time the unit departs the scene for the hospital. Travel to hospital time is the interval from the time the unit departs the scene to travel to the hospital through the time the unit arrives at the hospital. At-hospital time is the time it takes for patient turnover at the hospital.

This table analyzes times by run. Normally, the number of runs will exceed the number of calls as a call may have multiple runs. In addition, average times may differ slightly from similar averages measured per call.

TABLE 7-35: Time Component Analysis for Ambulance Transport Runs by Call Type

Call Type	Average Time Spent per Run, Minutes				Number of Runs
	On Scene	Traveling to Hospital	At Hospital	Deployed	
Breathing difficulty	15.6	9.8	26.5	59.5	760
Cardiac and stroke	16.5	9.7	26.4	59.6	867
Fall and injury	15.5	10.7	25.1	58.4	1,342
Illness and other	14.5	10.3	24.0	56.3	2,962
Interfacility transfer	23.0	51.2	72.3	150.7	241
MVA	13.6	11.3	27.9	59.7	321
Overdose and psychiatric	13.0	9.5	21.5	51.7	941
Seizure and unconsciousness	16.2	9.4	26.2	58.8	681
EMS Total	**15.2**	**11.3**	**26.2**	**59.9**	**8,115**
Fire & Other Total	**14.7**	**10.6**	**28.3**	**59.8**	**210**
Total	**15.2**	**11.3**	**26.2**	**59.9**	**8,325**

Note: Average unit deployed time per run is lower than average call duration for some call types because call duration is based on the longest deployed time of any of the units responding to the same call, which may include an engine or ladder. Total deployed time is greater than the combination of on-scene, transport, and hospital wait times as it includes turnout, initial travel, and hospital return times.

Observations:

- The average time spent on-scene for a transport EMS call was 15.2 minutes.
- The average travel time from the scene of the EMS call to the hospital was 11.3 minutes.
- The average deployed time spent on transport EMS calls was 59.9 minutes.
- The average deployed time at the hospital was 26.2 minutes, which accounts for approximately 44 percent of the average total deployed time for a transport EMS call.

PART 3. 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 fire and medical response units and all calls within Plymouth fire to which at least one unit arrived. Mutual aid, canceled, and non-emergency calls were removed. Here EMS calls with emergency levels 1 and 2 and fire calls with response levels 3 and 2 were identified as emergency calls. 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, for all 13,665 calls in the studied period, we excluded 670 canceled calls, 2,960 non-emergency calls, 47 calls where no units recorded a valid on-scene time, 221 calls with a total response time exceeding 30 minutes, and 136 calls where one or more segments of the first arriving unit's response time could not be calculated due to missing or faulty data. Finally, we removed 151 calls occurring on days when Plymouth was hit by two tropical storms, which naturally increased response times on those days. These days were October 26 through 28, 2021, and January 28, 2022. As a result, in this section, a total of 9,480 calls are included in the analysis.

Response Time by Type

Table 7-36 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 7-36 shows an overall 90th percentile response time of 11.8 minutes, which means that 90 percent of the time a call had a response time of no more than 11.8 minutes. Figures 7-13 and 7-14 illustrate the same information.

TABLE 7-36: Average and 90th Percentile 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	
Breathing difficulty	1.5	0.8	3.7	6.0	1.9	1.7	6.5	9.4	776
Cardiac and stroke	1.4	0.8	3.8	6.0	1.9	1.7	7.2	9.9	939
Fall and injury	1.5	0.9	4.1	6.5	2.1	1.9	7.5	10.4	1,616
Illness and other	1.6	0.9	4.7	7.2	2.2	1.9	9.4	12.2	3,104
MVA	1.7	0.8	3.2	5.7	2.7	1.7	5.7	9.4	380
OD	1.6	1.1	5.8	8.5	2.4	2.2	10.5	13.9	1,128
Seizure and UNC	1.6	0.8	3.7	6.0	2.0	1.7	6.3	9.6	734
EMS Total	**1.5**	**0.9**	**4.4**	**6.8**	**2.2**	**1.8**	**8.7**	**11.7**	**8,677**
False alarm	1.4	1.1	4.7	7.2	2.3	1.9	9.2	12.4	164
Good intent	1.8	1.0	3.8	6.6	3.3	1.9	5.9	11.7	41
Hazard	1.6	1.3	5.1	7.9	2.4	2.3	9.7	13.9	119
Outside fire	2.4	1.5	6.1	9.9	3.7	3.3	10.9	18.1	55
Public service	1.7	1.0	4.2	6.8	2.3	1.8	7.7	12.2	371
Structure fire	2.2	1.1	3.6	6.8	3.4	1.8	6.3	10.0	47
Technical rescue	1.8	0.7	3.4	5.9	3.5	1.5	6.7	8.9	6
Fire Total	**1.7**	**1.1**	**4.5**	**7.3**	**2.5**	**2.0**	**8.8**	**12.9**	**803**
Total	**1.5**	**0.9**	**4.4**	**6.9**	**2.2**	**1.9**	**8.7**	**11.8**	**9,480**

Note: OD=Overdose and psychiatric; UNC=Unconsciousness.

FIGURE 7-13: Average Response Time of First Arriving Unit, by Call Type, EMS

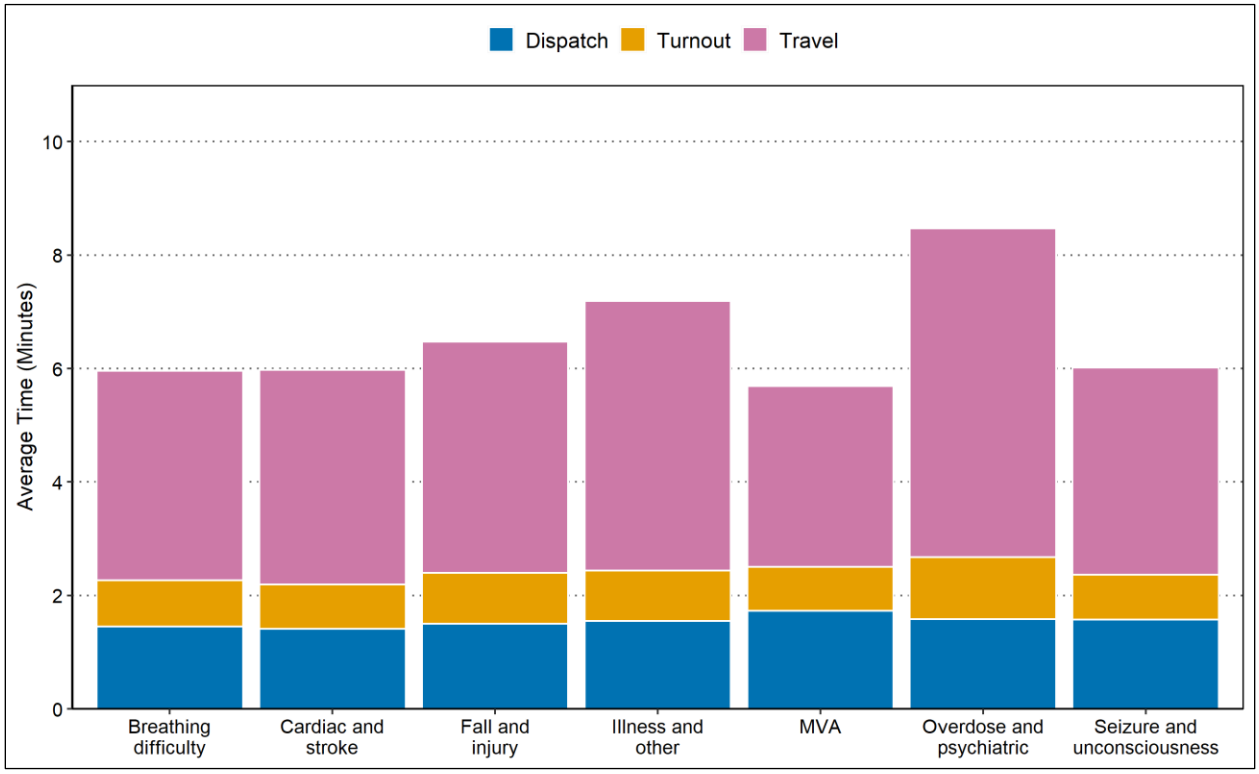
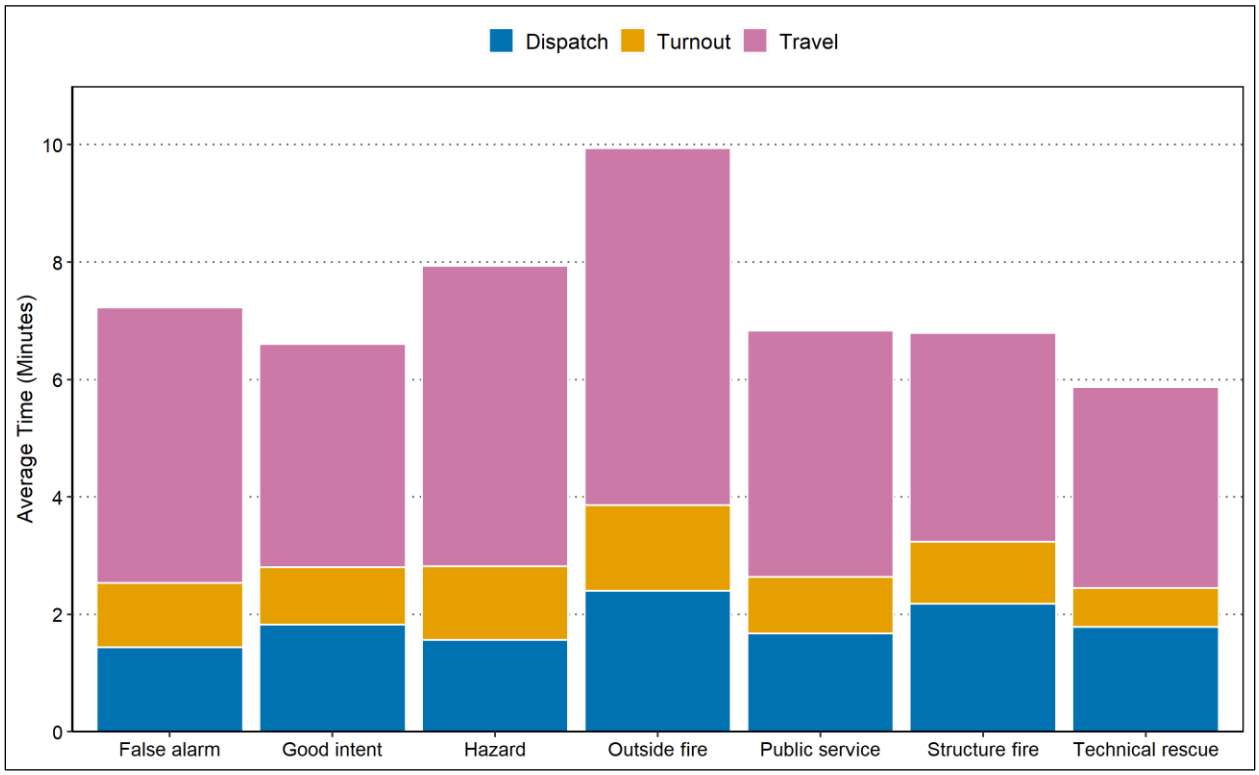


FIGURE 7-14: Average Response Time of First Arriving Unit, by Call Type, Fire



Observations:

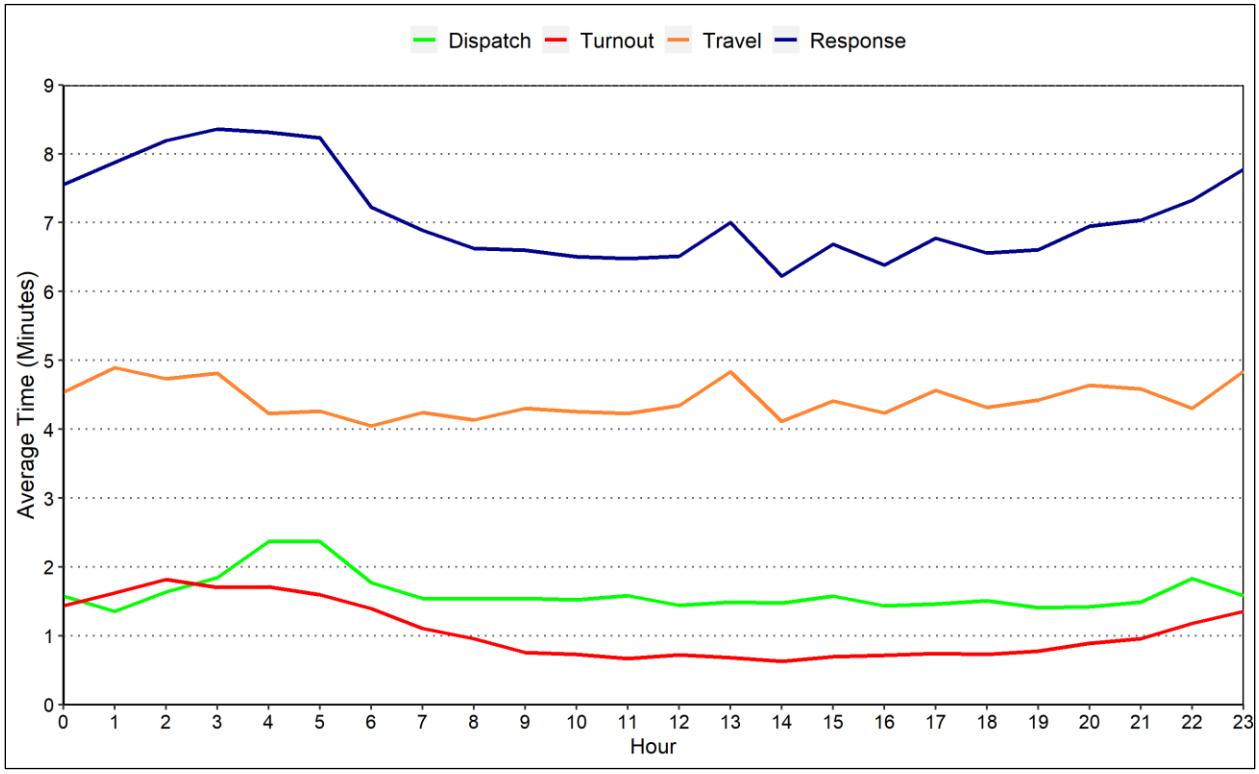
- The average dispatch time was 1.5 minutes.
- The average turnout time was 0.9 minutes.
- The average travel time was 4.4 minutes.
- The average total response time was 6.9 minutes.
- The average response time was 6.8 minutes for EMS calls and 7.3 minutes for fire calls.
- The average response time was 9.9 minutes for outside fires and 6.8 minutes for structure fires.
- The 90th percentile dispatch time was 2.2 minutes.
- The 90th percentile turnout time was 1.9 minutes.
- The 90th percentile travel time was 8.7 minutes.
- The 90th percentile total response time was 11.8 minutes.
- The 90th percentile response time was 11.7 minutes for EMS calls and 12.8 minutes for fire calls.
- The 90th percentile response time was 18.1 minutes for outside fires and 10.0 minutes for structure fires.

Table 7-37 shows the average response time by the time of day. The table also shows 90th percentile response times. Figure 7-15 shows the average response time by the time of day.

TABLE 7-37: 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	1.6	1.4	4.5	7.6	12.8	241
1	1.4	1.6	4.9	7.9	13.1	242
2	1.6	1.8	4.7	8.2	13.5	158
3	1.8	1.7	4.8	8.4	13.3	171
4	2.4	1.7	4.2	8.3	14.5	112
5	2.4	1.6	4.3	8.2	14.2	129
6	1.8	1.4	4.1	7.2	11.2	193
7	1.5	1.1	4.2	6.9	11.8	313
8	1.5	1.0	4.1	6.6	11.6	408
9	1.5	0.8	4.3	6.6	11.0	541
10	1.5	0.7	4.3	6.5	11.3	590
11	1.6	0.7	4.2	6.5	11.3	562
12	1.4	0.7	4.3	6.5	11.1	584
13	1.5	0.7	4.8	7.0	12.1	612
14	1.5	0.6	4.1	6.2	10.7	599
15	1.6	0.7	4.4	6.7	11.6	573
6	1.4	0.7	4.2	6.4	10.6	547
17	1.5	0.7	4.6	6.8	12.0	525
18	1.5	0.7	4.3	6.6	11.0	529
19	1.4	0.8	4.4	6.6	11.4	495
20	1.4	0.9	4.6	7.0	11.9	412
21	1.5	1.0	4.6	7.0	12.5	356
22	1.8	1.2	4.3	7.3	12.6	314
23	1.6	1.4	4.8	7.8	13.2	274
Total	**1.5**	**0.9**	**4.4**	**6.9**	**11.8**	**9,480**

FIGURE 7-15: Average Response Time of First Arriving Unit, by Hour of Day



Observations:

- Average dispatch time ranged from 1.4 minutes (1:00 a.m. to 2:00 a.m.) to 2.4 minutes (4:00 a.m. to 5:00 a.m.).
- Average turnout time ranged from 0.6 minutes (2:00 p.m. to 3:00 p.m.) to 1.8 minutes (2:00 a.m. to 3:00 a.m.).
- Average travel time ranged from 4.1 minutes (6:00 a.m. to 7:00 a.m.) to 4.9 minutes (1:00 a.m. to 2:00 a.m.).
- Average response time ranged from 6.2 minutes (2:00 p.m. to 3:00 p.m.) to 8.4 minutes (3:00 a.m. to 4:00 a.m.).
- The 90th percentile response time ranged from 10.6 minutes (4:00 p.m. to 5:00 p.m.) to 14.5 minutes (4:00 a.m. to 5:00 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 7-16 and Table 7-38. Figure 7-16 shows response times for the first arriving unit to EMS calls as a frequency distribution in whole-minute increments, and Figure 7-17 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 7-16, the 90th percentile of 11.7 minutes means that 90 percent of EMS calls had a response time of 11.7 minutes or less. In Table 7-38, the cumulative percentage of 73.2, for example, means that 73.2 percent of EMS calls had a response time under 8 minutes.

FIGURE 7-16: Cumulative Distribution of Response Time, First Arriving Unit, EMS

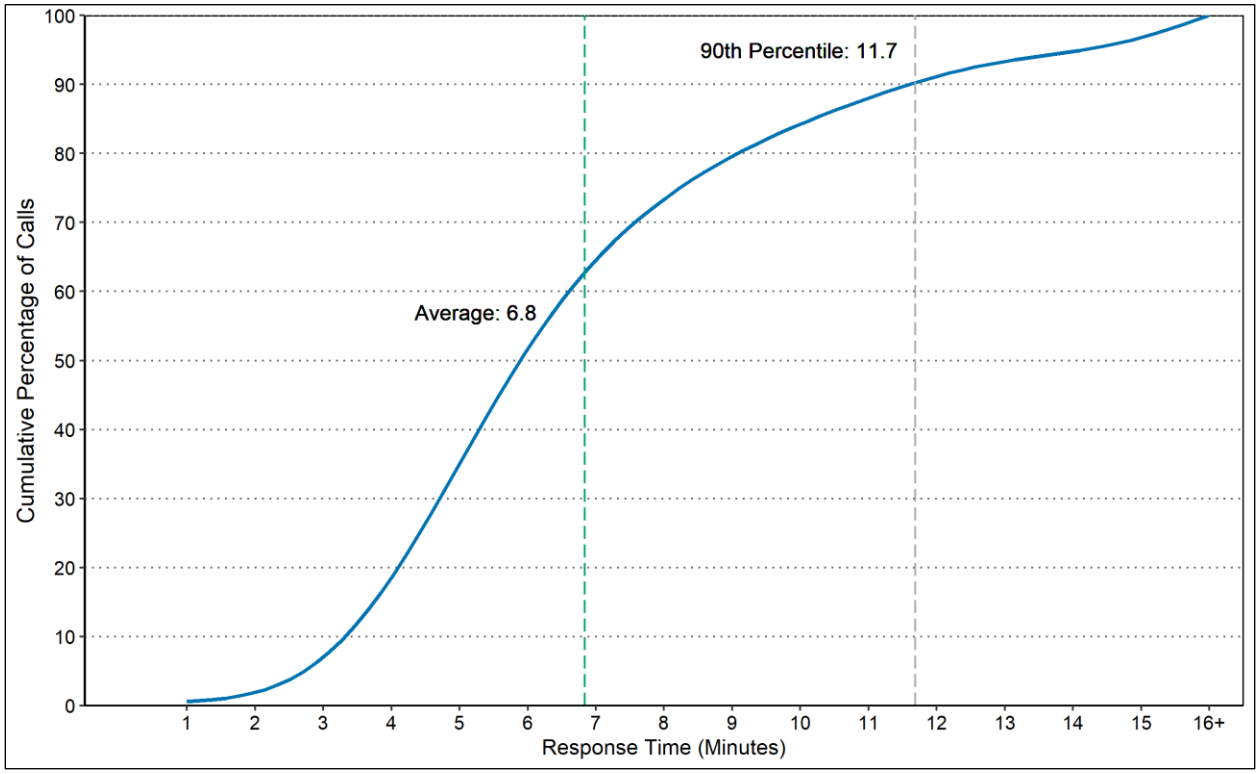


TABLE 7-38: Cumulative Distribution of Response Time, First Arriving Unit, EMS

Response Time (minute)	Frequency	Cumulative Percentage
1	62	0.7
2	104	1.9
3	427	6.8
4	1,022	18.6
5	1,440	35.2
6	1,465	52.1
7	1,103	64.8
8	741	73.3
9	558	79.8
10	400	84.4
11	315	88.0
12	274	91.2
13	204	93.5
14	146	95.2
15	91	96.3
16+	325	100.0

FIGURE 7-17: Cumulative Distribution of Response Timer, First Arriving Unit, Outside and Structure Fires

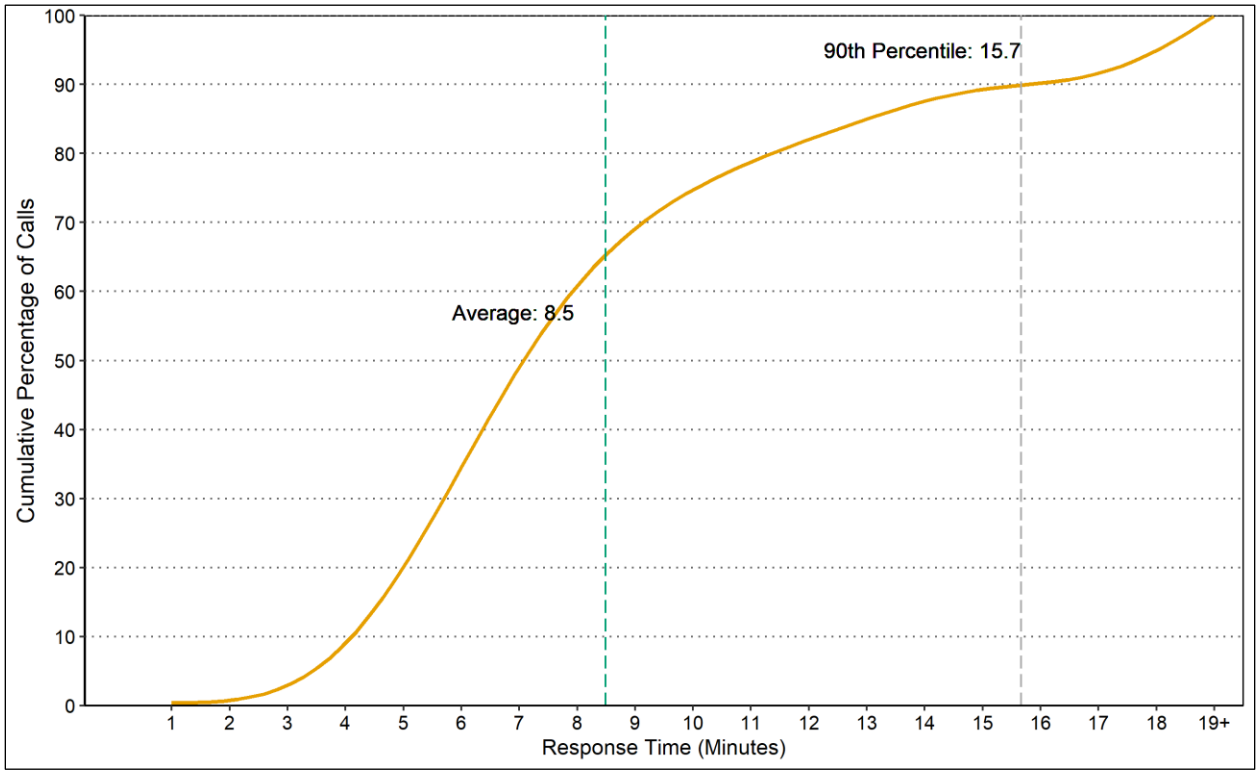


TABLE 7-39: Cumulative Distribution of Response Time, First Arriving Unit, Outside and Structure Fires

Response Time (minute)	Frequency	Cumulative Percentage
1	1	1.0
2	0	1.0
3	1	2.0
4	7	8.8
5	12	20.6
6	11	31.4
7	22	52.9
8	7	59.8
9	10	69.6
10	5	74.5
11	4	78.4
12	4	82.4
13	2	84.3
14	4	88.2
15	1	89.2
16	1	90.2
17	2	92.2
18	1	93.1
19+	7	100.0

Observations:

- For 73 percent of EMS calls, the response time of the first arriving unit was less than 8 minutes.
- For 60 percent of outside and structure fire calls, the response time of the first arriving unit was less than 8 minutes.

ATTACHMENT 3.1: CALL TYPE IDENTIFICATION

When available, NFIRS data serves as our primary source for assigning call categories. For 4,250 of the 13,651 calls (Table 7-1, excluding 10 mutual aid calls), NFIRS incident type codes were used to assign call types for fire, motor vehicle accident, and canceled calls. For 9,401 calls including EMS, public service, and motor vehicle incident calls that do not have specific NFIRS incident types, we instead used the problem description from the computer-aided dispatch (CAD) data to assign a call category. Tables 7-40 and 7-41 illustrate the method used to identify the category of calls.

TABLE 7-40: Call Type by RMS Incident Type Code and Description

Call Type	Incident Type Code	Incident Type Description	Frequency
Canceled	611	Dispatched and cancelled en route	291
	621	Wrong location. Excludes malicious false alarms	10
	622	No incident found on arrival at dispatch address	359
False Alarm	700	False alarm or false call, other	33
	710	Malicious, mischievous false alarm, other	7
	711	Municipal alarm system, malicious false alarm	23
	712	Direct tie to fire department, malicious false alarm	4
	713	Telephone, malicious false alarm	2
	714	Central station, malicious false alarm	9
	715	Local alarm system, malicious false alarm	4
	730	System or detector malfunction, other	42
	731	Sprinkler activated due to the failure or malfunction	27
	732	Direct tie to fire department, malicious false alarm	1
	733	Smoke detector activation due to malfunction	373
	734	Heat detector activation due to malfunction	8
	735	Alarm system sounded due to malfunction	220
	736	CO detector activation due to malfunction	91
	740	Unintentional transmission of alarm, other	87
	741	Sprinkler activation, no fire - unintentional	29
	743	Smoke detector activation, no fire - unintentional	185
	744	Detector activation, no fire - unintentional	56
	745	Alarm system activation (no fire) - unintentional	198
	746	Carbon monoxide detector activation (no CO)	42
Good Intent	600	Good intent call, other	59
	631	Authorized controlled burning	5
	650	Steam, other gas mistaken for smoke, other	3
	651	Smoke scare, odor of smoke, not steam	20
	652	Steam, vapor, fog, or dust thought to be smoke	9
	653	Smoke from barbecue or tar kettle (no hostile fire)	1
	661	EMS call. Left the scene prior to arrival	2
	671	HazMat release investigation w/no HazMat	42
Hazard	210	Overpressure rupture from steam, other	1

Call Type	Incident Type Code	Incident Type Description	Frequency
	212	Overpressure rupture of steam boiler	1
	223	Overpressure rupture of pressure or process vessel	1
	240	Explosion (no fire), other	1
	251	Excessive heat, scorch burns with no ignition	12
	400	Hazardous condition (no fire), other	3
	410	Combustible and flammable gas or liquid spills/leaks	1
	411	Gasoline or other flammable liquid spill	23
	412	Gas leak (natural gas or LPG)	62
	413	Oil or other combustible liquid spill	12
	421	Chemical hazard (no spill or leak)	1
	422	Chemical spill or leak	3
	424	Carbon monoxide incident	73
	440	Electrical wiring/equipment problem, other	26
	441	Heat from short circuit (wiring), defective/worn	5
	442	Overheated motor or wiring	11
	443	Breakdown of light ballast	1
	444	Power line down	95
	445	Arcing, shorted electrical equipment	74
	460	Accident, potential accident, other	3
	462	Aircraft standby	7
	463	Vehicle accident, general cleanup	14
	471	Explosive, bomb removal	1
	481	Attempt to burn	1
Motor Vehicle Accident	322	Motor vehicle accident with injuries	248
	323	Motor vehicle/pedestrian accident (MV Ped)	16
	324	Motor vehicle accident with no injuries	291
Outside Fire	131	Passenger vehicle fire	19
	132	Road freight or transport vehicle fire	1
	134	Water vehicle fire	3
	138	Off-road vehicle or heavy equipment fire	1
	140	Natural vegetation fire, other	33
	141	Forest, woods, or wildland fire	19
	142	Brush or brush-and-grass mixture fire	9
	143	Grass fire	2
	150	Outside rubbish fire, other	1
	151	Outside rubbish, trash, or waste fire	12
	153	Construction or demolition landfill fire	1
	154	Dumpster or other outside trash receptacle fire	3
	160	Special outside fire, other	2
	161	Outside storage fire	1
	162	Outside equipment fire	2
	331	Lock-in	5

Call Type	Incident Type Code	Incident Type Description	Frequency
Public Service	500	Service call, other	9
	510	Person in distress, other	30
	511	Lock-out	40
	512	Ring or jewelry removal, without transport to hospital	16
	520	Water problem, other	8
	522	Water or steam leak	27
	531	Smoke or odor removal	34
	541	Animal problem	1
	542	Animal rescue	3
	550	Public service assistance, other	40
	551	Assist police or another governmental agency	29
	552	Police matter	54
	553	Public service	76
	554	Assist invalid	293
	555	Defective elevator, no occupants	1
	561	Unauthorized burning	120
	571	Cover assignment	13
	812	Flood assessment	3
	813	Windstorm	17
	814	Lightning strike (no fire)	1
	815	Severe weather or natural disaster standby	2
	911	Citizen's complaint	2
Structure Fire	111	Building fire	35
	112	Fires in structure other than in a building	1
	113	Cooking fire, confined to container	26
	114	Chimney or flue fire	4
	116	Fuel burner/boiler, delayed ignition, or malfunction	1
	118	Trash or rubbish fire in a structure	1
Technical Rescue	341	Search for person on land	1
	350	Extrication, rescue, other	1
	351	Extrication of victim(s) from building or structure	1
	352	Extrication of victim(s) from vehicle	2
	353	Removal of victim(s) from stalled elevator	8
	356	High-angle rescue	2
	361	Swimming/Recreational water areas rescue	1
	364	Surf rescue	2
	365	Watercraft rescue	2
Total			**4,250**

TABLE 7-41: Call Type by EMD Protocol

Call Type	EMD Protocol	Calls
Breathing Difficulty	Breathing Problem (Protocol 6)	780
	Choking (Protocol 11)	42
Cardiac and Stroke	Cardiac Arrest/Death (Protocol 9)	81
	Chest Pain (Non-Traumatic) (Protocol 10)	459
	Heart Problems/AICD (Protocol 19)	253
	Stroke/CVA (Protocol 28)	195
Fall and Injury	Assault/Sexual Assault/Stun Gun (Protocol 4)	53
	Burns/Explosion (Protocol 7)	6
	Drowning/Diving/Scuba Accident (Protocol 14)	4
	Electrocution/Lightning (Protocol 15)	1
	Falls (Protocol 17)	1,338
	Hemorrhage/Laceration (Protocol 21)	169
	Inaccessible Incident/Other Entrapments (Protocol 22)	1
	Stab/Gunshot Wound/Penetrating Trauma (Protocol 27)	4
	Traumatic Injury (Protocol 30)	133
Illness and Other	Abdominal Pain/Problems (Protocol 1)	296
	Allergic Reaction/Stings (Protocol 2)	86
	Animal Bites/Attack (Protocol 3)	10
	Back Pain (Non-Traumatic) (Protocol 5)	133
	Carbon Monoxide/Hazmat/Inhalation (Protocol 8)	1
	Diabetic Problem (Protocol 13)	118
	Eye Problem/Injury (Protocol 16)	6
	Headache (Protocol 18)	47
	Heat/Cold Exposure (Protocol 20)	14
	Pandemic (Protocol 36)	2
	Pregnancy/Childbirth/Miscarriage (Protocol 24)	12
	Sick Person (Protocol 26)	2,319
	Unknown Problem/Person Down (Protocol 32)	498
Interfacility Transfer	Interfacility Transfer	257
Motor vehicle Accident	Traffic/Transportation Incident (Protocol 29)	44
Overdose and Psychiatric	Overdose/Poisoning/Ingestion (Protocol 23)	155
	Psychiatric Problem/Abnormal Behavior/Suicide Attempt	1,036
Public Service	Assist	17
	Automated Crash Notification	6
	Detail	10
	Discharge	16
	Medflight	24
	Outpatient Appointment	1
	Safe Drug Program	1

Call Type	Type Description	Calls
Seizure and Unconsciousness	Convulsions/Seizure (Protocol 12)	280
	Unconscious/Fainting/Near-Fainting (Protocol 31)	493
Total		**9,401**

Note: *NFIRS incident type code is 321.

- END -