TRIDATA
A Division of SPC

Comprehensive Review of the Tacoma Fire Department Facilities and Units

June 2004

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ACKNOWLEDGMENTS

The project team wishes to thank the leadership and personnel of the Tacoma Fire Department and Port of Tacoma for their help and cooperation in undertaking this study. From the outset, it was apparent that many individuals were committed to making this study useful to the City and Port as both go forward.

We especially thank the key participants and advisors involved in this study:

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Although we received excellent cooperation from Tacoma Fire Department and Port of Tacoma staff, the findings and recommendations here are those of the TriData project team.

Listed below are the principal members of the project team and their primary areas of responsibility. This study was truly a team effort; most individuals dealt with areas in addition to their primary focus.

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EXECUTIVE SUMMARY

In 2003, TriData, a division of System Planning Corporation of Arlington, VA was selected to review the current station and unit locations and support facilities of the Tacoma Fire Department, especially in light of contemplated changes in the Port area. The study was to consider a 10-year planning horizon with intermediate points of the present situation (2003–2004), the situation in 2008, and the situation circa 2013–2014.

Key findings and recommendations are summarized below.

Current Fire and EMS Operations

The Tacoma Fire Department protects a population of approximately 214,000, the vast majority of which are within the city limits. The Port of Tacoma is the sixth largest container port in North America, and covers over 2,400 acres.

The Tacoma Fire Department has 16 active fire stations distributed throughout the City, including the Port area. Each station has one engine. Four stations also having truck companies and five stations have Advanced Life Support (ALS) medic units. In addition, Station 18 is used for fireboat moorage and maintenance, and unstaffed Stations 5 and 12, are used for storage and other purposes. TFD staffing is 410 uniformed personnel and 32.33, civilians for a total of 442.33 FTE. The majority of the uniformed force is engaged in fire suppression and emergency medical service delivery.

Battalion Chiefs (BCs) – The TFD service area is divided between two battalions – 181 and 182. Battalion Chief 181 oversees 8 stations (12 units). BC 182 oversees 8 stations (13 units). Most fire departments maintain a span of control of five or six stations for battalion chiefs; few go as high as 8. TFD should soon add at least one BC, and add a second between 2008 and 2015.

Unit Staffing – Engines and trucks are staffed by TFD with three firefighters each. Current NFPA standards recommend a staffing of four. The number of firefighters per unit is not necessarily a concern if the response time it takes to get a complement large enough to begin fire ground operations is adequate, as at present. If response times for the complement needed to begin operations get too high, then the department should consider changing its unit staffing.

Response Times –The study looked at each component of response time: call processing and dispatch, turnout time, and drive time. Drive times are generally very good (3.65 minutes vs. a goal of 4 minutes in 2003). Dispatch and turnout times were below standard and need to be improved; each should average about a minute, and each was at least a half-minute higher. These findings were given to the department early in the study, and measures have been implemented to reduce the dispatch and turnout times.

Workload and Demand

When looking at the adequacy of station locations and unit deployment, a starting point is analysis of current unit workloads and response times. Going into the future, population projections or projections of past demand can be used to project future demand for fire services, and approximate workloads by area and unit. The population is projected to increase by 25 percent in the next 10 years, and workload by about 30 percent.

Population Projections – Population density is expected to increase 50–100 percent in the two most densely populated areas (Engine 1 and Engine 4's areas), and also increase everywhere else except for the Port area. The growth in population is going to be virtually continuous and affect the whole city.

Current Workload – The overall workload of the Tacoma Fire Department has increased over 30 percent in the past seven years. The main part of the workload increase is EMS calls, but demand for "other calls"—a wide variety of services and false alarms—are increasing by an even faster rate, up to 42 percent vs. 30 percent for EMS. Fire calls only increased by 0.04 percent in this period. The overall increase in calls has been much faster than the increase in population, which means that the citizens are asking the fire department for more service per capita.

TFD should continue to analyze automatic alarm incidents. Attention to quality control in the maintenance of automatic alarms might also be in order.

The increase in workload has had an impact on all fire units. Overall, 52 percent of the units in 2003 had more than 2,000 incidents. A few units have very high workloads at 3,000 or more incidents per year. Engines 1, 10, and 11, and Rescues 2 and 4 are beyond the very high workload point. Engines 3, 6, and 15, and Trucks 3 and 4 are at the other end of the scale, with relatively low workloads. Overall, the fire system has the ability to handle a higher workload in some areas of the city, but needs additional units at peak demand times in some areas. Additional units are needed in Engine 1 and Engine 10's areas; they might initially be peak-load (part-time), two-person EMS units.

Projected Workloads – Table 1 shows the projected number of incidents by engine zone for 2008 and 2015. Zones with more than 3,000 calls are shown in bold. There will be many zones by 2008–2015 that will need additional units in order to meet response time goals.

Table 1: Projected Incidents by Engine Zone

Engine Zone	2008	2015
1	4,048	4,292
2	3,017	3,735
3	1,161	1,508
4	2,782	3,052
6	344	257
7	2,876	3,509
8	2,735	3,133
9	3,346	4,355
10	5,268	6,475
11	3,980	4,710
12	2,094	2,526
13	1,666	1,947
14	1,640	2,041
15	252	283
16	3,424	4,257
17	2,071	2,556

With the 31 percent increase in demand from 1997 through 2003 and an expected similar increase over the next 10 years, changes will be needed in the entire system.

Tideflats Facility and Unit Deployment

There are many fire and explosion hazards in the Port area that require the TFD to have hazardous material mitigation and technical rescue capability. There is constant railway traffic in and out of the Port. Ships arrive daily loaded with containers holding many hazardous chemical products. And there are large numbers of cargo truck movements. Each ship, train, or truck that enters the Port brings with it the possibility for a complex emergency event.

The City and Port need to ensure that emergency access areas are maintained throughout the areas where containers are stacked, and around all industrial buildings and piles of combustible materials. Response time to a fire or hazmat event or injury does not stop in the street outside; emergency crews must be able to get to the scene of the incident.

Fire Loss – The Tacoma Fire Department and Port management should be proud of the level of prevention and protection that has helped to keep dollar losses minimal in the past few years. While there are not many fires nor large fire loss, there is considerable potential given the number and value of the buildings and containers. The Port area must be well protected because of the long-term potential risks, e.g. once-in-ten-years $10 million fire such as the $62 million Mountain Cold Storage fire loss in 1992, or a large hazmat incident.

Port Fire Stations – The host of problems and concerns regarding fire protection for the Port area revolve around Port expansion, road changes, and bridge or other fire department access issues. A number of Port-related infrastructure issues have not been decided yet. The Port is likely to continually change and adapt in order to remain productive and profitable.

Currently the bridge over the Hylebos Waterway is not operational. The bridge is a critical link for the TFD, as it allows Engine 15 on the east side of the tideflats to get to the northeast region of the city quickly to assist or cover for Engine 3, and vice versa.

On the southwest side of the Port area, the Murray Morgan Bridge (MMB) is in hazardous condition. Fire units may cross it for emergency response but must reduce speed and keep designated intervals between vehicles. To reduce stress on the bridge, they are not allowed to return over the same route; instead they must take a more circuitous trip back to their station.

There also is discussion about closing the 11^{th} Street Viaduct (among other Port area road changes). Vacating the 11^{th} Street Viaduct has an impact on the overall Port area fire response. Currently, the viaduct is used as the connector between Station 6, the downtown stations (with the MMB passable) and the middle of the Port area. Without the viaduct, even if the MMB is available, TFD units all will need to go first south to the base of the Port area and then come back up to get to the large middle section of the Port area – a much longer, less direct route. Together, the Murray Morgan Bridge and the 11^{th} Street Viaduct provide the shortest and most direct route from downtown to the majority of the Port area. Removing the Murray Morgan Bridge and/or the viaduct would significantly change the level of protection for the Port area.

Given the various near-term and longer-term changes, we recommend that the fire department consolidate Stations 6 and 15 into a new Port area station to be built near the intersection of 509 and Port of Tacoma Road. The combined station would have adequate response to all of the Port area. Table 2 presents the proposed deployment for the consolidated station.

Table 2: Deployment Recommendations for New Port Area Fire Station by Scenario

Current Deployment	Recommended Deployment
• Engines: 2 (6 and 15) with 3 staff each • Water Tender: (SU 45) Unstaffed • Fireboat Defiance (cross staffed) • Fireboat Commencement (unstaffed) **Total Staff: 6**	• Engines: 1 active (3 staff) and 1 in reserve for major emergencies (unstaffed) • Truck: Relocate Truck 4 from Station 12 and increase staffing by 1 (4 staff) • EMS Unit: 1 response vehicle as discussed in Chapter V (cross-staffed) • Hazmat Unit: Relocate the Hazmat unit from Station 12 (cross-staffed) • Water Tender: Relocate from Station 15 (cross-staffed) **Total Staff: 7 (net reduction of 2 overall)[1]**

Fireboats – The city has two fireboats – Defiance and Commencement – that were put into service in 1982 and 1983, respectively. The Defiance is the first-line fireboat. The Commencement is the backup. Defiance used to be housed at Station 5 before it was closed because of budget constraints. Recently, the police department secured funding for a new boat for homeland security purposes. With some repair work, Station 5 could be used as a joint marine operations center for the police and fire departments. If fireboat Defiance was repaired and then staffed full time from Station 5 it would be able to provide better coverage of the waterways as well as assist with inspections, environmental and safety issues in the tideflats.

Station Location and Deployment Outside the Tideflats

Several changes are recommended to meet the demand increases that are projected. The actual circumstances of workloads and response times should dictate the timing of the changes. If demand increases quicker than projected, the recommendations may need to be expedited. If demand projections do not come true and demand does not rise as quickly as projected, then implementation of some of the recommendations may be delayed.

[1] There would be a net reduction of 2 positions city wide: the two Port engine and the truck now have 9 positions; the combined station would have 7.

There are three major issues:

1. **South area:** The demand at Stations 10 and 11 is well above 3,000 incidents, with the other areas in this region approaching that level very rapidly. By 2008, a new fire station will be needed in this area to help keep up with the demand levels and keep response times within city goals and industry standards.

2. **Downtown area:** The demand at Station 1 is currently above the very high workload threshold of 3,000 incidents. Going forward, the entire downtown region is expected to get very busy. By 2015, the Tacoma Fire Department will need to build a new downtown fire station (which could also serve as a new fire headquarters, as well).

3. **Northeast Tacoma:** Engine Zone 3 has a low workload, however, it has a very large coverage area. With the consolidation of the Stations 6 and 15, the backup coverage Engine 15 currently provides would be eliminated, which would leave Northeast Tacoma even more vulnerable. The inoperable Hybelos Bridge cuts off Engine Zone 3 from its past most rapid support. Another unit needs to be added here, preferably in northern NE Tacoma where the protection is the weakest in the city.

Browns Point/Dash Point and University Place – It would improve efficiency and safety of both Browns Point/Dash Point and University Place if TFD were to provide services to those areas. There would be greater ability to deal with growth in the adjacent areas of the city as well. The Browns Point/Dash Point protection would alleviate the concern with protection in Engine Zone 3 in Northeast Tacoma. The University Place coverage should be conditioned on that area fully paying for the cost of service.

Support Facilities

We reviewed the adequacy of facilities for training, communications, garage, electrical, warehouse, administrative, and prevention. Overall, most need to be enlarged, moved, or both.

Training Facility – The new training facility has excellent classroom space but is inadequate for hands-on training, especially live fires. The Fire Department should construct a new training tower with the capability to conduct aerial equipment exercises as well as live firefighting.

Communications Center – The Communications Center is well laid out and appeared to function well. However, expansion of the center is needed for the growing call volume.

Fire Garage – The fire garage has perhaps the most pressing facility need. While it makes use of this in very cramped space as well as possible, the crowded environment poses a safety issue and affects productivity. Parts are stacked and stored in every possible location, including the floor of the bays. More working space for emergency vehicle repairs is an urgent need; important to allow quicker turn around for small repairs and preventive maintenance of fire vehicles, and less time out of service.

The department needs to construct a new, modern fire garage. Preferably it would be at or near the site of the training facility, so a crew could get routine maintenance on its vehicle while it trains, further reducing downtime.

Supply Warehousing – TFD presently uses a number of distributed facilities, including some abandoned fire stations to store or warehouse its supplies, equipment, and materials. A more efficient approach would be to have a central facility with better inventory control. The department should create an adequately staffed centralized warehouse near a current fire station, and close down the various scattered sites.

Administrative Offices and Prevention – Both fire department administration and the prevention division need additional space. The TFD headquarters building is fully utilized and out of space. Prevention is located in former Station 17, which was intended to be a short-term location. The prevention office should be located in or near an expanded fire headquarters facility. This would reduce travel times for inspectors and allow the chief of prevention to work more closely with the rest of the command staff. Improving prevention is one of the keys to keeping a lid on demand.

A Final Word

Overall, the City of Tacoma should be very proud of its fire department. The Tacoma Fire Department is a group of dedicated and committed individuals who genuinely care about the performance and abilities of the department. They have been doing an excellent job of deploying and operating the fire department. (This opinion is based on our comparative experience with over 100 departments nationally.) The recommendations here are intended to maintain the good performance going into the future. They should be a starting point for dialogue on the changes needed. Planning needs to be an annual process because of the rate of change taking place in the city's economic development and its impact on the City's infrastructure.

I. INTRODUCTION

The total call volume and distribution of demand in a growing city will continue to change**.** So does its geography. To be most cost effective, a fire department needs to periodically assess the location of its stations as well as the number and type of units in each station. The number of stations and the number of units in them dictates to a large extent the number of personnel and hence the majority of the cost of the fire department. So this planning is crucial for overall cost effectiveness.

The Tacoma Fire Department (TFD) has been well led by its fire chiefs over the past decade. The department is among the leading departments in the United States in taking an analytical view toward management and in using outside consultants periodically to get fresh ideas and third party perspectives.

The Port of Tacoma likewise has had excellent leadership and also has made use of a variety of expert consultants. They funded the Port-related chapter of this study.

In 2003, TriData, a division of System Planning Corporation of Arlington, VA was selected to review the location of current stations and facilities. This study is a follow-up to the 2002 Buracker and Associates audit of TFD that included station location recommendations. This report takes into account new issues and contemplates changes in the Port area that have emerged since the previous report was completed. TriData has undertaken over 100 studies of fire departments, including Seattle, Bellevue, and Everett. Last year TriData did what is considered a landmark study of the emergency preparedness of Seattle.

Looking at the City's population projections and future trends, recommendations are made in this study for improvements to the current fire protection system and facilities, including a specific chapter relative to changes in the Port area.

Study Scope

This study was directed toward some specific deployment and facility questions, and is not a general evaluation of the Fire Department. The study addressed two critical planning areas: first, the necessary number of fire stations, fire and EMS units, and their deployment; and second, the adequacy of various support facilities—the space needed to run the department.

Included in the scope was an assessment of the Browns Point-Dash Point (BP/DP) area north of NE Tacoma, and University Place southwest of the city to determine the potential for TFD to provide service to those areas.

Deployment – The present deployment of TFD units was examined and recommendations made to open, close or relocate stations or units in light of various potential scenarios. A major consideration was the impact of various changes to the bridges and road networks in the Port area. These are discussed in a separate chapter, in part so the information can be extracted for Port-related planning.

Support Facilities – The Fire Department needs adequate space for its various support facilities. The space issues that were considered included the following:

- Training Facility – capability for hands-on operations training and evolutions (the classroom space is new and considered satisfactory),
- Fire Communications
- Fire Garage – adequacy to support the department for maintenance of vehicles,
- Warehouses – storage of four types of supplies: garage supplies, station supplies, EMS supplies, uniforms, safety equipment and fire prevention supplies,
- Administrative Office (Fire HQ),
- Fire Prevention Bureau – adequacy of space, the need to combine with Fire HQ or near the building department and the need to be more centrally located.
- Fire Electrical Division

Time Horizon for Study – The study considered a 10-year planning horizon; the present situation (in 2003–2004), the situation in 2008, and the situation circa 2013–2014. To avoid being bureaucratic and excluding an important change that might take place around 2013, TFD and Port staff mutually agreed to consider changes planned for 2013–2014 as taking place in 2013 for the purposes of this study.

Methodology

The study was undertaken with close collaboration between the TriData project team and TFD staff. TriData recommended the desired data analyses, which were produced by TFD's senior technical analyst, and then interpreted by TriData.

On the initial visit, the TFD staff and TriData project team jointly triaged the issues. TriData became re-familiarized with the geography of the Port and the rest of the city. TriData met with the Port's Senior Director for Facilities Development and their engineering consultants, with planning staff from the City's Economic Development Department, and with TFD's Chief, Deputy Chief of Operations, Deputy Chief for Prevention, Education and Investigations, Assistant Chief for EMS, union president, and others.

Of great importance was the meeting with the senior technical analyst for TFD. TriData suggested a variety of initial GIS and trend analyses to undertake; much of this study consisted of analyzing the various special GIS analyses and data produced at TriData's request, and suggesting additional analyses to provide more insight. This approach also hopefully will help the City do further analyses on its own, and simultaneously reduce the cost of this study.

The Tacoma Fire Department has excellent fire data, information systems, and analysis capability—much better than most fire departments. Based on this, the project team has assumed generally that the data is accurate. As part of due diligence during the data analysis process, TriData questioned some data that did not have face validity, which led to additional review and some modifications while developing the final report.

For the deployment analysis, the goal was to recommend the best placement of stations and unit resources taking into account the existing system, available land, costs, etc. TriData attempted to recommend station and apparatus locations that will allow the Tacoma Fire Department to meet its response goals in the future, keeping in mind the practicality of and the costs associated with building new stations. (e.g., is it cost-effective to build a new station to serve a few hundred calls a year or to close a station that is only 20 years old and build a new station a mile away?) TriData also kept in mind, and urges readers to keep in mind, the fact that these changes cannot be made overnight.

About Tacoma

The City of Tacoma, incorporated in 1884, is governed by a City Council and City Manager. The city is located in the lower Puget Sound area, on Commencement Bay. Tacoma is the State of Washington's third largest city and the largest in Pierce County. A number of major highways, Seattle-Tacoma International Airport, a municipal airport, two major military installations, a public transportation system with regular bus service, a ferry service, and rail system serve the city and add to transportation-related risks of accidents and hazmat incidents.[2]

[2] "Discover the City of Destiny: Tacoma" brochure: http://www.cityoftacoma.org/21about/files/tacoma.pdf.

According to the 2000 census, the population is about 200,000. Approximately 99,600 people work in the city, with over 20,000 working in the downtown region.[3,4] The City of Tacoma is growing in diversity, with a 25 percent non-white population.[5] Various characteristics of the population affect demand for services, and some in surprisingly positive ways as will be discussed.

The Port of Tacoma is the sixth largest container port in North America.[6] It covers over 2,400 acres and ranks in the top 25 worldwide for container trade. Over 15 steamship lines, 2 railroad lines, over 20 airfreight companies, and hundreds of trucking companies utilize this major port.[7]

Containers have combustible wooden bottoms and a wide variety of contents. There is great concern nationally these days about hazards that may be inside containers, including weapons of mass destruction (WMD). The fire department has a growing role in homeland security. Being prepared for incidents involving containers must be a major concern and is an important aspect of risk management.[8]

The Tacoma Fire Department currently protects a population of approximately 214,000, the vast majority of which are in the Tacoma city limits and also includes Fife/District 10 and Fircrest in Pierce County. The total square miles protected is 60.6.

Outline of Report

After this introductory chapter, Chapter 2 discusses the current deployment and current response times. Chapter 3 discusses present and projected demands for fire department services. Chapter 4 discusses deployment issues involving the Port area. Chapter 5 discusses alternative deployments for the fire department as a whole, including a discussion of the potential service to University Place and the Browns Point/Dash Point area. Chapter 6 discusses adequacy of support facilities. Chapter 7 presents all of the recommendations together.

To assist the reader, a companion to the text is a separate book of analysis maps developed in the study and referenced in the text. The idea is to put the mapbook next to the report, for ease of reference while reading, and to avoid breaking up the continuity of the text with the maps.

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[3] "Discover the City of Destiny: Tacoma" brochure: http://www.cityoftacoma.org/21about/files/tacoma.pdf.
[4] United States Census 2000: American Fact Finder. http://www.census.gov
[5] Ibid.
[6] Port of Tacoma. "Facilities & Services Summary 2003-2004."
[7] "Discover the City of Destiny: Tacoma" brochure: http://www.cityoftacoma.org/21about/files/tacoma.pdf.
[8] In parallel with the present study but independent of it, System Planning Corporation, TriData's parent company, is doing a study for the Port of Seattle and Port of Tacoma regarding container security in the port.

II. CURRENT FIRE AND EMS OPERATIONS

This chapter looks at the current fire and EMS operations of the Tacoma Fire Department (TFD). It considers operations at the unit level, including response times.

The Tacoma Fire Department's mission statement states, "As a team of dedicated professionals, we serve the community needs while protecting people, property, and the environment." The deployment of units shows these are not mere words.

The department strives for a response time of six minutes for the first arriving engine company, truck company, and BLS provider. This response time goal includes an allowance of one minute for dispatching, one minute for turnout time (from dispatch to wheels moving), and four-minute drive time to the scene. The second arriving engine company is to arrive three to five minutes after the initial responder(s). For Advanced Life Support (ALS) calls, the goal is to get a paramedic-equipped medic unit to the scene within eight minutes, 80 percent of the time, including one minute each for call processing and turnout. Both of these response time goals are consistent with Pierce County Ambulance Rules and Regulations and/or generally accepted national industry standards.

As discussed later, there is very small difference in the response times for different types of calls (fire vs. EMS vs. other). This is a good sign that the fire personnel are treating all types of emergency calls with equal seriousness and do not lag in their turnout or driving for one versus another.[9] This positive characteristic is very telling about the overall operations of the Tacoma Fire Department and simplifies the analysis.

Another unusual aspect of current TFD operations is that the drive time goals are being met but the dispatch and turnout time goals are not—the opposite of many departments.

Unit Operations

The Tacoma Fire Department has 16 fire stations distributed throughout the City, including the Port area. In addition, there is Station 18 (fireboat moorage and

[9] Some cities, for example, Washington, D.C., take a longer time to respond to EMS calls than to fire calls because of the different levels of motivation among the firefighters for different types of calls.

maintenance) and the unstaffed Stations 5 and 12, which are used for other purposes. The distribution of the fire stations is shown in Map 1, along with their first-due areas.[10]

Table 3 shows the deployment of fire apparatus. There are 16 engine companies, 4 truck companies, 5 rescue units, 2 battalion chiefs, and a number of special units strategically located throughout the TFD service area. Engines and trucks are staffed with at least 3 firefighter/EMTs and ALS medic units with 2 firefighter/paramedics. Each Battalion Chief's (BC) car has two staff, the BC and a lieutenant who serves as Incident Safety Officer.

Table 3: Present TFD Units and Staffing

Station	Engine	Truck	Chief	Rescue	Other
1	E1	T1			
2	E2		182 (BC)		
3	E3 (ALS)				
4	E4			R4	
6	E6				SU 49 (17' Boston Whaler)
7	E7				
8	E8	T2		R2	SU 48 (Tech Rescue)
9	E9	T3	181 (BC)		
10	E10				
11	E11			R5	
12	E12	T4		R3	SU44 (Hazmat Unit)
13	E13				
14	E14				
15	E15				SU 45 (Water Tender)
16	E16			R1	
17	E17 (ALS)				SU 42 (Mobile Air Unit)
18					FBD (Fireboat Defiance) FBC (Fireboat Commencement)
Minimal Daily Staffing	48	12	4	10	Total 74

TFD actual staffing is estimated at 410 uniformed personnel and 32.33 civilians for a total of 442.33 FTE. The majority of the uniformed force is engaged in fire suppression and emergency medical service delivery. The operations personnel have 24-hour shifts. They work an average of 46.6 hours per week, utilizing a four shift or platoon system (A, B, C, and D).

[10] All of the maps used in this report are found in the Map Book.

The TFD's minimum daily staffing total is 74 firefighters. The department will use overtime to bring the number up to 74 if needed because of leave. When over the minimum of 74, TFD strategically places the individuals using a planned priority of placements by unit.

Engine and Truck Zones – Each TFD fire station has an engine assigned to it. Some stations (1, 8, 9, and 12) also house trucks. Each engine and truck (referred to as "units" throughout this report) is assigned a geographical zone in the TFD service area within which they provide primary emergency response coverage. When calls for assistance come in, the Computer Assisted Dispatch (CAD) system identifies engines and/or trucks available for dispatch based on TFD Standard Operating Procedures. The distribution of TFD stations and units are further discussed later in this report (Chapter 5, Station Location and Deployment). The current distribution of engines is shown in Map 2, along with the associated CAD Zone for each. The CAD zones for ladder trucks are shown in Map 3.

Water Tender Operations – The TFD has a single water tender. It is at Station 15 and cross-staffed by the crew of Engine 15. It has a 3000-gallon capacity and is dispatched upon request. The water tender is used on brush fires, locations where hydrants are scarce, and in some circumstances, to supplement hydrants. When it runs out of water, the water tender will shuttle between the emergency scene and a water supply to refill.

There is general agreement that the water tender is reasonably well-located at present. Ultimately, since it is the only water tender in the district, it needs to go everywhere it is needed. It would have a much greater rapid response range if the Hylebos Bridge were operational, allowing rapid response up to NE Tacoma (Station 3's area).

Battalion Chiefs (BCs)– The operations units of TFD are grouped into two battalions. Battalion Chief 181, North Battalion, is made up of 8 stations and 12 units (including two medic units). Battalion Chief 182, South Battalion, oversees 8 stations and 13 units (including three medic units). Each Battalion Chief has an Incident Safety Officer (ISO) assigned to him/her. Battalion Chiefs are senior Incident Commanders who respond to incidents involving three or more units. The ISOs are responsible for assessing the incident scene for safety and developing measures to ensure personnel safety at those scenes. BCs and their ISOs need to be able to get to most incidents within 8 minutes.

Most fire departments maintain a span of control of five or six stations for Battalion Chiefs; few go as high as 8. The more stations under their supervision, usually the further geographically they are spread – negatively impacting response times for incidents to which they are dispatched.

There reaches a point where proper Battalion Chief supervision cannot be done with large spans of control, and some things will be overlooked or work not completed.

If TFD added one Battalion Chief (BC), that would reduce the span of control to eight units for two of the BCs and nine units for the third. If two BCs were added, the span of control would be reduced to six units for three of the BCs and seven units for the fourth. Either way, the workload of the current BCs would be reduced to more manageable levels, which will be necessary in the near future with the projected increase in demand for service. (Demand projection is discussed in Chapter III.)

Recommendation 1: Add one additional Battalion Chief with an Incident Safety Officer now and a second in the next decade, as demand for service dictates. This will reduce the large span of control to more manageable levels, and also speed up getting BCs to incidents they need to command.

Reserve Apparatus – It is an NFPA guideline and generally accepted rule of thumb that a fire department should have a reserve capacity of 25 to 33 percent of the front line fleet. TFD is meeting this goal. Table 4 shows the number of reserve apparatus.

Table 4: TFD Reserve Apparatus

Vehicle Type	Front Line	Reserve	Percent (%)
Engines	16	4	25
Trucks	4	1	25
MedicUnits	5	4	80[11]

Recommendation 2: Continue to maintain a reserve capacity of at least 25 percent of the front line fleet. The number of days without available spares and the frequency of not being able to operate a unit due to lack of apparatus should be tracked. Those are the ultimate measures of the adequacy of the reserve fleet.

Response Complement – The rapidity with which an adequately sized complement of firefighters can be assembled at a working fire in a structure (e.g., a home, business or Port area facility) is one of the key aspects of fire protection. The rapidity of response is a function of the dispatching policy as to which vehicles are sent, the proximity of stations, the number of units per station, the number of firefighters per

[11] The percentage of reserve medic units is higher because medic units generally require more maintenance than engines and trucks due to their shorter life cycles. At any given time, 1 or 2 are in for repair or maintenance. In addition, at least one has to be ready to support special events (e.g., concerts at the Tacoma Dome). TFD practice is to

unit, and the closeness of reliable mutual aid from other jurisdictions, especially near the city's borders. The main criterion is how fast the total team needed for a given type of incident can be assembled at the scene, regardless of the number of vehicles they ride on. Some cities use fewer units with four-person staffing per unit.

In considering response complements and response times, it is important to consider NFPA standards whether or not they are adopted locally, because NFPA standards have become the "standard of care" for the industry. The NFPA standards are recommendations and guidelines developed by committees of chief officers, volunteer representatives, union officials, and industry representatives. They are not legally binding, and for staffing standards do not have adequate research to back them up. However, when litigation occurs, lawyers often turn to the applicable standard of care in determining their course of action. It is up to decision-makers in political jurisdictions to determine levels of acceptable risk and the degree of liability exposure they will tolerate.

The *NFPA Fire Protection Handbook*, 18th edition, "Table 10-2A, Typical Initial Attack Response Capability Assuming Interior Attack and Operations Response Capability," makes recommendations for the number of firefighters to be sent on first alarm to a fire, depending upon the type of occupancy (low-, medium-, and high-hazard occupancy). The recommendations were developed years ago for a typical non-sprinklered structure in each risk category, based on a detailed timeline of the typical tasks to be accomplished and the number of people needed for each. The NFPA staffing and unit recommendations for each type of hazard are noted below in italics as follows:

HIGH-HAZARD OCCUPANCIES *(e.g., schools, hospitals, nursing homes, explosive plants, refineries, high-rise buildings, and other high-risk or large fire potential occupancies):*

At least four pumpers, two ladder trucks (or combination apparatus with equivalent capabilities), two chief officers, and other specialized apparatus as may be needed to cope with the combustible involved; not fewer than 24 firefighters and two chief officers.

MEDIUM-HAZARD OCCUPANCIES *(e.g., apartments, offices, mercantile and industrial occupancies not normally requiring extensive rescue or firefighting forces):*

At least three pumpers, one ladder truck (or combination apparatus with equivalent capabilities), one chief officer, and other specialized apparatus as may be needed or available; not fewer than 16 firefighters and one chief officer.

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preserve its EMS response capability by putting additional reserve units into service for those events rather than taking regular medic units out of the field—a good idea.

***LOW-HAZARD OCCUPANCIES** (e.g., one-, two-, or three-family dwellings and scattered small businesses and industrial occupancies):*

At least two pumpers, one ladder truck (or combination apparatus with equivalent capabilities), one chief officer, and other specialized apparatus as may be needed or available, not fewer than 12 firefighters and one chief officer.

The above NFPA recommendations were developed before the development of the OSHA-required "Two-in, Two-out" rule. They also pre-date the use of a Personnel Accountability System and Incident Safety Officer (ISO) to track the whereabouts and welfare of incident scene personnel and the deployment of a Rapid Intervention Team (RIT), which provides the capability to immediately start rescue of a lost or trapped firefighter. All of these practices are considered necessary for firefighter safety. So, to these staffing recommendations should be added an Incident Safety Officer and another company to serve the RIT function in a working fire. These guidelines do not vary by whether a property was sprinklered because they do not count on sprinklers operating.

The TFD response complement for a residential fire is four engines, one truck, one medic unit, and two BCs and their accompanying ISOs, for a total of 21, including 17 firefighters. This more than meets the NFPA criteria, including enough for a RIT function.

The standard TFD response complement for a commercial structure fire (likely to be a medium or high hazard occupancy by NFPA definition) is one more truck than for a residential fire, for a total of 24, including 20 firefighters. This meets the NFPA guidelines for medium-hazard occupancy plus enough for a RIT team. For high-hazard occupancy fires, additional units are sent as required.

Actual structure fires (vs. alarms with no fire) are low and stable. TFD must continue to be able to protect the majority of the city while responding to a house fire. Fortunately, the most common calls are EMS, for which only one or two units need to be sent.

Engine and Truck Staffing – TFD engines and trucks are each staffed by three members, one of whom is a vehicle operator. City fire departments in the U.S. usually use three or four members per unit, with some as few as two, and others (mostly very large cities) with as many as five.

NFPA Standard 1500, Fire Department Occupational Safety and Health Program says that "…a minimum acceptable fire company staffing level should be four members responding or arriving with each engine and each ladder company responding to any type of fire." The new and controversial NFPA Standard 1710, Standard for the Organization and Deployment of Fire Suppression, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, also suggests that fire suppression companies be staffed with a minimum of four members. The key requirements include ensuring rapid response, safety of firefighters, and an adequate total suppression response, not just the number of firefighters per unit.

Also critical in risk management is the intensity of the prevention program; loss per capita is the product of the number of incidents and the loss per incident. Firefighter and civilian safety are as much, if not more, affected by the intensity of the prevention program than the size of the suppression force or number of firefighters per unit.

There is little statistical data on the cost-benefits of the four-person staffing standard. It is clear that four-person staffing is more efficient and effective on the fire ground than three-person staffing for non-trivial fires. One four-person unit can do as much work in many situations as two three-person units because it can be split into two interior two-person teams, whereas a three-person unit should not be divided, for safety reasons. It also can be difficult for an officer to supervise personnel if he or she is actively involved in suppression operations, as is often the case when a unit is staffed with three personnel. One firefighter of a three-person unit is left to operate the vehicle, leaving one firefighter and officer to be a two-person team, vs. having the officer available to supervise a two-person team with four-person staffing.

Another reason to consider four-person staffing is the "Two-In/Two-Out" rule imposed by the Occupational Safety and Health Administration (OSHA). It requires that at least four firefighters be present to start interior fire operations unless there is a confirmed life hazard in the burning structure. Interior operations are not supposed to start until a two-person rescue team is available outside of the structure to go to the aid of the two firefighters inside. Having four personnel on the first arriving unit makes it possible to start interior operations immediately upon arrival; a three-person unit has to wait for a second unit to arrive unless there is known to be a life in immediate danger. Fires tend to grow in size exponentially with time. The longer you wait, the larger the fire, and the more resources needed to control it.

Recommendation 3: Compare the amount of time it takes for initial units to arrive on the scene of a working fire vs. the amount of time it takes for four firefighters on one unit to arrive to satisfy the "Two-in, Two-out" rule. If the amount of time it takes to get a first arriving unit on the scene is significantly lower than the amount of time it takes to get a complement large enough to safely start work on the fire (about 2-3 minutes), then changes to either the staffing of units (e.g. four-person staffing per unit) or relocation of stations should be considered. The higher staffing might be needed first where an engine is based alone (no truck or medic unit to respond together) and makes a significant number of structure fire responses.[12]

EMS Operations

The Tacoma Fire Department provides many forms of emergency medical service. All firefighters and officers through the rank of Captain are required to be certified at least to the EMT basic level. All engine and truck companies provide EMS first response for their respective zones. Two engine companies have a certified paramedic on board (Engines 3 and 17), and are referred to as paramedic engines. They speed ALS response to areas where medic units are more distant. As additional certified paramedics are available, TFD plans to convert more engine companies to paramedic engines, a good trend to further improve ALS for the citizens.

Along with the two paramedic engines, there are the five medic units that provide Advanced Life Support (ALS) services along with transport. Stations 4, 8, 11, 12, and 16 are home to these medic units. When a call comes into the communications center for emergency medical services, the dispatcher sends the closest engine or truck company. If, based on standard EMS protocols it is determined that ALS care also is needed, the closest medic unit will be dispatched.

Map 4 shows the CAD zones for the medic units. Map 5 is an overlay of the 6-minute drive time for all ALS units—both engine and rescues. The vast majority of the city is within range; only a small area in the northwestern area is not.

Private ambulance companies provide Basic Life Support (BLS) transport. TFD is currently involved in an RFP process to select a single BLS transport provider for its service area.

Additionally, all TFD units except Battalion Chief (BC) vehicles are equipped with Automatic Electronic Defibrillators (AEDs). It would be preferable for the Battalion Chiefs to have AEDs also.

Overall, TFD is well deployed to fulfill its EMS responsibilities.

Recommendation 4: Automatic Electronic Defibrillators should be placed on the Battalion Chiefs' vehicles. This is a small extension of the already widespread use of AEDs by TFD.

[12] Everett, WA, which also has used 3-person staffing with success, is an example of a city that computes the "Two-in, Two-out" response time.

Response Times

Response times are perhaps the most important of the commonly used indicators of emergency service system performance because of their relative ease of measurement and understandability. For the general public, the clock for response time starts when the calling party dials 911 and stops when the first emergency provider arrives at their side or at the scene of the emergency. In the fire service, total response time is usually measured from the time a call is received by the emergency communications center to the arrival of the first field unit at the scene. It is clear that faster is better: the longer it takes to get to a fire, the larger it may grow and the more dangerous to people and property. The longer it takes to get to a medical emergency such as a heart attack, the worse it may get.

Additional time may need to be accounted for if there is considerable "vertical" response time, such as in a high rise. In the Port area, for example, this might be the time needed to get onto a ship, or into the center of a large container storage facility. To measure this time, one would need to keep the response time clock running until the rescuer is at the fire or victim's bedside, or wherever in a structure the emergency exists.

The response time goals of the Tacoma Fire Department are as follows:

- Achieve an average emergency response time of 6 minutes for all the first-in unit types of calls. This is comprised of 1-minute dispatch, 1-minute turnout, and 4-minute drive time.
- For ALS calls, the goal is to get an ALS transport unit to the scene within 8 minutes 80 percent of the time. (That is required by Pierce County Ambulance Rules and Regulations.)

Several caveats need to be kept in mind with respect to response times. First, they are subject to a variety of measurement errors. For example, response time measurement is subject to error when units report their arrival on scene prematurely or belatedly, or the reported times are not recorded immediately. Second, response times are frequently not comparable across emergency service systems because of variations in how they are collected and calculated. Third, they measure only one aspect of system performance. Fourth, whether a call response district is urban, suburban, or rural also plays a part in setting goals.

Various agencies have attempted to set and standardize response time goals. The medical community suggests that electrical defibrillation should occur within eight minutes of cardiac arrest for a positive patient outcome to be possible. Fire theorists have tried to determine the point of flashover and use a time-temperature curve to push national response time standards. Modern building construction drives the need for quicker total response times due to the potential for sudden structure collapse after limited fire and heat impingement. Private organizations, such as insurance companies and the National Fire Protection Association, IAFF, IAFC, and others have influenced the discussion of response times through their own points of view.

Response times should be evaluated in terms of their components: dispatch, turnout time, drive time, and "vertical" response time, as illustrated in Figure 1 which follows on the next page.

Dispatch Time – Dispatch time is the time it takes to ascertain the location and type of incident from the caller and then dispatch selected emergency service providers to respond. The Commission on Fire Accreditation International's "Fire and Emergency Service Self-Assessment Manual" recommends that dispatch time take no more than 50 seconds. 50 to 60 seconds is widely used as the standard for dispatch.

As shown in Table 5, the average dispatch time for all calls in Tacoma in 2003 was 1.92 minutes. For fires it was 1.59 minutes and for EMS 1.76 minutes.

Table 5: Dispatch Times – From Receipt of 911 Call to First Unit Dispatched in minutes

Initial Type	1999	2000	2001	2002	2003
EMS	1.78	1.65	1.58	1.69	1.76
Automatic Alarm	2.08	2.09	1.89	1.89	1.89
Fire	1.77	1.54	1.48	1.69	1.59
Hazardous Condition	2.00	1.87	1.94	1.96	1.86
Hazmat	2.56	2.16	2.98	3.33	3.17
Investigate Only	2.21	2.17	2.27	2.11	2.12
Search/Rescue	2.01	2.72	1.62	1.54	1.38
Annual Average	1.82	1.69	1.63	1.73	1.92

Figure 1: Components of Total Response Time

Total Response Time			
			Unit arrives at patient, fire floor, etc.
Citizen calls 911.	**Unit dispatched.**	**Unit leaves station and drives to scene.**	**Unit arrives at scene.**
Call processing and dispatch: Generally, should not exceed 50-60 seconds.	***Turnout time:*** Time it takes for crew to don gear, board apparatus. Begins at the end of dispatch (when call is received in the fire station) to the time unit leaves the station. Generally, should not exceed 1-1.5 minutes.	***Drive Time:*** Time for unit to drive from fire station to curb side of the incident's address. Dependent on traffic, weather, etc.	***"Vertical" response time:*** Time for crew to dismount, assemble equipment, and reach the patient or fire floor. Can be significant in high-rises or large structures, and structures with large setbacks from the curb.

Overall, only 25.4 percent of calls in 2003 were dispatched in one minute or less. In other words, the percentage of calls dispatched in more than one minute was 75 percent, so the majority of calls are being affected by the slow dispatch process.

The dispatch times are much higher than desirable, by almost a full minute. The emergency medical community estimates that each additional minute of delay reduces chances of surviving a critical injury and illness by 7–10 percent.

There are probably several factors that contributed to TFD's slower than desired dispatch time:

- The dispatchers did not have adequate training, and were not aware that their dispatch time was high.
- There was inadequate dispatcher supervisory time.
- Too much time was spent getting details on the incident before sending a dispatch. Once the nature of a call is determined, some unit(s) should be dispatched even before getting all the details. The call-taker can continue to get relevant information from a caller after the initial units are dispatched and pass on that information to the responding units.

This dispatch time problem was brought to the attention of TFD management in the middle of the study, and TFD has since taken several actions to address the problem:

- The number of dispatchers has been increased from two to three on-duty, which allows two to handle most calls. The dispatcher can get units started while the call-takers continue to collect information.
- The dispatchers have been given additional training, and are now in the process of becoming certified as Emergency Medical Dispatchers (EMDs). They now are giving pre-arrival instructions to emergency callers.
- The supervision of this function has increased to include a supervisor and overall dispatch center manager.

These are all excellent steps that should reduce the dispatch time considerably.

Recommendation 5: Monitor the new dispatch procedures and staffing to determine if dispatch times have been reduced. If not, determine why and take further corrective actions. Reducing travel time is much more difficult and expensive than reducing dispatch time.

Turnout Time – Turnout time is measured from the time the alarm is received in the station to the time the apparatus begins its actual driving response to the incident scene. Turnout time should not exceed, on average, more than 60 seconds, but is subject to variability based on time of day and station design. The Commission on Fire Accreditation International (CFAI) uses a 60-second benchmark for turnout time for staffed fire stations. NFPA Standard 1710, section 4.1.2.1.1, also outlines a 60-second turnout time.

Table 6 shows Tacoma's average turnout times from 1999–2003 and the percentage of calls for which turnout time was less than one minute. For 2003, the average turnout time was 1.45 minutes, almost half a minute above the goal. Turnout was under one minute for only 37 percent of calls. Tacoma's average crew size of three should give it an edge in turnout time over a crew of four (less chance of a straggler), but that does not appear to be the result.

Table 6: Average Turnout Times

	1999	2000	2001	2002	2003
Annual Average (in minutes)	1.44	1.42	1.44	1.43	1.45
Percent in one minute or less	39.1	39.6	40.7	39.5	36.9

The turnout times have been quite stable over recent years. As with dispatch time, turnout time is relatively inexpensive to modify and can significantly improve overall response times. Turnout can be expected to be higher in the evening than daytime, and higher in some stations where living quarters are further from vehicles than in others. Future station design should consider any particular stations with poor layout that potentially impacts turnout time.

As was the case for dispatch times, when the higher than desired turnout times were identified during the middle of the study, several actions were taken by TFD management. Battalion Chiefs were informed about the overall goals and the general problem. The stations or shifts where there were particularly high turnout times were informed and are being monitored.

Recommendation 6: Monitor improvement in turnout times in 2004. If they still consistently exceed one minute, explore the reasons and strategies to reduce them. Some units have much higher turnout times than others. Sometimes one shift is higher than another. By reducing both dispatch and turnout times, TFD can improve response times by over one minute, a substantial improvement that will allow the department to meet its overall response time goals.

Drive Time – Drive time is the time it takes for units to drive from the fire station (or other location from which personnel are responding) to curbside at the address of the incident. In Tacoma, narrow old streets in combination with the current practice of allowing 28-foot residential street width with parking on both sides has the negative impact of slowing emergency vehicles (and thus overall response time) as well as increasing accident risk. The major strategies to decrease drive time are to construct new fire stations, move existing stations, or use system status management to dynamically relocate units by time of day and day of week. Drive times also can be reduced by controlling traffic lights (e.g., Opticom system). Adding stations is expensive, so other strategies are usually considered first.

Table 7 shows drive times for first-in units by engine zone. These are the times for the first arriving unit to drive to a call in each engine zone, whether the first arriving unit was from that zone or from another. In other words, the response time for Engine Zone 1 is the average of time for Engine 1 or whatever other units were first to arrive at calls in Engine 1's initial response zone. The table shows that the overall drive time goal is being met citywide—in 2003 it was 3.65 minutes vs. the goal of 4.0 minutes. This is excellent city-wide performance.

As can be seen in the table, there is considerable variation in drive time from area to area. The highest average response time is 5.58 minutes in Engine 3's area (NE Tacoma). This area has many hills and narrow winding roads, making it difficult to drive fast safely. Any calls that require response into Engine 3's area by another unit would take several extra minutes, even worse with the Hylebos Bridge inoperable. That has led to TFD's current practice of immediately sending a standby unit to Engine Zone 3 whenever Engine 3 is on a call, at training, or away from its zone for any reason.

Another rather remarkable aspect of the TFD drive time statistics is that not only is TFD meeting its 4-minute drive time goal overall, but it is meeting it in every area of the city but four—Engine 3 (NE Tacoma), Engine 6, Engine 10, and Engine 14.

In the downtown areas with the highest call volume, Engines 1 and 2, the 2003 drive time averages are under 3 minutes.

In the Port area, Engine 6's 2003 drive time average was slightly above the desired target (4.35 minutes) and Engine 15 average drive times were well below at 3.07 minutes.

Table 7: Drive Times by CAD Engine Zone
(First Unit Enroute Status to Unit Onscene Status)

Eng Zone	1996	1997	1998	1999	2000	2001	2002	2003	Avg for Zone
E01	2.48	2.45	2.31	2.21	2.28	2.35	2.22	2.30	2.32
E02	3.04	2.86	2.84	2.60	2.81	3.02	3.17	2.94	2.91
E03	5.17	5.21	4.57	6.10	5.02	5.69	5.17	5.58	5.31
E04	2.87	2.84	2.66	2.63	2.52	2.80	2.76	2.90	2.75
E06	4.19	4.71	5.87	4.96	4.37	4.32	2.94	4.35	4.47
E07	3.72	3.46	3.53	3.46	3.59	3.57	3.56	3.78	3.58
E08	3.30	3.35	3.14	3.18	3.26	3.34	3.47	3.55	3.33
E09	3.11	2.94	2.83	3.03	2.86	3.26	2.80	2.93	2.97
E10	4.27	3.98	4.01	4.19	3.96	4.21	4.17	4.53	4.16
E11	3.94	3.97	3.76	3.59	3.60	3.63	3.46	3.47	3.68
E12	4.24	3.75	3.97	4.02	3.92	3.96	3.64	3.74	3.91
E13	3.59	3.61	3.38	3.34	3.14	3.50	3.74	3.54	3.48
E14	4.17	4.48	4.61	4.19	4.13	4.41	4.26	4.45	4.34
E15	4.05	3.14	3.00	3.33	3.02	3.04	3.50	3.07	3.27
E16	3.93	3.76	3.79	3.86	3.54	3.46	3.47	3.57	3.67
E17	4.07	4.01	3.98	3.86	3.84	3.87	3.81	3.68	3.89
Annual Avg	3.76	3.66	3.64	3.66	3.49	3.65	3.51	3.65	3.63

Table 8 presents the drive time data in terms of percentages. In 2003, 68 percent of calls were reached in less than 4 minutes. It is desirable to have a percentage closer to 90 percent, as it is in Engine 1's zone. The data shows that, while about a quarter of drive times are above 4 minutes; they are not so much higher than the goal as to raise the overall average above 4 minutes.

The trend in average drive time over the last eight years has been relatively flat. In addition, the difference between drive times for daytime hours (0800–2000) and nighttime hours (2000-0800) is not great: the average is 3.59 minutes in daytime and 3.65 at night. Overall, this is a quite healthy picture of the drive time component of overall emergency response. It speaks to good fire suppression management and relatively well-distributed stations—not excessive and just enough to meet the target.

Table 8: Percent On Scene within 4 minutes or less by CAD Engine Zone (First Unit En Route Status to Unit On Scene Status)

Eng Zone	1996	1997	1998	1999	2000	2001	2002	2003	Percent by Zone
E01	90.6%	92.1%	93.6%	93.3%	92.7%	91.9%	92.4%	92.1%	92.3%
E02	85.2%	85.1%	86.7%	86.3%	88.0%	85.7%	82.1%	84.3%	85.4%
E03	42.0%	47.3%	44.3%	39.2%	43.3%	47.6%	43.5%	42.4%	43.7%
E04	86.0%	89.0%	90.6%	91.5%	91.6%	88.2%	87.9%	87.0%	89.0%
E06	55.9%	50.4%	57.1%	49.0%	53.8%	54.8%	78.1%	38.1%	54.7%
E07	66.3%	70.7%	68.9%	69.3%	68.9%	68.9%	68.1%	65.3%	68.3%
E08	81.0%	78.8%	81.0%	77.7%	79.7%	74.3%	77.3%	75.3%	78.1%
E09	83.2%	86.4%	88.0%	82.0%	84.7%	82.4%	84.0%	84.7%	84.4%
E10	51.4%	57.1%	60.5%	57.0%	57.8%	53.7%	51.4%	46.9%	54.5%
E11	64.7%	62.6%	65.6%	67.4%	68.2%	69.0%	68.5%	68.6%	66.8%
E12	68.8%	69.9%	70.5%	68.5%	71.1%	67.0%	70.6%	70.4%	69.6%
E13	72.9%	74.1%	78.2%	76.3%	81.5%	77.5%	72.8%	73.2%	75.8%
E14	51.7%	46.5%	44.4%	49.7%	50.3%	48.8%	49.5%	46.1%	48.4%
E15	71.7%	81.9%	81.8%	73.6%	84.7%	75.6%	70.1%	74.4%	76.7%
E16	69.4%	71.9%	65.9%	69.5%	69.9%	73.9%	73.5%	70.9%	70.6%
E17	63.5%	66.6%	70.3%	67.2%	65.3%	64.6%	65.3%	68.3%	66.4%
Annual %	69.0%	70.6%	71.7%	69.8%	72.0%	70.2%	70.9%	68.0%	70.3%

This study also looked at the percent of time that a unit other than the scheduled initial responding unit arrived first to a call. For example, in Engine 1's zone, how often did another unit respond first in their zone? As a unit gets busier with increased demand, other units need to cover for it more often, and response times increase. Table 9 shows that E3 had the highest percentage of calls answered in its zone by another company. The primary reason is that E3 is relatively isolated with the Hylebos Bridge inoperable and the TFD policy is to move another unit to Station 3 whenever Engine 3 is out on a call, at training, or otherwise not available. When that outside unit responds from Station 3, it registers as an outside unit responding. E6, E7, and E8 also had relatively high percentage of responses to their areas from outside their zone; that may explain why E6 had one of the higher average response time zones. The out-of-zone effect on E7 and E8 response times was less.

Table 10 shows drive times by type of call and engine zone of first response. The difference in drive times between the fire and EMS responses are small, which is as they should be in a well-managed, well-motivated group of firefighters. Automatic alarms were responded to with equal diligence, even though most prove to be false alarms.

Table 9: Percent of Calls for which a Non-zone Unit was First in the Zone (2003)

Engine Zone	Percentage (%)
E1	18
E2	26
E3	52
E4	25
E6	38
E7	41
E8	51
E9	24
E10	24
E11	39
E12	12
E13	13
E14	13
E15	12
E16	14
E17	21

Table 10: First Unit Drive Time by Engine Zone and Initial Incident Type

Engine Zone	Initial Type	2000	2001	2002	2003
E01 Zone	EMS Patient	2.13	2.20	2.11	2.17
	Automatic Alarm	2.26	2.30	2.24	2.29
	Fire	2.06	2.55	3.04	2.45
	Hazardous Condition	2.45	2.34	2.62	2.66
	Hazmat	1.58	2.47	1.84	
	Investigate Only	2.89	3.02	3.33	3.22
	Search and/or Rescue	1.51	1.57	3.61	1.71
E01 Zone Avg		**2.28**	**2.35**	**2.22**	**2.30**
E02 Zone	EMS Patient	2.69	2.78	2.93	2.88
	Automatic Alarm	2.26	2.78	2.79	2.69
	Fire	3.22	3.59	2.99	3.23
	Hazardous Condition	3.43	3.05	3.11	3.28
	Hazmat	2.79		3.26	
	Investigate Only	2.83	3.25	4.94	3.48

Engine Zone	Initial Type	2000	2001	2002	2003
	Search and/or Rescue		3.18		
E02 Zone Avg		**2.81**	**3.02**	**3.17**	**2.94**
E03 Zone	EMS Patient	4.91	4.87	4.58	4.79
	Automatic Alarm	5.06	3.77	4.46	4.44
	Fire	5.01	4.30	4.65	5.82
	Hazardous Condition	4.95	5.63	6.18	6.27
	Hazmat	4.01	3.59		
	Investigate Only	5.49	5.73	6.43	6.55
E03 Zone Avg		**5.02**	**5.69**	**5.17**	**5.58**
E04 Zone	EMS Patient	2.35	2.60	2.65	2.71
	Automatic Alarm	2.44	2.63	2.47	2.62
	Fire	2.68	2.64	2.71	2.73
	Hazardous Condition	2.63	2.77	3.38	2.84
	Hazmat	3.12	1.45		5.05
	Investigate Only	3.11	3.85	3.94	3.67
	Search and/or Rescue		3.28		0.97
E04 Zone Avg		**2.52**	**2.80**	**2.76**	**2.90**
E06 Zone	EMS Patient	4.11	4.31	2.67	4.75
	Automatic Alarm	3.75	4.40	3.45	
	Fire	4.11	3.39	3.10	3.37
	Hazardous Condition	5.87	6.48	2.91	
	Hazmat	5.18	2.05		
	Investigate Only			4.00	
	Search and/or Rescue				
E06 Zone Avg		**4.37**	**4.32**	**2.94**	**4.35**
E07 Zone	EMS Patient	3.50	3.52	3.47	3.65
	Automatic Alarm	3.74	3.70	3.34	4.14
	Fire	3.92	3.51	4.10	4.02
	Hazardous Condition	3.25	3.16	3.58	3.53
	Hazmat			6.12	2.98
	Investigate Only	4.99	4.29	5.70	4.93
E07 Zone Avg		**3.59**	**3.57**	**3.56**	**3.78**
E08 Zone	EMS Patient	3.12	3.26	3.29	3.27
	Automatic Alarm	2.62	2.71	3.96	3.16
	Fire	3.41	3.50	2.93	3.88
	Hazardous Condition	3.72	3.23	3.53	3.43

Engine Zone	Initial Type	2000	2001	2002	2003
	Hazmat	2.59		4.83	
	Investigate Only	4.18	5.11	4.84	4.45
	Search and/or Rescue		4.44	3.27	
E08 Zone Avg		**3.26**	**3.34**	**3.47**	**3.55**
E09 Zone	EMS Patient	2.88	3.04	2.77	2.87
	Automatic Alarm	2.79	3.25	3.03	2.69
	Fire	2.68	3.19	3.29	3.26
	Hazardous Condition	3.24	3.90	3.11	3.24
	Hazmat	2.03			
	Investigate Only	3.78	4.34	4.55	5.04
	Search and/or Rescue				3.43
E09 Zone Avg		**2.86**	**3.26**	**2.80**	**2.93**
E10 Zone	EMS Patient	3.90	4.11	4.13	4.34
	Automatic Alarm	4.48	3.92	4.66	4.09
	Fire	4.26	4.18	4.06	4.79
	Hazardous Condition	4.15	4.23	4.02	4.03
	Hazmat	4.36	4.51		3.42
	Investigate Only	5.45	5.21	5.00	5.52
	Search and/or Rescue	4.44			
E10 Zone Avg		**3.96**	**4.21**	**4.17**	**4.53**
E11 Zone	EMS Patient	3.52	3.48	3.50	3.42
	Automatic Alarm	2.71	3.74	3.74	3.50
	Fire	3.66	3.72	3.47	4.04
	Hazardous Condition	4.14	3.41	3.98	4.28
	Hazmat	5.95			
	Investigate Only	4.43	4.33	4.68	4.58
E11 Zone Avg		**3.60**	**3.63**	**3.46**	**3.47**
E12 Zone	EMS Patient	3.54	3.62	3.37	3.41
	Automatic Alarm	3.04	3.71	3.73	3.38
	Fire	3.88	3.81	4.20	3.94
	Hazardous Condition	2.45	2.84	5.42	2.36
	Hazmat	4.00	2.73		
	Investigate Only	5.44	6.11	4.55	5.53
	Search and/or Rescue			3.60	
E12 Zone Avg		**3.92**	**3.96**	**3.64**	**3.74**
E13 Zone	EMS Patient	2.99	3.15	3.39	3.35

Engine Zone	Initial Type	2000	2001	2002	2003
	Automatic Alarm	2.23	3.07	3.33	3.03
	Fire	2.71	2.92	3.69	3.11
	Hazardous Condition	2.93	3.29	2.76	3.35
	Hazmat	4.08			
	Investigate Only	3.72	4.57	4.03	5.07
	Search and/or Rescue	2.93			
E13 Zone Avg		**3.14**	**3.50**	**3.74**	**3.54**
E14 Zone	EMS Patient	3.96	4.08	4.12	4.30
	Automatic Alarm	4.28	4.37	3.75	4.06
	Fire	3.24	4.00	4.32	4.33
	Hazardous Condition	4.60	5.44	4.00	2.11
	Hazmat	2.15	3.53		
	Investigate Only	5.46	4.91	4.24	4.81
E14 Zone Avg		**4.13**	**4.41**	**4.26**	**4.45**
E15 Zone	EMS Patient	3.03	3.57	3.72	3.29
	Automatic Alarm	2.08	3.19	2.85	3.79
	Fire	4.21	4.19	4.03	
	Hazardous Condition		4.87	6.75	4.65
	Hazmat				2.97
	Investigate Only	4.74			
E15 Zone Avg		**3.02**	**3.04**	**3.50**	**3.07**
E16 Zone	EMS Patient	3.43	3.33	3.31	3.44
	Automatic Alarm	3.48	3.56	3.33	3.04
	Fire	4.07	3.66	3.95	3.90
	Hazardous Condition	3.15	3.24	3.71	5.25
	Hazmat	5.04			
	Investigate Only	4.74	5.68	4.89	5.02
E16 Zone Avg		**3.54**	**3.46**	**3.47**	**3.57**
E17 Zone	EMS Patient	3.66	3.68	3.69	3.64
	Automatic Alarm	3.57	3.22	3.50	3.49
	Fire	3.88	3.50	3.78	3.59
	Hazardous Condition	3.86	4.03	4.31	3.01
	Hazmat	3.99	3.35		
	Investigate Only	4.76	5.29	5.15	5.20
	Search and/or Rescue				
E17 Zone Avg		**3.84**	**3.87**	**3.81**	**3.68**

Average Drive Times by Unit – The previous sections discussed drive times of first-in units for the whole city and each response zone. This section looks at average drive time by unit.

Table 11 shows the average drive time for each unit. The average drive time in 2003 for all units—engine, truck, and medic was 4.23 minutes. Most of the truck units and medic units had higher response times than the engines, as would be expected, because there are many more engines than either of the other types of units, and truck and rescue first-due response areas tend to be larger. Nevertheless, the average drive time for all types of units is quite good.

Table 11: Unit Response Times: Unit Enroute to Onscene Average Drive Time by Unit/Year[13]

Unit	1996	1997	1998	1999	2000	2001	2002	2003	Unit Avg.
E01	3.64	3.95	3.24	3.49	3.33	2.43	2.64	2.98	3.20
E02	3.86	4.29	3.84	3.76	3.66	3.55	3.79	3.79	3.81
E03	4.73	4.86	5.73	6.14	4.57	4.82	5.11	5.23	5.14
E04	3.27	3.67	3.37	3.69	3.49	2.81	3.04	2.28	3.26
E06	4.65	4.38	5.23	4.03	4.14	4.07	3.79	4.48	4.41
E07	3.92	4.00	3.88	4.15	4.24	3.85	3.80	4.07	3.99
E08	4.28	4.17	3.94	4.22	4.87	3.92	4.18	4.24	4.23
E09	3.61	3.88	3.94	3.74	3.67	3.93	3.73	3.37	3.74
E10	4.25	4.26	3.95	4.90	4.35	3.86	4.36	4.02	4.25
E11	4.04	4.03	4.75	4.03	4.28	3.56	3.74	3.75	4.02
E12	4.45	5.67	5.94	5.30	5.14	5.27	5.42	3.89	5.15
E13	3.65	3.72	4.40	4.16	3.93	3.95	4.02	4.10	4.00
E14	4.13	4.15	4.54	4.43	4.46	4.11	3.96	3.92	4.22
E15	5.60	4.38	5.06	5.20	5.24	3.85	4.53	6.25	5.05
E16	3.58	3.72	3.95	3.97	3.99	3.56	3.50	4.08	3.80
E17	4.62	4.37	5.35	4.63	4.50	4.47	4.45	4.20	4.58
RU1	4.65	5.01	5.02	4.79	5.55	5.05	5.51	4.57	5.03
RU2	4.82	4.89	5.21	5.10	4.96	4.81	4.91	4.33	4.88
RU3	6.77	7.25	6.82	6.04	6.76	7.25	6.68	6.59	6.78
RU4	4.76	3.92	3.48	4.28	5.20	5.06	4.17	3.72	4.33
RU5	Rescue 5 came into service July 1, 2003.							4.60	4.29
T01	3.62	4.23	3.76	3.87	4.48	3.12	3.09	3.03	3.63
T02	4.28	4.88	5.26	5.22	5.45	5.35	5.04	5.68	5.14
T03	5.43	4.78	5.50	4.92	5.00	4.85	4.79	5.20	5.06
T04	5.92	5.94	6.33	8.30	6.07	7.12	6.24	4.91	6.42
Avg.	4.37	4.46	4.61	4.66	4.55	4.29	4.24	4.23	4.43

[13] Unit response statistics are for all unit responses, not just first unit on scene.

These drive times are the average for all calls to which a unit responds– those for which it is second or third to arrive, as well as first to arrive. The average drive time time and the percent of drive times under 4 minutes (not shown) have been quite stable over the past eight years, which is long enough to show a clear and relevant trend.

Full Response Time – The response time discussion above has been about each component of the full response time: dispatch time, turnout time, and travel time.

Table 12 shows the average full response times including all three components.[14] Table 13 shows the percent of calls with full response time of the first arriving unit within 6 minutes.[15]

The overall average response time for 2003 was 6.33 minutes across all types of calls. For ALS specifically, the average overall response time was 5.89 minutes. The overall average is about a half minute higher than the goal of 6 minutes. If dispatch time and turnout time can each be reduced by as little as 15 seconds, then TFD's overall response time goal would be achieved.

Table 12: Incident Full Response (Call Received to First Unit On Scene)
Average Full Response Time

Initial Type	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Avg for Type*
EMS Patient	5.92	5.83	5.86	5.88	5.73	5.86	6.00	6.19	**5.90**
ALS	5.65	5.67	5.64	5.64	5.54	5.59	5.71	5.89	**5.66**
BLS	6.22	6.21	6.13	6.29	5.99	6.23	6.38	6.60	**6.14**
Automatic Alarm	5.69	5.35	5.24	5.14	5.15	6.05	6.15	6.25	**5.61**
Fire	5.98	5.81	5.75	5.85	5.81	6.06	6.32	6.67	**5.99**
Hazardous Condition	8.20	6.94	6.51	6.39	6.69	6.93	7.24	7.01	**6.99**
Hazmat	8.70	8.24	9.34	8.25	7.54	8.09	9.33	8.77	**8.28**
Investigate Only	7.50	7.20	7.58	7.61	7.25	7.81	7.95	8.23	**7.62**
Search and/or Rescue	12.65	8.32	5.50	7.32	7.27	5.03	6.72	4.97	**6.70**
Annual Average	**6.04**	**5.90**	**5.93**	**5.96**	**5.80**	**5.99**	**6.13**	**6.33**	**6.00**

[14] As a technical side note, the means (averages) of the component response times are not additive. That is, the sum of the means of the components is not necessarily the mean of the total response time because the components are not independent random variables.
[15] This form of response time measurement is called a "fractile" response time, because it is stated in terms of the fraction of calls responded to within a specified time. A fractile response time standard specifically acknowledges that there will be some response time outliers in even the best-performing EMS systems – 10 percent of calls can have response times greater than eight minutes and the system can still meet the standard. The standard specifically does not use average response time as its measurement because arithmetic averages can be distorted by a relatively small number of anomalies.

**Table 13: Incident Full Response (Call Received to First Unit On Scene)
Percent Full Response Time 6 min. or less**

Initial Type	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Per by Type*
EMS Patient	61.2%	62.4%	61.8%	61.1%	63.4%	61.5%	58.6%	54.5%	**60.7%**
ALS	64.7%	65.0%	64.9%	65.4%	66.6%	66.0%	63.7%	59.5%	**64.6%**
BLS	58.6%	59.8%	59.2%	57.3%	60.2%	57.4%	53.9%	49.5%	**57.3%**
Automatic Alarm	68.5%	72.7%	69.2%	73.2%	72.6%	59.7%	54.4%	54.4%	**65.9%**
Fire	61.7%	63.6%	64.4%	62.3%	60.9%	59.3%	55.6%	50.4%	**60.5%**
Hazardous Condition	31.7%	46.7%	55.1%	51.2%	51.6%	45.8%	39.1%	40.0%	**45.2%**
Hazmat	33.3%	23.1%	29.4%	14.3%	47.2%	15.8%	16.7%	27.3%	**30.5%**
Investigate Only	38.0%	39.9%	37.3%	38.2%	37.9%	34.0%	31.2%	25.6%	**35.7%**
Search and/or Rescue	0.0%	9.1%	63.6%	20.0%	50.0%	75.0%	50.0%	70.0%	**47.8%**
Percent by Year	**59.8%**	**61.5%**	**60.9%**	**60.2%**	**62.2%**	**59.7%**	**56.7%**	**52.6%**	**59.4%**

ALS Response – Time is especially crucial for a critically injured or seriously ill patient. Guidelines published by Basic Trauma Life Support International (a widely known training institute) suggest that a trauma patient's odds of survival are directly linked to the amount of time that elapses between the injury and definitive surgical treatment.[16]

Similarly for cardiac patients, the American Heart Association states:

> [The] passage of time drives all aspects of emergency cardiac care and determines patient outcomes. The probability of survival declines sharply with each passing minute of cardiopulmonary compromise. Some interventions, like basic CPR, slow the rate at which this decline in resuscitation probability occurs. Other interventions, such as opening an obstructed airway or defibrillating [as indicated], can restore a beating heart. The longer it takes to perform these interventions, however, the lower the chances of benefit.[17]
>
> If brain tissues are deprived of oxygen, they will begin to die within four to six minutes. For that reason it is imperative to begin resuscitation measures as soon as possible. A study in Ottawa, Ontario found that defibrillation (a critical intervention that can be provided by paramedics using manual defibrillators or by laypersons, police officers, or EMTs using automatic external defibrillators) was most effective if it was provided within six minutes of the patient's initial collapse.

The study also noted:

[16] Campell JE. 1995. *Basic Trauma Life Support 3rd Ed.* Englewood Cliffs, NJ: Prentice-Hall. pp. 24-26.

[17] Cummins RO (Ed.). 1994. Textbook of Advanced Cardiac Life Support. Dallas, TX: American Heart Association. pp. 1-3

The effectiveness of defibrillation decreased significantly as the interval increased between six and 11 minutes.

After 11 minutes the odds of patient survival were extremely poor. The odds of patient survival were doubled if ALS (paramedic) care was provided alongside BLS (layperson/police officer/EMT) defibrillation at all points prior to 11 minutes.[18]

Some studies attribute a drop in survival of 6–10 percent for every extra minute of delayed ALS response.

Nationally, the accepted industry standard for medic unit (ALS) response times in an EMS system that has automatic defibrillation-capable first responders (BLS) is eight minutes for 90 percent of the critical (ALS) calls.

Table 14 shows the average ALS response time, overall and by time of day for Tacoma. The average response time for the first ALS unit on scene is just under 6 minutes. That is outstanding, much better than the target of getting to the ALS calls in 8 minutes. Additionally, TFD is getting an ALS unit to the scene within 8 minutes of receiving the call about 98 percent of the time. The response times and percentages are similar for both day and night times. Note that an ALS unit here is either a paramedic engine or a medic unit. Map 5 showed that most of the city is within an 8-minute response time, and indeed that is borne up in practice.[19]

Table 14: ALS Response Times:
(Time from Call Received to First ALS Unit on Scene)

Response Times	1996	1997	1998	1999	2000	2001	2002	2003
Avg. ALS Response	5.67	5.71	5.66	5.70	5.60	5.61	5.71	5.93
Percent <8 min.	98.0	98.2	98.6	98.1	98.7	98.8	97.9	97.8
Avg. ALS Resp. Daytime	5.45	5.51	5.48	5.54	5.39	5.43	5.56	5.77
Percent <8 min.	97.2	69.7	97.6	97.0	98.0	98.0	96.6	96.5
Avg. ALS Resp. Nighttime	6.06	6.08	5.99	6.01	5.98	5.94	6.00	6.24
Percent <8 min.	97.4	98.2	98.0	97.9	98.1	98.5	97.7	97.3

[18] Nichol G, Stiell IG, Laupacis A, Pham B, De Maio VJ, and Wells GA. 1999. A Cumulative Meta-Analysis of the Effectiveness of Defibrillator-Capable Emergency Medical Services for Victims of Out-of-Hospital Cardiac Arrest. *Annals of Emergency Medicine, 34* (4 pt. 1): 517-25.
[19] This incidentally is a partial validity check of the GIS drive time analyses in this study.

Recommendation 7: Continue to maintain the excellent average ALS response time as demand and population grow. Also, it would be desirable for the city to compute the 90th percentile of ALS response time to obtain a statistic more comparable to other cities.

Response Time for Full Complement – Ideally, one would like to compute the time it takes for the full complement to arrive for a house fire or commercial fire. The most critical response times are those for the second and third units to arrive. Table 15 shows the average second-in unit drive times, and Table 16 shows the average third-in unit drive. (E.g., this shows the average time for Engine 1 is 4.97 minutes in 2003 when Engine 1 is second-in.)

Overall, the second and third-in response times are under 8 minutes, which is good. The only two engines with well above 8 minutes for second and third-in times are Engines 3 and 12 in the northeast corner of the city. This would be expected since in most cases, when responding as part of a complement, they have the furthest to travel. Engine 15 has a high third-in response time, as well, however, that is expected with its location in the port area.

Table 15: Second-in Unit Response Times: Dispatch to On Scene

Unit	1999	2000	2001	2002	2003	Unit Avg
E01	7.17	5.14	5.09	3.82	4.97	**5.06**
E02	6.14	5.45	5.70	6.02	7.41	**6.13**
E03	8.08	8.05	9.25	12.40	7.10	**9.19**
E04	6.12	5.31	3.97	5.87	4.29	**5.18**
E06	5.37	6.98	6.64	7.40	9.24	**7.31**
E07	5.79	6.18	5.97	7.82	6.43	**6.51**
E08	8.88	5.27	5.25	7.98	7.28	**7.04**
E09	6.71	5.95	5.53	6.32	5.44	**6.05**
E10	6.01	6.70	4.93	7.41	6.88	**6.47**
E11	8.90	6.11	6.12	7.48	5.66	**6.97**
E12	9.67	10.28	8.66	9.72	11.52	**10.02**
E13	6.67	6.14	5.75	8.90	5.62	**6.73**
E14	8.60	6.56	6.89	6.95	5.65	**6.95**
E15	7.64	7.91	8.87	6.58	7.30	**7.69**
E16	6.91	6.68	5.47	5.65	5.83	**6.16**
E17	5.59	5.26	7.29	5.96	7.53	**6.27**
T01	5.74	5.03	4.81	4.58	4.49	**4.89**
T02	6.68	6.49	6.60	6.29	7.38	**6.65**
T03	5.36	5.94	6.01	6.54	6.37	**6.04**
T04	10.54	8.64	9.24	6.81	7.87	**8.66**
Annual Avg	**7.20**	**6.50**	**6.32**	**7.01**	**6.86**	**6.79**

Table 16: Third-in Unit Response Times: Dispatch to On Scene

Unit	1999	2000	2001	2002	2003	Unit Avg
E01	5.12	5.90	4.26	4.36	5.39	**5.01**
E02	5.39	6.40	5.24	5.33	6.24	**5.74**
E03	8.09	7.32	14.55	9.67	8.63	**9.83**
E04	5.80	9.74	3.83	6.77	3.94	**5.97**
E06	5.40	5.51	7.54	6.32	9.53	**6.90**
E07	7.15	6.83	8.38	6.06	7.35	**7.15**
E08	7.27	8.22	7.30	6.20	5.39	**6.86**
E09	5.99	7.44	7.01	4.10	6.26	**6.14**
E10	6.69	8.09	6.32	6.98	7.50	**7.20**
E11	8.01	6.31	5.02	5.88	5.59	**6.14**
E12	13.34	10.99	10.87	11.35	10.73	**11.53**
E13	5.39	7.53	5.45	4.79	6.21	**5.90**
E14	5.67	4.32	7.73	9.34	5.62	**6.59**
E15	7.62	9.33	5.70	9.79	10.12	**8.41**
E16	6.70	8.62	6.24	9.22	6.40	**7.43**
E17	6.15	8.11	6.13	6.46	6.84	**6.70**
T01	6.24	4.35	5.64	5.55	4.86	**5.30**
T02	5.91	6.23	6.70	6.77	7.00	**6.55**
T03	6.20	10.21	6.76	6.90	8.01	**7.57**
T04	11.55	12.32	10.18	11.41	9.59	**11.01**
Annual Avg	**7.22**	**7.94**	**7.18**	**7.38**	**7.14**	**7.37**

III. WORKLOAD AND DEMAND ANALYSIS

When looking at the adequacy of station locations and unit deployment, a starting point is analysis of current unit workloads and response times. Going into the future, population projections can be used to project overall demand for fire services, and workloads by area and unit. Population is projected to significantly increase in the next 10 years, and unit workload most likely will increase proportionately, if not faster. The degree of increase may vary with demographics; there usually is an inverse correlation between emergency calls per capita and income per capita, but there can be surprises.

The intensity and quality of the TFD prevention program can also significantly affect demand. In fact, the estimated size of the workload over the next decade suggests the need for an even more intensive prevention program than the current program to curtail demand.[20]

Under the direction of the TriData project team, the Tacoma Fire Department's Fire Information Services staff extracted much of the base data and developed the maps presented in this chapter. With assistance from the city's Economic Development planning staff, population projections by engine zone were created using data from the 2000 census, the Puget Sound Regional Council, and the Washington State Office of Financial Management. The workload projections were created using the exponential smoothing method to derive service demand forecasts for 2008 and 2015 based on the actual incident growth data from 1996 through 2003.

Population Size and Density

Population size is one of the factors that has the largest effect on service demand levels. Overall, Tacoma's population is growing and its population density is increasing. The population per square kilometer from 1997 to 2003 and the projection for 2005–2020 are shown in Table 17. Map 7 shows the change in population density from 1997-2003, while Map 8 shows the projected change from 2002 – 2015.[21] Map 9 shows the projected population density in 2010, while Map 10 shows the projected density in 2020.

Table 17: Resident Population Density per Square Kilometer by Engine Zone*

	WA OFM estimate **	Census	WA OFM estimate **	Projections***

[20] The U.S. Navy in the Puget Sound area and elsewhere has curtailed demand by very intensive prevention programs that include universal public education, semi-annual inspections, and built-in fire protection (sprinklering of many buildings). TFD already has such programs but may need to intensify them, or else pay much more on the suppression side to keep up with demand.
[21] The scale on the maps are different, which should be noted when reading the two maps.

Engine Zone	1997	1998	1999	2000	2001	2002	2003	2005	2010	2015	2020
1	252.1	254.1	255.9	252.9	259.3	259.8	261.7	307.6	357.7	405.4	453.2
2	86.4	87.1	87.7	88.1	88.9	89.1	89.7	96.2	104.0	112.2	120.4
3	106.1	107.0	107.7	104.5	109.2	109.4	110.2	115.9	123.2	131.7	140.2
4	252.4	254.4	256.3	258.4	259.7	260.2	262.1	280.4	302.3	325.1	347.9
6****	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
7	130.1	131.1	132.1	127.0	133.8	134.1	135.1	150.2	167.3	186.1	205
8	165.1	166.4	167.6	168.2	169.9	170.2	171.4	184	199.1	212.6	226.2
9	204.7	206.3	207.9	209.6	210.6	211	212.6	221.4	233.2	245.5	257.8
10	174.7	176.1	177.4	181.6	179.7	180.1	181.4	201.2	223.8	229.9	236
11	159.2	160.5	161.7	156.9	163.8	164.1	165.3	173.1	183.4	195.3	207.2
12	30.9	31.1	31.4	28.9	31.8	31.8	32.1	35.1	38.7	43.2	47.7
13	179.4	180.8	182.2	181.6	184.6	184.9	186.3	193.0	202.4	212	221.5
14	118.2	119.1	120.0	116.9	121.6	121.8	122.7	128.1	135.3	143.2	151.1
15**	9.4	9.5	9.6	9.5	9.7	9.7	9.8	9.6	9.6	9.6	9.6
16	148.2	149.3	150.5	160.5	152.5	152.8	153.9	159.3	166.8	176	185.1
17	109.5	110.4	111.2	111.8	112.7	112.9	113.7	120.7	129.2	138.6	147.9

*Table reflects Census-derived resident population only and does not include the number of workers whose presence inflates the population of a given zone (e.g.; Engine 1 downtown)
** Source: Washington State Office of Financial Management County Population Projections
*** Source: Pierce County Regional Council applied by Forecast Analysis Zone
**** Areas with 0 population or 0 percent growth will not show growth.

Population density reflects resident population only; it does not include worker population. There is very low population density in the Port area (engine zones 6 and 15). However, although few people live in the Port area, there is considerable risk for fire, EMS exposure, hazardous material incidents, and even the potential for a WMD (weapons of mass destruction/terrorist) incident. So the low resident population density noted in this section is not necessarily synonymous with low risk.

Most of the city varies in population density in the range of 100–200 people per square kilometer. Over the next 15 years, population density is projected to increase 50–100 percent in the two densest areas and increase everywhere else as well, except for the Port area. The number of areas with over 200 people per square kilometer is projected to increase from 3 areas today to 8 areas by 2020. The growth trends appear to be virtually continuous, affecting the whole city. Accordingly, demand for fire and EMS service also will rise citywide.

The downtown area had the largest change in population density in the last five years. Not surprisingly, that translates to TFD engine zones 1 and 4 as the two most densely populated areas of service, and they are projected to continue as such. Population density is projected to increase for 2010 and 2020 with the greatest changes likely to be that of already dense areas getting denser. Looking system-wide, the TriData project team analyzed the projected population by Tacoma Forecast Analysis Zone (FAZ) as well as by TFD CAD Zone. Although the FAZ Zones do not correspond directly with CAD Engine zones, they give a good indication of areas that will see major population changes, and are the formats used by city planners. The method used to do the TFD engine zone population projections overlaid FAZ projections in a small grid map to ensure an accurate spatial correlation between FAZ and TFD engine zones. Map11 shows the relationship of each FAZ Zone compared to the TFD service area.

Table 18 shows the percent change in population from 2000 until 2020 by FAZ zones. The base year is the 2000 census. For the purposes of this study, the most notable change expected in population is in Engine Zones 1 and 2 (FAZ Zones 1810 and 1820). Engine Zone 1 is projected to have a population increase of almost 102 percent from 2000 through 2020. Engine Zone 2 is projected to have a population increase of almost 80 percent in that same time period. This would dramatically increase the workload of the TFD units in those areas, as well as impacting nearby Engines 4, 6, and 9, Trucks 1 and 3 and Rescue 4. The other increases in population also are substantial, and are considered in the workload discussion to follow. They are not, however, as dramatic as the projected changes in Engine Zones 1 and 2.

Table 18: Population Change by FAZ Zones, Percent

FAZ Zone	Engine Zone(s) in FAZ	2005	2010	2015	2020
1310	8, 10	13.9	278	29.8	31.8
1320	8, 10, 11	6.9	13.7	20.8	27.9
1410	2, 7, 8, 17	12.6	25.3	39.7	54.1
1420	7, 8, 10	14.1	28.2	43.4	58.6
1505	17	5.1	10.2	15.4	20.6
1605	9, 16, 17	4.8	9.6	15.6	21.7
1606	13, 14, 16	6.2	12.4	19.4	26.4
1710	2, 4, 9, 17	6.2	12.3	18.9	25.5
1720	1, 4, 9, 13	5.1	10.1	15.1	20.0
1810	1, 2, 4	24.8	49.7	75.7	101.7
1820	1	21.0	42.0	61.0	79.9
1900	6, 15	1.0	2.0	5.8	9.6
2000	12	11.2	22.5	37.0	51.5
2100	3	6.6	13.1	20.8	28.5
Citywide		8.5	17.0	24.8	32.5

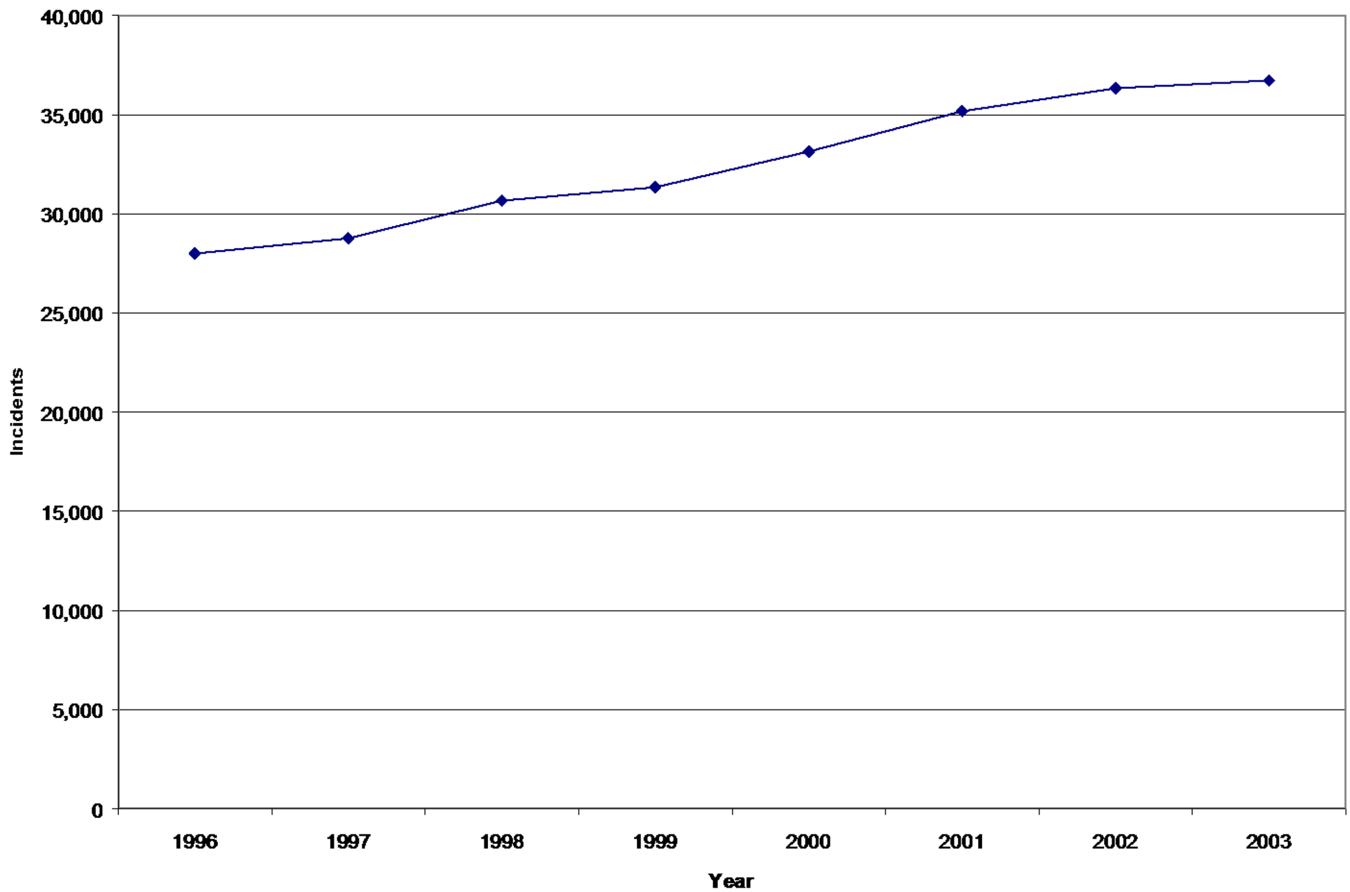
Workload

The overall workload of the Tacoma Fire Department has increased by more than 30 percent in the past eight years. This is seen in Table 19 and Figure 2. Although most of the increases from one year to the next are relatively small, the overall trend has been upward, and the cumulative affect over several years is a significant increase, without the addition of fire units.

Table 19: Tacoma Fire Department Incident Totals by Initial Call Type (1996 – 2003)[22]

Type	1996	1997	1998	1999	2000	2001	2002	2003	Percent Increase
EMS	19,422	20,362	21,592	21,650	22,650	24,877	24,388	25,432	30.94
Fire	2,357	2,220	2,311	2,202	2,289	2,372	2,400	2,446	0.04
Other	6,216	6,185	6,751	7,491	8,202	7,932	9,535	8,849	42.36
Total	**27,995**	**28,767**	**30,654**	**31,343**	**33,141**	**35,172**	**36,323**	**36,727**	**31.19**

Figure 2: Tacoma Fire Department Incidents (1996–2003)



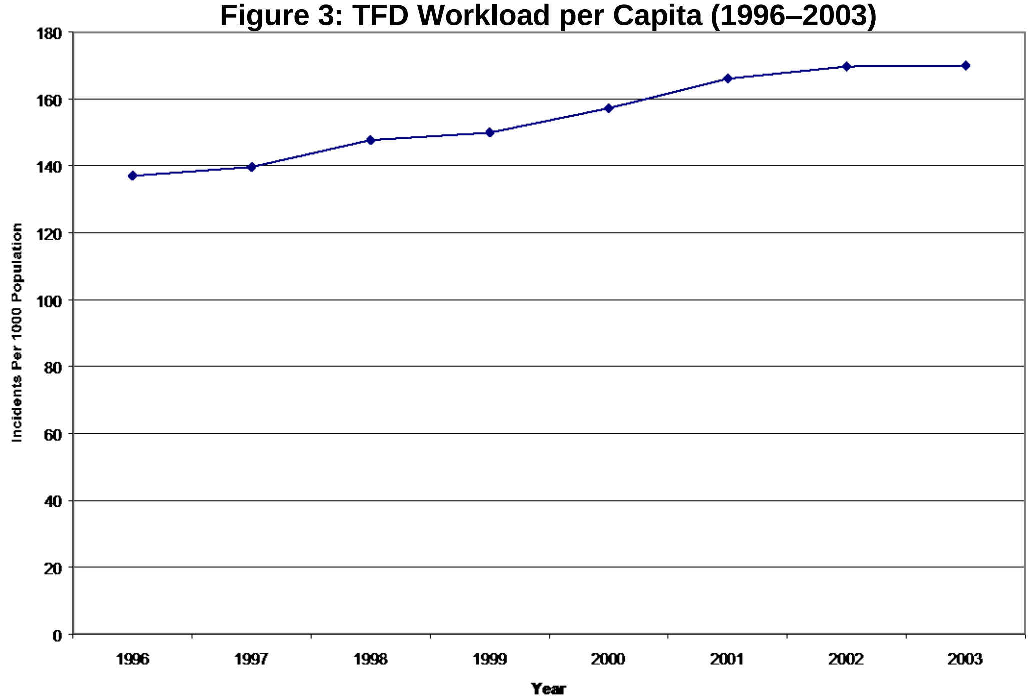
[22] Includes non-dispatched incidents.

The bulk of the workload increase is attributable to EMS calls, as is happening almost everywhere in the nation. But demand for "other calls" is increasing even faster, up 42 percent vs. 30 percent for EMS and 0.04 percent for fires in this period. The other category can be misleading because these are the initial incidents (what the dispatch center thought they were vs. what they turned out to be). "Other" includes automatic alarms, investigations, standby, and events that no unit is dispatched to. Automatic alarms could turn out to be a fire, for example.

The increase in calls also has been much faster than the increase in population, which means that the citizens are asking for more service per capita. Because it is unlikely that the health of the community is changing as rapidly as the call volume in this period, the increase may be caused by a combination of factors such as increased 9-1-1 awareness, aging population, decreased access to primary care, and disproportionate uninsured or underinsured population.

Figure 3 depicts the trend in workload per capita. The population of Tacoma only increased 4.7 percent from 1996 through 2003, while call volume increased by more than 30 percent.[23] Given this, the increased demand for service during this time frame is most likely due to more residents calling for service (as measured by the 23.8% increase in workload per capita) rather than increased population.

Figure 3: TFD Workload per Capita (1996–2003)



[23] Note that the actual population growth percentage, 4.7%, is lower than the population growth projections given by the Puget Sound Regional Council (Table 18).

Types of Calls – Map 12 shows the numbers of incidents by census block in 2000. Map 13 shows the number of fire incidents by census block in 2000. Map 14 shows the number of medical incidents in 2000. Further analysis by census block shows there are calls coming from virtually the entire land area of the city. Emergencies happen everywhere. The areas with the most fires also tend to have many EMS calls; in general these are areas of high population density. The reverse is not always true; some areas with high EMS calls do not have high fire incidence.

The areas with high fire incidence are relatively few. This analysis might be used to help target the fire prevention program, with more intense public education and inspections given to the areas that have, say, five or more fires per year. Likewise, areas with the most EMS calls might be a focus for injury prevention programs.

Recommendation 8: TFD should review call types by census tract and target its prevention program based on needs in each specific region of the service area. The purpose is to reduce the increasing demand, which ultimately requires more fire units at an increased cost to the taxpayer, as will be discussed later.

As discussed previously, there are many more EMS and other calls as compared to the number of fire incidents. Most city fire departments have about two-thirds EMS calls vs. one-third fire and other calls. In Tacoma, it is about 60 percent vs. 40 percent, making it comparable to others.

The number of fire calls reported by dispatch is about 25 percent greater than the number of fires as finally determined. Many calls that come in as fires turn out to be false alarms. There was virtually no increase in the number of actual fires from 1996 through 2003.

Unlike the fire calls, which did not increase, the number of EMS calls dispatched increased by 30 percent. The biggest increase during this time period was in ALS responses – in 1996 there were 7,028 ALS calls; in 2003, there were 10,747 ALS calls. This is a 53% increase over the last eight years. BLS calls also increased, but not at the same pace. The main reason for the increase in ALS calls was a change in county protocols. The protocols for sending ALS response were expanded to include the more vague, non-specific cardiovascular complaints (e.g., jaw pain, arm pain) that may seem like BLS but can end up being ALS.

The most dramatic increase was in “other” incidents—a 42 percent increase over eight years. It should be noted that included in the “other” category are non-dispatched incidents and unit standby and staging events. The trend changed in 2003 – automatic alarms were down 57.4% from 2002, a great improvement, while non-dispatched calls were up 23.9% from 2002 and standby / staging calls were up significantly from the year 2000 (mostly for covering Engine 3, a policy change).

The majority of "other" incidents were automatic alarms and investigations of a potential incident (5,022 or 57 percent). The high number of "other" calls would not be a significant problem if some units were not approaching 3,000 calls. However, with the large number of units with high or very high workloads – or units expected to have high workloads very soon – the number of false alarms or mistaken automatic alarms can become a burden on the city's whole fire system. It will be an increasingly costly burden if the number of false alarms cannot be reduced. In effect, the city is facing having to add extra units at a cost of millions of dollars to deal with false alarms, or having to add them earlier than would be necessitated by the growth in EMS calls. An engine company, not a smaller rescue unit, must respond to a call from an automatic alarm system, in case it actually is a fire and needs to have the attack started immediately.

As example of the problem these "other" calls can create, consider engine zone 16. This area had a very high workload of 3,061 incidents in 2003. Of those, 229 were automatic alarms and 183 were investigation of an incident. In other words, about 15% of the responses were automatic alarms or investigations. The volume of those calls push the workload into the category of possibly needing relief now or soon.

The 57 percent decrease in automatic alarm incidents between 2002 and 2003 shows improvement is being made, and should continue to be a focus of TFD.

Recommendation 9: TFD should continue to analyze automatic alarm incidents and implement measures to decrease their number. The alternative is increasing personnel to deal with the higher workloads.

Workload Level by Unit – When considering future workloads, it is important to look at each station and individual unit's workload as well as the system as a whole. The activity level of the units in a station indicate whether additional units are needed there or nearby. A fire/EMS system also must incorporate back-ups based on whether stations or units in adjacent areas are likely to be busy much of the time. Workload analysis also must consider the other duties assigned to each station such as training, building inspection, equipment and facility maintenance and other special assignments. As the emergency response component of the overall unit workload increases, the ability of that unit to perform its other assigned duties is compromised. Having this work performed by existing TFD staff contributes to more economical department operations. The loss of that capability has financial ramifications that must be considered in comparison to or along with the cost of adding units to meet the community's service demands.

A general "rule of thumb" for unit workload analysis is when workloads of an engine or medic unit exceed 3,000 calls per unit annually it is time to start considering:

- The addition of a second unit in that station, or
- Placement of a second unit in a nearby station, or
- Subdivision of the response area (referred to as engine zones in this study) and the addition of a new station and unit.[24]

Outlined below are some general guidelines for workload levels of engine and medic units. The crucial thing to consider is the degradation of response time, not just the number of incidents. Additionally, the distribution of calls across the day is another significant factor. The more bunched the calls are, the more likely a backup unit is needed.

- **Very Low Workload (<500 incidents/year)**: Stations/units can be spaced relatively far apart and not have much effect on established drive time objectives. Simultaneous calls are infrequent and unit availability usually is assured.
- **Low Workload (500-999 incidents /year)**: Stations/units can be spaced relatively far apart. Few calls will overlap and unit availability usually is assured.
- **Moderate Workload (1,000-1,999 incidents /year)**: Stations/units must be located with at least marginal overlap to achieve established drive time objectives. Some simultaneous calls will occur, usually at peak demand periods; however, stations/units are usually available.
- **High Workload (2,000-2,999 incidents /year)**: Stations/units must be located with significant overlap to achieve established drive time objectives. Overlap of calls will likely occur, however, stations/units will probably be available for emergency response.
- **Very High Workload (3,000-3,999 incidents /year)**: Stations/units must be located with significant overlap to achieve established drive time objectives or more units must be added to the stations. Overlapping calls occur daily, usually during peak demand periods, and working incidents are frequent. The closest station/unit may not be available, thus requiring the response of adjacent stations/units.

[24] For ladder trucks, the call threshold for being "busy" is lower than for engines, about 2000-2500, because of their length of runs and higher percent of longer calls (e.g. fires).

- **Extremely High Workload (>4,000 incidents /year)**: Stations/units must be located with high overlap or multiple units deployed per station to achieve established drive time objectives. Overlapping calls may occur several times a day. The closest station/unit is often likely to be unavailable thus requiring the response of adjacent stations/units (if there are not multiple units in that station). Frequent transfers or move-ups are required for the delivery system to meet demand. This footprint usually is found in very densely populated urban areas and is especially evident in EMS services located in urban areas with very high demand for service.

Using these workload guidelines, TFD engine responses were categorized based on current workload data and projections of future workload. The number of calls per unit and per station range from a few hundred (low workload) for two units (Engines 6 and 15) to the 3,691 (very high workload) made by Engine 10 in 2003.

Table 20 shows the individual Tacoma unit response levels for the years 1996 through 2003. Figure 4 graphically shows the variation in workload across companies.

This data shows that every unit but one (Engine 6 in the Port area) had a large increase in workload over the 8-year period shown. Generally speaking, the table shows an upward trend in all categories, something that is quite likely to continue into the future.

Three engines have low workloads: Engine 3 in NE Tacoma and Engines 6 and 15 in the Port area. They have about 1–2 calls a day. Engine 3 is in a relatively affluent, low population density area, with lower than average calls per capita. Engines 6 and 15 are in the Port area which has almost no residents, and the workload there is primarily industrial or transportation-related incidents. Two of the truck companies, T3 and T4, also have low workloads, which is not uncommon for specialty units.

At the other extreme are five units with very high workloads of over 3,000 calls per year in 2003: Engines 1, 10 and 11 and Rescues 2 and 4. They are on the verge of needing additional units in their station (Engine 10 is based alone at present). Overall, 52 percent of TFD units in 2003 were in the high or very high workload category.

The good news here is that there is some potential for other units to absorb additional volume before adding additional units in certain areas. That is, the overall fire system has the ability to handle a higher workload. But as calls in each station increase, there will be more times when calls are missed by the initial responding unit. As all units get busier, even the second responding unit may be busy. Geographic areas with high workload can't always be adequately served by units from areas with lower workloads without the risk of degraded response time. Therefore, response times need to be carefully monitored as the demand increases, and as prevention measures are taken to slow or reverse the increase in demand.

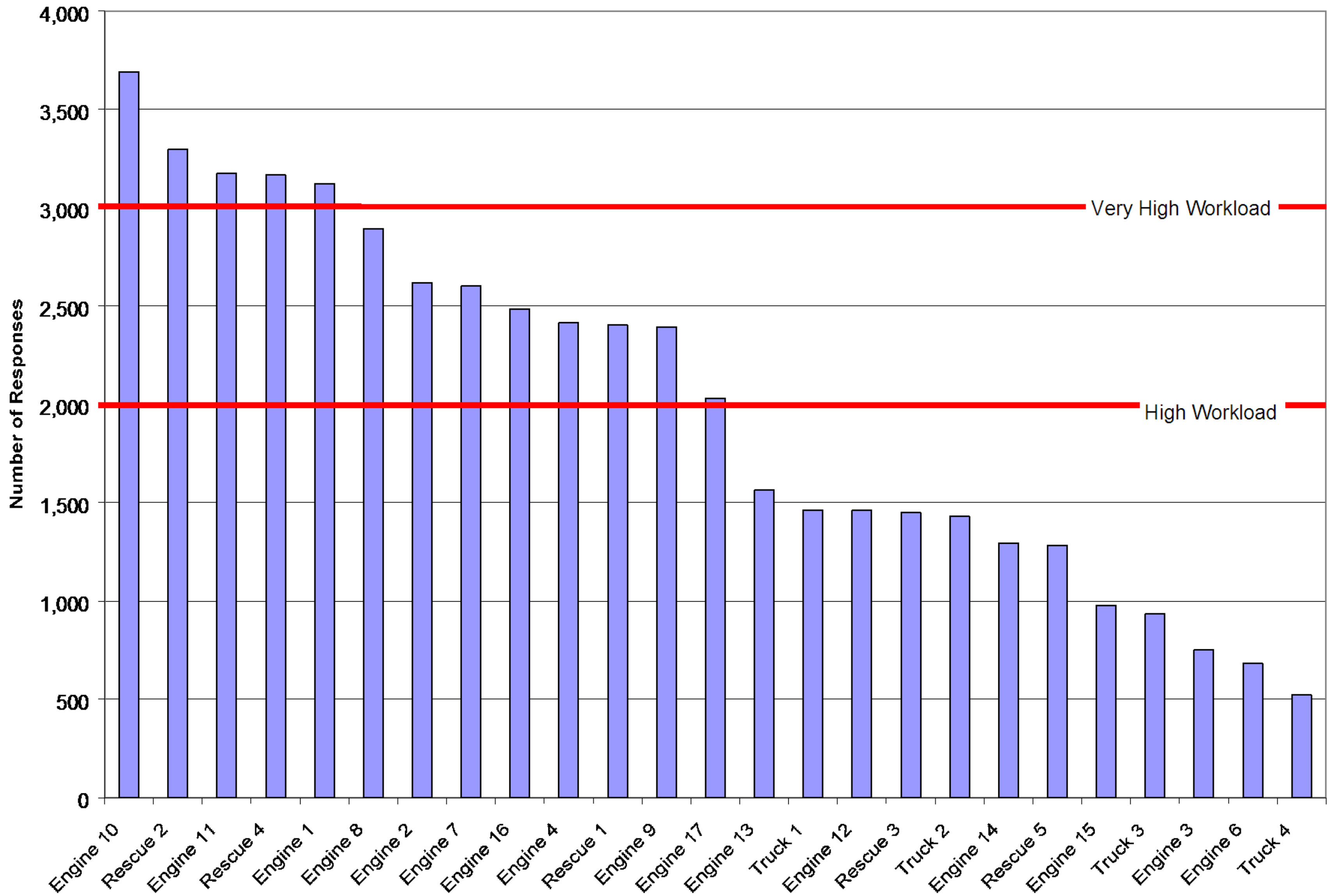
Table 20: Total Responses by TFD Units (1996 – 2003)

Unit	1996	1997	1998	1999	2000	2001	2002	2003
Engine 1	2,768	2,903	3,107	3,147	3,205	3,257	3,228	3,123
Engine 2	2,193	2,279	2,483	2,442	2,626	2,366	2,436	2,619
Engine 3	468	497	589	595	667	695	774	753
Engine 4	2,152	2,306	2,419	2,540	2,685	2,796	2,647	2,417
Engine 6	767	679	719	707	780	709	695	684
Engine 7	2,190	2,374	2,492	2,421	2,681	2,803	2,654	2,602
Engine 8	2,302	2,452	2,569	2,637	2,808	2,598	2,639	2,893
Engine 9	1,783	1,875	2,018	2,022	2,199	2,294	2,229	2,394
Engine 10	2,631	2,856	2,968	3,083	3,274	3,584	3,678	3,691
Engine 11	2,122	2,474	2,560	2,656	2,807	2,908	2,877	3,175
Engine 12	1,167	1,223	1,204	1,329	1,308	1,430	1,468	1,461
Engine 13	1,203	1,264	1,366	1,407	1,432	1,539	1,543	1,563
Engine 14	852	897	1,067	989	1,067	1,156	1,165	1,296
Engine 15[25]	409	424	467	515	480	400	666	979
Engine 16	1,654	1,783	2,022	1,905	2,106	2,357	2,381	2,486
Engine 17	1,389	1,552	1,727	1,829	1,994	1,937	1,952	2,029
Truck 1	1,005	1,136	1,224	1,255	1,523	1,530	1,480	1,463
Truck 2	974	1,227	1,343	1,345	1,607	1,389	1,498	1,431
Truck 3	437	593	608	713	760	670	728	936
Truck 4	375	418	465	523	530	525	519	521
Rescue 1	2,010	2,528	2,569	2,015	2,135	2,274	2,304	2,405
Rescue 2	2,561	3,101	3,008	3,170	3,448	3,482	3,524	3,297
Rescue 3	1,053	1,235	1,251	1,349	1,513	1,540	1,624	1,451
Rescue 4	2,137	2,512	2,618	2,773	3,194	3,358	3,319	3,167
Rescue 5	Rescue 5 went into service on July 1, 2003.							1,284

The present call volume argues against the reduction of units, particularly with the staffing parameters now commonly accepted as industry standards.

[25] Engine 15 numbers reflect their movement into Engine Zone 3 to provide coverage when Engine 3 is out of the station, which is an environmental issue rather than a true measure of demand for service.

Figure 4: Workload Levels by Unit, 2003



Another aspect of analyzing fire department workload is the number of responses to other jurisdictions. However, in the year 2002, TFD gave mutual aid on only 65 occasions. These included response to fires, hazmat incidents, EMS calls, and even two false alarms. Thus, mutual aid has no significant impact on TFD workload.

Projected Workloads — To forecast total incidents and incidents by engine zone for 2004 through 2015, two techniques were used to mathematically model the 1996-2003 data: linear regression and trend-adjusted exponential smoothing. For 1996-2003 data, the non-dispatched incidents for all engine zones plus the engine zone 3 stand-by incidents were excluded from the base numbers used to prepare the workload projections.

For linear regression (LR), the method of least squares was used to obtain the "best fitting" trend line for each engine zone and for the entire service area. Those trend lines were then extended through 2015 to obtain forecasts.

For trend-adjusted exponential smoothing (ES), the method described by Hillier and Lieberman in *Introduction to Operations Research (Seventh Edition)* was used. Unlike LR, which gives equal weight to all the historical data, ES places more weight on the most recent data (incident counts and year-to-year changes of those incident counts). In this model, the weights for earlier data decrease exponentially so that the older data have less influence on the projected trend line than do the more recent. ES is similar to a weighted moving average, but offers an improvement over the latter by weighing all the historical data, not just the most recent.

After obtaining two mathematical models for each engine zone and the entire service area, the forecasts were compared. To avoid projecting too high a growth into the future, the more conservative set of forecasts was chosen. That turned out to be ES for total incidents and for most engine zones. As a cross comparison of the two techniques, a third set of forecasts was obtained by adjusting the ES parameters downward so all the data would have essentially equal weight, similar to LR. In all cases the third set of forecasts were virtually identical to the LR forecasts.

Since neither method directly takes into consideration projected population increases, that will be discussed with each engine zone discussion. As discussed earlier in this chapter, the population of the TFD service area is expected to increase rapidly which could impact the accuracy of the demand projections. On the other hand, if the population of a zone levels off, the demand on units in that area also could level off.

Table 21 shows the projected number of incidents for 2008 and 2015 by engine zone. The engine zones with more than 3,000 calls are shown in bold. Table 21 also shows the stations that have a truck (T) to share the workload with the engine.

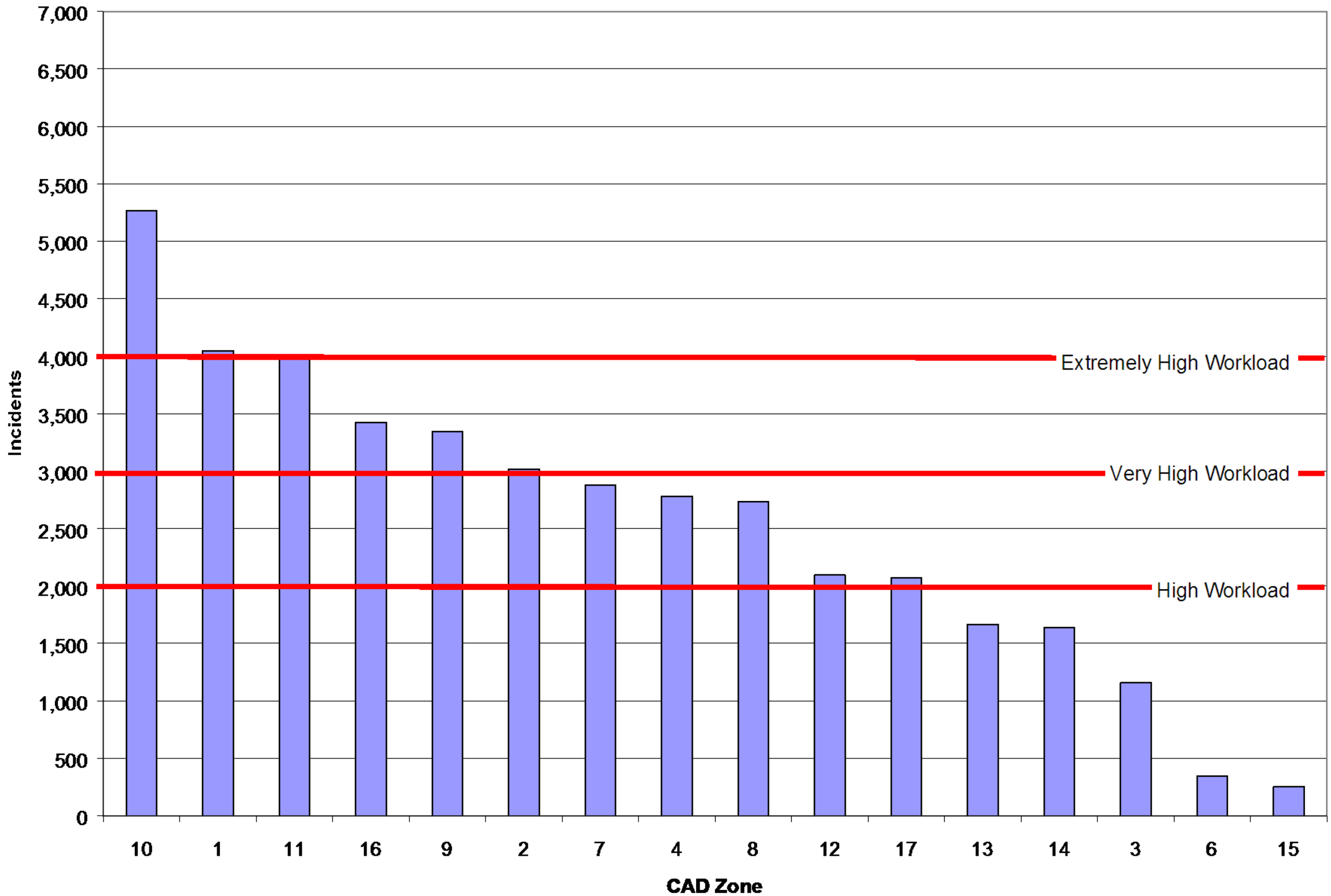
Table 21: Projected Incidents by Engine Zone

Engine Zone	2008	2015
1 (T)	4,048	4,292
2	3,017	3,735
3	1,161	1,508
4	2,782	3,052
6	344	257
7	2,876	3,509
8 (T)	2,735	3,133
9 (T)	3,346	4,355
10	5,268	6,475
11	3,980	4,710
12 (T)	2,094	2,526
13	1,666	1,947
14	1,640	2,041
15	252	283
16	3,424	4,257
17	2,071	2,556

These projections only look at an individual incident in an engine zone, not the total number of units that respond to these incidents. In other words, the projection of 4,048 incidents in Engine Zone 1 in 2008 does not mean there will only be 4,048 unit responses in that year. The reality is that multiple units are often required to handle calls in these zones, so the projections could understate actual workload. The discussion going forward will be about the engine zones for the most part, not specifically the workload of a particular unit. The recommendations in Chapter IV and V do consider the overall ability for a region to respond to an incident within established goals.

Figure 5 and Figure 6 graphically show the projected workloads for each engine zone. Of the seven engine zones that exceed 3,000 calls by 2008, two have co-located trucks that can share the volume. Five zones do not, and will probably need additional units. By 2015, 9 zones are projected to exceed 3,000 calls, and seven probably will need additional units (two more than 2008). This is not that large an increase in units for a growing city. Specific recommendations for addressing the projected need for additional units are outlined in Chapter 5.

Figure 5: Projected Workload by Engine Zone, 2008



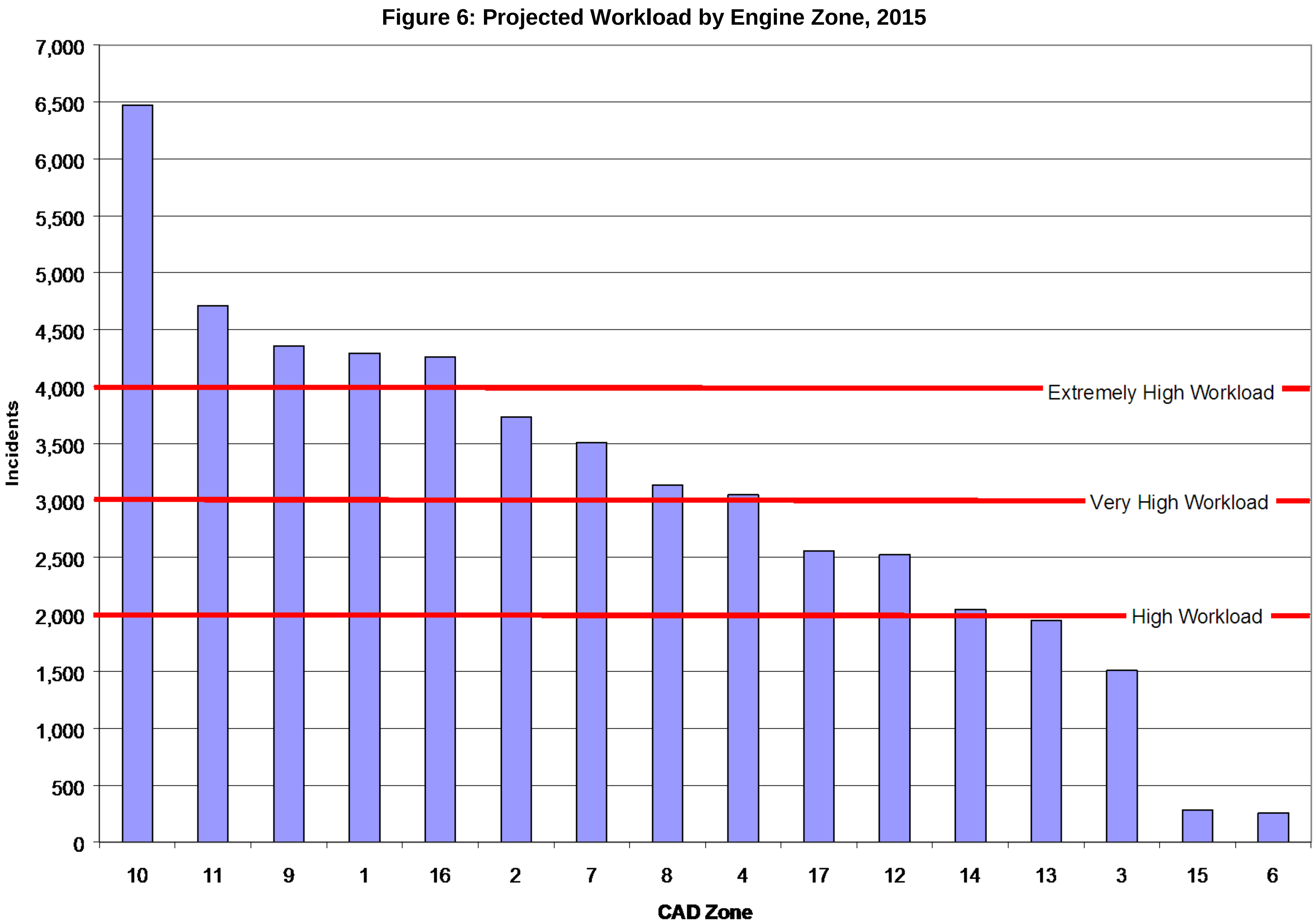


Figure 6: Projected Workload by Engine Zone, 2015
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Incidents
Extremely High Workload
Very High Workload
High Workload
10
11
9
1
16
2
7
8
4
17
12
14
13
3
15
6
CAD Zone

Downtown/Central (Stations 1, 2, 4, and 9): Table 22 below shows the 2003, incident data for Engines 1 2, 4 and 9. Although these four stations in contiguous areas complement each other well at present, by 2008 their zones will be too busy for just four engines.

Table 22: Engine Zone 1, 2, 4, and 9 Incident Data

Engine Zone	2003 Dispatched Incidents	2008 Incident Projections	2015 Incident Projections
1	3,721	4,048	4,292
2	2,394	3,017	3,735
4	2,307	2,782	3,052
9	2,372	3,346	4,355

The unit responses of most engines may be higher than the number of incidents in the zone because they go to fires outside their zone even if the calls are favorably distributed.

If the projections hold true, by 2008, there will be approximately 13,100 incidents among these four stations. This is a 9 percent increase over 2003 where there were 10,794 calls. The addition of about 2,300 incidents in this area could be enough for work for another whole unit. By 2015, there will be almost 15,500 incidents between the four stations – another, even larger increase of almost 2,500 incidents. Given the current workload levels of the units in this area and the projected outlook for demand, this area will need more assistance, as will be discussed in Chapter 5.

The strain on the downtown/central area also is illustrated by the number of times that units in this area respond outside their initial response zones to cover other units in the area. Out of the 3,123 calls Engine 1 responded to in 2003, 21 percent were out of their engine zone. Fifty percent of these out of district responses are going to Zone 4 and Zone 9. Of the calls Engine 2 responded to, 42 percent were outside of their engine zone, with many of them going to Engine 1's zone. This means Engine 2 responded to only one out of every two calls in its district. Engine 4 responded out of their zone 32 percent of the time (764 calls) in 2003. Almost half of these out-of-zone calls went to Engine 1.

The medic unit (R4) and truck (T1) in this area both have very high workloads. Rescue 4 responded to 3,167 incidents in 2003, with 2 out of 3 calls coming from one of these four stations. Zones 1 and 4 had the highest number of dispatches of the medic unit in 2003. Truck 1 responded to 1,463 calls in 2003, of which only 37 percent were out of Zone 1.[26]

The resident population base in the downtown and central zones is expected to rise going forward as well. Zone 1's population density is expected to rise by almost 47 percent from 2003 to 2015 (307.6 to 453.2 per square kilometer). Zone 2 and 4 are both projected to see an increase of more than 30 percent in this same time period. Zone 9 will see the smallest increase in their population density (21 percent). If demand increase proportionally to population, the number of incidents may be much higher than shown in Table 6. Thus the projected need for units here is likely to be conservative (low); the city will need at least as many units as projected.

Port-area (Stations 6 and 15): The Port area stations have a low workload. Engine Zone 6 includes the majority of the Port area. While it may be good to have a station with primary responsibility for the Port area, the unfortunate geography of Engine 6's station location dictates the need for another station (15) to adequately cover the entire Port area. Table 23 shows the incidents in these areas and projected incidents for Zones 6 and 15.

Table 23: Engine Zone 6 and 15 Incident Data

Engine Zone	2003 Dispatched Incidents	2008 Incident Projections	2015 Incident Projections
6	346	344	257
15	197	252	283

Although neither zone has a high workload, both are helping to backup other areas of the system. Engine 6 ran 684 calls in 2003, of which 209 (or 1 out of 3) were into Engine 1's zone. With the overload in Engine Zone 1, Engine 6's low workload provides good backup for the downtown area.

Engine 15 ran 979 incidents in 2003, of which 648 (or 2 out of every 3 times Engine 15 was dispatched) were into Engine 3's zone. Many of these are standbys; when Engine 3 is dispatched, Engine 15 is usually dispatched into the zone as backup because the zone is so large.

Even though the number of incidents and projected incidents are low, Chapter IV discusses the importance of protecting the Port area and a proposed deployment for this area.

[26] Truck 3 was moved from Station 13 to Station 9 on July 1, 2003 to provide back up coverage in the downtown area. In 2003, 50 percent of their responses (578) were within Zone 9.

NE Tacoma and Fife (Stations 3, 12): Table 24 shows actual and projected incident growth in Engine Zone 3 and 12.

Table 24: Engine Zone 3 and 12 Incident Data

Engine Zone	2003 Dispatched Incidents	2008 Incident Projections	2015 Incident Projections
3	829	1,161	1,508
12	1,701	2,094	2,526

The current practice for Engine Zone 3 is to have Engine 15 automatically move into that area to cover whenever Engine 3 is away from the station for any reason. Without this "standby" support from Engine 15, Northeast Tacoma would be extremely vulnerable since there is no other station in close enough proximity to provide timely back up coverage to Engine Zone 3. The incident counts in Table 24, therefore, do not reflect the 600 "standby" incidents in Engine Zone 3 in 2003 since they are attributed to environmental factors rather than true workload demand. This is discussed further in Chapter V.

Engine Zone 12, which is to the south of Engine Zone 3 can be categorized as having a moderate workload. In 2003, the zone had 1,701 incidents.

In 2002, Engine 12 responded 32 percent of the time out of their zone. This number is uncharacteristically high for this unit. From 1996 until 2001, an average of 17 percent of the responses were out of the district. In 2003, Engine 12 responded to 19 percent of the calls out of district. It seems 2002 was an outlier, and not indicative of the normal circumstances facing Engine 12.

Truck 4 at Station 12 had a low workload in 2003 with only 521 responses. Of these, 1 out of every 2 were out of the district. Nearly half of their out of Zone 12 responses went to Zone 10 and 11, which have extremely high and very high workloads as discussed later.

The resident population base in the Northeast Tacoma and Fife areas is expected to rise going forward. Zone 3's population density is expected to rise by almost 21 percent from 2003 to 2015. Zone 12 is projected to see an increase of more than 45 percent in this same time period, however this zone has the lowest population density with the exception of the Port area in the entire service area.

South and Southeast (Stations 7, 8, 10, and 11): As previously noted, when an engine responds to more than 3,000 incidents annually, it is considered to have a very high workload. Zone 10 has an extremely high workload. Zone 11 has a very high workload level, while zones 7 and 8 are high. Table 25 shows the total workload of this area.

Table 25: Engine 7,8,10, and 11 Incident Data

Engine Zone	2003 Dispatched Incidents	2008 Incident Projections	2015 Incident Projections
7	2,431	2,876	3,509
8	2,462	2,735	3,133
10	4,409	5,268	6,475
11	3,416	3,980	4,710

The current as well as historic emergency response workload for Engine 10 was "red flagged" for additional review during the TriData project team's initial triage visit. Engine 10 has the highest engine company workload in the TFD service area (the overall engine zone also has the highest workload in the service area). It has the highest population in its initial response area. Engine 10 responded to 3,691 calls in 2003; 638 (17 percent) were out of their district. Out of a total call volume in Engine 10's CAD zone of 4,409 calls, Engine 10 responded to 3,053 of them in 2003 (69 percent). That is, nearly a third of the initial responses to calls in Engine 10's area were from another area. With the zone workload as high as it is, when Engine 10 leaves the area or is otherwise assigned, the response time to an incident within its zone could well exceed the department's goals.

With over 30 percent of the calls in Zone 10 not being responded to by Engine 10, a number of other engines must respond into the region. Engine 7, Engine 8, and Engine 11 all are responding to this area because Engine 10 is often unavailable due to its extremely high workload.

If the number of responses by Engines 7, 8, and 11 into Engine 10's CAD zone were reduced, each of those engines would retain high workloads, but would not approach the "very high" workload levels as they currently do.

Engine 11 in particular needs to remain in its own zone more often, with more than 3,400 calls in that area. Otherwise there will be a cascading effect of units going to the next district for calls and missing their own. The currently good response times could deteriorate quite rapidly. This area is in need of immediate relief, and will need an additional station long term to alleviate the extremely high workload levels projected.

Two medic units serve this area – Rescue 2 at Station 8 and Rescue 5 at Station 11. Rescue 2 has a very high workload with 3,297 responses in 2003. Of these, 78 percent were within this south and southeast coverage area. Rescue 5 came online on July 1, 2003. During that half of the year, the unit responded to 1,284 calls. Half of these were in Zones 10 and 11.[27]

The population density in this area is expected to rise – and it is already very high. The four zones range from 135 per square kilometer in Zone 7 to 181 in Zone 10. By 2015, Zone 7 will still be the least populated per square kilometer, but will jump to 205. Zone 10 will continue to be the most densely populated at 236.

North End, West End, and Fircrest (Stations 13, 14, 16, 17): Engine Zones 13, 14, and 17 all have moderate workloads, which is not projected to change in the next 10 years. Engine Zone 16 has a high workload now, and projected to be very high workload in the coming years. Table 26 shows the 2003 incidents and 2008, 2015 incident projections for Engine Zones 13, 14, 16 and 17.

Table 26: Engine Zone 13, 14, 16, and 17 Incident Data

Engine Zone	2003 Dispatched Incidents	2008 Incident Projections	2015 Incident Projections
13	1,404	1,666	1,947
14	1,337	1,640	2,041
16	2,835	3,424	4,257
17	1,726	2,071	2,556

Currently, Engines 13, 14, and 17 run out of district a significant percentage of the time (which is good since their zones only have a moderate workload). On the other hand, Engine 16 and Zone 16 are bordering on a very high workload – which is projected to increase in the coming years.

Engine 13 responded to 1,563 calls in 2003, of which almost 2 out of every 5 were out of their district. Engine 14 responded to 1,296 calls in 2003, with 18 percent out of their district. The majority of the responses out of district for Engines 13 and 14 are for each other, or into Engine 16’s response area.

Engine 16 responded to 2,486 calls in 2003 with almost 15 percent being out of their district. Many of their out-of-district responses are going into Engine 9, 13, 14, and 17’s CAD zones. Engine 17 responded to 2,029 calls in 2003 with 37 percent out of district.

[27] Truck 2 was moved to Station 8 on July 1, 2003 to help provide coverage in this area.

Rescue 1 at Station 16 has a high workload with 2,405 calls in 2003. 25 percent of these calls were within Zone 16, the only high workload zone in the region. As things stand, the only unit requiring a lot of assistance from other unit is Engine 16. The other units in the area are meeting that need.

The population density in these zones is going to increase by about 20 to 25 percent, which could further increase demand.

With an increase in demand by 31 percent from 1997 through 2003 and an expected further increase in demand– in some areas a dramatic increase—over the next 10 to 15 years, changes will be required in the entire service area. More units will be needed.

When considering these demand increases, and in some cases dramatic increases, it needs to be remembered that the number of fires might be low, but when they happen, they require many units to contain. During a major fire event, multiple units could be out of service for hours at a time. For example, if a major fire were to occur in Northeast Tacoma, there would not be a second responding unit after Engine 3 for quite some time. Although Zone 3 only has about 900 incidents per year, Engine 3 is the only unit protecting the Northeast corner of the city.

Additionally, if a major fire occurred in the Port area, almost all of the downtown units (engines, trucks, and medic units) would be dispatched to help contain it. During that time, with the high to very high workload levels in these zones, it is very likely a number of other incidents could be occurring in which other units would need to respond.

The increase in demand and workload is beginning to have an impact on units today. If the projections hold true, they will have a very dramatic increase on the level of protection of Tacoma going forward. Recommendations on how to address the increasing workload are detailed in Chapter 5.

IV. TIDEFLATS FACILITY AND UNIT DEPLOYMENT

The Port of Tacoma is the sixth largest container port in North America. Its capacity is expected to expand by at least a third over the next decade. Correspondingly, the infrastructure of the Port area is changing, with the re-location and/or blockage of roads, railroad and vehicle overpasses and underpasses, and extended waterways. In addition, the Hylebos Bridge remains inoperable and the Murray Morgan Bridge is in hazardous condition and can be used by emergency vehicles only under very limited circumstances.

The geography of the Port area can be compared to a hand and fingers. Overall, the planned infrastruture changes have the effect of re-routing major transportation routes in the Port area from east-west (via E. 11th Street, now minus the Blair Bridge, across the "fingers" to NE Tacoma) to a more north-south orientation from the base of the "palm" of the hand and up the fingers (from State Route 509 via major Port arterials such as Port of Tacoma Road, Taylor Way and Portland Avenue). An overview map of the Port area is seen in Map 15.

As part of this study, the TriData project team reviewed the fire department units, stations, and support facilities in the Port area. Consideration was given to current workloads, response times, and hazards in the Port area, as well as the immediate and longer term infrastructure issues that impact fire and other emergency response.

While there are some fires that occur in the Port area each year, and there is potential for major fires, most calls there are for EMS. There also is a need to be prepared for industrial technical rescues (e.g., crane operators high up) and a wide variety of hazardous materials incidents that may result from materials stored out in the open, containers that spilled or have some other problem with them, or any of the risks associated with the variety of transportation modes used in the Port area.

The Port hired Jacobs Civil, Inc., to conduct a comprehensive study of the transportation issues in the port area, and they provided much information on the plans as best known at this time.

Tideflats Hazards

There are many fire and explosion hazards in the Port area that require TFD to have hazardous material mitigation and technical rescue capability, in addition to adequate fire and EMS response capability. There is constant railway traffic in and out of the Port. Ships and barges come in daily, loaded with containers that hold many combustible and/or hazardous chemical products. There also are large numbers of cargo truck movements. Each ship, train, or truck that enters the Port brings with it the possibility for a complex emergency event.

A tour of the Port area revealed large quantities of logs, woodchips, scrap metal, and other materials in large outdoor piles or conical "mounds." Many are quite close to the roadways and seem to be in areas that are not guarded well, which raises the possibility of somebody maliciously or malevolently igniting those piles. If the piles are ignited and the wind off the water blows the fire, there could be a major conflagration in the Port area that would be extremely difficult to combat.

There are several oil refineries and storage facilities in the Port area. Additionally a great deal of grain is handled, stored, and loaded in the Port to be shipped to Asian and other destinations. All have potential for a major fire.

Other hazards in the Port area include chemical plants, old pre-World War II storage warehouses, wood products plants, manufacturing companies, military facilities, hazardous materials recyclers, ship repair and marinas, petroleum-product tank farms, fueling racks and sawmills.

The newer structures have sprinklers but many of the old buildings do not.

Perhaps the most notable aspect of the Port area is the multiple stacks of containers that fit on the backs of tractor trailers. While the sides and tops of those containers are metal, the bottoms are made of wood. When stacked, they are essentially large wooden pallets with metal boxes between them. The contents of those pallets may be highly combustible wood, plastic, or other products or various chemicals.

Recommendation 10: Continue the practice of requiring sprinklers in new structures and consider the possibility of retrofitting the older structures. Sprinkler systems should be an even more critical part of risk management going into the future than they have been in the past. They are reliable and cost-effective for industry, often reducing insurance.

Recommendation 11: Ensure that emergency access is maintained throughout the areas where containers are stacked, and around all industrial buildings and piles of combustible materials. Response time to a fire or hazmat event or injury does not stop in the street outside; emergency crews must be able to get to the scene of the incident.

Fire Loss

Overall, the number of fire incidents in the Port area is low. But while there have not been many fires or large losses over the past few years, there is considerable potential given the number of buildings and the average value of each of those buildings. The exposure is summarized in Table 27.

Table 27: Number of Buildings and Average Building Value in Port Area (2002–2003)[28]

Occupancy Type	# of Buildings	Average Building Value
Assembly	7	$1,350,400
Business	168	$1,418,562
Factory	65	$518,722
Hazardous	106	$1,552,339
Mercantile	7	$716,500
Storage	84	$924,631
Utility	5	$100,820
Assembly	7	$1,350,400

The low average fire loss recently is shown in Table 28. The fires have been small – a few thousand dollars loss on average, but the potential is there every day for a multimillion dollar fire in light of the risks noted above.

Table 28: Average Fire Loss in Port Area Fires (2001–2003)

Occupancy Type	Number of Fires			Average Fire Loss		
	2001	2002	2003	2001	2002	2003
Assembly		1		$0	$250	$0
Business	2	1		$500	$1,800	$0
Factory	11	7	2	$15,918	$1,643	$7,500
Hazardous	3	1	1	$65,123	$100	$722
Mercantile	1			$25,000	$0	$0
Residential	1	3		$500	$80,999	$0
Storage	2	1		$5,047	$0	$0
Utility	2			$68	$0	$0
Mobile Property	12	17	9	$78,779	$3,953	$18,350

There were only 38 reported fires in three years in mobile properties, despite the thousands of transportation vehicles and ships that enter and leave the Port area. The total dollar loss from the fires compared to the property value in which the fire occurred in the Port area also is impressively low.

[28] Source: City of Tacoma Fire Department data, April 2004.

The Tacoma Fire Department and Port management should be proud of the level of prevention and protection that has helped to keep dollar losses minimal. The low fire loss also could be due in part to the increasing number of Port area buildings being sprinklered, but that would not affect the count of fires much, since there is usually some dollar loss and the TFD notified in any fire where a sprinkler activates; virtually all would receive a fire response.

It is hard to draw firm conclusions on three years of data since it might not be representative of the “true” longer-term fire situation in the Port area. Nevertheless, the low number of incidents over the three years, and low fire loss in those incidents, could indicate that the employees in the Port area understand the importance of fire protection. The low total fire loss and low loss per fire also suggest that the inoperable Hylebos Bridge has not yet created a problem from having slower second-in response to the Port area than would be the case if Engine 3 had rapid access to the Port area. The risk analysis, however, must consider the long-term potential risks: A once-in-ten-years $10 million fire, such as the $62 million Mountain Cold Storage fire loss in 1992, or a large hazmat incident must be considered in fire protection planning.

Present Tideflats Fire Stations

The host of problems and concerns regarding fire and EMS protection for the Port area revolve around Port expansion, road changes, and bridge or other fire department access issues. A number of infrastructure issues have yet to be decided. The Port is likely to continue to change and adapt in order to remain productive and profitable, and that must be considered in fire department planning.

There is presently much demolition as well as construction taking place in the Port area. Much of this work is being done to increase storage areas for cars and containers. In the process of this enlargement, roads are being re-routed or discontinued. In many cases, responses for both the fireboat and engine or truck companies are becoming a much greater challenge.

The Hylebos Bridge is currently inoperable. Station 15 is located near the base of that bridge on the easternmost “finger” of the Port area. The Murray Morgan Bridge to the west is in extremely hazardous condition and only passable under limited conditions. Station 6 is located between the Murray Morgan Bridge and the 11th Street Viaduct. The Tacoma Fire Department Training Center is located in the center of the Port area. These situations will be discussed in great detail throughout this chapter.

Scenarios Considered – After considering the planned changes to the Port and the possible variations, a set of scenarios was selected to analyze emergency responses to the Port area for the next decade, and then develop station location plans. The scenarios selected were as follows:

Baseline (Streets – B): The existing 2003 street network with the Hylebos Bridge inoperable and the Murray Morgan Bridge useable for emergency vehicles only under very limited conditions. 11th Street Viaduct available.

Scenario 1 (Streets – 1): Hylebos Bridge inoperable; Murray Morgan usable by emergency vehicles only under very limited circumstances PLUS the following viaduct and street segments no longer exist or are not passable due to reconfiguration in the Port area:

- 11th Street Viaduct
- Alexander Avenue from SR-509 halfway to Lincoln
- Milwaukee from Lincoln to 11th Street
- E D Street from 11th S to 3rd Street
- E 7th Street from D Street to E Street
- Olympic Street

Added is Thorne Road (new passage) from Lincoln to Marshall.

Scenario 2 (Streets – 2): Same as Scenario 1 but with the Murray Morgan Bridge closed (i.e., both bridges out).

Scenario 3 (Streets – 3): Same as Scenario 1 but with Hylebos Bridge operable (i.e., both bridges available).

Scenario 4 (Streets – 4): Baseline with Hylebos operable and Murray Morgan Bridge closed PLUS any 2004 street changes.

Each scenario is discussed below in more detail, with implications for response times. Recommendations follow the scenario.

These scenarios are considered the most likely options to be implemented between now and 2014. When station location and unit deployment are discussed later in the chapter, these scenarios will serve as the backdrop. The scenarios are referenced by their abbreviated name on each map that follows.[29] Port area roads are shown in red.

Hylebos Bridge and Station 15 – Currently there is a bascule bridge over the Hylebos Waterway that has been inoperable since January 11, 2001. This situation forces Engine 15 to make a detour south around the Hylebos Waterway and then back north on Marine View Drive when they have to support or cover for Engine 3 in Northeast Tacoma. TFD standard operating procedure has an engine relocate into Engine 3's zone

[29] In all analyses, private, unpaved roadways are not counted. Also, the maps color in the area between reachable roads to simplify the visual presentation of the area that can be reached within x minutes, but in reality the off-road areas, such as the middle of a parking lot of containers, will take longer to reach.

every time it goes on a call or is out of station for training or other reasons, in order to maintain protection in hard-to-reach Northeast Tacoma.

Estimates vary from $12 million to $16.5 million to repair the Hylebos Bridge. With the construction of State Route 509 and the removal of the Blair Bridge, East Eleventh Street (the road that leads into Northeast Tacoma) has seen a large reduction in vehicular traffic. Consequently, there seems to be no urgency to make the necessary repairs to the Hylebos Bridge. Nevertheless, that bridge remains important for emergency response and evacuation.

The Hylebos Bridge is a critical link for TFD, as it allows Engine 15 to get to Northeast Tacoma quickly to assist or cover for Engine 3 and vice versa. (Engine 3 used the bridge for quick access to the Port area to support Engine 15). Without the Hylebos, Engine 15 cannot reach a significant part of its initial response area (the east side of the Hylebos Waterway). As seen in Map 16, Engine 15's 4-minute drive time range without the Hylebos Bridge is limited to a very small area—basically just the fifth "finger" of the Port area.

With the Hylebos Bridge operable, Engine 15 could respond into Engine 3's area and cover a portion of it within 4 minutes. This is depicted in Map 17. The difference in 4-minute drive area into the Port area is noticeable as well.

Map 18 shows Station 3's 6-minute (second-in) response time area without the Hylebos Bridge; Map 19 shows it with the bridge operable. Engine 3 can respond to most of Engine 15's initial response area within 6 minutes when the bridge is operable, but none of it when closed.

The impact of not having the Hylebos Bridge is even more evident when looking at full response maps. "Full response maps" are an innovative set of TFD analyses that show the area within which one to five units can respond within 4 minutes drive time to the Port area. The darker the color, the more units that can reach the area in 4 minutes. This is one way to show the depth of response capability of TFD's fire response system; the more units that can respond to an area in 4 minutes drive time, the more likely it is to have rapid overall response times.

With the Hylebos Bridge operational, there can be a second-in unit responding to more of Station 15's area within 4 minutes drive time than is possible with the bridge out. The 4-minute full response map without the Hylebos Bridge is shown in Map 20, while the map with the bridge available is Map 21.[30] They show that the eastern side of the Port

[30] This map is labeled as "Streets 4."

area has thin coverage with the Hylebos Bridge inoperable—only one unit can reach it in 4 minutes drive time.

The Hylebos Bridge makes an even more dramatic difference for ALS response. Map 22 shows the drive time response in the Port area without the Hylebos Bridge for ALS coverage, while Map 23 shows the Port area with the Hylebos Bridge available. Much more of the Port's area is covered by ALS response with the Hylebos Bridge available. Remember that a 6-minute drive time translates to an 8-minute overall response time.

With its low workload and the Hylebos operational, Engine 15 can handle the first response to the vast majority of the calls in its zone. Without the Hylebos Bridge, however, as seen in the previously cited figures, most of Engine Zone 15 cannot have a second engine or other unit reaching it within 6 minutes drive time, nor a 4-minute drive time if Engine 15 is busy, nor an 8-minute ALS response.

Recommendations for this station are made later in this chapter combined with recommendations for Station 6.

Station 6, the Murray Morgan Bridge, and the 11th Street Viaduct – On the southwest side of the Port area, the Murray Morgan Bridge (MMB) is in hazardous condition. Fire units may cross it for emergency response but must reduce speed and keep designated intervals between vehicles. To reduce stress on the bridge, they are not allowed to return over the same route; instead they must take a more circuitous trip back to their station. If the bridge is overhauled, that process likely would be lengthy (probably years). The bridge route likely would not be available to TFD units, either for responding or returning; a worse situation than at present. The response times would, however, be restored between the downtown area and Engine Zone 6 if and when construction is completed.

Currently, Engine 6 uses the MMB when called upon to respond into downtown Tacoma. Without this access another unit will have to be dispatched to take their place on a downtown assignment.

There also is discussion about closing the 11th Street Viaduct (among other Port area road changes). Vacating the 11th Street Viaduct would have a significant impact on the overall Port area fire response. Currently, the viaduct is used as the connector between Station 6, the downtown stations (with the MMB passable) and the middle of the Port area. Without the viaduct, even if the MMB is available, TFD units all will need to go first south to the "palm" of the Port area and then back up the "fingers" to get to the large middle section of the Port area – a much longer, less direct route.

With the Murray Morgan Bridge passable and the viaduct open, the current 4-minute drive time area for Station 6 is depicted in Map 24.[31] If the Murray Morgan Bridge and the viaduct are removed, a portion of the Port area has no protection within 4-minutes drive time by either of the two Port area engines. Again, both Engine 6 and Engine 15 would need to drive to the "palm" of the Port area and then drive up to reach the top half of the middle two "fingers" of the Port area. The 4-minute drive time area for Engine Zone 6 without the MMB and viaduct is shown in Map 25. There is a noticeable and significant difference.

As mentioned earlier, the Murray Morgan Bridge and the viaduct link several other stations to the Port area. With the MMB and the viaduct passable, Engine 1 can respond to the majority of Engine 6's initial response area within 4-minutes, as shown in Map 26. Given the risk potential in this part of the Port area, it is advisable to have this additional coverage. With the MMB and viaduct out, however, Engine 1 can respond only to the "palm" of the Port area in a 4-minute drive time (see Map 27).

Station 2's 4 minute drive time area in the southern end of the Port area also is reduced when the MMB is removed; however, the impact is minimal. The majority of the Station 2 baseline coverage within 4 minutes is to the "palm" of the Port area. Map 28 shows Station 2's 4-minute drive time zone with the MMB and viaduct present, while Map 29 shows it without either.

Station 4's 4-minute drive time capability into the southern end of the Port area is completely eliminated when the MMB is removed. However, Station 4 can only reach a small portion of the Port area within 4 minutes anyway, so it is not a major impact. Map 30 shows Station 4's 4-minute drive time zone with the MMB and viaduct present, while Map 31 shows it without either.

The impact of not having the MMB and viaduct is most evident when looking at the full response maps. With the bridge and viaduct in place, a good portion of the southwest end can be reached by at least four units within 4-minutes drive time, and almost the entire Port area can be reached by at least one unit with 4 minutes drive time. When the MMB and viaduct are removed, the Port area has several locations with no protection within 4 minutes drive time, and even more locations where only one unit can respond within 4 minutes drive time. This is shown in Map 32.

Removing the MMB and viaduct significantly impacts truck and ALS response, although not nearly as dramatically as engine response. Map 33 showed the 6-minute drive time response for truck and ALS coverage in the Port area without just the Hylebos Bridge. Map 34 shows the Port area without the MMB, Hylebos, and viaduct. Although

[31] All references to the removal of the 11th Street Viaduct include the other changes discussed as part of "Streets 1."

the southern area is still protected by at least one or two trucks and/or ALS units within 6-minutes drive time in most areas, the overall level of protection is significantly reduced by the absence of the Murray Morgan Bridge and viaduct. The absence of the Hylebos Bridge is less critical in this section of the Port area.

Future Tideflats Fire/EMS Coverage

The previous sections showed that there are already response time problems into the Port area. Removing the Murray Morgan Bridge and/or the Viaduct would significantly make response times even worse, and thus the level of protection, for the Port area. On the positive side, both Station 6 and Station 15 have low workloads. In 2003, Engine Zone 6 had 399 incidents (140 of which were EMS). Engine Zone 15 had 220 (130 of which were EMS). Despite the low workload, the high risk potential in the Port area requires a high level of fire protection, including response to EMS, hazmat, and technical rescue incidents.

With the MMB and viaduct in place, Engines 1, 2, and 4 can all respond rapidly to help protect the western and southwestern sections of the Port area. Engine 1 could even provide adequate initial response coverage for most of the western section of the Port area if Engine 6 were relocated. Engines 2 and 4 would be able to provide additional assistance and coverage in the southwestern Port area and Engine 1's initial response area. From an emergency response viewpoint, therefore, the presence of the MMB and the viaduct is highly desirable.

On the eastern side of the Port area, Engine 15's current coverage area is minimal. With the Hylebos Bridge out of service, the unit is forced to drive to the "palm" of the Port area to respond to any call outside of the "finger" on which they are located. As long as the Hylebos Bridge remains inoperable, Engine 3 cannot assist Engine 15 without going first to the "palm" and then driving up the "finger". Thus Engine 15's placement has become highly inefficient.

The "palm" of the Port area is currently well covered within 4 minutes drive time by Engines 6 and 15, with support from Engines 11 and 12, as seen in Map 35 and Map 36.

With the western and southwestern sections of the Port area as well protected as they are, and the very low workload of Engine Zone 15, it makes sense to consolidate and relocate Stations 6 and 15 to the "palm" of the Port area. This new Port area station would address the concern about the response area of Engine Zone 6 being minimized if the MMB and/or viaduct are closed. The units in the new Port area station would not be isolated on a "finger", but rather could respond more directly and quickly to the entire "hand" of the Port area.

Even if road changes are not made, consolidating stations makes good sense economically. The Port area would remain well protected at the "palm." If MMB and the viaduct are operable, the downtown engines will be able to respond more quickly, making full-response times better. Therefore, it makes sense to consolidate the stations to save costs in the long run.

Recommendation 12: Consolidate and relocate Stations 6 and 15 into a new station to be built near the vicinity of State Route 509 and Port of Tacoma Road. This new station would have good response to all of the "fingers", and the entire "hand" of the Port area. It also will be relatively immune to various changes in east-west travel across the Port; with various future changes possible, it is wise to locate the station where it can respond satisfactorily under a wide range of scenarios.

Map 37 depicts the 4-minute drive time area from the proposed station. The entire Port area (with a small exception) is covered from one station. Map 38 shows a drive time of 6-minutes from the proposed station. Almost all of the Port is covered by at least three units within 6-minute drive time, and a good portion is covered with five units.

Map 39 shows the 6-minute full response drive times without either bridges or viaduct (unlike the previous two maps that just were missing the Hylebos, as currently is the situation). Map 39 is the worse case scenario, but the Port still would have at least four units able to reach the majority of the Port within 6-minutes—excellent coverage. Many of the highest risk areas of the Port have five units able to reach it within 6-minutes. An added advantage is that the new station would have better response to other areas of the city, which would allow Truck 4 to be relocated from Station 12 to the new consolidated station, giving the Port even stronger protection. The new station would have at least two fully staffed units.

Table 3 presents the project team's proposed deployment for the consolidated station. (The fireboat is not included, but is discussed separately later in this chapter.)

Recommendation 13: Redeploy units and staff for the new Tideflats station as discussed in the chapter.

Table 29: Deployment Recommendations for New Tideflats Fire Station by Scenario

Current Deployment	Recommended Deployment
• <u>Engines</u>: 2 (at stations 6 and 15) with 3 staff each • <u>Water Tender</u>: (SU 45) Unstaffed • <u>Fireboat Defiance (cross staffed)</u> • <u>Fireboat Commencement (unstaffed)</u>	• <u>Engines:</u> 1 active (3 staff) and 1 in reserve for major emergencies (unstaffed) • <u>Truck</u>: Relocate Truck 4 from Station 12 and increase

Current Deployment	Recommended Deployment
Total Staff: 6	staffing by 1 (4 staff) • EMS Unit: 1 EMS response vehicle as discussed in Chapter V (cross-staffed) • Hazmat Unit: Relocate the Hazmat unit from Station 12 (cross-staffed) • Water Tender: Relocate from Station 15 (cross-staffed) **Total Staff: 7 (net reduction of 2 overall) in Port area**[32]

Evacuation

With the closing of bridges and various other construction projects underway, occupants of some of the Port area land masses (the "fingers") could be left without a single way out, their evacuation options cut off if an incident occurs at the "palm" of the Port area. Removing those trapped could only be done by way of waterborne transportation and helicopter for some indeterminate period.

Recommendation 14: Fire department and city emergency management personnel should develop an evacuation route procedure for various scenarios and disseminate it to the businesses in the Tideflats. Resources for water evacuation should be considered.

Recommendation 15: The Tacoma Fire Department should be consulted before road changes are implemented because of evacuation route concerns, as well as for emergency vehicle response access. With several businesses having only one route for evacuation, and with the many risks associated with the Port area, TFD needs to have some input in the configuration of the road network.

Fireboats

The Port and City of Tacoma have 44 miles of waterfront within their jurisdiction. The Port area is replete with serious fire or explosion related hazards. Considering the extensive waterfront mileage and the large and varied amount of water-bound traffic in and out of the Port area, the City needs constant maritime fire protection from fireboats as well as land-based approaches.

[32] There would be a net reduction of 2 positions citywide: the two Port engine and the truck now have 9 positions; the combined station would have 7.

Typically fireboats have few runs but when needed they are indispensable. Typical uses of fireboats include shipboard fire protection, pier and port facility fire protection, water rescue, and inspection of ships, piers, port facilities, and marinas.

Fireboats also have been used for many years to provide large flows of water for major fires. In those cases, the fireboat ties up at the waterfront and land companies stretch their hose lines from the fireboat to tactically advantageous positions.

Fireboats also can serve as a supplemental water supply in the event of a natural or terrorist-related disaster. They proved invaluable in San Francisco to fight the fires created by the Loma Prieta earthquake and in New York City to battle the blaze after the World Trade Center disaster. In both cases the downtown water supply suffered major damage.

The Philadelphia Fire Department has put an interesting twist on this concept. At the landside of one of their center city piers they have installed a bulkhead connection. This tool is a clustered array of eight three and a half inch hose line intakes that can be supplied by one of their fireboats and when charged can supply their high pressure fire fighting water main system. A similar arrangement could be explored for feasibility in Tacoma.

Currently, the City has two fireboats—the Defiance and the Commencement. The Defiance was put into service in 1982 and the Commencement in 1983. The Defiance is the first line, but part-time, fireboat, and has the better hull of the two. The Commencement is in reserve and available for emergency response provided staff can be reached in time to come and operate it. Both are staffed according to the State standards (a Pilot, officer and deckhand on board who meet minimum qualifications).

These boats were built with an expected maximum speed of 30 knots but in the intervening years have slowed down to approximately 19 or 20 knots due to general wear and tear. It is anticipated that the hulls of these units could still have a life expectancy of another 15 to 20 years if retrofitted.

The Coast Guard does not have firefighting capability in the Port of Tacoma. If needed, they would have to come down from the Seattle area. Thus, the fireboat or its backup needs to be available with high reliability. The city would have to stand on its own for this capability for a long time into any incident.

Recommendation 16: Consider bulkhead connections at strategic locations along the Tacoma shoreline to be supplied by the fireboat. This is insurance if the water supply is interrupted.

Recommendation 17: The TFD should overhaul at least Fireboat Defiance, if not both boats. The retrofits should include a new foam system, vital when handling Class "B" fires, e.g., fires involving oil products.

Location of Fireboat Defiance – The Defiance used to be moored at Station 5 but it was closed due to budget constraints. This location was optimal for risk management. With a fireboat stationed there, TFD could provide faster, more comprehensive marine fire protection than from its current basing.

Recently, the police department secured funding for a new patrol boat for homeland security purposes. With some repair work, Station 5 could be restored as a joint operations center for both the police and fire department boats. The fire department could use this location to moor Fireboat Defiance and the police department its new patrol boat.

A fireboat at Station 5 would not have the five-knot limit ("no wake speed") that restricts its movement up the Thea Foss Waterway from its current mooring at Station 18. From Station 5, a fully staffed crew could reach most places in Commencement Bay and in front of the Port area much faster than from Station 18.

If the fireboat were staffed full time, it could assist with some of the Harbor Master responsibilities, such as inspections. Finally, not to be overlooked is the fact that Port area safety would be enhanced by a fireboat staffed on a full-time basis -- both for its inspection capability and for its suppression, environmental and rescue capabilities.

Recommendation 18: Repair Station 5 and base Fireboat Defiance there with full-time staffing. The Tacoma Fire Department should work with the Tacoma Police Department to make Station 5 a joint marine operations center, dividing the repair costs between both departments.

Location of Fireboat Commencement – The reserve Fireboat Commencement is currently located at Station 18. There is a machine shop and moorage accommodations at this location. If the Tacoma Fire Department consolidates the Port area stations as previously recommended, this location will not be quickly accessible to the crew of Engine 6 that currently cross-staffs the fireboat (the crew would be in the new station).

If the proposed new Port area station is constructed and the MMB is no longer available, TFD could move the fireboat to a mooring along the Blair Waterway, closer to the new Port station. The crew of Engine 6 that currently cross-staffs the fireboat would continue to do so. With this configuration, the fireboat would have better access to the Northeast Tacoma shoreline in support of Engine 3, as well.

If the MMB remains available, the fireboat could remain moored in reserve at Station 18. It can be staffed when necessary by calling in qualified personnel from the downtown area, or the Port area, as needed.

V. STATION LOCATION AND UNIT DEPLOYMENT OUTSIDE THE TIDEFLATS

This chapter evaluates the current station locations and the units at each station, and makes recommendations for future improvements in deployment. Not discussed in this section are the Tideflats stations, 6 and 15, which were discussed in the previous chapter. All proposed changes city-wide are summarized at the end of the chapter since the whole system of interdependent stations must be considered when contemplating changes.

Background

Planners are often faced with the question of how to provide essential city services to citizens in a timely, yet cost effective manner. This includes deciding where to locate fire and police stations. More facilities lead to higher operational costs but faster response times and better service. Fewer facilities increase travel time for emergency responders.

Budgetary and political constraints often require that planners address current problems instead of planning for future issues and scenarios before they become a problem. Predicting future situations is not easy, which is one reason that planning is often reactive rather than proactive.

Due to the high costs of operating fire units, budgets often restrict the ability of a city to build a new station or add units until it is deemed absolutely necessary. As areas become further developed and demands increase without additional coverage, response times increase. Sometimes cities build fire stations by looking just at the present-day risks and without adequate consideration for projected demand. Politically, it is often challenging to close or move an existing station even when the lack of demand or efficiency justifies it.

In the end, there is no single answer for the most desirable yet cost-effective fire-rescue system. There are many different approaches that work across the country and around the world. Given Tacoma's current boundaries and demand for service, and more importantly, the projected demand for service, the systematic approach to dealing with expected growth that is discussed in this chapter will be effective and efficient for the citizens of Tacoma. Ultimately, judgment is needed to determine the most appropriate approach to protect citizens and visitors.

Much of the discussion in this chapter builds on the data and discussions in previous chapters, especially Chapter III on workload and demand. Those workload projections should be considered as just one of many workload distributions that may develop. They should be considered the answers to a "what if" question—what if workload were this high by such and such a date. The analysis here shows how the city might cope with that growth.

If the workloads are slower to develop than projected, the 2008 scenario might not be needed until closer to 2015. If demand develops faster than predicted, then the 2015 scenario might have to be implemented sooner. If growth of workload is slower, then fewer units need be added into the system.

An even more intensive prevention program than the current program might help curtail demand. Demand also might rise slower if the growth in demand per 1,000 resident population slows, or if population growth and business growth is less than expected. The recommendations here should not be tied to a definitive timeline, but rather taken as a suggested approach on how to proceed as demand exceeds the 3,000 annual incidents per unit threshold detailed earlier in this report.

Use of GIS Technology

The late twentieth century saw an adoption of geographic information systems (GIS) technology in urban planning. These customized information systems allow analysis of response times as a function of street networks and other factors (among many other uses). Such systems can be built using existing GIS technology such as ArcView, the program TFD used to perform the station location analyses requested by TriData for this report.

GIS can be used for collecting, analyzing, and presenting spatial data (e.g., street maps, location of incidents). Planning data also can be collected and stored in the GIS database (e.g., projected growth, projected demand). Once collected, a wide range of spatial analysis functions can be performed on the data to create suitable data layers. These spatial data layers can then be presented in the forms of maps, reports, and charts.[33]

Under the direction of TriData, the Tacoma Fire Department planning staff produced the GIS analyses that were used extensively throughout this study to compute drive time response rings for current and proposed stations. The TriData project team considered four important factors when considering station location:

- Response times for the first-in units in light of future demand;
- Location and response times of second and third-in units, and specialty units;

33 Pullar, David and Chris Pettit. "Introduction to Urban and Regional Planning Concepts." ESRI, 2000-2001.

- Workload and trends – when additional units are likely to be needed, and whether they should be put into overloaded stations or new stations; and
- Trends in population growth – a factor in forecasting future demand and in determining reasonableness of adding stations based on size of population to be served.

Current Deployment System

The Tacoma Fire Department has deployed its units in a very reasonable manner to help meet the City's response time goals for all of the units. This section first discusses deployment of battalion chiefs and EMS units, and then deployment of engines and trucks for each area of the city.

Battalion Chiefs(BCs) – In Chapter II, the study team recommended adding a third battalion chief as soon as possible. The span of control for the two current BCs is very large, much greater than the normal five or six stations, and their response times are excessive for parts of the city. Map 40 shows an overlay of the 6-minute drive times from Stations 8, 9, and 12. If BC 182 moved to Station 8, and a third BC was added at Station 12, the majority of the city could be reached by the Battalion Chiefs within a 6-minute drive time (8-minute total response time).

The move of BC 182 and the additional BC not only expands the coverage of BCs within 6 minutes, but also provides some overlap in the critical downtown area. Table 30 shows one possible division of responsibility between the three BCs. Others as good or better may be determined by the TFD Operations Bureau.

Table 30: Proposed Battalion Chief Span of Control in Near Future

Battalion	Stations
181 – St. 9	4, 9, 13, 14, 16, 17
182 – St. 8	1, 2, 8, 7, 10
183 (Rec.) – St. 12	3, 6, 11, 12, 15[34]

As noted in Chapter II, by 2008 the demand for service will be significantly greater than it currently is. At that point, the addition of a fourth BC may be necessary to continue to balance their workload and keep them available for major incidents. Table 31 presents a possible division of units in 2008, with the associated 6-minute drive time overlay for the four BCs as depicted in Map 41.

[34] If the two Port stations consolidate, this would reduce to four stations, but includes the whole Port area.

Table 31: Proposed Battalion Chief Span of Control Post 2008

Battalion	Stations
181 – St. 13	9, 13, 14, 16
182 – St. 7	8, 7, 10, 17
183 (Rec.) – St. 12	3, 6, 15, 12
184 (Rec.) – St. 1	1, 2, 4, 5, 11

Both of the proposed spans of control for BCs take into consideration the recommended new Port area station.

EMS Response – As noted earlier in the report, the number of fire calls per year is not increasing nor is it expected to increase much, if at all, in the future. However, given Tacoma's economic development, the value of the potential loss risk due to fire is increasing significantly and likely to continue. Investment in prevention activities and adequate staffing will help mitigate this risk.

On the other hand, EMS calls are rising steadily and projected to continue in that upward trend. Currently, the Tacoma Fire Department is dispatching an engine for a BLS call, and an Engine and a medic unit for ALS calls. This is a good practice until call volume reaches the point that when a fire breaks out, there may often be excessive response times due to too many engines being out of service (e.g., on EMS or other calls).

For ALS calls, it is appropriate and national practice to send both an ALS medic unit and an engine for first response. A true ALS incident may require many hands to deal with the medical aspects, protect the patient, and move the patient. The importance of rapid ALS response was discussed in the Current Operations chapter.

To optimize engine availability and ensure adequate fire response capability, there must be some increased efficiency and augmentation of the EMS response component of TFD's operations as EMS workloads increase. One way to reduce engine time out of service is to have ALS units, upon arrival at the scene, triage the call quickly and determine if the engine is needed. If not needed, the engine and its crew of three should immediately be sent back to the station to be available for other incidents.

Another approach is to add EMS response units rather than additional engine companies or medic transport units when workloads or increasing response times require some form of relief.

The concept of an EMS response unit (sometimes called a “chase car”) is as follows:

- They have ALS response capability; are staffed by at least one paramedic; and do not provide transport, which means less out of service time.
- They are stocked with the necessary equipment and supplies to triage and initiate treatment until a transport unit arrives.
- They are located at stations in engine zones with high workloads to augment the response capability of the units in that zone, with a goal of keeping engines and trucks available as often as possible.
- They are less expensive to purchase and maintain (most are SUVs, and a two-person crew is less expensive anyway).
- They may be added at first during peak-times only, adding less cost than a 24/7 unit.
- For calls that are clearly BLS-only incidents the EMS response units could be dispatched without an engine. This will prevent an engine or transport unit from being out of service for minor incidents.

Where the addition of EMS response units is recommended in the future, TFD should consider the workload of the medic units. If the medic units would be overloaded with the transports of the EMS response units, then some more medic units should be added instead of EMS response units. The coordinated use of the new EMS response units and existing ALS transport units can be fine-tuned with experience.

Downtown and Central Region (Stations 1, 2, 4, and 9)

Stations 1, 2, 4, and 9 protect the downtown and a large portion of the surrounding areas. If a major situation were to develop in the downtown, these stations would be the first to the scene because of their proximity. Stations 1, 2, and 4 also have response capability into the Port area, as discussed in the previous chapter. Station 6 in the Port area can respond quickly to downtown. These stations complement each other’s response area well, as shown in the 4-minute drive time overlay in Map 42. The whole area can be reached by the first unit in 4 minutes.

Engine Zone 1, which has a very high and increasing workload, can be covered by the other units in its vicinity. Truck 1, co-located with Engine 1, normally would be held back and Engine 1 sent to EMS calls. The truck is there as a second, dispatchable unit when Engine 1 is out.

Engines 2, 4, and 9 all have high workloads, which will be exacerbated by the need to compensate for the support role currently played by Port area Engine 6. With the new consolidated Port area station, Engine 6 can no longer provide quick backup (within 4-minute drive time) into Engine Zone 1.

Engine Zone 4 also has a high workload, but the other three engines all can respond to some part of its initial response area within a 4-minute drive time. (The partial overlap of 4-minute ranges is good here, and necessary due to the high call volume and risks in the downtown area.)

A cost-effective, short-term solution would be to introduce a 12-hour, two-person EMS response unit at Station 1 during the peak call hours. The addition of an EMS response unit could reduce the need for the engines (and trucks) to respond on so many calls. The EMS response unit could be located at Station 1 to have rapid response into the entire downtown area (and even the Port areas as long as the Murray Morgan Bridge and viaduct are functional).

Truck coverage in the downtown area will be impacted by the proposed Port area station. Moving the truck at Station 12 to the new Port area station brings it closer to the downtown area in case of a major event there. The response from that station into the downtown is faster than from Station 12. With the workload increasing downtown, this will provide a good backup if Truck 3 at Station 9 is not available. With only four truck companies in the TFD service area, it is important a system of backups is in place. It is also important that trucks be available for their less frequent but important use for extrication, technical rescue and fire suppression.

Recommendation 19: Add a peak-hour EMS response unit at Station 1 to help alleviate the downtown workload.

Deployment in 2008 – As discussed in the workload chapter, by 2008 there may be more than 13,190 incidents between these four engine zones each year. This is over 1000 more calls than in 2003, when there were 12,060 incidents. Three of the four engine zones will individually have very high workloads (more than 3,000 incidents), with the fourth (Engine Zone 4) being just short of that very high threshold.

Engine Zone 1 will see an approximate annual increase of 325 incidents between 2003 and 2008. Engine Zone 2 will jump up by almost 625 incidents. Engine Zone 4, the only one not exceeding 3,000 incidents, will increase annually by about 475 incidents. Engine Zone 9 jumps up by about 975 incidents.

Station 1 should be in a good position to handle the additional calls if the EMS response unit is added as recommended previously. There will be about 4,000 incidents in the engine zone each year, most of which can be divided between an engine, truck, and the EMS response unit. The units will have a very high but manageable workload.

Also, the response times need to be maintained, not just demand. The average length of calls may increase, which could adversely affect response times. When units stay out of service longer, and their area has to be covered by another unit from outside the area, this contributes to increased response times.

Recommendation 20: If demand materializes as forecast, make the EMS unit at Station 1 full time to provide coverage for Engine Zones 1 and 2. The additional EMS response unit will reduce the workload of Engines 1, 2, and Rescue 4. Here, as for every recommendation to add units, the timing can be altered depending on how fast the growth in demand actually materializes.

Station 4 is projected to have the lowest workload of the four Engine Zones in this area in 2008—but still considered high at just under 2,800 total incidents. There would not be need for an additional unit in this area yet. Rescue 4, which is located in this station, most likely will continue to experience increased demand for service but that should be somewhat mitigated by the EMS response unit proposed.

Station 9 will have a very high workload with over 3,300 incidents by 2008. However, its calls can be divided between Engine 9, Engine 13 to the north, and Truck 3. Engine 13, as discussed later in this chapter, is not busy and can easily handle more incidents.

Deployment in 2015 – The whole downtown area is projected to have a major workload problem by 2015. The four stations together could have nearly 15,500 incidents between them. Engine Zones 1 and 4 are projected to increase by at least another 250 incidents from 2008 to 2015. Engine Zones 2 and 9 also could increase by approximately 700 and 1,000 incidents, respectively.

Between Engine Zones 1 and 2, there could be more than 8,000 incidents. If these projections hold true, these two zones probably should be divided into three zones. Station 2 could remain in its current location, with Station 1 moved north and a third station placed somewhere between the two stations. The new station could serve as the headquarters station for the Tacoma Fire Department and contain an engine, truck, and medic unit. The relocated Station 1 could house an engine. Station 2 could have an engine and an EMS response unit.

With this deployment, the medic unit at the new station could serve the ALS transport demand of the downtown area. The increased demand in Engine Zone 9 will make it exceedingly difficult for the medic unit located there to continue to serve the needs of the downtown area. The EMS response unit at Station 2 will be able to provide quick first response in the downtown area while the medic unit does the transport.

Adding fire stations is expensive. The cost of the personnel is, however, a lot more than the cost of the station over time. Moving any station is traumatic for a neighborhood, especially in areas with high residential population. Another, less optimal alternative is to add the units to existing stations. On the other hand, traffic is likely to increase and reduce downtown travel times, so adding another station may be necessary to maintain travel times.

Recommendation 21: Consider dividing Engine Zones 1 and 2 into three zones circa 2015. Relocate the current Station 1 to the north and add an additional Station located between the two existing stations. Station 1 would continue to house the engine, but the EMS unit would be relocated to Station 2. Truck 1 at Station 1 would be relocated to the new station. The new station would also house a new engine company and a new medic unit. Alternatively, add the two new units proposed for this station to existing downtown stations. The need for all these could be sooner than 2015 if demand rises faster than projected.

Engine Zone 4 will still have the lowest workload of the four in 2015 – but still considered very high with just over 3,000 total incidents. If that ends up being the actual situation, there would not be a need for an additional unit in Engine Zone 4 quite yet.

With a medic unit added at the new downtown station, and the lower workload in Engine Zone 4, Rescue 4 should be relocated to Station 9 where it will be needed. The workload in Engine Zone 9 will be extremely high, with over 4,350 incidents by 2015. If the calls are divided between Engine 9, Truck 3, and the medic unit, there should be no major response problem. The EMS response units in Stations 1 and 2, as well as the medic units in the new station and Station 9 will cover the EMS needs of Engine Zone 4.

Recommendation 22: Relocate Rescue 4 to Station 9 by 2015. This assumes the added coverage in the downtown area from previous recommendations.

The Browns Point/Dash Point (BP/DP) Area

There are many beautiful, expensive homes in the residential area northwest of Station 3’s initial response area, which includes the Browns Point and Dash Point (BP/DP) communities. The average property value is $220,000. There are two volunteer fire stations up there: one is partially staffed and the other strictly volunteer. Together they comprise Fire District 13 and answer approximately 250 calls per year. Mutual aid is provided by TFD and Federal Way.

An estimated 2,700 people reside in the Fire District 13 area; another 16,000 in adjacent Northeast Tacoma. The population of NE Tacoma continues to grow.

Many of the homes right on the water have extremely poor accessibility. Many lots are steeply angled, sloping downward from the main road to the home. In several cases, homes are situated such that a vehicle would have virtually no access to fight a fire. These homes all should be fully sprinklered. They are occupied by a generally well-educated, upper class population (demographics with generally lower than average risk), but if there is a fire, there is potential for high dollar loss and spread to adjacent houses because of the difficult access.

The total annual revenues for the BP/DP Fire District 13 is approximately $375,000; $122,000 of that is obligated to debt service for the recently built fire station, remodeling of the older station, fire apparatus and Self-Contained Breathing Apparatus (SCBA). Those funds are insufficient to cover the cost of staffing a station in that area by TFD full time.

Currently, Engine 3 responds to Northeast Tacoma and BP/DP on mutual aid. Engine 15 in the Port area or another unit are automatically dispatched into the area to provide coverage or respond to assist Engine 3. As seen in Map 43, Engine 3 cannot reach all of Northeast Tacoma or BP/DP within a four-minute drive time (six-minute total response). This is one of the most significant gaps in coverage in the TFD service area.

The following recommendation is made for the good of the area, and with the understanding that politics, budget constraints or citizens' desires may preclude the implementation of this recommendation. In the opinion of the study team, it is in the best interest of the region to implement it as soon as possible.

Recommendation 23: The City of Tacoma should contract with Fire District 13 for TFD to provide full-time fire/EMS protection for BP/DP. A financial cost-sharing arrangement should be negotiated between District 13 and TFD for this service. It would be more efficient and effective if the BP/DP area were covered by TFD, but if not they should either augment their own coverage or install more sprinklers.

Recommendation 24: The Fire District 13 volunteers and TFD Station 3 firefighters should launch a public education campaign in Northeast Tacoma and BP/DP about fire prevention and the importance of having homes retrofitted for sprinklers. They are at risk from fire, and there are ways to reduce the risk.

Northeast Tacoma and Fife (Stations 3 and 12)

Stations 3 and 12 protect the eastern end of the TFD service area. Station 3 covers the northeast section of the City, and when the Hylebos Bridge was operating, could respond directly into the furthest east "finger" of the Port area. Station 12 is located to the south of Station 3. Station 12 not only protects its own area but also is one of the first stations that would assist in the Port area since it can respond straight up to it.

In 2003, Engine Zone 3 had only 829 incidents. Station 3 houses only an engine, but it is an ALS-staffed engine. Engine 3 has one of the largest coverage areas. In fact, a large percentage of its coverage area cannot be reached within a 4-minute drive time as was shown in Map 43.

The inability of Engine 3 to respond to a large percentage of its response area within 4 minutes drive time is of concern, but the low workload makes it hard to justify an additional unit at present. The response times in Engine Zone 3 area do need to be monitored closely.

With the recommended consolidation of Stations 6 and 15 into one Port area station, Zone 3's closest backup (Engine 15) would be eliminated. Two-thirds of Engine 15's calls are into Zone 3 (mostly for backup). Given the lengthy response times to Northeast Tacoma, the best alternative is the BP/DP contract arrangement (as discussed previously). If that is not an option, a 2-person EMS response unit should be added if and when Engine 15 is consolidated into the new Port area station.

Recommendation 25: Consider adding an 2-person EMS response unit in Engine Zone 3 if response times become excessive after the Port area stations are consolidated and if a contract agreement is not reached with District 13. Besides the size of the coverage area, Northeast Tacoma has an aging population, which generally utilize EMS more, which could lead to response time deterioration.

In 2003, Engine Zone 12 had more than twice as many incidents as Engine Zone 3, but still moderate workload at just under 1,700 incidents for the year. Besides Engine 12, Station 12 houses Truck 4, Rescue 3, and the Hazmat unit. In the previous chapter, it was recommended that the hazmat unit and Truck 4 be moved to the new Port area station.

Truck 4 responded to about 519 calls in 2003. If the City builds the recommended Port area station, Truck 4 should be relocated to that station. It would provide better response into the Port area, and still be able to respond back into Engine Zones 2, 3, and 11. For many calls the response time would be improved. The difference is seen in the comparison of the 6-minute responses from the consolidated port station and Station 12 in Map 44 and Map 45.

Recommendation 26: If the City builds the recommended Port area station, Truck 4 should be relocated to that new station. This will improve response time to almost all of Truck 4's current coverage area, and provide better response into the downtown area if a major incident occurs there in which multiple of the trucks would be needed. This assumes the move can be negotiated under the terms of the Fife/District 10 contract that oversees Engine Zone 12 service.

No other changes are presently needed in this area.

Deployment in 2008 – By 2008, there could be approximately 3,250 incidents between Stations 3 and 12.

Engine Zone 12 should be in a good position to handle most of the additional incidents even if its truck is moved to the Port area by this time. With the medic unit located there Station 12 will be able to continue cover its area adequately.

Engine Zone 3 will still not have a high enough workload to warrant any additional changes.

Deployment in 2015 – As predicted in the workload chapter, there will be approximately 3,750 incidents between these two stations by 2015. Engine Zones 3 and 12 should continue to be able to handle that workload between them, though response time might increase and need to be monitored.

If BP/DP is being protected full time by TFD, as recommended earlier, the unit in that area would be able to handle the calls in Northeast Tacoma, which will lighten the workload in Zone 3 and improve response times even more. If still no BP/DP contract, it should be reconsidered at this point.

The medic unit at Station 12 will be able to continue handling transport and no additional units should be needed in this area.

South and Southeast (Stations 7, 8, 10 and 11)

Stations 7, 8, 10, and 11 protect the southern section of the TFD service area. Station 10 has the highest workload in the entire service area. This station has the highest population in its initial response area. The current level of calls is such that an increasing number are answered by a station in the adjoining districts resulting in longer response times. With Station 11 to the northeast of Station 10 having one of the next highest zone workloads in the city, supplemental response to these two areas either needs to come from the downtown area to the north or Stations 7 or 8 to the west and the south.

In 2003, Engine Zone 7 and Engine Zone 8 each had about 2,400 incidents. Station 8 also houses Truck 2, which ran almost 1,500 calls in 2003, and Rescue 2, which ran almost 3,300 calls. Engine Zone 10 had about 4,400 incidents. Engine Zone 11 had about 3,400 incidents. Due to the increased demand in this area, the Tacoma Fire Department added Rescue 5 to Station 11 in mid-2003.

The 4-minute response time overlay of the units in the southern region is depicted in Map 46. Although there is much overlap of units covering Engine Zone 8 within 4 minutes drive time, most of Engine Zones 7, 10, and 11 can be reached only by the unit in that zone within 4 minutes drive time. There is a small area in each of those three zones that units cannot reach within 4 minutes drive time. This would not be an issue if the engine zone workloads were not so high. Engine Zones 10 and 11, two of the highest workload zones in the city, do not have a second unit nearby that can cover for them within 4 minutes drive time in most of their area. Like the downtown area, a high amount of overlap is needed to help keep the area protected adequately.

A cost-effective, short-term solution would be to introduce a 12-hour, two-person EMS response unit at Station 10 during the peak call hours. This could take a considerable part of the workload off of Engines 10 and 11 at the cost of effectively one additional FTE firefighter instead of adding a full unit.

Recommendation 27: Add an EMS response unit at Station 10 during peak call hours. The unit would be available to respond on EMS calls, and also assist on fire calls. The unit could be housed at the shed located behind Station 10, if some retrofitting were done to the facility. Crew quarters also will have to be modified to accommodate the additional staff.

The deployment of the medic units in this area seems appropriate. Map 47 shows the overlaid 6-minute drive time ranges of both Rescue 2 and Rescue 5. With Rescue 5 being a new unit, there is not enough data yet to determine whether the current division of the initial response area is the best. Rescue 5 is covering almost all of Zone 11 and part of Zone 10, and Rescue 2 is covering the balance, so a high demand section of residential population is well-covered by ALS transport first-response.

The addition of an EMS response vehicle at Station 10 will help alleviate the workload on Rescues 2 and 5. If the EMS response unit is dispatched to basic BLS calls, the two medic units will be left available for more serious ALS incidents.

Truck 2 at Station 8 also can help reduce the workload in Station 10 and 11. As seen in Map 48, Engine 8 or Truck 2 can respond to a portion of Station 10's first-due within 4-minutes. With Truck 2 not being very busy in 2003, it could be utilized when needed in Station 10's initial response area.

Deployment in 2008 – By 2008, there could be almost 15,000 incidents between these four stations. Stations 7 and 8 are each projected to increase by about 300 to 400 incidents. Station 10 will see the largest increase—an increase of another 868 incidents from 2003 to 2008. Station 11 will jump up by another 564 incidents.

By 2008, this area probably will need a fifth station due to the workload in Station 10 and 11's initial response area. By adding an additional station, the workload of Station 10 and 11 would be eased somewhat. Station 11 would ideally be relocated a little further northeast—toward the Port area. The new station should be built between Station 10 and 11. There would be considerable overlap in coverage area, but with a projected workload of over 9,200 incidents in those two Engine Zones, that is needed.

Recommendation 28: If the workload materializes as projected, relocate Station 11 a little further northeast and add a new station between Station 10 and the relocated Station 11. Station 10 would continue to house Engine 10. The EMS peak-hour unit could be taken out of service, because of the addition of the new engine in the new station. Station 11 should continue to house Engine 11. The new station could house Rescue 5 along with the new engine just mentioned.

Stations 7 and 8 will still be in a good position to respond to their projected workload. With approximately 2,800 incidents in each station's initial response area, Engine 7, Engine 8, Truck 2, and Rescue 2 should be able to handle the workload. With the extremely high workload in Zones 10 and 11, response time in areas 7 and 8 could be impacted, and should be monitored closely. If response times are negatively impacted, consideration should be given to adding an EMS response unit in Station 7.

Recommendation 29: Continue to monitor response times for the units in Stations 7 and 8 and consider adding an EMS response unit at Station 7 if the response times get excessive. The threshold for considering this would be when response times consistently fail to meet established goals (e.g. for ALS, an overall response time of 8 minutes 80% of the time).

Deployment in 2015 – Engine Zone 7 is projected to meet or exceed approximately 3,500 incidents by 2015, while Engine Zone 8 is projected to have more than 3,100 incidents. Engine Zones 10, 11, including the proposed new station, are projected to have a total workload reaching 11,000 incidents by 2015.

If an EMS response unit has not been added to Station 7 by 2015, it should be added at this point to help reduce the total workload of Rescue 2, Engine 7, and Engine 8. Between the EMS response unit, the medic unit, and two engines, the area will remain well protected, especially if a new downtown station is added as recommended. If a new downtown station is built, Station 2 will be able to assist in Station 8's initial response area.

Recommendation 30: Add an EMS response unit at Station 7 by 2015, if not needed earlier.

With the addition of a station between Station 10 and relocated Station 11, the units assigned there should be able to handle the incidents despite the high workload. As recommended previously, it is important to monitor response times. If response times get excessive, consideration should be given to adding an EMS response vehicle at Station 10 to lighten the EMS workload of the engines and Rescue 5.

Recommendation 31: Monitor response times for the units in Stations 10, 11, and the new station and consider utilizing the peak-hour EMS response unit at Station 10 again if needed.

North End, West End, and Fircrest (Stations 13, 14, 16, and 17) and University Place

Stations 13, 14, 16, and 17 cover the northern and western section of the TFD service area. Engine Zone 13 had 1,404 incidents in 2003. Engine Zone 14 had 1,337 incidents in 2003. Both Stations 13 and 14 house just one engine. Engine Zone 16 had the highest workload in this area at just over 2,800 incidents. Station 16 is home to Engine 16 and Rescue Unit 1. Rescue 1 protects the whole northwestern area of the TFD service area fire district. Engine Zone 17 is at the border of University Place (discussed later) and ran 1,726 incidents in 2003. Station 17 has an ALS engine. The 4-minute drive time overlay map for this response area is shown in Map 49.

This region is well-covered. In fact, there is unused capacity in this area right now. The current workload between the four stations (13, 14, 16, 17) by itself does not justify four full time units; however, the area covered necessitates it.

Between Engine 1, 9, 14, and 16, virtually all of Engine 13's initial response area can be covered within a 4-minute drive time without Engine 13 itself. The only area that is not covered is a small portion of the shoreline that used to be home to Station 5. This is seen in the 4-minute overlay of Stations 1, 9, 14, and 16 in Map 50.

On the other hand, Engine Zone 1 already has an extremely high workload and cannot be counted on for E13 coverage. The workloads of Engine Zones 9 and 16 are very high as well. Due to its location, Engine 14 has a low first on-scene percentage in its own initial response area, a measure of its ability to get to a scene within the 4-minute drive time goal. As the unit workloads increase, they will require more coverage from out of zone and that contributes to increased response times. In addition, the area is home to some of Tacoma's oldest structures and an older residential population. Demand for service there is projected to exceed the current capacity by 2015.

Recommendation 32: Monitor the annual workload of Station 13 with special attention to growth in demand for EMS services and the impact of the workload of surrounding engine zones. If the workload projections do not materialize, alternative deployment for its area should be considered to improve efficiency.[35]

The only other area in this region for which deployment or response protocols should be changed is Station 16's initial response area. Engine 16 has a very high workload, but if Rescue 1, which ran almost 2,405 calls in 2003, handled more EMS first response calls, Engine 16's workload could be reduced. This would have to be balanced against ensuring that Rescue 1, by taking additional EMS calls, would still be available for ALS calls, its primary mission, and for coverage to outlying areas.

Deployment in 2008 – This region is projected to get busier by 2008, but not be overloaded. Engine Zones 13 and 14 are projected to be at approximately 1,650 incidents per year. Zone 16 is expected to reach 3,400 incidents per year, while Zone 17 could approach 2,100 incidents. If Rescue 1 is able to handle more EMS first response for Engine 16, there most likely will not be any changes needed in 2008 in this region.

Recommendation 33: Monitor EMS response times at Station 16, and if they get excessive, consider adding an EMS response unit. More than likely, this will not be needed, but that should be dictated by response times and actual demand levels.

Deployment in 2015 – This region will begin to reach the very high workload level by 2015, but it still will not be overloaded collectively. Engine Zone 13 and 14 could each have about 2,000 incidents. Engine Zone 16 is expected to see an 800 incident increase from 2008 and reach 4,250 incidents per year. Engine Zone 17 also could see almost a 500 incident increase to 2,500 incidents.

Engine 14 will continue to be able to handle their projected workload as it is. If any reductions are made at Station 13, by 2015 they would most likely need to return to

[35] It is useful for the overall city-wide system to have one or two units not totally overloaded that can be used to fill in for others when needed for training, etc. Engine 13 is a candidate for that role occasionally—in the whole western half of the city.

full staffing. With approximately 2,000 calls and Station 14's workload increasing, and Stations 9 and 16 at very high workloads, Station 13 will not be able to rely on other units reaching its initial response area within a 4-minute drive time much of the time.

The strategy for protection in Station 16 and 17's initial response areas will be affected by what happens in University Place (discussed below). If TFD contracts to provide service to this area and has an engine and medic unit at University Place that is not overloaded, adding just an EMS response unit at Station 16 could be sufficient to handle the increased workload by 2015 (if not already done earlier). If University Place is overloaded, or TFD does not provide its fire/EMS protection, then an EMS response unit at both Station 16 and 17 could be necessary to provide adequate EMS first response. With Engine 17 being an ALS engine, the EMS response unit could be staffed with the firefighter/paramedic from that engine, and two firefighter/EMTs placed on the engine.

Recommendation 34: Add either one or two EMS response units between Stations 16 and 17, depending on the workload in University Place and response times in this area. Two units would be necessary only if the EMS response unit was not added to Station 16 in 2008, as previously recommended.

University Place – University Place, southwest of Tacoma, is primarily a residential community with little or no industry. It currently has one station housing an engine, a rescue unit and a battalion chief with full time staffing of six people. This force is augmented by a volunteer component. TFD Engines 16, 17, and 7 frequently respond into University Place as part of mutual aid.

The geographic location of University Place and its proximity to TFD's service area provides an ideal opportunity for partnering in the provision of fire and emergency medical services to enhance service capabilities to the residents of both communities. The workloads of the University Place station and Stations 16 and 17 are projected to increase in the near future. The partnership would assist both communities to more effectively absorb that increased workload without immediately resorting to the addition of new units.

Recommendation 35: If the University Place region will pay the costs for labor, supplies, and upkeep of the vehicles, the Tacoma Fire Department should contract to provide fire/EMS protection to this service area. This would be beneficial to both jurisdictions.

Summary of Station and Unit Recommendations

The recommendations made throughout this chapter, and summarized in Table 32, were based on demand projections made in 2003-4. As mentioned throughout the chapter, the actual workload and response time circumstances should dictate the timing and nature of changes made to stations and units. If the demand increases quicker than projected, the recommendations may need to be expedited. If demand levels drop off or do not rise as quickly as projected then introduction of new units can be slowed.

Table 32: Summary of Station and Unit Deployment Recommendations

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Station 1 901 Fawcett Ave.	Engine 1 Truck 1	Add 1 peak-hour EMS response vehicle.	Make EMS vehicle full time. Add BC 184 and ISO.	Relocate T1 to new downtown station. Relocate EMS unit to Station 2.
Station 2 2701 Tacoma Ave. So.	Engine 2 BC 182	Relocate BC 182 and ISO to Station 8.	No change.	Add EMS response vehicle from Station 1.
Station 3 206 Browns Pt. Blvd.	Engine 3	Add a 2-person response vehicle.[36]	No change.	No change.
Station 4 1453 So. 12th	Engine 4 Rescue 4	No change.	No change.	Relocate Rescue 4 to Station 9
Station 5 3301 Ruston Way		Moor Fireboat Defiance (with staff).	No change.	No change.
Station 6 1015 East F	Engine 6 SU 49 (17' Boston Whaler)[37]	Station 6 consolidated with Station 15 as new Port Station Y.	No change.	No change.
Station 7 5448 So. Warner	Engine 7	No change.	Add 1 EMS response vehicle. Add BC 182 and ISO.	No change.
Station 8 4911 So. Alaska	Engine 8 Truck 2 Rescue 2 SU 48 (Technical Rescue)	Add BC 182 and ISO.	Relocate BC 182 and ISO to Station 7.	No change.
Station 9 3502 6th Ave.	Engine 9 Truck 3 BC 181	No change.	Relocate BC 181 and ISO to Station 13.	Add Rescue 4.

[36] This unit would not be needed if an agreement is reached with BP/DP to add a TFD unit there, or the Hylebos Bridge is fixed and the port station is not consolidated.
[37] A new home also would be needed for storing the vehicle.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Station 10 7247 So. Park	Engine 10	Add 1 peak-hour EMS response vehicle.	Redeploy peak hour unit.[38]	Add 1 peak-hour EMS response vehicle.
Station 11 3802 McKinley Ave.	Engine 11 Rescue 5	No change.	Relocate Rescue 5 to new south central station.	No change.
Station 12 2015 54th Ave. E. Fife	Engine 12 Truck 4 Rescue 3 SU44 (Hazmat Unit)	Relocate Truck 4 and Hazmat to new port station. Add BC 183 and ISO.	No change.	No change.
Station 13 3825 No. 25th	Engine 13	Consider alternative deployment for Engine 13.	Add BC 181 and ISO.	Add Engine 13 back if previously subject to alternative deployment.
Station 14 4701 No. 41st	Engine 14	No change.	No change.	No change.
Station 15 3510 E. 11th	Engine 15 SU 45 (Water Tender)	Station 15 consolidated with Station 6 as new Port Station Y.	No change.	No change.
Station 16 7217 6th Ave.	Engine 16 Rescue 1	No change.	Add 1 EMS Response Vehicle	No change.
Station 17 302 Regents Blvd. Fircrest	Engine 17 SU 42 (Mobile Air Unit)	No change.	No change.	Add 1 EMS Response Vehicle
Station 18 302 E. 11th	Fireboat Defiance Fireboat Commencement	Relocate Fireboat Defiance to Station 5 with staff. Either leave Commencement at Station 18 or build new facility for it (unstaffed).	No change.	No change.
New Station X: Downtown				Build Station. Add Truck 1. Add Engine X. Add Rescue X.

[38] The vehicle and staff could be used for implementing one of the newly added full-time EMS response vehicles in Stations 3, 7, or 16. The new station between 10 and 11 will reduce the EMS workload at Station 10.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
New Station Y: Tideflats		Build Station. Add Engine 6 (3 staff) Add Engine 15 (reserve - unstaffed). Add Truck 4 (4 staff). Add EMS unit (cross-staffed). Add Hazmat unit (cross-staffed). Add Water Tender (cross-staffed).	No changes.	No changes.
New Station Z: South Central area			Build Station. Add Engine Z. Add Rescue 5.	No changes.
Browns Point / Dash Point	No TFD full time protection.	Contract so TFD provides full time protection with at least one engine	No changes.	No changes.

The cumulative impact of the above recommendations on unit and staffing is shown in Table 33. Overall, the report recommends an increase of on-duty staffing by 32 percent between now and 2015, to handle a projected increase in demand of approximately 31 percent and population increase of approximately 25 percent. Some of the changes are needed now to help deal with current workloads; most are to provide relief in the future as the population and demand increases.

In summary, the Tacoma Fire Department has been doing an excellent job of deploying its units. There is considerable capacity to handle more calls with the existing resources in some parts of the city while other areas are at or beyond capacity and require mitigation soon. As population and call volumes increase, more units and some new stations will be needed to maintain adequate response times. Two-person ALS-capable EMS response units, in some cases just at peak-times, can be added gradually to keep workloads manageable. That should be the main near- and intermediate future strategy. This study gives specific examples that hopefully will stimulate further discussion of future options.

Table 33: Unit and Staffing Totals Per Shift

Unit	Current Units	Current Shift Staffing	2004-05		By 2008		By 2015	
			Recommended Units	Recommended FTE Staffing	Recommended Units	Recommended FTE Staffing	Recommended Units	Recommended FTE Staffing
Engines	16	48	15	45	16	48	17	51
Trucks	4	12	4	13	4	13	4	13
Rescue	5	10	5	10	5	10	6	12
EMS response vehicle (new)	0	0	4	4[39]	5	8[40]	7	11[41]
Battalion Chief/ISO	2	4	3	6	4	8	4	8
Specialty units	5	0	5	0	5	0	5	0
Fireboats	2	0	2	3	2	3	2	3
TOTALS	34	74	38	81	41	90	45	98

[39] Units are peak time (1 FTE) at Stations 1 and 10, fulltime at Station 3, and cross-staffed at Port area Station.
[40] Units are fulltime at Stations 1, 3, 7, and 16, and cross-staffed at Port area Station.
[41] Units are peak time at Station 10, fulltime at Stations 2, 3, 7, 16, and 17, and cross-staffed at Port area Station.

VI. SUPPORT FACILITIES

Fire departments, like armies, require a number of support services to ensure their efficiency and effectiveness. The quality of the support functions can either enhance or decrease productivity of the department.

The Tacoma Fire Department leadership is well aware of the need for adequate support services and, in particular, adequate facilities for the support services. As part of this study, we were asked to review the current facilities and determine whether they are adequate for a department the size of Tacoma. Included here are:

- Training facility
- Communications facility
- Garage and warehouse space
- Administrative office space
- Fire prevention office space
- Electrical Division

The fire stations and fireboat basing were discussed in the Chapter 5.

Some of these facilities are adequate for the needs of the City; however, there are several that need to be renovated and/or enlarged. There also are consolidation possibilities.

Training Facility

The fire department developed a new training facility in 1998. It is a flexible building for conducting simultaneous classroom sessions or one large session. It is reasonably well located in the port area. The location is somewhat important for reducing travel time from various stations to the training center, because it affects the amount of time they are out of service and either require backups from neighboring stations or leave areas unattended, which may result in longer response times.

The three individual classroom spaces can each hold a class of about 35. This has proven to be reasonably adequate. However, the facility did not include any capability for live fire training, evolutions, or other hands-on training outside the classroom.

On the site, the outdoor training facility has a traditional multi-story training tower but does not have a special burn room, nor an updated facilities for practicing firefighting. The training tower was built around 1961. When a class on confined space operations was conducted, a special trailer unit had to be brought in from Bates Voc-Tech to make it possible to do "hands on" training evolutions. A more modern, up-to-date training tower or building would include this capability. Not having adequate live fire training is an increasing problem as the number of structural fires decreases, and thus on-the-job firefighting experience also decreases. More training is needed in realistic situations to be prepared for fires. Ultimately 3-D virtual reality simulators may be available, but they are not there yet.

Recommendation 36: Construct a new training tower. It should provide the capability to conduct aerial equipment and confined space exercises as well as firefighting in interior rooms, balconies, stairways, fire escapes, and on a flat roof and various pitched roofs. The height should be typical of the buildings in the City and Port area. A variety of window types, a standpipe system, and the ability to introduce smoke would be desirable. NFPA Standard 1402, Chapter 9 provides more detailed recommendations on building a training tower, including photographs and suggested floor plans for consideration.[42]

Fire Communications

Overall, the Communications Center currently handling TFD calls is well laid out and appears to function well. This facility, however, needs to be expanded. The expansion should include improved restroom facilities (currently there is one shared bathroom), a training room (currently there is none), increased dispatcher quarters, and more advanced fire protection. There is ample space in the vacant Emergency Operations Building adjacent to the communications facility to accommodate this expansion.

Recommendation 37: Expand the current Fire Communications Center to provide more restrooms, training space, and fire protection. The City should quickly move forward with these plans to renovate the Fire Communications Center.

Fire Garage

The fire garage is the primary facility for maintaining fire vehicles. It is located at the city's solid waste landfill near the Traffic Signal Sign Shop at 35th and Mullen Street. The fire garage is well managed but its space limitations are causing problems, and they will get worse.

[42] Much of the information on this training tower comes the NFPA Handbook.

The garage has only three bays. Three shipping containers on the property are used for additional storage. A modern garage with six bays is needed.

While the garage is kept as clean and orderly as possible in such cramped space, the crowded environment is a safety issue and also affects productivity. Parts are stacked and stored in every possible location, including the floor of the bays. More working space for vehicles is an urgent need, important to allow quicker turn around for small repairs and preventive maintenance of fire vehicles. This practice helps return apparatus to service quickly, which affects response times to some extent.

The need to improve or replace this facility is the highest priority among all the support facility issues considered in this study. The municipal sign shop has expressed the desire to use the current fire garage space to expand for its needs if the TFD moves to larger space. Even better, the garage space could be used for a centralized TFD warehouse. This would eliminate the many satellite storage spaces being used, and greatly increase the efficiency of the warehouse operation. The department’s messenger presently operates from the garage facility and could continue to do so if the space was converted solely to warehousing.

An ideal location for a new fire garage would be near the training center. Units could then bring vehicles in for preventive maintenance while engaged in classroom training, saving time.

Recommendation 38: Construct a new fire garage. Putting it near the existing training center would be highly efficient.

Warehousing for Supplies

All fire departments have a need for space to store the tools of the business and supplies for stations, which are also living quarters. EMS equipment and supplies, fire prevention materials, specialty supplies associated with hazardous materials responses and technical rescue, and consumables for firefighting (such as foam) are just some of the many supplies a sophisticated fire department like TFD uses**.**

TFD presently uses a number of distributed facilities and some old unstaffed fire stations to store or warehouse its supplies, equipment, and materials. Old fire Station 12 (2316 East 11th Street) is currently used as storage for station and other supplies. The basement of Station 8 has a storage area for EMS and prevention supplies.

Firefighter protective gear is stored at fire headquarters, but this is not a good arrangement because the chiefs themselves have to spend too much time issuing turnout gear to firefighters. That time could be better used for supervising the suppression force. The distribution of this gear can and should be absorbed into a general TFD warehouse.

The biggest concern the study team had with warehousing was how spread out the supplies are at present. Table 34 shows the locations where supplies are being housed. The fire units have to make trips to many places, and it is more difficult to account for the supplies, and more wasteful in time to manage them.

Table 34: Current TFD Warehouse Array

Station/Site	Supplies Warehoused
Station 16	EMS pharmaceuticals
Garage	Class “A” Foam
Station 8	Fire Prevention material, EMS supplies
Station 17	Breathing air resupply facility
Station 2	Oxygen resupply facility
Station 12 (old)	Janitorial & Office supplies
Garage	Janitorial & Office supplies – Small parts & tires
Fire Headquarters	Firefighter protective gear
Station 6	Class “B” Foam
Training Center	Class B and seasonal uniforms
Station 7	O2 regulators and demand valves; oxygen supplies and equipment

A more efficient plan would be having one centralized warehouse facility with adequate staffing to handle all of the department’s storage needs. Ideally this facility would be centrally located and near a fire station. Absent a central location, the TFD should place the warehouse near the training center or garage so units can pick up supplies while visiting these sites.

Recommendation 39: Create a centralized warehouse, with adequate staffing, located near a current fire station, and close down the various scattered sites. The warehouse should have an inventory control system. There are many off-the-shelf software packages that can be purchased. If the warehouse is located near a fire station, then even in the middle of the night when the warehouse staff is not available, the station officer could assist with filling an emergency need for supplies. The Philadelphia Fire Department’s supply warehouse operates under this type of setup. Another alternative is to use the fire garage building for this warehouse, if the fire garage function is relocated (see Recommendation 38 above).

Administrative Office Space

The TFD headquarters building is fully utilized and out of space. The space shortages critically impact three units. In addition to fire headquarters personnel, the information services unit is in an undesirable space on the mezzanine. The Fire Prevention and Education staff are not housed at headquarters, but preferably should be close or co-located for better integration of prevention with operations, and getting prevention more involved in fire department strategic planning instead of being geographically and functionally isolated.

Recommendation 40: Expand the current fire headquarters or obtain a new building. This could be done in conjunction with building the new downtown station as recommended for 2015. The cost of remodeling the current facility versus building a new facility needs to be considered.

Fire Prevention

The Fire Prevention Bureau is located in a former fire station (Station 17) on the west side of the city. The use of this facility as prevention headquarters was supposed to have been temporary and not the long-term situation it has turned out to be.

The location of prevention at Station 17 is less than ideal. It is inefficient for inspectors to travel to assignments in the eastern half of the city from this location. Its location impairs coordination with fire department headquarters. TFD's inspectors and the City's building staff have good working relationships despite not being in close proximity.

Recommendation 41: Locate fire prevention either in fire departments, or a central location near headquarters and the building department.

Electrical Division

Electrical Division personnel are currently housed in a building at South 23rd and Holgate. The Electrical Division would be better located next to the Fire Communications Center adjacent to their shop, possibly combined with Information Services into a computer support group. The electrical staff and IS staff could then share technologies and work together more closely. This also would reduce crowding at fire headquarters.

Recommendation 42: Relocate the electrical division to one location next to the current Fire Communications building at 425 Tacoma Avenue South (old fire station) or co-locate with TFD's IS staff at 421 Tacoma Avenue South. In either place, their office space would have to be separate from vehicle and supply storage.

VII. SUMMARY OF RECOMMENDATIONS

This report includes 42 recommendations for improving the Tacoma Fire Department. Some are low-cost or no-cost, while some require considerable planning and resources.

Table 35 is a comprehensive list of the formal recommendations. Some other suggestions and recommendations are embedded in the text. A summary of the deployment and station location recommendations by year of implementation is shown in Table 36.

Table 35: Project Recommendations

CHAPTER II: Current Fire and EMS Operations
1. Add one additional Battalion Chief with an Incident Safety Officer now and a second in the next decade, as demand for service dictates.
2. Continue to maintain a reserve capacity of at least 25 percent of the front line fleet.
3. Compare the amount of time it takes for initial units to arrive on the scene of a working fire vs. the amount of time it takes for four firefighters on one unit to arrive to satisfy the "Two-in, Two-out" rule.
4. Automatic Electronic Defibrillators should be placed on the Battalion Chiefs' vehicles.
5. Monitor the new dispatch procedures and staffing to determine if dispatch times have been reduced.
6. Monitor improvement in turnout times in 2004.
7. Continue to maintain the excellent average ALS response time as demand and population grow.
CHAPTER III: Workload and Demand Analysis
8. TFD should review call types by census tract and target its prevention program based on needs in each specific region of the service area.
9. TFD should continue to analyze automatic alarm incidents and implement measures to decrease their number.
CHAPTER IV: Tideflats Facility and Unit Deployment
10. Continue the practice of requiring sprinklers in new structures and consider the possibility of retrofitting the older structures.
11. Ensure that emergency access is maintained throughout the areas where containers are stacked, and around all industrial buildings and piles of combustible materials.
12. Consolidate and relocate Stations 6 and 15 into a new station to be built near the vicinity of State Route 509 and Port of Tacoma Road.
13. Redeploy units and staff for the new Tideflats station as discussed in the chapter.

14. Fire department and city emergency management personnel should develop an evacuation route procedure for various scenarios and disseminate it to the businesses in the Tideflats.
15. The Tacoma Fire Department should be consulted before road changes are implemented because of evacuation route concerns, as well as for emergency vehicle response access.
16. Consider bulkhead connections at strategic locations along the Tacoma shoreline to be supplied by the fireboat.
17. The TFD should overhaul at least Fireboat Defiance, if not both boats.
18. Repair Station 5 and base Fireboat Defiance there with full-time staffing.
CHAPTER V: Station Location and Unit Deployment Outside the Tideflats
19. Add a peak-hour EMS response unit at Station 1 to help alleviate the downtown workload.
20. If demand materializes as forecast, make the EMS unit at Station 1 full time to provide coverage for Engine Zones 1 and 2**.**
21. Consider dividing Engine Zones 1 and 2 into three zones circa 2015.
22. Relocate Rescue 4 to Station 9 by 2015.
23. The City of Tacoma should contract with Fire District 13 for TFD to provide full-time fire/EMS protection for BP/DP.
24. The Fire District 13 volunteers and TFD Station 3 firefighters should launch a public education campaign in Northeast Tacoma and BP/DP about fire prevention and the importance of having homes retrofitted for sprinklers.
25. Consider adding an 2-person response unit in Engine Zone 3 if response times become excessive after the port stations are consolidated and a contract agreement is not reached with District 13.
26. If the City builds the recommended Port area station, Truck 4 should be relocated to that new station.
27. Add an EMS response unit at Station 10 during peak call hours.
28. If the workload materializes as projected, relocate Station 11 a little further northeast and add a new station between Station 10 and the relocated Station 11.
29. Continue to monitor response times for the units in Stations 7 and 8 and consider adding an EMS response unit at Station 7 if the response times get excessive.
30. Add an EMS response unit at Station 7 by 2015, if not needed earlier.
31. Monitor response times for the units in Stations 10, 11, and the new station and consider utilizing the peak-hour EMS response unit at Station 10 again if needed.
32. Monitor the annual workload of Station 13 with special attention to growth in demand for EMS services and the impact of the workload of surrounding engine zones.
33. Monitor EMS response times at Station 16, and if they get excessive, consider adding an EMS response unit.

34. Add either one or two EMS response units between Stations 16 and 17, depending on the workload in University Place and response times in this area.
35. If the University Place region will pay the costs for labor, supplies, and upkeep of the vehicles, the Tacoma Fire Department should contract to provide fire/EMS protection to this service area.
CHAPTER VI: Support Facilities
36. Construct a new training tower.
37. Expand the current Fire Communications Center to provide more restrooms, training space, and fire protection.
38. Construct a new fire garage. Putting it near the existing training center would be highly efficient.
39. Create a centralized warehouse, with adequate staffing, located near a current fire station, and close down the various scattered sites.
40. Expand the current fire headquarters or obtain a new building.
41. Locate fire prevention either in fire department headquarters, or a central location near headquarters and the building department.
42. Relocate the electrical division to one location next to the current Fire Communications building at 425 Tacoma Avenue South (old fire station) or co-locate with TFD's IS staff at 421 Tacoma Avenue South.

Table 36: Station Location and Deployment Recommendations

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Station 1 901 Fawcett Ave.	Engine 1 Truck 1	Add 1 peak-hour EMS response vehicle. NEW	Make EMS vehicle full time. Add BC 184 and ISO. NEW	Relocate T1 to new downtown station. Relocate EMS unit to Station 2.
Station 2 2701 Tacoma Ave. So.	Engine 2 BC 182	Relocate BC 182 and ISO to Station 8.	No change.	Add EMS response vehicle relocated from Station 1.
Station 3 206 Browns Pt. Blvd.	Engine 3	Add a 2-person response vehicle.[43] NEW	No change.	No change.
Station 4 1453 So. 12th	Engine 4 Rescue 4	No change.	No change.	Relocate Rescue 4 to Station 9

[43] This unit would not be needed if an agreement is reached with BP/DP to add a TFD unit there, or the Hylebos Bridge is fixed and the proposed Pport area station is not implemented.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Station 5 3301 Ruston Way		Moor Fireboat Defiance (with staff).	No change.	No change.
Station 6 1015 East F	Engine 6 SU 49 (17' Boston Whaler) [44]	Station 6 consolidated with Station 15 as new Port Station Y.	No change.	No change.
Station 7 5448 So. Warner	Engine 7	No change.	Add 1 EMS response vehicle. NEW Add BC 182 and ISO relocated from Station 8.	No change.
Station 8 4911 So. Alaska	Engine 8 Truck 2 Rescue 2 SU 48 (Technical Rescue)	Add BC 182 and ISO relocated from Station 2.	Relocate BC 182 and ISO to Station 7.	No change.
Station 9 3502 6th Ave.	Engine 9 Truck 3 BC 181	No change.	Relocate BC 181 and ISO to Station 13.	Add Rescue 4 relocated from Station 4.
Station 10 7247 So. Park	Engine 10	Add 1 peak-hour EMS response vehicle. NEW	Redeploy peak hour unit.[45]	Add 1 peak-hour EMS response vehicle. NEW
Station 11 3802 McKinley Ave.	Engine 11 Rescue 5	No change.	Relocate Rescue 5 to new south central station.	No change.

[44] A new home also would be needed for storing the vehicle.
[45] The vehicle and staff could be used for implementing one of the newly added full-time EMS response vehicles in Stations 3, 7, or 16. The new station between 10 and 11 will reduce the EMS workload at Station 10.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Station 12 2015 54th Ave. E. Fife	Engine 12 Truck 4 Rescue 3 SU44 (Hazmat Unit)	Relocate Truck 4 and Hazmat to new Port area station. Add BC 183 and ISO. NEW	No change.	No change.
Station 13 3825 No. 25th	Engine 13	Consider alternative deployment for Engine 13.	Add BC 181 and ISO relocated from Station 9.	Add Engine 13 back if previously subjected to alternative deployment
Station 14 4701 No. 41st	Engine 14	No change.	No change.	No change.
Station 15 3510 E. 11th	Engine 15 SU 45 (Water Tender)	Station 15 consolidated with Station 6 as new Port Station Y.	No change.	No change.
Station 16 7217 6th Ave.	Engine 16 Rescue 1	No change.	Add 1 EMS Response Vehicle. NEW	No change.
Station 17 302 Regents Blvd. Fircrest	Engine 17 SU 42 (Mobile Air Unit)	No change.	No change.	Add 1 EMS Response Vehicle. NEW
Station 18 302 E. 11th	Fireboat Defiance Fireboat Commencement	Relocate Fireboat Defiance to Station 5 with staff. Either leave Commencement at Station 18 or build new facility for it (unstaffed).	No change.	No change.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
New Station X: Downtown				Build Station. Add Truck 1.relocated from Station 1 Add Engine X. NEW Add Rescue X. NEW
New Station Y: Tideflats		Build Station. Add Engine 6 (3 staff) relocated from Station 6 Store Engine 15 relocated from Station 15 (unstaffed). Add Truck 4 relocated from Station 12 (4 staff). Add EMS unit (cross-staffed). NEW Add Hazmat unit relocated from Station 12 (cross-staffed). Add Water Tender relocated from Station 15 (cross-staffed).	No changes.	No changes.

Stations	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
New Station Z: South Central area			Build Station. Add Engine Z. NEW Add Rescue 5 relocated from Station 11.	No changes.
Browns Point / Dash Point	No TFD full time protection.	Contract so TFD provides full time protection with at least one engine	No changes.	No changes.

Support Facilities	Current	2004 Recommendations	By 2008 Recommendations	By 2015 Recommendations
Training Facility	Lacks training tower.	Construct new training tower	No changes.	No changes.
Communications Center	Lacks adequate space.	No changes.	Expand current center.	No changes.
Headquarters	Small and lacking administrative space.	No changes.	No changes.	Move headquarters with additional space to the new downtown station.
Prevention	Located in old Station 17.	Move out of Station 17.	No changes.	Combine with new Headquarters.
Electrical Division	Located at 23rd and Holgate.	No changes.	Locate near Communications Center.	No changes.