City of Duluth, Minnesota

COMPREHENSIVE STUDY OF THE DULUTH FIRE DEPARTMENT

FINAL REPORT

March 2012

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Duluth, Minnesota

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Table of Contents

ACKNOWLEDGEMENTS **1**

1. INTRODUCTION **1**

Study Objectives 1
The Study 2
Organization of the Report 2

2. ORGANIZATION AND MANAGEMENT **4**

Organizational Overview 4
Organizational Structure 7
Labor/Management Relations 11
Analysis of Current Organizational Effectiveness and Efficiency 11
Analysis of Administration & Support Services 13
Finance 15
Capital Improvements Program 15
Analysis of the Training Bureau 16
Analysis of Fire Prevention (Life Safety Division) 17
Analysis of Emergency Management/Planning 18

3. POPULATION, RISK, AND DEMAND **20**

Planning Areas 20
Citywide Population Growth and Development 21
Demand Analysis 22
Fire Risk Analysis 28

4. FIRE STATION LOCATION AND RESPONSE TIME ANALYSES **32**

Response Times 32
Workload Analysis 38
Review of Current Fire Station Locations 42
Evaluation of Possible Fire Station Location Changes 43

5. FIRE AND EMS OPERATIONS **49**

Overview of Current System 49
Staffing and Overtime Analysis 54
Apparatus Types and Deployment Conclusions 55
Fire/Rescue Operations 55
Emergency Medical Services 56

6. BENCHMARKING AND INTERJURISDICTIONAL COMPARISONS 60
Interjurisdictional Comparisons 60
Population 60
Stations and Equipment 62
Cost Per Capita 63
Demand for Service 65
Staffing 65
Conclusions 66
7. CONCLUSIONS AND RECOMMENDATIONS 67
Key Recommendations and Options to Improve Service Delivery 67
Key Recommendations and Components to Improve Organization and Management 70
Master Plan 71
Prioritizing Key Issues 72
APPENDIX A: PERFORMANCE MEASUREMENT 76
APPENDIX B: EVALUATING UNIT WORKLOADS 79
APPENDIX C: APPARATUS CIP CRITERIA 82

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While TriData received excellent input and cooperation from the city, the evaluation and recommendations reflected in this report are those of our project team. The principal members of the team and their areas of responsibility are shown below; however, this was a team effort and views were sought from multiple team members on virtually every subject area.

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1. INTRODUCTION

The City of Duluth Fire Department (DFD) requested the assistance of an outside firm to provide a comprehensive analysis of fire and emergency medical service delivery. The purpose of this analysis is to seek improved service delivery while maintaining acceptable levels of service to the community. To perform the evaluation, the city selected TriData, a division of System Planning Corporation.

TriData is a nationally recognized consulting firm that has undertaken over 200 studies of this type, including studies for Saint Paul, Boulder, Portland, OR, Palo Alto, 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.

Study Objectives

The overall goal of the study was to assess the efficiency and effectiveness of the Duluth Fire Department so that the City will be better able to develop a sound vision for the fire services in the future and develop a plan for achieving that vision. In particular, the city is seeking answers to the following questions:

1. For a fire department of this size and make-up, what is the appropriate and most effective management structure and functional responsibilities of each management level?
2. How can fire personnel best be utilized given the current and future demand for fire department services and available resources?
3. Within the fiscal constraints of existing budgets, what is the appropriate staffing for each functional area of the department? What if only operational issues are considered?
4. Evaluate the current EMS program of Duluth Fire and recommend changes that can be made to improve efficiency and services. In addition, evaluate the feasibility of the fire department becoming an advance life support transport department. Will the expected revenues offset the cost of the program? Will this result in improved, more cost effective patient care for the citizens of Duluth?
5. Evaluate the effectiveness of the current fire district and fire station location based on response data and other relevant metrics compared with national norms. What changes in the district or station relocation/consolidation/additions should be considered to become more efficient and meet the future response needs of the community?

6. Evaluate the effectiveness of the fire training program. Make recommendations for improvements where needed.

The Study

The City of Duluth engaged the services of TriData to analyze current Fire Department structure, management, and operations and prepare a detailed report with recommendations to the Fire Chief. The study incorporated the following tasks and activities into the work plan:

1. Interviewed various staff and officials designated by the City, Including the Mayor, Chief Administrative Officer, Fire Chief, Deputy Fire Chief, Assistant Chief's, Training Chief, Fire Marshal, representatives of the Fire Union, Budget Analyst responsible for the fire budget, and rank and file fire fighters as needed.
2. Reviewed adopted budgets, business plans, and applicable organizational charts.
3. Presented the draft findings that address key questions above to the Fire Chief..
4. Delivered final report and presented findings as requested by the city.

Organization of the Report

The remainder of the report is organized as follows:

Chapter 2. Organization and Management – This chapter discusses the overall management and organization of the Duluth Fire Department. It includes discussions about the organizational structure and mission, emergency management/planning, fire prevention, training, maintenance, internal and external communications, organizational culture, labor and management relations, and finances. It also discusses the human resource areas of hiring, promotion, performance appraisal, grievances, and discipline. This review is critical to understanding the situation that is occurring internally and for developing a plan to address the organization's future.

Chapter 3. Population, Risk, and Demand – This chapter includes analysis of the risks and trends in demand currently experienced by the City of Duluth and what the city can expect in the future. Specifically, we review the major factors that drive emergency service needs: population growth, risk and demand. The assessment of risk and demand is critical to not only the determination of the number and placement of resources, but also to the mitigation measures that may be available to the fire department.

Chapter 4. Fire Station Location and Response Time Analyses – The major steps for a deployment analysis include a risk assessment (discussed in the previous chapter), working with the public and local government officials to determine response time goals for the community as a whole or by individual planning areas, and measuring current and potential performance against selected goals. The Center for Public Safety Excellence (CPSE) publishes

an excellent reference that can be used by communities to understand the process and determine the choices available to them. Generally referred to as a "standard of cover" analysis, we used the CPSE methodology in the analysis of response time.

Deployment decisions concerning fire station and apparatus locations should be an iterative process largely based on continual or periodic performance measurement. Because the needs of Duluth do change, the recommendations made by this analysis should be considered as a step in a continuing process. Going forward, the fire department needs to be regularly conducting neighborhood-level performance measurement for the process to be effective.

Chapter 5. Fire and EMS Operations – This chapter discusses the current operational profile of the DFD including the different operational policies used by the department. Operational profile is the set of independent operations the DFD performs to deliver fire, rescue, and EMS services.

To provide effective service, fire departments should have an operational profile that permits them to provide a good level of service consistent with the demands of the community. Sometimes the decision about the type of operating profile to use is consistent with the demand and sometimes, as is the case with many communities, it is not. In these cases, the decision about what type of operating profile is best for the community is not made by a rational decision making process, but rather, is the result of incremental policymaking or is based on tradition.

Chapter 6. Benchmarking and Interjurisdictional Comparisons – In choosing cities for comparison, we considered population size, density, services offered (especially whether there is EMS and EMS transport), climate, socioeconomic factors (age, poverty levels, ethnic groups), number of operations staff on duty per 1000 population; and the average work week of firefighters. We also considered whether fire incidence and fire losses were comparable. We included Minnesota area communities and communities elsewhere including other Midwest cities. We show how Duluth Fire Department ranks among the set of comparison cities and against the means.

Chapter 7. Conclusions and Recommendations – Duluth Fire Department is a well-run operation, but there are many opportunities for improvement. This chapter will present recommendations for improving the effectiveness and efficiency of the department based upon the information and observations from the past four chapters of this report. Finally a strategic plan will be presented to map a course for the future of the department and provide city leadership with a roadmap for the next 10 years.

2. ORGANIZATION AND MANAGEMENT

This chapter discusses the overall organization and management of the Duluth Fire Department. It includes discussions about the organizational structure and mission, emergency management/planning, fire prevention, training, apparatus maintenance, internal and external communications, organizational culture, labor and management relations, and finances. It also discusses the existing reporting mechanisms, support services, and communications in the Duluth Fire Department (DFD). It discusses the interaction with other City departments/agencies and their shared service. This review is critical to understanding the situation that is occurring internally and for developing a plan to address the organization's future.

Organizational Overview

As of July 2011 there were a total of 141 full time employees in the DFD organized in three divisions; Administrative, Operations, and Life Safety. The divisions provide services from nine functional areas: Department Administration, Emergency Management and Preparedness, Fire Suppression and Rescue, Emergency Medical Services, Training, Fire Prevention, Arson and Fire Investigation, Housing and Rental Licensing, and Nuisance Abatement. Services are provided through three 24-hour shifts. Nine stations are staffed with a department total of 13 fire companies.

The DFD is a medium-sized, all-career fire department that provides all-risk emergency services, including a very active EMS component. The goals of its mission statement are to safeguard Duluth through progressive fire prevention principles and responding to emergencies. Their emphasis on prevention first is commendable, and demonstrates a progressive, forward looking approach toward doing business and providing emergency service for the safety of its citizenry.

As with most departments, the fire chief is an appointed position, which usually takes the form of either being hired from within the ranks or bringing in a chief from the outside. The current fire chief was hired internally, and has a long tenure as both firefighter and chief in the organization.

The DFD has a traditional organizational structure for a department its size and for the city it protects. It effectively meets the intent of its mission statement through an aggressive fire prevention program, which is integrated into its emergency response. The department has three major divisions, and within those divisions, are two primary sub-divisions, which comprise the operational structure and prevention structure of the department. The Life Safety Division is further subdivided into three components that include fire prevention, housing inspection and solid waste compliance. This division also is in the process of adding a police officer to be assigned to the unit which is a unique component of the organizational structure (more on this in

the Fire Prevention section). The department has a staff of 141 full-time equivalent (FTE) personnel.

Authorized FTE personnel for the DFD, including are shown in Table 1.

Table 1: DFD Authorized Positions, 2011

Position	Authorized Personnel
Fire Chief	1
Deputy Chief	1
Fire Marshal	1
Assistant Chief	3
Training Chief	1
Deputy Fire Marshal	2
Solid Waste Compliance Officer	1
Housing Inspector	4
Lead Housing Inspector	1
Administrative Support Clerical	3
Fire Captain	36
Engineer	39
Firefighter	48
Total Full Time	**141**

The Fire Chief (FC) and Deputy Chief (DC) describe themselves as supervisors not managers and consider themselves to be the primary supervisors for 141 personnel. There are two additional perfunctory administrative positions which perform management duties in the form of a Training Chief (TC) and a Fire Marshal.

The lack of a clearly delineated supervisory distinction extends to the rank of Assistant Chief (see the operations section in this chapter), and down to the rank of Captain in the DFD. Captains in this system are considered “lead firefighters”, and although they sit in the front seat of the cab, direct firefighters on fire scenes, are incident commanders until an AC arrives on scene, etc., personnel are adamant in their assertion that under the collective bargaining agreement they are not first line supervisors. This is especially emphasized when it comes to disciplinary functions. They too are careful not cross the line between the definition of what a supervisor is and does versus the union contract.

For the DFD, from an administrative standpoint this also creates a span of control issue. Essentially there are only two management level positions that must handle all personnel issues form the top of the organization to the bottom. These duties are in addition to the other administrative tasks required to run a good-sized fire department. Both the fire chief and the deputy chief have a number of associated responsibilities, which are incumbent to their jobs that further create inefficiencies in the running of the department because of the large span of control.

While they administer these duties as well as they can, given the level of their workload, there is a gap that is created in their effectiveness on several levels. The Training Chief must by proxy fill many of these administrative gaps by taking on accompanying duties outside of training requirements for the department, which further puts a strain, his span of control.

The office of the Fire Chief is stretched thin. In addition to running the day to day fire department administrative and operational aspects of the department the Fire Chief's time is divided between grant preparations; ensuring that the demanding state training requirements are met; grant administration once the grants are secured; meetings with Regional Dispatch, city hall; 9-1-1 issues; union concerns and negotiations; personnel issues; and being the city's emergency manager. Further exacerbating the problem, during the last three years and until recently the Deputy Chief of Operations was basically reassigned to City Hall by the Office of the Mayor to run and realign the city's Planning and Construction Services Division. Eighty percent of the DCs time was spent on the city administration tasks.

Operations – The Operations Division is responsible for fire and emergency response for the City of Duluth. In this system the front line Assistant Chiefs (AC)/shift commanders are not considered in the organizational structure to be supervisors or managers. They do in practice often act at a supervisory level in disciplinary and management level matters, but even this is performed on an almost ad-hoc basis. From an organizational structure standpoint there is no middle management component built into the organization. This is a curious alignment, which we rarely see in a city and organization of this size and complexity, except in jurisdictions north of the border in Canada. Part of this mindset, that appears to be quite standard for the department as a whole in the way they view themselves, is predicated on the fact that every position from the DC down is unionized. This middle management/supervisory function is usually relegated to assistant chiefs in the traditional hierarchy of fire departments. In most cases the ACs in the DFD fill this role, but they do so discretionally within the confines of drawing a line between management and union functions and loyalties. They are then able to be selective as to when they will exercise their management roles or not cross union boundaries.

Life Safety – The Life Safety Division is a newly formed division, which combines the Fire Prevention Division, housing inspection program, and nuisance property oversight. The Fire Marshal (FM), who is equal in rank to an Assistant Chief in department hierarchy, manages the division. This position unlike the Assistant Chief positions in operations clearly delineates the managerial role in this division. The structure of the hierarchy is clearly defined and the FM's position and duties, by their nature, are that of a manager with all of the decision-making powers and oversight commensurate with the position. This carries over on a number of levels in the division from the supervision and management of personnel in the unit, to the Authority Having Jurisdiction (AHJ) role and to the review and signing off of new building plans, construction codes, compliance of fire prevention codes and content of public education initiatives. Also

unlike the operations division the FM appears to have an ownership and mindset of a middle manager in the running of the Fire Prevention Division.

Organizational Structure

DFD organizational structure is classic of many fire departments in the U.S. with departmental administration under the Fire Chief and Deputy Chief. However the separation of the organization into operations division and life safety division is somewhat unique. Though operations is a standard division of nearly all fire departments, the life safety division is a unique designation for DFD and accurately describes the combination of fire prevention and housing inspection services provided by the division. Training is also a part of the operations division equivalent to the level of assistant chief. There are 3 shifts of 42 personnel staffing 13 apparatus and a staffing pool of 6 firefighters. The DFD organizational chart is depicted below:

Figure 1: Duluth Fire Department Organizational Chart

Organizational Culture – Culture refers to the values, beliefs, and traditions shared by all members of the organization. Culture has a profound impact on organizational performance as it guides everyday practices and behaviors, which may or may not be in harmony with the stated vision and core values of an organization.

In the fire service, understanding and managing an organization's culture is key to promoting and reinforcing positive team behaviors, and addressing obstacles to individual fulfillment and performance. It is therefore important to talk about the organizational culture in

the DFD, because it directly and indirectly affects much of what is wrong with aspects of the department, as well as aspects of what is right with it.

This is by and large a traditionally run department whose operations and response procedures are greatly determined by the city's geography, weather and terrain. So many aspects of the department's operational and therefore organizational and procedural mindset are in place because of these factors. The terrain is almost precipitously hilly in some areas of the city and geographically Duluth covers an elongated response area, which is particularly challenging for emergency response. Consequently much of the staffing philosophy and strategy for DFD revolves around these unique factors and creates some quite unique staffing configurations.

Another overriding organizational culture feature of this department is union involvement and influence in the department. It permeates and is blended into the very fabric of this organization. It affects the management and supervisory structure of the department in very fundamental ways. During our site visit interviews, it was apparent from the feedback we received across the board that there is a perceived air of little separation between the mid-management (AC), supervisory (Captains) and firefighter levels. As previously stated it even affects upper management's view of itself as "supervisory" as opposed to administrative/management. This lack of separation is in our view creates a functional stalemate. While the organizational system within the DFD is functional it lacks a clear hierarchy or a commitment to it conceptually for fear of making it an official position and therefore contrary to the union's official posture. It definitely fosters a cloudy chain of command disciplinary atmosphere, because of the lack of accountability in a loose, undefined captain/supervisory structure. When disciplinary issues arise they almost always ascend to the DC or FC level, and this is in many cases probably unnecessary and certainly inefficient.

This mindset does not coincide with Volume 1, 103.01, C of the Duluth Fire Department Administrative Policies, Procedures, Guidelines which states:

1. The Fire Suppression function is commanded by three Fire Assistant Chiefs (251), each one having the functional title of Shift Commander. *Each Shift Commander is in charge of one of the three Fire Suppression shifts. The Shift Commanders directly supervise the Company Commanders assigned to their particular platoon.* In addition, each Shift Commander is charged with one or more *administrative* assignments. [Italics added]
2. Each shift is composed of a number of fire companies. *The Fire Captains who serve as Company Commanders are the direct supervisors of the personnel assigned to the fire companies.* [Italics added]

Nor does the stated mindset coincide with Civil Service Commission's Job Description Database. All of the duties, purposes and functions of the AC position clearly differentiate between the level of supervision and management and their duties include disciplinary functions

at a management decision-making level. Equally captain's duties and purpose as described in the document lay out a definitive supervisory role.[1]

How these positions are perceived seems to be more based on the Class, Union and Pay Range classification then the actual job description. To change these perceptions from an organizational culture standpoint it seems would be a sea change. It would also probably require that the City of Duluth to change in particular its "Union" classification of these positions, which are listed as "Fire" only with no explanation as to what those duties entail. Are captains Base Unit Employees or higher? Are assistant chiefs supervisory? The lines of fire department hierarchy are usually very clear and usually of a paramilitary nature. This does not seem to be the organizational culture case in the DFD.

Internal Communications – Internal communications, the system by which organizations give and receive information and feedback, is a cornerstone of effective communications and a well run, well functioning fire department. The best labor-management relationships combine collaborative relationships and communication mechanisms that are inclusive in their decision-making process. They are respect-motivated and driven. This includes formal and informal communications. In general internal communication within DFD is good. The union membership and both the Deputy Chief and Chief clearly involve Local 101 in department policy issues especially with regard to safety issues, EMS and apparatus selection input. There are however some pockets of concern.

The flow of information within the DFD is structured and formalized. There is a defined mechanism to give and get information. However, there is no mechanism in place for the routine sharing of information from administration to all levels of the department such as a weekly letter from the Chief to all personnel to disseminate pertinent information concerning the good of the order. Developing such a regular communications instrument would benefit the department. In the past when first appointed the Chief made a point to visit stations regularly to address this. He was the first DFD chief to employ this practice to good effect, but as earlier stated, as time went on this has become problematic due to the Chief's expanded duties, work schedule and work related commitments. The Chief now has at his disposal a sophisticated internal closed circuit audio visual network in each of his fire stations that could be a wonderful tool in disseminating information that he should take advantage of. Fire departments such as Portland Fire & Rescue have effectively used this method to great effect.

On an administrative level internal communications work well. The upper management level of the department that encompasses the offices of the chief and the deputy are close knit, and they implement policy uniformly and collaboratively. It should be noted that they often rely

[1] City of Duluth Job Description Database

heavily on the training chief to help with administrative duties and that communication conduit works well also.

External Communications – This describes how well the organization communicates with other entities and the community. DFD has some routine communications with other departments in the City as well as outside agencies. Key among the outside agencies is the 911 PSAP and the Gold Cross Ambulance Service. The local hospitals are also a key stakeholder for DFD. These external communications networks are weak and lack a formalized system of input and feedback essential to maintaining optimum efficiency. A scheduled system of external stakeholder input and feedback should be developed to keep everyone on the same page and working at optimum efficiency. This is especially relevant with regard to Gold Cross. For example, several new procedural EMS changes were put into place for DFD EMTs to implement in the field without conferring with or even communicating the changes to Gold Cross. Gold Cross has been equally uncommunicative with DFD on similar notifications. While these agencies are autonomous, they do work together, on a sometimes daily basis, and communication between the two is generally fair to poor. A formalized scheduled system of interface for instance between the DFD and Gold Cross could greatly improve this issue on a number of levels including training.

Labor/Management Relations

The single most prevalent issue is the tension between labor and management in the City. IAFF and City administration clearly are at odds with each other and most significant issues can only be resolved by arbitration and negotiations are invariably contentious. There is an atmosphere of distrust and clearly poor communications by both labor and management. Continuity is also an issue, as there have been five Chief Administrative Officers (CAO) in two years on the administrative level. However the current CAO has been in his position for close to three years and as a result the continuity issue is beginning to improve.

Departmental staffing and benefits are the largest specific issues and since both are basic job security issues to the sworn staff there is much fear of losing parts of these key workforce issues. Administration on the other hand is forced by income reduction to look at all ways of reducing the City budget. The key to arriving at the best solution lies in positive straightforward discussion and negotiations rather than going to arbitration where it becomes a win all or lose all scenario.

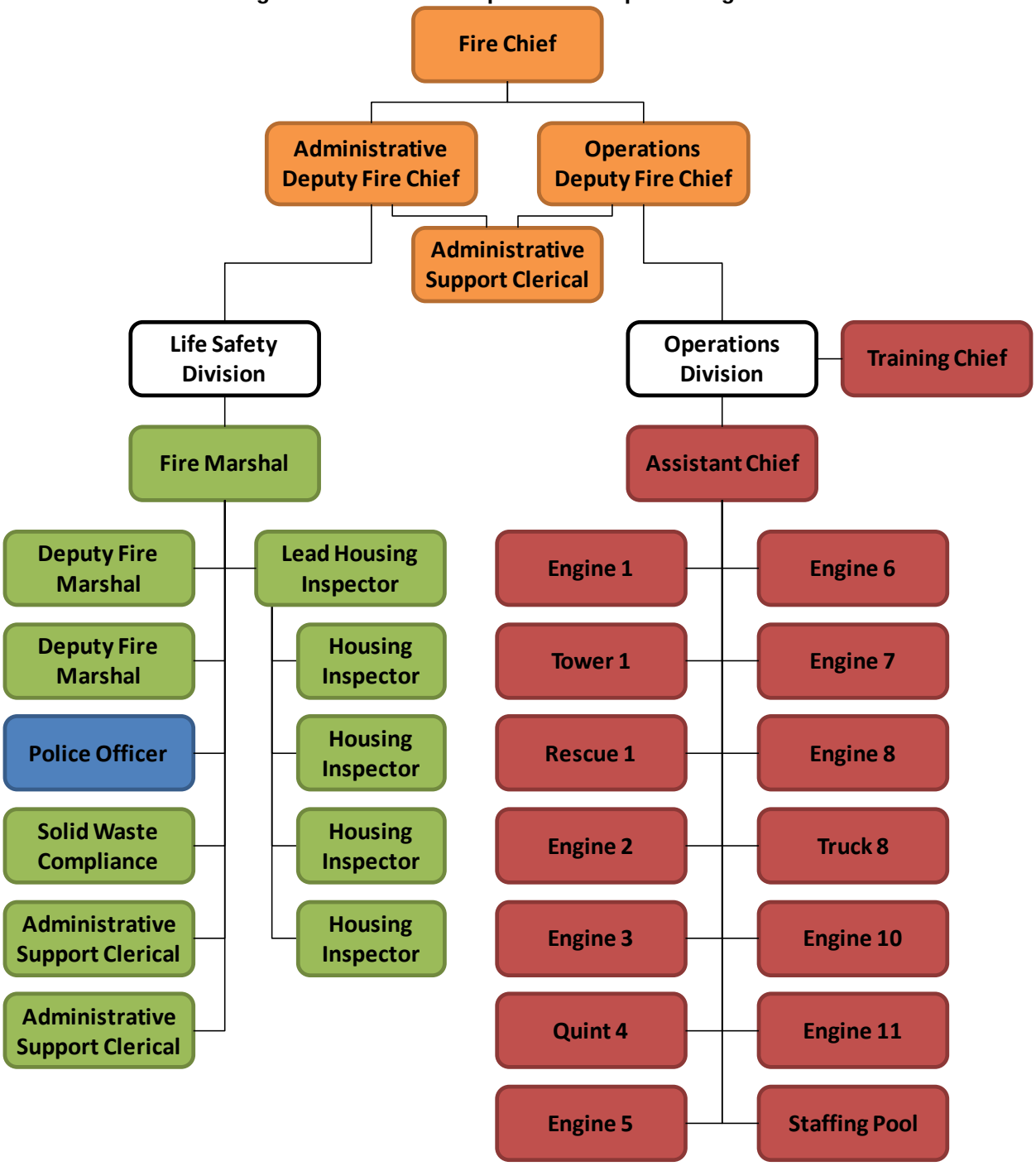
Analysis of Current Organizational Effectiveness and Efficiency

DFD is good department, which fights fires very well and provides excellent BLS EMS services. That said there are areas where DFD can be more effective and efficient. The first area is the need for an additional Deputy Chief. Currently the single Deputy Chief and the Fire Chief have a span of control, which does not allow either to be effective planners. Simply stated both

positions must deal with tasks that should be handled at the Assistant Chief level and the current Assistant Chiefs feel underutilized and want to do more administrative functions. The stumbling block is the fact that the labor contract provides no separation of either the Assistant Chiefs or the Captains from the rest of the shift positions.

There is also the need for an additional Deputy Chief, which would allow the separation of DFD into an Operations Division and an Administration Division. Currently the Fire Chief and the single Deputy Chief are trying to handle all these functions. Also the Training Chief is spending more time doing administrative tasks than supervising the complex issues of departmental training and safety. The bottom line is simply that the current DFD administrative personnel are spread too thin to be effective as chief officers of DFD. The proposed DFD organizational chart is shown below:

Figure 2: Duluth Fire Department Proposed Organizational Chart



Analysis of Administration & Support Services

DFD administration consists of the Fire Chief and Deputy Chief. With only two real administrative positions the leadership of the department is very thin and these two individuals must not only multi-task, but they must prioritize their time to achieve as many of the needed tasks as possible. This constant triaging of issues and only being able to deal with the most

pressing problems means that many important but less pressing issues do not get the attention they need for resolution. Ideally, Assistant Chiefs as well as the training chief and the fire marshal should be part of the management team.

The focus is on primarily operations issues, and longer term issues such as strategic and master plans do not get enough analytical attention to develop detailed reports, documents and analytical long term strategies. There are several longer term issues such as succession planning and a multi-year capital improvement plan which are not able to be addressed.

There is clearly a need for a second Deputy Chief to split the departmental administrative workload. This position could separate operations and administrative tasks to allow sufficient focus being placed on both departmental functions. This will also give the training chief time to focus strategically on DFD fire and EMS training plans and maintain necessary safety files for OSHA requirements. Finally with this new deputy chief position, the Fire Chief could spend the time needed to get the safety services division operating at maximum efficiency and improve internal communication.

This management team consisting of the fire chief, two deputy fire chiefs, training chief, and fire marshal would also be the departmental strategic and master planning group. Using regularly scheduled meeting they could develop the key plans for DFD.

Succession Planning – At present DFD has no program for succession planning. Planning for future leadership is a key need for any organization. This includes the formal classroom and on the job education of motivated individuals in the department to develop the future chiefs and officers of DFD. Monies invested in these future leaders now will pay large benefits in future years as understanding of fiscal management, human resources, organizational communications, and many other key topics of administration are expanded and formalized. The DFD training division provides essential firefighter training and EMS continuing education. Presently lacking is training for officers, especially for chief officers as managers and captains as first line supervisors. This is a common problem in many fire organizations and one that compounds its effectiveness in expanding the diversity of future leadership and in succession planning efforts.

There also seems to be a real absence of succession planning and preparing people for promotion throughout all levels of the department. Organizationally, many of the line personnel and administrative staff are eligible to retire. The institutional memory and brain trust at the heart of many of the most fundamental functions of the department will be decimated if certain individuals leave the department, without any real planning for their replacement. It is therefore essential that DFD and the City of Duluth begin to invest in this area.

Finance

The preparation of the financial statement is somewhat confusing since the department has split a division, added a division, and removed a division from the department budget over a three-year period. Notable changes include the removal of Building Safety from the fire department budget in 2011 and addition of Life Safety to FPB. The fire department continues to manage Building Safety. Another significant change was the increased revenue and associated increased cost for staff in 2012

Fire department revenues are limited to the rental-licensing program, operational permit program, various State aids, and grants. The largest and most costly division does not have revenue generation opportunities. The permit revenue levels have remained constant over the years. State Aid has declined significantly over the last five years. Revenues cover approximately 5% of the cost of the department. Additional resources have been generated through local, state and federal grants allowing the department to offset operational cost.

DFD has a 2011 budget of $13.2 M and anticipates about $1M in revenues. Operations accounts for 90% of department funds with life safety using 6% and administration 4%. Other city departments with a large part of the budgets being used for operational needs include police, public works, and library. Overtime is budgeted at $500,000 for 2011, but DFD will likely exceed this amount due to unfilled positions, which though causing overtime budget number higher at the same time it also lowers the cost of regular salaries as well as benefits. Overtime for FLSA is approximately $132,000 annually and payouts for holiday pay and personal leave account for $50,000 and $191,000 respectively. These 3 factors account for $371,000 annually in overtime monies of the $500,000.

Capital Improvements Program

New Public Safety Radio System – Over the two-year period of 2011 and 2012, DFD has budgeted $1,200,000 in capital purchases. This will provide a substantial percentage of the system replacement, but not all. They have received a 2010 fire grant of $106,000 to purchase portable radios for the entire department, a $360,000 communication infrastructure grant from the State of Minnesota, and have received approval for a 2009 port grant application of $1,000,000 for communications equipment for police and fire departments. With the grant funding from the port grant and FEMA fire grant DFD does not expect to have to request additional funding from the city.

Apparatus Maintenance – Apparatus maintenance is an integral part of any fire department and budget wise it is invariably a large ticket item—it takes a big chunk of the budget to maintain a fleet. As fleets age, it is logical and sound planning to conclude that repairs and costs will increase exponentially. There are two proven ways to mitigate the long term and short term costs associated with repairs and replacements. The primary way is to have a sound,

dedicated Preventative Maintenance (PM) program that is on a regular cycle for each and every vehicle in a department's respective fleet. This strategy not only saves money, but saves lives by keeping the number of viable fleet apparatus ready to respond to emergencies. The other method is to have a realistic CIP replacement plan for new apparatus when the old has outlived its usefulness. NFPA 1911 Appendix D, which sets standards for Guidelines for First-Line and Reserve Fire Apparatus has changed and adapted over the years to reflect the changes in industry standards. It states:

> "The length of that life depends on many factors, including vehicle maintenance, engine hours, quality of the preventive maintenance program, quality of driver training program, whether the fire apparatus was used within the design parameters …there are fire apparatus with 8 to 10 years of service that are simply worn out. There are also fire apparatus …that have excellent maintenance, and that have responded to a minimum number of incidents that are still in serviceable condition after 20 years. …the care of fire apparatus while being used and the quality and timeliness of maintenance are perhaps the most significant factors in determining how well a fire apparatus ages."[2]

Apparatus Purchasing Plan – Apparatus purchases are planned 5 years in advance. Replacement of fire equipment at the appropriate time is critical because fleet costs rise rapidly near the end of the equipment's life expectancy. Leasing of fire apparatus has been examined to determine the cost effectiveness. With the current interest rates and bonding costs, bonding still remains the most effective way to finance fire apparatus. The plan detailed below will get DFD on track with their fire apparatus replacement program.

Table 2: Proposed Apparatus Plan

	2011	2012	2013	2014	2015
Quint 4	850,000				
Truck8		850,000			
Engine2			500,000		
Engine6			500,000		
Rescue1				515,000	
Staff cars				80,000	
Engine10					520,000
Engine3					520,000

Analysis of the Training Bureau

The training division of DFD is currently staffed by a Chief Training Officer and receives clerical support from the administrative assistant. To say this position is overused for functions other than training would be an understatement. Duluth firefighters spend a great deal of on-duty

[2] NFPA 1911 – Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus; Appendix D

time training. They are expected to be proficient in fire suppression, EMS, confined space rescue, hazmat, extrication, rope rescue, water & ice rescue, incident command, elevator rescue, forcible entry, public education, terrorism and weapons of mass destruction, fire inspection, as well as training in all fire department and city policies. This undertaking takes a great deal of planning. Each one of these subjects has many different training classes. For example, fire suppression training includes classes in self contained breathing apparatus (SCBA), knots, ladder drills, ventilation drills, fire suppression tactics, foam application, special vehicle fires, rapid intervention teams, firefighter safety, fire-ground accountability, defensive driving, etc. The training officer effectively uses the CCTV system whenever possible to assist with training. This tool helps to make the system more efficient in terms of having the ability and flexibility, when possible, of not having to put units out of service to attend out of quarters training sessions in some other location not in their respective districts, which can sometime cause logistics nightmares.

Analysis of Fire Prevention (Life Safety Division)

As the division responsible for preventing fire loss and managing risk, DFD Fire Prevention has a very important function. Fire Prevention services include building and fire protection system plans review, new construction inspections, code enforcement inspections of existing buildings, annual licensing inspections, public education, as well as fire and arson investigations. These services are typical of fire prevention divisions in other fire departments. What is unique in this division is the effort through concrete policy to streamline services, all existing property oversight and inspections into this one division. Fire inspection, fire investigation, public fire education, car seat clinics, smoke detector installations, landlord education, and other proactive programs are also provided through this division.

Fire departments most effective in reducing losses are those that have successfully integrated prevention as a core value throughout the organization and continuously review the impact of prevention on the overall services provided by the department. There are basic approaches that can be used to insure that prevention is treated as a paramount department-wide priority. DFD has been very successful in this in most instances. However, overall, DFD's Fire Prevention Division is one of the most innovative we have seen, and implements some of the best programs in terms of the ground it covers and the integration of prevention, housing inspection and nuisance property oversight into one entity.

Fire Prevention Staffing – DFD Fire Prevention (DFD FP) is managed by the Fire Marshal (FM), and the division she heads up is the authority having jurisdiction (AHJ) for the City of Duluth. Primary responsibilities include plan checks, new construction inspection, consulting with developers and builders, building permit inspections, and inspections mandated by the State of Minnesota. The current FM has been managing the division for the last year as an interim FM, and became the official FM in October 2011. The FM was previously one of the two

Deputy Fire Marshals in fire DFD FP, knows the structure and system, and is in the process of making the management of the unit her own.

The division has two units with one side of the house covering compliance and the other side housing inspections (see the organizational chart in this chapter). The division has two Deputy Fire Marshals (DFM) heading up compliance, fire prevention, cause and origin and public education, and a Lead Housing Inspector heading up the housing inspection program. There is also a one stop shop component for the public that has combined the previously divided fire prevention and housing inspection component. There appears to some organizational culture conflict in styles in implementing and operationally in the way the public is handled via the merger. Both the FM and the Deputy Fire Chief have acknowledged the need for a smoother transition and are working on and aware of the need for continuity.

Approach – DFD FP has an innovative and foresightful approach to many of their fire prevention programs. They have in the department, a built-in integrated risk management program which includes the use of fire companies installing smoke detectors and providing public education while on site. The fire companies also do commercial re-inspections almost exclusively, while DFMs do the initial inspections. This system was put in place because in Duluth businesses are required to pay for inspections, so DFD FP has decided that the initial inspections should be detailed and thorough, and that fire companies follow-up on specific violation corrections. The division also has a police officer in the unit whose duties include enforcement of code and compliance issues, arson investigation and "crime free drug free" rental ordinances, to name a few. The combination of all of these particular programs conceptually and in action is slightly ahead of the curve in relation to many other fire prevention programs we have seen.

The Life Safety Division and the Building Safety, Construction Services and Inspection Division department are physically separated and are the two key elements of municipal construction safety which seems to work in concert. Construction Services is responsible for new construction in the City of Duluth, along with the Fire Marshal's office review and approval of plans and joint on-site inspections. DFD Life Safety is responsible for the safety and proper maintenance of all structures, and many times must use construction inspectors' expertise to assess problem buildings. Communications between the two agencies is good and the offices work closely and are constantly updating policy and procedure concerns. All building plans from Building Safety are reviewed and approved by the FM and the Minnesota Building code office is involved as well.

Analysis of Emergency Management/Planning

The Emergency Manager position moved to the fire department 15 years ago. In 1997, the fire department took over Duluth's emergency management responsibilities. This includes maintenance of an emergency operation plan, coordination and planning of community

exercises, grant application and administration, liaison with local, state and federal agencies and coordination of the outdoor warning siren system. Although the emergency planning is an all-hazard view and approach, the terrorist attacks of 9/11 and subsequent events have created additional demands on the department's time and resources. A half time employee was approved to assist the Fire Chief. This position was cut due to budget issues before the position was filled. Following the September 11, 2001 terrorist attack, the scope, responsibility, and time commitment was greatly expanded. The added requirements in training, planning, exercises, grant management, and the sheer volume of meetings has made it increasingly difficult to be effective with only a part time emergency manager. In the future, it will be likely that the fire chief will need an assistant to aid in the required work and reporting.

In 2009, the state began providing Duluth $20,000 per year to help support the emergency management program. With Emergency Management Program Grant dollars, DFD sponsored intermediate and advanced National Incident Management System (NIMS) training classes. Thirty-five fire, police, and public works employees successfully completed the advanced training. This greatly expanded the City's incident management capabilities. DFD also sponsored an American Red Cross seminar on emergency sheltering. In 2011, DFD focused on training for elected officials and city administrators. Emergency management will become a part of all employees training requirements in the future.

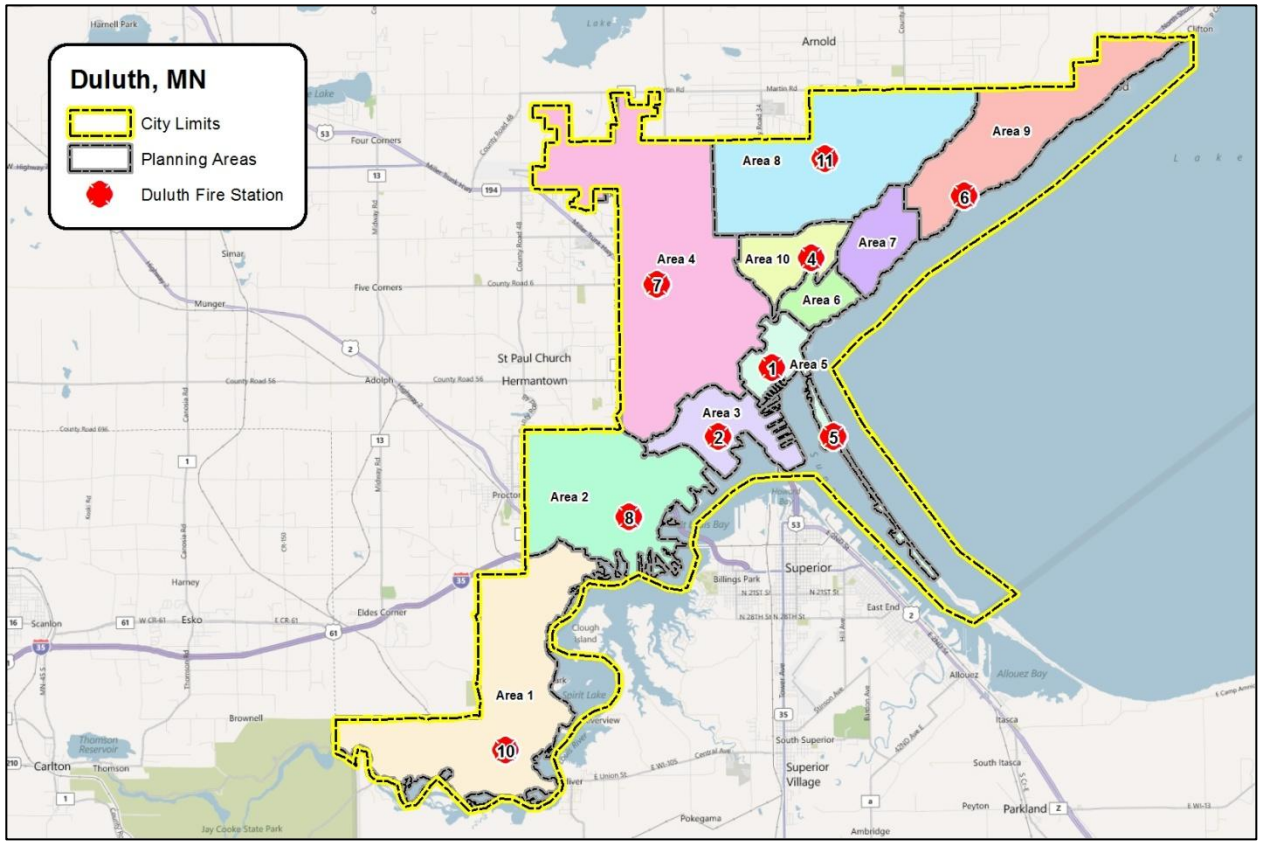
3. POPULATION, RISK, AND DEMAND

This chapter provides a review of factors that can affect demand for emergency services. Specifically, we review population growth, fire risk and historical demand for emergency services. Where possible, we conduct this analysis at a neighborhood or planning area level. The assessments conducted in this chapter are critical to not only the determination of the number and placement of resources (discussed in the next chapter), but also to the mitigation measures that may be available to the fire department (e.g. residential sprinkler ordinance or increased prevention efforts).

Planning Areas

It is good practice for fire departments to consider risk and demand at a neighborhood or planning area level because of the variation across them. Figure 3 shows the planning areas we used for our risk and demand analysis. These planning areas were provided by the city of Duluth.

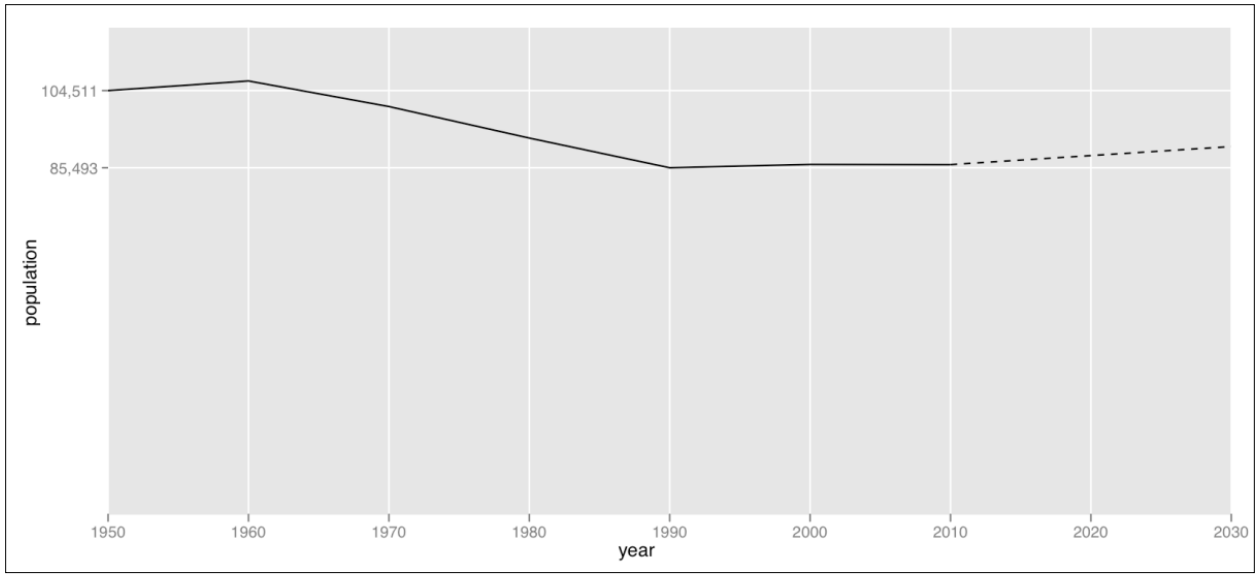
Figure 3: Planning Areas



Citywide Population Growth and Development

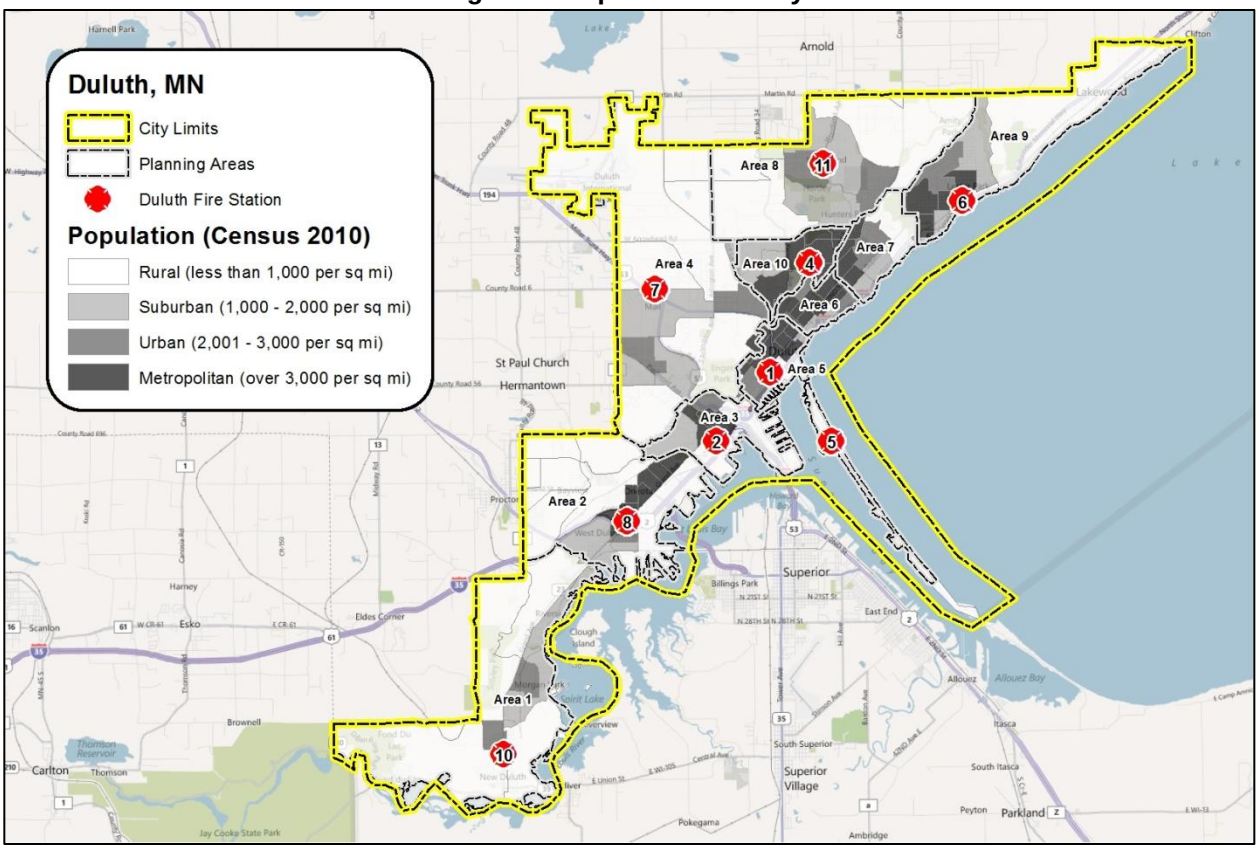
Population in Duluth has been holding steady and is expected to begin increasing slightly, as seen in Figure 4. Although the population decreased by about 20% between 1960 and 1990, the population has held fairly steady in the two decades since then. The current population is 85,4934 and it is projected that population will actually increase just slightly (about 2,000 residents each decade) through 2030.

Figure 4: Actual (solid) and Projected (dashed) Population, 1950-2030



The current population density is shown in Figure 5. The City of Duluth has a wide variety of population densities ranging from rural to metropolitan using the Center for Public Safety Excellence (CPSE) population density classifications. Most of the areas of higher population density run along the Interstate 35 corridor. The different population densities will be considered both when evaluating response times and station locations. The areas with the highest population density can expect to have the highest amount of emergency services demand.

Figure 5: Population Density



Demand Analysis

Demand is defined here as the number of calls for assistance to the fire department for emergencies and non-emergency services. In this section, we forecast the total number of calls (or incidents) and review trends for the different incident types. We also compare emergency services demand by planning area and map out fire and EMS hotspots. Understanding both current and predicted future demand will help make important decisions in the following areas:

- **Fire Unit Locations** – Planning areas with high levels of demand help indicate where fire apparatus should be located. Further understanding of the types of incidents in each area helps to determine the number and type of response equipment that is most appropriate.
- **Weight of Response** – The demand analysis shows the number of fires versus the number of fire alarms. A higher weight of response is prudent for planning areas with higher-risk properties, and where more structure fires actually occur.
- **Prevention** – Some areas have such a high demand for emergency service that an increase in prevention and education efforts targeted to them should be considered.

Demand Projection – Using a statistical software package, a multi-linear regression procedure was used to investigate how both time[3] and population affect the total number of incidents to which the fire department responds. A best-fit multi-linear model was used to predict future demand.

In statistics, linear regression is an approach to modeling the relationship between a dependent variable y and one or more independent variables denoted x_i. For our incident type trending, we are using year (x_1) and population (x_2) to predict incident type totals (y). We realize that time and population are not the only factors determining emergency services demand, so the model is not perfect for predicting the exact number of incidents. The use of linear regression is useful in that it shows trends, and trends are valuable for planning purposes.

For any model, it is necessary to say how statistically accurate it is, or what the confidence is in the estimates. For example, if we predict that there will be 1,000 emergency incidents ten years from now, we also have to state the confidence limits of that prediction. The confidence interval is a statistical plus/minus calculation. To continue with our example, we might say there will be 1,000 emergency incidents, plus or minus 100. This gives the reader both a prediction and a range within which we are fairly certain (95 percent certain to be exact) that the eventual number of incidents will fall.

The confidence intervals are the result of a statistical calculation that analyzes how accurately our prediction model represents the actual data. A very good model will have a small confidence interval and is typically the result of historical trend that stays fairly steady from year to year; as a result, a multi-linear regression is able to make fairly accurate predictions for total incidents for at least several years into the future. The further into the future, the wider the confidence limits become.

Large confidence intervals occur when there are large incident type fluctuations from year to year that are inconsistent and cannot be accurately modeled with any of the independent variables (time and population). For instance, if the annual number of incidents fluctuates up and down 30 percent from year to year, the model cannot accurately predict the exact number of incidents for a given year. In that case, there would be a large confidence interval that essentially says we predict y, but the number could be much higher or much lower.

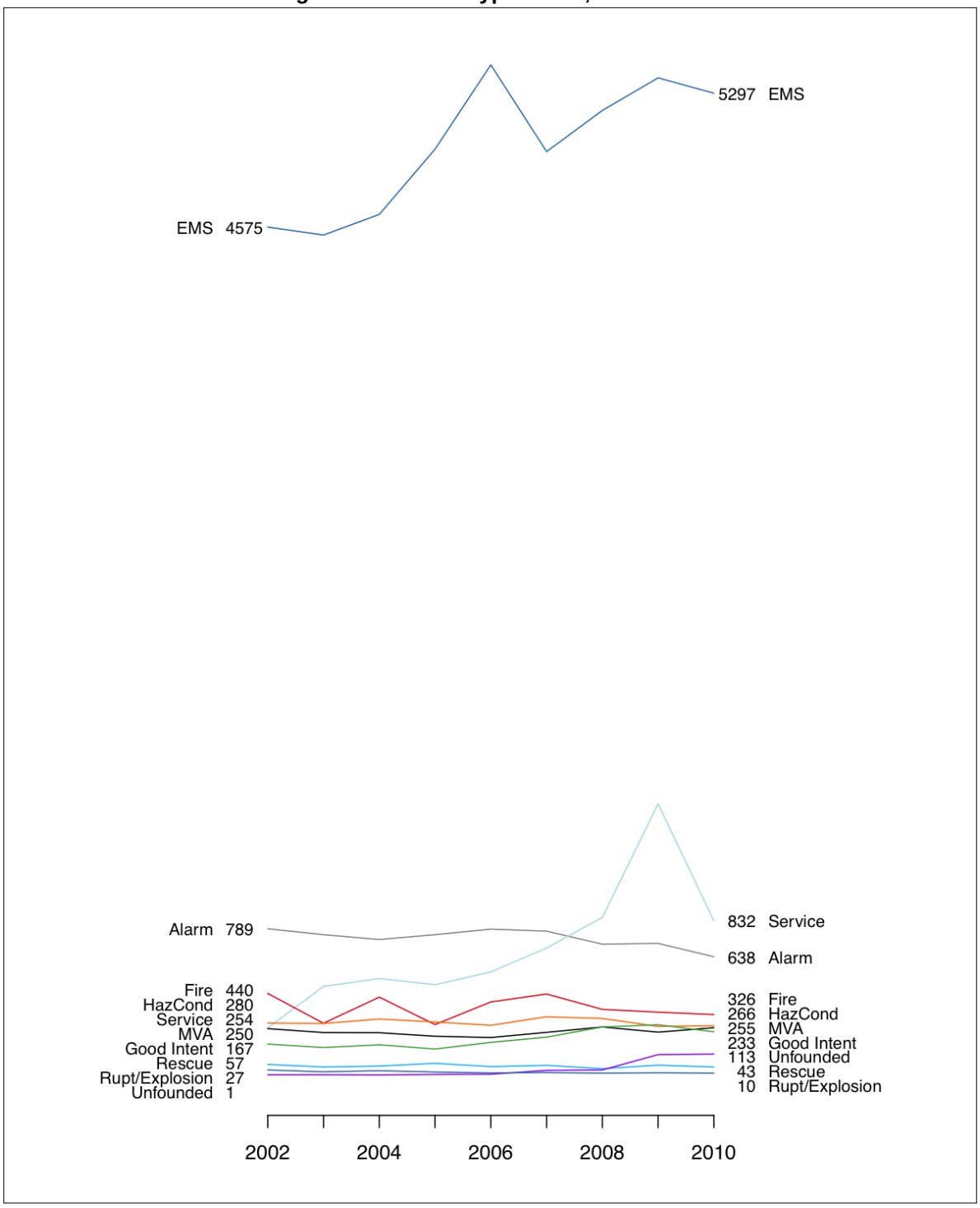
Professional judgment is needed in addition to this statistical prediction to develop an accurate picture of where demand may be headed within the bounds of the confidence interval. A solid understanding of the underlying factors that drive demand for local emergency services combined with statistical forecasting like that provided in this section is a powerful combination for successful deployment planning.

[3] Time reflects changes in inclination to use EMS and factors other than population.

Over the last decade, population in Duluth has remained constant; however, the total number of incidents has increased. In 2009, there was a particularly large spike in total calls, which was partially the result of a FEMA smoke detector installation program (see next section). Because of the large spike in calls for 2009 that statistical prediction looks at 2010 as a decrease in incidents because there is no easy way to account for variables such as smoke detector installations. Although the projection shows decreasing incidents, we know that this unlikely. With total incidents having increased over the last couple years and an expected slight increase in population, total incidents will likely continue to increase slightly. It would be reasonable to expect total incidents to rise to 9,000 over the next couple years.

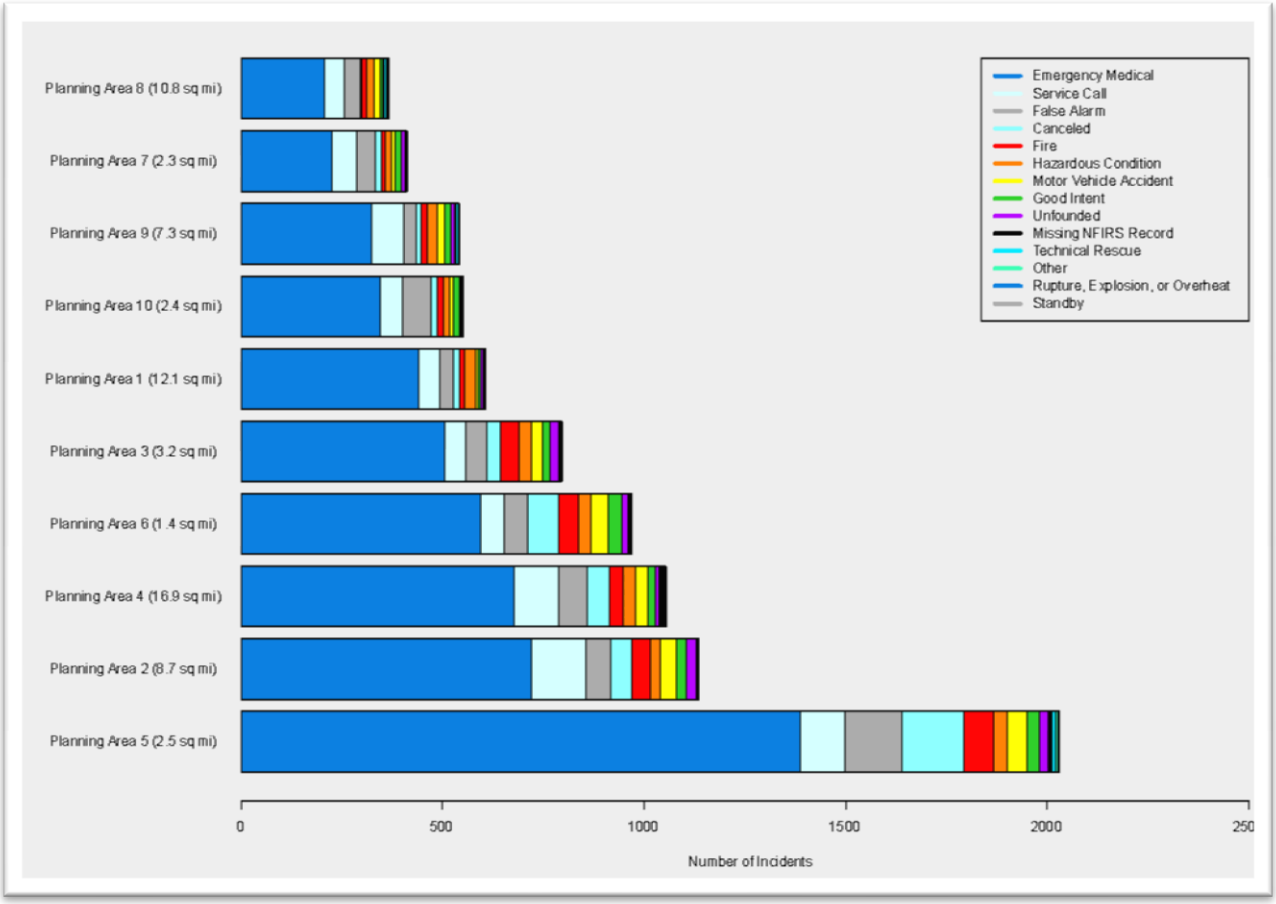
Incident Type Trends – Figure 6 shows the incident type trends from the period of 2002 to 2010. EMS calls accounted for the highest proportion of demand and increased 16 percent from 2002 to 2010. Although service calls and good intent calls accounted for a significantly smaller portion of total demand, they also increased over the same time period. Service calls increased by 228 percent, largely the result of the earlier mentioned FEMA smoke detector program implemented in 2009; good intent calls increased by 40 percent. Motor vehicle accidents and hazardous condition calls held fairly steady, while fires decreased by 26 percent. The remaining incident types (rescue, rupture/explosion, and unfounded) made up only a very small portion of demand.

Figure 6: Incident Type Trend, 2002-2010



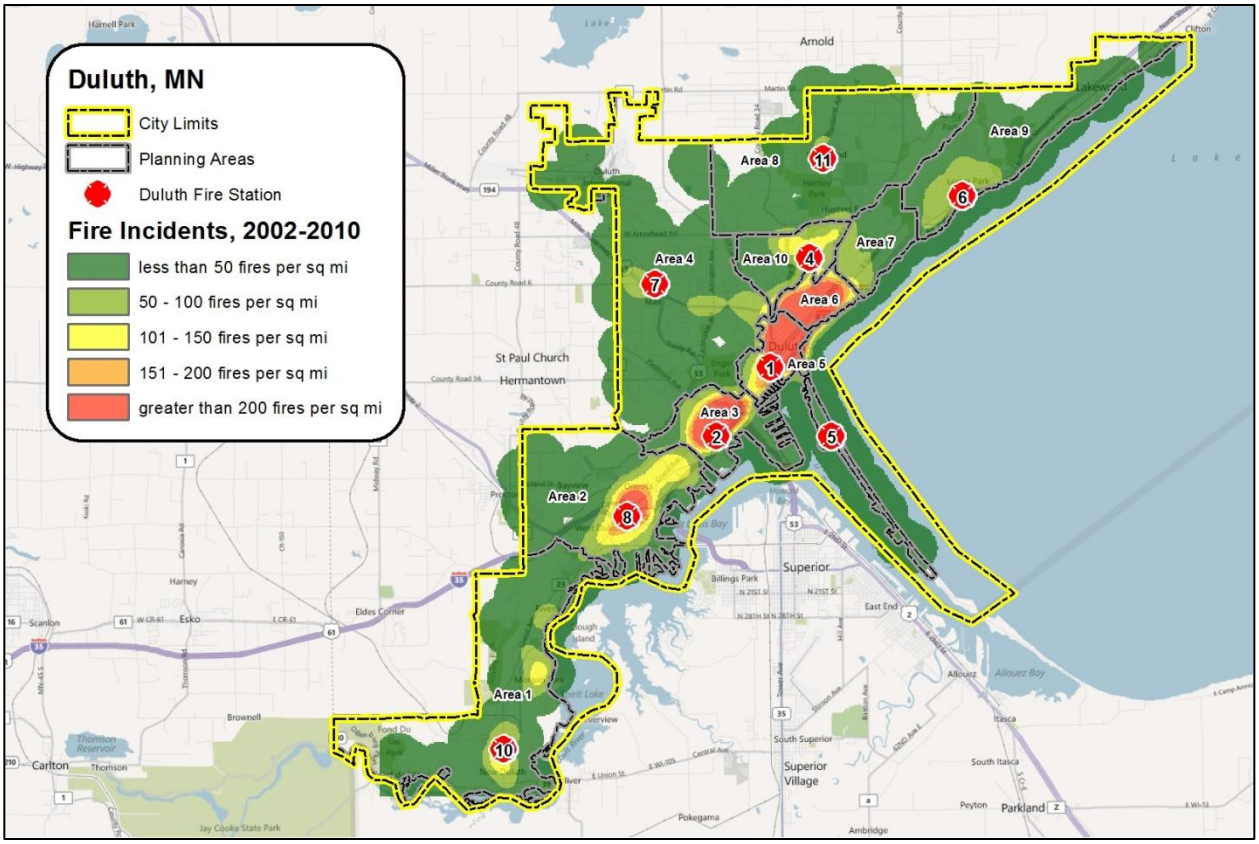
Demand by Planning Area – Figure 7 shows the emergency incidents by incident type and planning area for the period of July 2010 to June 2011. As shown on Figure 7, EMS incidents account for the majority of emergency service demand in all planning areas. Planning Areas 1, 7, 8, 9 and 10 had the least amount of incidents. Planning Area 5 had the largest number of incidents despite being one of the smaller planning areas in terms of land area. It had nearly double the number of incidents as the second highest area of demand (Planning Area 2).

Figure 7: Emergency Incidents by Incident Type and Planning Area, July 2010-June 2011



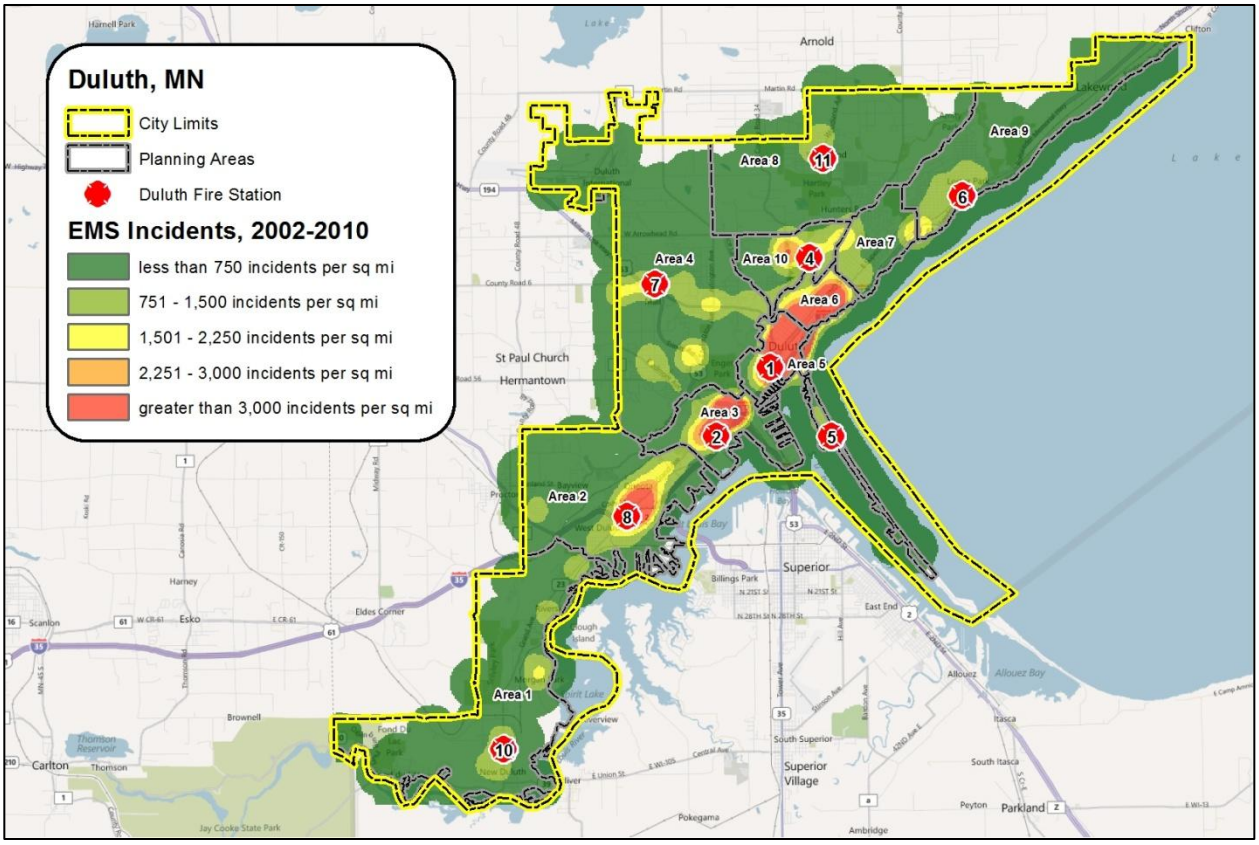
Geospatial Mapping of Fire and EMS Demand – A better way of looking at demand is to actually map out fire and EMS incident densities using GIS software, which allows for pinpointing of high-demand areas ("hotspots"). Figure 8 and Figure 9 show fire and EMS incident densities.

Figure 8: Fire Incident Density



The fire incident density map includes all incidents classified as a fire within the NFIRS database. This includes structure fires, vehicle fires, and outside fires. Based on the fire density map, it appears that most of the demand occurs in Planning Areas 3, 5 and 6, which are almost entirely covered by fire hotspots. Additionally, there is a hotspot located in Planning Area 2 around Fire Station 8. The majority of fires occur along the Interstate 35 corridor.

Figure 9: EMS Incident Density



EMS incident density, as shown in Figure 9, shows essentially the same hotspot pattern as was seen in the fire density map. Both EMS and fire calls tend to be driven by population—the old saying that the three leading causes of fire are men, women and children generally holds true for all incident type densities. Although there are some differences in the fire and EMS incident density maps, for the most part, they follow the residential population density shown earlier in Figure 5.

Fire Risk Analysis

Fires are a small percent of total emergency services demand, but fire suppression activities require more personnel to mitigate than do most other emergencies. The fire risk assessment in this section evaluates the overall trend in fires, the probability of fires in different planning areas, and the consequence or likely severity of fires in different planning areas. All of these factors were considered for the overall protection requirements of each planning area.

Jurisdiction-Wide Fire Losses – One of the best indicators of fire risk is actual data collected from fires over multiple years. Table 3 shows total fires, dollar loss (defined as both property and contents), and civilian fire deaths, per year.

Table 3: Total Fire Loss, 2002-2010

	Total Fires	Dollar Loss	Deaths
2002	440	$3,172,014	1
2003	279	$3,467,399	1
2004	420	$4,038,647	0
2005	272	$2,200,574	0
2006	394	$3,125,602	1
2007	437	$3,293,797	2
2008	351	$5,280,982	4
2009	339	$2,698,565	0
2010	326	$4,236,371	0
(average)	362	$3,501,550	1

The data reflects all fires, including vehicle fires and outside fires. Table 3 shows that, on average, there were 362 fires and one fire death per year. Annual dollar loss averaged $3.5 million dollars.

Table 4 compares the fire loss data to national averages, regional averages, and similar-sized community averages. Fire loss data can be easily skewed. A single exceptional incident or under- or over-reporting of deaths or property loss could have a huge impact on the comparisons. Also, different jurisdictions may collect data in slightly different ways, making comparison imperfect. Nevertheless, it is of interest to make the comparison and ask questions about differences found.

Table 4: Per Capita Fire Loss and Comparison Statistics, 2002-2010

	Total Fires	Dollar Loss	Civilian Deaths
	(per 1K capita)	(per capita)	(per 1M capita)
United States	4.4	$40.8	9.8
Region: midwest	5.2	$53.6	12.1
Population: 50,000 to 99,999	3.3	$36.4	6.7
Duluth : 2002	5.1	$36.8	11.6
Duluth : 2003	3.2	$40.2	11.6
Duluth : 2004	4.9	$46.8	0.0
Duluth : 2005	3.2	$25.5	0.0
Duluth : 2006	4.6	$36.2	11.6
Duluth : 2007	5.1	$38.2	23.2
Duluth : 2008	4.1	$61.2	46.4
Duluth : 2009	3.9	$31.3	0.0
Duluth : 2010	3.8	$49.1	0.0
Duluth : (average)	4.2	$40.6	11.6

Per Table 4, Duluth had a lower than average number of fires when compared to the national and regional averages and a higher than average number of fires when compared to communities of similar size. Similarly, Duluth had a lower per capita dollar loss when compared to the national and regional averages, but a higher per capita dollar loss than communities of similar size. Civilian fire deaths were slightly higher than the national average and significantly higher than communities of similar size average. Duluth had fewer civilian fire deaths than the

Midwest regional average. Although there are certainly deviations from the comparison fire loss statistics, it appears that fire loss in Duluth is fairly average—not exceptionally high or low.

Fire Risk by Planning Districts – Fire risk is the product of fire probability and fire consequence. High risk can result from either a large number of small fires, or a small number of large fires. Table 5 provides both probability and consequence statistics for each planning area for the period of 2002 to 2010. Probability is reflected in the total number of structure fires, defined as the number of fires that spread beyond their object of origin (meaning we excluded things such as trash can fires and cooking fires that did not extend beyond the can or pot).

The table shows both the actual number of structure fires and the number normalized by land area (per square mile). Consequences are compared for each planning area using the following metrics: property loss in dollars, contents loss in dollars, civilian fire deaths, and the number of fires that spread beyond the room of origin (more serious structure fire).

We normalized the consequence statistics by land area to make them more comparable between planning areas. Finally, we color-coded each of the statistics using the normalized value. If the normalized value fell in the lower 25 percent of incidents or losses, it was color-coded green. If the normalized value fell into the higher 25 percent of incidents or losses, it was color-coded red. The remaining values were left uncolored. Using this technique, it is usually fairly easy to determine which planning areas have higher fire risks (higher probability and/or consequence of fire) and which planning areas have lower fire risks (lower probability and/or consequence of fire).

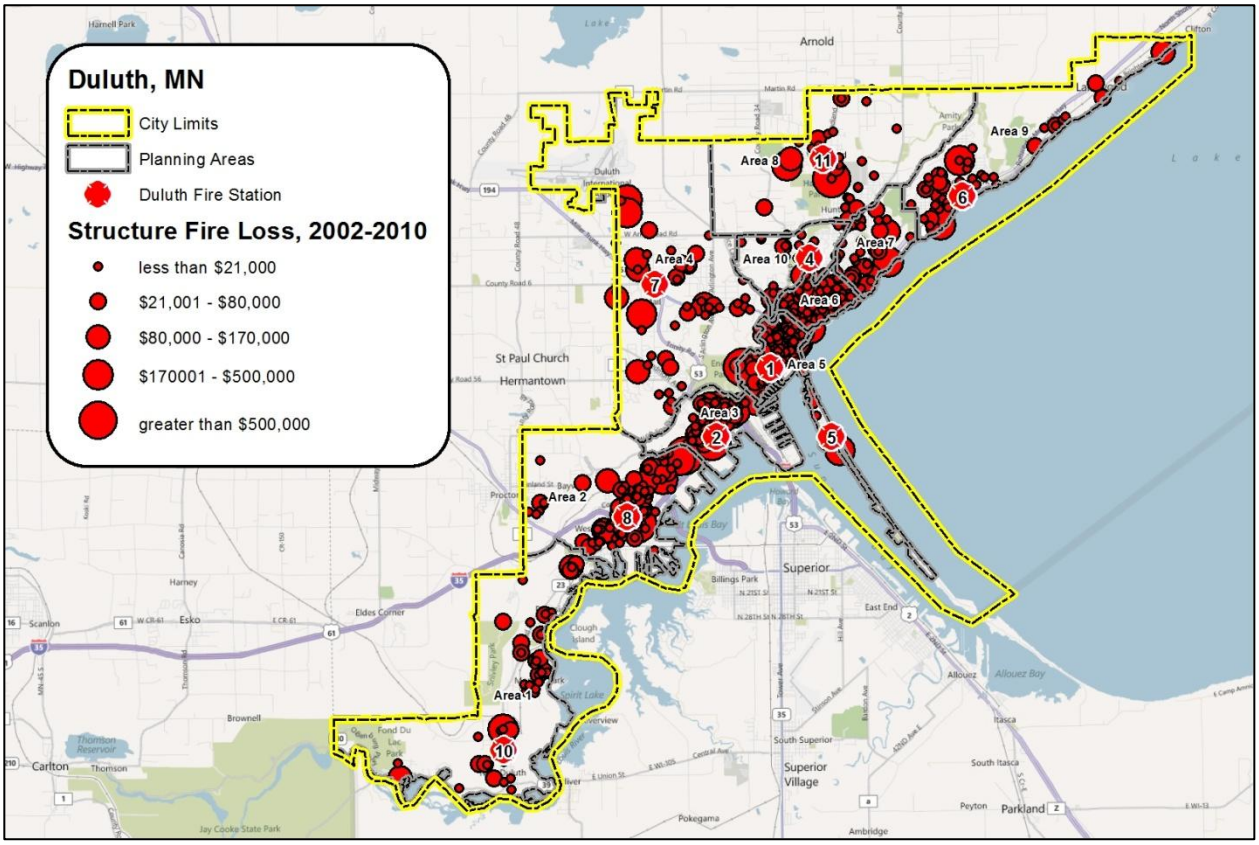
Table 5 shows the fire risk classifications. Planning Areas 5 and 6 had the highest number of fires per square mile, whereas Planning Areas 1, 4 and 8 had the lowest number of fires per square mile. Property loss per square mile was highest in Planning Areas 3 and 5 and content loss per square mile was highest in Planning Areas 5 and 6. Civilian fire deaths only occurred in Planning Area 3 (3 deaths) and Planning Area 1 (1 death). Based on this analysis, it appears that Planning Areas 3, 5, and 6 have the highest fire risk.

Table 5: Fire Risk Classification by Planning Areas, 2002-2010

	Fires	(per sq mi)	Beyond Room	(% of fires)	Property Loss	(per sq mi)	Contents Loss	(per sq mi)	Deaths	(per sq mi)
Planning Area 1	18	1.5	7	39	$518,000	$42,864	$136,910	$11,329	0	0
Planning Area 2	38	4.4	25	66	$1,066,500	$122,461	$404,000	$46,389	0	0
Planning Area 3	44	13.7	32	73	$2,553,750	$793,965	$459,075	$142,727	3	0.9
Planning Area 4	18	1.1	12	67	$869,350	$51,556	$175,300	$10,396	0	0
Planning Area 5	51	20.8	29	57	$3,039,800	$1,238,793	$361,301	$147,239	0	0
Planning Area 6	41	30.4	26	63	$848,275	$627,975	$338,310	$250,450	1	0.7
Planning Area 7	16	6.9	9	56	$312,300	$135,577	$112,065	$48,650	1	0.4
Planning Area 8	8	0.7	7	88	$1,386,000	$128,187	$27,000	$2,497	0	0
Planning Area 9	18	2.5	8	44	$470,200	$64,624	$291,800	$40,105	0	0
Planning Area 10	17	7.1	9	53	$285,200	$119,214	$67,110	$28,052	0	0

Geospatial Location and Severity of Fire Incidents – To help evaluate the appropriateness of fire unit locations, it helps to understand where the more serious structure fires (those that involve large fire losses) are occurring. Figure 10 shows the location and severity of structure fires shown by red circles. The sizes of the circles are scaled to the amount of fire loss. Although fires occur throughout Duluth, there is a clear pattern of higher structure fire density along the Interstate 35 corridor, particularly in Planning Areas 2, 3, 5, and 6. This map is considered when looking at the appropriateness of current fire station locations and any recommended alternatives in the next chapter.

Figure 10: Structure Fire Locations, Population Density, and High Fire Risk Areas



4. FIRE STATION LOCATION AND RESPONSE TIME ANALYSES

The analyses of the fire station locations and response times are important considerations as the city considers changes within the fire department. For this part of the study, we analyzed current station and unit performance with respect to the emergency service needs of the various planning areas. To do this, we analyzed response time performance (both citywide and by planning areas) and reviewed current workload for each of the individual fire units.

Response Times

Response time is the most common performance measures used by the fire service because it is understood by citizens, easy to compute, and useful in the evaluation of end results. Rapid response is also an aspect of the quality of service about which most citizens care. There have been a few attempts to measure the incremental value of a minute faster response time for fires and EMS calls, but there is no definitive study of the incremental benefit. Faster is better, but it is unclear how much better in terms of dollars or lives saved. In place of true measures of fire rescue service outcome, response time is often used as a proxy measure.

Most fire departments use the NFPA 1710 standard as a goal, not as a prescriptive requirement. Few departments are currently meeting or exceeding NFPA 1710, especially with respect to travel time (which is the hardest to improve). In this response time analysis, we show average times, 80th percentile times and 90th percentile times to show how different calculation methods provide drastically different measures of performance. Average response times have been increasingly less used by the emergency service industry because small numbers of very short or long response times (or data errors) can distort the results. We show average response times because people typically understand them better than percentile/threshold times, but fire departments should never gauge performance strictly on average response times.

The public is interested in how fast a system responds to most calls, which is better reflected in percentile/threshold times rather than average times. More and more departments are adopting the 90th percentile for reporting response times (mostly due to NFPA 1710's use of this measure). However, meeting the 90th percentile goal is not always the most efficient means for delivering emergency services. A 90th percentile response time of *x* minutes means that, at least 90 percent of the time, emergency crews arrive in less than *x* minutes. A system designed for 90 percent compliance allows only 10 percent of calls to have response times that exceed the target goal time.

Although it is certainly possible to design a system with 90 percent compliance for all areas of a jurisdiction, it is usually not a cost-effective strategy. Urban areas close to several fire stations should have high compliance, but it does not always make sense to dictate such high

compliance for suburban and rural areas (NFPA 1710 even acknowledges that it would not make sense to apply 1710 goal times to more rural areas).

Although NFPA 1710 recommends 90 percent compliance for their goal times, a better approach, we believe, is to use the 80th percentile level instead. There are several reasons for this. First, we subdivide our analysis into incident types and geographic areas (which most departments do not do). To have 90 percentile compliance in each of these subdivided areas would result in much higher than 90 percent compliance citywide. Second, departments that do not have rigorous data quality controls will typically have more calls with incorrectly long response times than incorrectly short response times. DFD can immediately improve on these concerns through the improved collection of arrival times by all units and making sure that all necessary data is transferred from the CAD system to NFIRS, moves that they are already in the process of implementing.

Because 90 percent compliance is very difficult to achieve, we use 80 percent compliance to account for some erroneous data. Finally, almost no departments achieve 90 percent compliance with NFPA 1710. Achieving NFPA 1710 at 90 percent compliance is a great goal but, in our professional judgment, using 80 percent compliance is a more appropriate measure of performance (the CPSE Standards of Cover Manual also uses 80th percentile times for assessing station location performance). Ultimately, the best way of determining appropriate performance measurement metrics is for the city and fire department officials to set those metrics for each individual planning area. Appendix A provides a template by which to put in place a planning area-based system of performance measurement.

The analysis of response times included only incidents dispatched as an emergency (we eliminated service calls from the response time analysis). Our analysis included only frontline pumping and aerial apparatus for fire incidents and only first-response capable units for EMS calls. These criteria were applied to keep the analysis in line with the 1710 standard specifications.

For all time segments, we analyzed one year's worth of data. We eliminated those time segments that were more than three standard deviations from the mean (outliers). Three times the standard deviation was used because, if travel times had a normal probability distribution, 99.7 percent of incidents are expected to fall within three standard deviations. Anything more than three standard deviations is likely to be an error in the data or a highly unusual situation. Each response time segment is analyzed both by hour of the day and incident type.

Call Processing or Alarm Handling Time – According to NFPA 1710, the Alarm Handling Time is the "time interval from the receipt of the alarm at the primary public safety answering point (PSAP) until the beginning of the transmittal of the response information via voice or electronic means to emergency response facilities (ERFs) or the emergency response units (ERUs) in the field."

NFPA 1710 (4.1.2.3.3) specifies that "the fire department shall establish a performance objective of having an alarm processing time of not more than 60 seconds for at least 90 percent of the alarms and not more than 90 seconds for at least 99 percent of the alarms, as specified by NFPA 1221."

Figure 11 and Table 6 show the call processing times by time of day and incident type. As shown in Table 6, the 90th percentile call processing time for fire and special operations incidents was 3:20 (three minutes, 20 seconds). This time is almost over 300 percent higher than the standard. EMS incidents had a 90th percentile call processing time of 2:49, which is also significantly over the standard. Improving call processing times is a significant issue that needs to be addressed. It is financially prudent to address long call processing times (even if they were just slightly over the standard) because dispatch center technology and staffing is much less expensive than adding additional units and stations to reduce the travel time component of total response time

The red line in Figure 11 shows that when there are peaks in the number of incidents (meaning the dispatch is having to take more 911 calls), there does not appear to be an associated change in call processing time. Furthermore, there is no pattern in call processing time based on time of day.

Figure 11: Call Processing Time by Hour of the Day, July 2010-June 2011

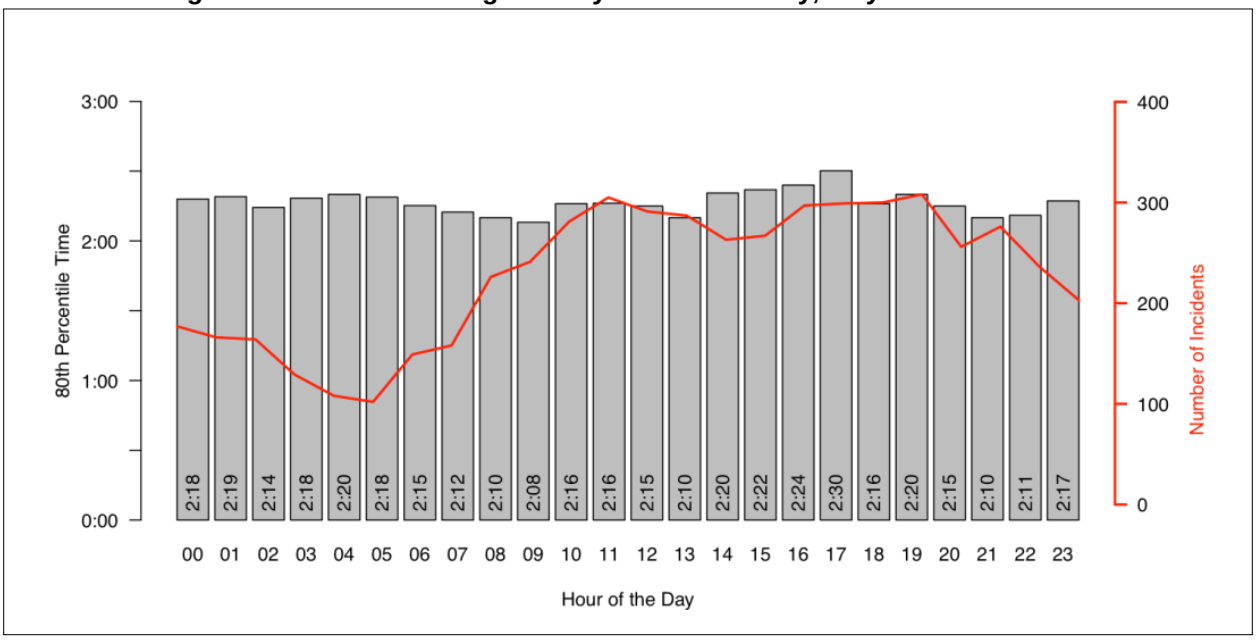


Table 6: Call Processing Time by Incident Type, July 2010-June 2011

	Average	80th Percentile	90th Percentile
Emergency Medical Service	1:41	2:16	2:49
Fire & Special Operations	1:44	2:28	3:20
(all)	1:41	2:17	2:51

Turnout (or Reaction) Time – NFPA 1710 defines turnout time as "the time interval that begins when the emergency response facilities (ERFs) and emergency response units (ERUs) notification process begins by either an audible alarm or visual annunciation or both and ends at the beginning point of travel time." The standard specifies an "80 second turnout time for fire and special operations response and [a] 60 second turnout time for EMS response."

Figure 12 and Table 7 show the turnout times by time of day and incident type. For fire and special operation responses, the 80th percentile turnout time of 1:19 is faster than the recommended NFPA standard and unusually fast when compared with other fire departments. For EMS responses, the 80th percentile turnout time of 1:26 is 26 seconds over the standard, but consistent with what most other fire departments achieve. However, because EMS turnout does not require the turnout gear, this time should really be faster than fire incident turnouts.

Figure 12 shows that turnout times are fastest between 4:00 PM and 8:00 PM. Although there is a clear difference between overnight and daytime turnouts, this difference is far less drastic than what we often see with other fire departments.

Figure 12: Turnout Time by Hour of the Day, July 2010-June 2011

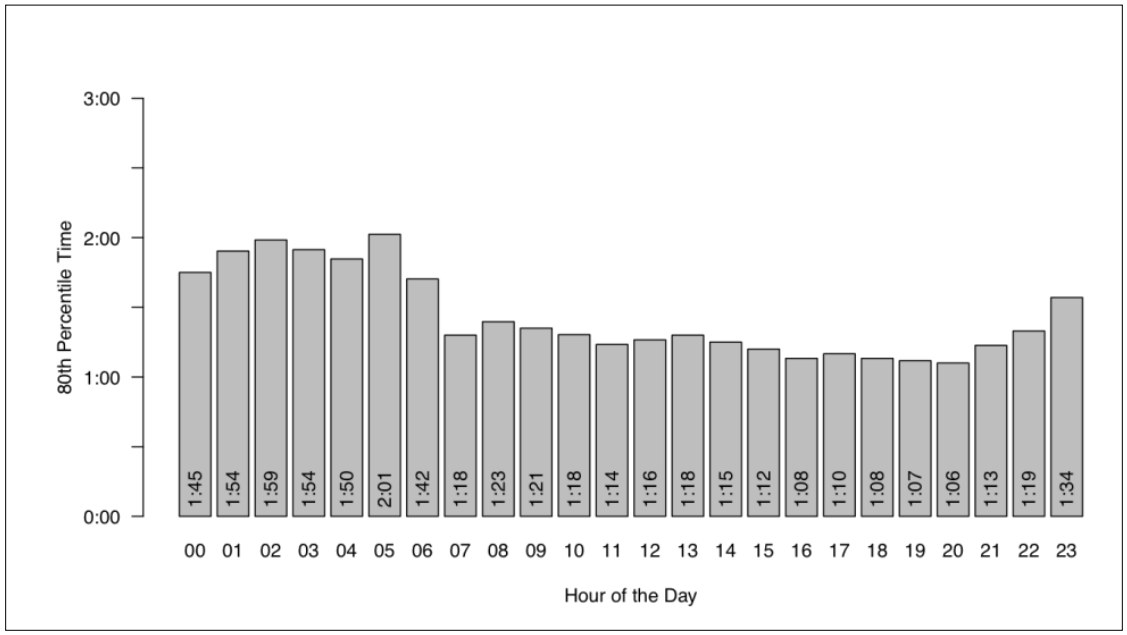


Table 7: Turnout Time by Incident Type, July 2010-June 2011

	Average	80th Percentile	90th Percentile
Emergency Medical Service	0:58	1:26	1:47
Fire & Special Operations	0:49	1:19	1:45
(all)	0:57	1:26	1:47

Travel Time by Hour of the Day and Incident Type – Travel time is the time interval that begins when a unit is en route to the emergency incident and ends when the unit arrives at the scene. Travel times are a function of geography, road conditions, traffic/congestion, and the number of and location of fire stations with respect to the location of actual calls. NFPA 1710 recommends "240 seconds or less travel time for the arrival of the first arriving engine company at a fire suppression incident" and "240 seconds or less travel time for the arrival of a unit with first responder with automatic external defibrillator (AED) or higher level capability at an emergency medical incident."

Figure 13 shows travel time for the first arriving unit by hour of the day, and Table 8 shows the travel time for the first arriving unit by incident type. At the 80th percentile level, travel time for all emergency incidents was 3:37, which is below the NFPA travel a time recommendation of 240 seconds (four minutes). Travel times were 3:47 for EMS incidents and 3:43 for fire and special operations at the 80th percentile. Duluth Fire Department should work to maintain these excellent travel times for their units. Travel time for the first arriving unit is fairly consistent throughout the day, though there are minor peaks during the 7:00 AM and 5:00 PM hours, which is consistent with peak travel times due to commuter traffic.

Figure 13: Travel Time (First Arriving Unit) by Hour of the Day, July 2010-June 2011

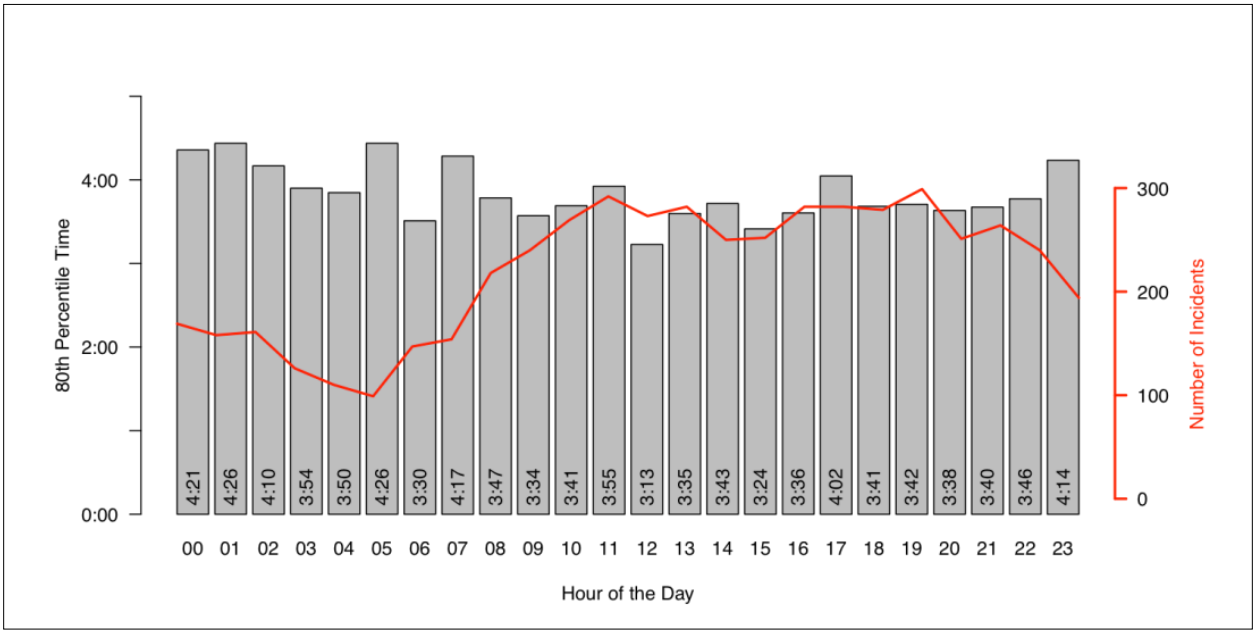


Table 8: Travel Time (First Arriving Unit) by Incident Type, July 2010-June 2011

	Average	80th Percentile	90th Percentile
Emergency Medical Service	2:34	3:47	4:37
Fire & Special Operations	2:19	3:43	4:53
(all)	2:33	3:47	4:38

Total Response Time – Total response or reflex time is the most important time segment because it combines all the previously analyzed time segments and is the measure by which the public evaluates the effectiveness of fire and EMS service. The NFPA defines total response time to include three phases: "(1) Phase One – Alarm Handling Time, (2) Phase Two – Turnout Time and Travel Time, and (3) Phase Three – Initiating Action/Intervention Time." Although NFPA 1710 does not explicitly provide a time objective for total response time, we added together the call-processing time objective (1:00 for all call types), the turnout time objective (1:00 for EMS incidents and 1:20 for fire and special operations incidents) and the first-arriving unit travel time objective (4:00 for all call types). By adding up the individual NFPA 1710 time segment objectives, one can conclude that the total response time should be less than 6:00 for EMS incidents and less than 6:20 for fire and special operations incidents.

Figure 14 shows the total response time for the first arriving unit by hour of the day, and Table 9 shows the total response time for the first-arriving unit by incident type. The 80th percentile total response time for EMS incidents was 6:59, which is about a minute longer than the recommended 6:00 minute response time. Fire and special operations incidents had an 80th percentile response time of 7:06, which is 46 seconds longer than the recommended 6:20 minute response time. While most fire departments are not meeting the NFPA 1710 response time standard, most are within 1 to 1.5 minutes of the time, and Duluth falls within the lower end of this range. By addressing the extremely long call processing times, it should be possible to improve on these already good response times.

Figure 14: Total Response Time (First Arriving Unit) by Hour of the Day, July 2010-June 2011

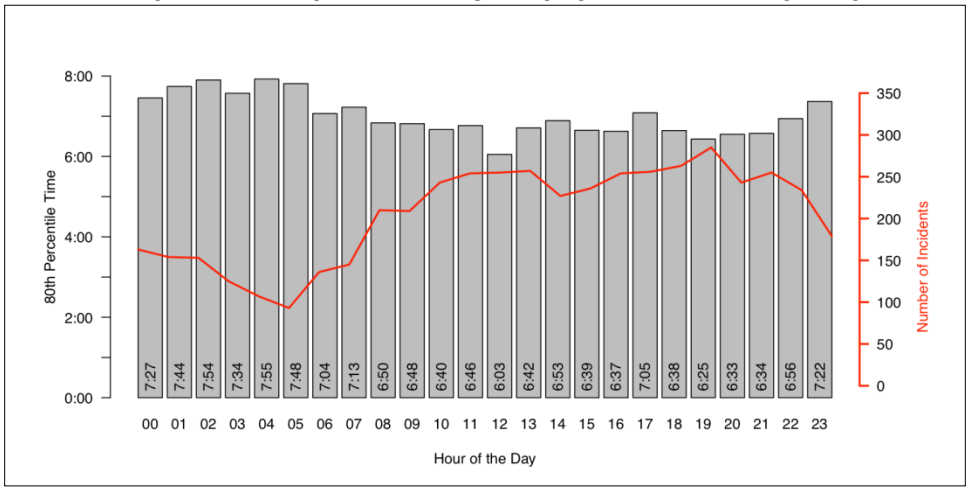


Table 9: Total Response Time (First Arriving Unit) by Incident Type, July 2010-June 2011

	Average	80th Percentile	90th Percentile
Emergency Medical Service	5:38	6:59	8:01
Fire & Special Operations	5:32	7:08	8:06
(all)	5:37	6:59	8:01

Table 10 shows the 80th percentile fire department response time (FD Reflex) and total response time (Total Reflex) by area. Total response times for the planning areas range from a low of 5:29 for Planning Area 5 and a high of 7:58 for Planning Area 1. The areas of highest fire risk (Planning Areas 3, 5, and 6) have total response times of 6:07, 5:29, and 7:06. With the exception of Planning Area 1, all areas have excellent response times. Planning Area 1 is largely rural and served by Station 10, which has one of the largest first-due areas – slightly longer response times are both expected and acceptable for this planning area.

Table 10: 80th Percentile Response Time by Planning Areas, July 2010-June 2011

	Travel	FD Reflex	Total Reflex
Planning Area 1	4:45	5:59	7:58
Planning Area 2	3:23	4:49	7:06
Planning Area 3	2:57	4:04	6:07
Planning Area 4	4:49	5:56	7:48
Planning Area 5	2:25	3:34	5:29
Planning Area 6	4:00	5:13	7:06
Planning Area 7	4:19	5:17	7:16
Planning Area 8	4:25	5:29	7:16
Planning Area 9	3:23	4:34	6:20
Planning Area 10	3:24	4:41	6:33
(all)	3:45	4:55	6:51

Workload Analysis

For this project we also analyzed the call types and workload for each unit. As explained in Appendix A, workload sometimes does affect response time performance. As units become busier, they are sometimes unable to handle all of their first-due area calls, which may affect response time performance depending on how close other stations are located.

Generally speaking, units in high demand downtown areas with closely spaced stations can get away with higher workloads because other stations can adequately cover their first due areas. More suburban and rural areas, where fire station coverage areas do not typically overlap, are much more susceptible to response time issues, especially when workloads get heavy.

Table 11 presents the responses by station and unit, and Figure 15 shows the amount of time spent on calls (unit hours) for each fire unit. We grouped different unit types (engines, heavy rescues quints, and trucks) to allow us to see how each unit's workload compares with both its group and the entire fleet.

Table 11: Response by Station and Unit, July 2010-June 2011

Station	Engine	Heavy Rescue	Quint	Truck
Station 1	1479	2065	–	770
Station 2	1034	–	–	–
Station 3	1021	–	–	–
Station 4	–	–	1503	–
Station 5	115	–	–	–
Station 6	686	–	–	–
Station 7	933	–	–	–
Station 8	1219	–	–	451
Station 10	516	–	–	–
Station 11	460	–	–	–

Figure 15: Workload (Unit Hours) by Unit and Incident Type, July 2010-June 2011

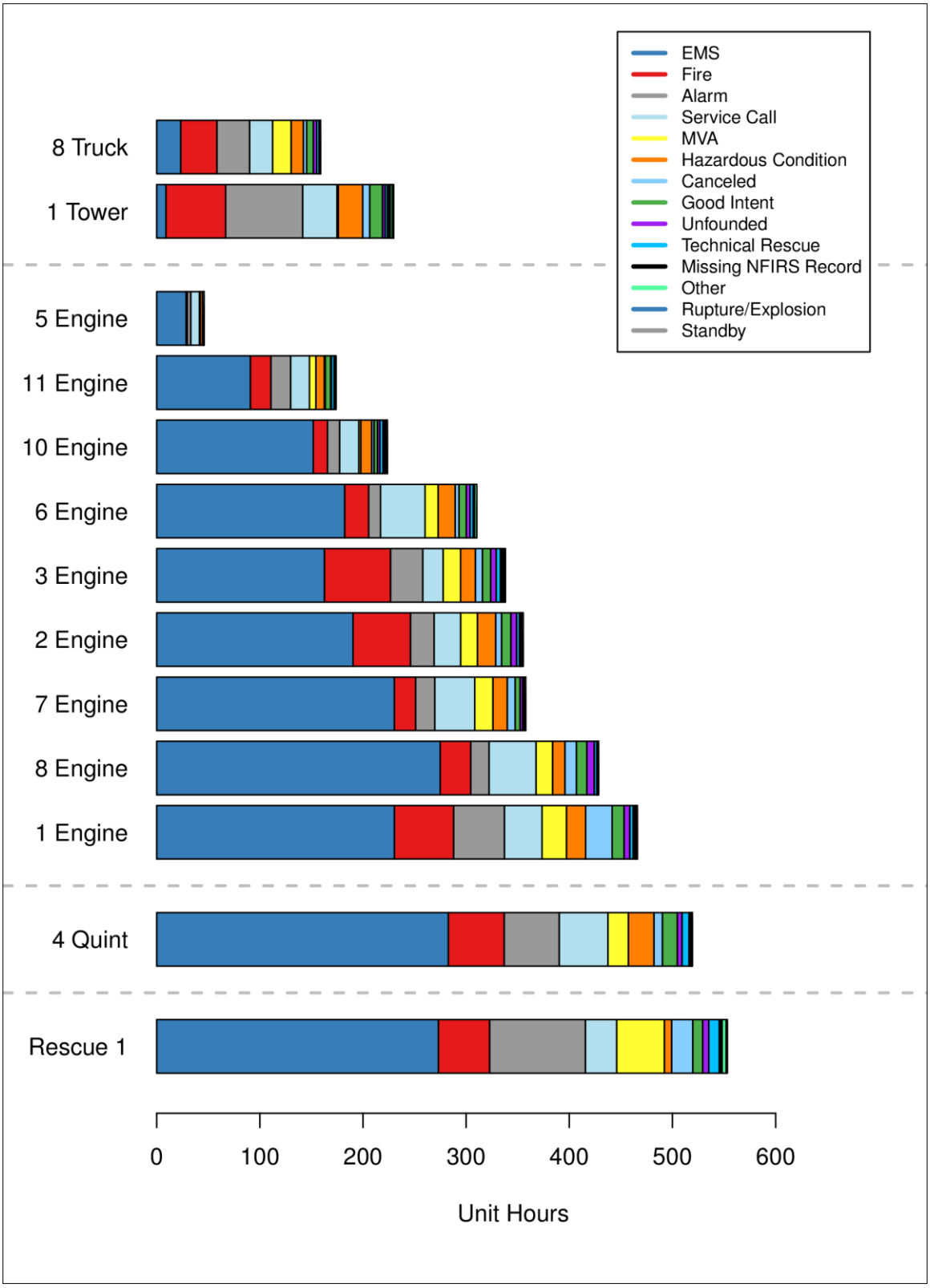


Table 12: Heavy Rescue Workloads by Unit, July 2010-June 2011

	Total Runs	Runs per Day	Total Unit Hours	Unit Hours per Day	Unit Hours per Run
Rescue 1	2072	5.7	555	1.5	0.27
(average)	2072	5.7	555	1.5	0.27

Table 13: Truck and Tower Workloads by Unit, July 2010-June 2011

	Total Runs	Runs per Day	Total Unit Hours	Unit Hours per Day	Unit Hours per Run
I Tower	771	2.1	230	0.6	0.30
8 Truck	455	1.2	164	0.4	0.36
(average)	613	1.7	197	0.5	0.32

Table 14: Engine Workloads by Unit, July 2010-June 2011

	Total Runs	Runs per Day	Total Unit Hours	Unit Hours per Day	Unit Hours per Run
1 Engine	1479	4.1	466	1.3	0.32
2 Engine	1034	2.8	355	1.0	0.34
3 Engine	1021	2.8	338	0.9	0.33
4 Quint	1503	4.1	519	1.4	0.35
5 Engine	115	0.3	46	0.1	0.40
6 Engine	686	1.9	310	0.8	0.45
7 Engine	933	2.6	358	1.0	0.38
8 Engine	1219	3.3	428	1.2	0.35
10 Engine	516	1.4	224	0.6	0.43
11 Engine	460	1.3	174	0.5	0.38
(average)	897	2.5	322	0.9	0.36

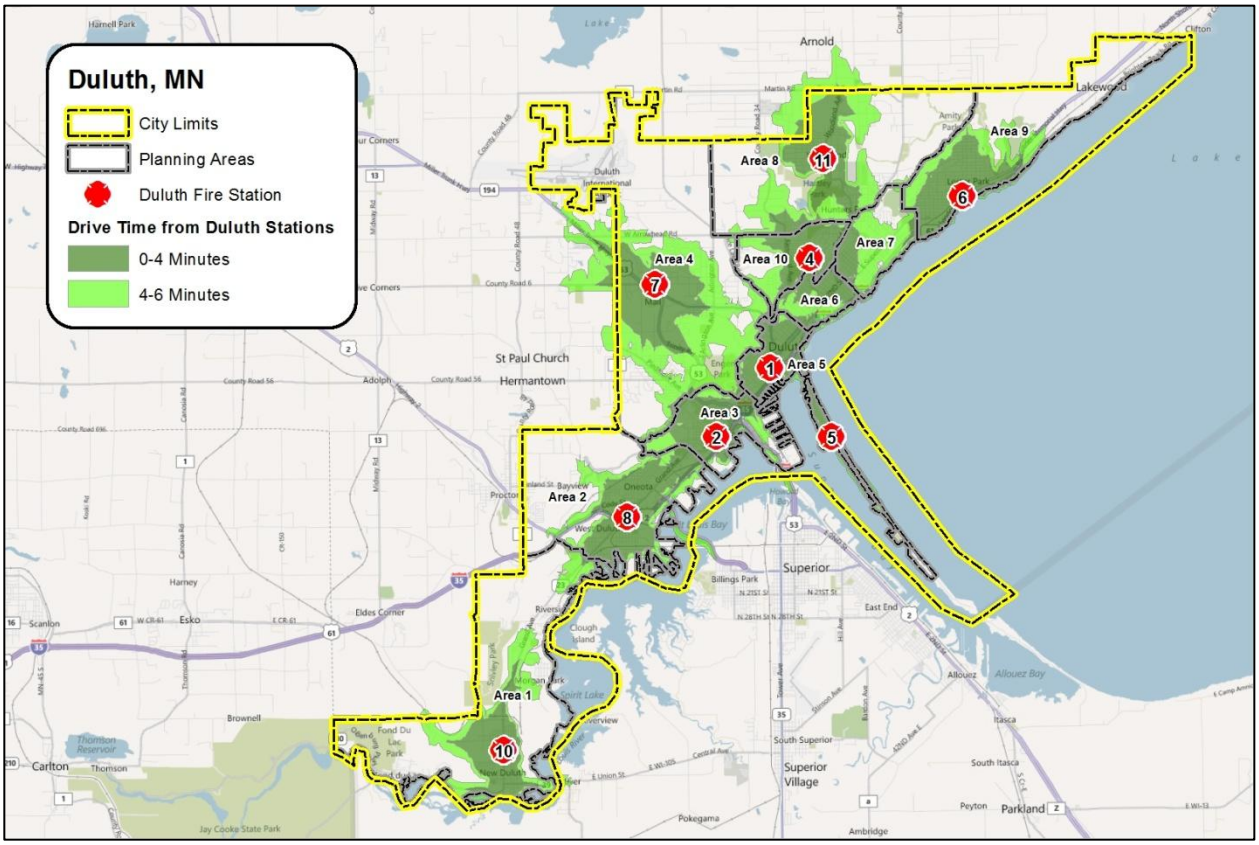
Table 12 through Table 14 break down the analysis by heavy rescue, truck/tower, and engines/quint, respectively. Last year, the heavy rescue had 2,072 runs, with an average of 1.5 unit hours spent on 5.7 runs per day (Table 12). The truck and tower averaged 613 runs, with 0.5 unit hours spent on 1.7 runs per day (Table 13). Engines averaged 897 runs per year with 0.9 unit hours spent responding to 2.5 calls (Table 14).

Overall, Duluth Fire Department units have a workload that ranges from very low to high, depending on the unit type (see Appendix B for a description of workload levels). Rescue 1 had the highest workload with 2,072 runs and Engine 5 had the lowest workload with 115 runs. Units with "very low" workload (under 500 responses per year) include Truck 8, Engine 5, and Engine 11; units with "low" workload (500-999 responses per year) include Tower 1, Engines 6, Engine 7, and Engine 10. All the remaining units other than the heavy rescue had "moderate" workload (1,000 to 1,999 responses per year). The heavy rescue unit was just above the "high" workload threshold (2,000 to 2,999 responses per year). If population and emergency services demand in Duluth slightly increases, it can be expected that these workloads will also slightly increase.

Review of Current Fire Station Locations

In this section, we present an analysis of fire station locations using Geographic Information System (GIS) software. TriData also visited each fire station to get a feel for its location and overall condition. This allowed us to understand the location of the fire stations relative to the area protected, not just from a GIS map. Figure 16 shows the current location of all the Duluth fire stations, as well as the theoretical travel time from each of the stations. Areas in dark green can theoretically be reached in four minutes, and areas in light green can be reached in six minutes.

Figure 16: Current Fire Station Locations

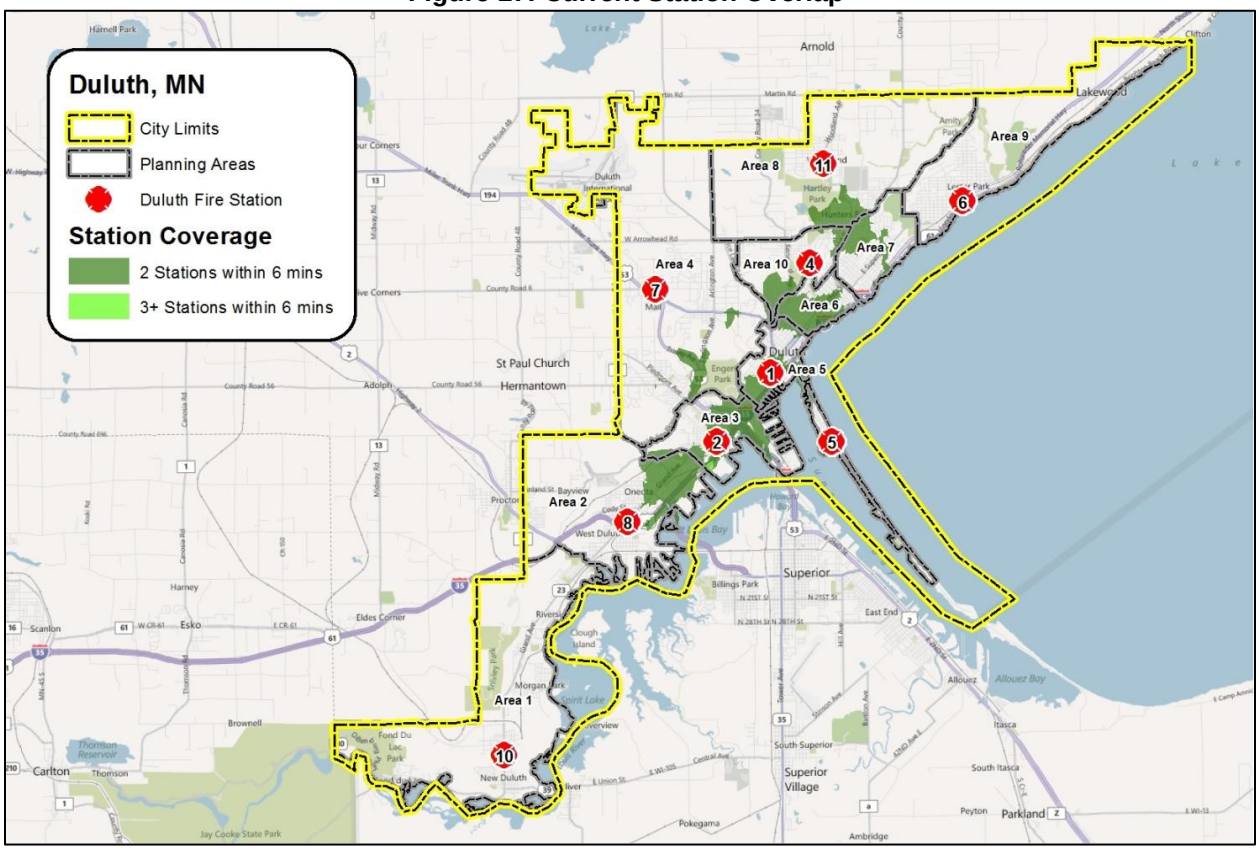


As the fire stations are currently laid out, they provide fairly good coverage for the city, but there are some coverage gaps. In particular, there are two areas that cannot be reached within 6 minutes travel time: one area between Station 8 and Station 10 and another north of Station 6. Both of these coverage gaps fall in areas that have low population density and limited emergency services demand. Ideally, all areas of the city are covered within a 6-minute travel time, but not necessarily practical. These coverage gaps are of limited concern because of where they fall.

Coverage is only one component of an effective station layout because it does not take into account that some areas are more likely to have concurrent emergency incidents. Some coverage overlap is necessary in the areas of highest demand.

Figure 17 shows how many stations can reach each part of the city within six minutes (coverage overlap). The fire and EMS incident density plots in the previous chapter showed that the majority of emergency services demand occurs in Planning Areas 3, 5, and 6 along the Interstate 35 corridor. It is beneficial to have some station overlap occur in these areas of higher demand (where concurrent calls are more likely). The current layout of fire stations does provide some coverage overlap in these areas, meaning at least two fire stations can reach them within six minutes travel time.

Figure 17: Current Station Overlap



Evaluation of Possible Fire Station Location Changes

The theoretical drive time map (Figure 18) showed good citywide travel time coverage and the coverage overlap map (Figure 19) showed good 6-minute coverage overlaps in those areas with the highest demand. The goal for this station location analysis is to consider whether it is possible to maintain this level coverage with fewer stations. We specifically reviewed the following possible station location changes, because of their location, low call volume and staffing configurations:

- Elimination of Station 5
- Elimination of Station 11
- Moving Station 6 and Eliminating of Station 11

Based on our analysis in the rest of this chapter, it appears that closing Station 5 would increase response times to the Park Point area and that closing Station 11 would create a significant coverage gap. There may, however, be an opportunity to merge Station 6 and Station 11 to a new central location above Northland Country Club along Glenwood Street. This possible new station location could provide nearly the same coverage as the two individual stations.

Elimination Station 5 – Station 5 is currently manned by a single firefighter and provides coverage to an area with very limited population density and almost no call volume. Engine 5 has, by far, the lowest workload (115 calls) and, on average, runs less than one call every three days.

Figure 18 shows that most of the peninsula is currently covered by a 6-minute travel time. If Station 5 were taken offline (Figure 19), the north peninsula would still be covered by a 6-minute travel time, but areas south of current Station 5 may have travel times longer than 10 minutes. Although eliminating Station 5 would significantly decrease coverage for the peninsula, it is important to remember that, in terms of population density, this is considered a rural area (less than 1,000 people per square mile) and longer response times are generally considered acceptable. Ultimately, the city of Duluth must decide what level of protection is appropriate for this area. There are many rural areas throughout the US that do not have 6-minute travel times from the nearest station.

Figure 18: Current Coverage with Station 5

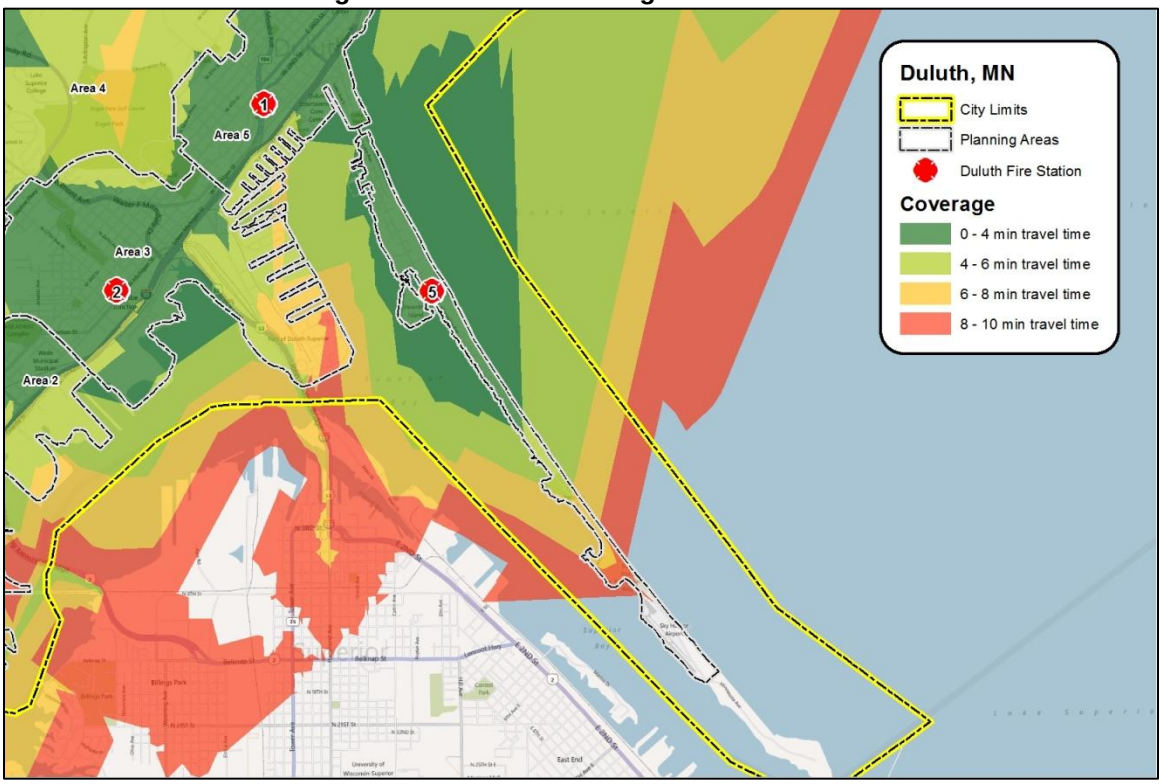
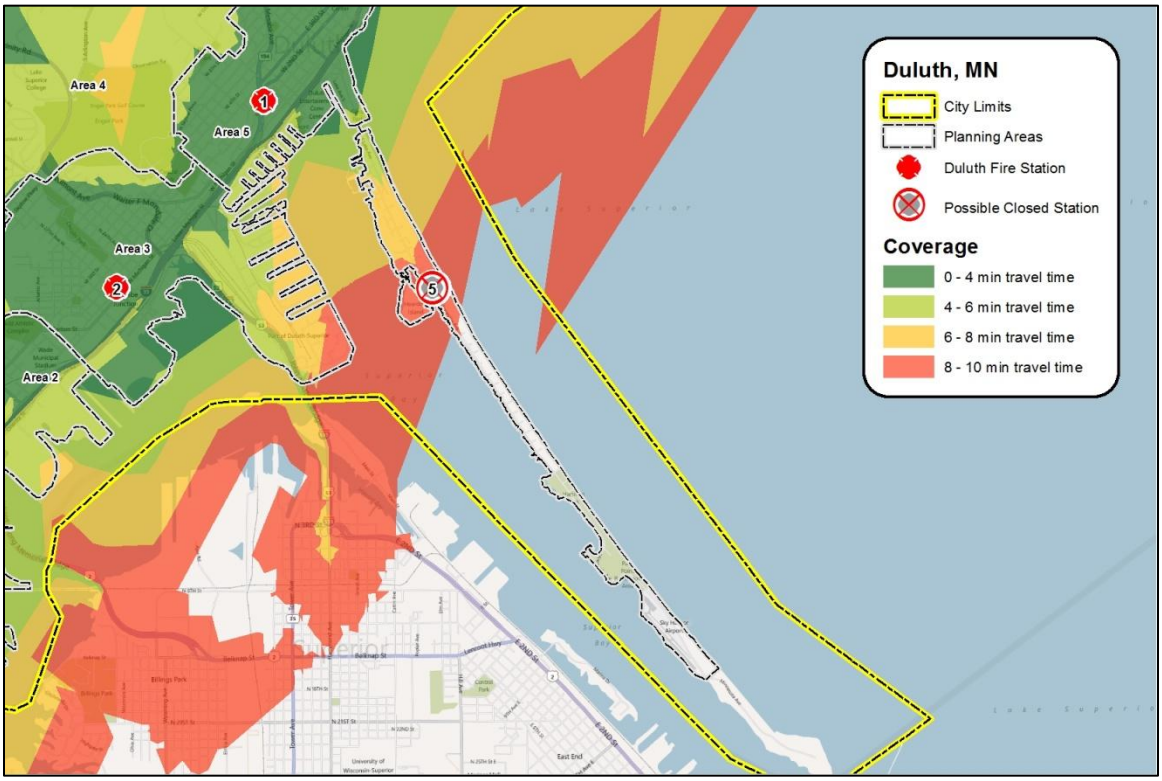


Figure 19: Coverage with Station 5 Eliminated



Elimination of Station 11 – Because of the condition, location and staffing configuration at Station 11(and DFD as a whole), our team seriously considered the elimination of this station. We found that eliminating Station 11 would significantly decrease coverage for Planning Area 8. Figure 20 shows that most of this area is currently covered by a 6-minute travel time. If Station 11 were eliminated (Figure 21), this area of the city would lose adequate fire coverage. Response times to the areas currently served by Station 11 would range from 6 minutes (for areas south of Station 11) to more than 10 minutes (for areas north of Station 11). Although Planning Area 8 has the lowest emergency services demand of all the planning areas, it does have an urban/suburban population density and reasonable response times here are necessary. Because of the impact on response times, Station 11 cannot be eliminated without otherwise changing the fire station layout.

Figure 20: Current Coverage with Station 11

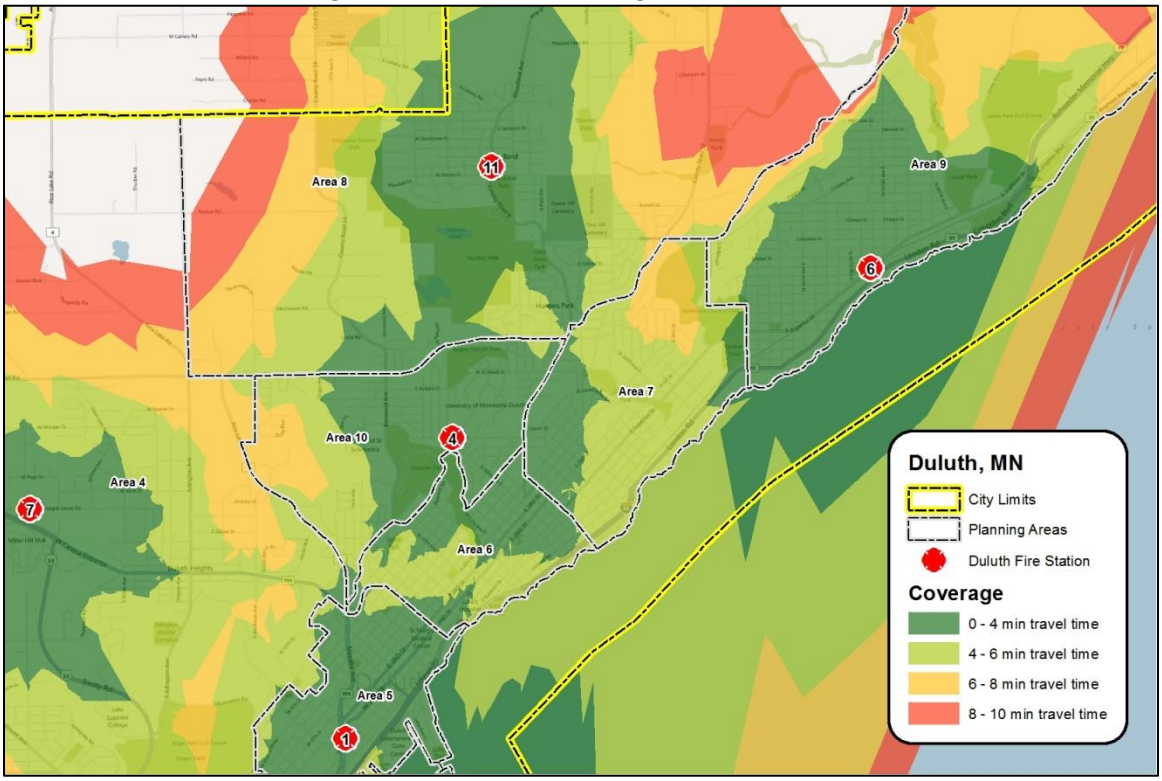
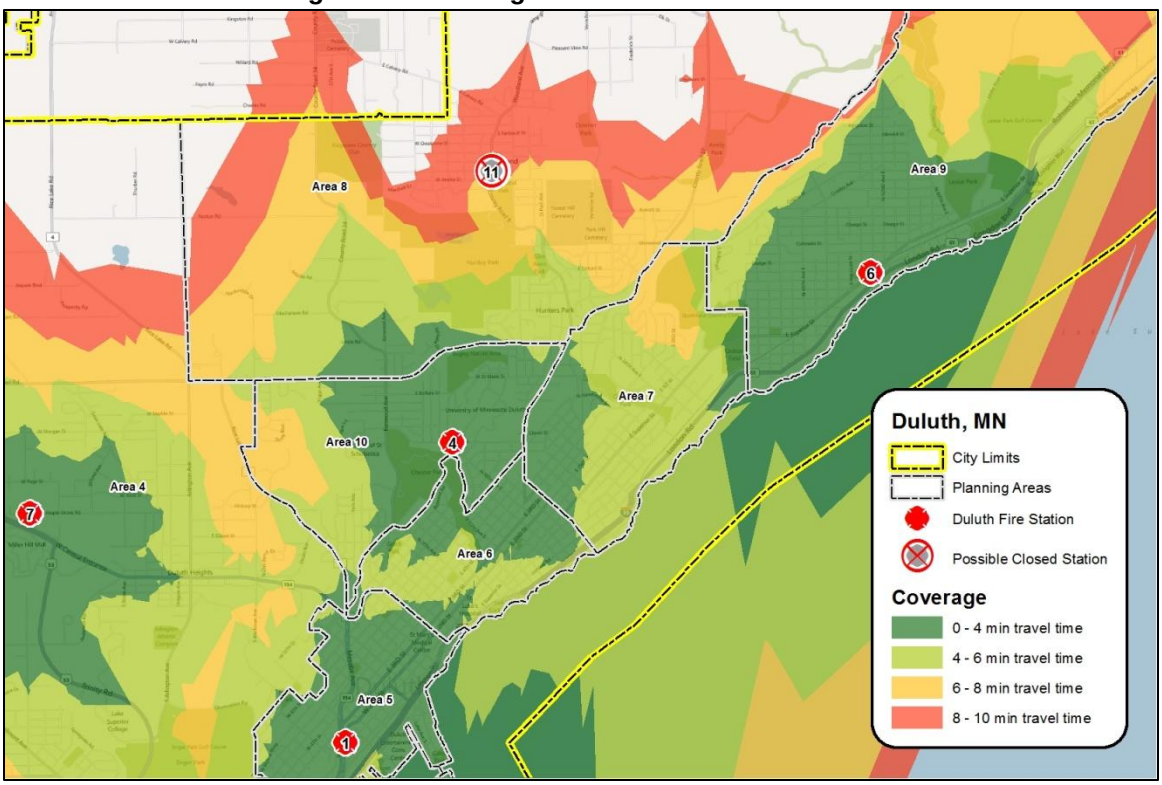
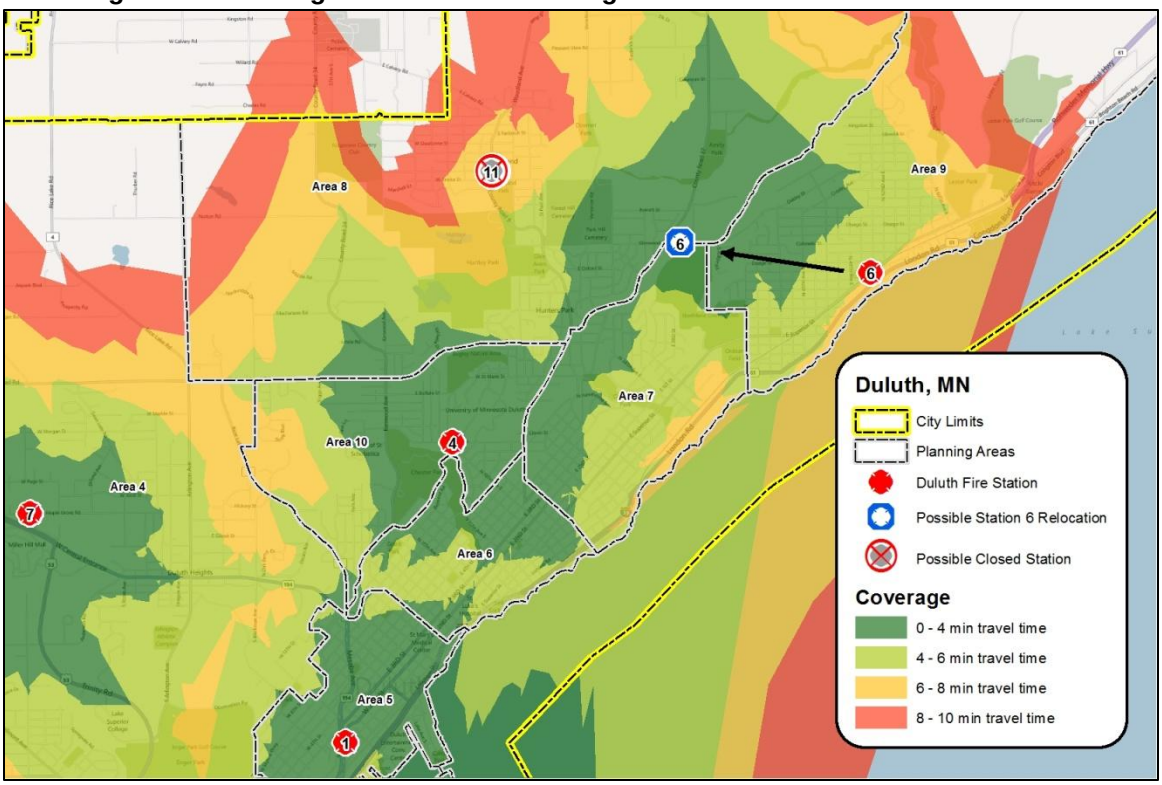


Figure 21: Coverage with Station 11 Eliminated



Moving of Station 6 and Elimination of Station 11 – Because both Station 11 and Station 6 have relatively low workloads, we also considered whether it might be possible to merge these two stations to a single location. Figure 22 shows the coverage that would be provided if Station 6 were moved to Glenwood Street north of the Northland Country Club and Station 11 was eliminated. This move would slightly decrease coverage, but much less so than just eliminating Station 11. The waterfront area near current Station 6 would be covered by a 6-minute travel time instead of a 4-minute travel time; the area just north of current Station 11 would be covered by 6-8 minute travel time instead of a 4-minute travel time. Both Station 6 and Station 11 have low workloads (Engine 6 has 686 annual responses and Engine 11 has 460 annual responses). If the newly merged station maintains approximately the same first-due area as the current Stations 6 and 11, the unit at the merged station would have approximately 1,200 annual responses (considered the low end of "moderate" workload).

Figure 22: Coverage from a Possible Merged Station 6 and Station 11 Location



Overall, the current station layout provides good coverage for the City of Duluth and appears to do it with as few stations as possible. In the long term it is advisable to, at the very least, explore the merger of Station 6 and 11. The move would create an overall decrease in coverage but in an area with a relatively low call volume. On the other hand it would create concomitant efficiencies throughout the whole system with regard to staffing. Eliminating Station 5 is essentially a question of what level of protection is appropriate for Park Point. Does 100 low level, mostly non-emergent calls per year warrant a fire station staffed with one person and all of the attendant liabilities that configuration brings? We don't believe so. Ultimately however it will be up to the City administration, DFD and citizens to decide the level of protection that is appropriate.

5. FIRE AND EMS OPERATIONS

This chapter discusses the current operational profile of the DFD including the different operational policies used by the department. Operational profile is the set of independent operations the DFD performs to deliver fire, rescue, and EMS services.

To provide effective service, fire departments should have an operational profile that permits them to provide a good level of service consistent with the demands of the community. Sometimes the decision about the type of operating profile to use is consistent with the demand and sometimes, as is the case with many communities, it is not. In these cases, the decision about what type of operating profile is best for the community is not made by a rational decision making process, but rather, is the result of incremental policymaking or is based on tradition.

Overview of Current System

DFD is a full service department, which provides fire, EMS, special operations, and emergency management services to the citizens of Duluth. Fire and EMS services are delivered from nine stations with thirteen apparatus. Nine stations are staffed with a department total of 13 fire companies. Resources include: 9 engines, 2 ladder trucks, 1 quint, and 1 rescue squad. In addition, there are several specialty units including two rescue boats, State Chemical Assessment Team, and confined space trailer.

DFD is operationally sound. The residents of Duluth can be assured that on the street level they are receiving competent fire emergency service. It is very traditional in its delivery system (although sparse in some areas/stations), which is totally designed to devote a majority of its effort and resources toward fire suppression. It is a philosophically aggressive department in its approach to fighting fire and is quite competent in its ability to implement operations.

Current Fire Stations – Duluth Fire Department currently provides fire and rescue services from 9 stations located in various parts of the city. The current station location and staffing model has been the operational mechanism used by the department for decades. The model is a result of many factors, but it is generally a product of population increases and decreases, changes in demand for emergency service and the political environment. The same can conceivably be said for most jurisdictions throughout the U.S.

The stations range from single unit one bay stations at stations 5, 10, and 11, to 6 bays at headquarters which houses 2 engines, a tower, a rescue, assistant chief, and several reserve and support vehicles. Station condition ranges from very good to deplorable and gender accommodations also range from poor to very good. Most stations have had or are getting remodels to improve living conditions and upgrade energy efficiency. All of the stations have been equipped with interactive closed circuit television (CCTV) with broadcast capabilities that are used extensively for training purposes to great effect (for training only).

Station 1 – Station 1 (Headquarters) is actually a combination of two companies. It houses Engines 1 and 3; Tower 1; Rescue 1; and Squad 251. There are currently 13 shift personnel assigned to this station daily. Additionally Headquarters is where DFD administration is located which includes: Fire Chief, Deputy Chief, Training Officer, and administrative assistant. The Life Safety division consisting of the Fire Marshal, 2 deputy Fire Marshals, lead housing inspector, 4 housing inspectors, solid waste compliance officer, and 2 administrative support staff is located in newly renovated offices in the lower level of headquarters that enhance customer service and the one stop shop concept.

Figure 23: Station 1

Station 2 – Station 2 Houses Engine 2, which is staffed by 3 personnel and is the regional HazMat unit. Station 2 was built in 1970's and in good condition with remodeling underway. It is centrally located and well placed for the district it serves (one of the busiest), and is more than adequate for the housing of both personnel and apparatus.

Station 4 – Station 4 was built in 1970's and has had no remodels. It houses one quint (Q-4). It is in a growing area with call increasing. Quint 4 is the only 4 person rig in DFD. Station 4 can get to 2nd and 3rd due areas very quickly.

Figure 24: Station 2

Figure 25: Station 4

Station 5 – Station 5 was built in 1920's and is in deplorable condition. Several efforts to renovate Station 5 have been delayed because of a reallocation of funds until the Station 5 situation is reassessed. It houses 1 engine (E5) but is too small for a regular engine in the bay area due to door height and bay length. Station 5 is a strong candidate for consolidation/elimination due to its level of activity and staffing with only 1 firefighter.

Station 6 – Station 6 was built in 1911and remodeled in 2001. The single bay station houses 1 engine staffed by 2 personnel. Station 6 is also a Duluth Police Department substation.

Figure 26: Station 5

Figure 27: Station 6

Station 7 – Station 7 was built in 1976 and houses 1 engine company. It is in fair to good shape and E-7 is staffed by 3 personnel.

Station 8 – Station 8 was built in 1990's and has subsequently been remodeled. The station has 2 bays and an ample apparatus floor which house: 1 engine and 1 truck (105' stick). Station 8 shares the building with a library and a police substation. It too is well placed for the immediate community/district it serves. It also acts as the primary backup company(s) for Engine 10. While being the closest station to Engine 10 there are still 8 to 10 (or more) minute response times to Station 10's area.

Figure 28: Station 7

Figure 29: Station 8

Station 10 – Station 10 was built in 1927 and has been recently remodeled and is in good shape. This one bay station houses Engine10, which is staffed by 2 personnel. The one bay does not have the height required to house a ladder truck so this station will always relegated to an engine company unless major, expensive renovations are performed. Part of this building is now unoccupied.

Station 11 – Station 11 was built in 1920's. It is the original station and in poor condition. It houses 1 engine staffed by 2 personnel and is a candidate for consolidation due to low call volume and ability of stations 4 and 6 to respond into 11's area quickly.

Figure 30: Station 10

Figure 31: Station 11

Current Staffing Profile – The staffing structure used by DFD is a product of two features, first is the nine-station system, which is DFD and second is the authorized departmental complement for fire and EMS operations. Staffing 13 rigs with 42 personnel of which 36 are assigned to specific apparatus nets an average staffing per unit of 3 personnel. However the actual staffing profile is much more complicated as listed below:

Table 15: Current Deployment by Station

Station	Unit Designation	Number of Staffed Personnel Per Unit
Station 1	E1	3
	E3	3
	R1	3
	T1	3
	S251	1
Station 2	E2	3
Station 4	Q4	4
Station 5	E5	1
Station 6	E6	2
Station 7	E7	3
Station 8	E8	3
	T8	3
Station 10	E10	2
Station 11	E11	2
Staffing Pool		6
Total		42

TriData in the over 200 studies we have performed has not experienced a staffing profile quite like DFD's. In many respects we found it quite inconceivable in terms of fire industry standards and operating procedures to find engine companies staffed with one and two personnel, which actually respond to emergency fire calls. Two person response vehicles in smaller rescue

units or in rapid response vehicles to EMS calls are certainly practiced regularly. Only one jurisdiction nationwide that we are aware of utilizes one-person response modalities other than DFD, and that is in a much different context and involves a specific response program/plan. We have also found volunteer organizations respond in this mode, with the caveat that more personnel/membership are potentially responding in their personal vehicles.

Two key issues of concern are to be drawn from this profile. Station 5, which is staffed with a single firefighter and Stations 6, 10 and 11, which are staffed with two personnel are units that are not only ineffective from a fire suppression standpoint, but they are also potentially dangerous for the firefighters as well as potentially disastrous for Duluth citizens.

Station 5 with the single firefighter is also a potential risk in EMS incidents since this individual could be injured, taken hostage, or killed by a deranged individual without any means of backup. There is also the potential for a civil suit against the city for sexual harassment or inappropriate behavior by the firefighter which would be nearly impossible to legally defend even if the incident did not occur.

Stations 10, 6 and 11, though able to handle most BLS/EMS incidents would also be at risk in the structural fire incident where rescue is immediately needed since the 2 personnel would be without on scene backup for quite some time. This commitment of all available personnel to rescue without back up would also potentially be noncompliant with OSHA regulations and industry standards. Stations 2, 6 and 7 are staffed with 3 personnel for the assigned apparatus, which could pose the same if lesser risks as stations 6, 10 and 11. Three personnel on an assigned company is slightly more common, and with multiple response backup a bit more acceptable than one or even two person staffed engine and ladder companies, which in our opinion is unacceptable.

Station 4 has 4 personnel assigned to the single apparatus assigned there and as such is compliant with all regulations and industry standards. Stations 8 and headquarters have multiple companies assigned to the stations and are capable of providing sufficient personnel on first due assignment to be safe and effective in EMS and fire emergencies.

Alarm assignments for a typical call are as follows:

1st Alarm All Structures	MVA	2nd Alarm	3rd Alarm	Automatic Alarms
3 Engines 2 Ladder 1 Assistant Chief 1 Rescue	2 Engines 1 Assistant Chief	2 Next Closest Engines 3rd Ladder	Special Call for DFD-wide Resources	1 Engine 1 Truck 1 Rescue 1 Assistant Chief

Staffing and Overtime Analysis

For this study we conducted a staffing-factor and overtime analyses. A staffing factor is the ratio of FTE positions per minimum on-duty position requirements. Because fire departments are 24/7 operations, the staffing factor (multiplier) determines the level at which to staff the department based on its daily staffing requirements.

Staffing Factor – To determine the DFD staffing factor we examined leave data for all fire personnel for an entire year. The staffing factor is based on the total number of hours in a year (8,760) divided by the average number of available hours for a single firefighter. Duluth firefighters are paid for 2,920 hours per year, but because of holidays, vacation, sick leave, other time off, and other duties such as training, a firefighter is not really available to work all 2,920 hours.

On average, each firefighter was absent an average of 434 hours during FY2011-2012. Thus, a firefighter is only available to work 2,486 hours. The staffing factor to cover one on-duty position 24x7 (8,760 hours per year) is 3.51; that is, it takes 3.51 firefighters (8,760 ÷ 2,486=3.51) for every position filled 24/7. An example of how to compute the staffing factor is illustrated in Table 16.

Table 16: Illustration of Staffing Factor Calculation

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 Per Year	***-434***
G	Number of Productive Hours per Employee per Year (E-F)	2,486
H	Staffing Factor (E / G)	1.17
I	Number of Employees Needed per Position for 24/7 Staffing (H X D)	3.51

A minimum of 141 FTE position are needed to staff the current shift fire system comprising one battalion chief, nine engines one rescue and two ladders 24/7. Of that 141 DFD has 126 FTEs that actually respond to fires. The overtime budget appears to be within respectable levels given that 141 FTE positions is the authorized strength for the DFD.

Some overtime will always be incurred because of daily staffing fluctuations that require more firefighters to be off above the norm. Overtime often costs less than carrying more firefighters—the cost of overtime may be less per hour worked if benefits are considered. The tipping point depends on whether the overtime is earned by experienced higher paid firefighters vs. full time entry level firefighters. It may be surprising to those who hold the widespread belief that overtime significantly drives up costs. In fact, if you don't spend enough on overtime, and have extra full time firefighters above the number needed each day, it costs more, not less.

Current Apparatus – DFD frontline apparatus include:

Table 17: DFD Frontline Apparatus

FD Apparatus No.	Make	Model	Year	Apparatus Type	Station	No. of Years	Mileage
7303	International	FMC	1981	Fire Engine 5	5	30	70,155
7314	Duplex	LTI-L-111-86	1986	Fire Quint (Reserve)	4	25	89,412
7318	Ford	L-9000	1991	Fire Engine 3 (Reserve)	1	20	103,029
7321	Pierce	ARROW	1995	Fire Truck 8	8	16	73,179
7322	Freightliner	FL80	1996	Fire Engine 2	2	15	92,837
7323	Freightliner	FL80	1996	Fire Engine1 (R)	1	15	109,092
7332	Freightliner	FL70	1996	Fire Engine 10	10	15	69,441
7333	Freightliner	FL70	1996	Fire Engine 6	6	15	90,100
7334	Pierce	DASH	1998	1 Tower	1	13	59,323
7340	American LaFrance	E134064S	2000	Fire Quint 4	4	11	89,632
7344	Freightliner	FL80	2001	Fire Engine 11	11	10	55,861
7345	American LaFrance	METRO	2001	Fire Engine 3	1	10	60,260
7349	American LaFrance	METRO	2002	Rescue 1	1	9	81,055
7354	Freightliner	MM1540425	2006	Fire Engine 7	7	5	40,715
7358	Freightliner	M2	2007	Fire Engine 8	8	4	30,734
7362	Freightliner	M2	2010	Fire Engine 1	1	1	12,564

Apparatus Types and Deployment Conclusions

It is our conclusion that the apparatus types used in Duluth are appropriate, and with the exception of Station5, the deployment of stations for a city laid out the way Duluth is, that the stations are appropriately located. The apparatus placement in the stations can be modified to better utilize staffing configurations and maximize staffing per unit in a more efficient and safety conscious manner (more on this later in the report).

Fire/Rescue Operations

Fire – Staffing continues to be the most important challenge for the Fire Department. DFD is currently working with mutual aid and automatic aid partners to ensure that they have adequate response resources when a large-scale event happens in Duluth. DFD continues to redeploy resources around the city to best address public safety needs as they arise. Over 90% of Fire Department employees provide direct emergency service on the street. A key issue for the future is finding new leaders in the Department that are willing to transition from emergency

response to an administrative position. Creating a work environment that features effective communication, outstanding labor management relations, and increasing morale will be a priority for the Fire Department over the next five years. Starting in 2011 and continuing into 2012, the department will conduct employee surveys to capture information about the workforce's educational background, job satisfaction, and continuing education needs. The department will continue to seek feedback, and to refine a strategy that will address effective communication, labor management relations and morale.

The fire department has operated under the same staffing model for decades. This model directs most of resources into fire operations/fire stations. There are limited number of managers, resulting in an inefficient span of control, lack of time for planning, difficulty with new initiatives, lack of mentoring new leaders, and a status quo department mentality. After years of budget cuts, increasing workloads, and additional training requirements, there is a need to look at alternate ways to provide the services to the community. Change is difficult in public safety and probably for good reason. Rash decisions can have significant negative consequences. The fire department operational review will provide the necessary data to provide a roadmap for making educated and rational decisions in the future. Issues including the number of stations, apparatus staffing, response times, safety needs, and the type of services delivery should be addressed.

Emergency Medical Services

DFD currently provides BLS first responder service to the City of Duluth as a first tier of EMS services in the city. Gold Cross, a paramedic service attached to Mayo Clinics, provides ALS transport service.

All DFD personnel are at least EMT basic and several personnel have advanced certification including 6 paramedics. Each DFD front line unit has a complement of EMS gear onboard and is capable of providing first response basic life support in the City. In 2010 DFD responded to 5,297 EMS calls.

Gold Cross is the licensed ALS provider for Duluth, southern St. Louis County in Minnesota and Douglas County in Wisconsin. Gold Cross covers an area of 847 square miles including the 87 in the City of Duluth. Gold cross began as a private company in 1972. The company was sold to Mayo Clinics, a not for profit corporation in 1994. Gold Cross staffs 5 ALS ambulances for emergency response in the licensed response area. 3 ambulances are assigned to the Duluth metropolitan area. Additionally there is 1 supervisor and 3 shift captains assigned to the Duluth operations area. Gold Cross refused to supply TriData with the number of EMS calls they responded to last year or any year.

Gold Cross uses a flexible deployment model to pre-assign ALS units to areas where calls are most likely to occur based upon past experiences. This system also provides pre-staging locations to change based upon time of day and day of the week. The system also establishes a

move up protocol when first due units are unavailable such as on a call. Gold Cross has mutual aid agreements with all ambulance services, which adjoin the Gold Cross primary service area.

Gold Cross administrative personnel describe the relationship with DFD administration as good but state that this could be improved with more communications between the two entities. Street level interaction is also good but some treatment changes initiated by DFD would be more effective if vetted with Gold Cross before initiation. Also cited is a lack of coordination between Gold Cross and DFD medical control which would also help communications between the EMS agencies. Finally there is an issue with St. Louis County 911 dispatch dispatching many calls as emergency calls thus sending fire and EMS units responding with lights and siren to calls which are not true life threatening situations. This is again an issue of interagency communications. Gold Cross does not stage an ambulance on Park Point citing the lack of sufficient calls and the fact that most calls come from the 2 nursing homes located on Park Point. Gold Cross has a very high approval rating and citizen satisfaction quotient in the City of Duluth. They also maintain acceptable response time statistics. Table 18 and Table 19 illustrate an example of their 2009 performance standards.

Table 18: Gold Cross Citizen Survey: 2009

Category	Results
Timeliness of response	98.3% good, very good, excellent
Quality of care	98.3% good, very good, excellent

Table 19: Gold Cross 2009 Response Times – City of Duluth

Mean	Median	90th Percentile
6:31	5:57	10:45

ALS/EMS for DFD – A key issue for DFD is the implementation of ALS transport into the department. Patient satisfaction with Gold Cross service is 98.3% good or above. 90th percentile response time is 10 minutes and 45 seconds. DFD would need 1.5 years minimum after hiring to have staff trained to PM levels in sufficient numbers to staff enough ambulances to provide ALS care 24/7. A position description for paramedic would need to be developed and negotiated into the IAFF contract along with pay levels which could also take years to complete.

More supervisory staff and support staff would have to be hired to handle the program and maintain necessary levels of care. Duluth could not go this alone since the current state approved PSA includes 847 square miles, and Duluth is just 10% of this total geographic size. Gold Cross is delivering service with a customer approval rating of 93%.

Additionally DFD would have to partner with some type of service consortium to cover the entire primary service area currently covered by Gold Cross.

There are several factors to look at before the City of Duluth even considers this undertaking:

1. It will take at least one and one half years to get paramedics hired and trained in sufficient numbers to provide 24/7 service in the City according to the current DFD medical director.
2. This service expansion will require a minimum of 24 additional personnel to staff 4 ALS ambulance and 2 to 3 clerical and administrative staff to handle the increased support functions to keep the program running.
3. There will be a need for 5 ALS ambulances (4 frontline and 1 reserve) and all necessary onboard equipment to transport patients. There will also be a need to establish a CIP to see that units are replaced in a timely and safe fashion. There will be the overhead issues of fuel, repairs, expendable supplies.
4. Training to maintain proper licensure of the medics and the service will be an annual expenditure.
5. Stations will have to be assessed to see that there is space for the ambulances as well as the crews including work spaces for medics to complete documentation and times for all calls.
6. The cost of 24 paramedics including salary, benefits, uniforms, and many other financial needs must be met.

The following is a calculated estimate of the cost of adding 24 PMs to staff 4 ALS transport units in the City of Duluth:

- $65,788 equals the average base salary for OPS personnel ($8,157,800 budget/124 OPS positions)
- $72,788 equals the average salary for PM with 10% premium(the average industry wide collective bargaining premium) for working as medic on ambulance
- $94,078 equals the average salary for a PM with benefits at (30%)
- $2,257,872 would equal the estimated annual personnel costs for 24 medics to run ALS transport (this does not include 2 to 3 clerical positions for billing if performed internally and a command position for program oversight)

Probable personnel costs for the program would potentially be closer to $3M. The additional cost of five ambulances (four frontline units and one reserve) at approximately $175, 000 per unit, would equal $875,000.

A conservative estimate is that a DFD ALS transport system would cost approximately $4M a year to operate. If the program were to bill an average of $1000 per call and collect 60% of the billing cost (the average collected cost for many systems nationwide), DFD would have to generate 6,667 calls per year to break even with no variables such as fuel cost increases, major vehicle breakdown, capital replacement costs, etc.

The bottom line is the fact that the current ALS transport provider, Gold Cross, has no short or long term desire to stop providing the service and is doing a good job. DFD would need at least one and one half years to get up to speed with training, capital expenditures, infrastructure, etc. Moreover, the revenues generated from this additional service delivery may not provide the funds needed to be a break even proposition much less a revenue generating operation.

It is logical that a better way to improve patient outcomes is by enhancing communications between DFD and Gold Cross administration, medical directors, and ultimately duty staff. This would include training together, vetting any treatment changes in both agencies, and scheduling top level meetings where both DFD and Gold Cross can plan strategically to better serve the citizens of Duluth. The current DFD basic EMT level service backed up by Gold Cross ALS service is working and with improved interaction and communications this EMS service model will continue to deliver first class service to the citizens of Duluth.

6. BENCHMARKING AND INTERJURISDICTIONAL COMPARISONS

In choosing cities for comparison, we considered population size, density, services offered (especially whether there is EMS and EMS transport), climate, socioeconomic factors (age, poverty levels, ethnic groups), number of operations staff on duty per 1000 population; and the average work week of firefighters. We also considered whether fire incidence and fire losses were comparable. We included Minnesota area communities and communities elsewhere including other Midwest cities. We show how Duluth Fire Department ranks among the set of comparison cities and against the means.

Interjurisdictional Comparisons

To put a department's performance in perspective, it can be helpful to compare the department with other organizations that share similar characteristics. In doing so, department leaders can identify benchmarks that can be used to assess their own performance. When these comparisons are drastically different, further evaluation is required.

Jurisdictional comparisons can be difficult to interpret as there are many variables. No two jurisdictions are exactly alike in terms of geographic size and features, population dynamics, governmental organization and services provided. Many jurisdictions, however, do share some similar qualities that are useful for comparison. While these comparisons are not direct indicators of departmental performance, they do provide a valuable function in assessing a department in relation to the performance of its peers. This direct comparison identifies organizational strengths and suggests areas for improvement.

All the jurisdictions chosen for comparison possess characteristics similar to Duluth. The data used was obtained from websites, through direct contact with the departments and from surveys, U.S. Census 2010 estimates, and other TriData research. We compared several different attributes on a per capita basis including: stations and equipment, cost, demand for service, and staffing. Averages shown in the comparison tables were calculated without Duluth included.

Population

Duluth, like many cities, sees an influx of people during the workday. As is shown in Table 20, the daytime population of Duluth is 15 percent greater than the nominal population, which is slightly less than in comparable jurisdictions. An interesting fact about Duluth is that the area of the city is almost double the size of comparable jurisdictions.

Table 20: Comparison of Populations Served by Various Jurisdictions, 2009

Jurisdiction	Population (2010)	Area (Square Miles)	Density (Pop/Square Mile)	Daytime Pop. Change	% Daytime Population Change
Roanoke, VA	97,032	43	2,262	25,853	26.64%
Charleston, WV	51,400	32	1,627	38,087	74.10%
Green Bay, WI	104,057	45	2,312	13,072	12.56%
St. Cloud, MN	65,842	40	1,646	17,578	26.70%
Kenosha, WI	99,218	27	3,675	(8,045)	-8.11%
Aurora, IL	197,899	45	4,398	(14,921)	-7.54%
Bloomington, MN	82,893	35	2,368	36,336	43.83%
Dearborn, MI	98,153	24	4,090	50,065	51.01%
Waukegan, IL	89,078	24	3,712	(4,625)	-5.19%
Racine, WI	78,860	15	5,257	4,217	5.35%
Davenport, IA	99,685	63	1,582	10,887	10.92%
Brooklyn Park, MN	75,781	26	2,906	(13,809)	-18.22%
Boulder, CO	97,385	25	3,948	36,427	37.41%
Rapid City, SD	67,956	55	1,226	11,224	16.52%
Average	**93,231**	**36**	**2,929**	**14,453**	**19.00%**
Median	**93,055**	**33**	**2,637**	**12,148**	**14.54%**
Duluth, MN	***86,265***	***68***	***1,272***	***12,906***	***14.96%***

Duluth has a total of 9 stations that each covers 7.5 square miles. Comparable jurisdictions average 5.7 square miles per station as shown in Table 21. Duluth stations serve an area larger than comparable jurisdictions, however, the population being served per station is only 64% of the comparable jurisdictions average.

Table 21: Comparison of Population Served per Stations, 2009

Jurisdiction	Population (2010	Area Served (Square Miles)	Number of Stations	Population/Station	Square Miles/Station
Roanoke, VA	97,032	43	11	8,821	3.9
Charleston, WV	51,400	32	9	5,711	3.5
Green Bay, WI	104,057	45	7	14,865	6.4
St. Cloud, MN	65,842	40	4	16,461	10.0
Kenosha, WI	99,218	27	6	16,536	4.5
Aurora, IL	197,899	45	9	21,989	5.0
Bloomington, MN	82,893	35	6	13,816	5.8
Dearborn, MI	98,153	24	4	24,538	6.0
Waukegan, IL	89,078	24	5	17,816	4.8
Racine, WI	78,860	15	6	13,143	2.5
Davenport, IA	99,685	63	7	14,241	9.0
Brooklyn Park, MN	75,781	26	4	18,945	6.5
Boulder, CO	97,385	25	7	13,912	3.5

Jurisdiction	Population (2010	Area Served (Square Miles)	Number of Stations	Population/Station	Square Miles/Station
Rapid City, SD	67,956	55	7	9,708	7.9
Average	**93,231**	**35.6**	**7**	**15,036**	**5.7**
Median	**93,055**	**33.3**	**7**	**14,553**	**5.4**
Duluth, MN	***86,265***	***67.8***	***9***	***9,585***	***7.5***

Stations and Equipment

Each jurisdiction was also asked about the amount of apparatus staffed each day. Table 22 shows the number of engines, trucks, heavy rescues or squads, and quints for each jurisdiction.

Table 22: Comparison of Fire Apparatus's, 2009

Jurisdiction	Population (2010)	Engine Companies	Truck Companies	Rescue Companies	Quints
Roanoke, VA	97,032	10	3	1	1
Charleston, WV	51,400	8	2	2	1
Green Bay, WI	104,057	7	2	0	0
St. Cloud, MN	65,842	4	1	0	0
Kenosha, WI	99,218	5	2	0	1
Aurora, IL	197,899	9	3	2	0
Bloomington, MN	82,893	6	5	2	0
Dearborn, MI	98,153	5	3	0	0
Waukegan, IL	89,078	4	1	1	1
Racine, WI	78,860	4	1	1	2
Davenport, IA	99,685	8	3	0	0
Brooklyn Park, MN	75,781	6	1	4	0
Boulder, CO	97,385	7	1	0	0
Rapid City, SD	67,956	9	1	1	1
Average	**93,231**	**7**	**2**	**1**	**1**
Median	**93,055**	**7**	**2**	**1**	**0**
Duluth, MN	***86,265***	***9***	***2***	***1***	***1***

Table 23 takes the comparison another step by considering equipment per capita and the ratios among different types of apparatus. Key comparisons include the number of engines as a function of population, and the ratios of engines to trucks and other special service units. Special service units, mainly ladder trucks, are usually called to perform search and rescue of occupants as well as vital support functions to engine companies necessary for fire suppression, including forcible entry, ventilation, and electrical and natural gas utility control. A smaller engine to special service ratio value indicates a department with greater special service companies available to perform these duties.

Table 23: Suppression Equipment Ratios, 2009

Jurisdiction	Engine:Truck Ratio	Engine:Special Service Ratio	Engines/ 10,000 Population
Roanoke, VA	3.3	2.0	1.0
Charleston, WV	4.0	1.6	1.6
Green Bay, WI	3.5	3.5	0.7
St. Cloud, MN	4.0	4.0	0.6
Kenosha, WI	2.5	1.7	0.5
Aurora, IL	3.0	1.8	0.5
Bloomington, MN	1.2	0.9	0.7
Dearborn, MI	1.7	1.7	0.5
Waukegan, IL	4.0	1.3	0.4
Racine, WI	4.0	1.0	0.5
Davenport, IA	2.7	2.7	0.8
Brooklyn Park, MN	6.0	1.2	0.8
Boulder, CO	7.0	7.0	0.7
Rapid City, SD	9.0	3.0	1.3
Average	**4.0**	**2.4**	**0.8**
Median	**3.8**	**1.7**	**0.7**
Duluth, MN	***4.5***	***2.3***	***1.0***

This is the case in Duluth, which has a smaller engine to special services ratio than similar jurisdictions. When comparing Duluth to the average, Duluth has a slightly greater engine to truck ratio and engines per 10,000 residents than comparable jurisdictions. This is due to the fact that Duluth has a far greater number of engine companies, 9 in total, than the average of 7. There is a good reason for this which is directly related to the unique geographical layout of the City of Duluth. Hence we understand the prescription for more engines in the original operational planning for the city fire and emergency services, but feel that in this case the staffing of the engines is more important, and that DFD can operate in a safer environment with less engine companies and more personnel on those units (see Chapter 7).

Cost Per Capita

Cost per capita for fire protection gives a rough indication of efficiency; it does not consider quality of service. Never the less, while many factors play into this ratio, it can be useful to compare peer jurisdictions. Table 24 shows comparative costs per capita and indicates that Duluth, with an operating cost per capita of $154, is below the average of $182. When considering the operating cost per capita of $134 for the daytime population, Duluth is still below the average.

Table 24: Cost Per Capita, 2010

Jurisdiction	Population (2010)	Annual Budget	Budget per Capita	Budget per Daytime Population
Roanoke, VA	97,032	$19,000,000	$196	$155
Charleston, WV	51,400	$15,723,846	$306	$176
Green Bay, WI	104,057	$19,835,811	$191	$169
St. Cloud, MN	65,842	$7,650,900	$116	$92
Kenosha, WI	99,218	$19,667,455	$198	$216
Aurora, IL	197,899	$38,162,454	$193	$209
Dearborn, MI	98,153	$15,000,000	$153	$101
Waukegan, IL	89,078	$17,630,823	$198	$209
Racine, WI	78,860	$15,500,000	$197	$187
Davenport, IA	99,685	$11,847,192	$119	$107
Boulder, CO	97,385	$15,064,376	$155	$113
Rapid City, SD	67,956	$10,932,000	$161	$138
Average	95,547	$17,167,905	$182	$156
Median	97,209	$15,611,923	$192	$162
Duluth, MN	***86,265***	***$13,254,900***	***$154***	***$134***

Duluth exceeds the average for the amount of money spent on overtime. When comparing the overall percentage of the annual budget used to fund overtime Duluth uses a much higher percentage, of their annual budget, funding overtime than the average (Table 25).

Table 25: Percentage of Annual Budget Spent On Overtime, 2010

Jurisdiction	Annual Budget	2010 Overtime	Overtime Percentage of Budget
Roanoke, VA	$19,000,000	$77,000	0.4%
Charleston, WV	$15,723,846	$414,070	2.6%
Green Bay, WI	$19,835,811	$768,100	3.9%
Kenosha, WI	$19,667,455	$540,000	2.7%
Aurora, IL	$38,162,454	$1,459,736	3.8%
Dearborn, MI	$15,000,000	$195,000	1.3%
Waukegan, IL	$17,630,823	$80,000	0.5%
Racine, WI	$15,500,000	$324,565	2.1%
Davenport, IA	$11,847,192	$241,826	2.0%
Boulder, CO	$15,064,376	$927,608	6.2%
Rapid City, SD	$10,932,000	$405,225	3.7%
Average	$18,033,087	$493,921	2.7%
Median	$15,723,846	$405,225	2.6%
Duluth, MN	***$13,254,900***	***$527,500***	***4.0%***

Demand for Service

Demand for fire department services is effectively assessed in terms of calls per 1,000 residents. Table 26 shows that the Duluth Fire Department responded to 98 calls per 1,000 residents in 2010 far less than the average of 135. When looking at the daytime population, Duluth Fire Department responded to 86 calls per 1,000 residents in 2010, which is still below the average of 113. Duluth is below the average demand per capita for fire and EMS calls, while near equal to the average for other calls.

Table 26: Calls For Service Per 1,000 Residents, 2010

Jurisdiction	Total Calls per 1,000 Population	Total Calls per 1,000 DAYTIME Population	Fire Calls per 1,000 Population	EMS Calls per 1,000 Population	Other Calls per 1,000 Population
Roanoke, VA	251.3	198.4	54.2	197.1	
Charleston, WV	324.7	186.5	12.2	243.9	68.6
Green Bay, WI	93.9	83.4	2.7	69.0	22.1
St. Cloud, MN	60.8	48.0	3.8	40.0	17.0
Kenosha, WI	103.7	112.8	14.2	89.5	
Aurora, IL	77.0	83.3	1.6	58.1	17.3
Dearborn, MI	101.9	67.5	22.4	79.5	
Waukegan, IL	111.2	117.3	1.7	58.7	50.8
Racine, WI	115.8	110.0	6.0	95.3	14.5
Davenport, IA	148.6	134.0	4.0	108.0	36.6
Brooklyn Park, MN	81.0	99.0	17.9	50.5	12.6
Boulder, CO	97.9	71.3	13.1	61.5	23.3
Rapid City, SD	188.9	162.2	3.1	147.6	38.2
Average	135.1	113.3	12.1	99.9	30.1
Median	103.7	110.0	6.0	79.5	22.7
Duluth, MN	***98.3***	***85.5***	***3.8***	***64.9***	***29.7***

Note: One jurisdiction was removed from this analysis since it is a combination, not a career department.

Staffing

There are several viewpoints from which staffing should be assessed. Total staffing, uniformed staffing, the ratio of uniformed to total staffing, and minimum on-duty staffing per 10,000 residents is depicted in Table 27. Total staffing includes both operational personnel and the support personnel who keep departments running as smoothly as possible, while uniformed staffing is those people whose primary job is staffing fire and EMS apparatus. Table 27 shows that Duluth Fire Department, with 95 percent of its employees in uniform, has more uniformed personnel than the average. Duluth has the same minimum on-duty staffing as the average.

Another number to note in this table is the minimum daily operations staffing maintained by the department at any given time per 10,000 residents. With 4.2 personnel per 10,000 residents, Duluth is slightly above the average value of 4.1. This is likely partially due to the larger geographic size which is using more engine companies from more stations to cover the City.

Table 27: Staffing Comparison, 2009

Jurisdiction	Total Staffing	Uniformed FF (Career)	Uniformed FF/10,000 Pop	Minimum On-Duty Staffing	Minimum On-Duty Staffing/ 10,000 Pop	% of Total Staffing in Uniform
Roanoke, VA	247	237	24.4			96%
Charleston, WV	186	185	36.0	47	9.1	99%
Green Bay, WI	185	165	15.9	43	4.1	89%
Kenosha, WI	155	151	15.2			97%
Aurora, IL	200	195	9.9	49	2.5	98%
Bloomington, MN	120	117	14.1			98%
Dearborn, MI	122	111	11.3	25	2.5	91%
Waukegan, IL	144	110	12.3			76%
Racine, WI	141	130	16.5	34	4.3	92%
Davenport, IA	139	130	13.0	33	3.3	94%
Boulder, CO	112	95	9.8	25	2.6	85%
Rapid City, SD	135	128	18.8	32	4.7	95%
Average	157	146	16.4	36	4.1	92%
Duluth, MN	**141**	**133**	**15.4**	**36**	**4.2**	***95%***

Note: Some jurisdictions are removed since they are combination, not career departments. The numbers given by combination departments are much lower, thereby skewing the results.

Conclusions

DFD when compared to similar jurisdictions, 14 overall, has many areas which are outside the averages and in some cases at the extreme ends of the comparable cities analyzed. Duluth is below the average population by 7.5% but, 188% the geographic size of the comparable jurisdictions. It has 20 percent more stations and each station covers 24 percent more territory than the sampling average. Duluth has more engines overall but a similar number of truck companies, rescue companies and quints as the other jurisdiction. The calls for service per thousand population are 72% of comparables. DFD total staffing is 11 percent below the average and daily duty crew size is average. Also of note is the fact that DFD total budget is 84.6% of comparables while overtime is 4 percent of the total budget compared to an average of 2.7 percent for the comparable jurisdictions.

7. CONCLUSIONS AND RECOMMENDATIONS

Duluth Fire Department is a well-run operation, but there are many opportunities for improvement. This chapter will present recommendations for improving the effectiveness and efficiency of the department based upon the information and observations from the past five chapters of this report. Finally a strategic plan will be presented to map a course for the future of the department and provide city leadership with a roadmap for the next 10 years.

Key Recommendations and Options to Improve Service Delivery

Recommendation 1: Put in place a planning area-based performance measurement system (see Appendix A).

Recommendation 2: Put in place measures to improve call processing times (see Chapter 4, pg. 35). This effort will require a high degree of coordination, collaboration and cooperation between DFD and the St. Louis County Sherriff's Office 9-1-1 Communications Center

Recommendation 3: The City of Duluth should close Station 5 permanently. For a number of reasons cited earlier and later in this report Station 5 perpetuates an untenable liability on a number of levels (see Chapters 4, 5 and 8). It also creates inefficiencies in staffing throughout the entire DFD emergency service system for the unnecessary deployment of a historically low call volume area of the city.

Closing station 5 is logical for several reasons; first with only 1 firefighter assigned to this station the likelihood of this single personnel being caught in a no win scenario during initial on scene operations (a citizen rescue from a burning structure, an uncompromising situation on an EMS call in an apartment) is just a matter of when, and the second due rig must come from headquarters. Secondly, the costs of maintaining a station, which only runs about 100 calls per year are out of line with good fiscal management. Finally in the past 19 years bridge operators have had only one incident where an ambulance was delayed due the bridge being raised at the time of the incident. This could be further controlled by a direct ring down line from 9-1-1 dispatch to the bridge operator which would allow the bridge operator to lower the bridge immediately while the rig is responding from headquarters. Lastly Station 5 is in deplorable condition.

Recommendation 4: Close Station 5 and consolidate existing staff with remaining stations.

Option 1: Place Engine 3 out of service and utilize existing staff to bring staffing to a minimum of 3 personnel on engines at all single engine stations.

Option 2: Place Engine 8 and Engine 3 out of service, staff Truck 8 with four firefighters, to provide four person staffing to Engine 2, Engine 7 and Engine 10. DFD currently operates fire companies with anywhere from 1 firefighter to 4 fighters on the rig. The use of 3 to 4 personnel is safer for fire and EMS operations. It allows the first on scene unit to be more flexible in beginning emergency operations in general. For Engine 10 it allows the most outlying unit to begin emergency operations without having to wait for a second arriving unit, per OSHA 29cfr.1910 regulations. All units with less than 4 personnel however must not initiate emergency operations until the second unit arrives which can be at a minimum several minutes.[4]

Analysis shows that by closing Station 5 and reassigning those personnel, as well as reassigning personnel from Engine 3 the remaining 7 station operating 6 engines, 2 ladders, 1 quint, 1 rescue, and 1 squad could all provide a first due unit(s) with a minimum of at least 3 to 4 personnel for single engine stations, 6 personnel for dual company stations, and 10 personnel from headquarters. With the reassigning of Engine 8 and the change in configuration of Truck 8, again the shift in staffing will create greater flexibility in deployment. This proposed deployment model will not only be safer for citizens and firefighters, it will allow for faster extinguishment and thus smaller fire losses than the current system.

Total personnel per shift would be deployed as below:

Table 28: Current and Proposed Deployment Models*

Station	Current Deployment		Proposed Deployment #1		Proposed Deployment #2	
	Apparatus	No. of Personnel	Apparatus	No. of Personnel	Apparatus	No. of Personnel
Headquarters	E1	3	E1	3	E1	3
	E3	3				
	R1	3	R1	3	R1	3
	T1	3	T1	3	T1	3
	S251	1	S251	1	S251	1
Station 2	E2	3	E2	3	E2	4
Station 4	Q4	4	Q4	4	Q4	4
Station 5	E5	1				
Station 6	E6	2	E6	3	E6	3

[4] Additional Enhancements: With the removal of Engine 8 a cross-staffed Rapid Response Vehicle (RRV) program should be explored for the City of Duluth at Stations 4 and 8. An RRV is a smaller two person vehicle which can be dispatched on non-emergent EMS calls as a first responder, and to other types of non-emergency calls. These units are typically small utility type vehicles that can be cross-staffed with existing personnel assigned to those particular stations. They would not replace a full emergency response unit, but would be used as a supplement to a normal full response mode. The shift to this concept would require a good deal of planning and coordination to establish proper dispatching protocols, the types of vehicles to be used and the times of day staffed units should be deployed for these types of RRV calls, and therefore would be a strategic planning item (see Table 29) .

Station	Current Deployment		Proposed Deployment #1		Proposed Deployment #2	
	Apparatus	No. of Personnel	Apparatus	No. of Personnel	Apparatus	No. of Personnel
Station 7	E7	3	E7	3	E7	4
Station 8	E8 T8	3 3	E8 T8	3 3	T8	4
Station 10	E10	2	E10	4	E10	4
Station 11	E11	2	E11	3	E11	3
Staffing Pool**		6		6	6	6
Total		**42 per shift**		**42 per shift**		**42 per shift**

*Without any fiscal constraints, in order to have full 4 person coverage on each unit (as per NFPA1710), DFD would have to hire an additional 14 FTEs per shift (excluding Engine 5). This is an unrealistic expectation and unnecessary financial burden on the City of Duluth. We are confident that the proposed deployments offered, while not perfect, are both safe and efficient alternatives.

**To decrease overtime after the staffing pool is depleted for shift overtime an option is to reduce the staffing on single engine companies with 4 personnel from 4 to 3which would add 2 to 3 openings per shift before overtime is called in. In addition the staffing on the Rescue1 could be cut from 3 to 2 which would add a 5th opening before overtime is called in for a total of 11 vacancies which can be filled daily before overtime must be called in from off duty staff.

Recommendation 5: As part of a long-term future solution the City of Duluth should consider merging Stations 6 and 11 in a more centralized location. We understand that Station 6 has been recently renovated and this presents a real challenge in the short-term with regard to any potential merger with Station11. However in the long-term Station 11 is in poor condition, has little capacity for more than 3 staff, and Station 6 is in a prime, attractive real estate location, which may prove a highly viable property for future sale.

Recommendation 6: The City of Duluth and DFD should explore the implementation of a fee for non-emergency responses to all area nursing homes to provide staffing augmentation for these private enterprises when the calls exceed a certain threshold. Such fee could also be enacted for "frequent flyers" that use DFD for more than a specified number of assists per year.

Recommendation 7: Staff all Engines with 3 to 4 personnel at single unit stations and 3 at all two piece stations. DFD currently has a varied staffing plan for apparatus, which ranges from 1 firefighter on an engine to 4 personnel on the quint. Single apparatus stations with 1 or 2 personnel on a rig are not an efficient use of personnel for structural fire incidents. (Note: The exception to this is Station 10, which will be going from 2 to 4.)

DFD could staff all single engine houses with 3 to 4 personnel and all multiple company houses with 3 personnel per rig with its current complement of personnel if Stations 5 were closed and Engine 3 or Engine 8 personnel were reassigned to other apparatus. The net effect would be faster initiation of suppression operations, lower fire losses, and safer scenes for firefighters and citizens alike.

Recommendation 8: Develop a long-term CIP with benchmark apparatus replacement. Exact vehicles types and replacement frequency should be assessed annually based upon the criteria provided in this report and any service delivery modifications by public safety services. This program can commence with the next budget process and be updated and reevaluated each year thereafter. (See Appendix B)

Key Recommendations and Components to Improve Organization and Management

Recommendation 9: The City of Duluth should add another Deputy Chief position to the hierarchy of the department. Splitting the department into Operations and Administrative at the Deputy Chief level is needed to create a span of control which is workable and more efficient. This would also bring individual work for the chief and the D/C's to a level where the department can actually begin to plan strategically for its and the City's future. Also as part of this realignment of organizational authority the shift A/C's should be Shift Commanders (new position) and be part of the DFD management team and not shift lead workers as is the case now (see Chapter 2).

Recommendation 10: Expand Assistant Chief roles as shift commanders and a more integral part of DFD middle-management. Currently the Assistant Chiefs serve as a shift commander for each of the 3 shifts of operations personnel. Their primary functions are to serve as Incident Commander at major emergency operations, monitor shift strength and maintain minimum daily staffing, review past incident records and provide QC, and see that assigned daily tasks are completed and stations and equipment are in good repair.

The Assistant Chiefs want to expand their role in organizational supervision and management. The chief impediment being the current labor contract has all personnel in DFD in the same unit except the Fire Chief and Deputy Chief. This is creating a management by contract environment in DFD. The A/C's need to be separated from this single class environment which would allow better use of the A/C position and create an environment of the A/C being part of the management team rather than a lead worker as is the case now.

Another potential separation could also be initiated to develop the Captain as the first line supervisor rather than their current role as a "lead firefighter". This new role would mean the captain would handle first line supervision of their company including discipline, incident command, station and apparatus care, and daily task assignment for the company.

Recommendation 11: The City of Duluth should seriously consider changing the status of classifications in the Civil Service Commission Job Descriptions to clarify and codify the first line supervisory status of captains and the middle management status of assistant chiefs in the Duluth Fire Department hierarchical structure. This is by and large a collective bargaining item, however in the long term it will garner significant benefits in defining department hierarchy and create more effective leadership and spans of control.

Recommendation 12: Enhance and expand training options throughout the DFD . The Training Chief is currently being used as a key asset for departmental administration for many tasks other than and in addition to training. With the addition of another Deputy Chief and more responsibility for the Assistant Chiefs, the Training Chief will be able to focus more specifically on departmental training and safety needs. One program which shows much potential is the interactive video conferencing between all stations. This technological asset could allow DFD to do many training functions from headquarters while keeping crews at their respective stations and ready to respond.

Recommendation 13: Create a comprehensive plan to improve internal and external communications. Communications inside and outside any organization are a key component, which all well-run companies and jurisdictions have in common. Communications in any organization must be well planned and continuously executed with a goal of keeping everyone informed with the same information. DFD administration currently does not have sufficient staff or time to see that information flows effectively inside and outside the department. Another advantage to adding a Deputy Chief position will be to greatly improve and enhance the flow of information throughout the system.

Recommendation 14: The Fire Chief and Deputy Chief should begin to utilize the closed circuit television (CCTV) network more to disseminate DFD information and as a weekly video "newsletter" to increase and improve internal communication throughout the department. There is no substitute to visiting stations when possible, but given the two chief's substantial workload, this method of communication can prove to be an effective supplement. With the addition of a second deputy chief station visits will become easier to facilitate. However, even with the advent of more visits the CCTV "newsletter" can be another effective tool in the tool box.

Master Plan

There is a need to develop a long range plan for all fire/rescue services in the City of Duluth. This is clearly a priority. Using DFD Fire administration, other key stakeholders, and the City chief administrative officer or designee as the working committee, this key team should set a plan for the next 2, 5, and 10 years. The resultant long range plan must have sufficient detail to build the structure, operations, and financial foundations for DFD services and to set a clear course for the foreseeable future.

A strategic process should be used to develop the long range plan for emergency services in the community. All potential stakeholders must be identified and included in this process and all input should be well structured to avoid allegations of favoritism or exclusion.

Master Plan Process

Step 1: Identify the future mission and vision for DFD services. This is the who, what, when, where, why, and how of the process. It is imperative that this process be consensual between the participating stakeholders.

Step 2: Prioritize the major and future issues that are identified in this study to develop direction for the plan.

Step 4: Establish broad brush goals to achieve your desired outcomes. These goals will be general statements of the outcomes needed to achieve and maintain the mission and vision of the Master Plan.

Step 5: Set objectives and activities under each goal area to achieve the desired results. This should include specific steps and timelines for these steps, as well as overall timelines for the objectives.

Step 6: Feedback and re-evaluation of the plan is essential to the overall success of the process. This must be done routinely during the entire implementation cycle of the plan and at least annually thereafter.

Prioritizing Key Issues

There are key and longer term issues identified above in this chapter of the report but, not all are of equal importance to the City of Duluth. To assist the City with the assessment process, we have developed a method to evaluate each of the issues using similar criteria. The criteria are:

1. What is the overall value of the key issue to the city? Does it improve the level of fire or emergency medical service provided?

2. What is the overall value of the recommendation to the City of Duluth as an organization? Does it contribute to firefighter safety employee welfare?
3. What is the overall level of difficulty to implement the recommendation? Can it be implemented quickly or does it require a long or difficult planning process?
4. What is the overall cost to implement? Is the cost a one-time expenditure or does it require repeated funding?

Criteria Defined – A general definition for each criterion follows:

Value of Recommendation to the City: Recommendations with very high value to the community would be those with the potential to significantly improve service delivery such as adding a new service or improving an existing one. An example may be a recommendation that has the potential to significantly reduce loss or response time. A value judgment score of five means the recommendation has very high potential to improve community safety and emergency service delivery. Conversely, a judgment value of 0 means the recommendation will have no impact on community safety.

Value of Recommendation to the Emergency Services: Recommendations with a very high value to the emergency services are those that improve daily operations, improve efficiency and effectiveness, or change the organizational culture and management in a positive way. These can also be recommendations that are perceived by firefighters as improving their quality of work life or that improve their safety and health. A value judgment score of five means the recommendation has the highest potential to improve the organization; a score of zero means the recommendation will have no impact on the Department.

Level of Difficulty to Implement: Recommendations with a high level of difficulty to implement are those that have long planning cycles, require significant changes to infrastructure, changes to codes or labor agreements, or require major policy changes. Recommendations with a judgment value score of zero means the recommendation has an extreme level of difficulty to implement; a score of five means there is no difficulty.

Cost of Implementation: Recommendations with high implementation costs are those requiring significant capital outlays like new fire stations, land purchases, or large recurring costs such as additional personnel. A recommendation that requires only a minor change in policy, for example, would likely have a low cost of implementation. Recommendations with a judgment value score of five means that it has no implementation cost; a score of zero means that it has an extremely high cost to implement.

Scoring – For each recommendation a value judgment was made using the four evaluation criteria above and a numerical score was assigned. The score ranges are shown below.

Criteria	Low Score (Poorest)	High Score (Best)
Value to the Community	No Value = 0	Extreme Value = 5
Value to the Organization	No Value = 0	Extreme Value = 5
Level of Difficulty to Implement	Extreme Difficulty = 0	No Difficulty = 5
Cost of Implementation	Extreme Cost = 0	No Cost = 5

For example, a recommendation with the highest possible value to emergency services and to the community would have a combined score of 10 for benchmarks 1 and 2. If the same recommendation had the lowest "level of difficulty to implement", and it also had little (or no) cost to implement, its total score would be 20 points. Such a recommendation would be considered to be a high priority because it could be implemented easily and economically; it would also be of significant value to the community and to the emergency services. The composite score values can be interpreted as follows:

Composite Values

Lowest Priority	0 to 4
Low Priority	5 to 8
Moderate Priority	9 to 12
High Priority	13 to 16
Highest Priority	17 to 20

This study has provided many recommendations, detailed analyzes, and comparisons of DFD to comparable cities and national benchmarks. The study is in essence a cookbook of emergency service recipes. The recipes you choose to use and the exact ingredients you add are in fact up to the City of Duluth.

Table 29: Summary of Recommendations

Rec. #	Text	Priority
1	Put in place a planning area-based performance measurement system (see Appendix A).	**Short Term**
2	Put in place measures to improve call processing times (see Chapter 4, pg. 35).	**Essential**
3	The City of Duluth should close Station 5 permanently.	**Short Term**
4	Close Station 5 and consolidate existing staff with remaining stations. Option 1: Place Engine 3 out of service and utilize existing staff to bring staffing to a minimum of 3 personnel on engines at all single engine stations. Option 2: Place Engine 8 and Engine 3 out of service, staff Truck 8 with four firefighters, to provide four person staffing to Engine 2, Engine 7 and Engine 10. DFD currently operates fire companies with anywhere from 1 firefighter to 4 fighters on the rig.	**Short Term**

Rec. #	Text	Priority
5	As part of a long-term future solution the City of Duluth should consider merging Stations 6 and 11 in a more centralized location.	**Strategic**
6	The City of Duluth and DFD should explore the implementation of a fee for non-emergency responses to all area nursing homes to provide staffing augmentation for these private enterprises when the calls exceed a certain threshold.	**Strategic**
7	Staff all Engines with 3 to 4 personnel at single unit stations and 3 at all two piece stations.	**Essential**
8	Develop a long-term CIP with benchmark apparatus replacement.	**Strategic**
9	The City of Duluth should add another Deputy Chief position to the hierarchy of the department. Splitting the department into Operations and Administrative at the Deputy Chief level is needed to create a span of control which is workable and more efficient.	**Short Term**
10	Expand Assistant Chief roles as shift commanders and a more integral part of DFD middle-management.	**Short Term**
11	The City of Duluth should seriously consider changing the status of classifications in the Civil Service Commission Job Descriptions to clarify and codify the first line supervisory status of captains and the middle management status of assistant chiefs in the Duluth Fire Department hierarchical structure. T	**Short Term/ Strategic**
12	Enhance and expand training options throughout the DFD.	**Short Term**
13	Create a comprehensive plan to improve internal and external communications.	**Short Term**
14	The Fire Chief and Deputy Chief should begin to utilize the closed circuit television network more to disseminate DFD information and as a weekly video “newsletter” to increase and improve internal communication throughout the department.	**Short Term**

Essential	Implement the recommendation at the earliest reasonable time. Not implementing the change may compromise efforts to prevent errors and increase efficiencies.
Short-Term	Implement the recommendation within the 2012 operational and fiscal year.
Strategic	Implement the recommendation within the three to five years. If able, implement the recommendation sooner.

APPENDIX A: PERFORMANCE MEASUREMENT

Many fire departments measure their deployment performance based entirely on the NFPA 1710 standard. The problem with using this standard "carte-blanche" is that it assumes all areas need equal fire protection. Even if it were possible to provide truly equal fire protection, the reality is that urban, downtown areas have different fire protection needs than a more rural area. A rural area, for instance, does not need three ladder trucks within an 8-minute reach; some urban, downtown areas do.

The 1710 standard is oriented towards achieving a 6-minute total response time, a time at which fires are likely to expand rapidly (flashover), and defibrillated cardiac arrest patients have a markedly lower chance of survival. NFPA 1710 does not actually specify a total response time standard. Instead, it provides time and reliability standards for each of the time segments that comprise total response time (call-processing, turnout, and travel). For example, the standard specifies that for fires and special operations incidents, the first-arriving unit will have a travel time (time from the unit leaving the station to arrival at the emergency incident) of four-minutes 90 percent of the time. In this case, 4-minutes is the time standard, and 90 percent is the reliability standard. Although the NFPA 1710 standard is an excellent goal to work towards, few fire departments are able to completely meet the standard.

The standard is based on what is ideal and not necessarily what is realistic. For instance, to achieve a six-minute total response time, the original version of the standard specified a call-processing time of one minute, a turnout time of one minute, and a travel time of four minutes. It was subsequently realized that one-minute was not enough time for firefighters to get to their unit, don full turnout gear and leave the station. As a result, the 2010 version of the NFPA 1710 standard was revised to allow 80 seconds of turnout time for fire and special operations incidents.

Just as the standard itself was revised to reflect reality, it makes sense to consider whether the standard makes sense for all parts of the jurisdiction in its current form. Take for instance a rural, sparsely populated area. It may not be reasonable to expect a 4-minute travel time for 90 percent of incidents. The jurisdiction might consider specifying a 5-minute travel time for 70 percent of incidents to account for the area's rural character.

Appropriate performance levels are very much based on the characteristics of individual planning areas. Response time and reliability goals should match a particular area's risk characteristics, not just conform to a one-size-fits-all standard. For this to occur, fire departments should depart from just using NFPA 1710 and ISO standards and instead move toward a data-driven process of analyzing risk and response.

Assessing Deployment Performance

Deployment decisions concerning fire station and apparatus locations should be an ongoing process largely based on continual or periodic performance measurement. Because jurisdictional needs do change, the deployment change recommendations made in this study should be considered as a step in a continuing process. Going forward, the fire department needs to be regularly conducting neighborhood-level performance measurement for the process to be effective.

Police departments are usually decades ahead of fire departments when it comes to using technology and data to drive operations. Most police departments have several technical crime analysts who specialize in data analysis and mapping. Many fire departments should consider hiring a dedicated data analyst and begin to incorporate performance measurement into a regular (perhaps quarterly) review of deployment. The fire department culture, which is based on meeting standards, should reconsider its emphasis on static deployment (where unit locations and first-due areas rarely change) to one of dynamic deployment based on data-driven performance goals.

An excellent resource on how to measure performance and adapt deployment is the Center for Public Safety Excellence's (CPSE) Developing Standards of Cover Manual. One of the advanced, but effective techniques used by the manual is to measure the trade-off between unit availability (percentage of incidents where the correct unit handled the call) and response time performance (percentage of incidents below the response time goal).

An important part of the Generally speaking, as the first-in correct unit for a particular area becomes less available (due to other calls, training, etc.), performance for that area decreases because units from other stations have to handle the call. How much of an impact reliability has on performance is largely dependent on how far away the nearest fire stations are. This type of analysis can be used to determine if a station needs an additional unit or might benefit from a first-due area adjustment. All fire departments should familiarize themselves with this performance measurement methodology and use it to gauge station and unit location performance.

Reporting Deployment Performance

After taking the time to establish deployment goals for each neighborhood or planning district and learning some of the more advanced CPSE analysis methodologies, the last step is to establish regular reporting mechanisms. We recommend that fire departments consider producing the following to types of reports:

- **Monthly Deployment Performance Report** – This report should be distributed department-wide each month. Such a report serves several very important functions. First, it provides information and data feedback to those entering in incident data; getting a detailed report that shows workload by units and response time performance can provide firefighters the ability to gauge and challenge themselves to better performance (e.g. one engine crew that has had the slowest turnout time in the past few months makes it their goal to be in the top three engine companies for turnout time in the next reporting period). Also, putting out a monthly report provides an excellent error checking mechanism, as firefighters will be the first to notice and announce any problematic performance statistics. Finally, having somebody try and pull together some statistics with Excel for an annual report is asking for problems because you cannot truly be familiar with data only looked at once a year. Putting together monthly reports helps to ensure that the fire department is on top of its data collection and performance measurement.
- **Quarterly Report** – While the monthly report can be fairly short and limited to some simple workload and response time results, we recommend a more in-depth quarterly report. The report should be set up so that department leaders can review deployment performance for the entire system and each individual planning district. The report should be set up to note performance changes/trends in specific planning areas so that fire department officials are in a good position to recommend near- and long-term deployment modifications. We strongly recommend that this annual performance measurement report reflect most of the analysis types found in the CPSE Standards of Cover Manual.

APPENDIX B: 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. 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.[5] 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).

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.

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

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:

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

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.

APPENDIX C: APPARATUS CIP CRITERIA

The NFPA guidelines for fire vehicle replacement are:

> "The normal life expectancy for first-line fire apparatus will vary from county to county, and city to city, depending upon the amount of use the equipment receives, and the adequacy of the maintenance program. In general, a 10–15-year life expectancy is considered normal for first-line pumping engines. First-line ladder trucks should have a normal life expectancy of at least 15 years. In fire departments where ladder trucks make substantially fewer responses to alarms than engines, a planned first-line service of 20 years may be warranted for ladder trucks. Some smaller fire departments that have infrequent alarms operate pumping engines up to 20 years with reasonable efficiency, although obsolescence will make older apparatus less desirable, even if it is mechanically functional. In some types of service, including areas of high fire frequency, a limit of 10 years may be reasonable for first-line service. The older apparatus may be maintained as part of the reserve fleet, as long as it is in good condition, but in almost no case should the fire department rely on any apparatus more than 25 years old.[6]"

These NFPA guidelines have proven to be reasonable in practice and tend to be followed by most fire departments that have neither extremely high nor extremely low numbers of runs or vehicle mileage. They are a good benchmark for "best practices."

The guidelines provide some latitude in determining useable life for a fire service vehicle. Age and accumulated mileage are the most important variables to consider in vehicle replacement. The numbers of calls to which a vehicle responds and the frequency and quality of preventive and other maintenance received can also affect vehicle lifespan.

As a rule of thumb, an annual replacement review process should be undertaken for any piece of front-line fire apparatus more than ten years old to determine whether replacement is warranted. More heavily used apparatus may need to be replaced sooner than less heavily used pieces. Apparatus can be taken out of front-line service and placed in a reserve status for a few additional years of life, as long as such vehicles can still be safely used for their designated purpose and still meet ISO and NFPA performance standards. Modern safety features also are important to consider. Older vehicles may lack important new features (e.g., enclosed cabs, and older aerial ladder may not have interlocking safety devices), which may be significant reason not to wait until the end of a replacement cycle to order a new vehicle, even if the current vehicle is in good condition.

[6] NFPA Fire Protection Handbook (18e), Quincy, MA, 2000, pp. 10-208-209.

Replacement Scoring System – Some fire departments use a scoring system developed by the American Public Works Association Fleet Service Committee for assessing fire apparatus for replacement, or a scoring system similar to it. Examples of its use may be found in Chesapeake, Hampton, Newport News, Virginia Beach, and York County, Virginia. The system entails considering a combination of variables that include age, mileage, maintenance costs, and operating conditions. A replacement score is calculated for each vehicle based on the sum of its scores for age, usage, and condition. The data for these calculations are usually obtained from computerized vehicle maintenance records and work orders, but can also be obtained otherwise.

The age of the vehicle is scored by assigning one point for each month from the date on which it was purchased. The usage score assigns one point for each 1,000 miles traveled or 3.5 points for each 100 hours of use, whichever is higher. The condition of the vehicle is scored on a scale of zero to four (with zero being the best and four the worst) for each of five aspects- body, interior, functionality, maintenance/repair cost, and mission. Each of the 5 aspect scores is then multiplied by 12, and these values are summed with the points assigned for age and mileage to obtain the overall vehicle score. If the overall score exceeds the point limit established for the respective vehicle category, the vehicle is recommended for replacement. The categories and associated maximum scores are listed in Table 30.

Table 30: Maximum Vehicle Points Before Disposal/ Replacement is Recommended (APWA System)

Vehicle Category	Maximum Vehicle Points
Sedans, station wagons, and jeeps	162
Light-duty trucks	196
Medium- to heavy-duty trucks (including ambulances)	220
Fire apparatus	225

The critical component in any service-life-assessment system is the absolute requirement that a vehicle must be able to safely and reliably perform in a manner consistent with the vehicle's design purpose, regardless of mileage or hours of use. Elected officials and organizational leaders must remember that fire service vehicles are subject to much more demanding operational conditions than other vehicles in a jurisdiction's fleet. Rapid acceleration and deceleration, hard turns, quick stops, and other extreme demands are placed on fire apparatus on a regular basis. Additionally, fire apparatus are almost always fully-loaded with equipment. The water carried on a pumper can easily weigh several tons (over 12 tons in the case of a pumper-tanker), and aerial ladders may weigh more than 40 tons. Public works type trucks are not always at their maximum load, which reduces wear and tear on suspension, brake, and driveline systems.