ASSESSMENT OF FIRE DEPARTMENT RESOURCE LOCATIONS, STAFFING, and FACILITIES

Alexandria, Virginia

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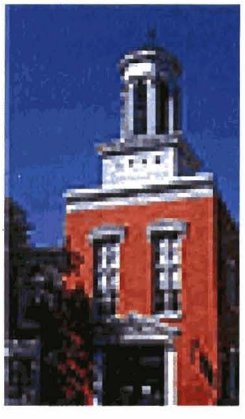

Revised Final Report

October 2007

SYSTEM PLANNING CORPORATION

TriData Division

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ASSESSMENT OF FIRE DEPARTMENT RESOURCE LOCATIONS, STAFFING, AND FACILITIES

Alexandria, Virginia

Submitted to:

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ACKNOWLEDGMENTS

We wish to thank the leadership and staff members of the many City of Alexandria departments and agencies that provided valuable insight for this study. They not only provided information and welcomed our visits to their areas, but also interacted helpfully with us throughout the study.

Former Fire Chief Gary Mesaris and many other chiefs, officers, firefighters, and managers of the Alexandria Fire Department were extremely cooperative, gracious, and forthcoming throughout the study.[1] We are also grateful and appreciative of Deputy City Manager Michele Evans, who met with the project team on several occasions. Ms. Evans provided insight into the emergency response issues and the new developments that are planned. Toward the end of the study, new Fire Chief Adam Thiel provided some useful critiques, for which we thank him.

Special thanks to Battalion Chief John North who was the project manager for the City. He efficiently and effectively handled and facilitated all of our data requests, arranged meetings, provided access to key leaders and coordinated the draft review process. We also thank President Thomas Y. (Jay) Johnson, Jr. of the Alexandria Volunteer Fire Department for his input and cooperation.

Although we received excellent input and cooperation from the city, the evaluation and recommendations reflected in this report are those of the TriData project team. The principal members of the team and their areas of responsibility are shown below. This was a team effort and views were sought from multiple team members on many aspects of the Alexandria Fire Department.

TRIDATA STAFF

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[1] At the time of this report update, Chief Gary Mesaris had resigned his position to become Fire Chief of the Washington Metropolitan Airport Authority.

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EXECUTIVE SUMMARY

The City of Alexandria selected TriData, a division of the System Planning Corporation, to assess its fire department. Specifically, TriData evaluated the present station locations, response times, apparatus deployment, and staffing. A review of the current facilities was also conducted.

This project is an update of a previous study conducted in 2005–2006. At the city's request, we updated this report to reflect the most recent incident and response time data. We also revisited the facilities review conducted in 2006. The facilities review is particularly important as it includes capital improvement costs for new facilities. Two new stations were recommended by TriData in the earlier study.

STAFFING ANALYSIS

The staffing analysis reveals that paying overtime is more cost effective than adding additional full time employees based on expected vacancies. To break even in EMS, there must be 300 or more days during a year when the minimum overtime staffing is one or more staff days. For suppression, the figure is 280 or more days during a year when the minimum overtime staffing is one or more staff days. The staffing factor for suppression personnel is 4.05 and 5.28 for EMS personnel. The difference is a result of the 56 hour firefighters schedule versus the 42 hours EMS personnel schedule.

DEMAND AND WORKLOAD ANALYSIS

Alexandria is a diverse community whose population is rising on a slow but steady basis. The highest population density is in the northwest and western portions of the city. Areas with the highest concentration of business and high-rise density include Old Town Alexandria and the Seminary Road area. The city is experiencing an increase in all demographic groups, especially among young professionals.

Population and development increases have resulted in moderate increases for fire and EMS demand. This trend is predicted to continue for foreseeable future, with EMS demand growing at a faster rate. Linear regression is used to estimate the growth rate of different incident types and provide an estimate for total incidents through the year 2020. The AFD responded to 18,222 emergency incidents in 2006 and it is expected that the number of responses will fall somewhere between 20,000 and 24,000 by the year 2020.

Workload is fairly well dispersed among AFD units. Stations 208 (Paxton Street) and 206 (Seminary), in the west and northwest areas have the highest demand. Citywide, over 65 percent of service demand is for EMS. Medic units are much busier than the fire units and, as a result, we recommend that the city plan for additional medic units in the future.

Response Time Analysis

Incident data from January 2000 through December 2006 was analyzed for this study. Data included type of incident, units responding, and overall response times. The analysis showed that response travel times are good, but call processing and turnout times need to be improved.

Call processing and turnout times exceed nationally accepted standards. Firefighters are not completely responsible for the high turnout times as the alerting system is outdated. The system requires between 5 and 30 seconds to alert personnel to an emergency. We recommend updating the alert system to reduce turnout times.

Station and Apparatus Location Analysis

Generally, the existing AFD stations are well-located. Projected growth in the Eisenhower Valley and Potomac Yard areas however, require new facilities to adequately cover the area. Access to Eisenhower Valley is extremely limited and development is occurring at a rapid pace. With plans already in place for a new station in Potomac Yard, the next priority is to should be the new station in Eisenhower Valley.

The greatest EMS call density is at a retirement community located equidistant from Stations 202 (Windsor), 205 (Cameron) and 207 (Duke Street). To meet the current and projected demand, a medic unit should be added to Station 203 (Cameron Mills). Fire density is greatest in Station 201 (Old Town), 205 (Cameron) and 206's (Seminary) first-due areas.

Facilities Review

In addition to the new stations for Eisenhower Valley and Potomac Yard, several other facilities are outdated and too small for modern equipment. Stations 203, 205, and 206 should be rebuilt on their present sites or nearby. The estimated cost for fire station capital projects is $52.9M over 12 years. The cost and expected year of completion for specific projects include:

- New Potomac Yard Station 209 — $1.0M (2009)
- New Eisenhower Valley Station 210 — $9.3M (2012)
- Rebuild Station 203 — $9.7M (2014)
- Rebuild Station 205 — $11.8M (2018)
- Station 208 Addition — $3.5M (2018)
- Rebuild Station 206 — $13.0M (2020)

I. INTRODUCTION

The City of Alexandria requested the assistance of an outside firm to provide an assessment of fire department facility and resource locations, deployment, and staffing. The purpose of this analysis is to seek improved service delivery and maintain acceptable levels of service to the community. To perform the evaluation, the city selected TriData, a division of System Planning Corporation, by competitive bid.

TriData is a nationally recognized consulting firm that has undertaken over 130 studies of this type, including studies for Arlington County, Washington, DC, Houston, Chicago, Long Beach, Seattle, Jacksonville, and many other comparably sized cities. In addition, TriData works closely with the United States Fire Administration to compile annual fire loss statistical data and complete topical studies on current issues affecting fire and emergency medical response in the United States.

SCOPE OF WORK

The review considered four key areas with the potential to improve the efficiency and effectiveness of the Department. The scope of the baseline study included the following:

Station Location, Deployment, and Suitability

- Evaluate the suitability of the locations of existing fire stations, and identify new locations for any station not in a suitable location.
- Evaluate the need for additional stations and identify the most desirable location(s) for any new stations.

  Analyze the impacts of new station locations or relocations.

  Assess the physical condition of existing fire stations that are candidates for relocation based on the station's capacity to house present and future equipment.

Staffing and Overtime

  Review the fire department staffing levels by rank.

- Review overtime history and develop an overtime/full-time equivalent (FTE) cost model.
- Review the fire department's leave history including scheduled and unscheduled absences.

OVERVIEW OF THE ALEXANDRIA FIRE DEPARTMENT

The AFD is a municipal fire department. It provides a full range of modern fire department services, including fire suppression, emergency medical services (including transport), code enforcement, and emergency management. The department also provides technical services such as technical/ heavy rescue, marine, and hazardous material response. The

AFD participates with the Northern Virginia Regional Hazardous Materials Team. It protects a population of 136,974 spanning 15 square miles.[2]

Alexandria has a mix of residential and commercial development. Major highways include Interstates 495, 395 and Route 1. The city is located in the Washington, DC metropolitan area which consists of approximately 4.8 million people.

Emergency and non-emergency services are provided by 280 employees. Eight engine companies, one hazmat unit, five advanced life support (ALS) paramedic units, and three aerial ladder trucks are deployed strategically. Firefighters are trained at the emergency medical technician–basic (EMT-B) level, and all suppression units have the capacity to provide basic life support (BLS).[3]

INFORMATION ON THE COMMUNITY RELEVANT TO FIRE/ EMS PROTECTION

For this project we reviewed statistical data to better understand community risk factors. Categories of statistical data that were reviewed include: population, demographics, education, transportation, economy and housing. Data on each of these is provided below.

Population – Population size, growth, and density all impact the demand for fire and EMS services. Population growth or decline are particularly important and directly impact future demands for both fire and EMS services.

The 2000 Census listed the city's population at 128,283. Between 1990 and 2006 the population grew by over 20 percent, as shown in Table 1.

Table 1: Population, 1990–2006

Year	Population
1990	111,183
1995	119,427
2000	128,283
2006	136,974

Demographics – National studies have shown an inverse correlation between income and fire risk. Residents with lower incomes are often at higher risk for becoming victims of fire than persons with higher incomes. A much lower percentage of families and individuals in Alexandria live below the poverty level than nationally (Table 2).

2006 Census population estimate

[3] In general, BLS includes treatment (such as first aid and essential lifesaving interventions, such as automated defibrillation, CPR with adjunctive equipment and oxygen administration) and transportation via ambulance. In contrast, ALS service involves more invasive procedures, including initiation of intravenous lines, medication administration, electrocardiograph interpretation and manual defibrillation, and endotracheal intubation). BLS is provided by basic-level EMTs, whereas ALS requires higher (i.e., intermediate-level EMT or paramedic) certification.

Table 2: Percent of Population Below Poverty Level

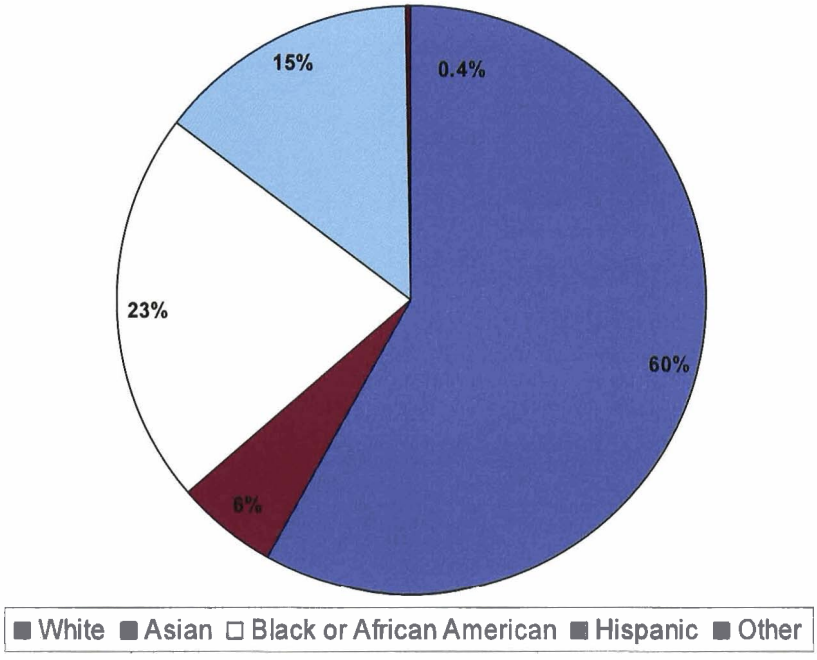
Subject	Alexandria	United States
Families	6.8	9.8
Individuals	8.9	12.7

Source: United States Bureau of the Census 2000

Ethnically, Alexandria is a very diverse community. National statistics show that African Americans and Hispanics tend to be at higher risk for fire injury and death than other groups. Asians, however, tend to experience lower risk than the general population.

Figure 1 depicts the percent of the population by race for Alexandria as of 2000. The percentage of Hispanics living in Alexandria is higher than the national average of 13.8 percent. Likewise, African Americans comprise a higher percentage of the population than the national average; 23 percent as compared to 12.1 percent. The Asian population is also higher in Alexandria.

Figure 1: Population by Race in Alexandria, 2000



Source: United States Bureau of the Census, 2000

Age – The median age is 34.4 years. Only 9 percent of the population is over the age of 65, and 10.8 percent is younger than 10.[4] These two age groups are at significantly higher risk

[4] Source: Table DP-1, Profile of General Demographic Characteristics, Census 2000.

for fire than the population at large. The elderly (individuals over age 65) also tend to use the EMS system at a higher rate than the general population.

Education – In Alexandria, 58.7 percent of the population has completed an Associate's Degree or higher, which is much higher than the national average of 30.7 percent.[5] Another 15.5 percent of the population has attended at least some college. Education has been related to fire risk; people with lower levels of education tend to be at higher risk for fire injury or death. Those with lower educational levels also earn lower incomes, another contributing risk factor.

Economy – Low income correlates with higher fire incidence rates. The unemployment rate in Alexandria was 2.9 percent, which is below the national average of 5.5 percent.[6] The median household income in Alexandria, according to the 2000 Census, was $56,054 with a per capita income of $37,645. Table 3 shows the industry sectors where people in Alexandria work.

Table 3: Alexandria Employment by Industry, 2000

Occupation	Percent
Professional, scientific, management, administrative, and waste management services	22.0%
Public Administration	14.2%
Educational, health and social services	12.9%
Other services (except public administration)	8.6%
Arts, entertainment, recreation, accommodation and food services	7.4%
Other professions and trades (combined)	34.9%

Source: Table DP3, Profile of Selected Economic Characteristics, Census 2000

Transportation – Higher levels of fire and EMS service are typically required where mass transportation systems are located. Although mass transportation is efficient, it does increase the risk for multiple-casualty, hazardous material, and terrorist-related events.

Four modes of public transportation are present in the city, including the Metro system, which is operated by the Washington Metropolitan Area Transit Authority. In addition to Metro buses, which have routes throughout the city, four Metro rail stations are located in Alexandria: King Street (blue and yellow lines); Braddock Road (blue and yellow lines); Eisenhower Avenue (yellow line); and, Van Dorn (blue line). Bus/shuttle service (DASH) lines also serve areas outside of the metro-rail and metro-bus system. The AMTRAK and the Virginia Railway Express (VRE) systems also traverse the city with a main station on King Street. CSX and Norfolk Southern Freight also have routes through the community.

[5] Source: Educational Attainment in Population 25 Years and Over, 1990-2000, Census 2000.
[6] Source: Virginia Employment Commission, 2004.

Housing[7] – Of the city's 64,251 housing units, 3.7 percent are vacant, which is lower than national average. Most people in Alexandria own their homes (62.5 percent), but this is less than the national average (66 percent)[8]. The largest percentage of the city's housing units are multi-family dwellings with 20 or more units (36.4 percent) followed by single-family attached units (21.1 percent).

Home ownership rates, type of residence, and structure age are all factors that contribute to fire risk and the need for emergency services. Older homes tend to be at higher risk for fire, particularly if they are not properly maintained. Some newer homes are constructed with built-in fire protection, such as sprinklers.

A significant portion of the city's housing stock was built before 1939 (40 percent). Nationally, only 15 percent of homes were built before 1960 (36.4 percent in Alexandria). Again, without proper maintenance, these older homes are at a higher risk for fire than newer ones. Only 7.1 percent of housing units were constructed between 1995 and 2000.

Table 4 contains the approximate residential values based on 2006 assessments. The median values for each group fall into the lower values of the groups.[9]

Table 4: Residential Values Based on Assessments of Units, 2006

Assessed Range	Number	Percentage
Below $250,000	4,000	10.7%
$250,000-$499,999	18,295	47.9%
$500,000-$749,999	10,390	27.2%
$750,000-$999,999	3,95	10.3%
$1,000,000 and above	1937	5.1%

STUDY PROCESS

The study began with a kick-off conference call in August 2005 between TriData staff and representatives from the AFD. The purpose was to discuss the study's scope, and the tentative study schedule. Shortly afterwards, TriData project members made their first visit to Alexandria where an initial "triage" of the AFD was conducted.

During the triage, meetings were held with the AFD command staff, rank-and-file firefighters, representatives of the International Association of Fire Fighters (IAFF) Local 2141, and the President of the Alexandria chapter of the International Association of Black Professional Firefighters (IABPFF). We also met with the President of the Alexandria Medic Association and other city officials. At the conclusion of the initial triage, a wrap-up meeting to discuss major issues identified during the visit was conducted with AFD officials.

[7] All statistics are from Census 2000.
[8] Personal Communications, Ms. Ann Radford, City of Alexandria, June 23, 2006.
[9] City of Alexandria, Budget Memo #2: Calendar Year 2006 Real Property Assessment Report. February 21, 2006.

Specialists then undertook a series of on-site, in-depth reviews of various AFD functions, concentrating on station location, station conditions and staffing issues involving the current model. The process included additional visits to each station, more dialogue between TriData representatives and crews, ride-a-longs with on-duty battalion chiefs and a medic supervisor. Follow-up meetings and phone calls were conducted throughout the study.

ORGANIZATION FOR THE REPORT

Five chapters and a summary of recommendations are included in this report. Additional GIS maps of the response time analysis are provided in the Appendix. Chapters include:

- ***Chapter II, About the Department*** – This chapter discusses the overall operations of the department, including the management and organizational structure. The concluding section lists some observations made by the TriData team.
- ***Chapter III, Analysis of Staffing, Applicable Standards, and Inter-Jurisdictional Comparisons*** – Chapter III begins with an analysis of AFD staffing, including a review of overtime used by each shift. A review of the staffing guidelines is discussed along with the comparison of the AFD with other, similar departments
- ***Chapter IV, Demand and Workload Analysis*** – This chapter analyzes population growth and the demand for services. Call types are analyzed and projections on future demand are provided.
- ***Chapter V, Response Time Analysis*** – This chapter includes the analysis of response time and compares Alexandria to nationally accepted standards..
- ***Chapter VI, Station Location Analysis, Apparatus Deployment, and Facilities*** – This chapter discusses the GIS analysis conducted for this study and includes maps on call density. Coverage of the current stations and recommendations for new facilities are also discussed. The chapter concludes with a review of each facility.

  Chapter VII, Summary of Recommendations – All recommendations made in this report are included here in one matrix. Each recommendation is prioritized as immediate, important, or strategic
- ***Appendix*** – This contains additional GIS maps used for the station location and response time analysis.

II. ABOUT THE DEPARTMENT

This chapter looks at the current fire and EMS operations of the AFD. It considers the major divisions and sections of the fire department. This section will aid the reader in understanding subsequent chapters in the report.

The AFD is a full service fire department that provides fire suppression, emergency medical services, code enforcement, hazardous materials mitigation, and other traditional fire department services. Services are provided by 201 uniformed career personnel, 67 non-uniformed personnel, and approximately 25 volunteers.

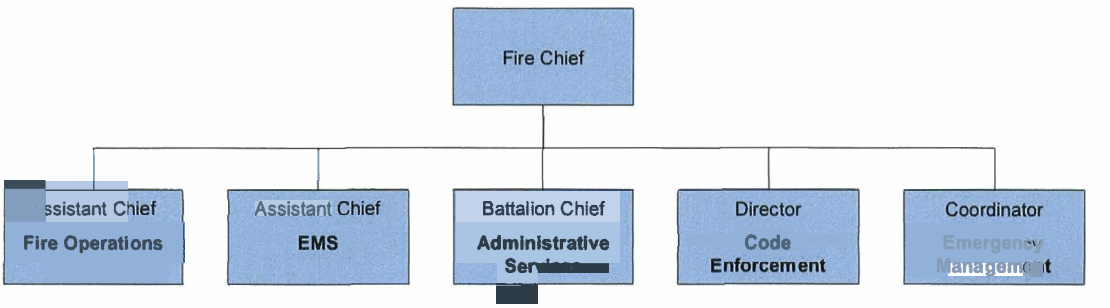
DEPARTMENT LEADERSHIP

The AFD is commanded by a fire chief who is appointed by the city manager. At the time the baseline study was conducted, the former chief had been in his position for approximately two years. Prior to joining the AFD, he served as a fire chief and career fire professional with adjacent departments. The organization is divided into five areas headed by both uniformed and non-uniformed personnel (Figure 2).

Fire suppression operations are commanded by an assistant chief who is responsible for all fire suppression, rescue, and training. EMS is commanded by another assistant chief responsible for EMS operations, maintenance, and health and safety. Administrative service functions are the responsibility of a battalion chief. The battalion chief oversees administration, dispatch, and special operations; he also reports directly to the fire chief.

Code enforcement is managed by the department's Code Enforcement Director, who is well versed in fire department matters and is considered a part of the AFD senior staff. Department health and safety is managed by a captain who reports to the EMS assistant chief though sometimes reports directly to the fire chief. There are several key staff members who are non-uniformed, but are integral to the daily operations. These include the emergency management coordinator, information systems, personnel commander, facility maintenance officer and finance officer. Generally, these personnel report to the administrative battalion chief except for the emergency management coordinator, who reports to the fire chief.

Figure 2: AFD Organizational Structure, Senior Staff



COMMAND STAFF

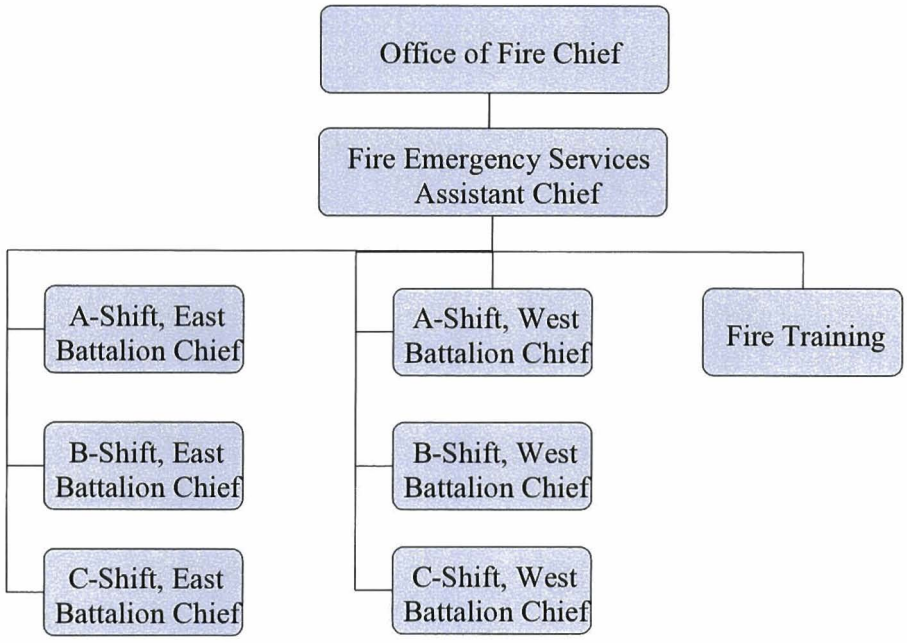
The office of the fire chief includes the fire chief and a small staff for administrative support. The command staff is quite capable and they appear to function well as a team. There is a good balance of uniformed and non-uniformed personnel on the staff, which enhances the team's expertise. The use of non-uniformed personnel in administrative positions (not usually sought by uniformed chief officers) is reasonable and prudent. The former fire chief was challenged to maintain a balance of civilian and uniformed staff, and he resisted the urge to "civilianize" simply to save salary and benefit costs.

Command personnel have significant responsibilities, and the AFD is not "top heavy." Four of the senior staff members are uniformed including the fire chief, assistant chief of operations, assistant chief of EMS, and the battalion chief of administrative services. Non-uniformed members include the emergency management coordinator and the director of code enforcement.

FIRE EMERGENCY OPERATIONS

As stated, fire emergency services are the responsibility of an assistant chief. The assistant chief is in the emergency operations on-call rotation and he substitutes for the fire chief. Fire suppression responses are handled from eight stations divided into two battalions. Each battalion has one battalion chief on each shift. A battalion aide (lieutenant) is assigned to each shift. The aide is responsible for time and attendance, scheduling, and other administrative functions. The lieutenant also assists the incident commander during emergencies. Figure 3 depicts the division's organizational chart.

Figure 3: Fire Emergency Operations Organizational Structure



Stations are organized by east or west battalion with one captain assigned per station/per shift. All multi-piece companies (engine and truck) have a captain and lieutenant on duty, with the lieutenant riding the truck. Each piece is staffed with a minimum of three personnel (including the officer). Table 5 shows the qualifications that firefighters must attain:

Table 5: Firefighter Qualifications*

Early Career Qualifications	Qualifications within 2 years Employment
NFPA 1021 Firefighter I	NFPA 1021 Firefighter II
Virginia Emergency Medical Technician-Basic	Basic Building Construction
Emergency Vehicle Operators Course (EVOC)	Virginia Fire Inspector I
Hazardous Materials Operation	

*These training programs are offered to all employees

Each engine and truck company responds with a minimum of three personnel. This includes one officer and two firefighters, one of whom is the driver/operator. Driving duties are rotated between firefighters with the officer designating the rotation sequence.

Station Locations – The AFD responds from 8 fire stations. Each fire station has various types of fire suppression, EMS, and other support response units (Table 6).

Table 6: AFD Station Locations

Station	Location	Equipment
201	317 Prince Street Old Town	Engine 201 Fire Boat 201 (at City Dock
202	213 East Windsor Avenue Del Ray	Engine 202 Hazmat 202 Hazmat Support 252 Support Unit 202 Hazmat Trailers [3] Medic 202
203	2801 Cameron Mills Road Beverly Hills	Engine 203 Truck 203 EMS 232
204	900 Second Street Headquarters	Engine 204 Truck 204 Boat 204 Boat B214 EMS 231 Battalion 211
205	1210 Cameron Street Cameron	Engine 205 Medic 205 Aide 215
206	4609 Seminary Road Seminary	Engine 206 Medic 206 Squad 206 Trailer 206 Battalion 212
207	3301 Duke Street Duke Street	Engine 207 Medic 207 Reserve Engine 297 Light and Air 207
208	175 North Paxton Street Landmark	Engine 208 Truck 208 Medic 208

Special Operations – Special operation teams include the technical rescue and hazardous materials teams. These are commanded by the battalion chief of administrative services. The battalion chief of training is responsible for the marine operations team. Specialty teams are assigned to specific stations.

The technical rescue team (TRT) is assigned to Station 206 (Seminary); it is also supported by Truck 208. The unit is primarily responsible for heavy rescue/ extrication, rope

rescue, trench rescue, building collapse and confined space rescue. The TRT consists of 36 members with 12 assigned to each of three shifts. Most TRT members are assigned to Station 206 (Seminary). Personnel assigned to Station 206 (Seminary) are required to become rescue technician certified and most have completed more advanced training. TRT personnel are required to complete 4 hours of monthly training to demonstrate proficiency in complex (and less used) skills. The TRT trains with the Arlington County's technical rescue team, and it has responded to mutual aid requests, such as the 9/11 Pentagon Disaster and the La Plata, Maryland tornado.

Marine operations are responsible for the protection of the waterways. Services include open-water rescue, swift-water rescue, and marine fire suppression. Efforts area coordinated with the Metropolitan Washington Council of Governments member departments (Arlington, Fairfax, and the District of Columbia).

There are 24 personnel qualified as marine operations team members; most are assigned to Station 201 (Old Town). Station 201 is responsible for staffing and maintaining Fireboat 201 (Vigilant), which is a Class C fireboat. ALS service provided by paramedics is also available. In addition to Fireboat 201, two smaller boats (204 and 214) are available at Station 204. Boats 204 and 214 are Zodiac watercraft used for open and swift water rescue. On trailers, these units can be towed either by Engine 204 or a support vehicle.

Marine operation personnel complete training that includes certification as a marine firefighter, swift water rescue technician, lifeguard, boat operator, and crewmember. Team members complete at least 24 hours of marine operations training annually. All AFD personnel receive at least basic water rescue training as prescribed by NFPA 1405.

The hazardous materials response team is a regional team comprised of both Alexandria and Arlington County Fire Department personnel. Agreements are in place to allow the team to operate statewide. The Alexandria/Arlington team is staffed by over 80 members. Each member is certified at the Technician or Specialist level. At a minimum, AFD personnel must have hazmat training at the hazmat 'operations' level.

The AFD hazmat team is located at Station 202 (Del Ray). Units here include Engine 202, Hazmat Unit 202, Trailers 202, Support Unit 202, and Support Unit 252. The hazmat units is stocked with materials needed for assessment, product identification, protective ensembles, reference materials, decontamination, and other technical devices needed for hazmat incidents. Support Unit 202 is a smaller version of the primary hazmat unit and responds to smaller incidents, or to investigate spill incidents. Team members attend a minimum of 24 hours of continuing education annually, which is in compliance with OSHA 1910.120.

Emergency Response – Fire and EMS units are dispatched from the AFD's dispatch center located at the headquarters station. All fire calls are dispatched as emergencies; however, company officers can exercise their discretion and respond non-emergency to low-risk incidents.

Table 7: Alexandria Alarm Assignments

Full Box Alarm	Second Alarm	Hazardous Material Incident	EMS Assist
4 Engine Companies 2 Truck Companies 1 ALS Unit 1 Battalion Chief 1 Battalion Aide	1 EMS Supervisor 1 Fire Marshal 1 Light/Air Unit 1 Health and Safety Officer On-Duty or On-Call Assistant Chief	1 Hazmat and Hazmat Support Unit	1 Engine or Truck Company (closest)

A first-alarm assignment is dispatched on structure fires and high-risk incidents. A second alarm is provides the same 'weight of response' as a first alarm. For hazardous materials incidents, the Alexandria/Arlington Regional Team is activated for the most serious incidents. For EMS calls, an AFD engine or ladder is dispatched when the first-due ALS unit is unavailable, upon the request of ALS unit, or when the call is classified as a high-priority incident (cardiac arrest). The closest engine company responds to all reported motor vehicle crashes with injury.

Mutual Aid – Since 1975, fire departments in northern Virginia have participated in the Northern Virginia Emergency Services (NOVA) mutual aid system. The mutual aid system includes a formal Memorandum of Understanding (MOU). Due to its success, the MOU was reaffirmed in 2004.

The current agreement is flexible enough to insure that jurisdictional boundaries do not negatively affect services. Provisions for mutual aid 'on request' or automatic aid are included.[10] Participating communities include the Cities of Alexandria and Fairfax, Arlington and Fairfax County. Fort Belvoir, the Metropolitan Washington Airports Authority, and Loudoun County are also NOVA participants.

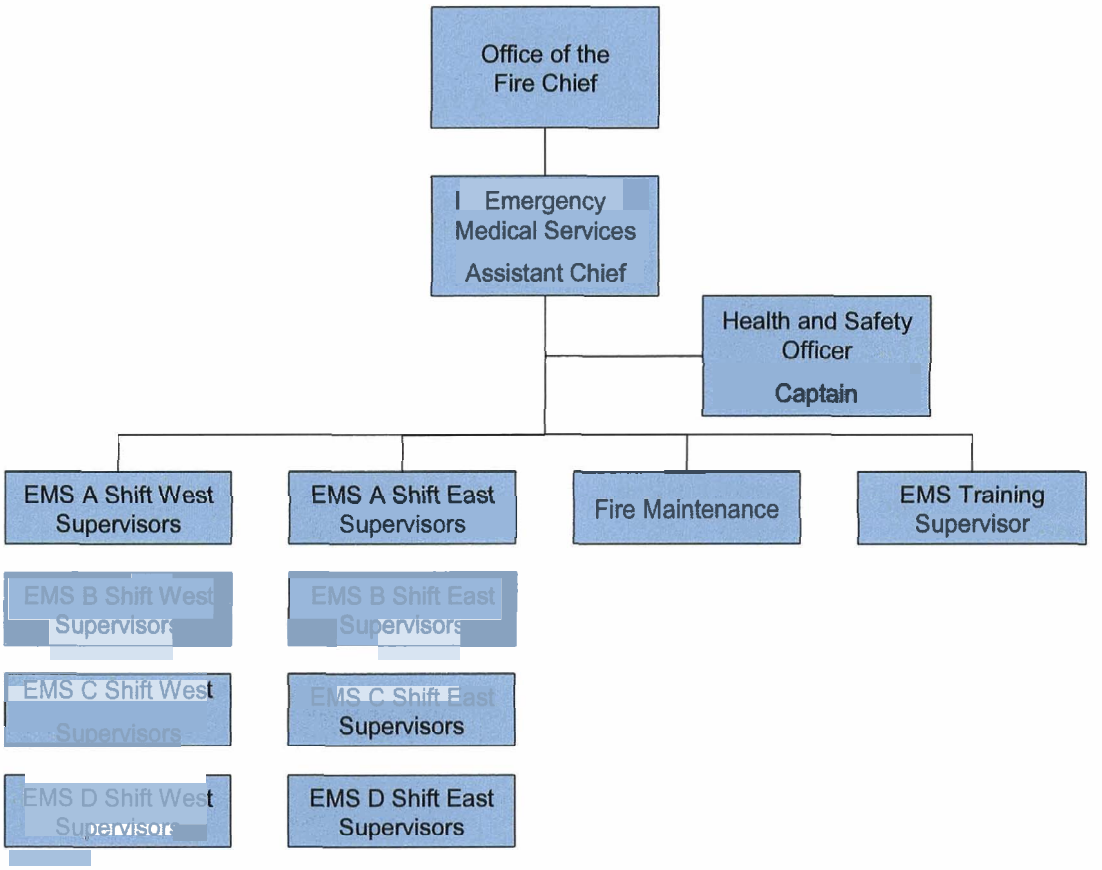
EMERGENCY MEDICAL SERVICES

ALS response and transportation is provided by five ALS transport ambulances. Four of the units are staffed by two paramedics (Virginia EMT-P or EMT-I). The fifth unit may be staffed by one paramedic and one EMT-B. AFD personnel classified as medical personnel work solely in EMS, and firefighters are rarely assigned to a medic unit. EMS supervision is the responsibility of the EMS cadre with minimal in-station supervision by fire suppression officers.

Organization – The EMS Division is under the command of an assistant chief, who reports directly to the fire chief. The EMS assistant chief is in the emergency operations on-call rotation and may also substitute for the fire chief in his absence.

[10] NOVA, Mutual Response Agreement, December 12, 1975, revised in 2004.

Figure 4: EMS Organizational Structure



The EMS staff includes one fire captain, who also serves as the department's health and safety officer. There are nine medic supervisors, two on each of the shifts; one supervisor is assigned to the training division. Medic personnel report directly to a medic supervisor. Of the 62 EMS personnel on the payroll at the time of this study, over 35 percent were female.

Daily Operations – Unlike fire suppression which works a three-platoon schedule, EMS personnel work a four-platoon schedule. They work 24-hours on, 48-hours off, 24-hours on, 4-days off. The average work week is 42 hours. The EMS shift schedule differs from the fire suppression schedule for two reasons. First, AFD management believes that a schedule with four consecutive days off mitigates the effects of stress caused by increased call volumes. Second, the 42-hour schedule decreases the overtime liability under the Fair Labor Standards Act (FLSA).

Medical Oversight – AFD medical oversight is the responsibility of the medical director, Dr. Vafier, who is a board-certified emergency physician. Dr. Vafier has worked as an emergency department director for 17 years.

Dr. Vafier serves in a volunteer capacity except for an 8-hour per month stipend to assist with ALS training. The medical director has medical practice oversight and provides some in-field supervision by riding with the medic supervisors.

EMS quality management within the organization is good. Medical supervisors are responsible for the program. Issues involving quality management and discipline are handled separately. Cases involving possible discipline are considered the highest priority.

Health and Safety – As stated earlier, the health and safety program is coordinated by a captain. The captain is responsible for all health and safety-related programs including: light duty assignments, ADA issues, Workers Compensation, safety training, FMLA paperwork, risk management, and OSHA compliance. This individual is also the liaison to INOVA, the department's employee health contractor. A considerable portion of the captain's workweek is required to coordinate the duty status of sick or injured fire and EMS personnel. The captain also responds to multi-alarm or high-risk emergency incidents as the incident safety officer.

EMS Training –Firefighters are required to maintain an EMT-B certification and paramedics are required to maintain ALS. Failure to maintain the certification can result in termination.

EMT-B certification requires 40 hours of continuing education every three years. Each responder is provided with a 40 hours of EMT-B continuing education every three years. ALS-level recertification is biennial and requires attendance at four, 6-hour classes annually. It also requires two days of Advanced Cardiac Life Support (ACLS), Basic Trauma Life Support (BTLS) and Pediatric Advanced Life Support (PALS) every two years. The two-day classes are attended off-duty and paramedics are paid overtime.

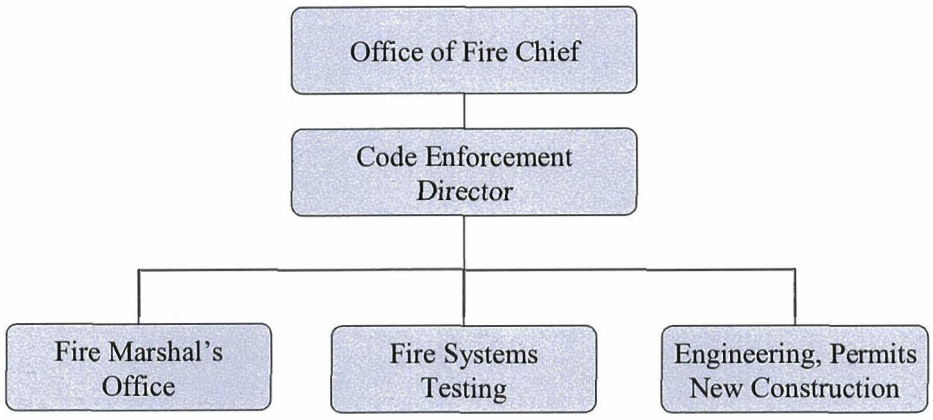
In November 2005, the American Heart Association published new guidelines for cardiac resuscitation. Revisions to the guidelines involve risk identification and prevention, basic life support, and advanced life support practices. These revisions are expected to be incorporated into EMS continuing education programs and will require some special attention by the AFD. Also, the recommendations involving Automatic External Defibrillators (AEDs) will require either reprogramming or replacement of some AEDs.[11] While the EMS community expects implementation of these changes to take at least one year, the AFD should begin planning for them now.

CODE ENFORCEMENT

Code enforcement and fire investigation is a combined effort of the AFD and the city's Code Enforcement Division. The main effort is coordinated by a director within code enforcement. The director is a non-uniformed staff member, though he is considered an integral part of the fire department senior staff (equivalent to an assistant chief). The current director has an extensive background in both code enforcement and fire department operations. As shown in Figure 5, the director reports to the fire chief.

[11] AHA. (2005). Highlights of the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Currents in Emergency Cardiovascular Care, 16(4), 1-28.

Figure 5: Code Enforcement Division Organizational Structure

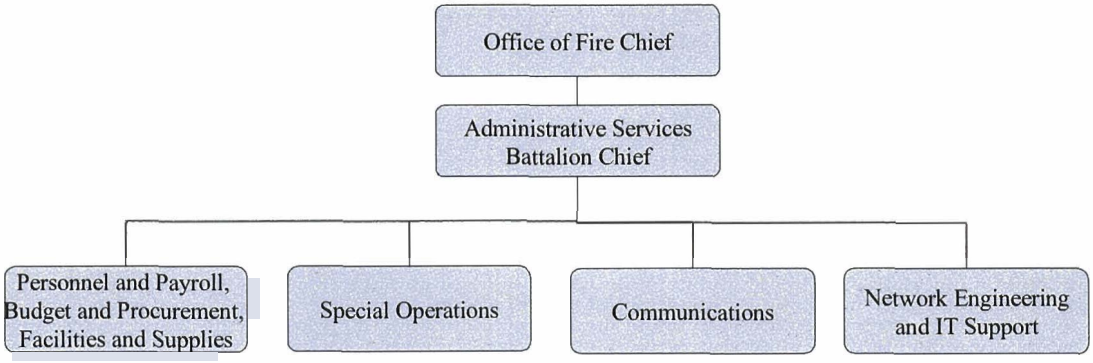


At the time of the baseline study, 74 FTE positions were authorized for code enforcement. In addition to the primary responsibility for inspections, code enforcement also conducts fire system tests and approves new building plans. Personnel are considered non-uniformed members of the AFD. At the time of the initial study, the chief fire marshal's position was vacant.

ADMINISTRATIVE SERVICES

Seven full-time and one contracted employee are assigned to administrative services. The division is responsible for the overall management of the organization. Core responsibilities include human resource management, information technology, and finance. It is also responsible for fire communications, which is a little unusual. The division is commanded by a uniformed battalion chief. The remaining staff is civilian (e.g., personnel, payroll, budget, network engineering). Recently, a non-uniformed management position was added to oversee human resources and finance. Figure 6 shows the administrative service organizational chart.

Figure 6: Administrative Services Organizational Structure



Human Resources – Human resources is under a non-uniformed person who coordinates classification and compensation, promotions, time and attendance, recruiting, recruits testing, and fair practices. This individual advises the senior staff on discipline and termination issues and issues involving diversity. The personnel officer also interacts with other professionals outside of the fire department. A clerk provides support.

The AFD has worked hard to diversify its ranks and include more women and under-represented groups. The former fire chief was particularly committed to diversification. Table 8 shows the current demographics within the department.

Table 8: Demographics of the AFD (Uniformed), March 30, 2006

Group	Number	Percentage
White Male	131	63.6%
African American Male	38	18.4%
White Female	26	12.6%
African American Female	4	1.9%
Other Male	7	3.4%
Other Female	0	0.0%
Total	**206**	**100.0%**

The demographics for fire suppression are shown in Table 9.

Table 9: Demographics for Suppression as of March 30, 2006

Group	Number	Percentage
White Male	100	67.6%
African American Male	34	23.0%
White Female	7	4.7%
African American Female	2	1.3%
Other Male	5	3.4%
Total	**148**	**100.0%**

African-American males make up 23 percent of the AFD suppression force. Three are chief officers. Females comprise 6 percent of the fire suppression force; however, there are no female chief officers. The demographics for EMS are depicted in Table 10.

Table 10: Demographics for EMS, March 30, 2006

Group	Number	Percentage
White Male	26	48.1%
White Female	19	35.2%
African American Male	4	7.4%
African American Female	2	3.7%
Other Male	3	5.5%
Total	**54**	**100.0%**

Three of the 9 medic supervisors are female, one of whom is African-American. The proportion of men to women in EMS continues to rapidly decrease.

Fire Communications – The primary 911 service access point is the police department. Fire communications, located at headquarters, is the secondary point.

Communications is staffed totally by non-uniformed personnel, including a center coordinator, 4 supervisors, and 9 technicians. Employees work an average 42-hour per week on two, 12-hour days, 24 hours off, two, 12 hour nights, and four, days off. If staffing is short, paramedics and firefighters are detailed from emergency operations. Policies for dispatch are locally written and they appeared to be followed.

TELESTAFF/ TIME AND ATTENDANCE TRACKING: TeleStaff is a computer program that allows employers to track time and attendance, assign personnel, keep accurate personnel records, and track the cost for specific situations (i.e. leave time, sick time). The system can also calculate overtime costs and recommend station-to-station details. Used to its full extent, TeleStaff improves the accuracy of time and attendance reporting. It is also an excellent tool for decision-making. A challenge for the AFD has been for personnel to use TeleStaff to its fullest. The software has more capacity than is being used now and efforts should be made to maximize its use.

Two of the biggest internal challenges with TeleStaff are training for personnel and the speed with which the system operates. To address these issues, the department should determine the level of use by each officer. For example, assistant and battalion chiefs should have the requisite skills to use TeleStaff as an analytical tool. On the other hand, company officers should be able to use the system for time and attendance reporting, payroll, and personnel records management.

To assure that personnel have the required expertise, computer lab training should be supplemented with on-line or CD-ROM review material. In addition, at least one AFD member should be trained as the subject matter expert and the individual should be available for consultation. To make training more efficient, each shift could have two trainer/consultants to

train and answer basic questions for each shift. Issues that cannot be answered by the shift trainer would be referred to the expert.

Another concern about TeleStaff is operational speed. A few departments (including the AFD) have expressed concerns that TeleStaff operates too slow. To address this concern, the AFD should work with the vendor. Monies should be also budgeted for the personnel who use the system to attend training conferences.

The TeleStaff software used by the AFD contains an added component ("FEMA Module") that can perform a partial or total recall of personnel. It is a more efficient way to recall personnel and it requires a minimum number of keystrokes by the operator. Using the FEMA Module, special operation members could be notified of an incident, or an entire shift of personnel could be notified to return to work for a large-scale incident. As the study was progressing, it did not appear the AFD knew of the FEMA module; however, through our direct contact with TeleStaff we confirmed the availability of the "FEMA module" and that it had been installed during the last system upgrade.[12] The amount of training necessary to use the FEMA module is minimal, and the training is available at no cost to subscribers.

Recommendation 1: Make greater use of TeleStaff software by implementing a training program for all officers and ensuring that all future human resource and finance software packages are compatible with TeleStaff.

The external issue involving TeleStaff is the ability to convert data into a format compatible with the city's time and attendance software. Unfortunately, software packages are often constructed with 8-hour shifts in mind, and not programmed to manage the complex FLSA issues unique to fire departments.

The City of Alexandria is experiencing a similar circumstance by using Kronos software. Reportedly, Kronos 5.2 is being installed, and the system is expected to mitigate the issues between Kronos and TeleStaff, especially those involving the 28 day work period and the 212 hour overtime threshold. Thus far however, city finance has been unable to convert TeleStaff data into Kronos data. During our visits we were advised that the city may be searching for a new HR software package. If this is done, the city should consider software compatible with TeleStaff.

Finance – AFD finances are managed by a fiscal officer, who is assisted by an administrative technician. Financial services prepare and manage the department budget in concert with the city Budget and Management Office. Financial services are responsible for preparing the annual budget for the fire chief to the city manager for final approval by the city council.

[12] PDSI. (2005) FEMA module now available in TeleStaff to assist departments in more efficient reimbursement. Available: [On-line]. http://www.pdsi-software.com/pressroom/news.asp?ID=72.

In FY05, the department budget was $31.8 million. Approximately $27 million (84.6 percent) was for personnel services. The FY06 budget has been approved for $33.2 million, including an increase of $1.1 million (3.9 percent) for employee merit increases and other incidentals, and a $50,000 (1.2 percent) decrease in non-personnel items. This budget designates $28.9 million (87 percent) for personnel services. This is in-line with most public safety agency personnel costs.[13]

The approved FY06 budget included the following additions:

- Upgrade of 4 Medic II positions to EMS supervisor, allowing a second EMS supervisor on each shift.
- Placing the fire marshals into the Medic/Sheriff Supplemental Retirement Plan.
- Conversion of leased vehicles into city owned vehicles.
- Addition of one deputy fire marshal and upgrade of three code enforcement specialists to fire marshal.
- Addition of a non-uniformed records manager to the Code Enforcement division.
- An additional 3 percent incentive pay for Marine Operations Team members.

The benefit package for employees costs the department approximately 41 percent above an employees based salary. Barring changes to the package, this rate is expected to rise to 42 percent during FY06. This includes the combined cost of retirement, medical, and other city provided benefits.

Overtime costs are of great concern to the city and the department. The overtime budget for FY05 was $700,000. The actual overtime expenditure exceeded the budget by over $400,000, with most attributed to suppression operations OT. This has been the most unpredictable variable in the overtime budget. EMS overtime is more predictable and controlled.

An overriding issue concerns how overtime can be controlled. The AFD struggles with how to best control their personnel costs without negatively affecting service. This involves a balance of hiring 'extra personnel' versus increased budgets to pay overtime.

EMPLOYEE INPUT: As part of this study we had the opportunity to meet with the various employee groups to discuss the project and obtain their input. The IAFF Local 2141, IABPFF Fire Service Professionals of Alexandria and the Alexandria Paramedic Association officials that we met with were very interested in the study and they offered the following as areas that should be addressed:

- A larger repair shop and additional mechanics are needed
- The heavy rescue at Station 206 (Seminary) should be staffed full time[14]
- There is need for at least one additional medic unit

[13] City of Alexandria, Approved Operating Budget FY06, p. 8-4.
[14] The squad is presently a cross-staffed unit located at Station 206 (Seminary).

III. ANALYSIS OF STAFFING, APPLICABLE STANDARDS, AND INTER-JURISDICTIONAL COMPARISONS

When, where, and how much are the common questions asked by city administrators and citizens when it comes to determining the resources for government. Determining the proper level of resources to deploy for a fire department involves asking the same questions. Balancing the safety concerns of citizens with the financial situation of the local government is also required.

Deciding how and where to deploy resources is not an exact science. There are no perfect deployment models. The ultimate decision is based on a combination of risk analysis, professional judgment, and the willingness to accept more or less risk. Accepting more risk generally means that fewer resources are deployed, though deploying more resources is no guarantee that loss will be less, especially in the short term.

Following are discussions on AFD staffing levels, including an analysis of overtime for fire and EMS. A discussion of standards and other factors which have an impact on emergency service deployment and response is also included.

STAFFING LEVELS

We first calculated the shift staffing requirements for the current set of fire and EMS units. From this we determined the efficiency of hiring additional personnel versus a reliance on overtime to fill vacant spots. From the analysis, we calculated the break even point of fire and EMS fulltime staffing versus overtime.

AFD Staffing Analysis – Using a recognized staffing formula we concluded that the AFD should consider staffing 150 slots for fire suppression and 63 for EMS. This level of staffing requires adding 3 personnel for suppression and 6 for EMS.

Calculating the required number of fire and EMS personnel can be accomplished in several ways. Although it seems logical to staff at a 1:1 or 1.5:1 ratio, a more precise method is to calculate the actual amount of time people are away from their assigned workplace, on the average. This requires data on the average number of hours worked each year minus vacation, other anticipated leave, and unanticipated absences such as sick and accident leave.

The analysis revealed a difference in the "productive hours" provided by fire versus EMS staff. The difference is related to the workweek for EMS personnel, which is less than for fire. Fire personnel used more leave on average (anticipated and unanticipated) than did EMS; 733 hours for fire personnel as compared to 533 hours for EMS.

As can be observed in Table 12, FTE staffing required for EMS is 5.28 FTE personnel for each 24-hour position as compared to 4.05 FTE personnel for fire. We did not include the projected vacancies created by the expected retirements in 2006 in the calculation.

Table 11: Fire Suppression Staffing Calculations

A	Number of Days in a Year	365
B	Number of Hours in a Day	24
C	**Number of Hours in a Year (A X B)**	**8,760**
D	Number of Shifts	3
E	Number of Hours of Scheduled Work per Employee per Year (C / D)	2,920
F	Less: Average Number of Hours of Leave Consumed for the Last Two Years.	773
G	**Number of Productive Hours per Employee per Year (E – F)**	2,147
H	Staffing Factor (E / G)	1.35
I	Number of Employees Needed per Position for 24/7 Staffing (H X D)	4.05

Table 12: EMS Staffing Calculations (EMS)

A	Number of Days in a Year	365
B	Number of Hours in a Day	24
C	**Number of Hours in a Year (A X B)**	**8,760**
D	Number of Shifts	4
E	Number of Hours of Scheduled Work per Employee per Year (C / D)	2190
F	Less: Average Number of Hours of Leave Consumed for the Last Two Years.	533
G	**Number of Productive Hours per Employee per Year (E – F)**	1657
H	Staffing Factor (E / G)	1.32
I	Number of Employees Needed per Position for 24/7 Staffing (H X D)	5.28

Cost Effectiveness – To determine whether hiring more permanent staff or overtime is more efficient, we analyzed overtime data for FY04 and FY05. In the analysis, we considered daily minimum staffing data for EMS and suppression for the two-year period.

The terms "overtime day" and "staffing day" are defined as follows:

- ***Overtime Day*** – Days when some overtime is required to meet the department's minimum staffing level. An "overtime day" can include one or more partial shifts. In 2004 there were 194 days out of 365 when EMS required overtime to fill a shift (Table 13).
- ***Staffing Day*** – Number of 24-hour overtime shifts worked to meet minimum staffing requirements. In 2004 EMS worked a total of 218.5 days or 5,244 hours of overtime (218.5 x 24).[15]

The data reviewed by us included the number of overtime days necessary to meet the minimum staffing requirement, and which shift was working. Table 13 shows the overall overtime used FY04 and FY05.

[15] Definitions provided by Mr. Peter Moy, FCS Consultant Group, project consultant.

Table 13: Overtime Statistics, FY04 and FY05

	FY04			FY05		
	Overtime $	# Overtime Days	Staffing Days	Overtime $	#Overtime Days	Staffing Days
EMS	$186,325	198	218.50	$326,037	255	347.25
Suppression	$153,152	144	193.68	$558,589	261	702.75

There were differences in the amount overtime necessary to meet minimum staffing requirements. As shown in Table 14, EMS on Shift D required more overtime. On the fire side, Shift C required more. Efforts should be made to understand these differences, which can result from one or two individuals with long-term injuries.

Table 14: EMS Overtime Shifts

Shift	FY04		FY05	
	# Overtime Days	Staffing Days	# Overtime Days	Staffing Days
A	54	52.7	55	62.3
B	40	31.3	59	60.8
C	32	23.5	66	72.4
D	72	110.9	75	151.8

Table 15: Suppression Overtime Shifts

Suppression Shift	FY04		FY05	
	Number of Overtime Days	Staffing Days	Number of Overtime Days	Staffing Days
A	53	72.1	74	130.0
B	41	65.8	90	182.9
C	50	55.7	97	389.8

To determine the cost effectiveness of hiring permanent staff, we analyzed the impact on overtime if one additional person were added per shift. To be cost effective, the reduction in overtime should be equal to or greater than the cost of adding staff to each shift. To calculate the cost of adding staff, the cost of one on-duty position is based on the staffing factor for either EMS (5.28) or suppression (4.05) multiplied by the salary and benefits for the position. Using the starting salary and benefits for each position, the initial FY04 cost of adding one on-duty EMS position was $275,493, while the FY04 cost for one on-duty suppression position was $220,454.

Based on the pattern of minimum staffing overtime and the amount of overtime, our analysis shows that it would not have been cost effective to add staff for either EMS or suppression to reduce the minimum staffing overtime in FY04 and FY05. In FY04 the amount of overtime for both EMS and suppression was less than the cost of adding one additional on-duty

position. For FY05, the amount of overtime was significantly higher, but the overtime did not occur on enough days and was not high enough on those days to support adding one on-duty position each day. The analysis showed the following:

EMERGENCY MEDICAL SERVICES: If one more on-duty position is available for each shift, FY04 overtime is reduced by 63 percent or 139 minimum staffing days, but overall costs increased by $157,273. For FY05, overtime is reduced by 57 percent or 199 minimum staffing days, but overall costs increase by $96,395.

In FY04 there would be 267 more days when staffing exceeds the minimum staffing required, and in FY05, there would be 209 more days.

- If Shift D with the most overtime adds one more person per shift, FY04 overtime is reduced by 28 percent or 61 minimum staffing days, but overall costs increase by $17,019. There would be 39 more days when staffing exceeds the minimum staffing required. For FY05, overtime is reduced by 19 percent or 67 minimum staffing days, but overall costs increase by $7,618. There would be 33 more days in FY05 when staffing exceeds the minimum staffing required.
- To break even when adding one additional on-duty EMS position, there must be at least 300 or more days during a year when the minimum overtime staffing is one or more staff days.

SUPPRESSION: If one more on-duty position is available for each shift, FY04 overtime is reduced by 49 percent or 95 minimum staffing days, but overall costs increase by $145,233. FY05 overtime is reduced by 32 percent or 225 minimum staffing days, but overall costs increase by $47,683.

In FY04 there would be 310 more days when staffing exceeds the minimum staffing required, and in FY05, there would be 174 more days.

- If Shift C with the most overtime adds one more person per shift, FY04 overtime is reduced by 17 percent or 32 minimum staffing days, but overall costs increase by $48,766. There would be 106 more days when staffing exceeds the minimum staffing required. FY05 overtime is reduced by 13 percent or 93 minimum staffing days, but overall costs increase by $12,292. There would be 34 more days when FY05 staffing exceeds the minimum staffing required.

  To break even when adding one additional on-duty suppression position, there must be at last 280 or more days during a year when the minimum overtime staffing is one or more staff days.

Based on our analysis, using overtime is more cost effective than adding additional staff. However, if the number of overtime staffing days increase more than FY05, adding staff may be more cost effective. It should also be noted that even if it is not cost effective to add an on-duty position only to reduce overtime, there may be other considerations besides overtime that make the additional position cost effective. For example, if another on-duty position is needed, additional capacity is added on many days besides reducing overtime. Therefore, when analyzing

the need for an additional on-duty position, the net impact on overtime as well as the additional staffing should be considered. For example, when overtime is high like it was in FY05, the addition of one person to Shift C in suppression would have only cost a net $12,292 because it reduced overtime, and the Shift would have gained an additional 34 more days when it exceeded the minimum staffing requirement.

Recommendation 2: Continue to use overtime instead of hiring additional personnel to reduce overtime costs. (Until the break even point is reached.)

HIRING: Another challenge is to determine the best method of hiring in order to attract the most qualified and competent employees. Whether hiring firefighters or medical staff, the most economical method is to require EMT-B certification prior to hiring. Although this approach can shave four to five weeks from the initial training period, the EMT-B requirement is likely to reduce the number of minority candidates.

Another way to meet both quality and diversity goals is to mount a strong recruiting campaign. There are various, regionally accredited, college and technical school EMS programs with considerable enrollments of women and other underrepresented groups. Recruiting at these schools before graduation can produce positive results. For certain, effective recruiting is a conscious and deliberate effort.

STAFFING TO MEET THE LEVEL OF RISK AND EXPECTED DEMAND

To effectively control fires, respond to medical emergencies, and mitigate other types of emergency calls, suppression and rescue units need to be available and respond with sufficient force to carry out essential job functions. Ultimately, decisions about staffing levels should consider both the level of service necessary to protect the public as well as the responders.

Proper staffing levels permit emergencies to be handled quickly and safely with the least number of units. To function effectively and perform their desired mission, fire/rescue vehicles should have sufficient personnel to:

- Allow apparatus to be used to its needed capability;
- Allow multiple priorities/tasks to be accomplished simultaneously;
- Allow officers and supervisory personnel to supervise company operations without becoming overly involved in the actual tasks, and;
- Allow essential tasks to be completed safely and with proper accountability measures to protect the individual responders.

Various cities staff fire response vehicles differently. While national standards like NFPA 1710 provide guidance, application of the standard is neither uniform across the country nor is it mandatory. It is also unclear if the standards are based on adequate data to justify them.

Instead of applying these standards blindly, a better approach is to develop a deployment model (and staffing allocation plan) to meet the risks and demand in Alexandria. The plan should

balance cost and the community's willingness to accept more or less risk. Ultimately, it is the public that should determine how much risk they will accept.

Complements Based on Risk – The number of firefighters needed per engine or truck (ladder) company is often a subject of debate. Considerations about the number of personnel to staff on a particular unit or system of units should include:

- The ability to start operations when the first unit arrives;
- The ability to rapidly amass critical staffing for incidents of various sizes and types of hazards;
- Firefighter safety, and;
- **Productivity of a unit** and the system of units.

While the staffing of the unit affects its efficiency, a more important criterion is how fast the total team can be assembled for a given incident regardless of the number of vehicles on which they ride. Responders in Alexandria can assemble the recommended number of personnel within the recommended time. Current exceptions to this are south west Alexandria, Eisenhower Valley, and Potomac Yard.

The *National Fire Protection Handbook, 18th Edition, Typical Initial Attack Response Capability Assuming Interior Attack and Operations Response Capability* (Table 10-2A), makes staffing recommendations based on the number of firefighters arriving on the scene of a fire depending upon the type of occupancy (low-, medium-, and high-hazard occupancy). The NFPA staffing recommendations by the type of hazard areas follows:

- **HIGH-HAZARD OCCUPANCIES** (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** (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.

- **LOW-HAZARD OCCUPANCIES** (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 recommendations and guidelines outlined in the *NFPA Handbook* should be considered, but are not necessarily the final word as the NFPA guidelines do not address how fire departments will also be able to comply with the OSHA mandated "Two-in/Two-out" rule (discussed below). Also, the NFPA guidelines do not address OSHA's requirement that a rapid intervention team/crew (RIT/RIC) be on-scene at a working fire. Depending on local staffing levels, the number of firefighters responding on various units may need to be increased by two or three from the levels outlined in NFPA's guidelines if they are to meet OSHA regulations which are, in fact, legal requirements.

OSHA Regulations – To protect the heath, safety, and welfare of firefighters, the federal government enacted regulations to ensure that firefighters operate in and around structure fires safely.

Enacted by the Department of Labor and the Occupational Safety and Health Administration (OSHA), 29 CFR 1910.134, also known as "Two-in/Two-out," mandates that there must be a minimum of four personnel on the scene of a structural fire before personnel can initiate interior operations. Two firefighters must remain on the exterior of the structure, properly equipped with full turnout gear and self-contained breathing apparatus (SCBA) to act as a RIC in the event the firefighters operating inside the structure become incapacitated or trapped. OSHA allows one RIC member to have an additional role such as incident commander or safety officer, as long as rescue activities can be performed without jeopardizing the safety of other firefighters.

RESPONSE TIME

Comparing actual response times with response-time goals combined with geographic information system (GIS) modeling gives an accurate assessment of coverage. Properly completed, a good GIS analysis will allow decision-makers to see the potential impact of various alternatives. Using actual data is less prescriptive than the ISO standard, albeit it is subject to different interpretations.

Table 16 summarizes the current response time goals adopted by the AFD. The reader should keep these goals in mind as they read the remainder of the report, especially the section on the actual response times in Alexandria, which is discussed in Chapter V, *Response Time Analysis*.

Table 16: AFD Goals

Measure	Goal/ Minutes
Average Dispatch to On Scene Time for Fire calls (turnout and travel time)	4:59
Average Dispatch to On Scene Time for EMS calls (turnout and travel time)	4:59

Measurement Methodology – To determine overall response time, the clock starts when an individual calls 911 (or alternate emergency number) and stops when the first emergency provider arrives at patient's side or the scene of the incident.

Several caveats should be kept in mind. First, response times are subject to a variety of measurement errors and only measure one aspect of overall system performance. For example, response times are distorted when units report their arrival on scene either early or late. Second, response times are frequently not comparable across fire-rescue systems because of the differing manners in which they are calculated. Not all departments track vertical response times (that is, the time from arrival on scene to patient contact), so their total response times likely would be lower than the total response times of a department that does track them.

Many fire/EMS departments report average response times while others report *fractile* response times.[16] Average response times have been increasingly less used by the emergency service industry because small numbers of very short or long responses—often recorded in error—can distort the results. Also, the public is interested in how fast a system responds in most cases (fractile) rather than usually (average). More and more departments are adopting the 90th percentile for reporting response times (mostly due to NFPA 1710's use of this measure).

A fractile response time of *x* at the 90th percentile means that unit's respond in *x* minutes, or less, 90 percent of the time. The remainder beyond the compliance fractile (90th percentile in this case) is the operational tolerance for the system, meaning the system is designed with the understanding that 10 percent of the calls will have response times that exceed the target. Although it is possible to design a system that may ensure rapid response close to 100 percent of the time, it is generally not cost-effective. In some communities with many large differences in risk, it is often too costly to reach the 90th percentile goal—especially in rural areas.

Response times here are defined to include four components, which are further illustrated in Figure 7.

- **Call Processing/Dispatch** – This time begins when the call taker/dispatcher answers the 911 call and ends when the first unit is dispatched.
- **Turnout** – This is the time elapsed from dispatch to departure from the station (or other location); it comprises activities such as donning protective gear and boarding the apparatus.
- **Travel** – This period begins with departure from the station and ends when the unit advises that they are on the scene. It does not include the time to actually reach the fire or patient after arrival at the street location of the incident.
- **"Vertical"** – This is the amount of time from arrival at the scene to arrival at the side of the patient or the site of the fire. It may include going up a high-rise (and hence the term "vertical" response) or traveling within a hospital, golf course, garage, or factory

[16] Fractile measurement reports the percentage of calls responded to in *x* minutes.

to get to the site of a fire or the side of a patient. This sometimes can add five minutes to the response time.

Figure 7: Components of Total Response Time

Response Time (lay public conception)			
911 call received →	Units dispatched →	Apparatus en route →	First unit on scene → Arrival at patient/fire
Call Processing – Begins when the emergency call is answered and ends when emergency responders are dispatched to the identified address of the call. Additional activities and information gathering may take place after notification of responders, but this is not included in call processing time.	**Turnout** – Begins when emergency responders are notified and ends when appropriate emergency apparatus actually leaves the station en route to the location of the emergency.	**Travel (Drive)** – Begins when the first appropriate emergency apparatus actually leaves the station and ends when the first appropriate apparatus arrives at the scene of the emergency.	**Vertical** – Begins when the first appropriate apparatus arrives at the scene of the emergency and ends when personnel arrive at the patient's side or the fire location.

Most departments, including the AFD, do not record the vertical response time component. However, given the number of high-rises, large facilities (i.e. malls, hospitals, schools), and large open areas (parks) in Alexandria, this component has the potential to be significant. While this time is nearly impossible to reduce, it is important to assess its impact on total response time and determine whether other components should be reduced to compensate for the vertical response component to maintain total response time goals. One method to measure and record vertical response time is to require personnel to radio the dispatch center when arriving on scene and again once at the patient's side.

Importance of Response Times – While the speed of response is not directly indicative of outcome or quality, response times do affect the number of lives saved and the value of property losses averted when an emergency occurs. This means that while arriving in 3 or 4 minutes every time does not guarantee everyone will live and there will be less damage, more people can be helped or the fire can be put out before the entire building is consumed when emergency personnel arrive in 5 minutes rather than 10 or 20.

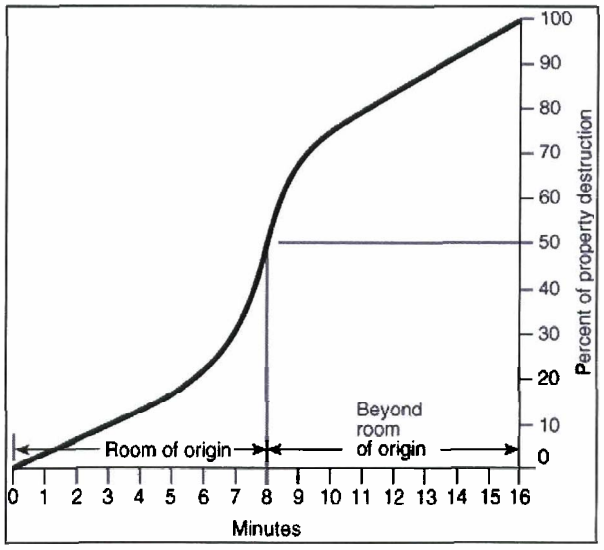
Fire spreads quickly after ignition and the faster it is found and extinguished, the better the results; similar to someone suffering from life threatening symptoms, the probability of survival increases the quicker the patient is treated.

Despite these general observations, current statistical models cannot realistically assess nor predict the quality of fire services in terms of lives saved and property losses averted. In place of these "true" measures of fire rescue service outcome, response time is often used as a proxy measure.

Figure 8 depicts the fire propagation curve, which shows the effect of time and temperature rise of a free-burning fire on the destruction of property. According to multiple

studies, extension of the fire beyond the room of origin begins approximately 6 to 8 minutes after ignition, and flashover of the room of origin occurs within 10 minutes of ignition. (Flashover is the simultaneous ignition of all flammable material in an enclosed area.[17]) In some modern rooms with low ceiling and plastics, flashover can occur in two to four minutes, according to studies by the National Institute of Standards and Technology.

Figure 8: Fire Propagation Curve



Source: Fire Protection Handbook, 18th Ed., National Fire Protection Association

Fire Response Time Standards: The most widely recognized standard used in response time analysis is outlined in NFPA 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Career Fire Departments*.

NFPA 1710 was established in 2001 and contains two recommendations that caught the attention of fire service managers and city administrators across the nation. The standard recommends 4-person staffing for all engine and truck companies (discussed later), and a 5-minute dispatch-to-arrival time to be met on 90 percent of calls. The time increases to 6 minutes when one minute is added for call processing/dispatch time, as recommended in NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*. The 5-minute period includes 1 minute for turnout time and 4 minutes for travel. The travel time translates to a driving distance of 2 miles from the first-due fire station to the incident (driving at an average speed of 30 mph). Detailed data regarding response times for the AFD is discussed in later chapters.

[17] http://en.wikipedia.org/wiki/Flashover

Again, like all NFPA standards, NFPA 1710 may be adopted by a local jurisdiction, but is not mandatory. Unlike many NFPA standards, NFPA 1710 is not based on much of a research foundation, but rather is the majority vote reflecting experience and opinion of a committee, within which there was much disagreement. There is no published information on the expected reductions in losses or injuries as a function of increased staffing and only a little on the effect of increased response times. Nevertheless, despite having been formulated largely on the basis of expert opinions and task sequencing (what must be done and how many it takes to do it) rather than research, NFPA 1710 has become the *de facto* benchmark for the emergency response community. However, NFPA 1710 has not been embraced by all groups, including the ICMA.

In addition to the NFPA, the CFAI has noted a 50-second average call processing/ dispatch time as a baseline. This is actually a far less stringent goal than 60 seconds 90 percent of the time since an average is closer to the 50th percentile. The CFAI also notes a 50-second average baseline for turnout time. The CFAI baselines were developed by analyzing response records from multiple departments over a decade ago. The new CFAI document, *Creating and Evaluating Standards of Response Coverage for Fire Departments*, now recommends using fractile measurements rather than averages.

EMS Response Time Standards – One method of evaluating EMS response times is to count the number of patients who survive to the point of being released from a hospital. Although survival is not solely a function of the timeliness of care, time is crucial to 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.[18]

Prevention of death and disability secondary to acute coronary syndromes is also an issue of time. The American Heart Association 2005 guidelines for CPR and Emergency Cardiac Care emphasize the importance of shortening response time to suspected cardiac arrest patients.[19]

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 recent study in Ottawa, Ontario, found that defibrillation was most effective if it was provided within six minutes of the patient's initial collapse.[20, 21]

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[18] Campell JE. (Ed.). 2000. Basic Trauma Life Support for Paramedics and Other Advanced Providers (4th ed). Englewood Cliffs, NJ: Prentice-Hall. pp. 24-26.

[19] AHA. 2005. Highlights of the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Currents in Emergency Cardiovascular Care, 16(4), 1-25.

[20] Defibrillation is a critical intervention that can be provided by paramedics using manual defibrillators, or by laypersons, police officers, or EMTs using automatic external defibrillators.

[21] *USA Today* ran a series of investigative reporting articles on EMS services across the country (July 28-30, 2003). The title of one article was "Six Minutes To Live or Die." In this article, new research was cited from the Mayo Clinic that suggested the six-minute mark is when lives are saved or lost.

The study also found the following:

- Effectiveness decreased significantly as the interval between cardiac arrest and defibrillation 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.[22]
- The American College of Emergency Physicians noted that for every minute of cardiac arrest the chance of survival decreases up to 10 percent. EMS systems should attempt to achieve response times of 3–4 minutes for Basic Life Support and 6–8 minutes for Advanced Life Support Response.[23]

Nationally, the closest thing to a response time standard for paramedic (ALS) units in an urban/suburban EMS system with automatic defibrillation-capable first responders is 8 minutes in 90 percent of the critical (i.e., life-threatening) calls. This *de facto* standard is an amalgamation of generally accepted criteria or rules-of-thumb. No standards-making consensus group has ever formally defined a standard for ambulance response times. Generally, various EMS systems interpret the idea of a standard in two ways. Some jurisdictions view the 8-minute standard to mean 8 minutes and all of the 59 seconds that follow; other jurisdictions view it as 8 minutes exactly. The latter, more stringent definition is suggested and is more consistent with the medical principles on which it is based.

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. In this case, 10 percent of calls can have response times greater than 8 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 small number of outliers.

Factors Which Positively or Negatively Impact Response Times – There are other factors which impact response time. For example, a requirement for automatic sprinkler systems in all residential occupancies has a positive impact on the system, and some cities have used this strategy to reduce their risk. TriData has often recommended this strategy for growing communities in lieu of adding more fire suppression resources in the future. Negative factors include traffic calming devices, which slow response.

[22] 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.

[23] Pratt, F. D. & Overton, J. (2005). Ground Transport Ambulances. In Brennan, J.A. & Krohmer, J.R. [Eds.]. American *College of Emergency Physicians Principles of Emergency Medical Services Systems*, [3rd Ed.]. Boston: Jones and Bartlett Publishers.

POPULATION DENSITY: Population density is the most basic and common measure used to define whether an area is urban, suburban, or rural. In many ways it determines the other factors listed above. That is, the more people you have in an area, the higher and more concentrated your call volume will be.

The U.S. Census defines urban and rural areas on multiple levels. On a county or city scale, the simplified Census definition of an urban area is an area with at least 1,000 people per square mile. All other areas are rural. However, this definition does not have a middle ground—suburban.

Suburban is a vague and somewhat subjective idea, which makes it the most difficult type of area to define. Suburban areas tend to be mostly residential and are generally on the edges of urban areas. A common division of areas into urban, suburban, and rural by population is:

- **Urban** – 2,000+ people/sq. mile or incorporated
- **Suburban** – 1,000–1,999 people /sq. mile or within one mile of a city's limits
- **Rural** – under 1,000 people /sq. mile

SUPPLEMENTAL PROTECTION SYSTEMS: A fire that smolders or burns undetected or is unreported for a long time may make such sufficient headway as to negate even the fastest response by a fire department. For example, if the fire burns 20 minutes before it is detected, even with a five-minute fire department response time, the damage will have been done.

For several years, Alexandria has had an ordinance that required all high-rise buildings (75 feet or taller) to be retro-fit with sprinklers, except for airport control towers, open parking garages, outdoor assemblies, low hazard use, telephone equipment rooms, and owner occupied residential co-ops. Within the last five years, all multi-family and 50 percent of Alexandria's town homes have been sprinklered.

Some communities have even begun requiring sprinkler systems to be installed in single-family homes. In 1978 San Clemente, CA, implemented the nation's first comprehensive and mandatory residential sprinkler program. Only a few other communities that we are aware of have such a comprehensive program. They include Prince Georges County, MD; Scottsdale, AZ; and most recently Montgomery County, MD. With residential sprinklers in place, response times to fire calls in suburban and rural areas (where most new housing development is taking place throughout the country) can be longer than for urban areas where the housing stock is older and more likely to be unsprinklered.

TRAFFIC CALMING: Many communities across the nation are installing traffic-limiting devices (speed bumps and speed humps) to reduce vehicle speeds, mostly in residential neighborhoods. These devices are popular with neighborhood residents, who often demand them. However, each speed bump adds an estimated 10 to 12 seconds to emergency apparatus response times. The installation of these devices is a value judgment on the part of elected officials, who

must weigh the satisfaction and possibly improved traffic safety to neighborhoods with the potential for longer emergency response times and the possible need for additional fire and EMS resources to compensate for the slower travel times. A study on this tradeoff undertaken for the Boulder, CO, City Council in 1997 showed that the likely reduction of traffic fatalities from the slowing of traffic was far less than the likely increase in deaths from slowing the response to delayed response for cardiac arrests and other emergencies.[24]

In 1998, the Portland, OR, Fire Bureau tested the impacts of 14- and 22-foot speed bumps on emergency apparatus response.[25] The tests found that ambulance response times were not impacted but engines and trucks were slowed by up to nine seconds per bump.[26] A compromise to slow traffic but not impact emergency response was to install offset speed bumps with enough room between to allow apparatus to drive around (one in the right lane only followed by one in the left lane only 50 feet ahead).

TRAFFIC SIGNAL PREEMPTION: On the positive side, traffic light preemption systems change the traffic lights as emergency vehicles approach, stopping civilian vehicles, and allowing emergency vehicles to enter intersections on a green light, thereby reducing the likelihood of a side-impact or head-on collision with another vehicle when having to go through red lights. These systems can be activated by siren or by infrared technology. When activated, the traffic light changes to a temporary green signal for the approaching emergency vehicle. Such a system is an excellent way to improve the safety of citizens and firefighters during emergency responses. In establishing operating procedures for such traffic devices, the department should restrict emergency vehicle operators from entering intersections on red lights because a delayed green light at an intersection with a preemption device can mean that another emergency vehicle is entering the intersection from the cross-road.

AUTOMATIC VEHICLE LOCATION (AVL) AND MOBILE DATA COMPUTERS (MDCS): Implementation of an AVL system is beneficial because it allows dispatchers to see the actual location of any unit on a computer-generated map of the city. The AVL data could also be integrated into the CAD system to calculate the truly closest unit to any given emergency and make a dispatch recommendation accordingly, rather than making dispatches on the basis of the fixed station locations. In addition to improving dispatching, AVL improves personnel safety because a unit that is in trouble can be quickly located.

Additionally, an AVL system can be integrated with MDCs installed in each emergency response unit. With the appropriate integration of AVL, navigational, and MDC technologies, the

[24] Deaths Expected From Delayed Emergency Response Due to Neighborhood Traffic Mitigation, 3 April 1997; submitted by Ronald Bowman to Boulder, CO City Council.
[25] These speed bumps are also commonly referred to as speed tables and are flat or slightly rounded on top with a maximum height of three inches in the middle.
[26] Source: http://www.trans.ci.portland.or.us/TrafficCalming/reports/split.htm

AVL can provide the MDC with a visual map showing the current unit location of the unit and the incident location along with the most efficient route of travel.

MDCs can be used to provide CAD data, city maps, building plans, fire-rescue pre-plans, hospital status, patient information, navigational directions to responding units, etc. to units directly in the field. MDCs can also be used to log status and file incident reports. MDCs can be supported by 800 MHz radio system channels, code-division multiple access (CDMA) cellular technology (the same technology used to access the Internet on cell phones), and other wireless communications technologies.

Evaluating Unit Workloads

The location of fire stations is only one factor in determining whether response-time goals will be achieved. The 'busyness' factor or workload is also important since units that are extremely busy may not be available for the next call, thus necessitating the response from a station further away. For Alexandria, none of the fire units have excessively high workloads. However, several medic units are approaching a high workload threshold. EMS workload is typically described as Unit Hour Utilization (UHU), which is discussed later in this section.

Through CAD systems, fire departments are able to keep detailed records about service times; these data are useful in determining the availability of a specific unit or station. Again, the concept of workload is not merely a count of how many calls to which a unit was dispatched. One unit can have fewer responses than another but remains on the scene longer on average (e.g. more working incidents), and so has a greater workload. Evaluating workload is important when looking at the overlaps in coverage to an area that may be required to achieve the response time goals adopted by the city/department and is part of the CFAI self-assessment process. An analysis of workload also can indicate whether a new station should be built or new apparatus purchased—or if current stations should be closed or units moved.

A fire/EMS system must incorporate the necessary redundancies based on whether adjacent stations or units are likely to be available for emergency response. Below are general guidelines developed by TriData to show the level of redundancy (overlap) necessary to achieve response-time goals. These were developed predicated on our experience of fire and EMS organizations.

1. **Very Low Workload (<500 responses/yr)** – Simultaneous calls are infrequent and unit availability usually is assured. Stations/units can be spaced at the maximum distance possible to achieve stated travel time objectives established by the community.
2. **Low Workload (500–999 responses/yr)** – Few calls will overlap and unit availability usually is assured. Stations/units can be spaced at the maximum distance possible to achieve stated travel time objectives established by the community.

3. **Moderate Workload (1,000–1,999 responses/yr)** – Some overlap of calls will occur, usually at peak demand periods; however, stations/units are usually available. Stations/units must be located with marginal overlap to achieve stated travel time objectives established by the community.
4. **High Workload (2,000–2,999 responses/yr)** – Additional overlap of calls will likely occur; however, stations/units will probably be available for emergency response. Stations/units must be located with significant overlap to achieve stated travel time objectives established by the community. This footprint usually achieves the best results in terms of cost efficiency and effectiveness of service delivery. (Overlap can be achieved with additional stations or additional units in existing stations.)
5. **Very High Workload (3,000–3,999 responses/yr)** – 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. Stations/units must be located with the significant overlap to achieve stated travel time objectives established by the community. (Overlap can be achieved with additional stations or additional units in existing stations.)
6. **Extremely High Workload (>4,000 responses/yr)** – Overlapping calls may occur hourly, regardless of the time of day. The closest station/unit is likely to be unavailable thus requiring the response of adjacent stations/units. Frequent transfers or move-ups are required for the delivery system to meet demand. Stations/units must be located with redundancy (back-up units) to achieve stated travel time objectives established by the community. This footprint is usually found in very densely populated urban areas and is especially evident in EMS services located in urban areas with very high demand. (Overlap can be achieved with additional stations or additional units in existing stations.)

The 3,000–3,900 response level (*very high workload* category above) is the point at which units are often considered "busy" and their availability should be evaluated. This is a rough rule of thumb, not a fixed standard. At this point, response times often begin getting longer because of simultaneous call occurring in the same area.[27] As units become busier, the chances for overlap or simultaneous alarms increase, and second-due units begin to answer more calls. This causes a domino effect where unit B is dispatched to a call in unit A's area because unit A is already engaged, causing unit B to be unavailable for the next call in its own area. Unit C must then respond to unit B or unit A's area, and so forth.

Again, the 3,000-response threshold is just a rule of thumb. How much time a unit is unavailable due to being involved with another incident is better assessment of the impact of workloads on availability and response times. This is the second factor in workload, known as unit hour utilization (UHU).

[27] A "first-due" 'area is a certain geographic area of the overall fire department response jurisdiction assigned to a particular fire station.

UNIT HOUR UTILIZATION: UHU is a calculation that estimates the amount of time a unit is occupied on emergency calls as a percentage of the total amount of hours a unit is staffed and available for response (a unit staffed full-time is available 8,760 hours per year). In other words, UHU measures the percentage of on-duty time consumed by emergency service field activities. A high UHU means lower availability for calls. Poor availability negatively impacts response times.

The specific formula used to calculate the UHU for each unit is:

$$\text{UHU} = \frac{\text{(number of calls)} \; x \; \text{(average call duration in hours)}}{\text{8,760 hours per year}}$$

UHU measures the percent of a unit's time in service that is spent running calls. There is other time that is *not* accounted for, however, which includes time for training, maintenance, and other preparedness-related functions. Public education efforts also are not included in the UHU calculation. In other words, when units are not engaged in emergency response, it does not mean they are not working.

UHU is used more in relation to EMS units than fire suppression units; although, evaluation of UHUs is useful to different extents in both cases.

While there is consensus within the industry on the importance of utilization rates and how to measure them, the interpretation of how indicative utilization rates are of overall system efficiency is debatable. Most believe that a UHU between 35 and 45 percent for EMS is good for economic efficiency. (This is more common with private ambulance providers.) If a UHU is greater than 45 percent, units often are not available and response times suffer. If a UHU is below 35 percent, units may not be well utilized, but response times may be high too often. Many communities choose to aim for a UHU in the 15 to 25 percent range to improve or maintain good response times. If a unit has a UHU of 40 percent, it will not be available for the next call 40 percent of the time. This is, of course, an average over the course of the day.

In order to develop an effective resource deployment plan, units must be available to respond to incidents most of the time. No amount of resource placement planning will improve system-wide response times if the responding units are not available.

PLANNING FOR NEW FACILITIES

This section looks at criteria for determining the number, location, size, and timing for stations.

Number and Location of Stations – How many stations a department needs to protect an area depends in part on the size of the area to be protected. The desired response times, built-in suppression systems (automatic sprinklers), automatic or mutual aid agreements,

risks present, and type of developments to be protected impact the need for stations in addition to the size of the area protected.

The desired response times will have the largest impact on the number of stations needed. For example, if apparatus from a given station currently can get anywhere in an area within six minutes at 30 mph, and if there were a perfect east-west, north-south street network, then the area served by one station would be an 18-square-mile diamond-shaped area three miles in diameter from the center (station location) to any corner. If one wished to serve that same 18-square-mile area with a two-minute response, one would need nine stations instead of one because each station would be able to serve only two square miles.

The road network and actual placement of stations also plays a sizeable role in the number of stations required. A perfect grid-patterned road network allows for the largest area to be reached in a given time, assuming uniform travel speeds on all road segments. Access to high-speed roadways (interstates, limited-access highways, etc.) increases the reachable area; winding, narrow, or steep roads decrease the reachable area.

Although analysis of an area's road network, demand, call locations, etc. is necessary to determine the number and timing of stations needed to provide the desired level of service in the most cost-effective manner, an approximate number of stations can be determined using other methodologies.

Determining Station Size – Once the decision to add, consolidate, or rebuild a station has been made and the site(s) selected, the process moves on to determining the size of the station needed.

While the architect will work with the department to determine the exact size and layout of the new station, there are some basic factors a department should consider from the beginning:

- How many units will be assigned to the station; now and in the future? (Apparatus bays typically make up the largest portion of a fire station.)
- How many personnel will be assigned to the units/ station?
- What facilities will they need (sleeping quarters, parking, fitness facilities, etc.)?
- How many offices are needed?
- Is space for public meetings desired?
- How much land is required?

Other considerations also come into play, including whether service deficiencies exist. For example:

- Current Service Levels – How large is the current service deficiency? How fast are calls being handled in that area? How many calls would a new station in that area handle? To what extent would the addition of a station in that area correct the deficiency?

- Future Service Levels – If there is no current deficiency, when will there be a service deficiency in the area in the future? Is the deficiency a function of response times, workload, or both?
- Cost of Alternative Solutions – What alternatives to building a station exist in the area (e.g., expanding/renovating the current station, redeployment of current resources)? What are the costs and benefits of each option?

The flowchart in Figure 9 is a useful tool for capital planning.

Figure 9: Capital Improvements Prioritization Methodology

INTER-JURISDICTIONAL COMPARISONS

When considering resource deployment, a useful tool is to compare the organization with similar ones. Such a comparison was made during this study.

Inter-jurisdictional comparisons can be subject to misinterpretations of data that cannot be perfectly compared or defined. Benchmarking is useful as an input into the planning process, but it is not an indication of the quality of service provided.

We compared Alexandria with communities of similar population nationwide, and with neighboring communities in the region. The average population served for the small-cities group is 139,922. Eight of the communities provided EMS (73 percent). Table 17 shows the baseline information for the comparison group used in this study.

Table 17: Comparison City Overview

Jurisdiction	2004 Population	Provide EMS Transport
Alexandria, VA	**128,206**	**Yes**
Naperville, IL	140,106	Yes
Orange City, CA	133,819	Yes
Pasadena, CA	144,068	Yes
Portsmouth, VA	99,291	Yes
Richmond, VA	192,494	No
Savannah, GA	129,808	No
Springfield, MO	151,580	No
Average Small Cities	**139,922**	**-**
Arlington County, VA	186,117	Yes
Fairfax County, VA	1,003,157	Yes
Washington, DC	553,523	Yes
Average With Large Cities	250,174	-

Number of Stations and the Population Protected per Station – Two measures of station coverage are the square miles protected per fire station and the number of citizens protected per station. In an urban setting with high population densities, stations will be closer together than in rural and suburban areas and thus will protect fewer square miles but more people. The average area per station, therefore, is an indirect measure of the level of service, since the number of stations in a given area is related to response times. Less area per station generally results in lower response times.

The population protected per station is a rough indicator of the workload that can be expected. The population per station is based on the resident population protected; it does not include visitors or non-resident workers.

As Table 18 shows, the AFD protects an average 1.9 square miles per station, half the area of the small-cities comparison group. The area protected varies from the low in Alexandria of 1.9 square miles to a high of 6.9 square miles in Springfield, MO.

Table 18: Square Miles per Station

Jurisdiction	2004 Population	Sq. Miles	Fire Stations	Square Miles/Station
Springfield, MO	151,580	76	11	6.9
Savannah, GA	129,808	72	12	6.0
Naperville, IL	140,106	35	8	4.4
Portsmouth, VA	99,291	33	8	4.1
Orange City, CA	133,819	27	8	3.4
Richmond, VA	192,494	63	20	3.1
Pasadena, CA	144,068	23	8	2.9
Alexandria, VA	**128,206**	**15**	**8**	**1.9**
Average Small Cities	**139,922**	**43**	**10**	**4**
Fairfax County, VA	1,003,157	399	34	11.7
Arlington County, VA	186,117	26	10	2.6
Washington, DC	553,523	69	33	2.1
Average With Large Cities	250,174	73	14	**5**

Table 19 shows that the population served per station varied from a low of 9,625 in Richmond, VA to a high of 16,026 in Alexandria. The average for the comparison group is 13,486 (small cities).

Table 19: Population per Station

Jurisdiction	2004 Population	Fire Stations	Pop/Station	Pop/Square Mile
Alexandria, VA	**128,206**	**8**	**16,026**	**8,435**
Pasadena, CA	144,068	8	18,009	6,237
Orange City, CA	133,819	8	16,727	4,956
Naperville, IL	140,106	8	17,513	3,958
Richmond, VA	192,494	20	9,625	3,080
Portsmouth, VA	99,291	8	12,411	3,009
Springfield, MO	151,580	11	13,780	2,002
Savannah, GA	129,808	12	10,817	1,815
Average Small Cities	**139,922**	**10**	**13,486**	**13,486**
Washington, DC	553,523	33	16,773	8,022
Arlington County, VA	186,117	10	18,612	7,158
Fairfax County, VA	1,003,157	34	29,505	2,514
Average With Large Cities	250,174	14	17,889	17,889

Not depicted in Table 19 is the 3.1 percent population increase that occurs weekdays in Old Town Alexandria area. This increase in population, especially to a small area, creates demand fluctuations, especially EMS.

Calls Per Capita – Calls per 1,000 population is the direct measure of demand. The AFD is 30 percent above the average for the small-city comparison group at 140 calls per 1,000 population. Alexandria most resembles Richmond, VA, Portsmouth, VA and its neighbor, Arlington County, in its calls per 1,000 people. The number of calls per 1,000 population, as seen in Table 20, varied from the low in Savannah, GA of 35 which is largely due to the jurisdiction not providing EMS service, to the high of 165 in Portsmouth, VA.

Table 20: Calls per 1,000 Population

Jurisdiction	Total Incidents	Fire Calls*	EMS Calls	Fire Calls/ 1000 Pop	EMS Calls/ 1000 Pop	All Calls/ 1000 Pop
Portsmouth, VA	16,396	3,301	13,095	33	132	165
Richmond, VA	28,746	12,472	16,274	65	85	149
Alexandria, VA	**17,948**	**6,295**	**11,653**	**49**	**91**	**140**
Pasadena, CA	14,975	4,056	10,919	28	76	104
Naperville, IL	13,653	7,783	5,870	56	42	97
Springfield, MO	14,211	4,738	9,473	31	62	94
Orange City, CA	10,002	3,442	6,560	26	49	75
Savannah, GA	4,473	4,473	0	34	-	34
Average Small Cities	**15,051**	**5,820**	**10,549**	**42**	**66**	**108**
Washington, DC	216,309	63,309	153,000	114	276	391
Arlington County, VA	23,021	8,019	15,002	43	81	124
Fairfax County, VA	83,584	26,977	56,607	27	56	83
Average With Large Cities	40,302	13,170	29,845	51	104	155

*Fire calls includes all false alarms, good intent calls, other calls, etc.

Mix of Calls – Table 21 shows the breakdown of calls for the comparison group. EMS calls constitute the largest percentage of calls in all departments, except Savannah. The AFD experiences about 65 percent of its demand in EMS, which is above the average for the group. In Portsmouth, VA, 80 percent of demand is for EMS while the split is closer to 50–50 in Naperville, IL.

Table 21: Mix of Calls

Jurisdiction	Total Incidents	Fire Calls*	EMS Calls	Percent Fire	Percent EMS
Portsmouth, VA	16,396	3,301	13,095	20%	80%
Pasadena, CA	14,975	4,056	10,919	27%	73%
Springfield, MO	14,211	4,738	9,473	33%	67%
Orange City, CA	10,002	3,442	6,560	34%	66%
Alexandria, VA	**17,948**	**6,295**	**11,653**	**35%**	**65%**
Richmond, VA	28,746	12,472	16,274	43%	57%
Naperville, IL	13,653	7,783	5,870	57%	43%
Savannah, GA	4,473	4,473	-	100%	-
Average Small Cities	**15,051**	**5,820**	**10,549**	**39%**	**61%**
Washington, DC	216,309	63,309	153,000	29%	71%
Fairfax County, VA	83,584	26,977	56,607	32%	68%
Arlington County, VA	23,021	8,019	15,002	35%	65%
Average With Large Cities	40,302	13,170	29,845	33%	67%

*Fire calls includes all false alarms, good intent calls, other calls, etc.

Fire Apparatus – Table 22 shows the number of engines and trucks used across the selected local jurisdictions. Nationally, larger cities tend to need a higher engine-truck ratio of 2:1. More suburban departments have generally operated with a ratio of 4:1 or higher. Rural departments can operate at an even higher ratio. Alexandria is at a ratio of 2.7:1. The averages do not take into account the City of Richmond because it utilizes quints instead of engines.

Table 22: Fire Apparatus[28]

Jurisdiction	Engines	Trucks	Engines/ 1,000 pop	E:T Ratio
Orange City, CA	8	1	0.06	8.00
Pasadena, CA	8	2	0.06	4.00
Naperville, IL	8	3	0.06	2.67
Alexandria, VA	**8**	**3**	**0.06**	**2.67**
Savannah, GA	12	5	0.09	2.40
Portsmouth, VA	7	3	0.07	2.33
Springfield, MO	10	5	0.07	2.00
Richmond, VA	20 Quints	20	0.10	1.00
Average Small Cities	**9**	**3**	**0.07**	**2.79**
Fairfax County, VA	34	12	0.03	2.83
Arlington County, VA	8	3	0.04	2.67
Washington, DC	32	16	0.06	2.00
Average With Large Cities	14	7	0.05	2.55

[28] Front-line apparatus only, not reserves.

Ultimately it is the location of trucks to meet response time goals that largely determines the number needed and hence the ratio. The need for truck companies becomes greater with the increase in population density usually associated with large numbers of multiple family dwellings or high-rise buildings. Although aerial ladders on the trucks are not able to reach the upper floors on many high-rise structures, they can reach a large portion of the building for water application as well as rescue. Whether the ladder is used, truck personnel are still needed for suppression activities such as ventilation and search/ rescue; operations which are often conducted simultaneously.

Alexandria has 0.06 engines per 1,000 population, which is slightly below the 0.07 average for the comparison group. Engines per 1,000 population varied from a low of 0.06 in Naperville, IL; Pasadena, CA; Orange City, CA; and Alexandria, VA to a high of 0.09 in Savannah, GA.

RELEVANT GUIDELINES CONSIDERED IN THIS STUDY

For this study we considered relevant guidelines and standards for station and staffing deployment from a variety of sources. Following is a brief synopsis of three more prominent ones considered during this study.

Insurance Services Office – The Insurance Services Office (ISO) is a national insurance engineering service organization that assigns a public protection classification (PPC) to jurisdictions based on fire department services. Insurance companies typically establish insurance rates for individual occupancies or groups of occupancies based on the PPC. PPCs are established using the ISO's *Fire Suppression Rating Schedule* (FSRS). Once widely used by fire departments to evaluate system performance, the FSRS's use is somewhat limited in that it only evaluates fire protection (not EMS, which most fire departments now provide to some degree). Also, the FSRS does not consider efficiency (e.g., how many resources are deployed in comparison to the number of actual calls). Though not as widely used now, ISO ratings are still appropriate to consider as part of a more comprehensive system performance review. Combined with other assessments, ISO standards are useful, but not by themselves.

National Fire Protection Association – The National Fire Protection Association (NFPA) is an international, nonprofit organization dedicated to reducing the worldwide burden of fire and other hazards on the quality of life by developing and advocating scientifically based consensus codes and standards, research, training, and education. The NFPA recommendations are standards and guidelines developed by committees of chief officers, volunteer representatives, union officials, and industry representatives. Although the NFPA's standards are not legally binding, they are often codified into local ordinances, and it is important to consider NFPA standards whether or not they are adopted locally since NFPA standards sometimes become the *de facto* standard for evaluating different levels of fire and emergency service protection.

Commission on Fire Accreditation International – Another highly influential group, the Commission on Fire Accreditation International (CFAI) consists of representatives from the International Association of Fire Chiefs (IAFC) and the International City/County Management Association (ICMA). The CFAI and the accreditation process were designed to establish industry-wide performance measures for overall organizational performance and the establishment of the standard for a jurisdiction is purely voluntary. While a small fraction of fire departments across the nation (about 100) have gone through the accreditation process and others are working toward that goal, most departments are focusing on the creation of a "Standards of Response Coverage" document (one of four items required for accreditation). The standards of coverage concept has proven so useful that the CFAI expanded the original 44-page chapter into a 190+ page "how-to" manual.

The CFAI does not make many explicit recommendations on standards for fire/EMS departments to adopt. Rather, it encourages a thorough assessment of risks in the community, public expectations and the resources needed to meet expectations given the risks. The creation of written standards should then be based on that assessment. Part of the methodology for setting standards includes looking at what other, similar communities are doing.

IV. DEMAND AND WORKLOAD ANALYSIS

This chapter reviews the past demand for emergency services and the factors which influence demand for service going into the future (population and demographics). The analysis includes incident data supplied by the department, population projections from the Metropolitan Washington Council of Governments (MWCOG), and demographic data obtained from the U.S. Census.

POPULATION

The 2006 Census estimates the city's current population at 136,974.[29] The city experienced only moderate population gains of 1.2 to 1.5 percent between 1990 and 2005, according to the data we reviewed. Using the 1990, 2000 and 2005 population data as the baseline, and comparing it to the projections for 2010 and 2020 (MWCOG data), growth is expected to slow to less than one percent annually by 2020.[30] Table 23 shows population totals from 1990 through 2020 for the years supplied by the MWCOG. Population totals include only the resident population. It does not include non-residents who may work in the city and require city services.

Table 23: City Population, 1990–2020 (Historic and Predicted)

Year	Population
1990	111,183
2000	128,283
2005	135,856
2010	143,903
2020	152,642

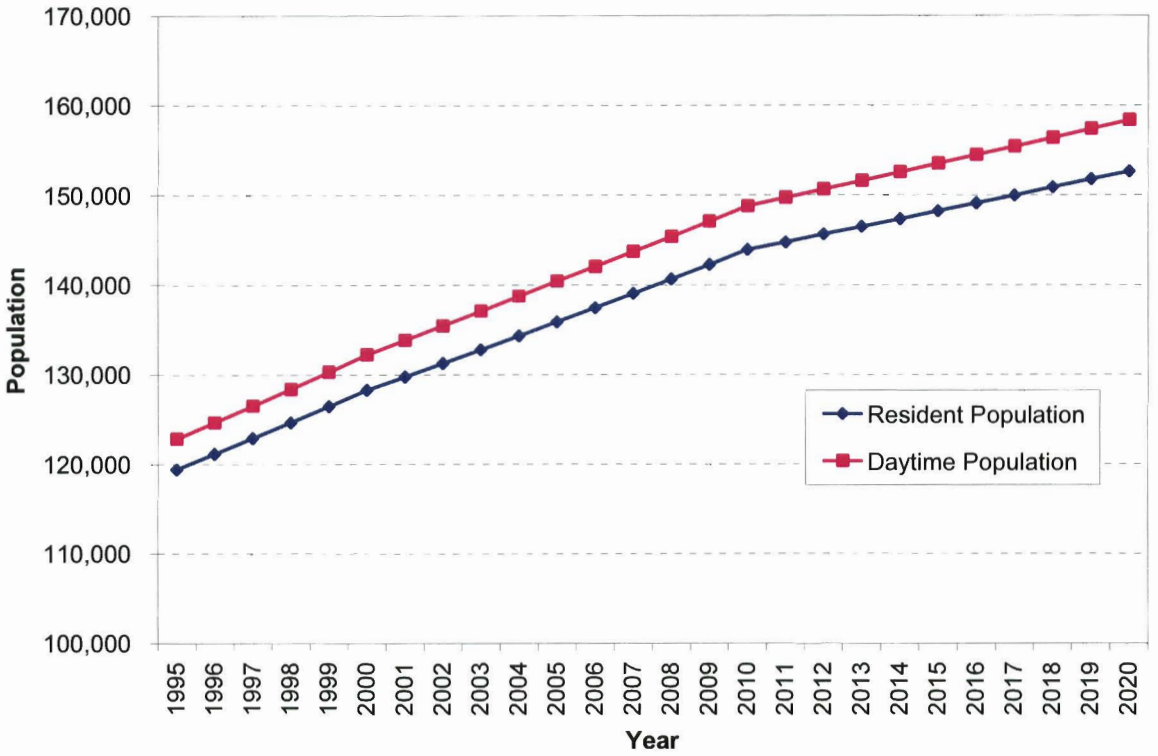
During business hours, Alexandria both loses and gains population. Some residents commute to DC and other workplaces outside of Alexandria. At the same time, many residents from nearby jurisdictions commute into Alexandria for work. The overall effect of the daily commute on the City of Alexandria is a 3.1–10.8 percent increase in daytime population.[31][32] This increase is presented as a range since different variables are used by different population analysts.

The Bureau of Census derives their population change estimate using the commuting worker variable. In contrast, the City of Alexandria planning office uses many variables including worker commuting, educational commuting, and pass-through travelers. Using

[29] Source: 2006 population from www.census.gov
[30] Source: MWCOG Round 7.0 RNC
[31] Bureau of Census for 2000
[32] Personal Communications, Mr. Robert Rosenbaum, City of Alexandria, Department of Planning, June 30, 2006.

MWCOG employment projections, the ratio of daytime population to resident population would remain relatively stable through 2020.[33] The likely increase is projected to be less than one-half of one-percent over the next fifteen years. Because daytime population increases affect EMS incident demand more than other call types, we have used the daytime population for modeling EMS incidents and resident population for modeling all other incidents. The results are discussed later in this chapter. Figure 10 shows a positive trend of resident and daytime population.

Figure 10: Projected Population



POPULATION DENSITY

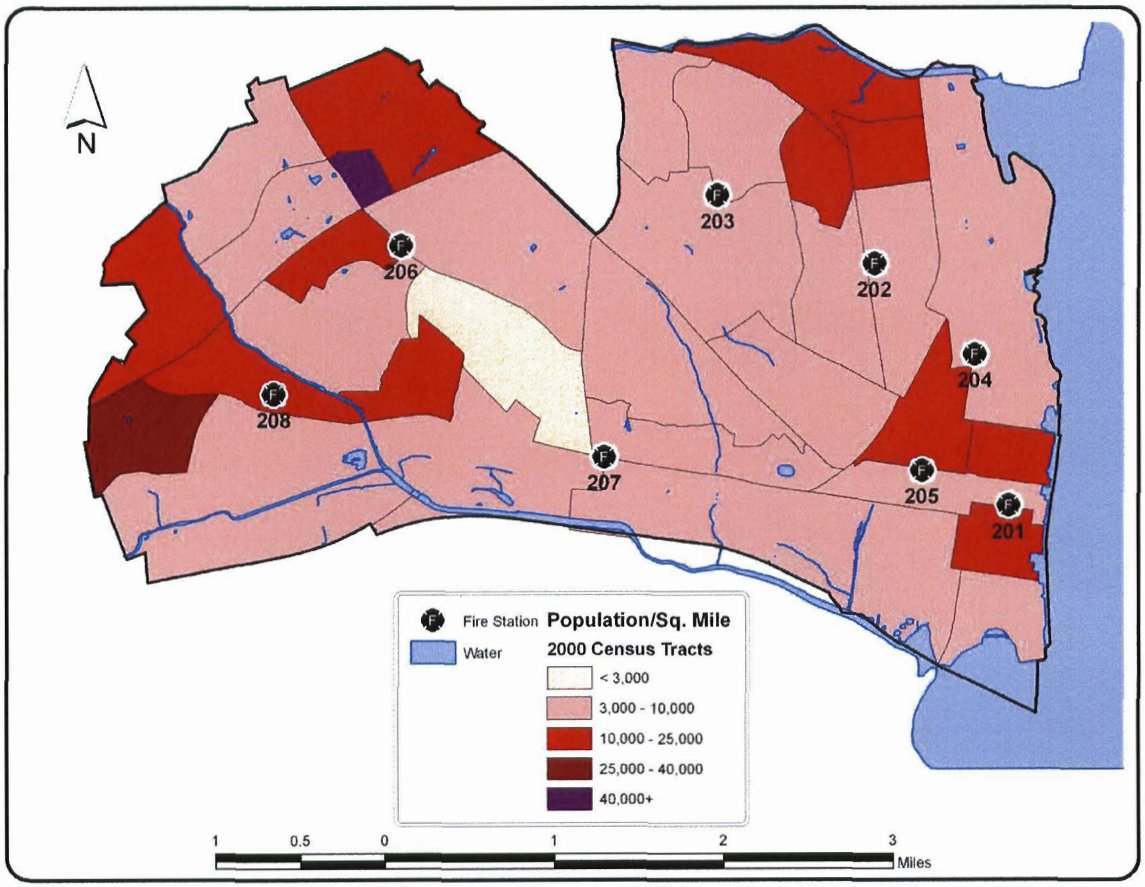
As stated previously, the size and density of the population served affects the demand for fire and EMS services. More people living in smaller areas typically results in higher demand as the same number of people living in one square mile will create more demand than the same number of people living in ten square miles. Factors influencing greater demand include higher traffic volumes and more renter-occupied structures.

[33] Source: MWCOG Round 7.0 RNC. A fixed ratio of workers living in the city to workers working in the city is assumed (ratio based on the 2000 Census). MWCOG employment projections were also factored into these calculations.

The city's estimated population density is 8,435 residents per square mile. This density varies significantly from one area of the city to the next. Map 1 shows density by census tract from 2000 (the most recent year for which this information is available).

The west side of the city is denser than the central and east sides. This includes only resident population density; visitor and business density is higher in Old Town (the east side). Old Town also has more traffic congestion, more high-rise buildings, and buildings closer together (greater exposure problems) than other areas of the city. Thus, Old Town requires more stations, placed closer together, to reduce travel times.

Map 1: Alexandria Population Density by Census Tract, 2000



AGE DEMOGRAPHICS

Studies have shown the elderly create a disproportionate amount of demand for medical service. The population is broken down by age group in Table 24. All values shown are percentages of the total population of the city with the exception of the average age, which is expressed in years. Growth is expressed as the ratio of an age group's proportion in 2010 divided by the same proportion from 2000. Between 2000 and 2010, two age groups, persons under age

20 and persons 55 to 64 years of age, are expected to increase their size in relation to the total population. In particular, the latter group is expected to increase overall demand for medical services.

Table 24: Population Age Demographics, 1990, 2000, and 2010[34]

Age	1990		2000		2010		2000 to 2010	
	Number	Percent	Number	Percent	Number	Percent	Net Change	Growth
Under 20	19,123	17.2%	23,348	18.2%	27,342	19.0%	3,994	4.4%
20 to 34	40,693	36.6%	42,333	33.0%	45,905	31.9%	3,572	-3.3%
35 to 54	32,132	28.9%	40,922	31.9%	46,337	32.2%	5,414	0.9%
55 to 64	7,894	7.1%	10,006	7.8%	11,512	8.0%	1,506	2.6%
65 and over	11,341	10.2%	11,545	9.0%	12,807	8.9%	1,262	-1.1%
Total	111,183	100.0%	128,283	99.9%	143,903	100.0%	15,620	12.2%
Avg. Age	**35.6**	**-**	**35.9**	**-**	**35.8**	**-**	**(0.1)**	**-**

CURRENT AND PROJECTED DEMAND

To prepare the AFD for the next decade and beyond, an understanding of the requirements for service is essential. Demand is a function of many variables including local risks, environment, and population characteristics. Table 25 shows fire department incidents from 2000 to 2006, according to the National Fire Incident Reporting System (NFIRS) database provided to us by the AFD.

Table 25: Fire Department Incidents, 2000–2006

	2000	2001	2002	2003	2004	2005	2006	Average	Proportion
Fires	373	433	581	457	511	533	541	490	3%
Explosion	141	163	122	130	112	99	70	120	1%
EMS	10,803	11,249	11,360	11,652	11,661	11,816	11,751	11,470	65%
Hazmat	519	630	668	877	613	670	685	666	4%
Service	913	878	815	969	963	961	1,136	948	5%
Good Intent	1,251	1,507	1,696	2,279	1,952	1,747	1,960	1,770	10%
False Alarm	1,692	1,885	1,742	2,070	1,932	2,077	2,007	1,915	11%
Weather	5	2	4	85	6	5	15	17	0%
Other	1,344	554	64	76	48	50	61	314	2%
Total	**17,041**	**17,301**	**17,052**	**18,595**	**17,798**	**17,958**	**18,226**	**17,710**	**100%**

In 2006, AFD units responded to over 18,000 incidents, of which 65 percent were EMS calls. The overall trend in total incidents is positive. The number of incidents has increased from

[34] Source: The 1990, 2000 US Census, Bureau of the Census, and Virginia Employment Commission (2003); from the City Department of Planning and Zoning.

17,041 in 2000 to 18,226 in 2006. Although there were fluctuations in the individual categories, generally each category increased over this time period.

The average number of fires for the past six years is 490 with the highest number occurring in 2002 (581). Emergency medical incidents are the largest incident category, accounting for sixty-five percent of incidents on average. This category showed slight growth over the observed time period.

Stations 204 and 208 responded to the most incidents in 2006. Combined, these stations responded to 39 percent of all fire and EMS incidents. Station 201, which has the lowest demand, also has the smallest response area. The proposed addition of new stations in Eisenhower Valley and Potomac Yard will decrease the call volume for Station 204 and 208. Generally, demand is split east/west with lower demand in the center of the city.

Table 26: AFD Demand (Calls) by Station First-Due Area, 2006

Station	Fire Incidents	EMS Incidents	Other Incidents	Total
201	545	752	7	1,304
202	408	1,121	5	1,534
203	400	1,131	15	1,546
204	1,013	2,268	15	3,296
205	513	983	4	1,500
206	886	2,030	9	2,925
207	488	1,576	3	2,067
208	1,089	2,563	8	3,660
Total	**5,342**	**12,424**	**66**	**17,832**
Percentage	**30%**	**70%**	**0%**	

As was discussed earlier, demand also varies by hour, day, and month.

Per Capita Demand – Demand is the product of population and calls per capita. Both factors need to be considered when projecting future demand. For this project we analyzed per capita demand using Census and MWCOG figures and the call types from 2000 to 2006. Per capita demand is shown in Table 27 and depicted graphically in Figure 11 and Figure 12. EMS per capita demand is depicted on a separate graph since the volume of EMS calls is much higher than other incident types, and it was difficult to accurately show the others on the same graph.

Table 27: Demand per Capita (per 10,000) Demand, 2000–2006

	2000	2001	2002	2003	2004	2005	2006
Fires	29	33	44	34	38	39	39
Explosion	11	13	9	10	8	7	5
EMS	842	867	865	877	868	870	855
Hazmat	40	49	51	66	46	49	50
Service	71	68	62	73	72	71	83
Good Intent	98	116	129	172	145	129	143
False Alarm	132	145	133	156	144	153	146
Weather	0	0	0	6	0	0	1
Other	105	43	5	6	4	4	4

Figure 11: Fire and Other Incidents - per capita Demand, 2000–2006 (With linear regression lines)

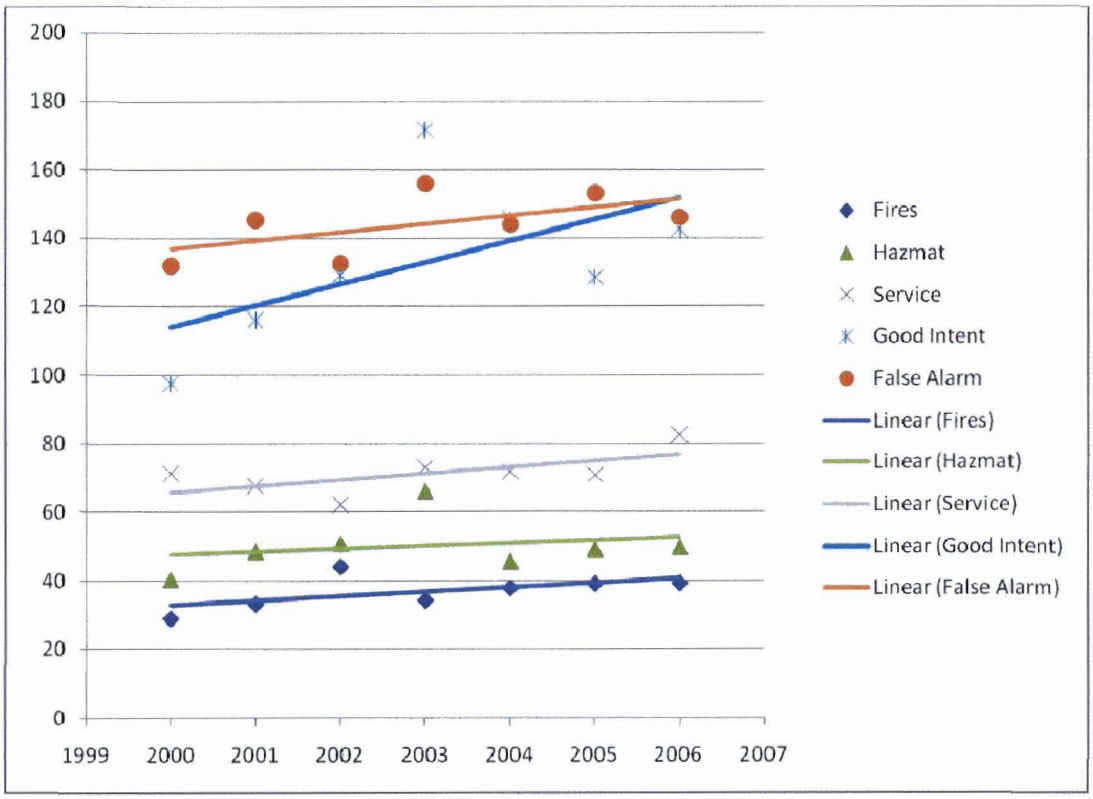
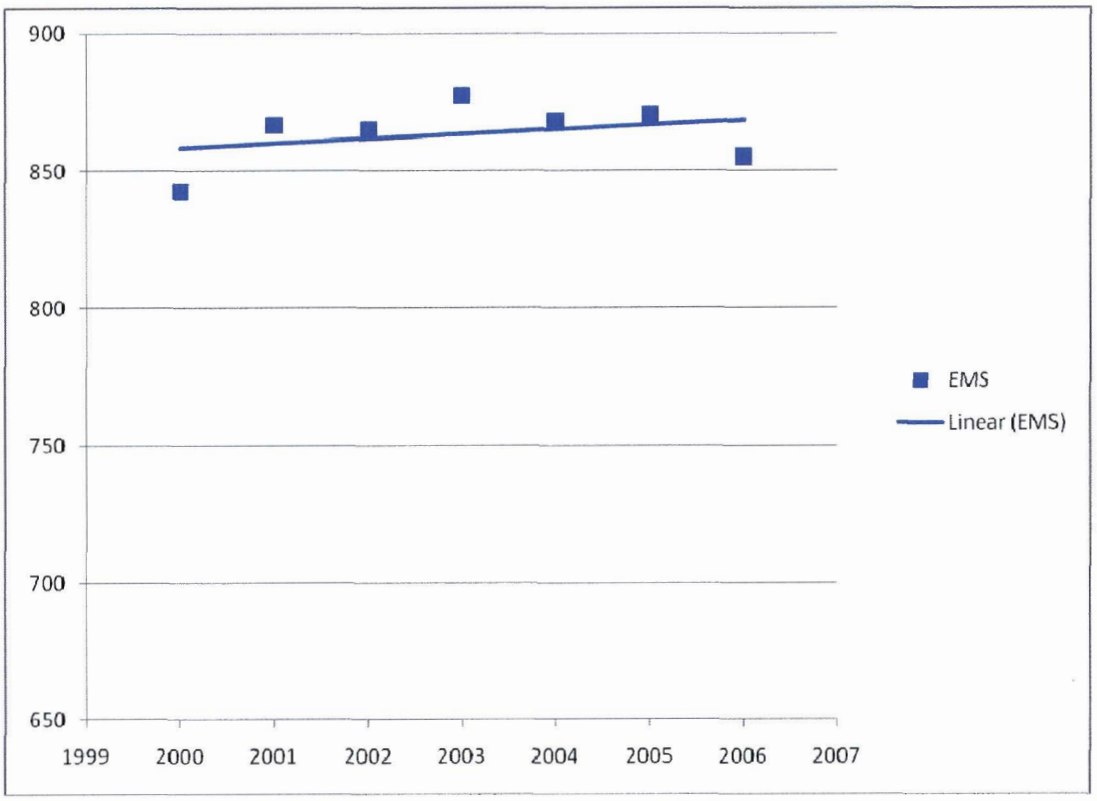


Figure 12: EMS Incidents - per capita Demand, 2000–2006



The number of good intent calls is rapidly increasing. Second, although annually there were fluctuations in the raw number of "other" incidents, their trend is positive. For EMS , the largest category of calls, per capita demand is also upward, increasing from 842 incidents per 10,000 population to 855 incidents.

Recommendation 3: Monitor yearly per capita demand by category and analyze data every five years. This is an important step for planning prevention efforts and suppression-related allocations. Particularly important in the analysis are trend changes in the type of calls handled and their impact on unit workloads.

Demand Projections – Trends in past demand were used to estimate future trends. To do this, we used a least squares fit linear regression model and applied it to each incident category. The incident projection model used for this study was developed over 20 years of conducting similar research. The model allows for demand increases due to both population and per capita demand changes. The result of the analysis is a high and low boundary between which a future year's incident totals can be expected to fall.

The first method of estimating the number of incidents in a future year is to assume the current per capita demand for service will remain constant. In this case, demand grows in proportion to population growth. This method produces slowly increasing call totals for

Alexandria. However, in most cases, per capita demand has been shown to increase over time; thus the demand predicted with this method will often fall short of the true value.

The second projection method assumes that per capita demand can be described by the historic trend. The number of incidents projected in this fashion tends to be above the true value since per capita demand levels off eventually. Using these two models, upper and lower boundaries are produced. The number of incidents in a given year can be predicted to fall between the two projections with a high degree of certainty.

Using population projections by the MWCOG and the observed per capita demand growth rates discussed above, high and low projections through the year 2020 were created. Table 28 shows the projections by categories. The best-case scenario projects incident totals to remain below 21,000 through 2020. High demand projections result in incident totals over 24,000 by 2020. Figure 13 illustrates the upper and lower boundaries for total incidents.[35]

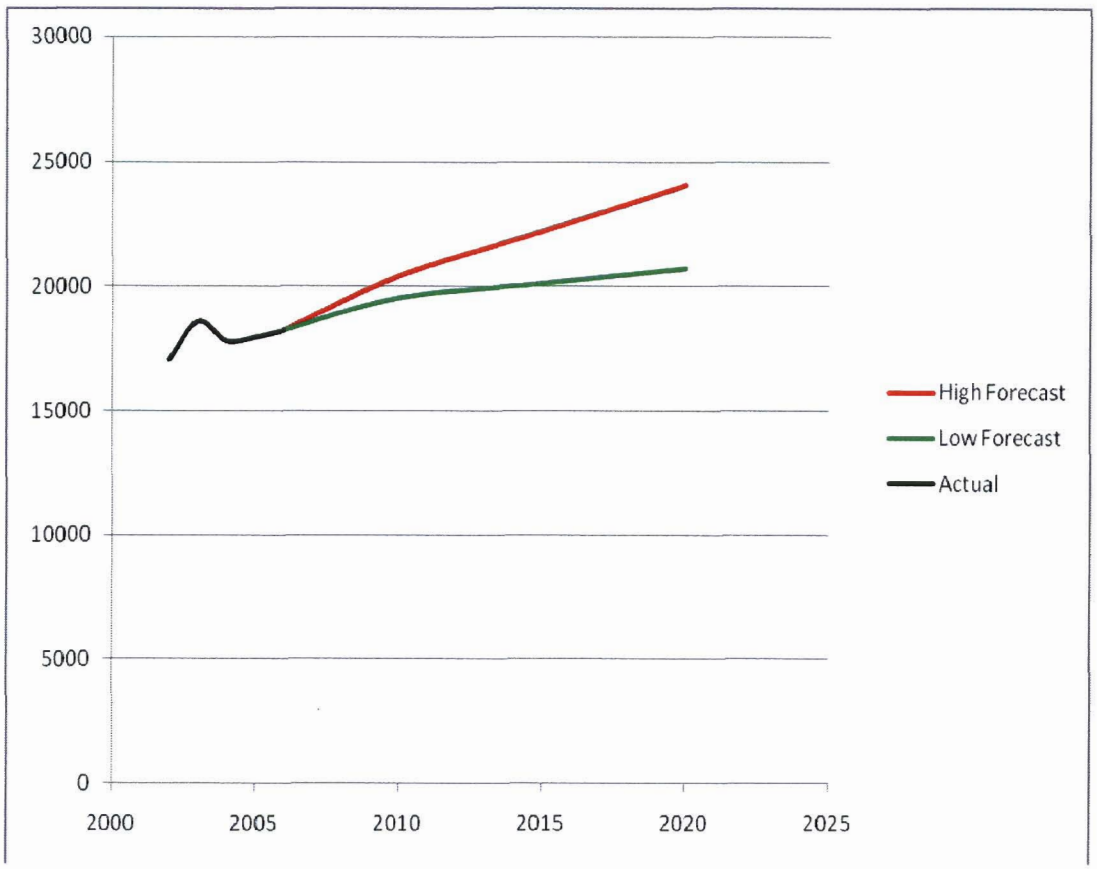
Table 28: Upper and Lower Incident Boundaries, 2010–2020

	2010		2015		2020	
	High	Low	High	Low	High	Low
Fires	636	577	731	595	830	612
Explosion	115	115	115	115	115	115
EMS	12575	12478	13082	12857	13596	13236
Hazmat	874	778	1024	801	1182	825
Service	1075	1076	1107	1109	1138	1142
Good Intent	2532	2170	3076	2236	3647	2301
False Alarm	2556	2259	3016	2327	3499	2396
Weather	25	25	25	25	25	25
Other	39	39	39	39	39	39
Total	**20,426**	**19,516**	**22,214**	**20,103**	**24,070**	**20,690**

Based on our projections, the number of fires is expected to remain manageable and within the capability of existing AFD resources. However, EMS calls are expected to increase by seven percent above the 11,751 calls experienced in 2006. The increase in EMS-related calls will likely require additional resources by 2010 (according to the high projections) or 2015 (if demand continues at the same rate).

[35] As a consequence of the projection method, high and low boundaries converge shortly after the initial year. To prevent this occurrence, totals from the converging year were replaced with the average of the neighboring years to produce a smooth boundary.

Figure 13: Upper and Lower Incident Boundaries, 2008–2020



Unit Hour Utilization – Overall, the majority of AFD units are only moderately busy with response levels below 3,000 responses annually and all units have a unit hour utilization (UHU) rate below 25 percent. Truck 203 is the least busy unit (we have chosen to consider Engine 206 and Rescue 206 as one unit), and Medic 205 is the busiest. It is difficult to evenly distribute the response levels among units because it is largely geographically driven. However, units are needed in areas with lower demand if response times are to be kept at acceptable levels throughout the city.

Based on the call duration of medic units, it would take about 3,600 responses per year to generate a UHU of 25 percent. Three medic units may approach the 25 percent threshold by 2010; therefore, plans should begin now to add EMS resources.

Table 29 summarizes the number of responses by each unit in 2006 and the UHU's calculated from the total responses. Response levels are noted both as dispatches and arrivals, because units are often canceled en route.

Table 29: AFD Unit Responses and UHUs, 2006

Unit	Dispatches	Arrivals	Avg Duration	Avg Duration (Hrs)	Total Hours	UHU
E201	1453	1187	0:15:14	0.25	8760	4.21%
E202	1426	1153	0:14:21	0.24	8760	3.89%
E203	1336	1044	0:16:41	0.28	8760	4.24%
E204	1372	1084	0:14:04	0.23	8760	3.67%
E205	2099	1558	0:14:22	0.24	8760	5.74%
E206	1999	1646	0:15:27	0.26	8760	5.88%
R206	514	364	0:14:09	0.24	8760	1.38%
E/R206	2513	2010			8760	7.26%
E207	2241	1827	0:15:49	0.26	8760	6.74%
E208	2850	2391	0:15:58	0.27	8760	8.66%
M202	2297	2025	0:42:07	0.70	8760	18.41%
M205	2822	2413	0:41:22	0.69	8760	22.21%
M206	2775	2449	0:38:33	0.64	8760	20.35%
M207	2345	2004	0:42:30	0.71	8760	18.96%
M208	2814	2515	0:37:37	0.63	8760	20.14%
T203	957	579	0:14:58	0.25	8760	2.73%
T204	1302	824	0:12:31	0.21	8760	3.10%
T208	1446	1057	0:15:49	0.26	8760	4.35%
Total	**34561**	**28130**	**0:22:27**	**0.36**	**157680**	**7.90%**

V. RESPONSE TIME ANALYSIS

This chapter begins with the analysis of response time and compares the AFD to national response time standards. Response time and demand projection findings were then used with ArcGIS to analyze the location of AFD stations and apparatus.

AFD RESPONSE TIMES VERSUS NATIONAL STANDARDS

Response time is the total time from the receipt of an emergency call until responders arrive on the scene. Although there is no single set of nationally accepted response time standards, a number of organizations, including the National Fire Protection Association (NFPA), have adopted consensus standards. These consensus standards have been used in evaluating Alexandria's response times. To begin, it is important that one understand the various segments of response time.[36]

- ***Notification*** – the time at which an alarm is received by the public safety answering point. In Alexandria, emergency calls are first answered by the Police Dispatch center and then transferred to the Fire Department Dispatch center.
- ***Call processing interval*** – the interval between the first ring of the 9-1-1 telephone at the dispatch center and the time the computer-aided dispatch (CAD) operator activates station and/or company alerting devices. This can, if necessary, be broken down into two additional parameters: "call taker interval" (the interval from the first ring of the 9-1-1 telephone until the call taker transfers the call to the fire department dispatcher) and "dispatcher interval" (the interval from the time when the call taker transfers the call to the dispatcher until the dispatcher/CAD operator activates station and/or company alerting devices).
- ***Dispatch time*** – the time when the dispatcher, having selected appropriate units for response, initiates the notification of response units.
- ***Reflex or turnout interval*** – the time between the activation of station and/or company alerting devices and the time when the responding crew activates the responding button on the mobile computer terminal or notifies dispatch by voice that the company is responding. During the reflex interval, crews cease other activities, don appropriate protective clothing, determine the location of the call, and board and start the fire apparatus. It is expected that the responding signal will be given when personnel are aboard the apparatus and the apparatus is beginning to roll toward the call.
- ***En route time*** – the point in time which the responding apparatus notifies the dispatch center that they are responding to the alarm.
- ***Travel interval*** – begins at the termination of the reflex interval and ends when the responding unit notifies the dispatcher unit that it has arrived on scene (again, via voice or mobile computer terminal notification).

[36] The response time definitions used here are from the Commission on Fire Accreditation manual on evaluating standards of response coverage (4th edition)::

- On-scene time – the point at which the responding unit arrives on scene.
- "Vertical" Interval – begins once the unit reaches the emergency scene and ends when the responding unit notifies the dispatcher that the crew has reached the patient.
- At-Patient time – the point at which EMS crews reach the patient

Different standards exist for fire and EMS incidents, therefore each was analyzed independently. Data was provided for all incidents to which AFD units responded including mutual aid. Only those incidents occurring within the city limits were used in this analysis.

FIRE EMERGENCIES

To save lives and limit property damage, fire companies must arrive within a short period of time with adequate resources to do the job. Matching the arrival of resources with a specific point of fire growth is one of the greatest challenges for chief fire officers.[37] According to nationally accepted standards, the first arriving unit should arrive within 6 minutes and the entire first-alarm complement should arrive within 10 minutes. These generally accepted standards were developed to provide a rapid initial response to contain small fires, and to assemble a larger firefighting force in a reasonable timeframe to suppress larger fires.

Travel times in Alexandria are within nationally-accepted standards. However, the overall response time goals are not being achieved because of high turnout and call processing times, which are higher than recommended. The 90th percentile travel times were 3:47 for first arriving unit and 6:28 for the total first-alarm complement.

Table 30 compares the AFD response time segments with the national standard.

Table 30: Fire Suppression Response Time Compliance (marked as NFIRS 100 level incidents in CAD records)

	Segment	Standard	Compliance Percentage	90th Percentile
First Arriving	Call Processing	01:00	52%	01:52
	Turnout	01:00	31%	02:12
	Travel	04:00	92%	03:47
	Total	**05:00**	**64%**	**06:38**
Full Complement	Call Processing	01:00	52%	01:59
	Turnout	01:00	9%	05:46
	Travel	08:00	96%	06:28
	Total	**10:00**	**80%**	**10:55**

Unlike travel times which are good, call processing times are only meeting the standard 50 percent of the time and turnout times 31 percent of the time for the first arriving unit, and 9 percent for the first- alarm compliment. However, we believe the 90th percentile turnout time for

[37] CFAI. Creating and Evaluating Standards of Response Coverage for Fire Departments. 4th Edition, 2003.

the first-alarm assignment, which includes truck companies may, in fact, be incorrect because of data reporting issues; this issue was discussed with the fire department's data analyst.

EMS EMERGENCIES

EMS emergencies are categorized as either Basic Life Support (BLS) or Advanced Life Support (ALS). Typically the more serious medical emergencies are categorized as advanced life support and receive both the nearest fire engine and ambulance. Although the generally accepted national standards do not differentiate between BLS and ALS incidents, we have provided slightly different response time goals.

For ALS calls, a first responder should arrive within 6 minutes and an ALS ambulance within 10 minutes. EMS response times are based on the knowledge that brain damage occurs when oxygen flow stops for more than six minutes.

Table 31: ALS Emergencies Response Time Compliance (marked as ALS in CAD records)

	Segment	Standard	Compliance Percentage	90% Percentile
First Responder	Call Processing	01:00	51%	01:52
	Turnout	01:00	43%	02:02
	Travel	04:00	91%	03:51
	Total	**06:00**	**81%**	**06:43**
ALS Ambulance	Call Processing	01:00	51%	01:52
	Turnout	01:00	41%	02:22
	Travel	08:00	96%	05:52
	Total	**10:00**	**92%**	**09:21**

System-wide, Alexandria exceeds the standard for ALS emergencies. While this is excellent, there is room for improvement in some areas. Travel times are good; however call processing and turnout times can be improved.

In the case of BLS calls, only an ambulance is dispatched. Because of the limited number of ambulances and the chance that an ambulance is out of its area, it is expected that response times are slightly longer. We have suggested a goal time of eight minutes and have found that this goal is met 77 percent of the time.

Table 32: BLS Emergencies Response Time Compliance (marked as BLS in CAD records)

	Segment	Standard	Compliance Percentage	Time at Target Compliance Level (90%)
First Arriving Unit	Call Processing	01:00	37%	02:03
	Turnout	01:00	40%	02:24
	Travel	06:00	88%	06:16
	Total	**08:00**	**77%**	**09:53**

Although the total response time for BLS calls is below the 90th percentile compliance goal, it is within the acceptable range given the non-life threatening nature of most BLS emergencies.

CALL PROCESSING TIME

For Alexandria, 911 calls are received initially by the police department and then transferred to the AFD communications center if the call requires fire or EMS service. Under the present arrangement incident numbers are not assigned until the initial call processing has been completed and the information is transferred to the AFD for dispatch, which means that some of the time for call processing is not being tracked. Identifying the call received time to a particular incident requires a manual procedure to match incoming call telephone number to the corresponding phone number of the incident.

Recommendation 4: Determine whether the CAD can be modified to create an incident number when the call is first received. Creating an incident number when the 911 call is initially answered will make analyzing call processing time more accurate. If the CAD is incapable, attempt to determine alternate solutions.

Jurisdictions often find that a tiered emergency call-taking system such as the one used by Alexandria is unable to meet the call-processing standards. As the time data at the front end of the process (call answered to the transfer to AFD dispatch) as well as the back end (vertical response time), is not available, it is not possible to determine the total response time. Figure 14 depicts the call processing times by incident type according to the data we analyzed.

Table 33: Call Processing Times for Incidents in the City of Alexandria Only

Incident Type	90th Percentile Call Processing
All Incidents	02:07
All EMS Incidents	01:59
All Fire Incidents	02:26
Emergency Incidents Only	01:56
Medical Emergencies (EMS)	01:54
Fire Emergencies	02:18

Alexandria has call processing times that are nearly double the accepted standard.

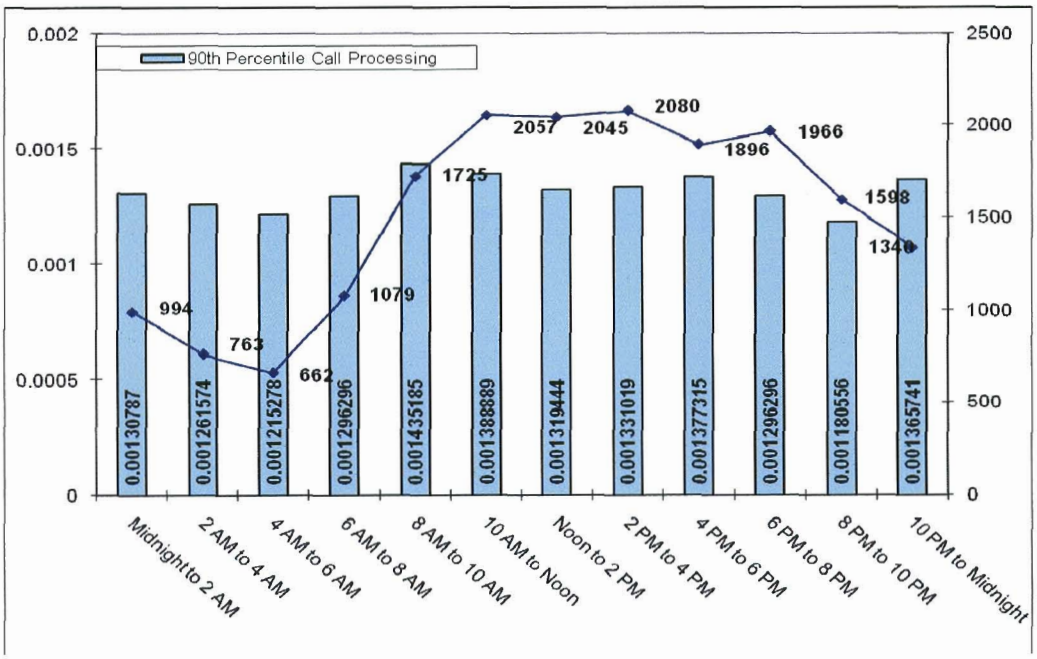
Variations in call processing and dispatch times can be expected during periods of lighter or heavier call volumes. Call processing times were similar throughout the day with only a modest increase during peak call hours (8 A.M. and 12 A.M.). Overall the call processing times are too high. In addition, there were no time segments when the city's call-processing time met the national standard.

Table 34: Call Processing by Time of Day (All Emergencies) and Incident Volume (All Calls)

Time Segment	90th Percentile Call Processing	Incident Volume
Midnight to 2 AM	01:53	994
2 AM to 4 AM	01:49	763
4 AM to 6 AM	01:45	662
6 AM to 8 AM	01:52	1079
8 AM to 10 AM	02:04	1725
10 AM to Noon	02:00	2057
Noon to 2 PM	01:54	2045
2 PM to 4 PM	01:55	2080
4 PM to 6 PM	01:59	1896
6 PM to 8 PM	01:52	1966
8 PM to 10 PM	01:42	1598
10 PM to Midnight	01:58	1340

The following graphic shows the 90th percentile call-processing times and the call volumes by the time of day.

Figure 14: 90th Percentile Call-Processing Time by Time of Day, 2006



The scope of this study did not include an analysis of emergency dispatch operations. Such an analysis would be necessary to determine the exact cause of the call-processing situation. The 90th percentile call-processing times are obviously too long, and changes are needed to fix the problem.

Recommendation 5: Reduce call processing times by 50 percent to meet nationally accepted standards.

TURNOUT TIME

Turnout time includes the time from dispatch to the time that responders are on the road. For some calls, the time includes donning protective turnout gear. The turnout time segment is measured from the time an alarm is received until the apparatus leaves the station. According to CFAI and NFPA, turnout times should approximate 60 seconds. The turnout matrix shown in Table 35 shows the average annual turnout time for each unit and shift.

Table 35: Turnout Times by Unit and Shift, 2006

	Mean				90th Percentile			
Unit	A	B	C	D	A	B	C	D
E201	01::28	01:23	01:28		02:09	01:57	02:01	
E202	01:19	01:20	01:24		02:05	02:00	02:06	
E203	01:42	01:38	01:46		02:43	02:30	02:35	
E204	01:39	01:24	01:18		02:16	02:28	02:02	
E205	01:17	01:32	01:36		01:49	02:13	02:17	
E206	01:31	01:28	01:32		02:30	02:16	02:21	
E207	01:31	01:09	01:23		02:19	01:54	02:02	
E208	01:29	01:31	01:19		01:58	02:07	01:58	
T203	04:00	01:41	01:58		07:16	02:50	03:33	
T204	03:00	01:20	01:56		03:04	02:52	02:20	
T208	01:32	02:05	02:00		02:17	02:55	02:39	
M202	01:29	01:19	01:26	01:17	02:23	02:20	02:18	02:04
M205	01:22	01:11	01:26	01:13	02:12	01:50	02:01	01:47
M206	01:25	01:28	01:27	01:31	02:25	02:20	02:24	02:24
M207	01:18	01:18	01:22	01:17	02:10	02:07	02:08	01:58
M208	01:20	01:10	01:21	01:18	02:04	02:02	02:00	01:55

Overall, turnout times are high and efforts should be made to reduce them. The matrix shows both mean and 90th percentile figures. 90th percentile turnout times for engines range from 1:49 to 2:43 and medic turnout times range from 1:47 to 2:24 (there are some very slow truck times but, because there are far fewer truck responses than engine responses, the turnout time analysis is less accurate for these units). That Truck 203 on A-Shift shows a 90th percentile turnout time of over seven minutes appears to be incorrect. We contacted the fire department to check their data.

The AFD uses a two-tone Zetron system that alerts units using a set of two frequencies specific to each unit. The first tone takes one second and the second tone three seconds. Only after those tones have gone through are the firefighters alerted by way of an alarm bell. This

process has to occur separately for each unit dispatched. In the case of a fire emergency where multiple units are dispatched simultaneously, 30 seconds could elapse before all units are dispatched. This may account for some of the slow turnout times.

Recommendation 6: Reduce unit turnout times by installing a faster alerting system. New systems that instantly alert personnel by radio or internet (if there is already a permanently wired LAN), are relatively inexpensive and they can shave up to 30 seconds of response time per incident. The cost for such a system is approximately $3,000 for each dispatching station and $3,000 for each receiving fire station. The total cost for the AFD is approximately $40,000.

TRAVEL TIME

The analysis of response travel times revealed that Alexandria is meeting the 90th percentile travel time standards in most areas. Although travel times are good city-wide, there are localized areas where travel times are longer than recommended.

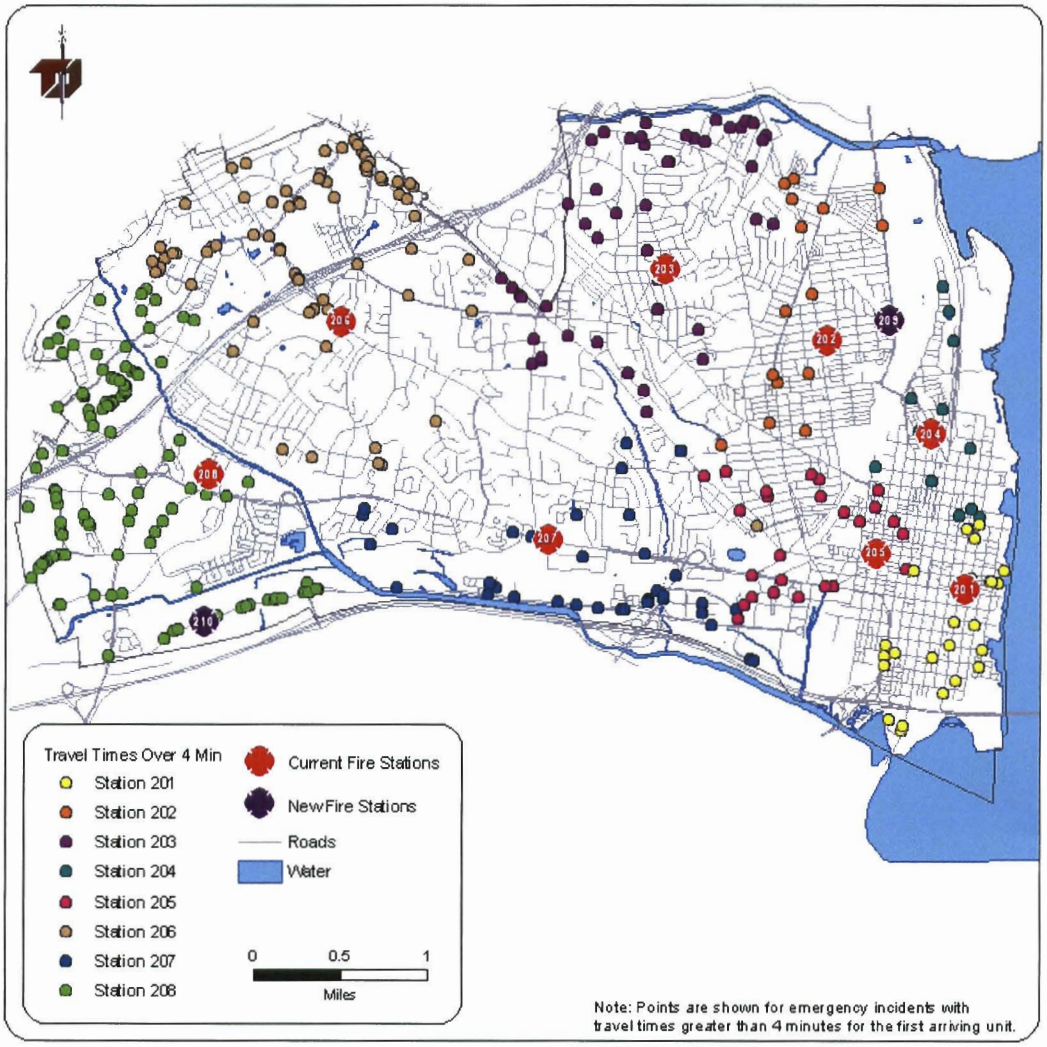
Travel time is the time it takes to travel from the station, or wherever the unit is, to the emergency incident. Station and apparatus placement has the biggest impact on travel time with traffic, road configuration, the presence of speed bumps, weather and driver familiarity also playing a role. Generally accepted standards recommend a 90th percentile travel time of four minutes for the first-arriving engine or BLS unit and eight minutes for the first-arriving ALS unit.

Longer than recommended travel times typically result for three reasons: 1) stations are improperly located (areas consistently cannot be reached within the travel time standard); 2) simultaneous emergencies are frequently occurring within the same geographical area (the station is properly located; however, the nearest unit has a very high call load); 3) increased traffic and congestion since the station was originally constructed.

For fire emergencies, the first-arriving unit arrived on-scene within four minutes 92 percent of the time. The eight minute travel time for the full complement of apparatus was met 96 percent of the time. For ALS emergencies, the first responder unit arrived within four minutes 91 percent of the time and the ALS ambulance arrived within eight minutes 96 percent of the time.

Map 2 identifies those incidents were the first-arriving unit did not meet the standard.

Map 2: Incidents Where Travel-Time Standards Were Unmet, 2006



The addition of Station 210 in Eisenhower Valley, which is recommended later in this report, will improve response times west of Station 208 and south of Station 207.

VERTICAL RESPONSE TIME

Alexandria does not collect data on vertical response time, which is the time from the arrival on-scene until the crew actually reaches the patient. In communities with many high-rise structures or large properties (e.g., malls), vertical response time can exceed the initial travel time. Nationally, vertical response times for EMS calls range from 4 to 6 minutes.

To collect vertical response time, an SOP should be developed and implemented (e.g. the crew announces their arrival at the patient over the radio). The SOP would allow the AFD to conduct a more thorough response time analysis in the future.

Fire units experience similar, or even longer, vertical response times. For fire units, there are added concerns, including the level of fire origin and the operability of elevators; in a fire or emergency in which power is out or intentionally disconnected, firefighters may have to use the stairs to reach the location of the fire.

Recommendation 7: The AFD should record "vertical" response time (time to arrive at the patient or the fire).[38]

While it is possible to reduce the other components of response time through technology and fire station location, substantially and safely reducing vertical response times is difficult. As a result, the importance of built-in fire suppression systems cannot be overstated. These systems buy time for the firefighters to get to where they have to be within the structure to extinguish the fire.

[38] We are familiar with at least one department (Arlington, TX) that collects data on the time that operations begin, e.g. water supply established, water on the fire, etc.

VI. STATION LOCATION ANALYSIS, APPARATUS DEPLOYMENT, AND FACILITIES

The process of evaluating fire station locations is vitally important. A reasonable goal is to achieve the response time goals with the least number of stations. A well-balanced station location plan will provide the best possible protection in a cost-efficient manner.

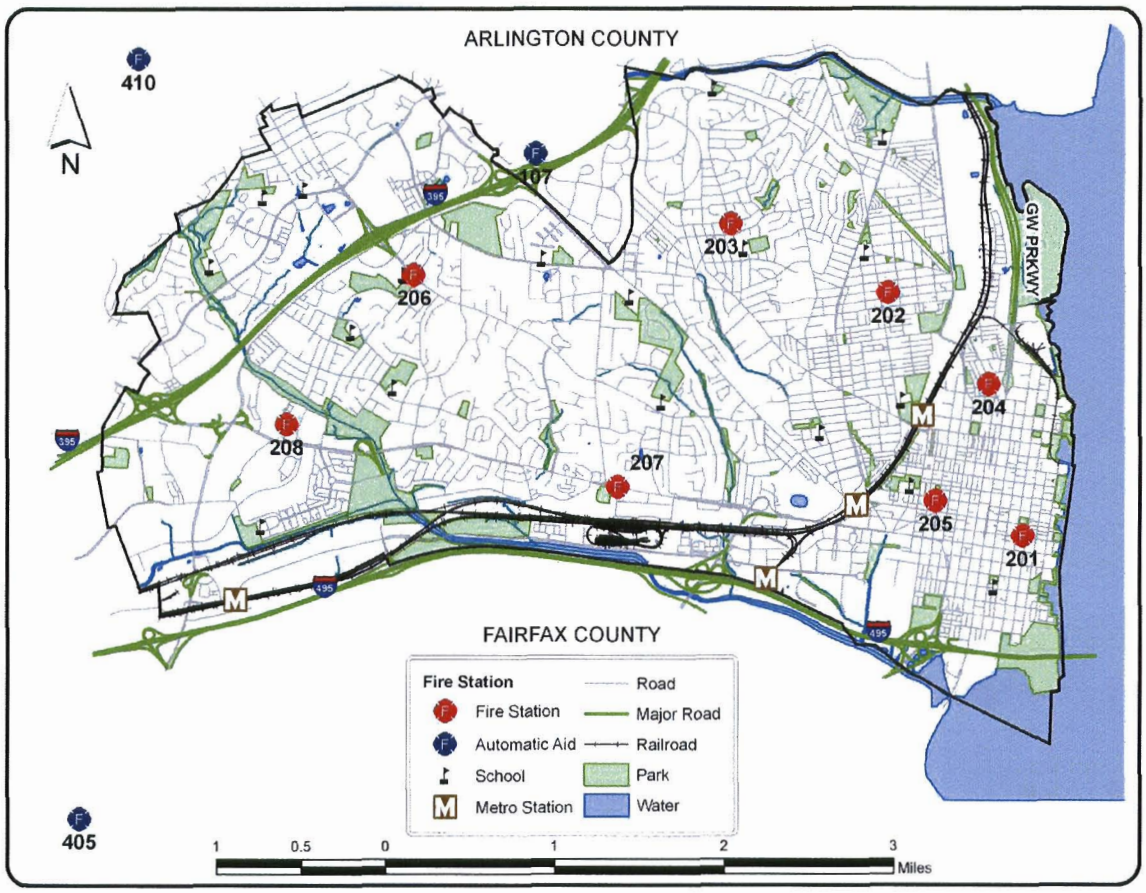
In this section we discuss the response time and theoretical coverage provided by the current AFD stations and apparatus. Included are the GIS maps that we analyzed for the study. We also analyzed many other GIS maps, and discussed the findings with the AFD staff. The additional maps are included as references in the Appendix.

Overall Distribution and Coverage of Resources

The AFD operates from eight stations. Each station is assigned at least one engine, which is staffed continuously by three firefighters. Automatic aid agreements are in place with neighboring Arlington County, Fairfax County, and the Metropolitan Washington Airport Authority. The agreement provides for the closest unit response to all incidents regardless of jurisdiction (closest unit is based on station locations, not actual location of units at the time of the incident). Map 3 shows the current station locations for Alexandria and neighboring counties.

At first glance, the distribution of stations appeared to be lopsided, as four stations are located in about one quarter of the city's east side. One of these stations (201) however, is considered by the city to be a historic treasure and the station location analyses show that the other stations provide adequate coverage. New development within Eisenhower Valley and Potomac Yard will require the addition of fire and EMS resources.

Map 3: Current Station Locations



Coverage – To determine whether there were areas that were not well covered and to evaluate the overlap among stations, it is necessary to understand the area covered by each unit and the actual location of incidents. Although a GIS analysis can determine travel distances based on road speed limits and other factors, the road layer provided to us by the city did not include this information. The road layer also did not contain information on one-way roads and their direction of travel. Without this restriction, units are shown in the analysis as having the ability to reach areas by using routes that are not recommended (e.g. traveling east on westbound Interstate 495.)

As an alternative to using road speed limits, incidents were grouped by unit and geocoded to determine the responding unit's average rate of travel. The distance of each incident from the corresponding station was then calculated. Distances were then matched with travel times to determine average miles per hour. This method does not, however, give exact results since units are not always in the station when a call is dispatched. All speeds under 10 mph and over 60 mph were excluded and the remainder averaged. This was done for most frontline units. The average

speed for units not analyzed was set to the average speed for other units of the same type. Results were rounded to the nearest mile per hour and are shown in Table 36.

Table 36: Sampling of Average MPH, Alexandria

Station	Engine	Medic	Truck
201	25	–	–
202	25	–	–
203	20	–	–
204	–	–	26
205	20	21	–
206	30	26	–
207	29	27	–
208	27	26	28
Average	**25**	**25**	**27**

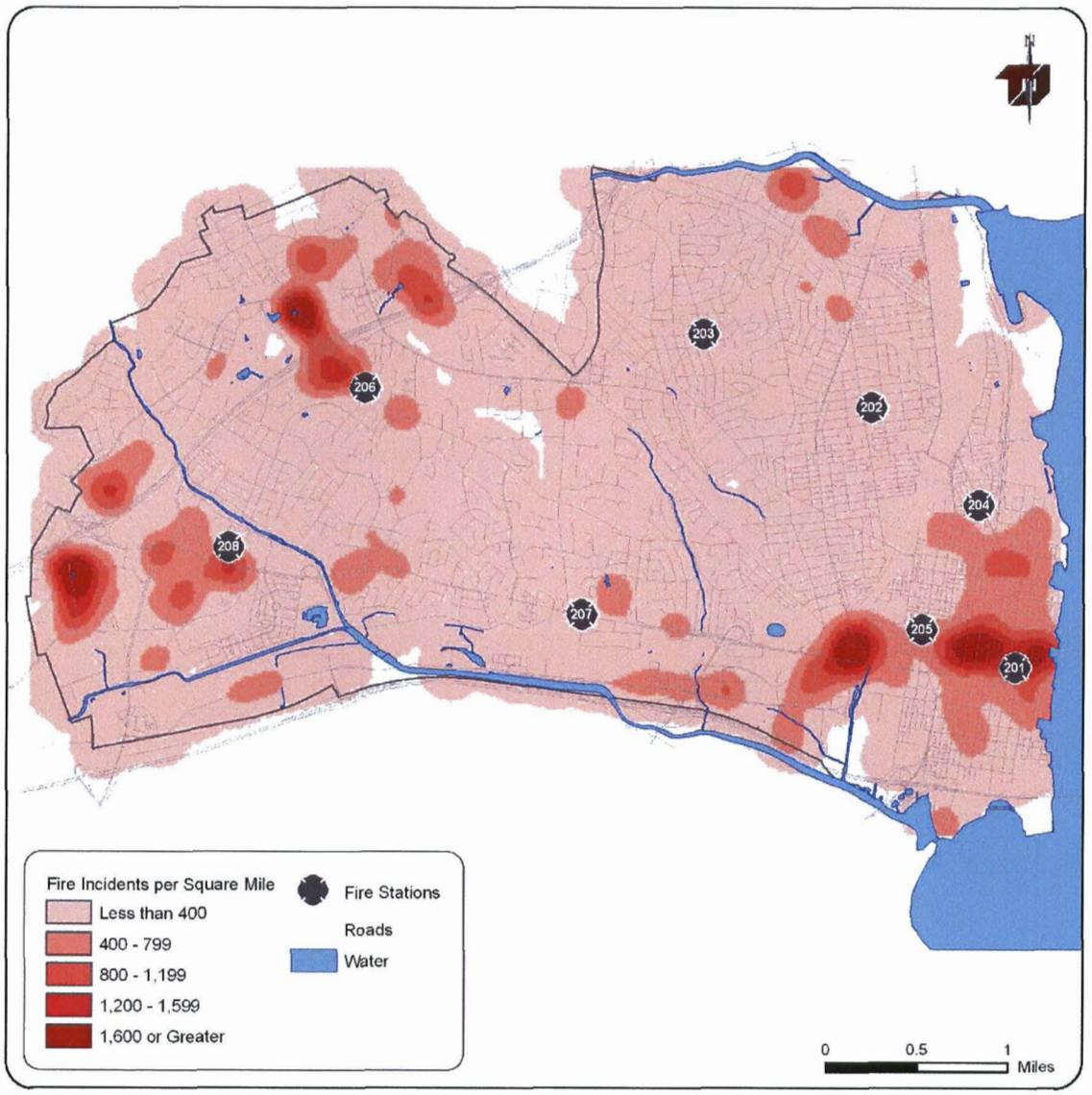
Average speeds were multiplied by the recommended 4-minute travel time for fire incidents, and 6-minute travel time for EMS incidents to generate station response reaches. The response reach of a station is the area that can be covered within a given time frame using the average speed of a unit.

ENGINE COVERAGE: Map 4 shows the density of 2006 fire and false alarm calls while Map 5 shows the four-minute response reach of engines in Alexandria.[39]

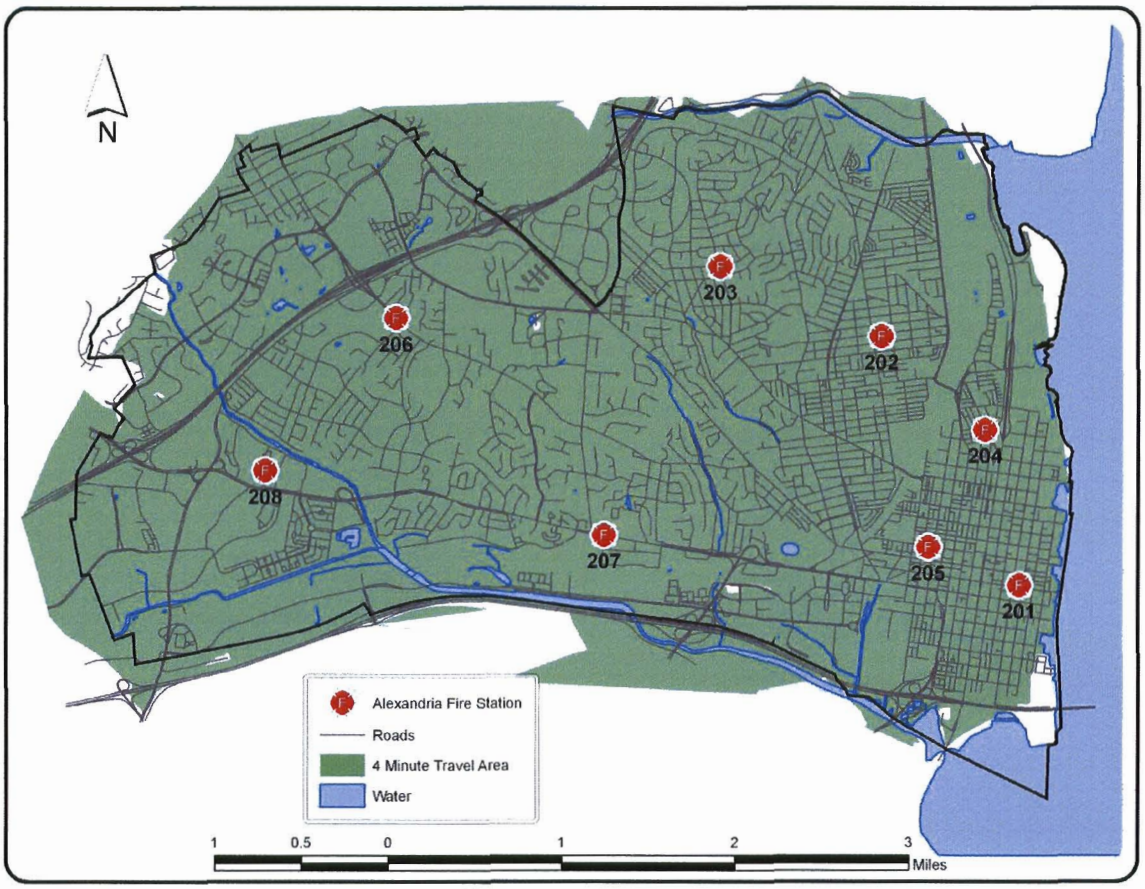
Map 5 reveals that the entire city can be reached by at least one engine within 4 minutes, using the coverage calculation methodology discussed above. We also determined that significant overlap exists between Stations 201 (Old Town) and 205. Since the engines at these stations have only moderate workloads, additional demand can be handled and the overlap is not required. Further analysis was not pursued because relocating Station 201 (Old Town) is not an option, according to the city.

[39] For individual station response areas, please see the Map Appendix.

Map 4: Fire and False Alarm Call Density, 2006



Map 5: Alexandria 4–Minute Engine Reach

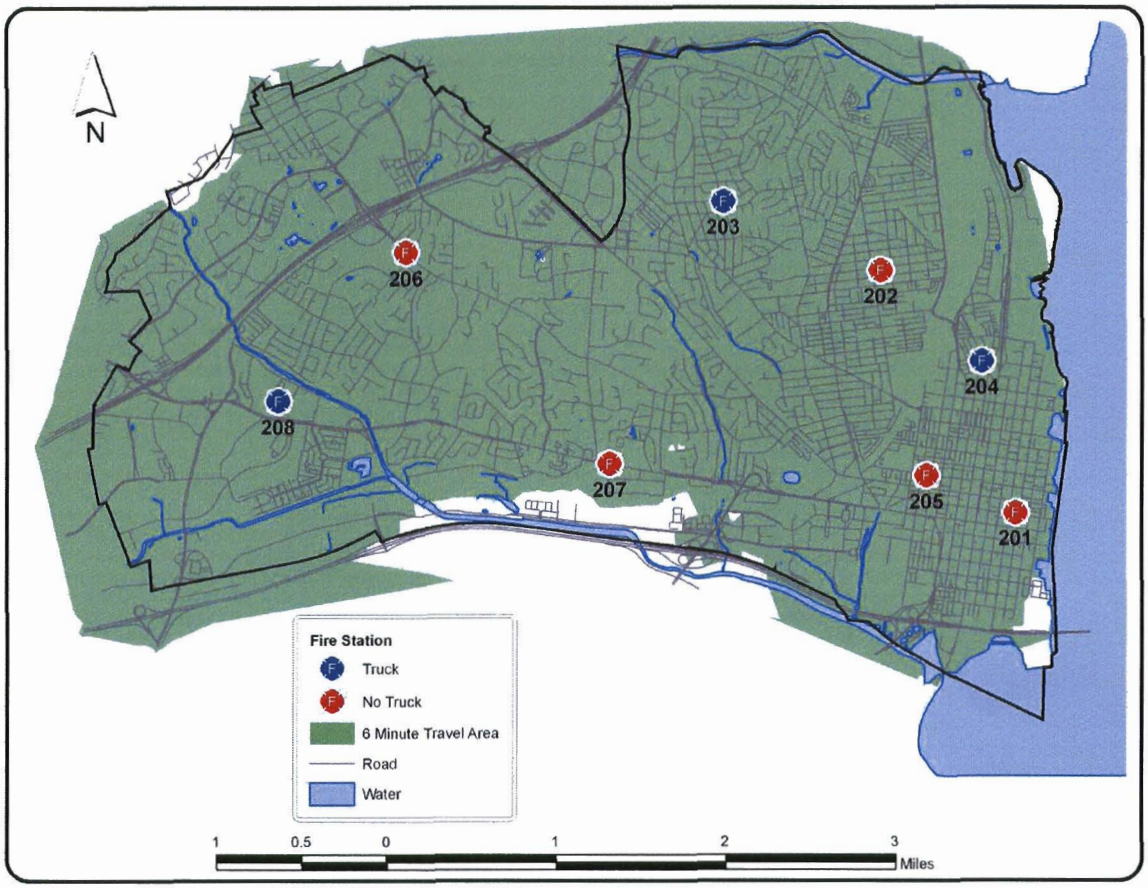


AERIAL LADDER TRUCKS: The City of Alexandria currently has three aerial ladder trucks, one each at Stations 203 (Beverly Hills), 204 (Headquarters), and 208 (Landmark). Map 6 shows the six minute response reach of aerial ladder trucks.

The aerial ladder trucks will only fit in the current stations due to their size and the sizes of available bays. The analysis that was conducted show a possibility of moving the aerial ladder truck from Station 204 (Headquarters) to Station 205. However, this would only be recommended if Station 205 (Cameron) was to be rebuilt; rebuilding Station 205 (Cameron) is not recommended at this time. Also, the coverage response area was negatively impacted due to the complex road network that currently exits in the area around Station 205. The road network in Old Town Alexandria consists primarily of narrow, one-way roads with on-street parking that makes it difficult for apparatus to navigate. Without new or expanded facilities, aerial ladder truck coverage will need to remain as it is.[40]

[40] For individual station response areas, please see the Map Appendix.

Map 6: Alexandria 6–Minute Aerial Ladder Truck Reach

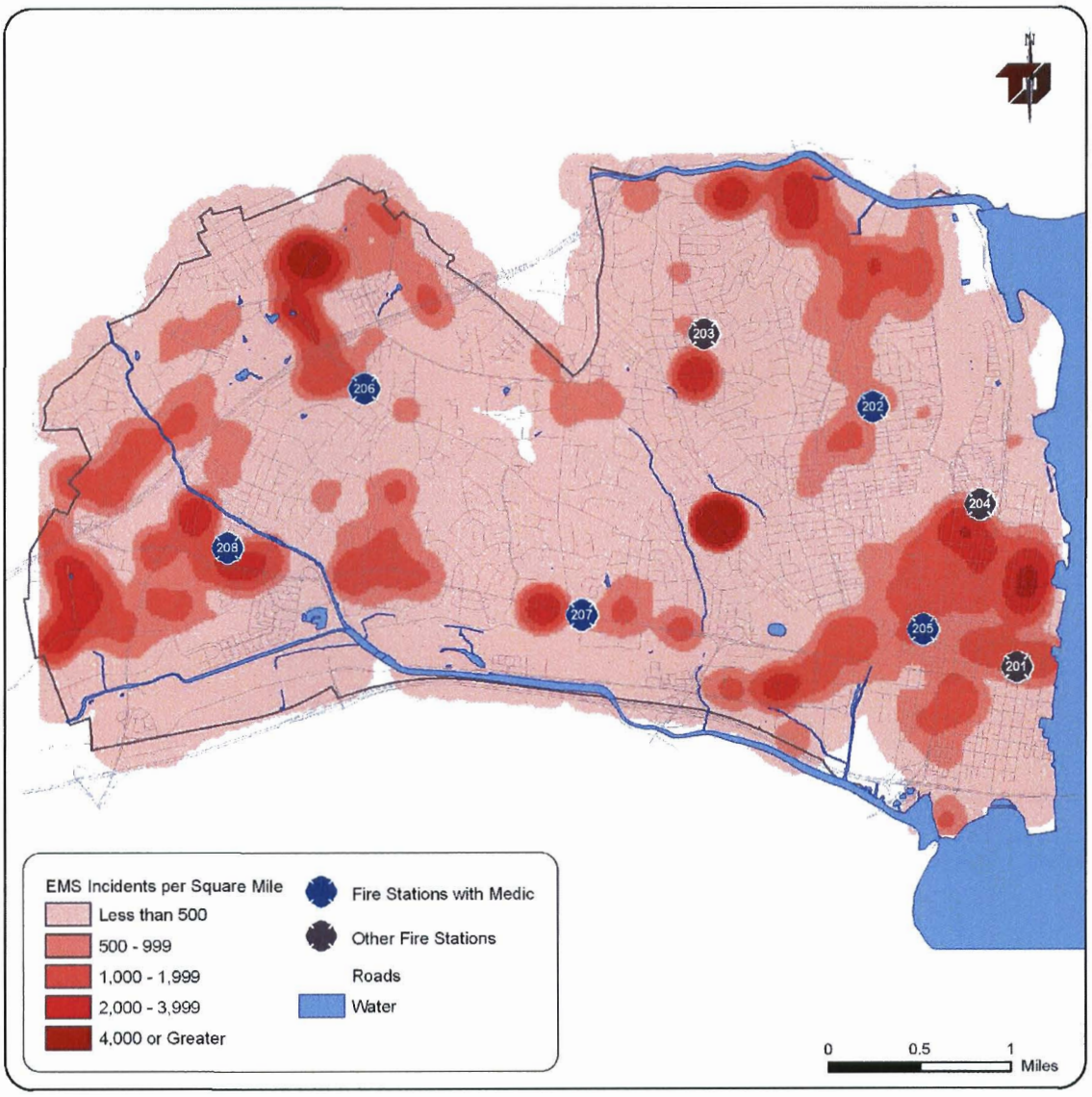


MEDICS: Currently, there are five medic units; one each at Station 202 (Del Ray), 205, 206 (Seminary), 207 (Duke Street) and 208 (Landmark). Map 7 shows the 2006 EMS density while Map 8 shows the current six-minute travel time reach of medics.[41]

The theoretical coverage by EMS units in the city is good; almost the entire City can be reached by a medic unit within six minutes of travel. Overall, the citizens of Alexandria are receiving a high level of EMS service, part of which is attributable to the medic units being located for the best possible coverage.

[41] For individual station response areas, please see the Map Appendix.

Map 7: EMS Call Density, 2006

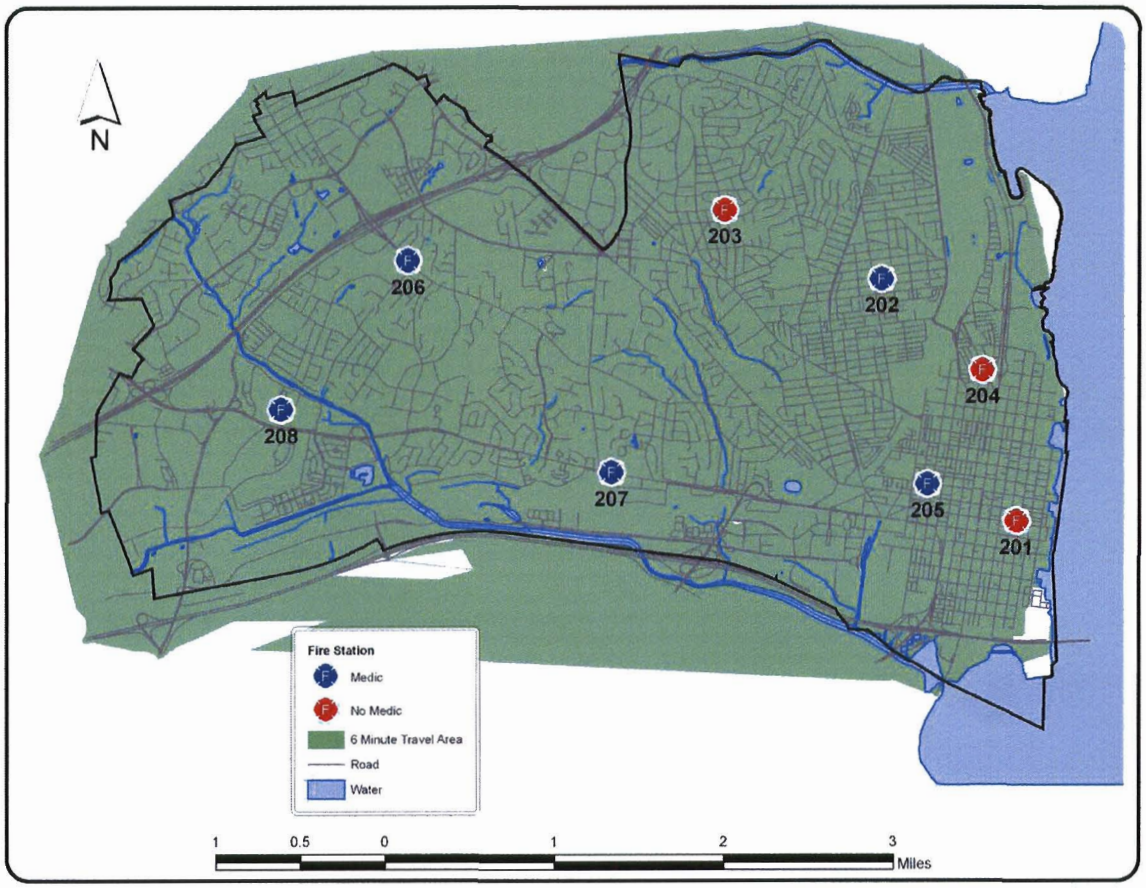


As shown in Map 7, EMS units are generally located in the areas of highest demand. The dark red area of the map just southeast of the center of the map represents a high call volume retirement community. Located equidistant from Stations 202 (Del Ray), 205, and 207 (Duke Street), the retirement community is well-served by these stations.

Although Map 8 does not show a time gap in Station 203's (Beverly Hills) area, AFD often relies on Arlington County Medics 109 and 105 to provide mutual aid to this area. This fact, along with projected run increases will warrant a medic unit in Station 203.

Recommendation 8: Consider adding a medic unit at Station 203 (Beverly Hills). Adding a medic unit will require either rebuilding or expansion of Station 203.

Map 8: Alexandria 6–Minute Medic Reach



New Development – The City of Alexandria has seen a significant increase in development over the last few years and there are still areas that are being developed. The city has recognized this issue and realizes there will be an increase in demand for service. To be prepared, the AFD asked TriData to look specifically at two areas of recent development: Potomac Yard and Eisenhower Valley.

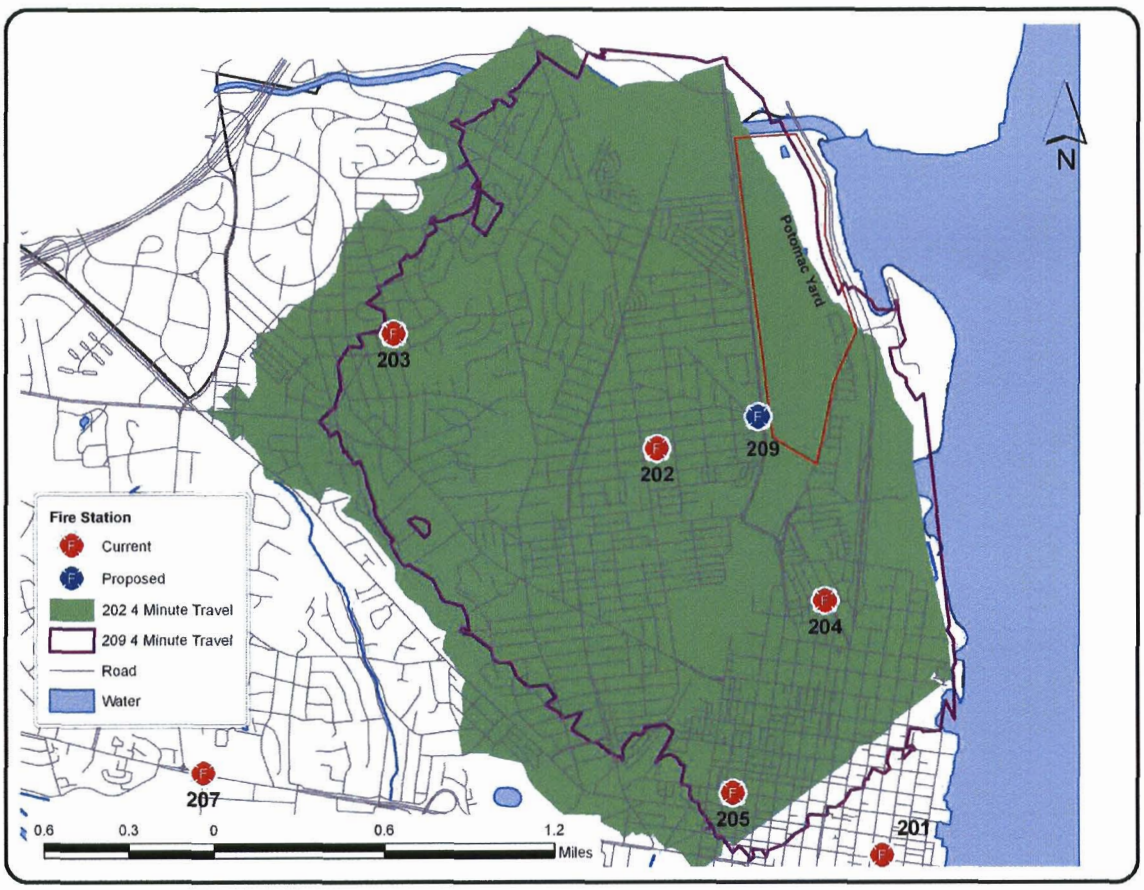
POTOMAC YARD: Recently, a developer purchased 165 acres of land located in the northeast area of Alexandria, known as Potomac Yard. The land is zoned for mixed use development. Building plans include 1.7 million square feet of office space, 300,000 square feet of retail, and 1,700 residential units.

An examination of whether the existing AFD stations could adequately serve this area was performed. Since all planning was not complete, TriData chose a location based on the current road network. Also, we considered the close proximity of Station 202 (Del Ray) to determine if its current location would afford coverage for the Potomac Yard area. The analyses determined that Station 202 (Del Ray) can cover a small area of Potomac Yard and that a new

location would provide better service to Potomac Yard and cover the area that it presently protects as well.

Results showed that it would be best to relocate Station 202 (Del Ray) into the new development at Potomac Yard, rather than build a ninth station which would create unnecessary overlap and unnecessary cost. Possible new locations for Station 202 (to be known as 209) were analyzed and a location near the intersection of East Del Ray Avenue and Jefferson Davis Highway was determined to provide the best coverage. The analysis revealed the new station should be constructed within the new development itself; however, it should remain close to Jefferson Davis Highway and Del Ray Avenue. Map 9 shows the change in current four-minute coverage for Station 202 versus the proposed four-minute coverage from the new location.

Map 9: Potomac Yard Current and Proposed Station 209, Coverage Difference



While the proposed coverage area appears to be smaller than the current coverage area, as more roads are built and the Potomac Yard area develops, the coverage area will expand.

Note: *At the time this report was revised, a new Potomac Yard station was in the development phase.*

EISENHOWER VALLEY: Of concern in terms of response time is the ability to cover the Eisenhower Valley corridor. Because of the limited access points for AFD units, the AFD relies heavily on Fairfax County for a good portion of the response. Using Fairfax resources to supplement the response to Eisenhower is a good approach and it provides redundancy. However, it should not be considered as a long-term plan, especially for first-response.

Eisenhower Valley is a 4.5-mile long area of land that stretches east to west along the City of Alexandria and Fairfax County border. Eisenhower Valley covers 500 acres and is currently home to 270 businesses that occupy nearly 3.8 million square feet of commercial space. Plans are in the works to develop another 273 acres.[42] The recent move of the United States Patent and Trade Office into Eisenhower Valley has added over 7,500 jobs to the area. Construction is planned and in-progress for additional office space, mixed use facilities (office, residence, etc.) and hotels.

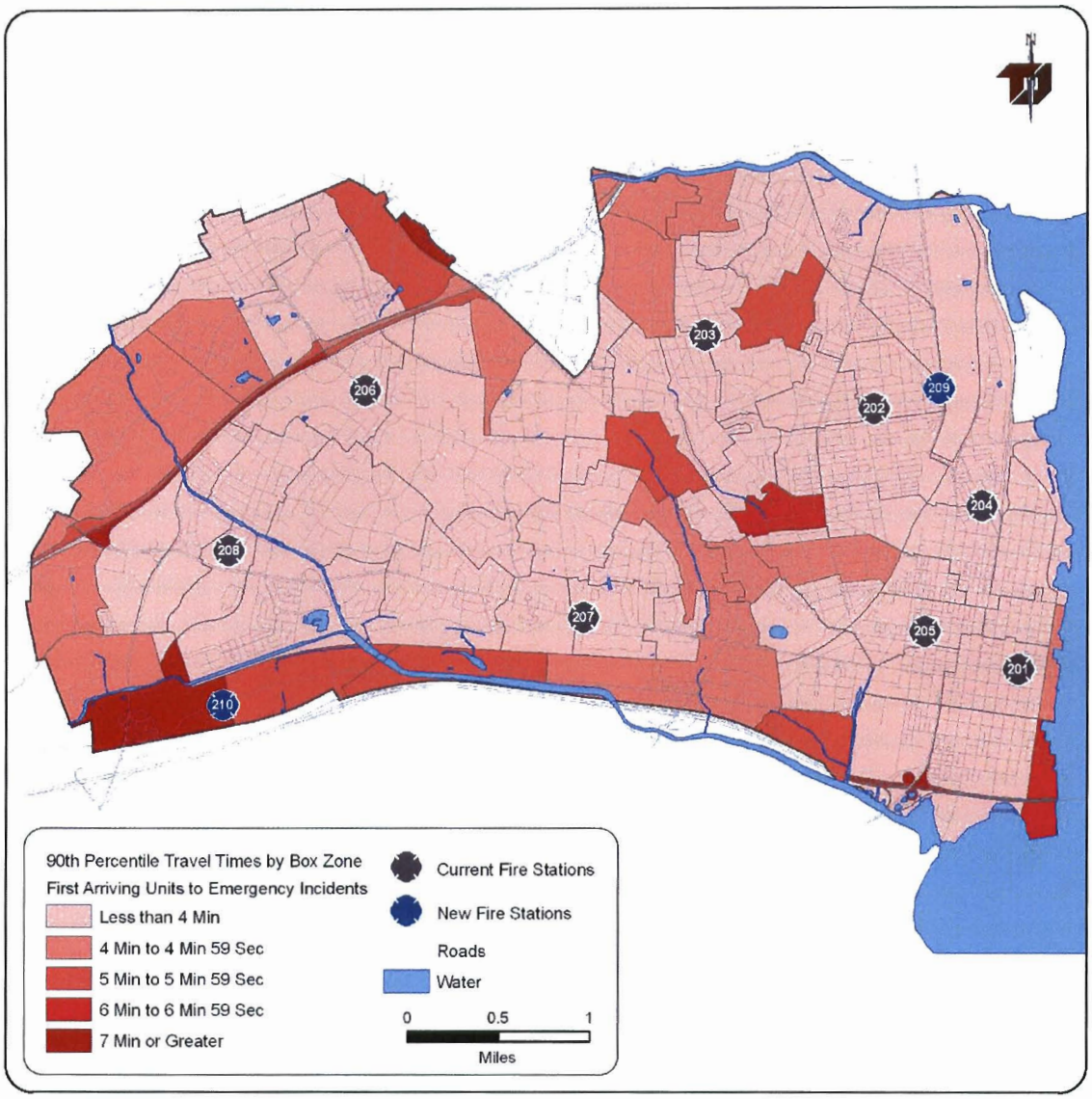
Currently, the 90th percentile travel times in Eisenhower Valley are greater than seven minutes for calls where multiple units are dispatched, such as a structure fire. Reasons for the high travel times include the limited access points at each end of Eisenhower Boulevard where Stations 207 (Duke Street), 205, 204 (Headquarters) and 201 (Old Town) access Eisenhower Valley. Currently, access is limited to Van Dorn Avenue from the north or Holland Lane from the south. Travel time is increased since fire and EMS units must travel the extra distance to limited access points.

During 2005, the closest Fairfax County Station 405 (Beulah Road) responded to 258 emergency calls and Station 426 (Edsal Road) responded to 429 emergency calls to Eisenhower Valley. This assistance could be considered *above the call of duty* and a decision by Fairfax not to provide first-response to Eisenhower Valley would increase response times and hurt coverage. Even when mutual aid is available from Fairfax County, the present agreement between Fairfax County and the City does not mandate automatic first-response to the degree that Fairfax County is assuming primary coverage for Eisenhower Valley. For example, during a recent weather-related emergency when Fairfax County made a decision to temporarily suspended mutual aid to each of its border governments; therefore, the City needs to rely on its resources first and then consider outside resources.

Map 10 shows the actual 90th percentile travel times by fire box in Alexandria. Of particular note is the dark-shaded areas near the proposed Station 210.

[42] http://dockets.alexandriava.gov/cmo/pressrel6.nsf/0/d7f1f37148903e848525686a00754182?OpenDocument

Map 10: 90th Percentile Travel by Fire Box, Alexandria

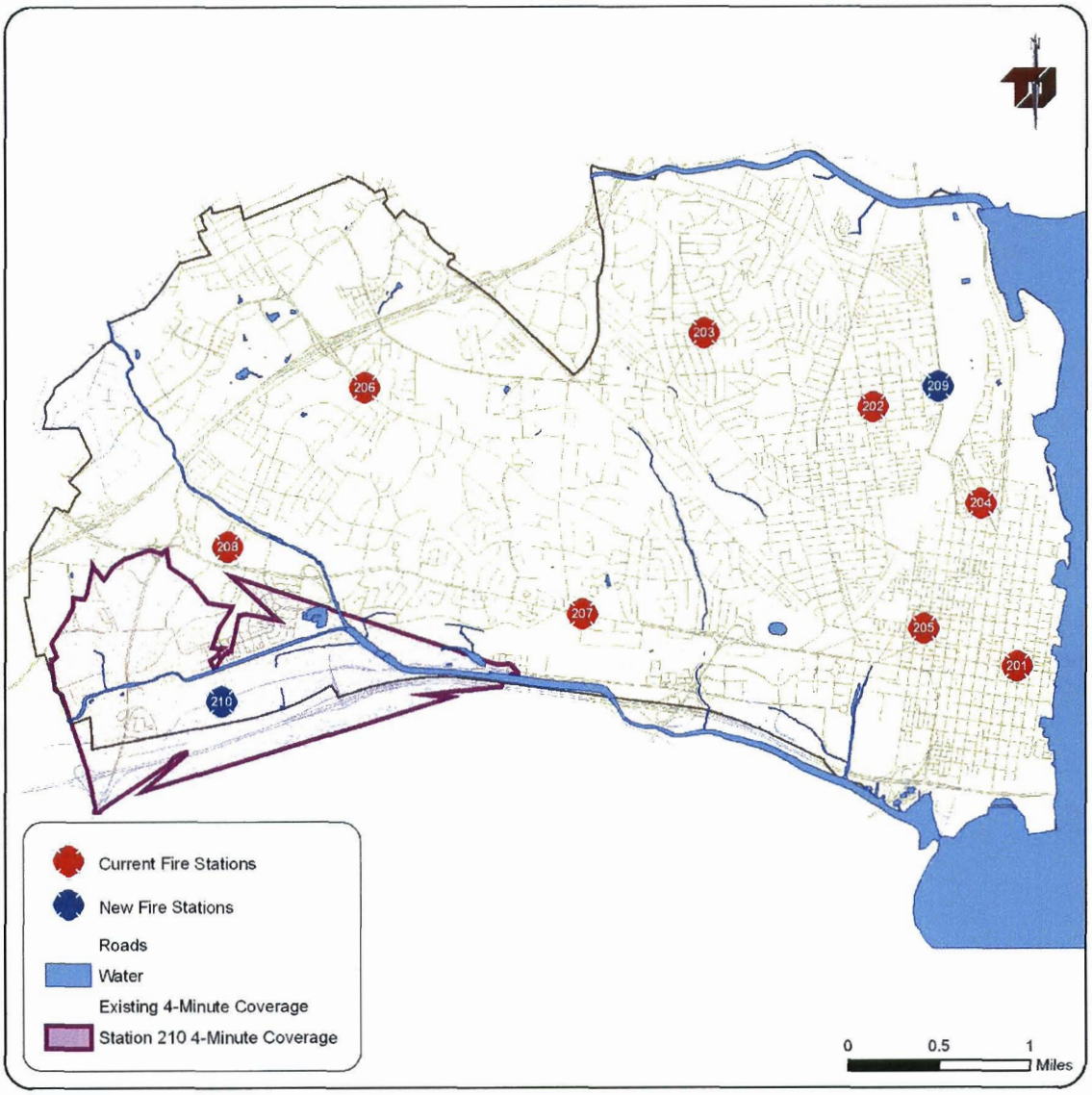


In 2006, there were over 900 incidents that occurred in Eisenhower Valley. Business and residential growth will continue in Eisenhower Valley to such an extent that future demand would place even more demand on Fairfax County if the city did not place a station in the area. However, as the rate and timing of growth was still uncertain at the time of this study, the City still has time to plan. We offer the following as considerations in developing the plans for Eisenhower Valley.

- The top priority is to secure a suitable site and work with a potential developer. While the demand for EMS and fire services are likely to increase at different rates (EMS higher at first), the facility should include plans for a full-service station; one that can accommodate an engine and a medic unit. ***Note:*** **At the time of this follow on review, the city had completed this step.**
- A public-private partnership of planning and building a new station, in our opinion, is mutually advantageous to the City and to the developer since it adds value and the station can be esthetically pleasing.
- The expected increase in development, population, and demand justifies the need for a new station; relying solely on Fairfax County to provide service is not a solution that is recommended.
- Providing emergency service into the Eisenhower Valley area can be phased-in. The first priority should be an EMS unit, followed by an engine company. One option is to provide daytime (7AM–5PM) coverage first and then increase coverage as demand increases. When the time comes to build a station in Eisenhower Valley, a review should be conducted to determine whether any new developments (i.e. road network, change in risk or demand) have impacted the effectiveness of the recommended location.
- While a new facility is not immediately needed, the City should begin the process of acquiring a site in the vicinity of Clermont Avenue and the Eisenhower Avenue Connector. Working with a potential developer now, the City should be able to identify a suitable site that will meet its long term needs. The four-minute coverage of a new station in the proposed area mentioned above can be seen in Map 11.

Recommendation 9: Continue with plans to build a station in Eisenhower Valley. The location that was selected has several merits. First, the location provides excellent coverage to the Eisenhower Valley area. Secondly, the fire and EMS units stationed in Eisenhower Valley can provide better second-due coverage to the south and west of Station 208, which has the highest combined call volume for engine and medic.

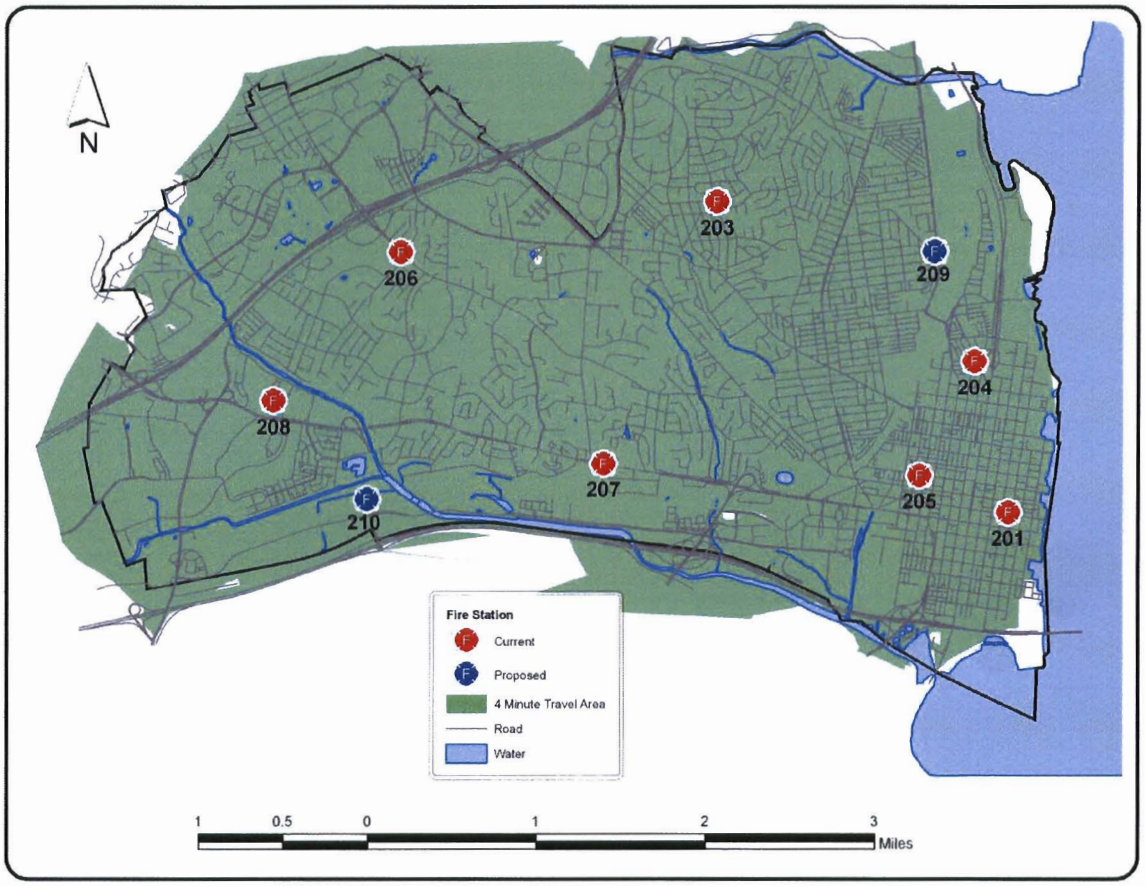
Map 11: Proposed Eisenhower Valley Station 210 with 4- and 6-Minute Response Coverage



Similar to the station location and response time map that was completed for Potomac Yard, the existing road network does not adequately project future coverage since many areas do not yet have the entire street and road network.

Proposed Coverage – The overall four-minute proposed coverage can be seen in Map 12[43]. This map includes the move of Station 202 (Del Ray) into the Potomac Yard development area and it includes the proposed station in the Eisenhower Valley development area.

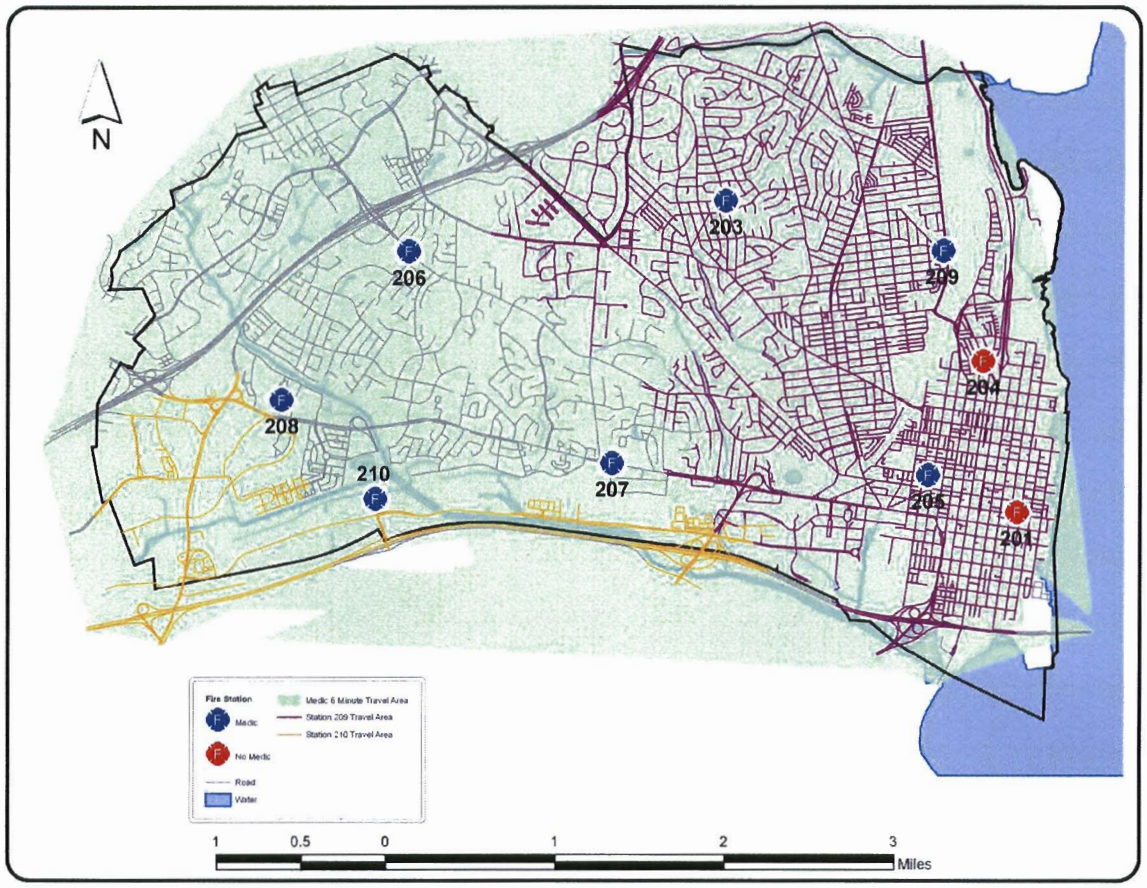
Map 12: Alexandria Proposed 4-Minute Coverage and Proposed Stations, Overall



Map 13 shows the proposed six minute medic coverage area. The coverage includes medics at their current locations as well as an additional medic at Station 203, one at the proposed Station 209 (relocated Station 202), and one at the proposed Station 210. If the entire slate of changes for additional medics were implemented, seven of the nine AFD stations would have medic units.

[43] For individual station response areas, please see the Map Appendix.

Map 13: Alexandria Proposed 6-Minute Coverage, Medics



FACILITIES AND CAPITAL PLANNING

During the facilities review we considered the overall adequacy of each facility. We also considered whether ample space is available to house the current assortment of equipment and personnel.

Included in this section is an overview of the current facility needs and a brief discussion about each AFD facility. It concludes with a matrix of the capital facility needs and a plan for capital improvement spending needs through FY2019.

The Current Situation – Many of the AFD's stations are older and some are in need of immediate attention to correct deficiencies, or extend their usable life. Although AFD facilities have been well maintained over the years, their age and overall condition suggests that a major improvement program is needed. Many of the current stations are too small to be modernized and they will need to be replaced at or near their present location.

The station location and deployment analyses conducted by TriData in 2006 recommended the addition of two new stations; one in the Potomac Yard development area and

one along the Eisenhower Valley corridor. In addition, several of the existing stations are recommended for total replacement or a major modernization.

At the time of this review, the city had implemented plans for a new station (209) in Potomac Yard. Remarkably, the city's portion of the project is only $1.0M. The facility is an excellent example of public and private partnership as the new station will be included as part of a 64-unit residential mid-rise project. With the exception of a small commercial space, the AFD will occupy the entire first floor of the new building, which will include four, 72' apparatus bays. Parking for AFD personnel will be included in the underground garage. Following is the architect's rendering of the proposed structure.

Figure 15: New Potomac Yard Station 209

THE STATION AT POTOMAC YARD
July 17, 2007

SOUTHEAST VIEW

A second new station (210) has been included in the current capital budget for funding beginning in FY09 with completion expected in FY11. The site of Station 210 was selected following a recommendation of TriData's response time and demand analysis. Located in the 5200 block of Eisenhower Boulevard near Van Dorn Street, $9.34M is allocated for the project. Although drawings have not been completed, Station 210 is proposed as a four-bay facility with a similar layout to that of Station 209.

In addition to the new facilities, capital funds are allocated to expand Station 203 from the current two-bay facility to four bays. Station 203 is located at 2801 Cameron Mills Road in the Beverly Hills section of the city. Under the capital plan, $9.72M is allocated beginning in FY10 with the new facility expected to be occupied by 2013 or 2014. As of this report, a decision has not been made of whether the existing facility should be modernized or a completely new structure built. Under the station location and apparatus deployment plan recommended by us, an additional medic unit is to be added to Station 203, thus the need for expansion.

In addition to the funds for two new stations and the complete upgrade of Station 203, $1.61M is allocated over the next six years (FY08-FY13) to maintain the AFD's eight existing facilities. Predicated on our facility assessment, $1.61M in CIP funds will be sufficient to maintain the existing facilities and correct most of their deficiencies. As we understand it, unused funds from previous years may also be available for other capital needs if they can be justified.

Although capital funds are available, there are difficulties getting projects completed (and using the available funds) because of the bid and specification process, which is managed by General Services. A problem exists for the fire department in that even when facility project needs are identified and budgeted for, the process of getting the projects through the bid process often takes too long. To complete projects in a timely manner, General Services may need assistance to expedite the specification-writing and bid process.

Following is a review of each AFD facility, a matrix of facility improvement needs, and a financial plan for capital projects. The financial plan was developed based on our understanding of the station location analysis and our judgment of the priorities. The city should review the financial plan and adjust the priorities based on new information.

Station 201 (Old Town) – Located at 317 Prince Street, Station 201 was constructed in 1921. It houses one engine company. Located in Old Town Alexandria, this station is considered a historic site. The engine crew also staffs the fire/rescue boat berthed nearby at the city's dock. One key to keeping this facility as a functional station is having members assigned who are dedicated to its continued maintenance and upkeep.

Figure 16: Station 201

Figure 17: AFD Fire/ Rescue Boat

Size and space limitations are major hindrances to the Old Town Station and today's larger fire apparatus will be a continuing problem. The station location analysis shows that Station 201 could be eliminated and the area covered by nearby stations. The city's desire to maintain the facility as an active station is reasonable. The station is located near the daytime population center, and it's close to the fireboat, which is cross-staffed by the station's engine crew.

In the future however, the city might consider operating Station 201 as a weekday only facility, or for special events. Its location is ideal to cover the increased demand that occurs with weekday population increases in the business sector. Eliminating the station does not hurt response time since the area can be covered by Stations 204 and 205.

To keep the station as operable considering its limitations, the city should continue annual investments in station maintenance. Present needs for Station 201 include:

- Energy efficient windows
- New Boiler

Following are additional pictures taken at Station 201.

Figure 18: The slide pole is unprotected at Station 201.

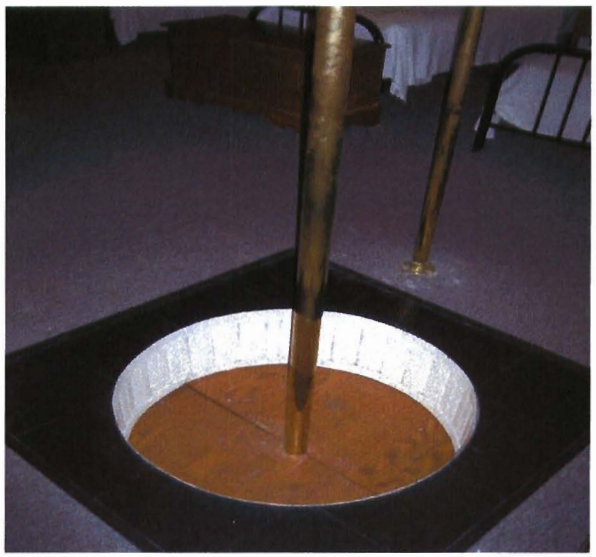


Figure 19: The kitchen facility at Station 201 was modernized to make the station more livable.

Figure 20: The size of Station 201 makes storage space a problem.

Station 202 (Del Ray) – Station 202 is located at 213 East Windsor Avenue. Constructed in 1926, Station 202 is a three-bay facility which houses one engine company, one medic, and the department's hazmat unit. The demand and response time analysis conducted by TriData revealed that Station 202 could be eliminated when the new station is constructed at Potomac Yard (209). At the time of this review, Station 202 was slated for a major overhaul at a cost of $750,000.

Figure 21: Station 202

Reportedly, concerns by the nearby community resulted in a decision to keep the station in operation despite its limitations. There are also concerns as to whether the final cost to update this station will exceed the $750,000 currently budgeted.

Fire department plans are to keep a medic unit at Station 202 and use the facility for classroom training, which it does need. There have also been discussions of whether an engine company should be located at Station 202 after Station 209 is built. If an engine is located here after Station 209 is operational, $1.3M in additional funding will be required for the additional personnel.

The budget impact statement for Station 209 included an acknowledgment that the fire department "does not anticipate any increase in personnel costs."[44] Although our analysis shows the city could operate without Station 202, a redundancy of service in the Station 202 and Station 209 area is not bad. In our opinion however, it is an extra, unnecessary cost. The hazmat unit and support equipment will be moved to the new Potomac Yard Station (209) from Station 202.

As it exists Station 202 is in need of major modernization or total replacement. Our inspection revealed several areas where major repairs will not correct the overall size deficiency of the station. Major facility needs at Station 202 include:

- Air Conditioning is needed during the winter to keep the downstairs at proper temperature
- Presence of lead paint, much of which is showing cracks
- Drainage is poor
- Roof flashing
- Electric service needs to be upgraded
- Shower facilities are faulty and in need of repair
- The sliding poles need maintenance
- The piping is old cast-iron that will be expensive to replace
- Height of the first floor equipment room is low, insufficient for apparatus or equipment storage
- Limited storage space requires suppression and hazmat hardware to be stored on the apparatus bay floor, increasing the chance of slip/fall injuries

There are also problems with the hazmat unit/ equipment located at Station 202. However, these problems would be eliminated when the hazmat unit is relocated to Station 209. Existing problems include:

- Climate control issues that affect sensitive hazmat detection devices
- Insufficient storage space for hazmat equipment and materials
- A multi-purpose/training room would offer a better facility for hazmat training and provide an alternate site for training

Following are additional pictures taken of Station 202.

[44] City of Alexandria – Proposed FY2008CIP, p.46.

Figure 22: Limited storage space at Station 202 requires equipment to be stored on the floors.

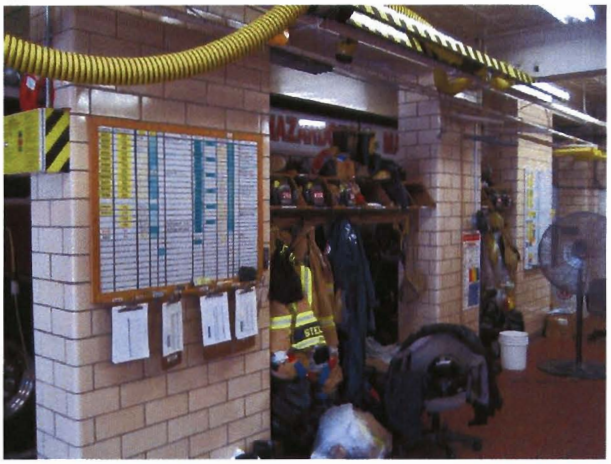


Figure 23: The size of newer apparatus is a problem at Station 202, and hazmat equipment is stored on the floor.

Figure 24: Moisture problems are causing the paint to peel at Station 202.

Figure 25: Close-up of moisture problems and peeling paint at Station 202.

As was stated, current plans are to upgrade Station 202 by making $750,000 worth of improvements. Although the planned upgrades are necessary given the state of the facility, the funded amount will not correct the most significant flaw of this structure; that of undersized doors and apparatus space. Based on the response time analysis conducted as part of this study and the expected new development for Potomac Yard, we are of the opinion that it makes better sense to discontinue operations at Station 202 and incorporate the needed training space at another facility.

Recommendation 10: Fully evaluate all of the available options (and costs) regarding the continued use of Station 202 before moving ahead with its current modernization project. An alternative to remodeling the facility (if a decision is made to keep the station, is to build a new facility on the present site while keeping the current one in operation. To do this, the new portion of the station could be built where the existing parking lot is now. However, the price tag would be considerably higher than the $750,000 currently budgeted.

Station 203 (Beverly Hills) – Station 203 was constructed in 1946. It is located at 2801 Cameron Mills Road. One engine, ladder truck, and an EMS Supervisor are located at Station 203.

Figure 26: Station 203

The apparatus deployment analysis conducted in 2006 resulted in a recommendation to add a medic unit to Station 203. However, the station does not have adequate space to accommodate the equipment already there, let alone another unit. The facility is also over 50 years old and the station has inadequate accommodations for female personnel. To add the new unit and improve the facility, we recommended a major overhaul to the exiting facility, or constructing a totally new facility on the present site. As a result of this recommendation, the city's capital improvement plan includes $9.72M for a new station to be constructed at this location.

Station 203 is in need of repairs to remedy the following problems:

- Female sleeping and bathroom facilities are located on separate floors
- Apparatus bays do not have sufficient space for the apparatus and turnout gear
- EMS Supervisor's vehicle must park diagonally inside the station and the space is inadequate
- Station windows (and soffits) are in need of extensive maintenance
- Bathroom and shower facilities are inadequate for the number of personnel

As can be observed in the following photographs, apparatus space is a severe problem at Station 203. These problems would not be alleviated unless the current facility is rebuilt or substantially altered.

Figure 27: A rear-view of Station 203 showing the tight space for equipment.

Figure 28: Front-view of Station 203.

Although there are issues with the facility, it is in a good location when response times (and demand) are considered. There is also sufficient land on which to build a new facility.

Recommendation 11: Continue with plans to rebuild Station 203 on its present site. This recommendation is based on station size, age, repairs, and the future response needs of the community. That the station is 10 years beyond its expected 50-year life cycle is a reason to

consider replacing it sooner rather than later. Since plans are underway to replace the facility, the only maintenance issues that should be addressed are those which impact safety and short-term livability.

Station 204 (Headquarters) – Located at 900 Second Street, the AFD's headquarters station (204) was constructed in 1961. In addition to the equipment and personnel located here, the facility is the administrative headquarters for the AFD chief and his staff. The fire department's dispatch center is located on the second floor of this facility. One engine and one truck company along with a battalion chief and an EMS Supervisor are located at Station 204 as are two small water rescue boats and trailers.

Figure 29: Station 204

Station 204 is in very good condition. There are, however, space issues in the dispatch center, the IT equipment room becomes overheated because of inadequate ventilation and cooling, and the HVAC system in the second floor administrative area does not heat/ cool evenly. The HVAC system is also very noisy.

The HVAC issues are being addressed under a multi-phase improvement project. Included in the HVAC improvement project is the addition of a two-ton AC unit, which has already been completed, and improvements to the air handling system. Air handling system improvements are expected to cost between $15K and $20K.

In addition to the HVAC issues now being corrected, the following problems exist at Station 204:

- Apparatus bays are somewhat limited in size
- Telephone system connection is an issue and the system is difficult to operate; there are also connection issues between the station system, headquarters, and the dispatch center

Facility issues in the dispatch center include a high-heat load within the IT equipment room. Currently the heat output of the equipment is too high for the residential air conditioner, and there is not a redundant system in case of failure. Reportedly, $90,000 has been allocated to

correct these issues. Funding for the HVAC improvements to the IT area are to be allocated from the city's Capital Facilities Maintenance Plan (CFMP), according to the AFD's building services manager.

The fire dispatch center is also too small and is nearing its capacity to accommodate personnel and equipment. At the time of this review, the city was assessing merger opportunities for police, fire, and EMS communications. Sufficient space is not available at fire headquarters to merge the centers. Within the current CIP, $275,000 has been allocated to review the expansion needs of the EOC.

Station 205 (Cameron) – Constructed in 1949, Station 205 is located at 1210 Cameron Street. One engine company and one medic are located at Station 205 as is the battalion aide. In relatively good condition considering its age, the apparatus floor space and the dimensions of the exit doors are its most limiting features. As it exists, Station 205 is unable to accommodate an aerial ladder company.

Despite its challenges, Station 205 still has a few years of service life remaining. When rebuilt, the apparatus bay areas should accommodate an aerial ladder truck. Truck 204 could then be moved to Station 205, which is closer to the highest demand for a ladder truck. As can be observed in the following picture, the apparatus doors at Station 205 are small, thus limiting the size of the equipment that can be located here.

Figure 30: Station 205

Station 205 is located on a one-way street and heavy traffic makes access and egress difficult. In the not to distant future, Station 205 will need to be replaced. The city should consider nearby locations with better access and not on one-way streets. For planning purposes, Station 205 should be scheduled for replacement after Station 203 is completed in 2013. The capital plan included in this report includes money to replace the facility beginning in 2014.

Until the new station is constructed, funds from the CFMP will be needed to make periodic repairs. Problem areas found during the review include:

- Water leak damage throughout the second floor. (The leak appeared to be from a faulty ice machine, which was repaired).
- Paint chips/ peeling throughout the station
- Air conditioning and heating disparities between the front and back dormitories
- Minor leaks in several areas of the roof and water migration through the walls

Figure 31: At Station 205, water is migrating through the exterior walls and causing the paint to bubble and peel.

Recommendation 12: Replace Station 205 when the Station 203 project is completed. Until then, continue to provide routine maintenance to keep the current facility safe and functional.

Station 206 (Seminary) – Station 206 was constructed in 1958. Located at 4609 Seminary Road, Station 206 houses one engine, one medic, one heavy rescue, and the shift battalion chief. The heavy rescue and engine are cross-staffed units. Station 206 is almost 50-years old and the city should replace the facility within the next 10 to15 years.

Figure 32: Station 206

Overall the facility is adequate and in reasonably good condition. However, some cosmetic work is needed to extend its useable life. Of particular importance to address is the exterior masonry, which is deteriorating in many places. Reportedly, there were also asbestos problems but these have been abated.

Currently, this station has sufficient space to accommodate the equipment and personnel. Until it is replaced, the station should continue to be maintained. Station 206 is in a good location and there is adequate space to build a new facility or modernize the existing facility at the present site. Maintenance problems to address at Station 206 include:

- The parking lot is small and the blacktop is deteriorating; parking of vehicles at shift change is a problem
- Condensation from the window air conditioners need to have drain lines installed such that water does not deteriorate the masonry (this is particularly a problem on the concrete overhang areas where water accumulates
- Overhead doors are old and the large glass panes are not energy efficient
- Storage facilities for lawn equipment are inadequate
- As a two-bay facility, the station does not accommodate a ladder truck

Figure 33: Air conditioners need drain lines and the large glass doors are inefficient energy-wise at Station 206.

At a minimum, consideration should be given to adding an additional bay and expanding the parking lot. Although the facility is presently adequate, a reasonable course of action for the long-term is to demolish the existing facility and rebuild a new one on the same site, since adding another bay does not address the parking lot and vehicle maneuvering problems. The facility is also nearing the end of the generally accepted life cycle (50 years) for a fire station.

Recommendation 13: Rebuild Station 206 at its current location (or nearby) beginning in 2016 with completion in 2019.

Station 207 (Duke Street) – Station 207 was constructed in 1963 and is located at 3301 Duke Street. The station has two apparatus bays with one engine, one medic unit, and the department's air/ light unit. The facility is in good condition and should provide at least 20 or more years of continued service if regular maintenance is performed.

Figure 34: Station 207

The air compressor system used to fill the air unit vehicle is located in the apparatus bay area and there is no protection against the noise level. We did not conduct a decibel test, but the noise level is excessively high. One option is to enclose the unit in its present location, another is to move it. If moved, a small addition at the side of the station could be constructed. Placed on a concrete slab and enclosed, a door would connect the compressor room to the apparatus bay. Sufficient space is available to add a compressor room to the side of the station.

Figure 35: The air compressor at Station 207 is located in the rear of this station in an unprotected area.

Other routine maintenance issues to be addressed include:

- Renovation of the kitchen facility (expected cost of $30k)
- Air leaks in the dormitory windows are reducing energy efficiency
- PlymoVent exhaust system needs a new compressor (*Work was completed on this during the study*)

Maintenance issues and the construction of a compressor room can be addressed using CFMP funds.

Station 208 (Landmark) – Constructed in 1976, Station 208 is the newest AFD facility and is located at 175 North Paxton Street. One engine, one truck company, and one medic unit are located here. The department's supply facility is also located in the basement level of this facility. Overall the facility is in excellent condition. Major issues here are that only two apparatus bays were originally constructed even though three response vehicles are assigned, including an EMS unit. The supply area is also becoming too small and will need to be expanded at some point in the future.

Figure 36: Station 208

Originally constructed to house one engine and one truck company, Station 208 now accommodates an advanced life support medic unit as well. To accommodate the medic, the engine is positioned behind the medic unit, which requires the medic unit to be moved for engine-only responses. Although it has only two exit doors, personnel have adapted to the situation. Station 208 also has a poor overall layout and the location of dormitory facilities is not advantageous. The large sleeping facilities and redundant beds make the use of space and utilities inefficient.

To improve the station and provide for its long-term use, we recommend adding another bay. As can be observed in Figure 37 and Figure 38, storage space is becoming limited in the supply area, and it could be expanded with the addition of a third apparatus bay.

Figure 37: Supply area in the basement of Station 208 is very neat, but storage space is becoming a problem.

Figure 38: The lack of storage spaces results in some equipment being stored on the floor in the supply area.

Based on our review of the land, it appears the topography will accommodate such an addition. Improving on the deficiencies by adding another bay would correct the functional

aspects of the facility; however, there is also need to address unresolved bathroom plumbing issues. [45]

Recommendation 14: To improve the functionality of Station 208, add an additional apparatus bay. This should be considered a lower priority as compared to the other facility needs recommended in this report.

FACILITIES SUMMARY AND CIP

Following is a summarization of the maintenance needs of each station and the CIP allocations to construct new facilities or modify existing ones.

Table 37: AFD Capital Facilities Summary

Station	Location	Facility Improvement Needs	Priority	Situation Summary
201	317 Prince Street	Energy efficient windows New boiler	Moderate Moderate	Although outdated, Station 201 can continue to operate with routine maintenance.
202	213 East Windsor Avenue	Eliminate or rebuild the facility to accommodate modern equipment	Very High	Funding is in place to upgrade the facility at a cost of $750k; however, the deployment analysis shows that Station 202 could be eliminated. If continued operations are desired, the station should be modernized to accommodate larger equipment.
203	2801 Cameron Mills Road	To be rebuilt on its present site.	Very High	$9.72M has been appropriated in the CIP beginning in FY08 with the facility expected to be completed in FY13.
204	900 Second Street (Headquarters)	Continue plans to improve the HVAC system, especially for the IT equipment room.	Very High	Funding from the CFMP and plans are in place to address this need.

[45] There is also a beautiful mural in the supply area that has been left uncompleted. Given the title of the mural, the department should take the necessary steps to complete the painting.

Station	Location	Facility Improvement Needs	Priority	Situation Summary
205	1210 Cameron Street	Water leakage issues throughout the structure. Paint chip issues throughout the station. Air conditioning and heating disparities. Minor leaks in several areas of the roof with water migrating through the walls.	High High Moderate Moderate	The station should be replaced after Station 203 is completed. CIP funds should be available beginning in 2014 with completion in 2017.
206	4609 Seminary Road	Parking area is small and the blacktop is deteriorating. Condensation from the window air conditioners need drain lines. Overhead doors are old and the large glass panes are not energy efficient. Storage facilities for lawn equipment are inadequate.	Low High High Low	Plans should be made to replace the facility beginning in 2016 with completion anticipated by 2019.
207	3301 Duke Street	Renovation of the kitchen facility ($30K). Air leaks in the dormitory windows are reducing energy efficiency.	Low Moderate	The facility is in excellent condition and should provide at least 20 or more years of continued service. A major issue is the location and noise level of the air compressor system, which should be compartmented.

Station	Location	Facility Improvement Needs	Priority	Situation Summary
208	175 North Paxton Street	Plumbing issues involving each of the bathroom facilities.	Low	Originally constructed to house one engine and one truck company another bay is needed to accommodate the medic unit. The supply area is becoming too small and will need to be expanded.

Based on our assessment of the AFD's overall capital needs, we suggest the CIP funding schedule on the following page as one possibility.

Table 38: Capital Facilities Budget, 2008–2013

	Current CIP						Sub Total
	2008	2009	2010	2011	2012	2013	
Major Projects							
Fire Station 209	$1,000,000						$1,000,000
Fire Station 203			$70,000	$450,000	$1,950,000	$7,250,000	$9,720,000
Fire Station 210		$800,000	$7,200,000	$1,340,000			$9,340,000
Modernize Station 202	$750,000						$750,000
CFMP Projects	$236,250	$248,063	$260,466	$273,489	$287,163	$301,522	$1,606,953
Totals	$1,986,250	$1,048,063	$7,530,466	$2,063,489	$2,237,163	$7,551,522	$22,416,953

Table 39: Capital Facilities Budget, 2014 –2019

	Future CIP						Total
	2014	2015	2016	2017	2018	2019	
Major Projects							
Fire Station 209							$1,000,000
Fire Station 203							$9,720,000
Fire Station 210							$9,340,000
Modernize Station 202							$750,000
Fire Station 205	$85,000	$547,000	$2,370,000	$8,800,000			$11,802,000
Fire Station 206			$94,000	$603,000	$2,600,000	$9,700,000	$13,000,000
Fire Station 208 Addition					$3,500,000		$3,500,000
CFMP Projects	$316,598	$332,428	$349,049	$366,502	$384,827	$404,068	$3,760,425
Totals	$401,598	$879,428	$2,813,049	$9,769,502	$6,484,827	$10,104,068	**$52,872,425**

Note: CFMP funds and the cost of new stations 206 and 206 were compounded five percent annually to account for the increased costs of labor and materials.

Under the proposed CIP funding plan, $52.9M will be needed over 12 years. Authorizations for the actual construction of new facilities would be required in 2010, 2013, 2017, 2018, and 2019. Of the total CIP cost, $44.7M is projected for actual construction. The remaining $8.2M will be needed for annual CFMP projects as well as the architectural and engineering work for new facilities.

VII. SUMMARY OF RECOMMENDATIONS

In this section we list each recommendation and a descriptor of its priority. Important to consider is that individual priorities were determined based on our understanding of the situation in Alexandria, which is obviously limited to the scope of work performed.

Table 40: Description of Priorities

Priority	Descriptor	Definition
1	Immediate	This recommendation should be given immediate attention. Action may include either planning or specific activity
2	Important	This recommendation should be addressed within the next one or two fiscal years
3	Strategic	This issue should be addressed as part of the AFD strategic plan

Table 41: Recommendations

Rec #	Recommendation Summary	Priority
1	Make greater use of TeleStaff software by implementing a training program for all officers and ensuring that all future human resource and finance software packages are compatible with TeleStaff.	1
2	Continue to use overtime instead of hiring additional personnel to reduce overtime costs.	1
3	Monitor yearly per capita demand by category and analyze data every five years.	3
4	Determine whether the CAD can be modified to create an incident number when the call is first received	2
5	Reduce call processing times by 50 percent to meet nationally accepted standards.	2
6	Reduce unit turnout times by installing a faster alerting system.	2
7	The AFD should record "vertical" response time (time to arrive at the patient or the fire).	2
8	Consider adding a medic unit at Station 203 (Beverly Hills)	1
9	Continue with plans to build a station in Eisenhower Valley.	1
N/A	The AFD should build a fire station at Potomac Yard. **Note:** *This recommendation appeared in our earlier report, and it is being implemented.*	1
10	Fully evaluate all of the available options (and costs) regarding the continued use of Station 202 before moving ahead with the current modernization project.	1
11	Continue with plans to rebuild Station 203 on its present site.	1
12	Replace Station 205 when Station 203 is completed. Until then, provide routine maintenance to keep the current facility safe and functional.	3

Rec #	Recommendation Summary	Priority
13	Rebuild Station 206 at its current location (or nearby) beginning in 2016 with completion in 2019.	3
14	To improve the functionality of Station 208, add an additional apparatus bay.	3

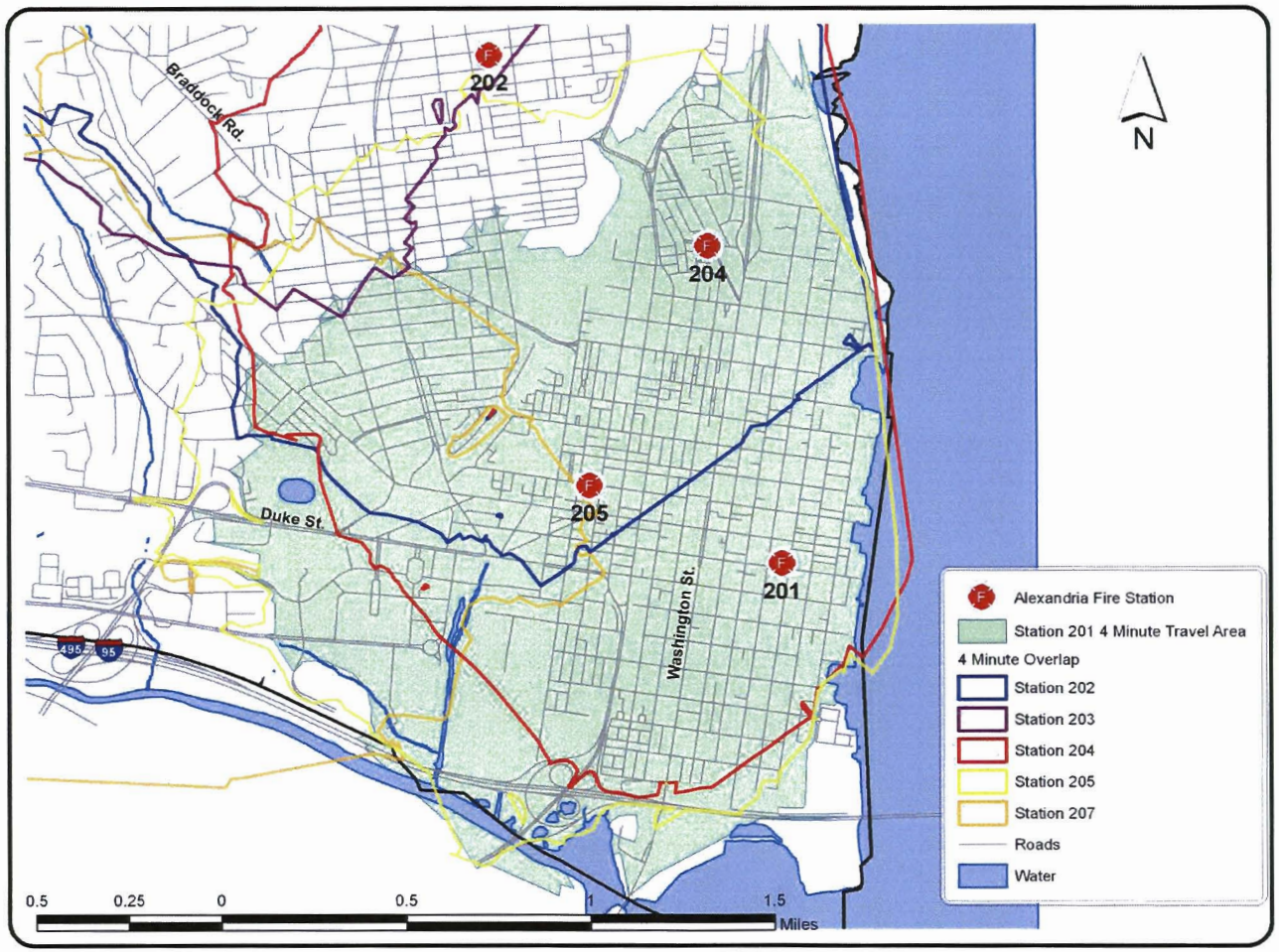
APPENDIX: ADDITIONAL STATION RESPONSE TIME MAPS

(*Coverage computed using ArcGis*)

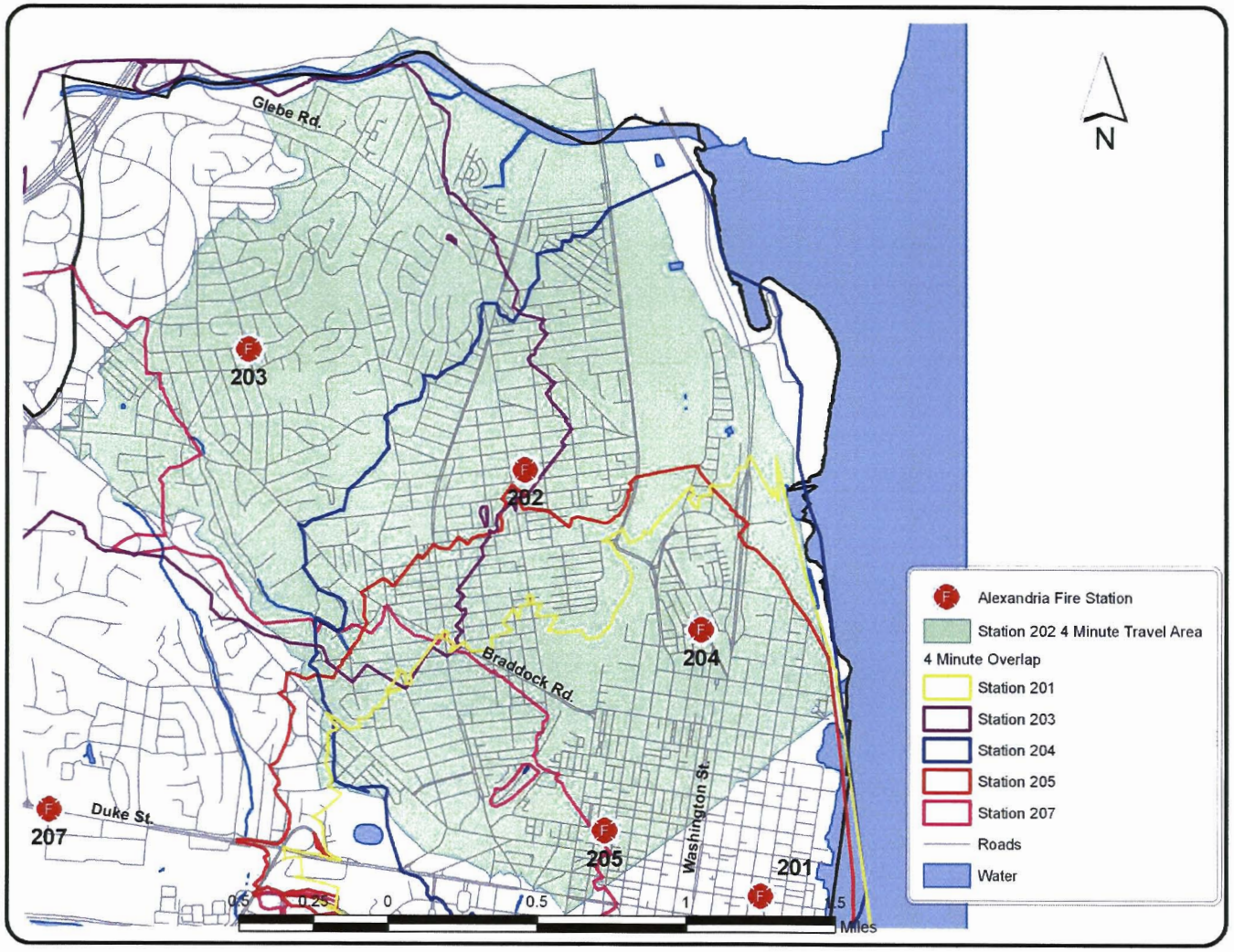
1: 4-Minute Coverage Area Station 201 110
2: 4-Minute Coverage Area Station 202 111
3: 4-Minute Coverage Area Station 203 112
4: 4-Minute Coverage Area Station 204 113
5: 4-Minute Coverage Area Station 205 114
6: 4-Minute Coverage Area Station 206 115
7: 4-Minute Coverage Area Station 207 116
8: 4-Minute Coverage Area Station 208 117
9: 6-Minute Coverage Area Medic 202 118
10: 6-Minute Coverage Area Medic 205 119
11: 6-Minute Coverage Area Medic 206 120
12: 6-Minute Coverage Area Medic 207 121
13: 6-Minute Coverage Area Medic 208 122
14: 6-Minute Coverage Area Tower 203 123
15: 6-Minute Coverage Area Truck 204 124
16: 6-Minute Coverage Area Truck 208 125
17: Proposed 4-Minute Coverage Area Station 201 126
18: Proposed 4-Minute Coverage Area Station 203 127
19: Proposed 4-Minute Coverage Area Station 204 128
20: Proposed 4-Minute Coverage Area Station 205 129
21: Proposed 4-Minute Coverage Area Station 206 130
22: Proposed 4-Minute Coverage Area Station 207 131
23: Proposed 4-Minute Coverage Area Station 208 132
24: Proposed 4-Minute Coverage Area Station 133
25: Proposed 4-Minute Coverage Area Station 134

CURRENT COVERAGE

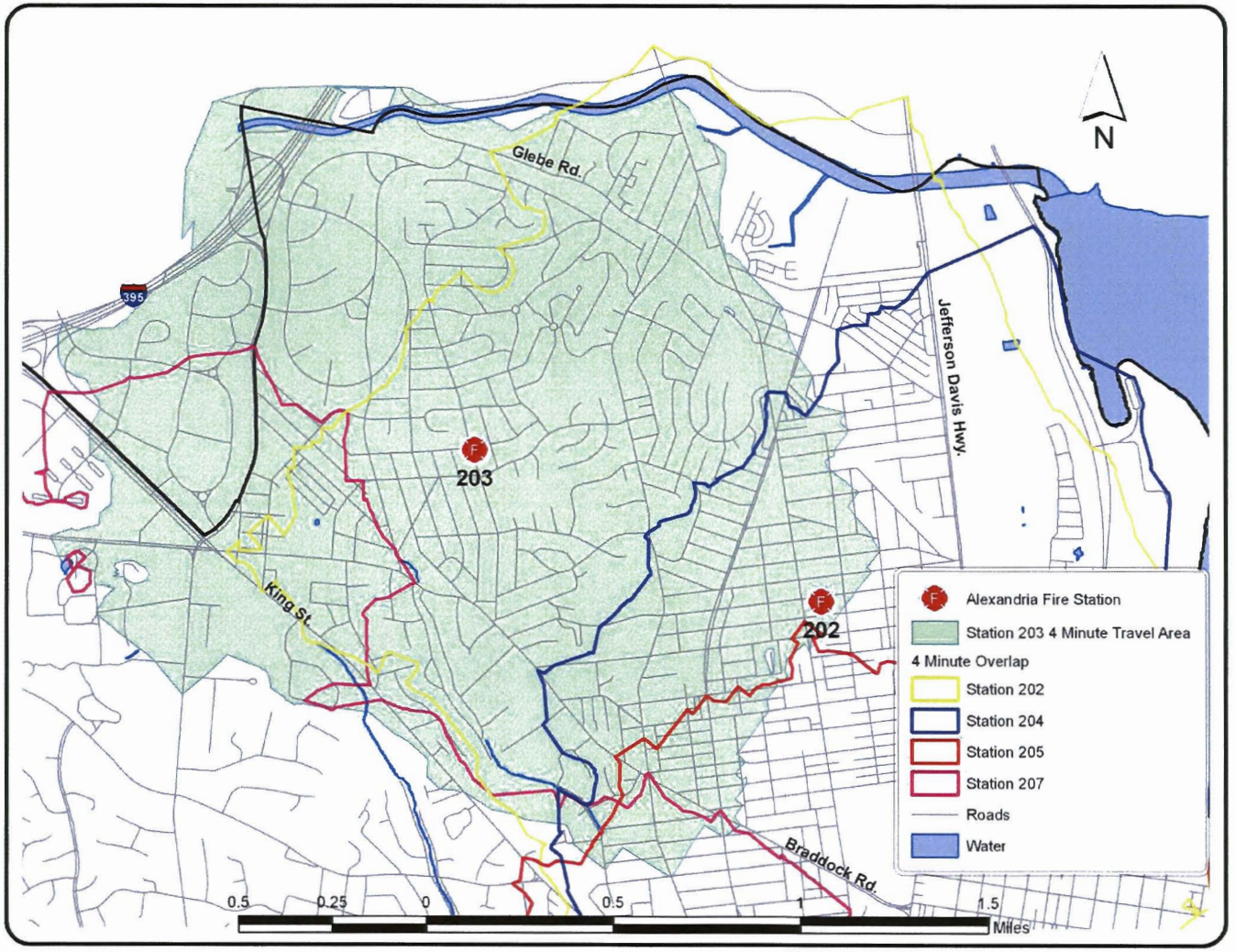
1: 4-Minute Coverage Area Station 201



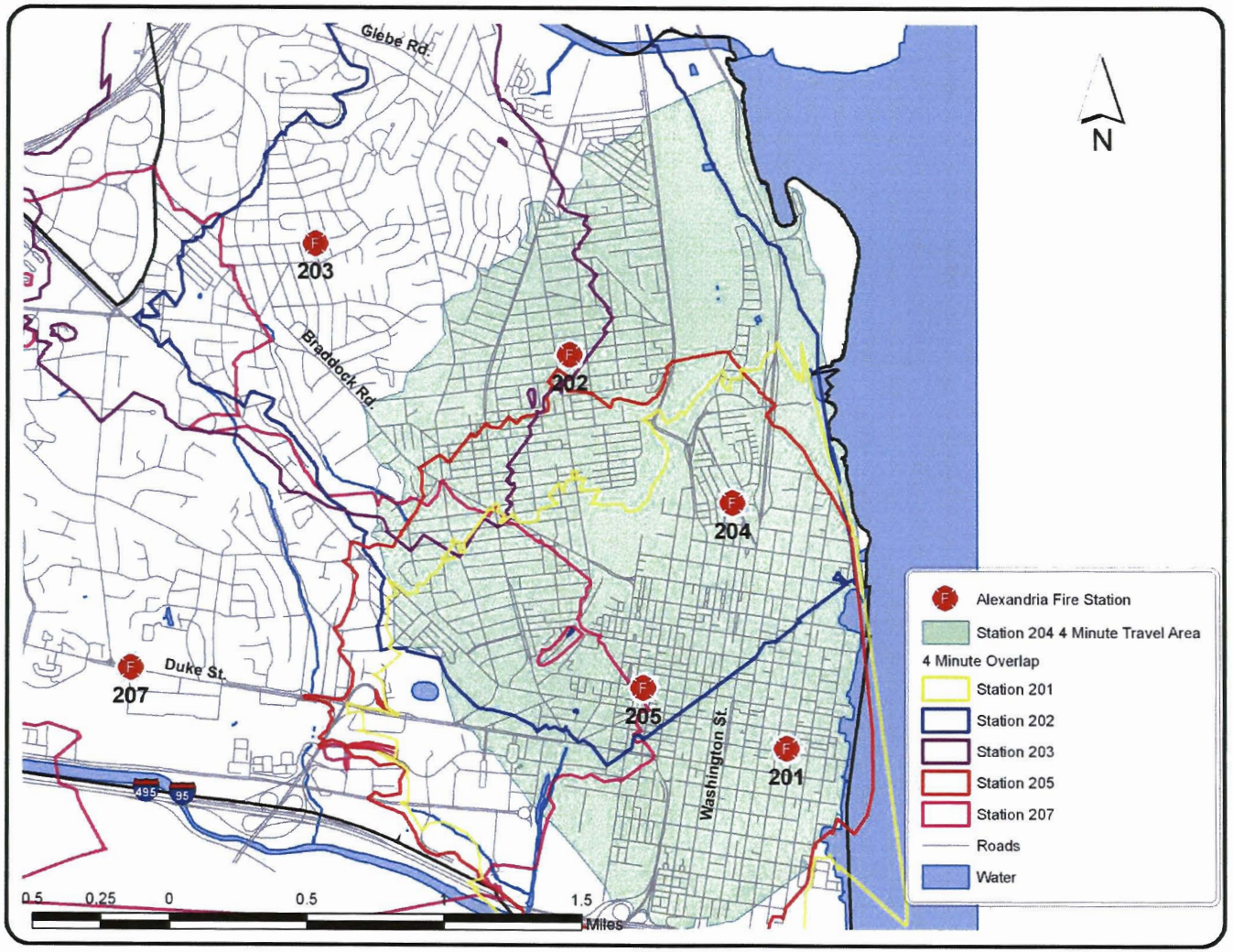
2: 4-Minute Coverage Area Station 202



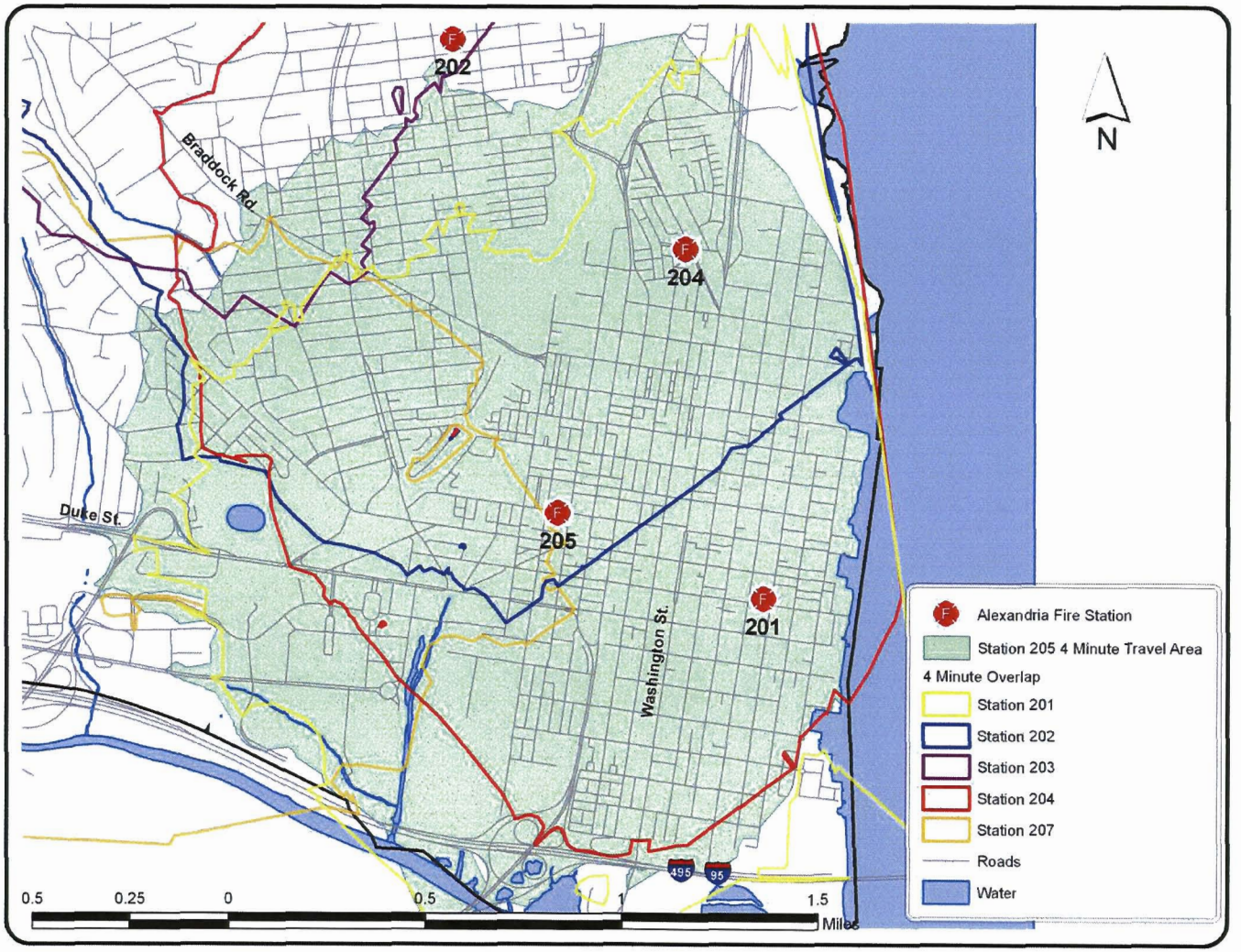
3: 4-Minute Coverage Area Station 203



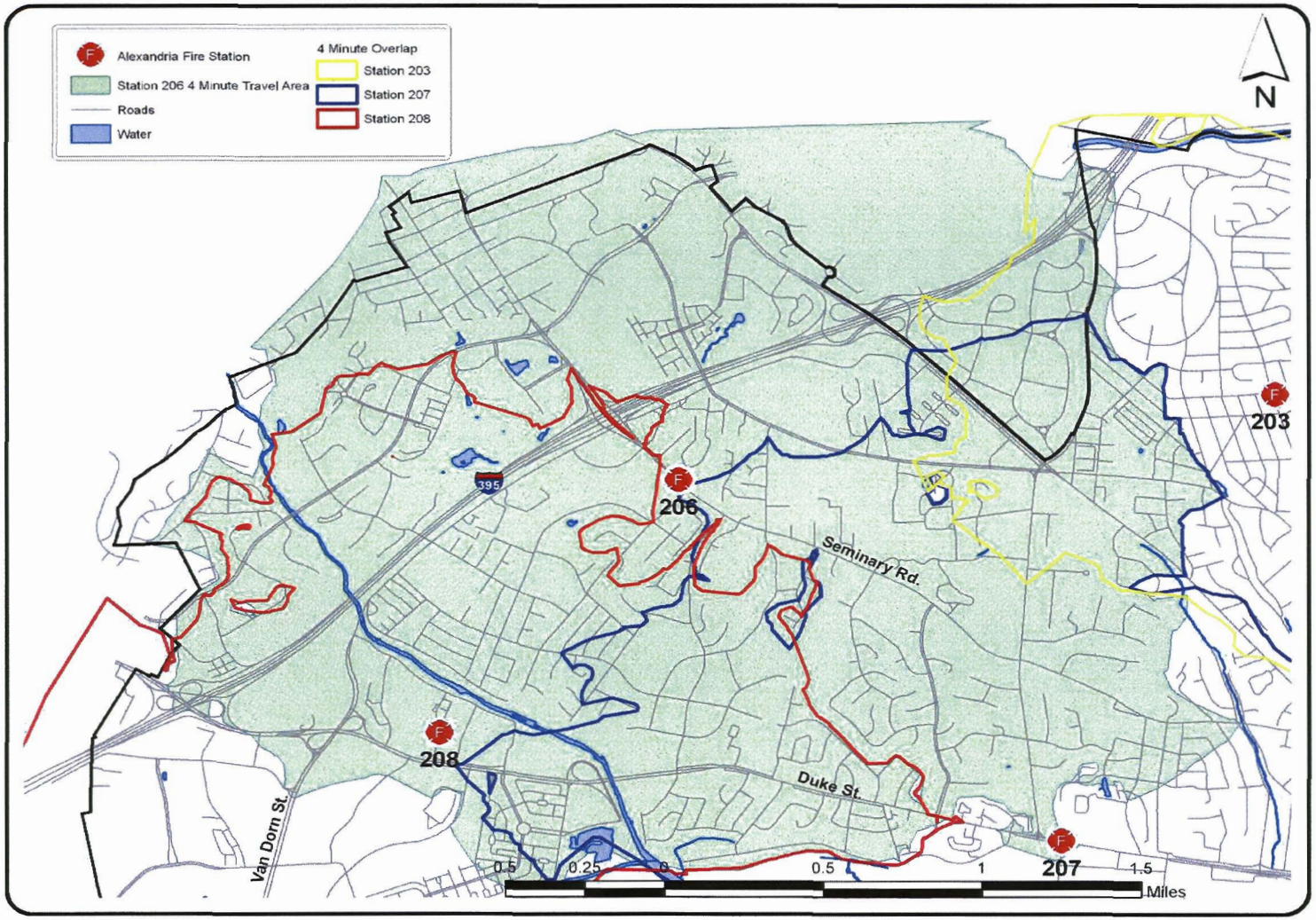
4: 4-Minute Coverage Area Station 204



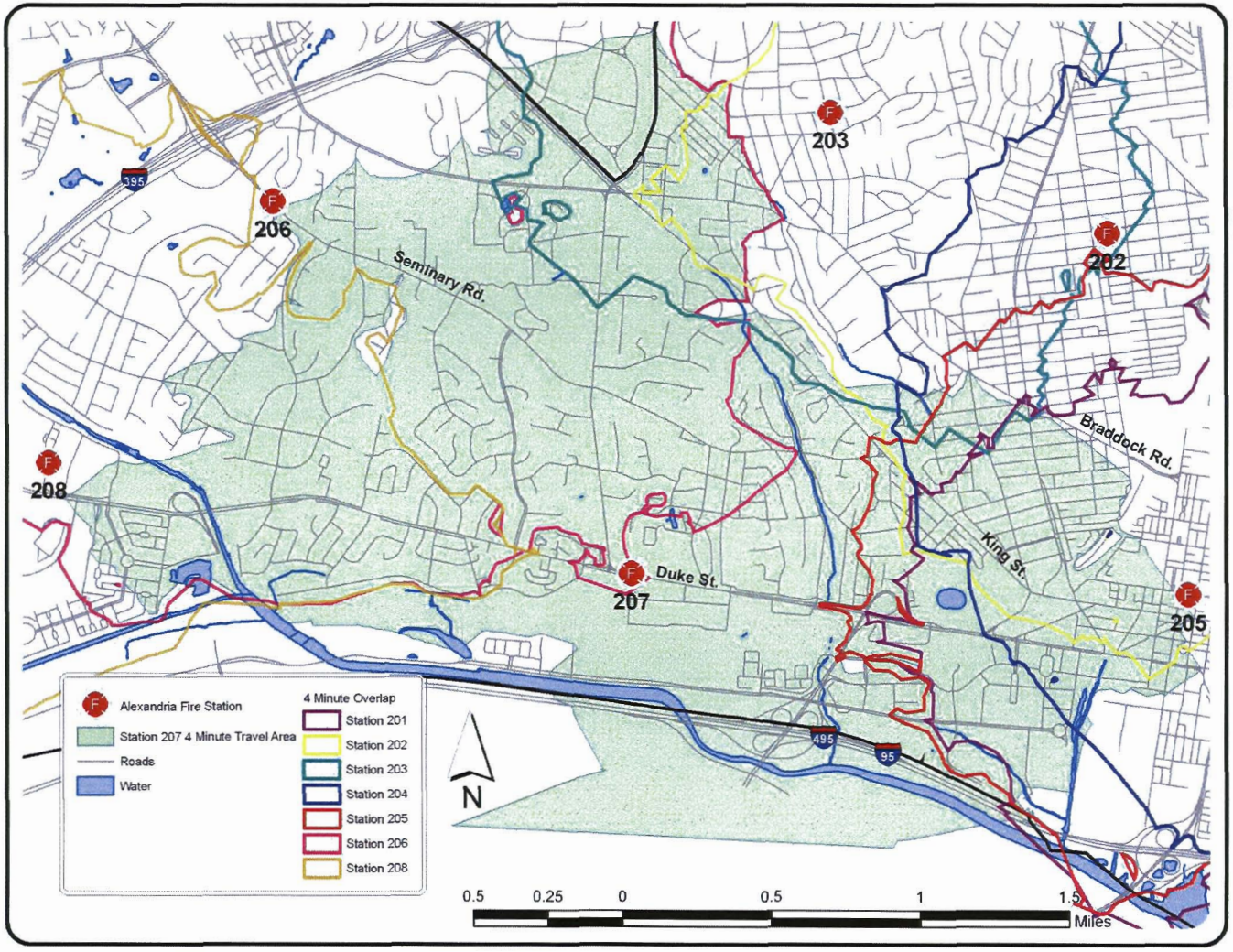
5: 4-Minute Coverage Area Station 205



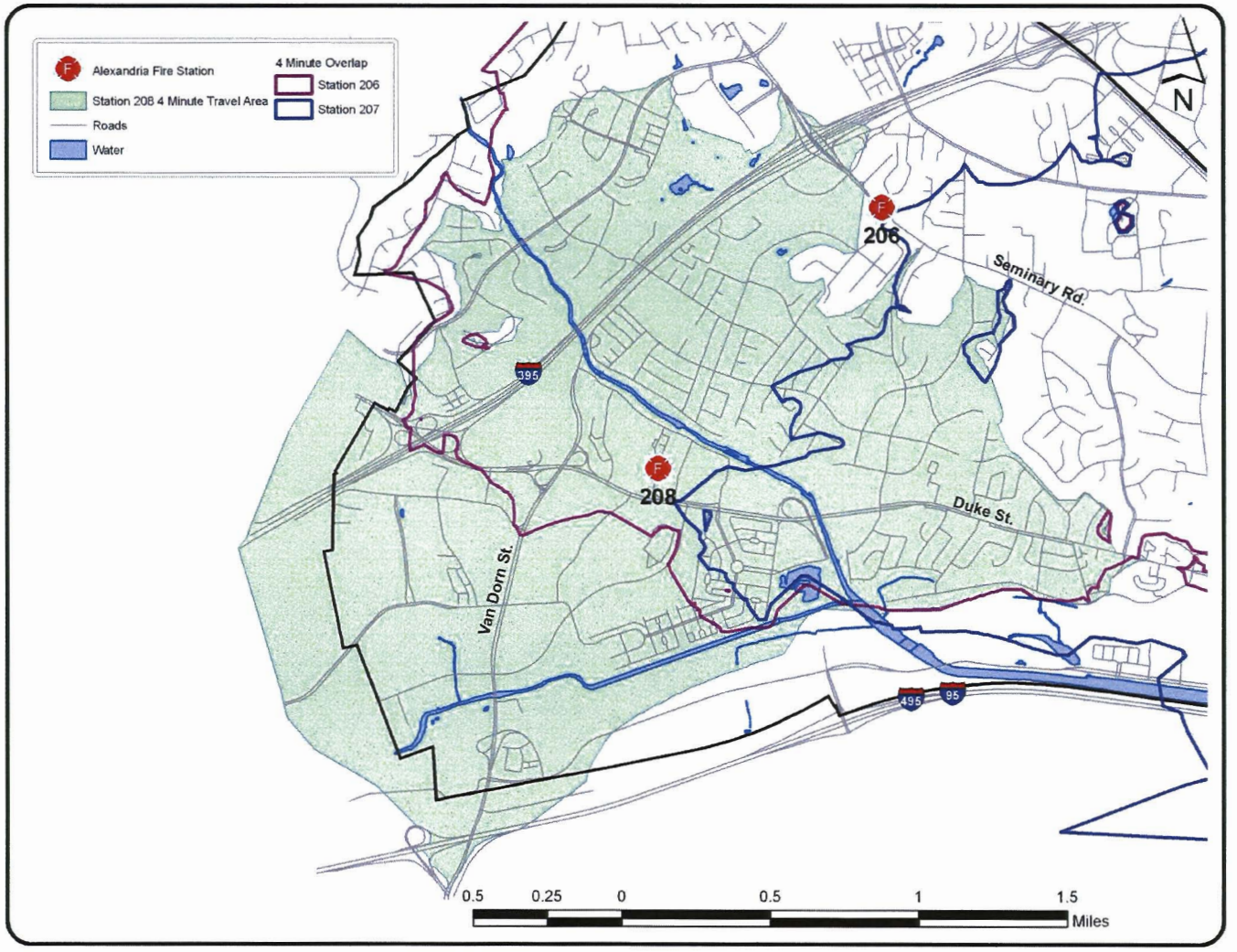
6: 4-Minute Coverage Area Station 206



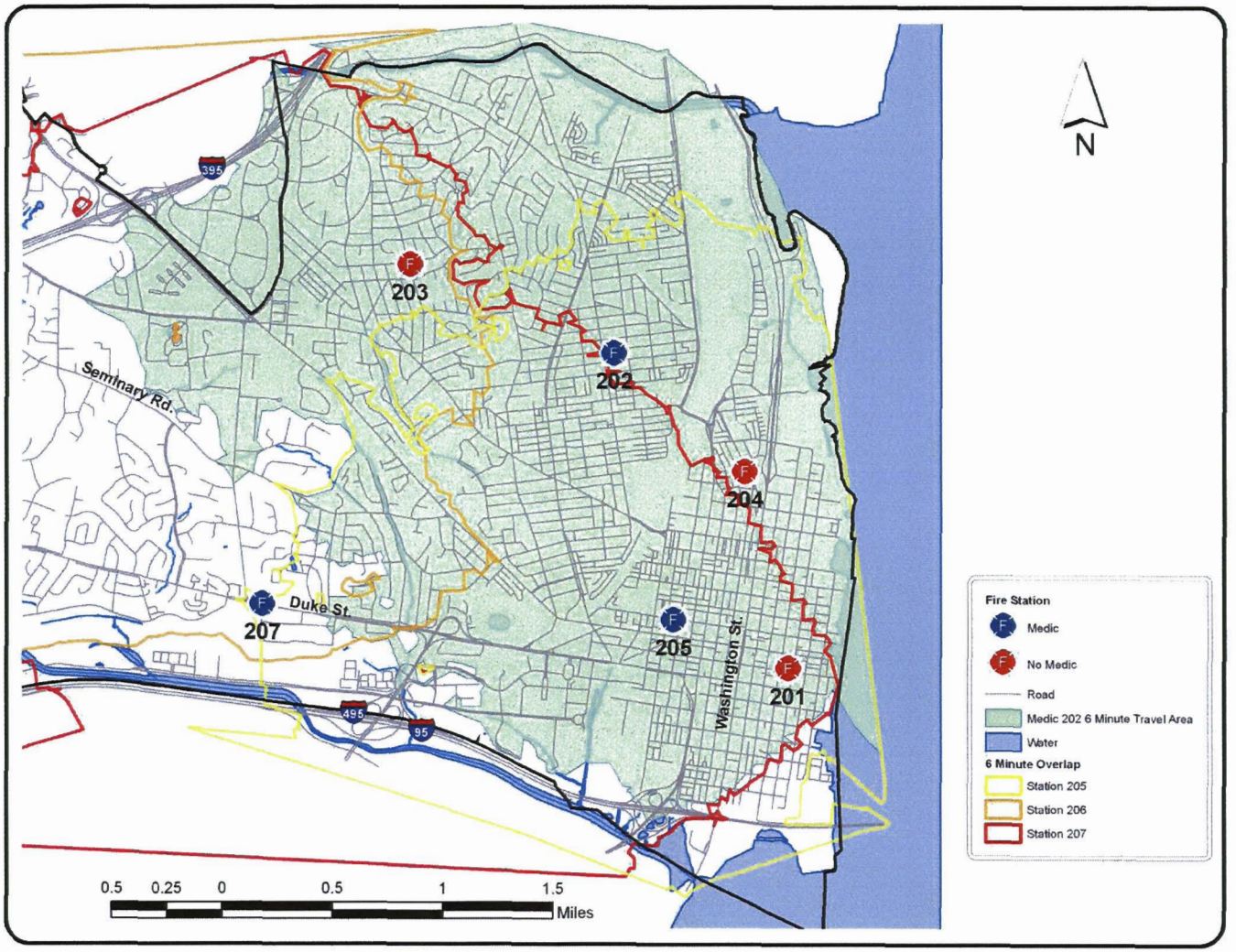
7: 4-Minute Coverage Area Station 207



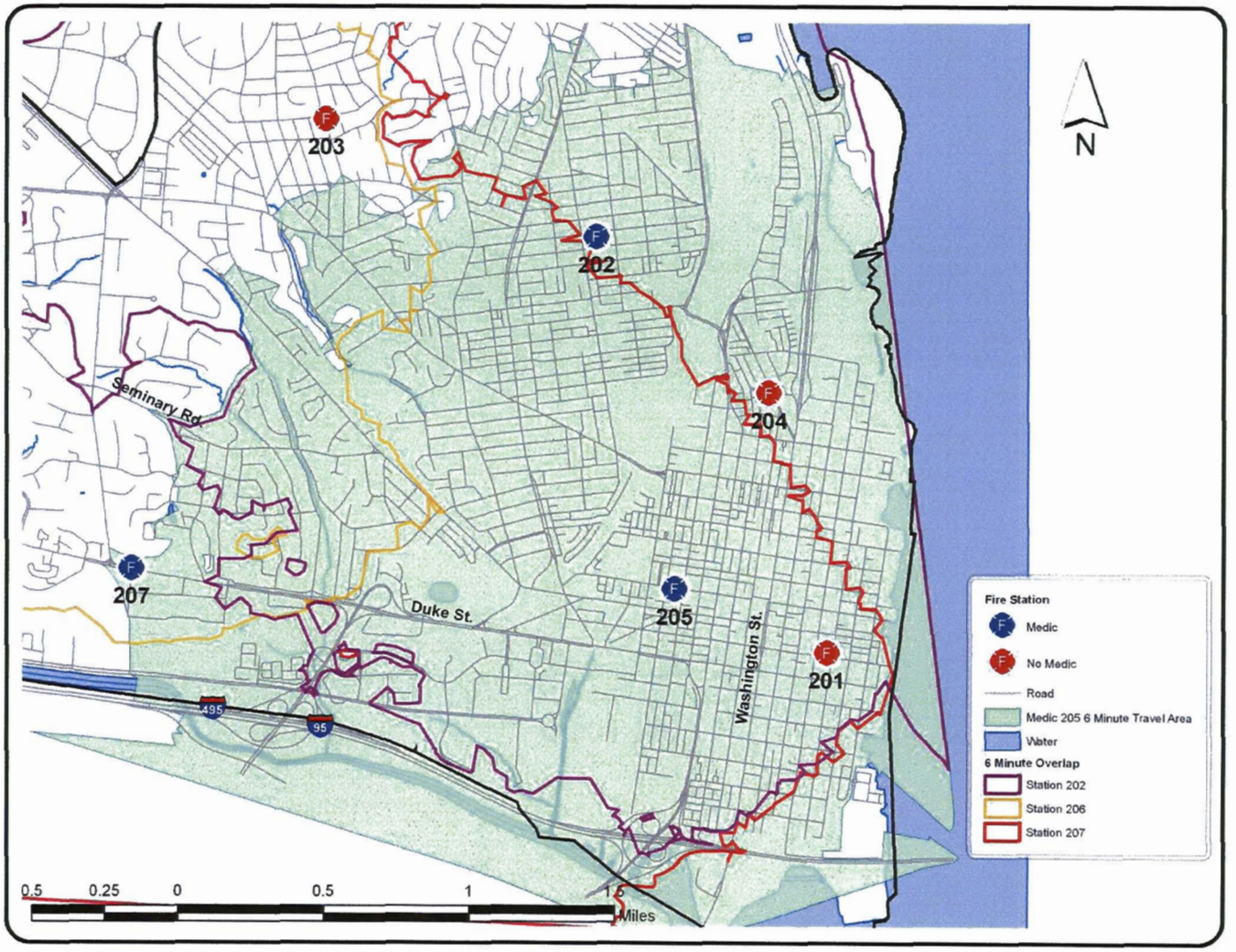
8: 4-Minute Coverage Area Station 208



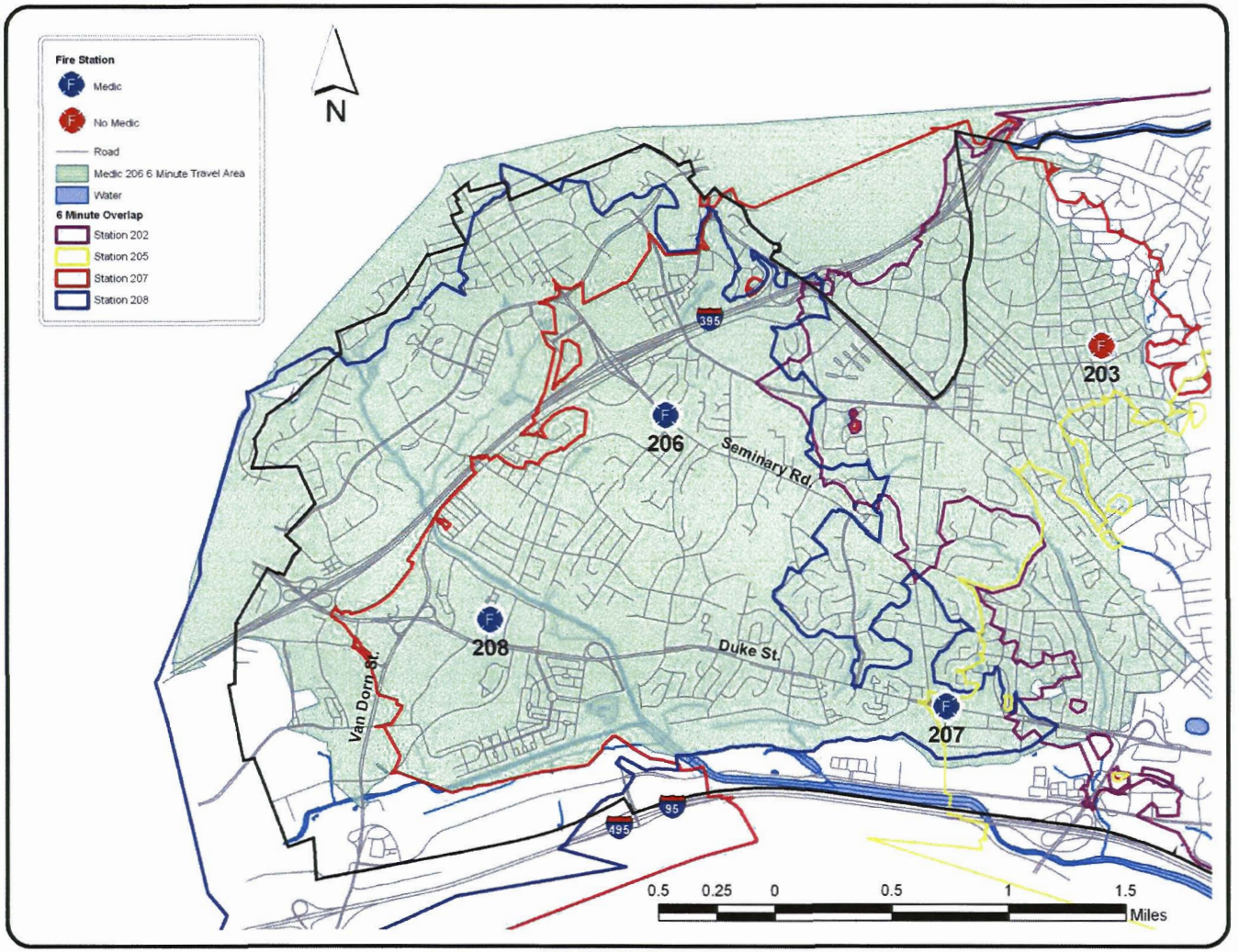
9: 6-Minute Coverage Area Medic 202



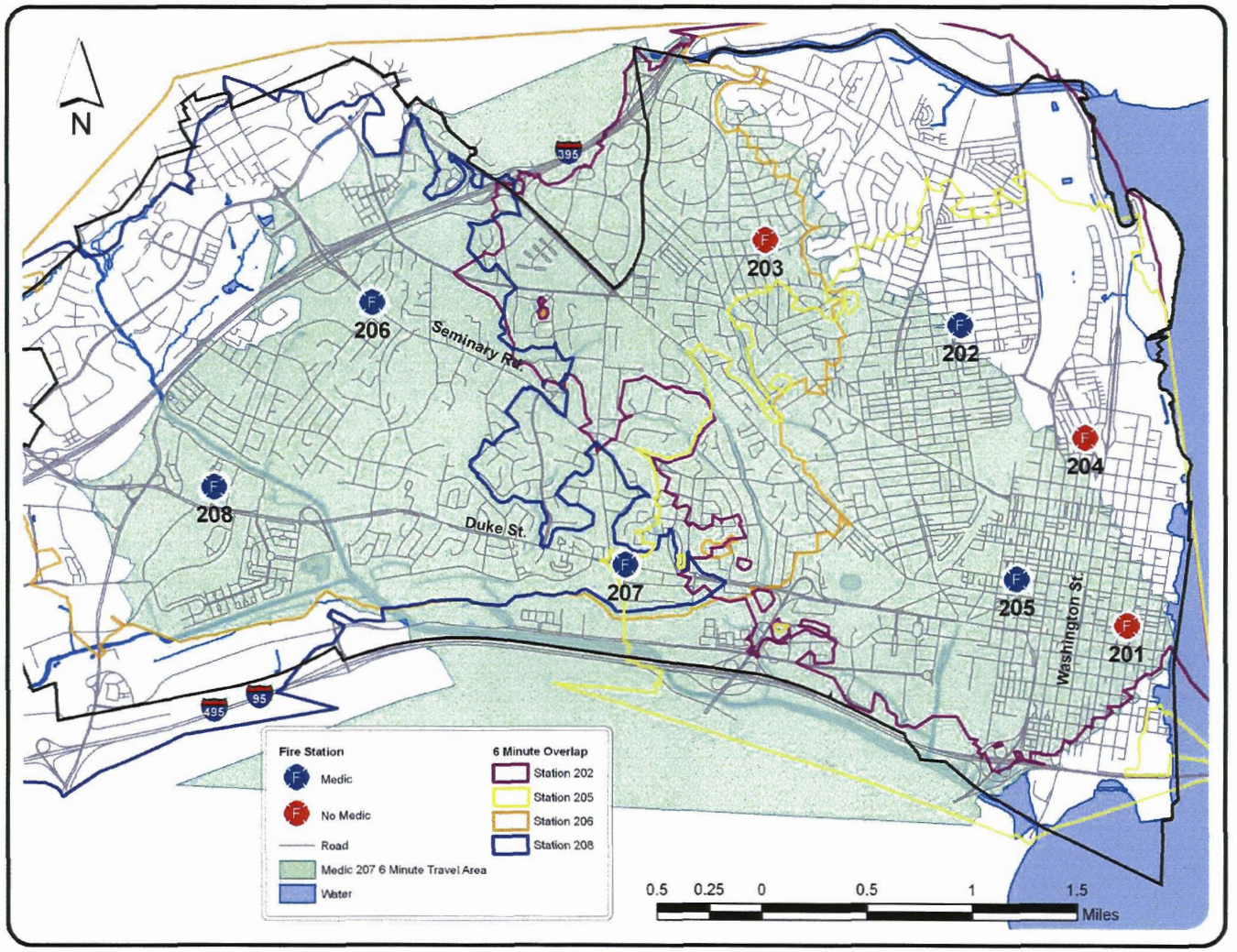
10: 6-Minute Coverage Area Medic 205



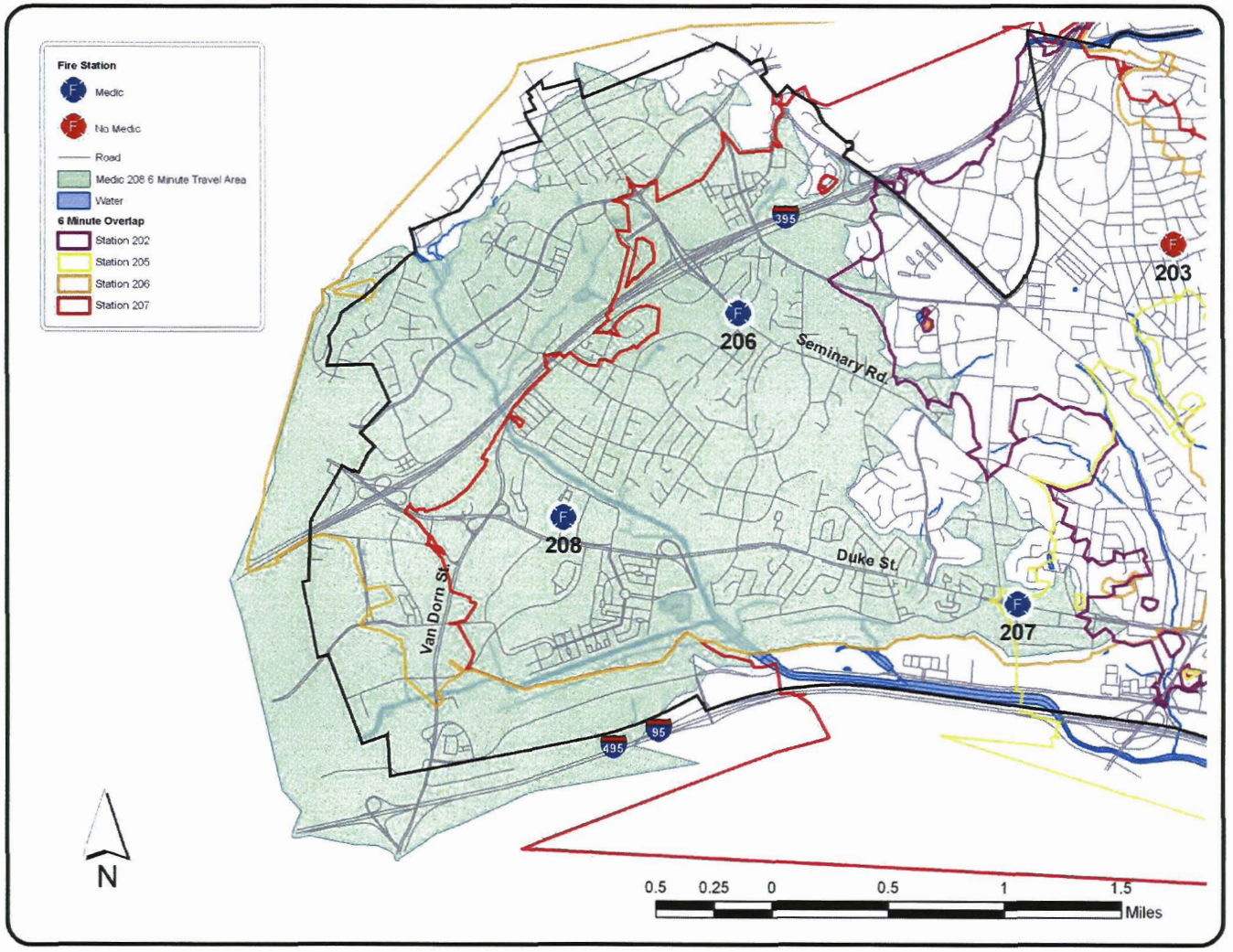
11: 6-Minute Coverage Area Medic 206



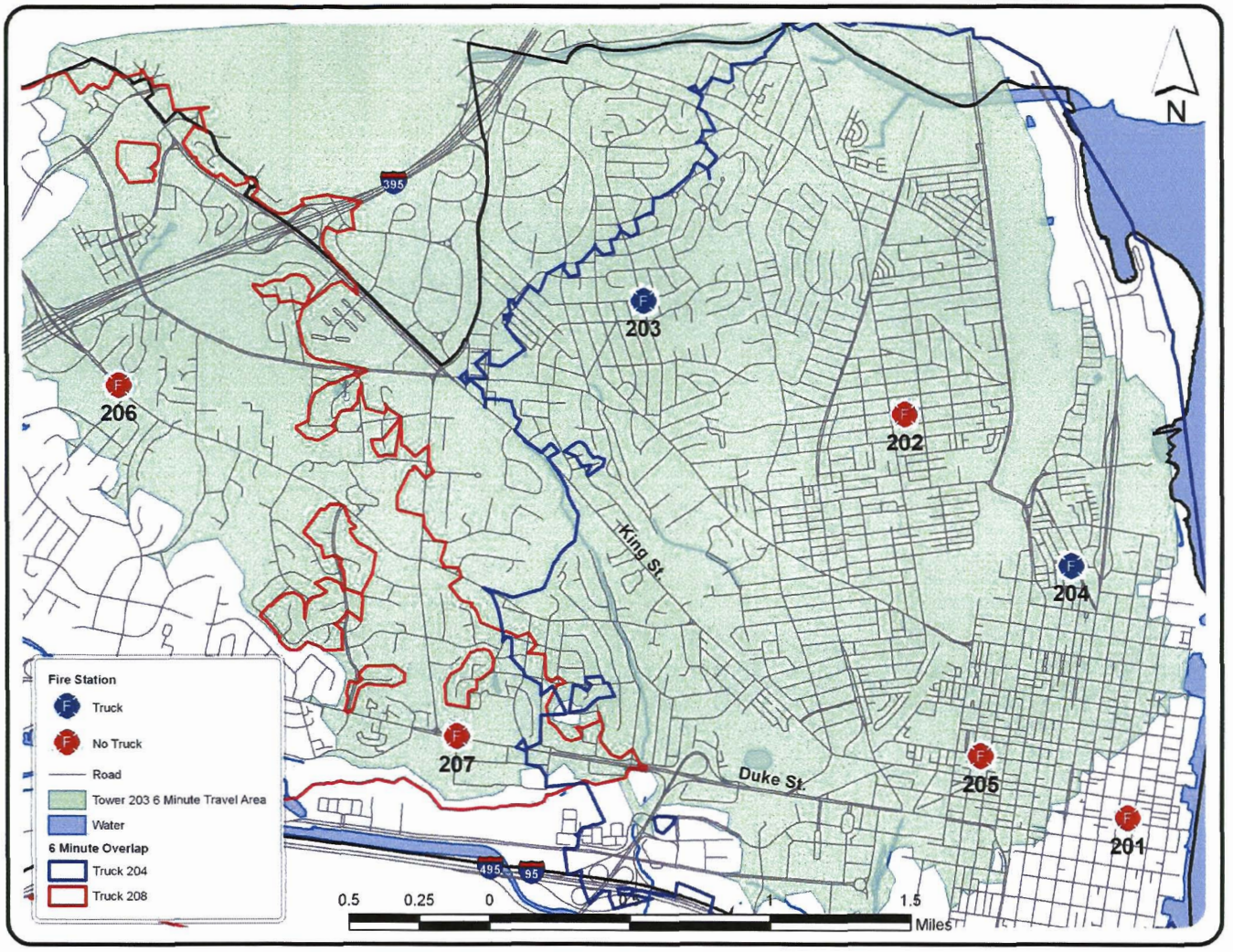
12: 6-Minute Coverage Area Medic 207



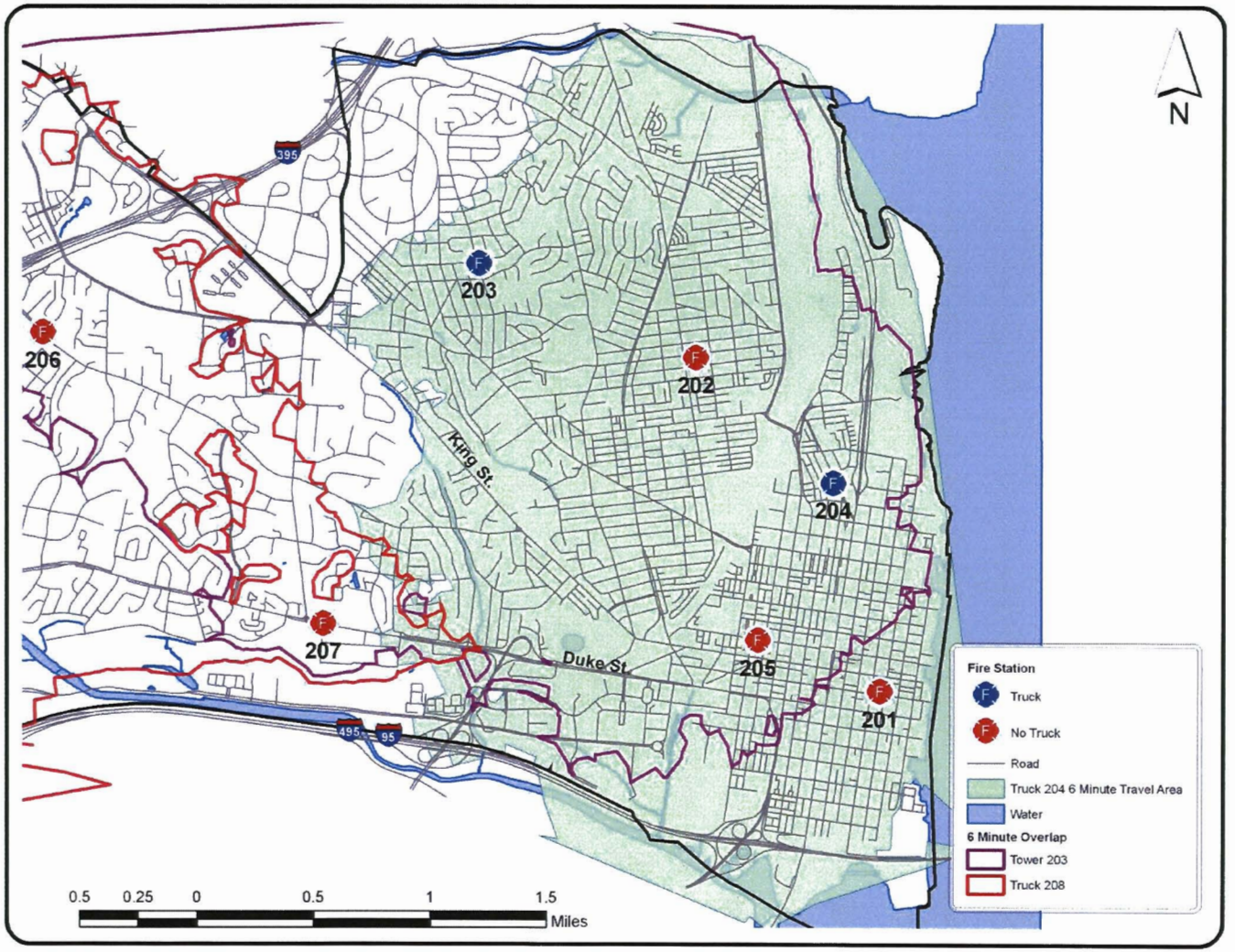
13: 6-Minute Coverage Area Medic 208



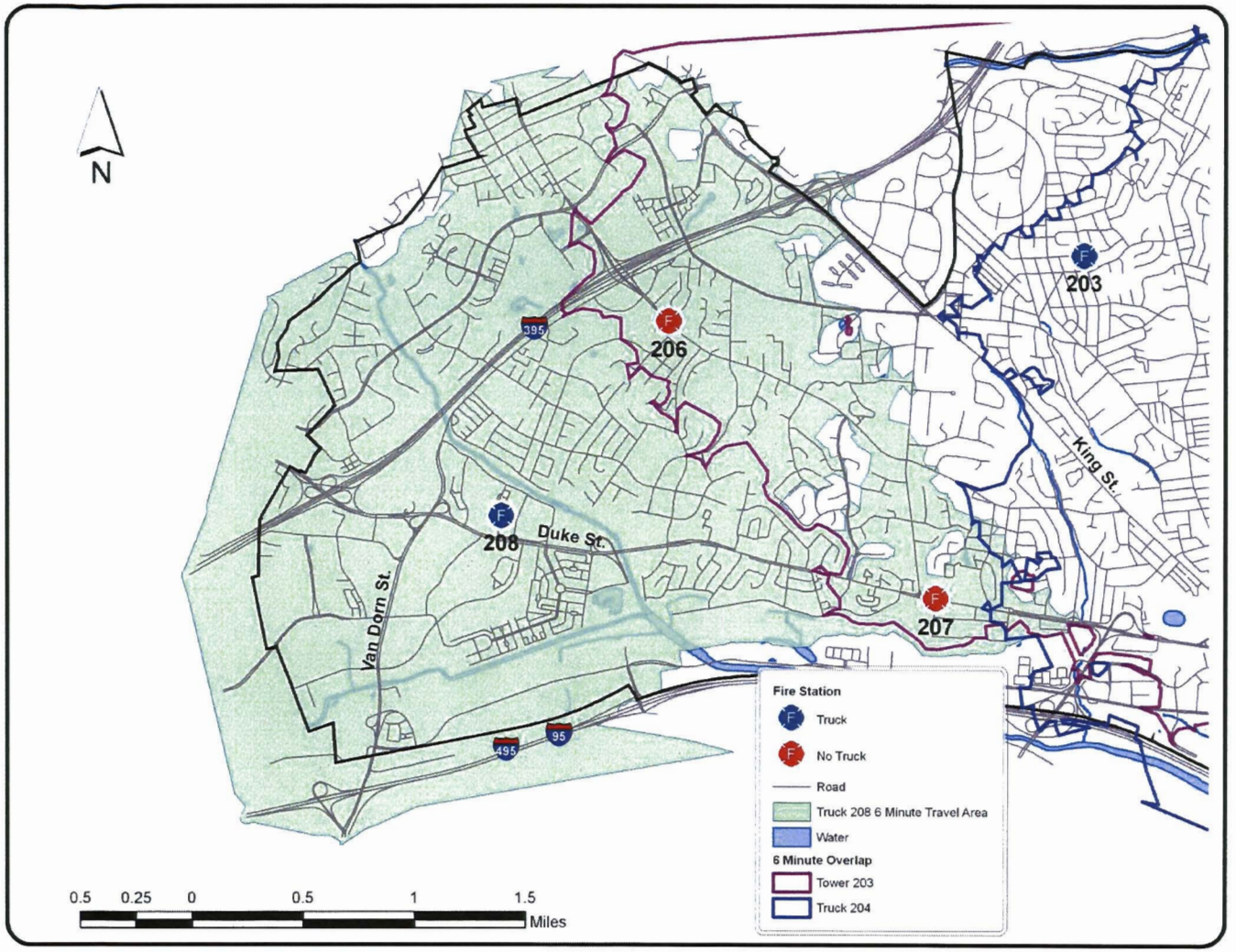
14: 6-Minute Coverage Area Tower 203



15: 6-Minute Coverage Area Truck 204

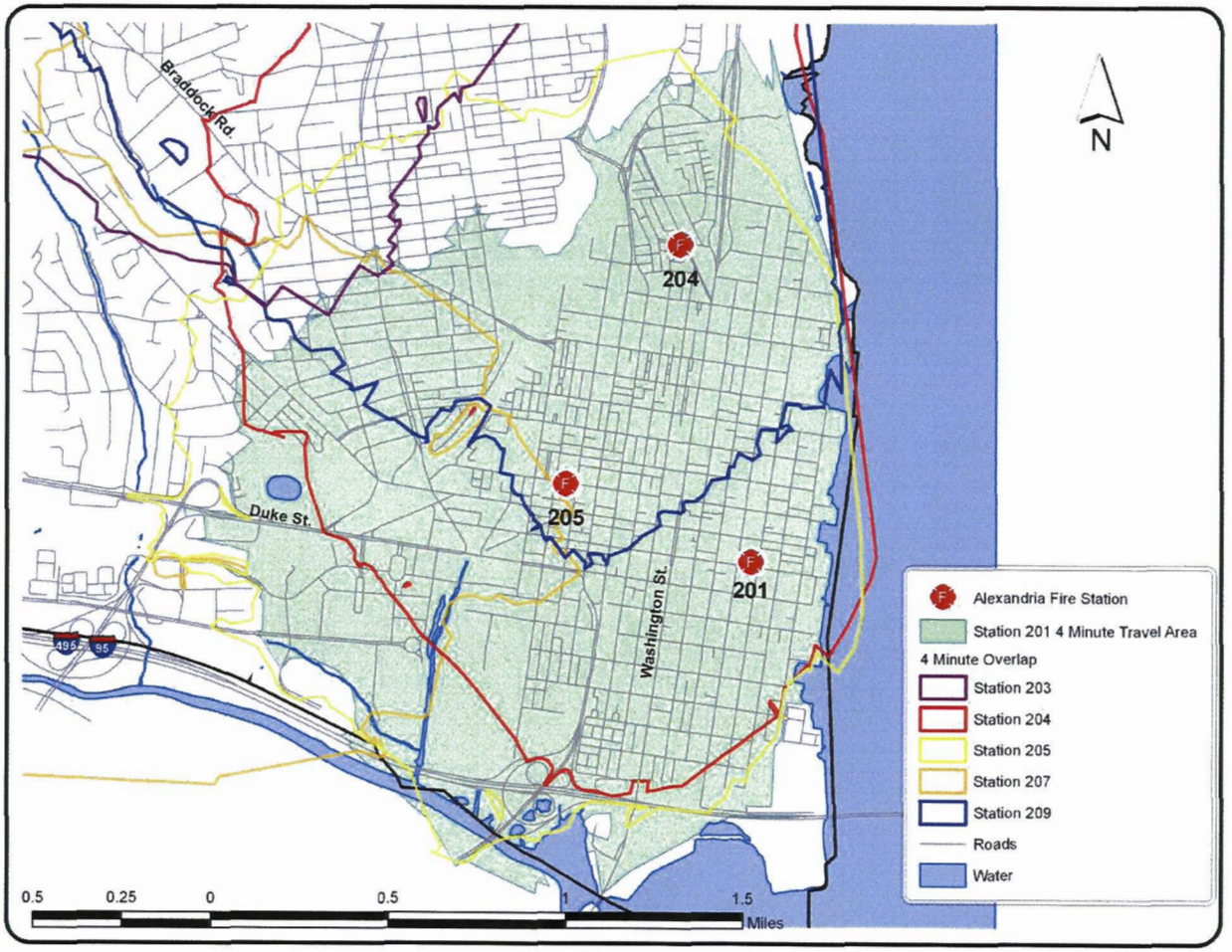


16: 6-Minute Coverage Area Truck 208

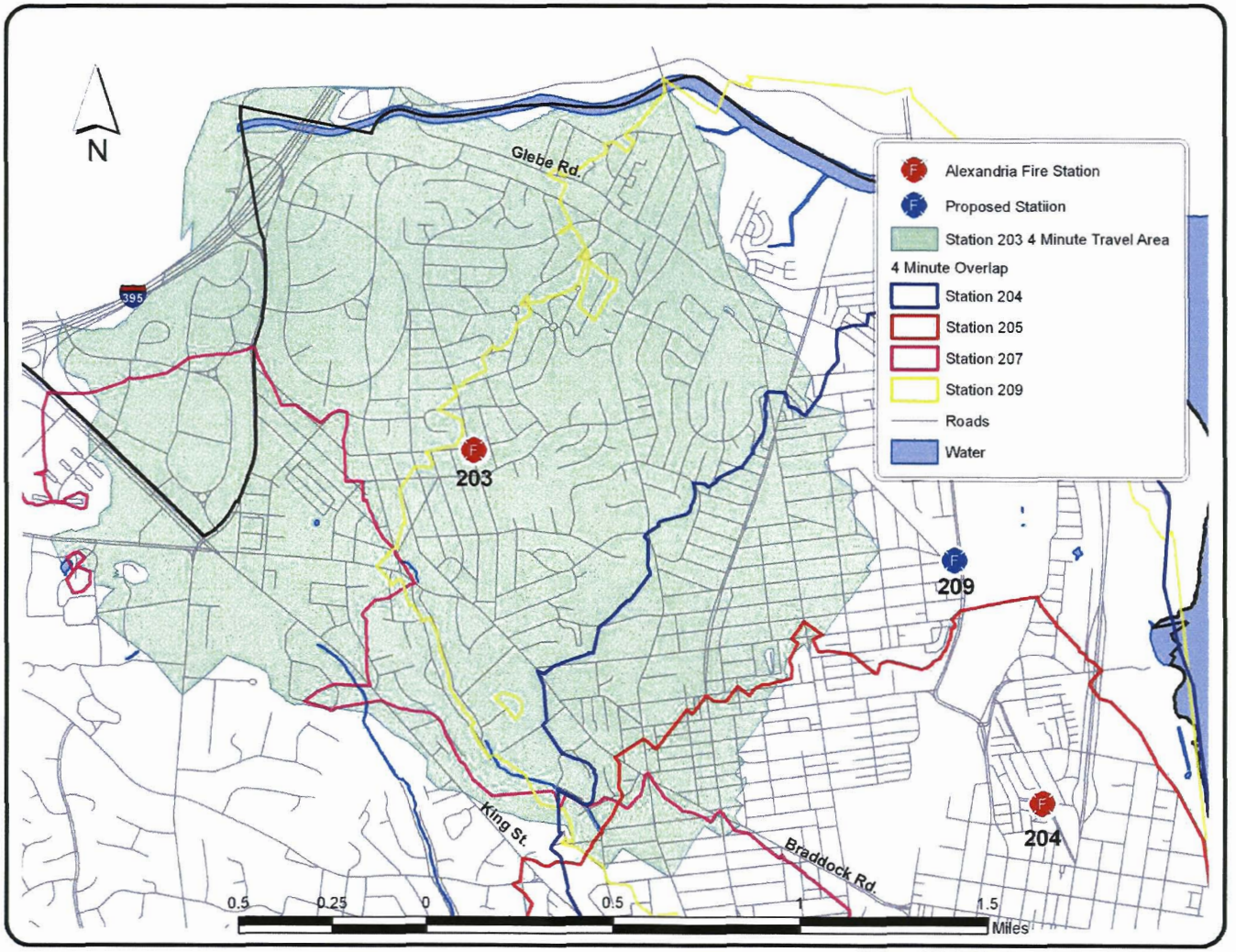


PROPOSED COVERAGE

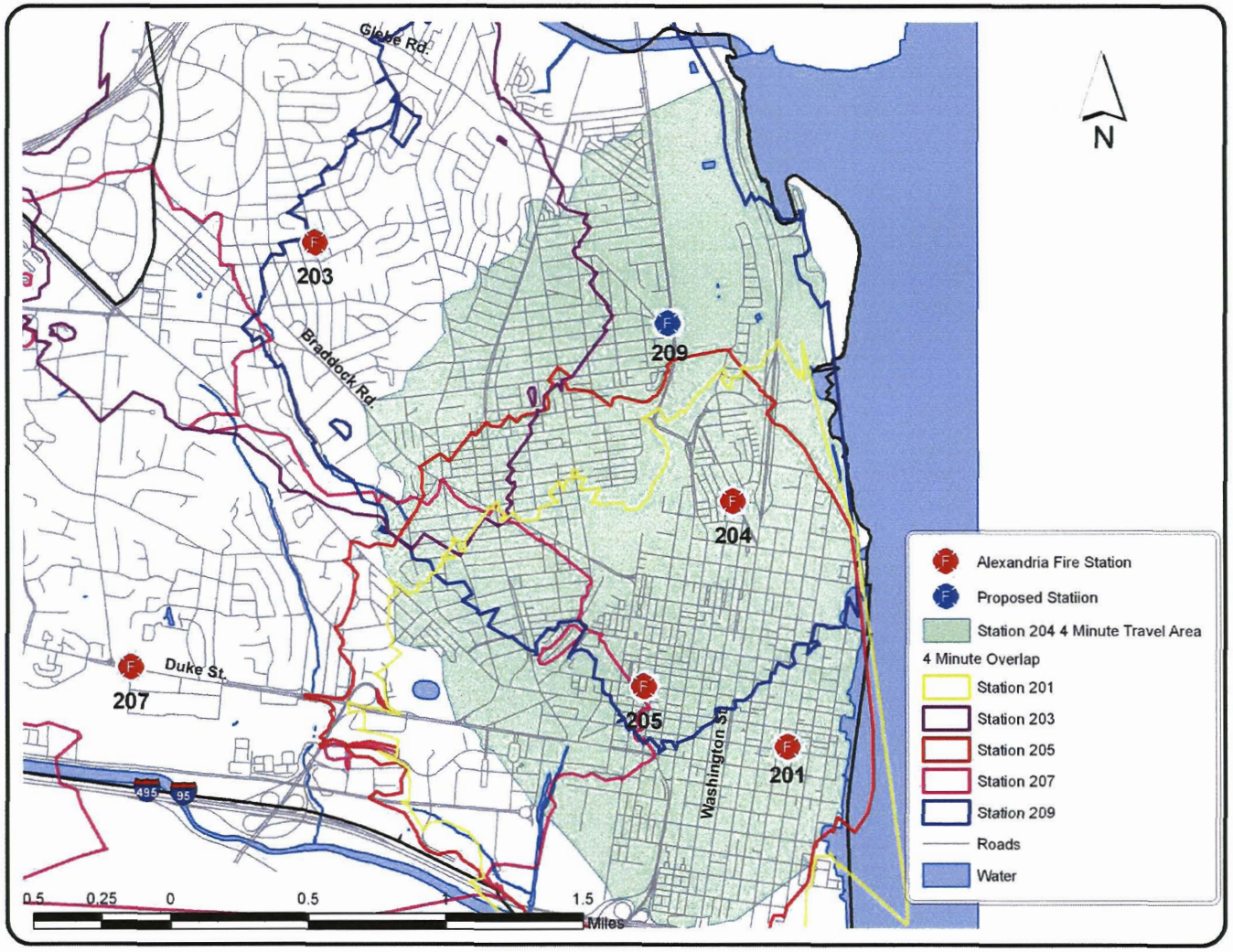
17: Proposed 4-Minute Coverage Area Station 201



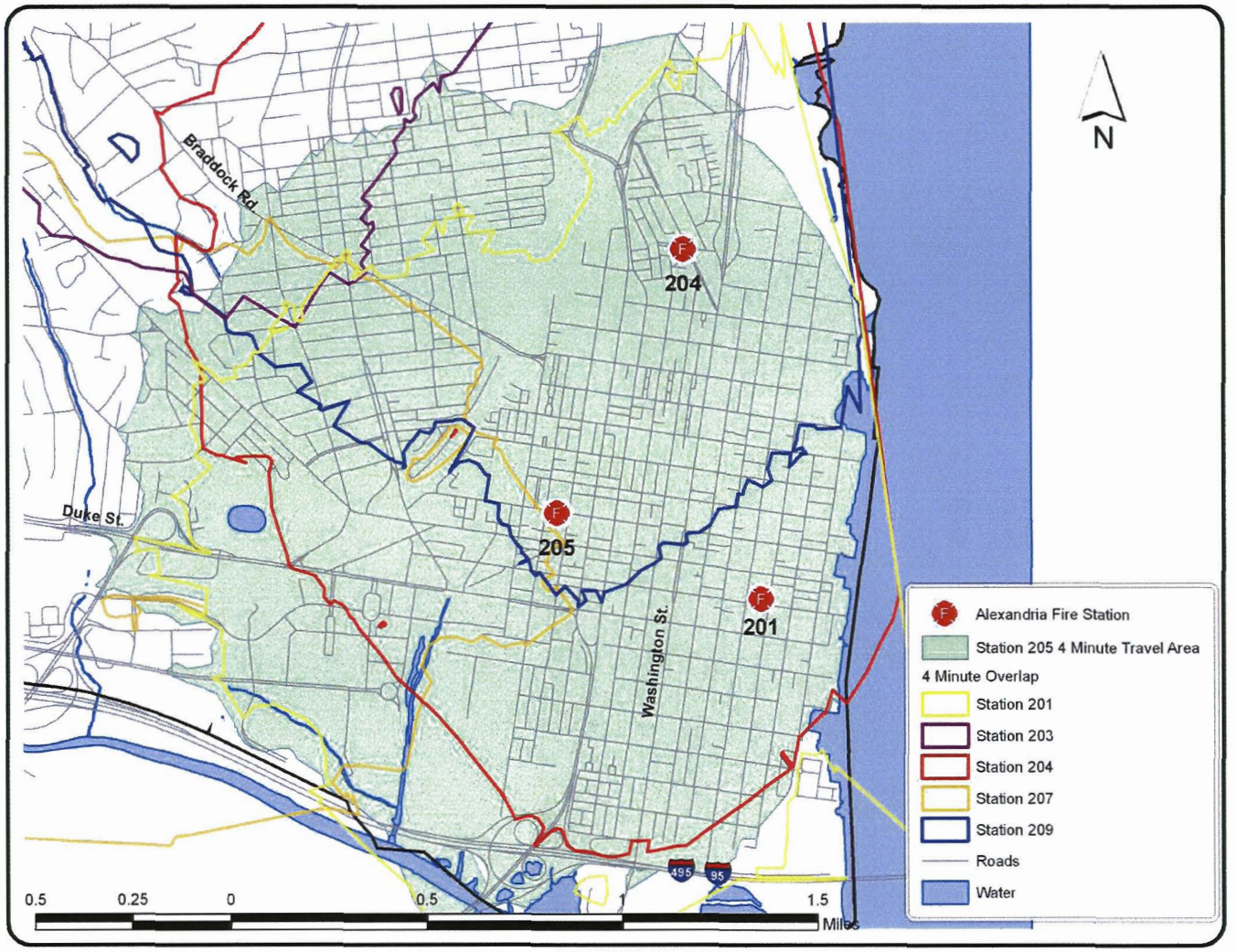
18: Proposed 4-Minute Coverage Area Station 203



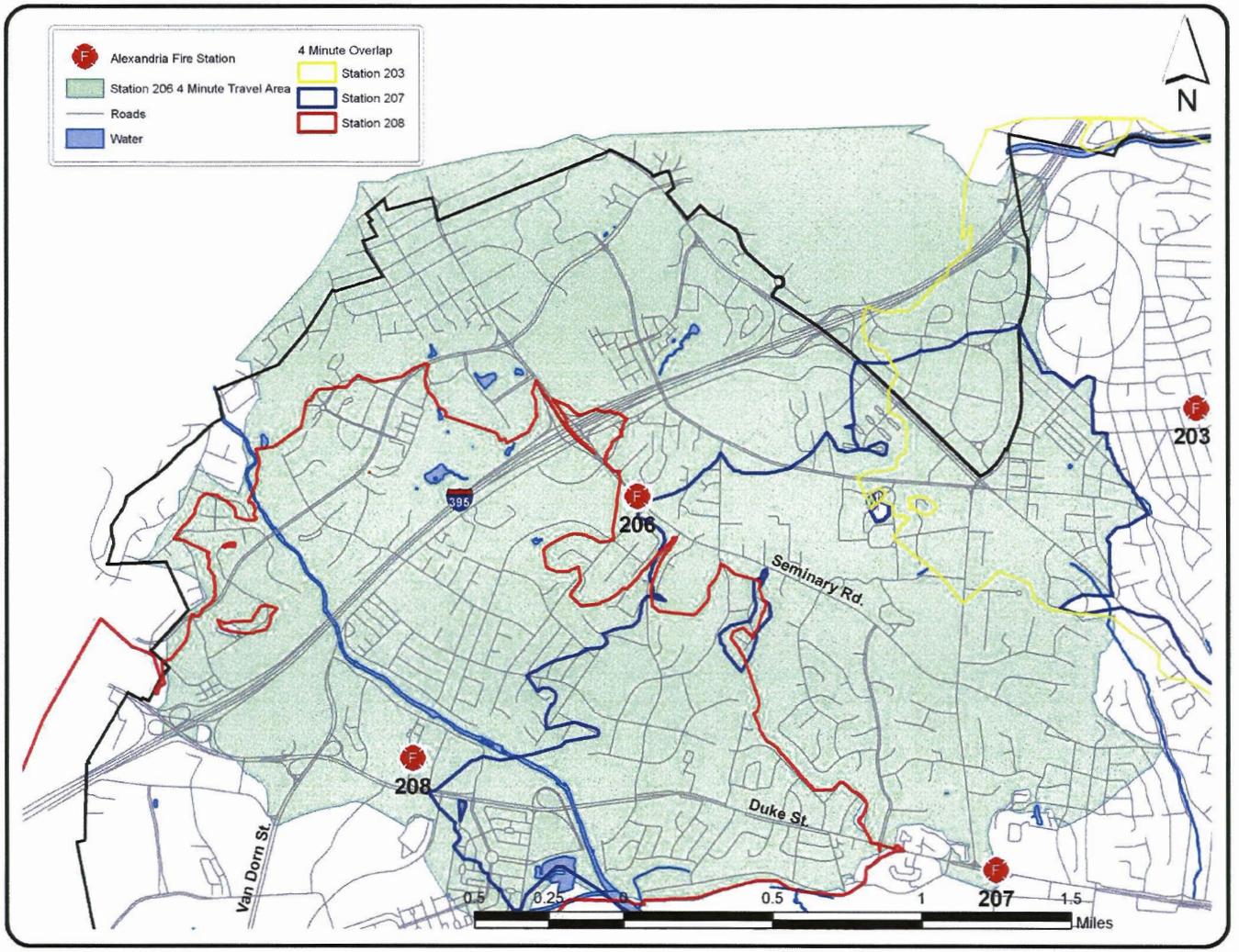
19: Proposed 4-Minute Coverage Area Station 204



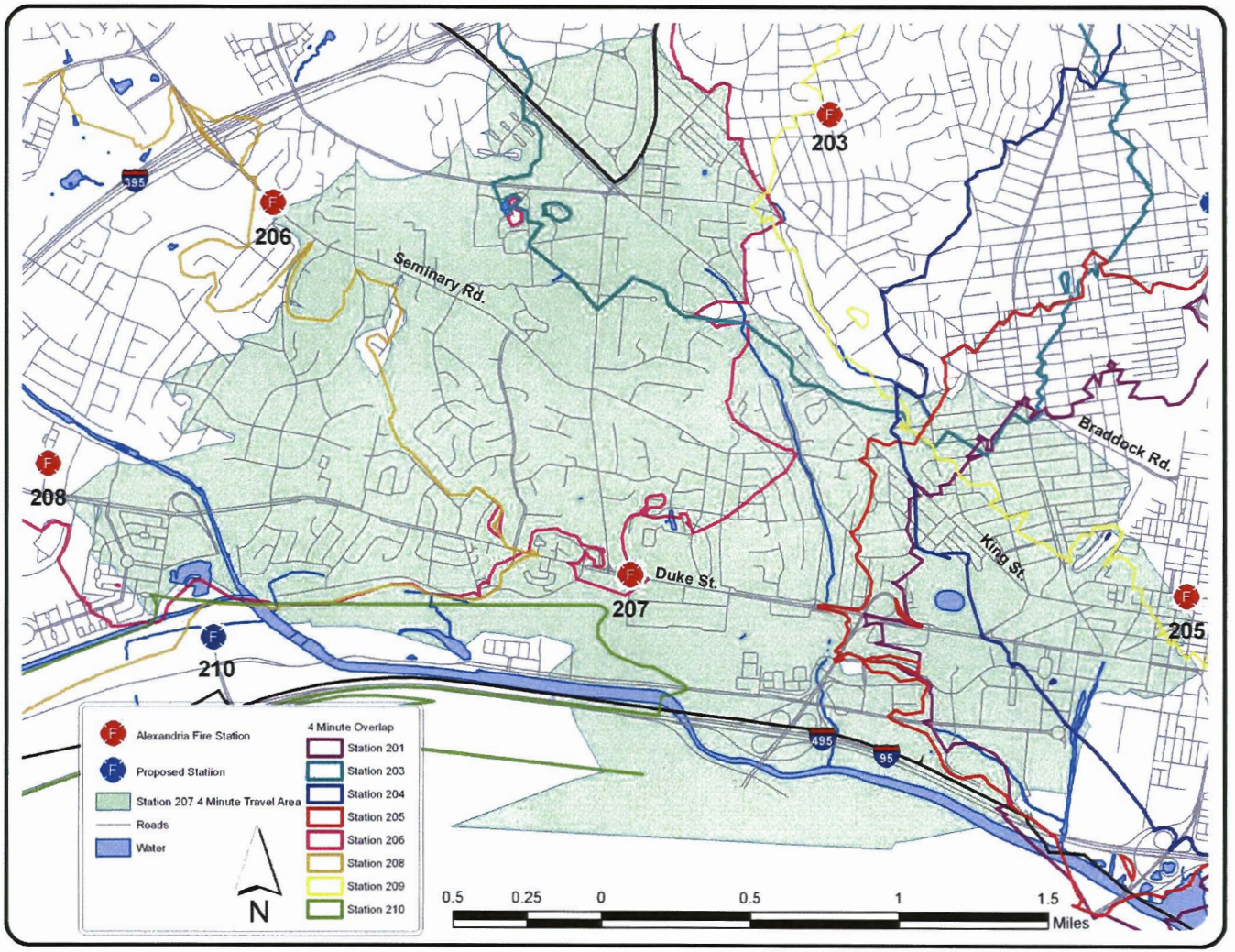
20: Proposed 4-Minute Coverage Area Station 205



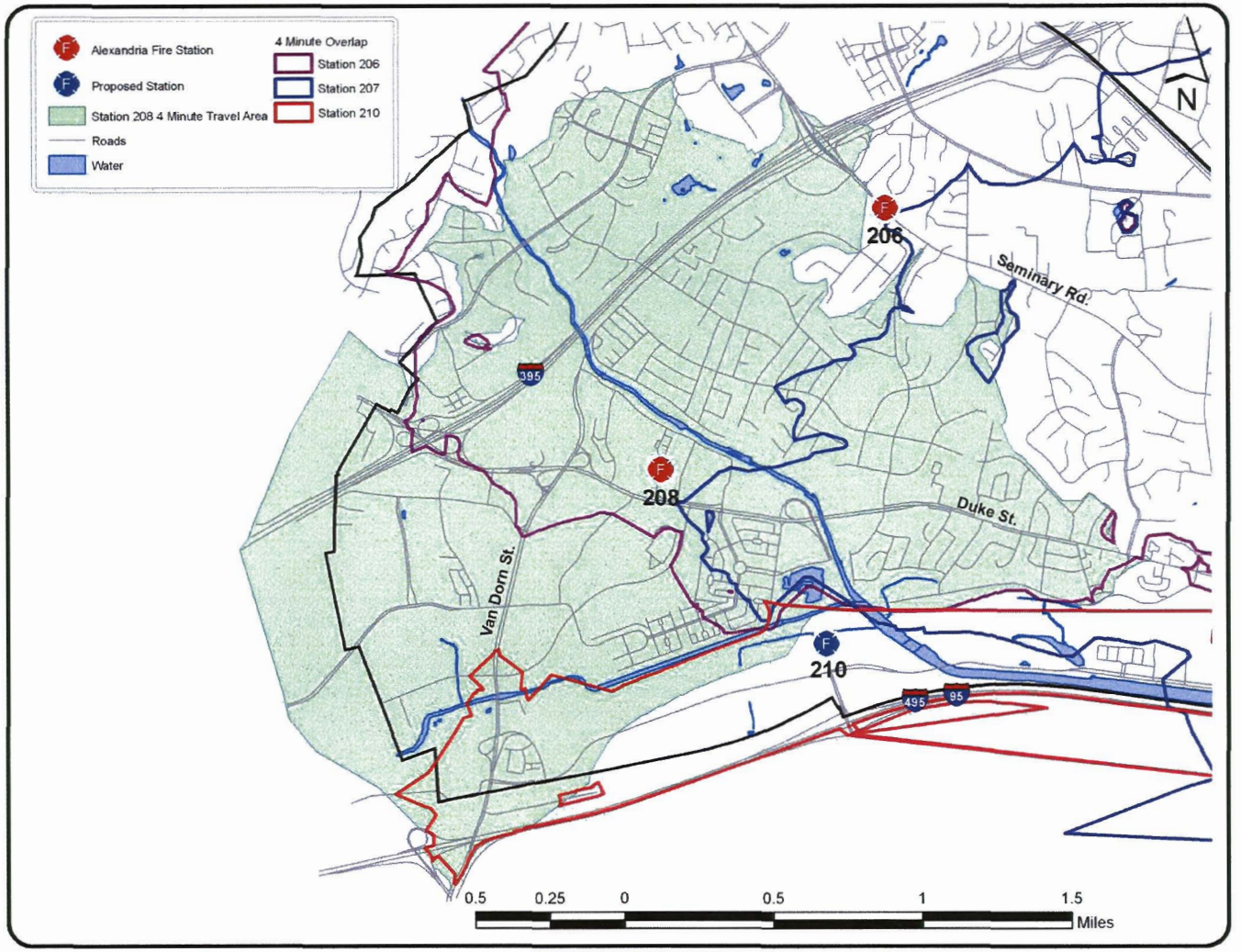
21: Proposed 4-Minute Coverage Area Station 206



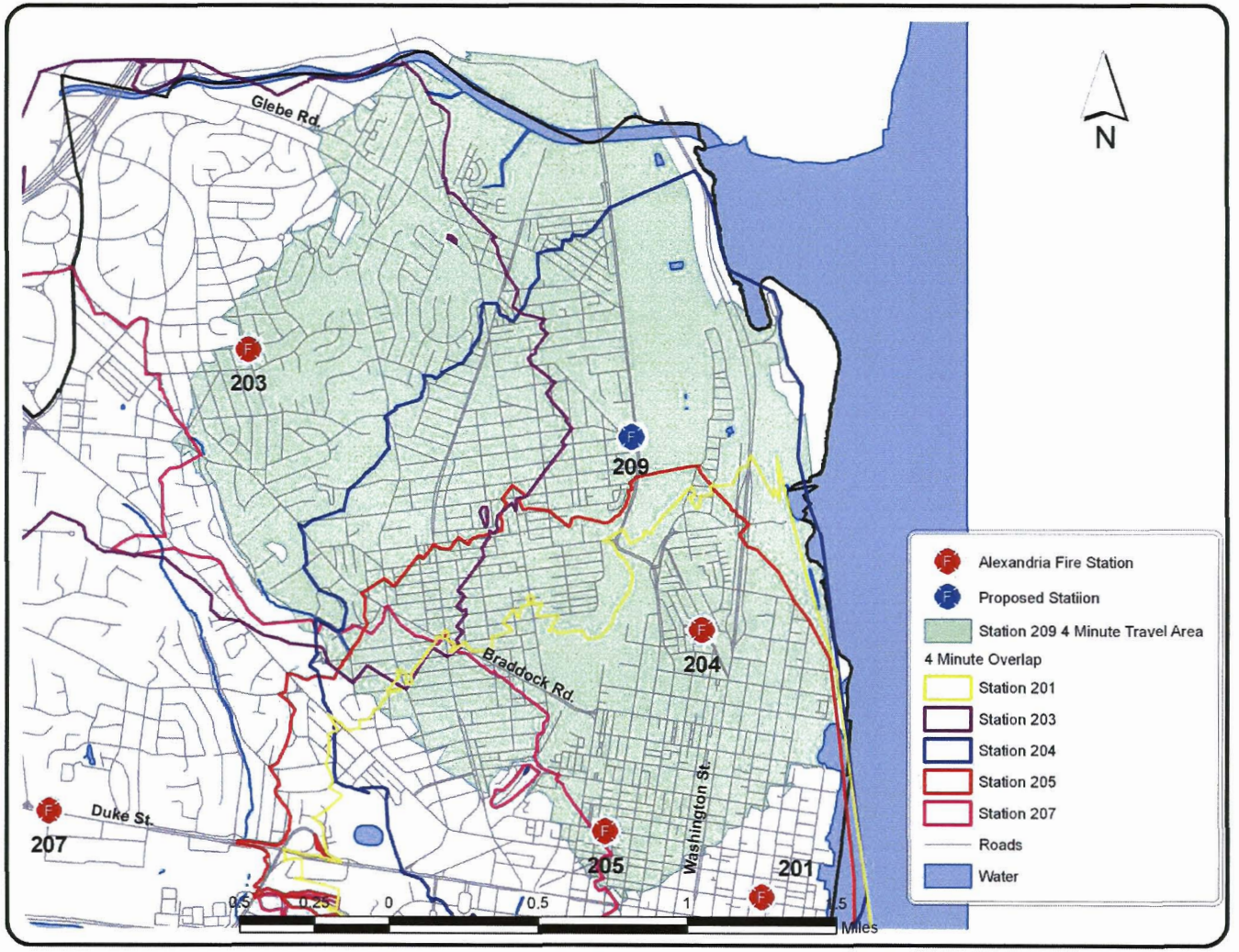
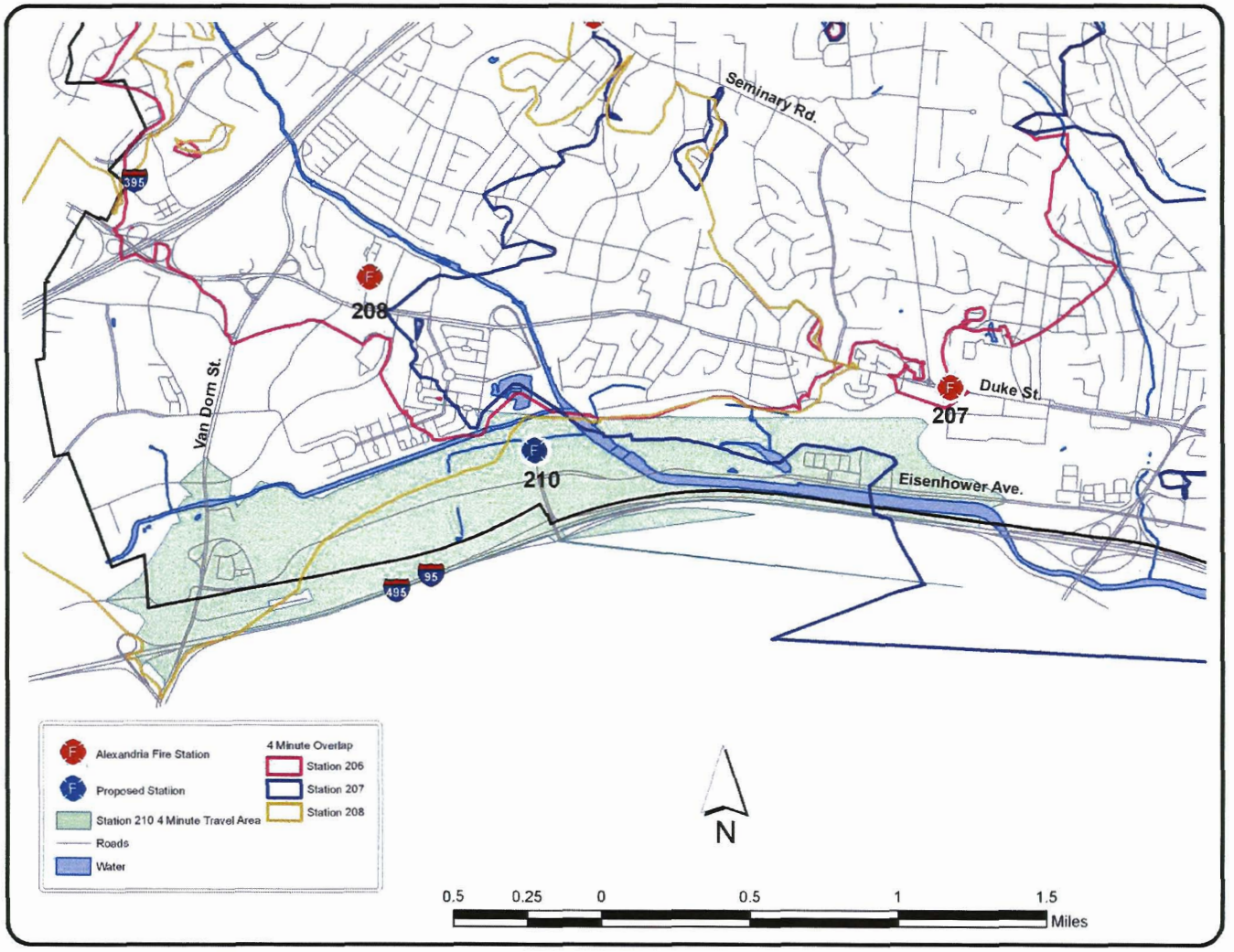
22: Proposed 4-Minute Coverage Area Station 207



23: Proposed 4-Minute Coverage Area Station 208



24: Proposed 4-Minute Coverage Area Station



25: Proposed 4-Minute Coverage Area Station