City of Kirkland Fire Department

Washington

Standards of Coverage and Deployment Plan

June 2014

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Introduction

The following report serves as the Kirkland Fire Department (KFD) Standards of Coverage and Deployment Plan. It follows closely the Center for Fire Public Safety Excellence (CPSE) Standards of Coverage model that develops written procedures to determine the distribution and concentration of an organization's fixed and mobile resources. The purpose for completing such a document is to assist the agency in ensuring a safe and effective response force for fire suppression, emergency medical services, and specialty response situations.

Creating a Standards of Coverage and Deployment Plan document requires that a number of areas be researched, studied, and evaluated. This report will begin with an overview of both the community and the agency. It will continue with a community risk assessment, a review of historic response workload, completion of a critical task analysis, establishment of agency service level objectives, and a detailed analysis of current resource distribution and concentration. The report will provide analysis and documentation of response reliability and response performance. The report will conclude with policy and operational recommendations.

ESCI extends its appreciation to the members of KFD, elected and appointed officials from the City of Kirkland, and all others who contributed to this plan.

Executive Summary

This document describes the Kirkland Fire Department (KFD) Standards of Coverage and Deployment Plan for the City of Kirkland, Washington. Response resources, deployment strategies, and overall community risks have been evaluated in this document. It establishes response time objectives and standards for measuring the effectiveness of the deployment of department resources. The document is segregated into components generally based on the format recommended by the Center for Public Safety Excellence, *Standards of Cover 5th Edition,* which will be referenced elsewhere in this document.

KFD is a direct operating department of City of Kirkland and provides fire protection and emergency medical services as well as hazardous materials response and technical rescue services to the community. It also manages the community building code enforcement program through plans review and inspection of new construction. The department's service area encompasses all of the area within the governmental boundaries of Kirkland.

The City of Kirkland has a resident population of 81,730. The department serves an area of approximately 18.25 square miles within the City of Kirkland. The department operates five fully staffed fire stations, one volunteer staffed station, and 19 apparatus. The North East King County Regional Public Safety Communications Agency (NORCOM) provides call receipt and dispatch services. KFD is also a participant in the King County Medic One system.

The Washington Survey and Rating Bureau (WS&RB) reviews the fire protection resources within communities and provides a Community Fire Protection Rating system from which insurance rates are often based. The rating system evaluates four primary areas: the emergency communication and dispatch system, the fire department emergency response capability, fire prevention and risk mitigation services, and the community's pressurized hydrant or tanker-based water supply. The overall rating is then expressed as a number between 1 and 10, with 1 being the highest level of protection and 10 being unprotected or nearly so. As of the latest rating, WS&RB gave the City of Kirkland a rating of Class 4. This rating was conducted in 2013.

In the typical deployment planning process, potential service area classifications are broken down into five categories:

- **Metropolitan** – geography with populations of over 200,000 people in total and/or a population density of over 3,000 people per square mile. These areas are distinguished by mid-rise and high-rise buildings, often interspersed with smaller structures.
- **Urban** – geography with a population of over 30,000 people and/or a population density of over 2,000 people per square mile.
- **Suburban** – geography with a population of 10,000 to 29,999 and/or a population density of between 1,000 and 2,000 people per square mile.
- **Rural** – geography with a total population of less than 10,000 people or with a population density of less than 1,000 people per square mile.
- **Wilderness/Frontier/Undeveloped** – geography that is both rural and not readily accessible by a publicly or privately maintained road.

An analysis of the City of Kirkland's population density reveals that it is primarily of one classification; urban.

A Performance Statement and Objectives for the services provided by KFD to the City of Kirkland have been developed. These further define the quality and quantity of service expected by the community and consistently pursued by KFD.

Overall Performance Statement

KFD has adopted the following Performance Statement:

Performance Statement (Mission Statement)

*"Our City * Our People * Our Duty * Our Commitment to Serve"*

In addition to the overall performance statement, the following response-specific performance objectives have been established by KFD and have been analyzed as part of this report. These objectives are based on the department's current resources, capability, and performance. As noted previously, the City of Kirkland is primarily urban.

Dispatch Performance Objective:

- *Response resources shall be notified of a priority emergency within 75 seconds of **receipt of the call at the dispatch center**, 90 percent of the time.*

Turnout Time Performance Objective:

- *Response personnel shall assemble on apparatus and initiate movement towards a priority emergency within two minutes seven seconds **of notification by the dispatch center**, 90 percent of the time for incidents requiring full personal protective equipment and within two minutes 0 seconds **of notification by the dispatch center**, 90 percent of the time for all other incidents.*

First-Due Total Response Performance Objective – Fire:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within eight minutes 55 seconds **from receipt of call at the dispatch center**, 90 percent of the time.*

First-Due Total Response Performance Objective – Emergency Medical Service:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within seven minutes 34 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

Concentration Performance Objectives:

- *For moderate risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within 13 minutes 0 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

- *For high risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within 16 minutes three seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

The analysis conducted during the evaluation phase of this process identified a number of opportunities to improve service (performance goals). The following goals to improve the capabilities of the KFD are offered for consideration. These goals and specific recommendations for each are described in more detail at the end of this report (Component I).

Improvement Goal A: Adopt New Response Performance Goals

In order to set targets for future improvement of the system it is recommended that the Kirkland City Council adopt response performance goals describing its desired level of response performance. These are goals to be achieved in the future as funding is available to provide the necessary resources. The following are recommended:

Dispatch Performance Goal:

- *Response resources shall be notified of a priority emergency within 60 seconds **of receipt of the call at the dispatch center**, 90 percent of the time.*

Turnout Time Performance Goal:

- *Response personnel shall assemble on apparatus and initiate movement towards a priority emergency within 80 seconds **of notification by the dispatch center**, 90 percent of the time for incidents requiring full personal protective equipment and within 60 second **of notification by the dispatch center,** 90 percent of the time for all other incidents.*

First-Due Total Response Performance Goal – Fire:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within six minutes 20 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

First-Due Total Response Performance Goal – Emergency Medical Service:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within six minutes 0 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

Concentration Performance Goal:

- *For moderate risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within ten minutes 20 seconds from **receipt of the call at the dispatch center**, 90 percent of the time.*

- *For high risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within ten minutes 20 seconds from **receipt of the call at the dispatch center**, 90 percent of the time.*

Improvement Goal B: Reduce Call Processing Time

This recommendation includes reviewing procedures to identify opportunities to notify response personnel more quickly.

Improvement Goal C: Reduce Turnout Time

Opportunities to reduce turnout time include review of station configuration, improved routing technology, and personnel management.

Improvement Goal D: Reduce Travel Time

Several initiatives were identified that will reduce the time required to travel to an incident these include:

- Improving street system connectivity.
- Relocating two fire stations.
- Staff all fire engines with four personnel to improve system reliability. This is accomplished by providing sufficient staffing to operate fire engines when personnel respond with an aid unit.

Improvement Goal E: Improve the Quality of Emergency Medical Services

Recommended is staffing all KFD response units with at least one properly equipped paramedic. This will reduce the time it currently takes to provide advanced life support care to a patient.

Improvement Goal F: Improve Water-Based Fire and Rescue Capability

This initiative recommends adding an appropriately sized and equipped fire boat to the KFD system to provide water-based fire and rescue capability.

Improvement Goal G: Improve Community Fire Risk Mitigation

Home fire sprinklers have a proven history in reducing fire deaths and property loss. Adopting residential fire sprinkler requirements is recommended.

Improvement Goal H: Improve Effective Response Force Capability

Delivering the full effective response force to a moderate risk structure fire within the recommended response performance goal is achievable. Delivering the full effective response force to a high risk structure fire within the same time standard is not without additional resources. Whether to add the resources or adjust the response performance goal is a policy level decision.

Component A – Description of Community Served

Organization Overview

Governance and Lines of Authority

The City of Kirkland is a municipal corporation operating under a Council-Manager form of governance (Revised Code of Washington Chapter 35). The City Council is provided with necessary power and authority to govern the provision of fire protection and emergency services. The City Council maintains strictly policy-level involvement, avoiding direct management and hands-on task assignment—an arrangement established within written policy.

The City Council appoints a City Manager who is responsible for carrying out the Council's policies and general administration of city government. The Fire Chief is appointed by the City Manager and is tasked with responsibility for directing fire and life safety emergency services within the city.

Organizational Finance

Establishment of financial policy for the City of Kirkland and KFD is the responsibility of an elected City Council with the City Manager responsible for fiscal administration.

The city uses a two-year budget cycle to prepare the operating budget and the capital improvement plan based on a January through December fiscal year. The City of Kirkland has a total assessed valuation of $15,774,360,007.[1] The total fire department budget for the 2013-14 biennium is $42,156,424. The Building Inspection Permit Services portion of this total is $4,782,909. The total 2013-14 budget for fire and emergency services is $37,373,515, or an annual average of $18,686,758.

The fire department's operating funds are received through the general revenue of the city. 36.7 percent of general fund revenue is property tax and sales tax. Fees for service, other taxes, and other revenues make up the balance.

[1] Source: King County Department of Assessments

Figure 1 lists the source and amount of non-tax revenue for KFD for 2013-14 biennium.

Figure 1: Budgeted Revenue

Fire Department Revenue Source	2013-2014 Biennium
Fire Permits	$95,778.00
Emergency Medical Services	$1,769,290.00
Emergency Transport Fees	$1,787,136.00
Fire Department Plan Review	$24,000.00
TOTAL	$3,676,204.00

Source: City of Kirkland

Figure 2 shows the general operating expenditure history (excluding the Capital Improvement Fund) for the previous two and the current biennia. Three major divisions of the budget are shown.

Figure 2: Budget/Expenditures by Biennium and Category, 2009 – 2014

	Fire Department Budget/Expenditure by Year and Category			
Budget (Biennium)	Salaries & Benefits	Services & Supplies	Capital Outlay	Total
2009-2010 (Actual)	$25,636,628.39	$5,802,602.34	0	$31,439,230.73
2011-2012 (Actual)	$28,225,603.02	$7,202,663.43	0	$35,428,266.45
2013-2014 (Budget)	$31,727,406.00	$7,104,040.00	$27,500.00	$38,858,946.00

Source: City of Kirkland

During the six-year period, the department's overall budget increased 23.6 percent. The current average annual cost of fire and emergency services to the community (excluding Building Department functions), based on assessed valuation, is $1.23 per $1,000 of assessed valuation.

A comprehensive capital improvement and replacement program is important to the long-term financial stability of any fire and emergency medical service organization. Such programs provide systematic development and renewal of the physical assets and rolling-stock of the agency. Items usually included in capital improvement and replacement programs are facilities, apparatus, land acquisition, and other major capital projects.

The City of Kirkland has an adopted a Capital Improvement Plan for the period 2013-2018. This plan describes capital facility and other improvement needs for a five-year timeframe, and schedules those improvements based on available funding. KFD has projects addressed in this plan.

Service Area Overview

KFD is a direct operating department of City of Kirkland and provides fire protection, emergency medical service, specialized rescue, city-wide emergency management, and building department services to the community. The department's service area encompasses all of the area within the governmental boundaries of Kirkland.

The City of Kirkland has a resident population of 81,730.[2] The department serves an area of approximately 18.25 square miles. The department operates five fully-staffed fire stations, one volunteer staffed station, and 19 apparatus. The North East King County Regional Public Safety Communications Agency (NORCOM) provides call receipt and dispatch services. KFD is also a participant in the King County Medic One system.

There are 104 individuals (104 FTE) directly involved in providing or supporting response, fire prevention, and other services. Staffing coverage for emergency response is through the use of career firefighters on 24-hour shifts at five stations and volunteer emergency medical technicians at night at a sixth station. For immediate response and at full staffing, no less than 19 personnel are on duty at all times.

The Washington Survey and Rating Bureau (WS&RB) reviews the fire protection resources within communities and provides a Community Fire Protection Rating system from which insurance rates are often based. The rating system evaluates four primary areas: the emergency communication and dispatch system, the fire department emergency response capability, fire prevention and risk mitigation services, and the community's pressurized hydrant or tanker-based water supply. The overall rating is then expressed as a number between 1 and 10, with 1 being the highest level of protection and 10 being unprotected or nearly so. As of the latest rating, WS&RB gave the City of Kirkland a rating of Class 4. This rating was conducted in 2013.

[2] Washington Office of Financial Management, April 2013.

Component B – Review of Services Provided

Services Provided

KFD provides a variety of services, including fire suppression, basic level emergency medical service, entrapment extrication, high-angle rescue, initial trench, confined space, and hazardous materials emergency response (Level A). The following figure provides basic information on each of the department's core services, its general resource capability for that service, and information regarding staff resources for that service.

Figure 3: Core Services Summary

Service	General Resource/Asset Capability	Basic Staffing Capability per Shift
Fire Suppression	5 staffed engines 1 staffed ladder truck (Truck Company) 1 command response unit Additional automatic and mutual aid engines, aerials, and support units available	19 minimum suppression-trained personnel per day Additional automatic and mutual aid firefighters available 3 minimum per engine and truck 1 minimum on command unit
Emergency Medical Services	5 engines – BLS equipped 1 ladder truck – BLS equipped 6 aid units – cross-staffed	94 certified emergency medical technicians
Vehicle Extrication	1 truck company equipped with hydraulic rescue tools, hand tools, air bags, cutting saws, stabilization cribbing. All engines carry a combination cutter-spreader hydraulic rescue tool.	All firefighters are vehicle rescue operation's level trained. The truck company members are advanced vehicle/machinery technicians, 3 minimum on duty.
High-Angle Rescue	1 truck company equipped with rescue rope, software, and all associated hardware. All truck members are Rope Rescue Technicians.	All personnel trained to the operations level. 9 personnel per shift trained to the technician level in rope rescue, 3 minimum on duty.
Trench and Structural Collapse Rescue	1 truck company with pneumatic shoring jacks, sheeting, cribbing, limited lumber, and hand tools for initial stabilization. All truck members are Trench Technicians. Additionally, there is 1 collapse rescue equipment trailer.	All personnel trained to the operations level. 9 personnel per shift trained to the technician level in trench and collapse rescue, 3 minimum on duty.

Service	General Resource/Asset Capability	Basic Staffing Capability per Shift
Swift-Water Rescue	All aid units, BC unit, and trucks equipped with PFD's and water rescue kits.	All personnel trained to the operations level. 20 personnel per shift trained to the technician level in swift-water rescue.
Confined Space Rescue	1 Truck Company equipped with tripod, SABA, communications set, air monitoring equipment, ventilation, basket stretchers, and rope rescue gear.	All personnel trained to the operations level. 9 personnel per shift trained to the technician level in confined space rescue, 3 minimum on duty.
Hazardous Materials Response	Hazardous materials response is via ILA and consortium. Primary response unit is a Bellevue Fire asset.	All personnel trained to the operations level. 3 personnel per shift trained to the technician level in hazardous materials.

Assets and Resources

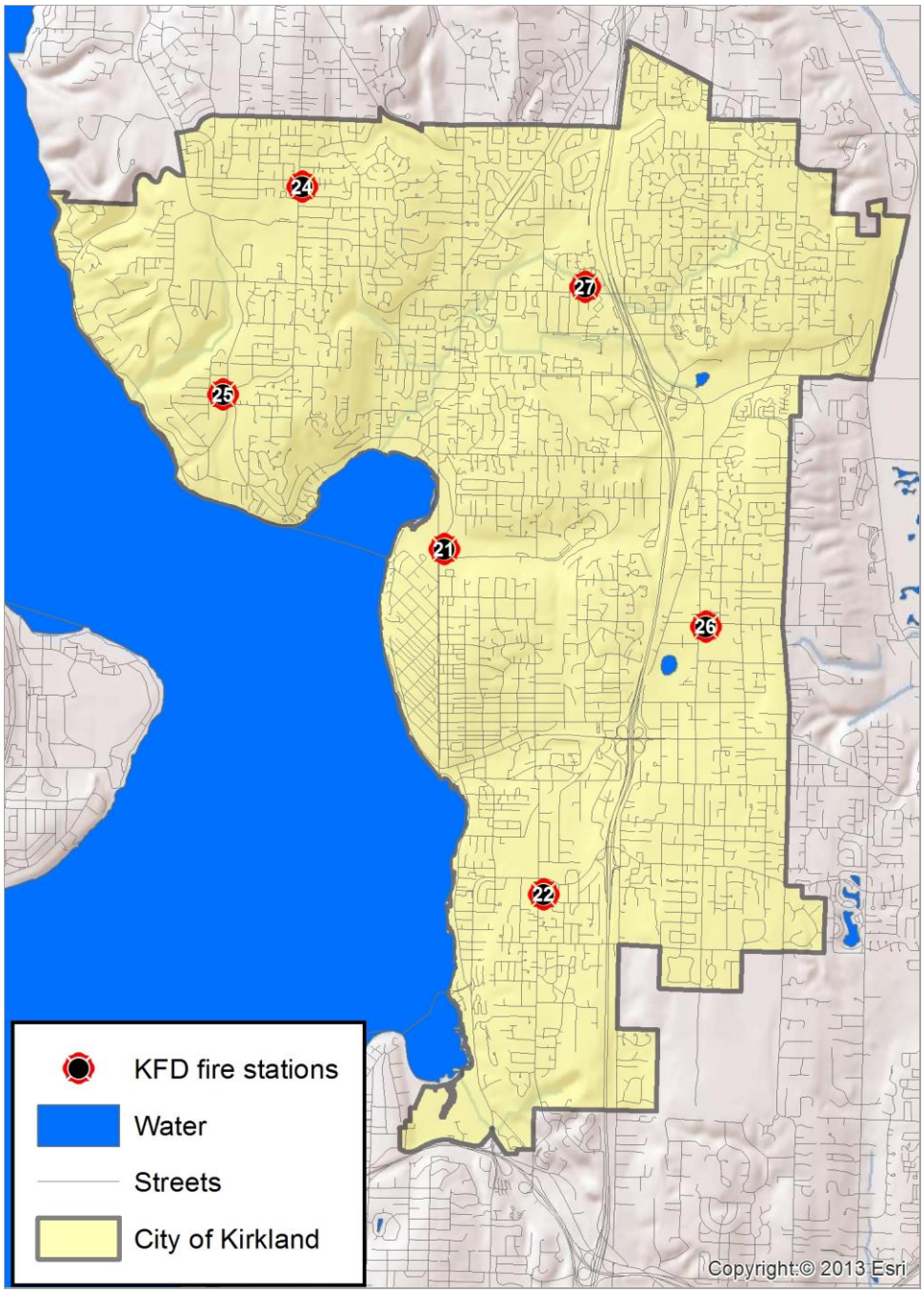
Fire Stations

Fire stations play an integral role in the delivery of emergency services for a number of reasons. A station's location will dictate, to a large degree, response times to emergencies. Fire stations also need to be designed to adequately house equipment and apparatus, as well as the firefighters and other personnel assigned to the station.

Station Location and Deployment

KFD delivers fire and EMS response from six city-owned fire stations located throughout the city. Five are staffed 24-hours per day by career personnel. A sixth is staffed at night by volunteer emergency medical technicians. The following figure shows the city boundaries and the locations of Kirkland fire stations.

Figure 4: Current Facility Deployment



Apparatus

Other than the firefighters assigned to stations, response vehicles are probably the next most important resource of the emergency response system. If emergency personnel cannot arrive quickly due to unreliable transport, or if the equipment does not function properly, then the delivery of emergency service is likely compromised. Fire apparatus are unique and expensive pieces of equipment, customized to operate efficiently for a specifically defined mission. The following figure lists apparatus assigned to each of the six KFD fire stations.

Figure 5: Apparatus Assigned to KFD Fire Stations

Station	Apparatus	Year built	Condition
Station 21	Engine 21	2005	Good
	Aid 21	2010	Good
	Engine 28 (Reserve)	1999	Fair
Station 22	Engine 22	2003	Good
	Aid 22	2006	Good
	Engine 29 (Reserve)	1995	Fair
	Air Unit 21	2006	Good
Station 24	Aid 24	2001	Fair
	Disaster Response Vehicle	1991	Fair
Station 25	Engine 25	2003	Good
	Aid 25	2008	Good
Station 26	Engine 26	2013	Excellent
	Aid 26	2002	Good
	Battalion 21	2008	Good
	Aid 28 (Reserve)	2006	Good
Station 27	Engine 27	2010	Good
	Aid 27	2012	Good
	Ladder 27	1997	Good
	Aid 29	2007	Good

KFD uses several types of apparatus as shown in the figure above. Each type is further described as follows:

- Engine – Primary response unit from each station for most types of service requests. Each is equipped with a 1,500 gallon per minute pump and carries 500 gallons of water.
- Ladder – A specialized apparatus equipped with long ladders, hose, salvage and overhaul equipment, and rescue tools. Used for structure fires, rescues, and other service requests. The ladder truck has a 1,250 gallon per minute pump and 300 gallon water tank.
- Aid – Vehicle for the transportation of people experiencing a medical emergency to the hospital.
- Air unit – A vehicle equipped with extra self-contained breathing air cylinders, cylinder refilling equipment, and lighting.

The department's apparatus are generally in good condition, properly equipped, and well maintained.

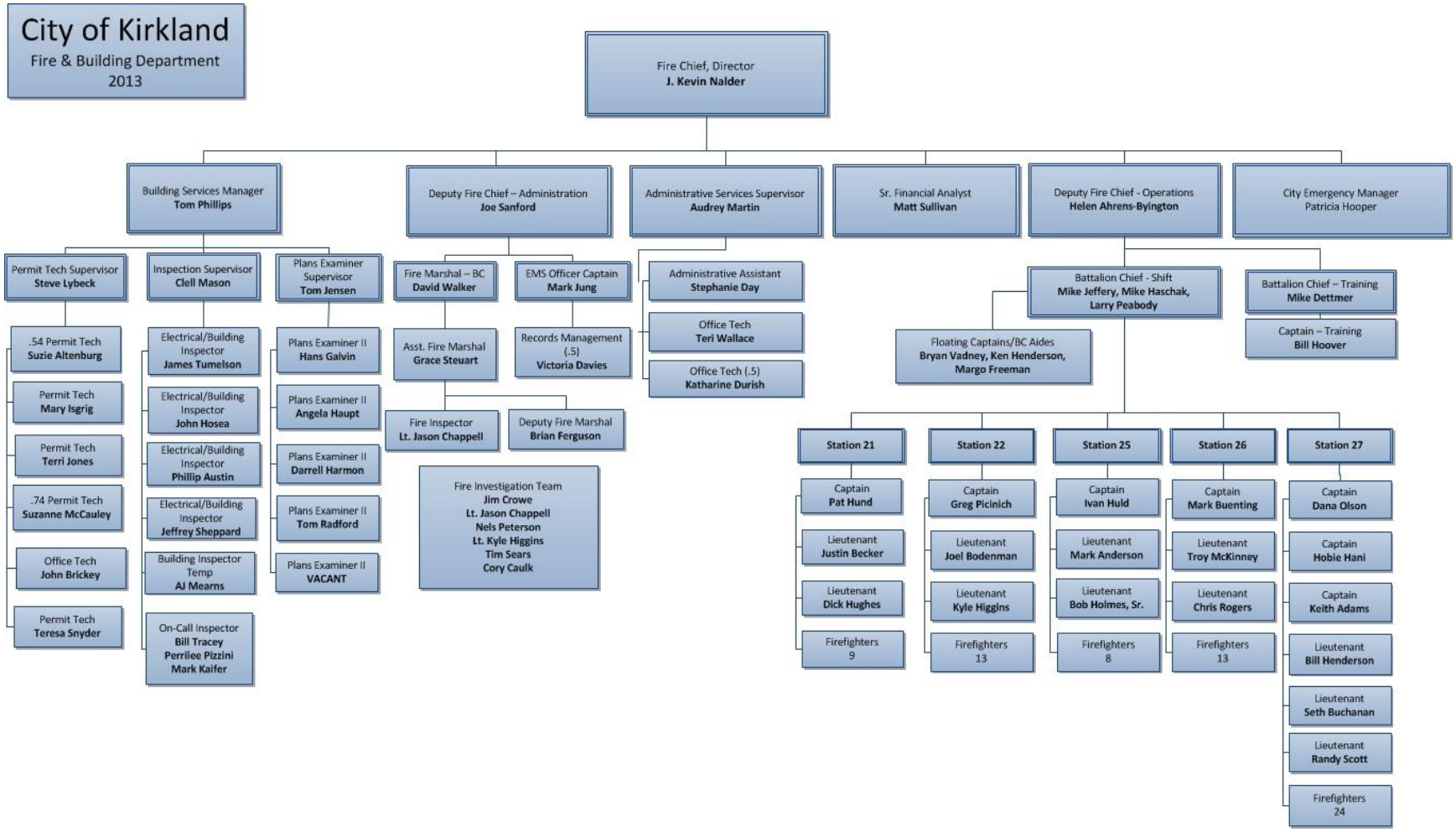
Staffing Information

Effective fire and emergency service organizations must provide adequate staffing in four key areas: emergency response services, administration, risk mitigation (prevention), and support. Key support functions include personnel training and development, logistics services, and records management.

Organizational Structure

KFD is organized in the typical top-down hierarchy. The chain of command is identified with common roles for a department of this size. KFD has six stations that house emergency response resources. The department's administrative office is located at the Kirkland City Hall. The department's multiple facilities and its three-shift, 24-hour-per-day, seven-day-per-week operational schedule create numerous internal communications and management challenges. The department's organizational chart is functional and primary roles are well identified.

Figure 6: Organizational Structure



Administration and Support Staff

One of the primary responsibilities of a department's administration and support staff is to ensure that the organization's operational elements have the ability and means to accomplish their service delivery responsibilities. Without sufficient oversight, planning, documentation, training, and maintenance, the department's operational entities will struggle to perform their duties well. Like any other part of a fire department, administration and support require appropriate resources to function properly.

There are 104 individuals involved in delivering or supporting response services to the City of Kirkland. KFD uses career and volunteer staffing to carry out its functions. All administrative and support staff are career personnel. The department's primary management team includes a fire chief, two deputy chiefs, administrative support manager, and a temporary senior financial analyst.

Figure 7: Management, Administration, and Support Personnel by Position

Position	Number
Fire Chief	1
Deputy Chief	2
Fire Marshal/BC	1
Asst. Fire Marshal	1
Training BC and Captain	2
EMS Officer	1
Fire Inspectors	2
Office Manager	1
Administrative Assistants	1
Office Tech's	1.5
Office Specialist	.5
TOTAL	14

Emergency Services Staff

It takes a sufficient number of well-trained emergency responders to put the community's emergency apparatus and equipment to its best use in controlling emergency incidents. Insufficient staffing at an operational scene decreases the effectiveness of the response and increases the risk of injury to all individuals involved. The following figure shows emergency personnel by rank.

Figure 8: Emergency Response Personnel by Rank

Position	Number
Battalion Chief	3
Fire Captain	10
Fire Lieutenant	11
Firefighter	66
TOTAL	90

KFD employs 90 emergency response personnel for emergency medical, rescue, and fire suppression activities. The population of the KFD service area is 81,730. KFD provides the City of Kirkland with 1.10 career firefighters per 1,000 population.

Regardless of the raw numbers of personnel available to a department, what matters most is actual number of emergency responders the agency is able to deliver to an emergency. This almost always relates to the actual number of emergency responders available for immediate deployment. KFD provides no less than 19 personnel on duty.

Methodology for Incident Staffing

This document will analyze how well KFD staffs incidents within its primary service area. This data is important and can be an indicator for the department as to the effectiveness of its staffing efforts.

It is also true that for larger incidents, this fire department is typically acting together with one or more neighboring fire departments in providing fire and life protection through a coordinated regional response system of mutual and automatic aid agreements. This is particularly true for large structure fires, other high-risk incidents where staffing needs are high, and during periods of high incident activity. Therefore, the document will go on to provide an overall view of aggregate staffing in this department and the neighboring agencies.

The prompt arrival of at least four personnel is critical for structure fires. Occupational safety and health regulations require that personnel entering a building involved in fire must be in groups of two. Further, before personnel can enter a building to extinguish a fire, at least two personnel must be on scene and assigned to conduct search and rescue in case the fire attack crew becomes trapped. This is referred to as the two-in, two-out rule.

There are, however, some exceptions to this regulation. If it is *known* that victims are trapped inside the building, a rescue attempt can be performed without additional personnel ready to intervene outside the structure. Further, there is no requirement that all four arrive on the same response vehicle. Many departments rely on more than one unit arriving to initiate interior fire attack. KFD's current minimum staffing policy provides one fire engine temporarily staffed with four firefighters, four engines with three firefighters, and a ladder truck with three firefighters. If a three person unit arrives first, it must wait for a second unit to arrive before it can initiate interior fire attack operations in a non-rescue incident.

Some incidents (such as structure fires) require more than one response unit. The ability of this department and its automatic aid neighbors to assemble an effective response force for a multiple unit incident within a specific period of time, also known as *resource concentration*, will be analyzed in a later section of this document.

KFD's minimum shift staffing is 19 firefighters, 24-hours per day. The following figure lists each station, staffed unit, and the staffing assigned to each at minimum staffing. Cross-staffed means that firefighters assigned to another response unit in the station may transfer to the cross-staffed unit as needed. An aid unit at Station 24 is staffed by volunteer personnel at night.

Figure 9: Staffing Complement

Station	Apparatus	Minimum Staffing
Station 21	Engine 21	3
	Aid 21	Cross-staffed by Engine 21
Station 22	Engine 22	3
	Aid 22	Cross-staffed by Engine 22
	Air Unit 21	Cross-staffed by Engine 22 if available
Station 24	Aid 24	3 Volunteers 1930-0500
	Emergency Supply Van	Not staffed
Station 25	Engine 25	3[3]
	Aid 25	Cross-staffed by Engine 25
Station 26	Engine 26	3
	Aid 26	Cross-staffed by Engine 26
	Battalion 21	1
Station 27	Engine 27	3
	Aid 27	Cross-staffed by Engine 27
	Ladder 27	3
	Aid 29	Cross-staffed by Ladder 27
	TOTAL	**19 career personnel minimum**

KFD relies on regional mutual and automatic aid agreements for major structure fires, other higher risk incidents, and during periods of high incident activity. The following figure represents the apparatus and staffing of fire agencies in reasonable proximity to the city and available for immediate dispatch.

Figure 10: Immediate Region Automatic Aid

Department	Resources Engines	Ladders Trucks	Other	Total Available Staffing
Bellevue Fire Department	9	2	2 Battalion Chiefs/6 Aid/1 Haz Mat	38
Redmond Fire Department	4	1	1 Battalion Chief/7 Aid/1 Rescue	27
Woodinville Fire and Life Safety	2	1	1 Battalion Chief/1 Rehab Unit	10
Bothell Fire Department	3	1	1 Battalion Chief	13
Northshore Fire Department	2	0	1 Battalion Chief	9
TOTAL AVAILABLE STAFFING				**97**

There are additional resources available for the rare major fire emergency. Fire agencies in the King County region have partnered to provide specialty response services such as hazardous materials response. This effectively spreads the cost of seldom used services across a broader base of agencies.

The State of Washington has a state-wide mobilization system that provides resources from around the state as requested and available. This can include one or more “strike teams” (groups of five similar

[3] This unit is temporarily staffed with four firefighters allowing two on Engine 25 for subsequent incidents.

resources) or "task forces" (groups of five dissimilar resources) staffed and equipped for the specific emergency.

Current Service Delivery Objectives

KFD has established response performance objectives primarily used to evaluate performance and provide guidance for future resource planning. The objectives are:

Dispatch Performance Objective:

- *Response resources shall be notified of a priority emergency within 75 seconds of **receipt of the call at the dispatch center**, 90 percent of the time.*

Turnout Time Performance Objective:

- *Response personnel shall assemble on apparatus and initiate movement towards a priority emergency within two minutes seven seconds of **notification by the dispatch center**, 90 percent of the time for incidents requiring full personal protective equipment and within two minutes 0 seconds of **notification by the dispatch center**, 90 percent of the time for all other incidents.*

First-Due Total Response Performance Objective – Fire:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within eight minutes 55 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

First-Due Response Performance Objective – Emergency Medical Service:

- *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within seven minutes 34 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

Concentration Performance Objective:

- *For moderate risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within 13 minutes 0 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

- *For high risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within 16 minutes three seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

KFD is currently achieving these objectives as will be demonstrated in a later section of this report.

Component C – Review of the Community Expectations

The ultimate goal of any emergency service delivery system is to provide sufficient resources (personnel, apparatus, and equipment) to the scene of an emergency in time to take effective action to minimize the impacts of the emergency. This need applies to fires, medical emergencies, and any other emergency situation to which the fire department responds. Obtaining and understanding the desires and expectations of community stakeholders is an important first step. KFD is committed to incorporating the needs and expectations of residents and policy makers in the service delivery planning process.

An extensive stakeholder input process was conducted in preparation for the development of the KFD 2012 Strategic Plan. The information gathered then is relevant to this document and is reprinted below.

Summary of Discussions

ESCI solicited input from internal and external stakeholders through two separate venues: one-on-one interviews conducted by the ESCI team during the initial data gathering process and a citizens group formed to participate in the strategic planning process. As part of the interview process, the internal and external stakeholders were asked to identify their perspectives on the department's strengths and weaknesses, as well as the challenges facing the department and critical issues it needs to address.

Internal and External Stakeholders

Organizational Strengths

It is important for any organization to identify its strengths in order to assure it is capable of providing the services requested by customers and to ensure that strengths are consistent with the issues facing the organization. Often, identification of organizational strengths leads to the channeling of efforts toward primary community needs that match those strengths. Programs that do not match organizational strengths or the primary function of the business should be seriously reviewed to evaluate the rate of return on precious staff time. In the course of ESCI's stakeholder interviews, the strengths of the KFD were identified by both internal stakeholders (representatives of the City Council, city management, and department directors, and the fire department) and a select group of external stakeholders (neighboring emergency service providers). They are listed below as stated by those interviewed.

City Council

- Community satisfied with service
- Good department—they work well with each other and know how to cooperate
- Personnel are devoted and well trained
- Provides good service and delivers what the public expects
- Good relationship between labor and management
- Department is trusted and respected by the public

City Management and Department Directors

- Best trained and highest morale in the area
- The fact that it is a city service—it is personal and available to the public
- Service is excellent and well-coordinated
- Good quality service and effective

KFD Members

- Training division is good, personnel are well trained
- Comprehensive system that has identified hazards and appropriate resources
- Building division is not under direction of Planning Department
- Good people who are interested and dedicated
- Good neighbors that we train with
- Good follow through on calls
- Cohesive staff—no grandstanding
- We do a lot with less
- People are treated well by their peers
- Good people
- Citizens really appreciate the service
- Training has improved significantly
- Chief is motivated and provides leadership
- Apparatus/equipment/PPE are in good shape
- Our people work hard
- Training is really good, troops are very professional

Neighboring Providers

- Department has good people and a good leader
- Good relations with KFD staff
- Partnership in mutual aid and NORCOM

Organizational Weaknesses

Performance or lack of performance within an organization depends greatly on the identification of weaknesses and how they are confronted. While it is not unusual for these issues to be at the heart of the organization's overall problems, it is unusual for organizations to be able to identify and deal with these issues effectively on their own.

For any organization to either begin or to continue to move progressively forward it must not only be able to identify its strengths but also those areas where it does not function well. These areas of needed enhancements are not the same as challenges, but rather those day-to-day issues and concerns that may slow or inhibit progress.

City Council

- System has never met response time goals
- The issue of overtime
- Huge department with very few fires—most calls are for EMS; many people are sitting around waiting for something to happen
- Concerns about sustainability of the system
- Location of fire stations—difficult to serve Kingsgate and Finn Hill
- Having building and fire under the same department is wrong

City Management and Department Directors

- City departments do not see that finances are now really difficult; there is a new normal
- Loss of public information/education and outreach capabilities
- Public education loss is serious

KFD Members

- Hard to say "no" to new projects
- Economy forces FDs to decrease resources and become over reliant on mutual aid
- No comprehensive wellness and fitness program
- Struggle with relationships with other city departments
- Low company staffing

- Struggle to maintain facilities
- We struggle with appropriate discipline
- Lack of buy-in on the importance of prevention by some operations personnel
- Very limited ability to change
- Uncertainties
- Declining money
- Officer training is non-existent
- Lack of standards
- Lack of administrative control
- No support to take corrective action

Neighboring Providers

- Rumor that KFD wants own paramedics—this will hurt regional strength
- Redundancies among neighbors
- Government can be a barrier
- Procedural differences; they seem to be out of position quite a bit (Engine 25)

Challenges

To draw the strong suit and gain full benefit of any opportunity, the challenges to the organization must also be identified. By recognizing potential challenges, an organization can greatly reduce the potential for future setbacks. In this particular exercise, stakeholders were asked to identify up to three challenges facing KFD.

City Council

- Geography; jurisdictional boundaries
- Money
- Political issues
- Coverage
- Competition for financial resources
- Possibility of RFA
- Staffing levels

City Management and Department Directors

- Need for a fireboat
- Stability and predictability in costs
- Any incident will generate overtime
- Getting people to engage in safe practices/emergency preparedness
- Firefighters at risk from injuries and age

KFD Members

- Containing growth of call volume
- Number of non-emergency calls
- Fees are not enough to finance Building Division
- Adding new permit tracking software
- Budget support
- Connecting to the community
- Need more staff (in prevention)
- Building good relationships with neighbors
- Act/behave like the size city we are
- Reserve program is gone
- Finn Hill Station
- Annexation impacts

Neighboring Providers

- External political forces

Critical Issues

After organizational strengths and weaknesses and challenges posed by the current environs, ESCI asked stakeholders to identify the critical issues they perceive the agency is facing. The following reflect the critical issues that the respondents felt pose the greatest risk today to the success KFD's service delivery. As with the organizational challenges, each stakeholder was asked to identify up to three critical issues.

City Council

- Response time
- Coverage in annexation area
- Financial stability
- Funding
- Building codes are overwhelming

City Management and Department Directors

- Slow growth of expenses
- Funding that is sustainable for all city departments
- Annexations, revenue, change in building stock

KFD Members

- Funding, leadership, too few administrative staff
- Funding, levy approval for Medic One program
- Budget challenge
- Administrative support resources (for data extraction and analysis)
- IT support
- Organizational communications
- No recognizable vision—old strategic plan not implemented
- Strategic planning
- Organizational communication—most information comes via the rumor mill
- Lack of communication between fire and building
- Team building
- Chief's decisions will set tone for organizational culture
- Administration is understaffed Operations Chief is overwhelmed
- Structure and accountability for offenders
- Staffing issue at the line (Fire Station No. 27)
- Battalion aid needs to be staffed 24/7

Neighboring Providers

- Cost of service
- Housing prices down
- Dramatically underprepared for a disaster
- Money
- Ongoing workload/cultural shift—need to be more community connected
- Need to be more agile in addressing change
- King County EMS Levy
- Declining economy
- Revenues
- Controlling expenses

Community Members

A citizens' group consisting of local business owners and representatives of several neighborhood associations were invited to participate in the strategic planning session facilitated by ESCI; a total of 11 community members attended the session. Rather than focusing on the organization's strengths, weaknesses, challenges, and critical issues, the community members were asked to identify their priorities, expectations, and concerns with regard to the department and its services.

Customer Priorities

In order to dedicate time, energy, and resources on services most desired by its customers, KFD needs to understand the community's priorities. To assist with the overall strategic planning process, members of the citizens' group were asked to review a short list of planning considerations and rank them through a direct comparison process. The results of that ranking appear below (in priority order):

- Technical competence of firefighters and emergency medical personnel.
- Ensuring that facilities and equipment are reliable and functional.
- Improving the response time of the first engine or ambulance to arrive at a scene.
- Maintaining the existing response times of the first engine or ambulance.
- Compassion, empathy, and customer service of emergency responders.
- Expanding the types of services offered by KFD.
- Keeping KFD costs and tax rates as low as possible.

Customer Expectations

Understanding what the community expects of its fire and emergency services organization is critically important to developing a long-range perspective. With this knowledge, internal emphasis may need to be changed or bolstered to fulfill the customer needs. The following are the expectations identified by several members of the citizens' group.

- Well trained, competent, professional personnel.
- Fast response times.
- Reliable, appropriate equipment and facilities.
- Community education and training for disaster preparedness.
- Adaptable to changing conditions; willingness to consider alternative delivery methods.

Areas of Customer Concern

The Customer Centered Strategic Planning process would fall short and be incomplete without an expression from the customers of their concerns about the organization. Some areas of concern may, in fact, be a weakness within the delivery system. However, they may also be perceptions of the customers based on limited knowledge.

- Does it have a sustainable structure? Can it adapt to changes in resources?
- How can services be provided equally across the city? Shift in city resources/personnel away from certain neighborhoods.
- Accountable and efficient. Do they have what they need to do the job? Training, equipment, etc.
- Lack of public outreach; communication skills could be improved.

Positive Customer Feedback

For a strategic plan to be valid, the customer views on the strengths and image of the emergency services organization must be established. Needless efforts are often put into over-developing areas that are already successful. However, utilization and promotion of the customer-identified strengths may often help the organization overcome or offset some of the identified weaknesses.

- Personnel are professional, well trained, experienced, and knowledgeable.
- Equipment and facilities are appropriate, adequate for the job, and well-maintained.
- The department enjoys good leadership.
- KFD firefighters/EMTs are visibly committed to their community.

Other Thoughts and Comments

The citizens' group participants were asked to share any other comments they had about KFD or its services. The response that appeared most often was an appreciation for the opportunity to participate in the process and a desire to improve and enhance the partnership that exists between KFD and the community it serves.

Component D – Overview of Community Risk Assessment

This section analyzes certain categorical risks that are present within the City of Kirkland that potentially threaten the people and businesses within the community and that can create response workload for KFD. These risks are identified to assist KFD in identifying where to locate response resources in the types and numbers needed to effectively respond to likely emergencies.

Additional information can be found in the *2005 City of Kirkland Hazard Vulnerability Assessment Update.* This comprehensive document describes various natural and man-made hazards that exist in the City of Kirkland and strategies to mitigate these risks.

General Risk Assessment

The fire service assesses the relative risk of properties based on a number of factors. Properties with high fire and life risk often require greater numbers of personnel and apparatus to effectively mitigate a fire emergency. Staffing and deployment decisions should be made with consideration of the level of risk within geographic sub-areas of a community.

The community's general risk assessment has been developed based on intended land use within the jurisdiction's boundaries. These uses are described on the City of Kirkland Zoning Map. The following figure translates these land uses to categories of relative fire and life risk.

Figure 11: Fire and Life Risk Based on Zone Description

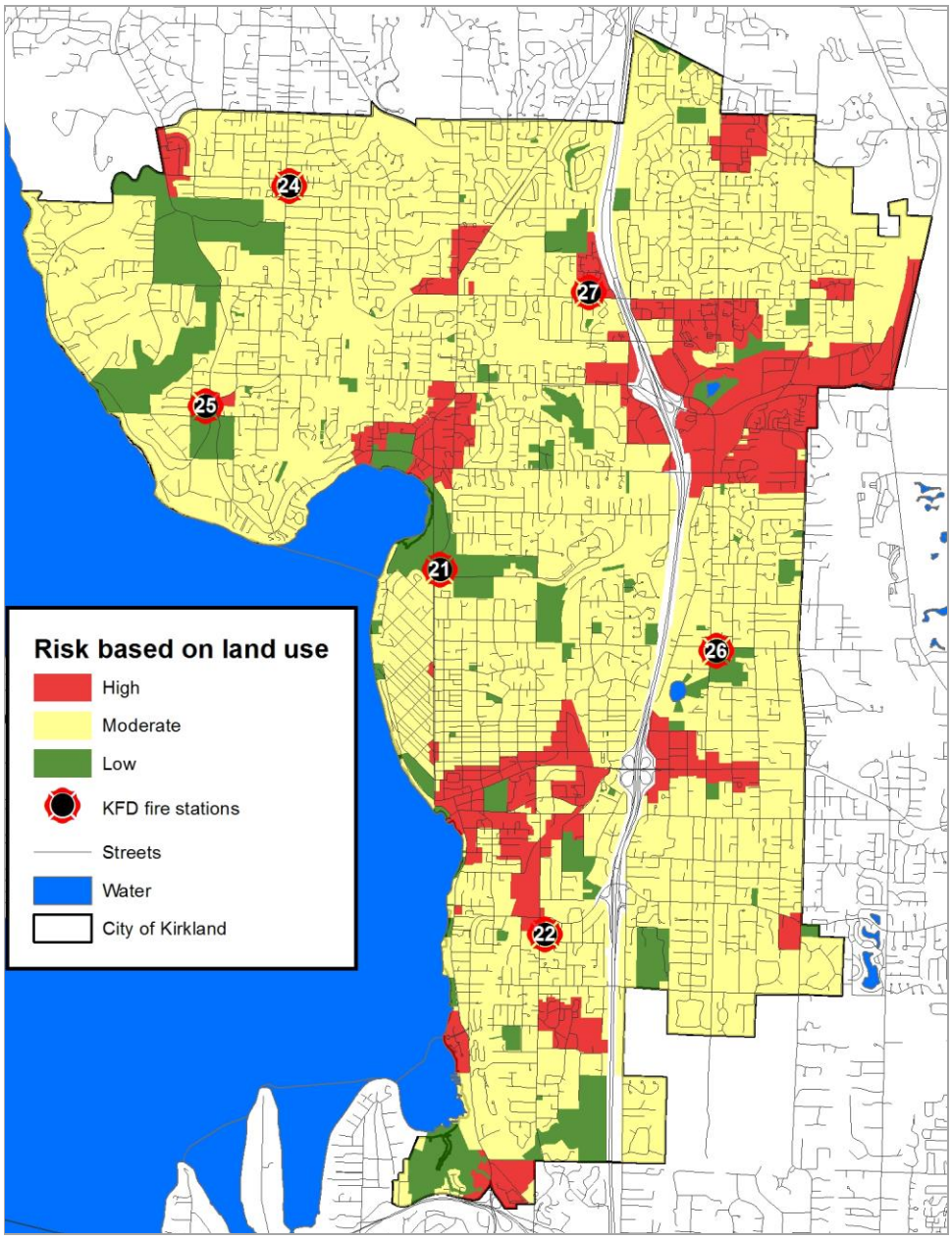
Zone Description	Risk
Commercial	High
High Density Residential	High
Industrial	High
Institutions	High
Low Density Residential	Moderate
Medium Density Residential	Moderate
Office	Moderate
Park/Open Space	Low
Transit Oriented Development	Moderate

Risk level is defined as follows.

- **Low Risk** – Minor incidents involving small fires (fire flow less than 250 gallons per minute), single patient non-life threatening medical incidents, minor rescues, small fuel spills, and small wildland fires without unusual weather or fire behavior.

- **Moderate Risk** – Moderate risk incidents involving fires in single-family dwellings and equivalently sized commercial office properties (fire flow between 250 gallons per minute to 1,000 gallons per minute), life threatening medical emergencies, hazardous materials emergencies requiring specialized skills and equipment, rescues involving specialized skills and equipment, and larger wildland fires.
- **High Risk** – High risk incidents involving fires in larger commercial properties with sustained attack (fire flows more than 1,000 gallons per minute), multiple patient medical incidents, major releases of hazardous materials, high risk rescues, and wildland fires with extreme weather or fire behavior.

Figure 12: Community Risk Assessment Based on Land Use Zones



Geographic and Weather-Related Risks

Weather Risk

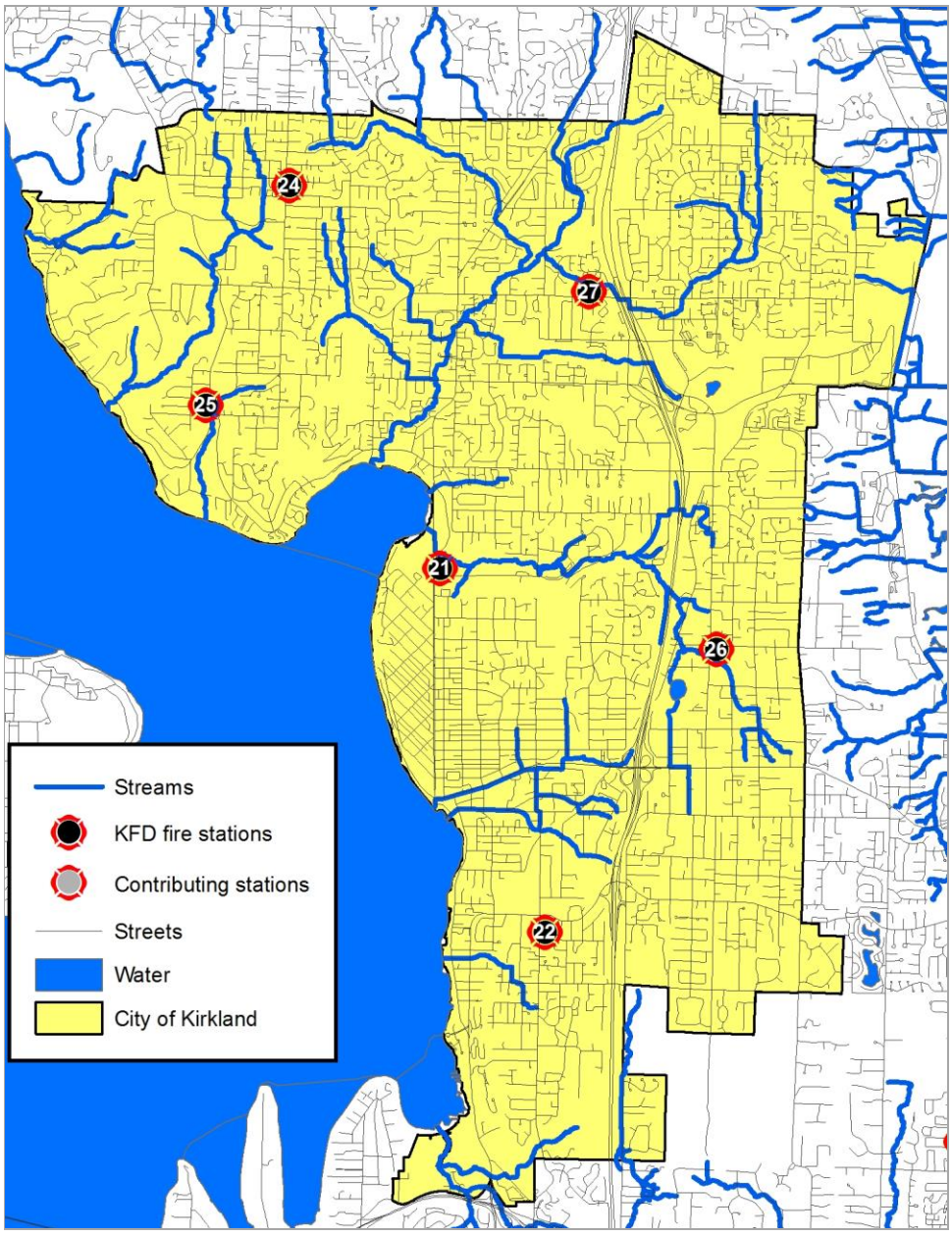
The weather a community experiences can impact the fire department's ability to respond. Snow, ice, and other conditions can slow response. Major storms can create emergency situations that can overwhelm local emergency response forces.

The Kirkland area enjoys a temperate marine climate and has a cool Mediterranean climate influenced by the Puget Sound. Temperatures are typically moderate with average monthly temperatures varying by only a few degrees. The average low temperature is in the mid-30°F during winter months and the summertime average high temperature is 75°F. Average rainfall is 37.4 inches per year.

Extreme weather, though rare, does occur. Thunderstorms, strong wind storms, and significant rain events happen infrequently. Snowfall is experienced annually but typical not in amounts more than a few inches at a time. The lowest recorded temperature was 0°F in 1950 and the highest recorded temperature was 103°F in 2009.

Flooding is a risk. There are numerous perennial streams that pass through Kirkland and empty into Lake Washington. During heavy rainstorms these streams can flood impacting areas along their path. The following figure illustrates the locations of these streams.

Figure 13: Streams Subject to Flooding



Wildfire Risk

Kirkland's climate, vegetation, topography, and the extent to which the community has developed make wildland fire a low risk to the most of the community. Few occur and primarily in park land or vacant lots.

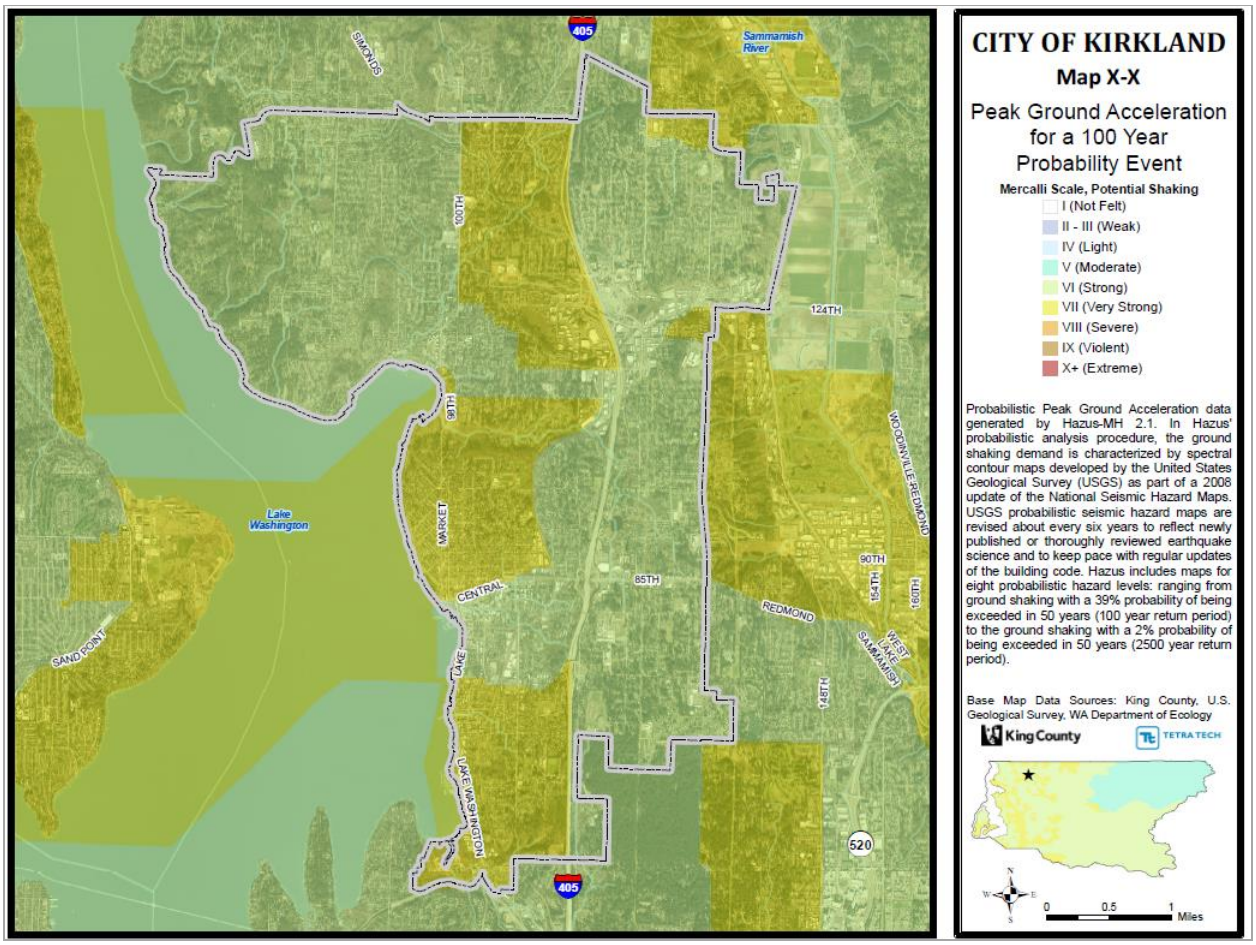
There are areas in the northwest portion of Kirkland with moderately dense vegetation, steep slopes, and interspersed homes that present a wildland/urban interface risk. A wildland fire in these areas combined with an extended drought and strong winds could lead to a significant fire event.

Geographic/Geological Risk

Certain geographic and geologic risks create situations that threaten the community, or are physical barriers to street connectivity for emergency service response. Steep slopes, water barriers such as rivers, and other geographic features can impede rapid response. The City of Kirkland area contains many geographic hazards.

The Kirkland region is geologically active. Damaging earthquakes have occurred with regularity through recorded history, most recently on February 28, 2001. The following figure shows the peak ground acceleration for the Kirkland area. The City of Kirkland lies in an area of strong to very strong ground shaking potential.

Figure 14: Earthquake Hazard – Peak Ground Acceleration



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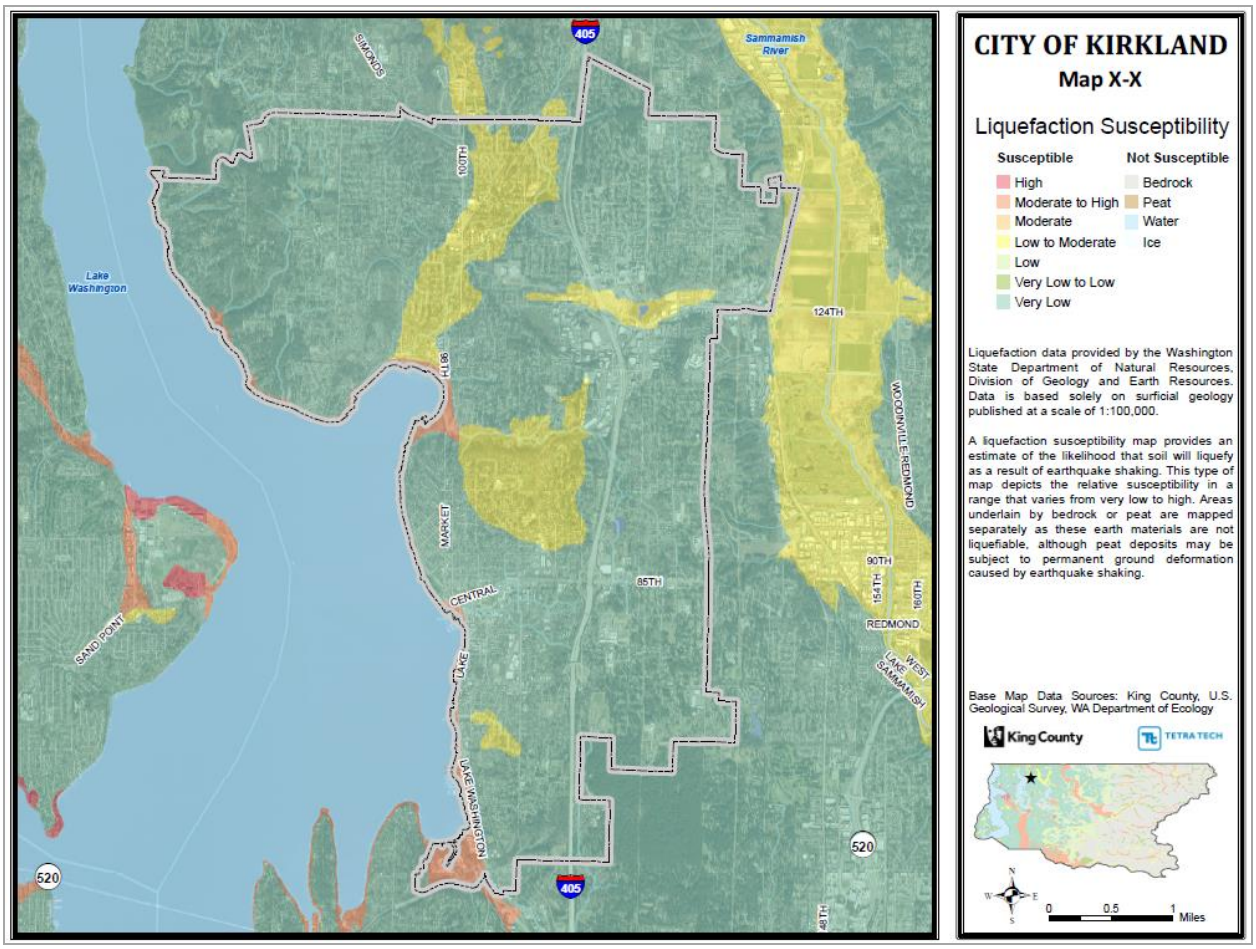
Liquefaction is another concern during an earthquake. Soils more prone to liquefaction contribute to greater damage due to its instability. The following figure shows liquefaction susceptibility for the Kirkland area. Kirkland soils exhibit low to moderate liquefaction susceptibility.

Figure 15: Liquefaction Susceptibility



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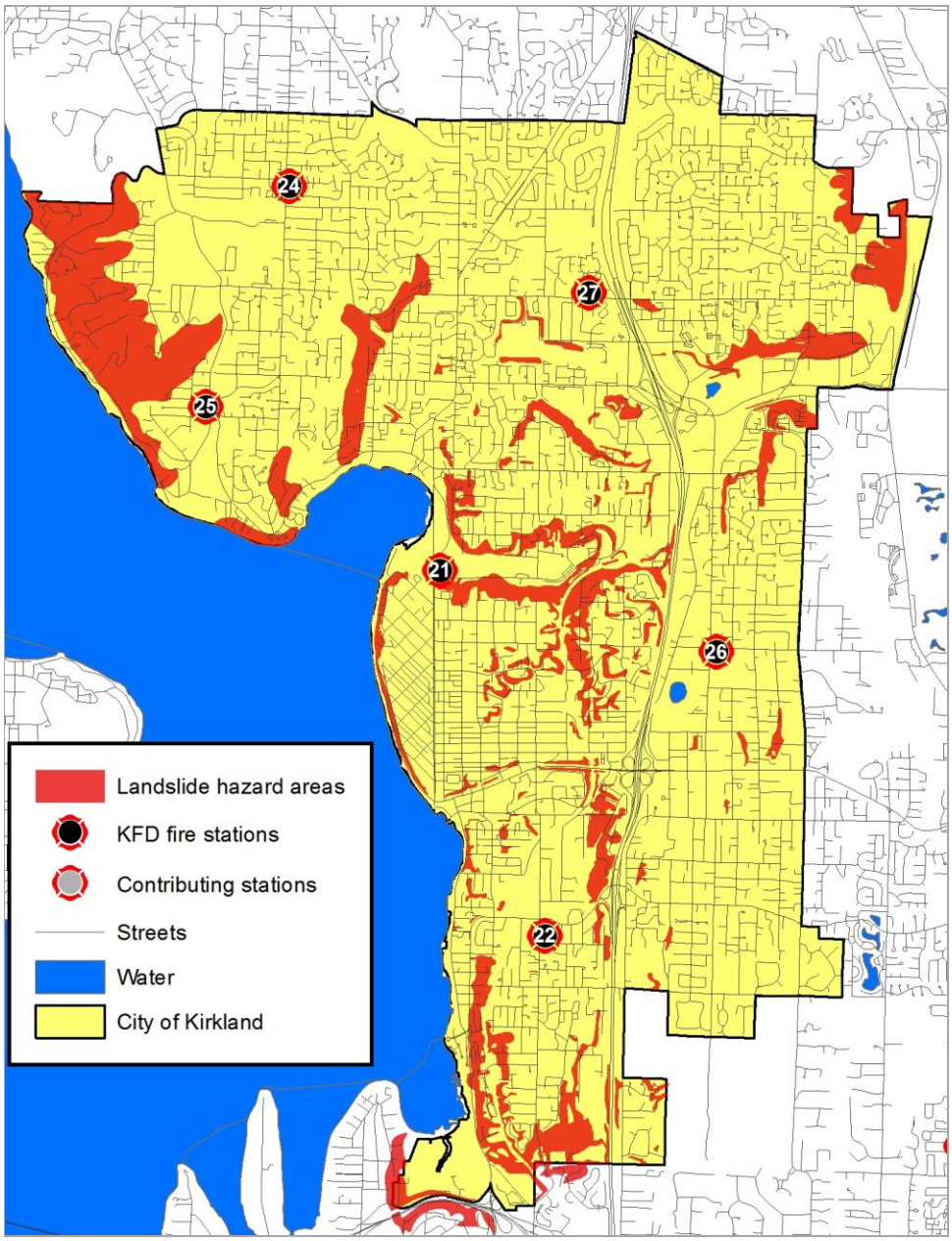
Landslides are another geological hazard present in the City of Kirkland. Heavy rains, earthquakes, and other events can cause landslides. The following figure illustrates areas within the city that have the potential for landslides.

Figure 16: Landslide Hazard Areas



Transportation Risks

Transportation corridors provide necessary access and egress for the city. These take the forms of roads, airports, and railways. The configuration of transportation systems can also affect the response capability of emergency services. Limited access freeways and rail lines can interrupt street connectivity, forcing apparatus to negotiate a circuitous route to reach an emergency scene. Street-level rail lines can impede traffic at crossings when the trains traverse through the city.

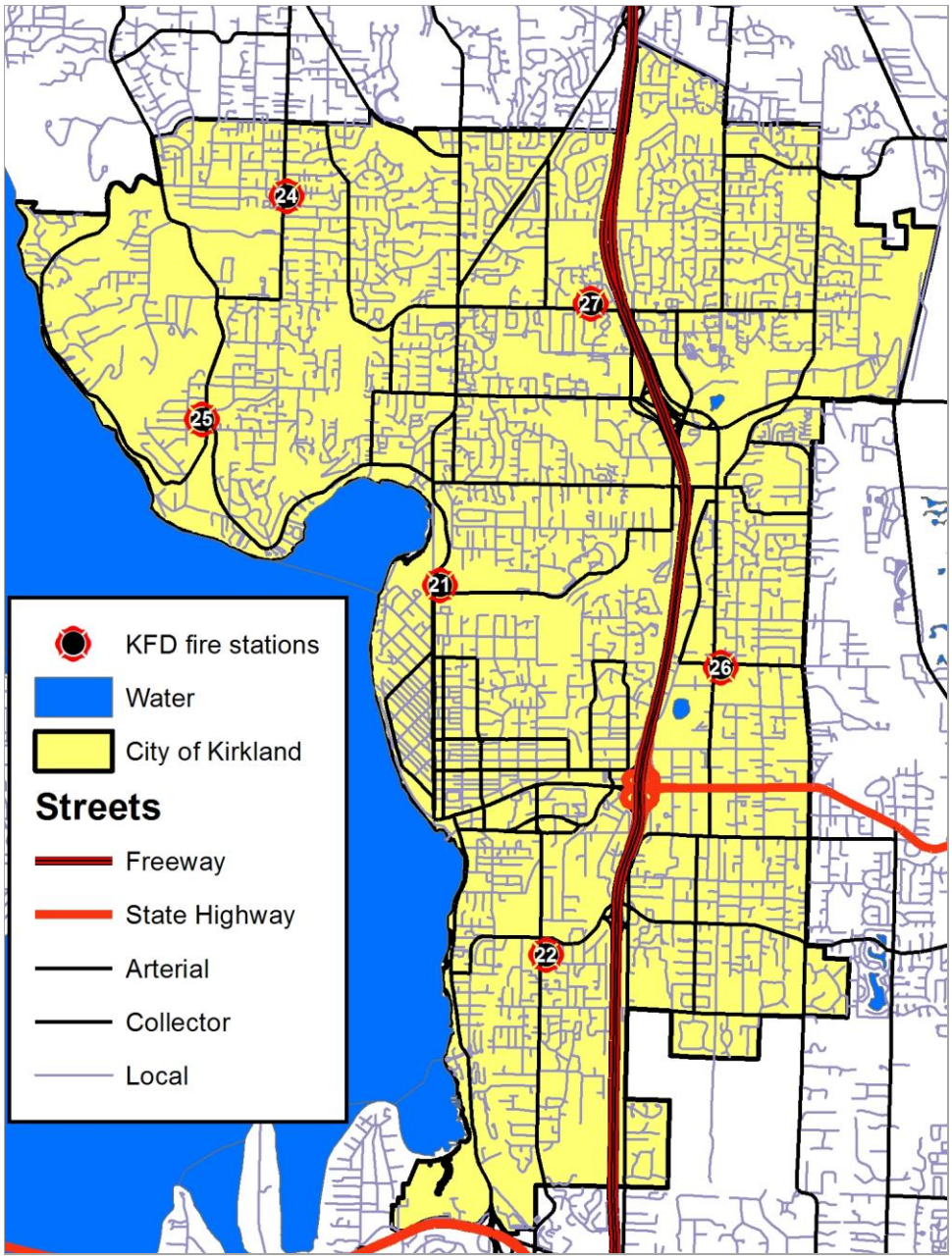
Roads

The City of Kirkland is bisected by Interstate 405 and is accessed via the state and U.S. highway system. The city's street system is generally well gridded, supporting the movement of emergency vehicles.

While much of the area supports emergency response there are challenges. Interstate 405 presents a significant barrier to east-west travel. Areas such as "Goat Hill" are accessed by very narrow and steep roadways. Along the waterfront are numerous homes that have very limited road access. Each of these areas impedes rapid access to an emergency.

Traffic signals within the service area are equipped with signal pre-emption equipment. This provides a response time performance advantage as well as improved safety to motorists.

Figure 17: Street System

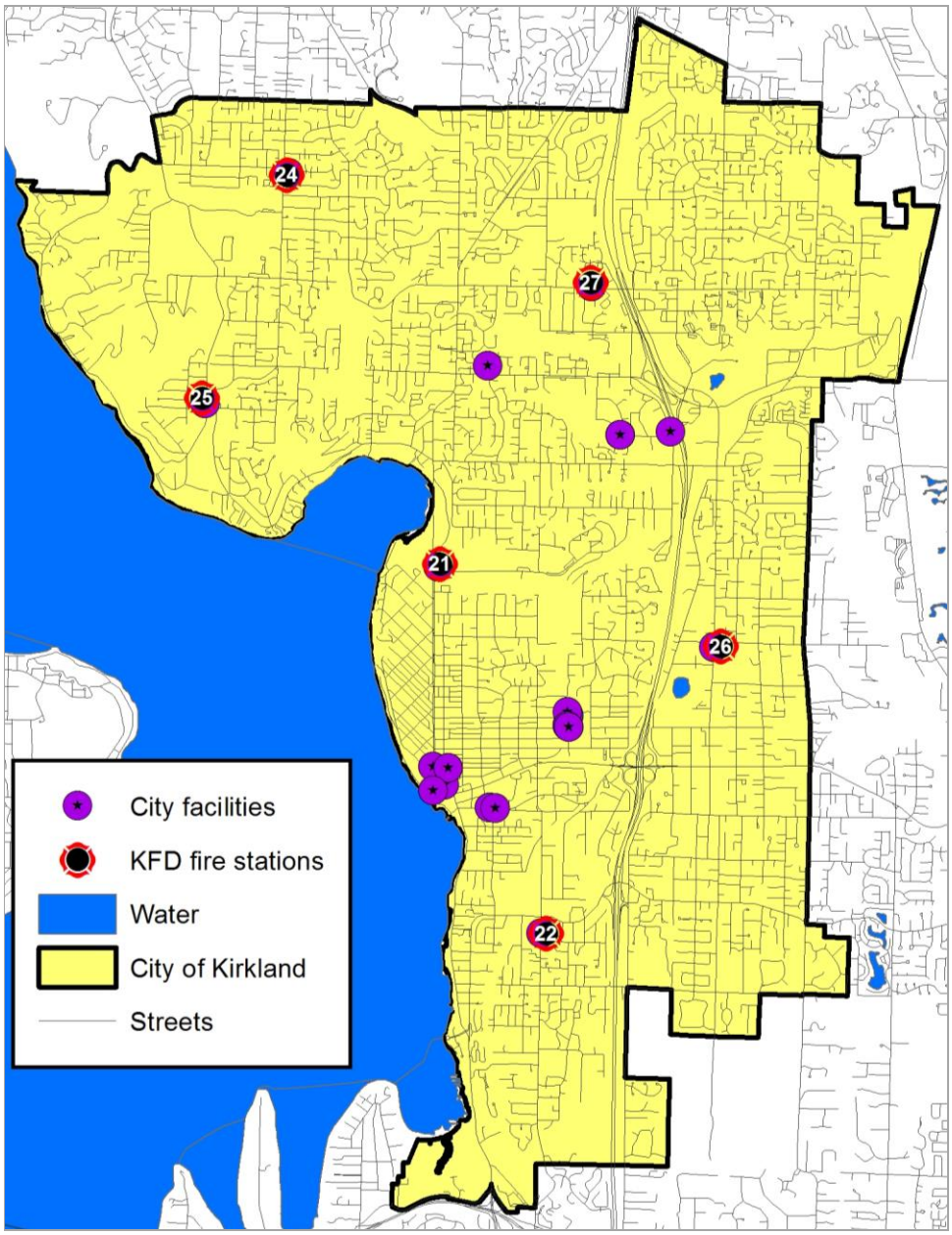


Physical Assets Protected

Government Buildings

There is a variety of government buildings in Kirkland considered important to providing critical services to the community in times of disaster. Buildings such as city hall, police and fire stations, and other city facilities provide important services to the community. The following figure shows the locations of the important city facilities within Kirkland.

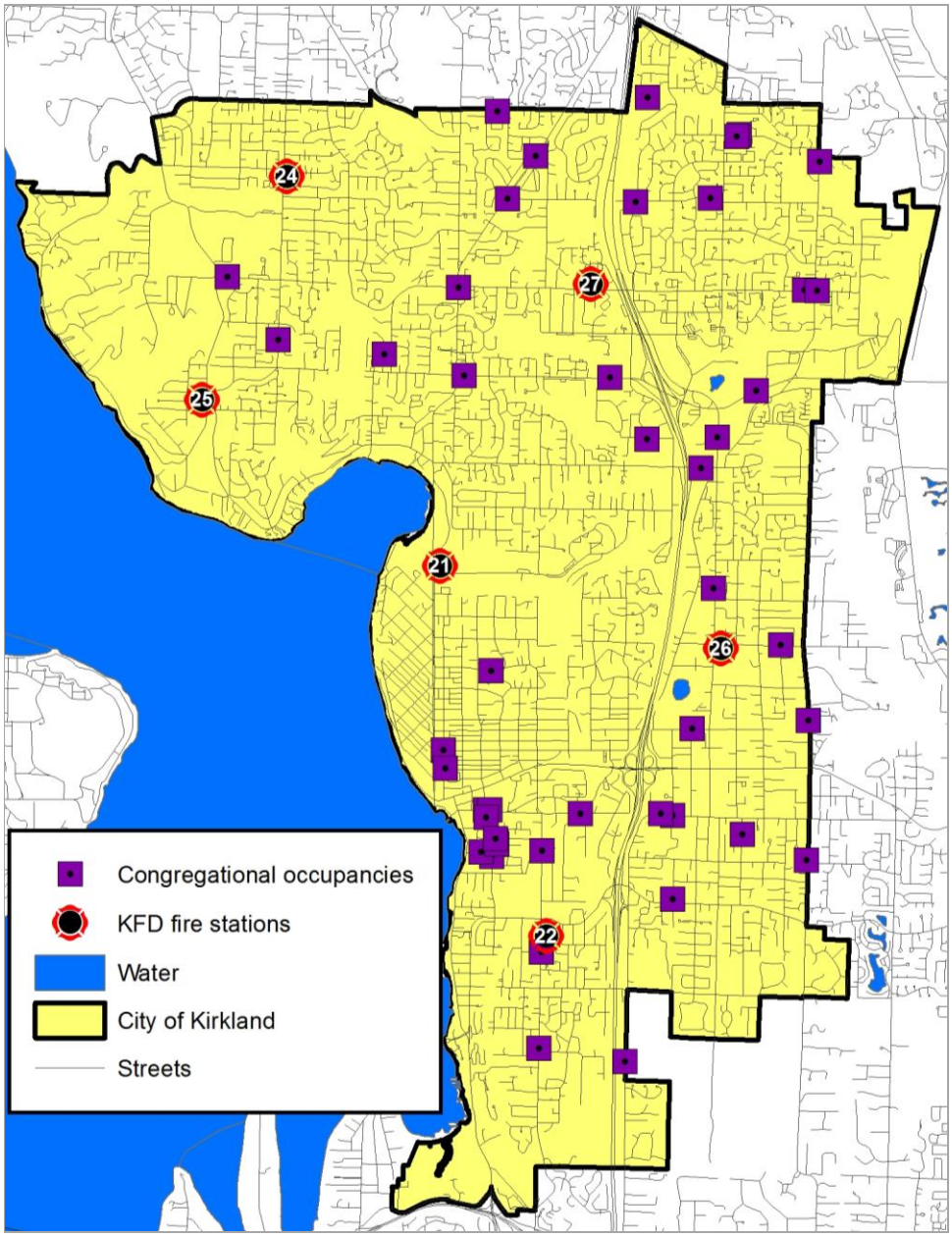
Figure 18: City Facilities



Congregational

Numerous buildings lie within Kirkland in which people gather for entertainment, worship, and such. A variety of nightclubs, theaters, and other entertainment venues exist in the downtown area. These facilities present additional risk, primarily for mass casualty incidents. Fire, criminal mischief, and potentially terrorism, could cause a major medical emergency requiring significant emergency service resources. The following figure shows the locations of congregational facilities.

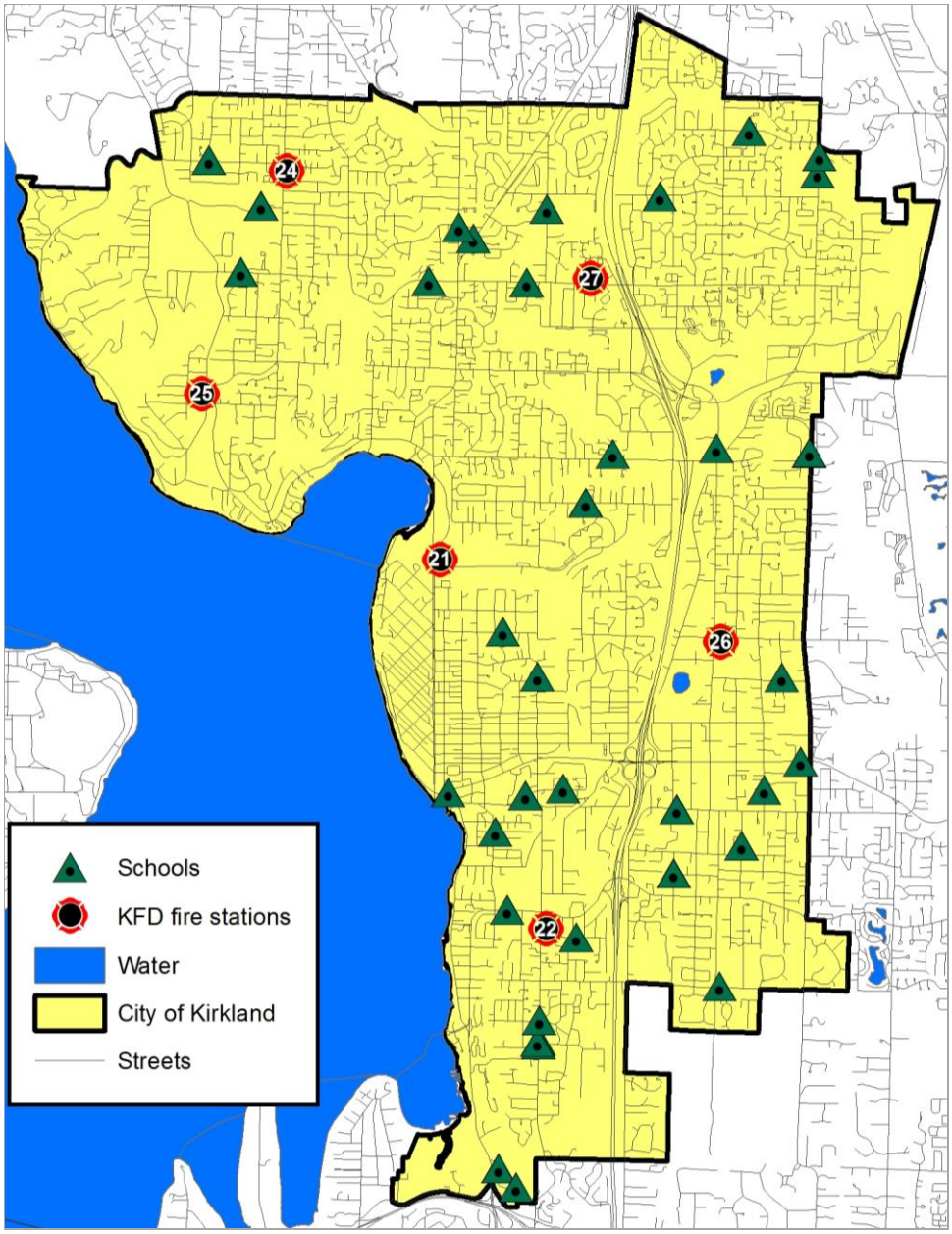
Figure 19: Congregational Facilities



Schools/Day Care

The Lake Washington School District serves a 76 square mile area including the City of Kirkland. It operates 31 elementary schools, 12 middle schools, eight high schools, and other facilities. Total enrollment in 2013 is 26,220. There are also a number of private and higher education schools, and pre-schools within the KFD service area for a total of 56 facilities. The following figure shows the locations of educational facilities.

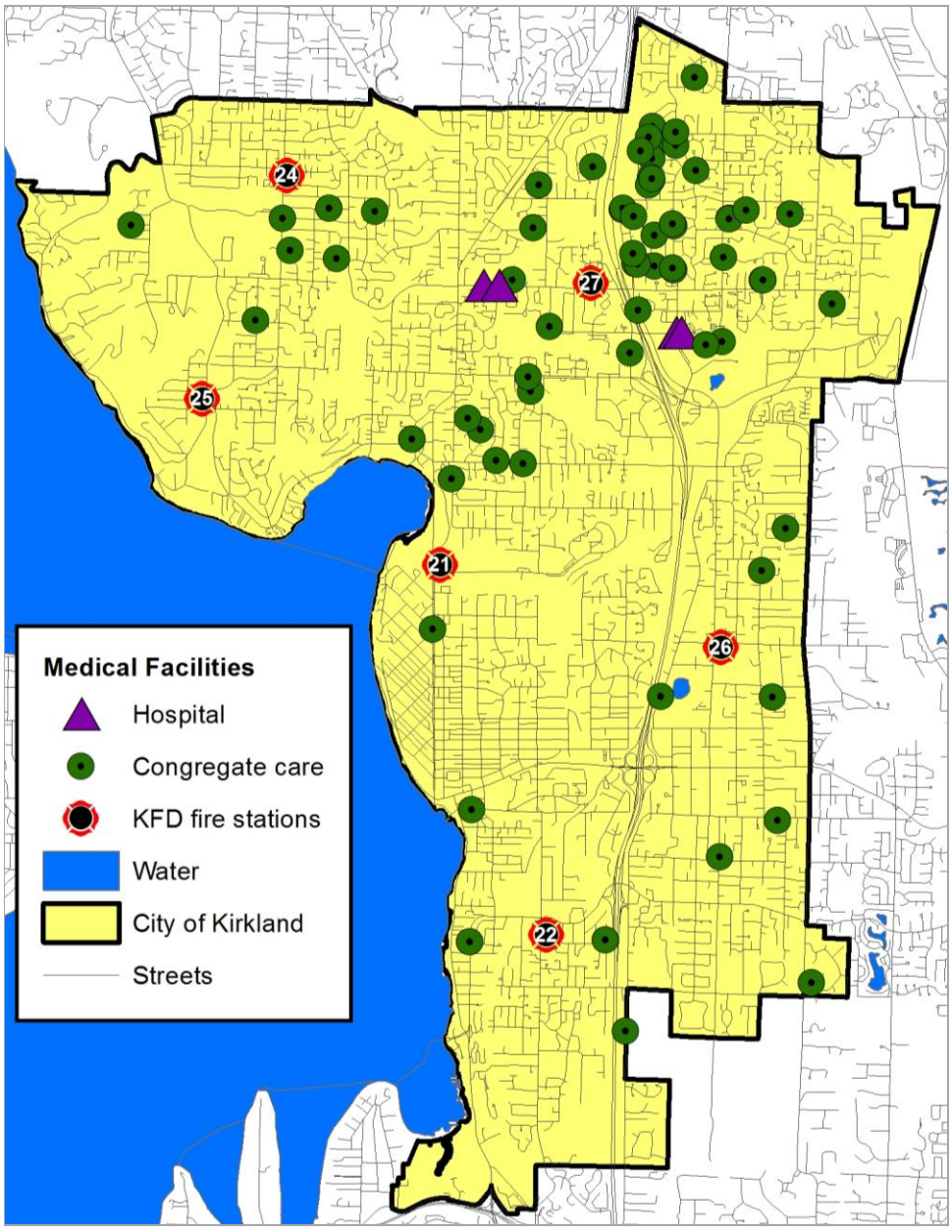
Figure 20: Kirkland Area Schools and Day Care Facilities



Medical Facilities

The city is home to a number of important medical care facilities, including the Evergreen Hospital and Fairfax Hospital. Other facilities include skilled nursing, assisted living, and other in-patient care facilities. These facilities present a unique life safety risk in that they house people who are likely of limited mobility or are non-ambulatory. Evacuation of patients requires additional emergency response resources and well trained facility staff. The following figure shows the location of many of these important community resources.

Figure 21: Medical and Care Facilities



Other Critical Infrastructure

In this section, other types of critical infrastructure to a community are discussed in general terms. Though Kirkland does not have any unusual critical community infrastructure, it is important the fire department plan for emergencies at these facilities.

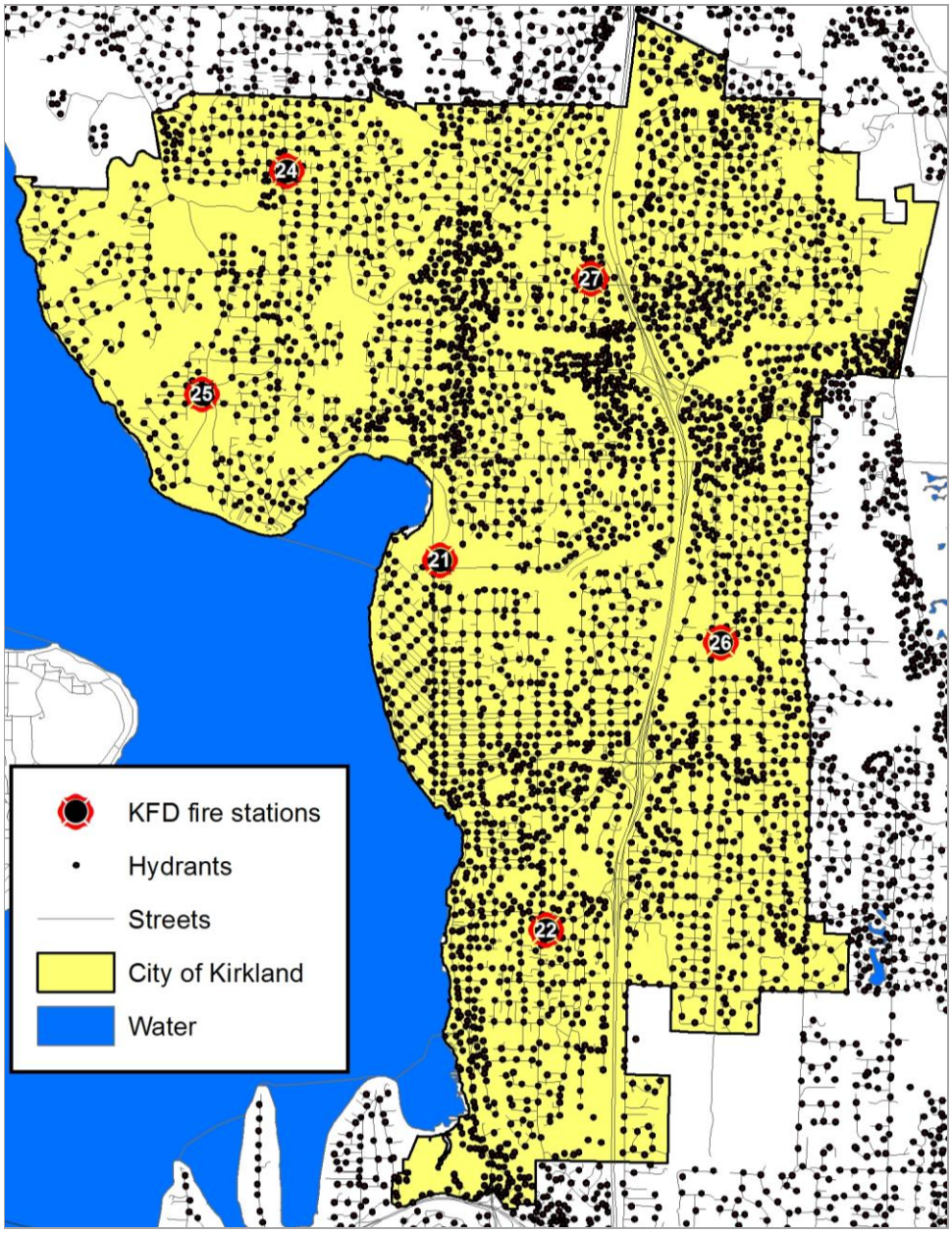
The most obvious concern to the fire department of this infrastructure is the reservoir, water main, and fire hydrant system. Providing sufficient storage, distribution, and access to this valuable firefighting resource through well-distributed fire hydrants is very important.

Firefighting water service from fire hydrants is available to nearly every developed property within the city. Fire flows are generally acceptable for risks protected.

The City of Kirkland in concert with the Cascade Water Alliance is the primary water service provider. Together they operate the water treatment facilities; installs and maintains water lines, reservoirs, and fire hydrants; and plans for future capital improvement. Kirkland is also provided water service by the North Shore Utility District, Woodinville Water District, the City of Bellevue, and the City of Redmond.

The last WS&RB review of the city's water system was in 2013. At that time, WS&RB gave the city's water system a relative classification of "1" indicating that the system provides excellent delivery of firefighting water supply. The following figure shows the location of fire hydrants in relation to developed lands.

Figure 22: Fire Hydrant Distribution in Relation to Developed Lands

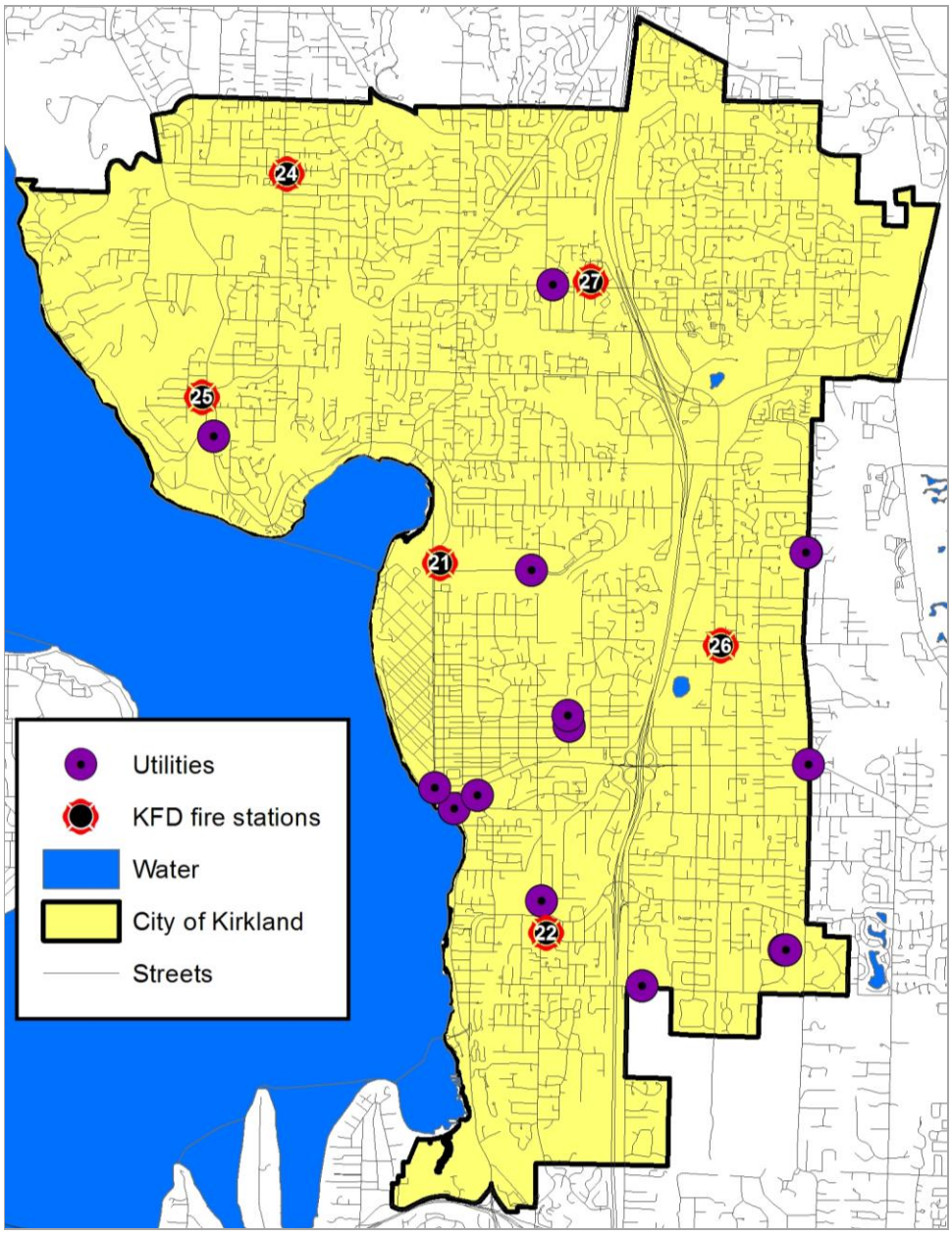


Emergency communication centers and the associated transmitting and receiving equipment are essential facilities for emergency response. The North East King County Regional Public Safety Communications Agency (NORCOM) provides call receipt and dispatch services. This center provides for the receipt of 9-1-1 calls for help, dispatching of fire and other emergency responders, and important support to the incident management function. There are other communication facilities and equipment that are equally important to the community and government operations. These include the telephone company central offices and the transmission lines of local telephone providers. Internet service providers, along with wireless cellular communication providers, provide essential communication capabilities for the community as well as emergency personnel through their facilities and equipment.

Previously discussed community services, from communications to traffic signals to normal operations, require the use of energy. Whether it is electricity generation and transmission systems, fuel distribution and storage tanks, or natural gas pipelines and regulator stations, the community is dependent upon energy sources.

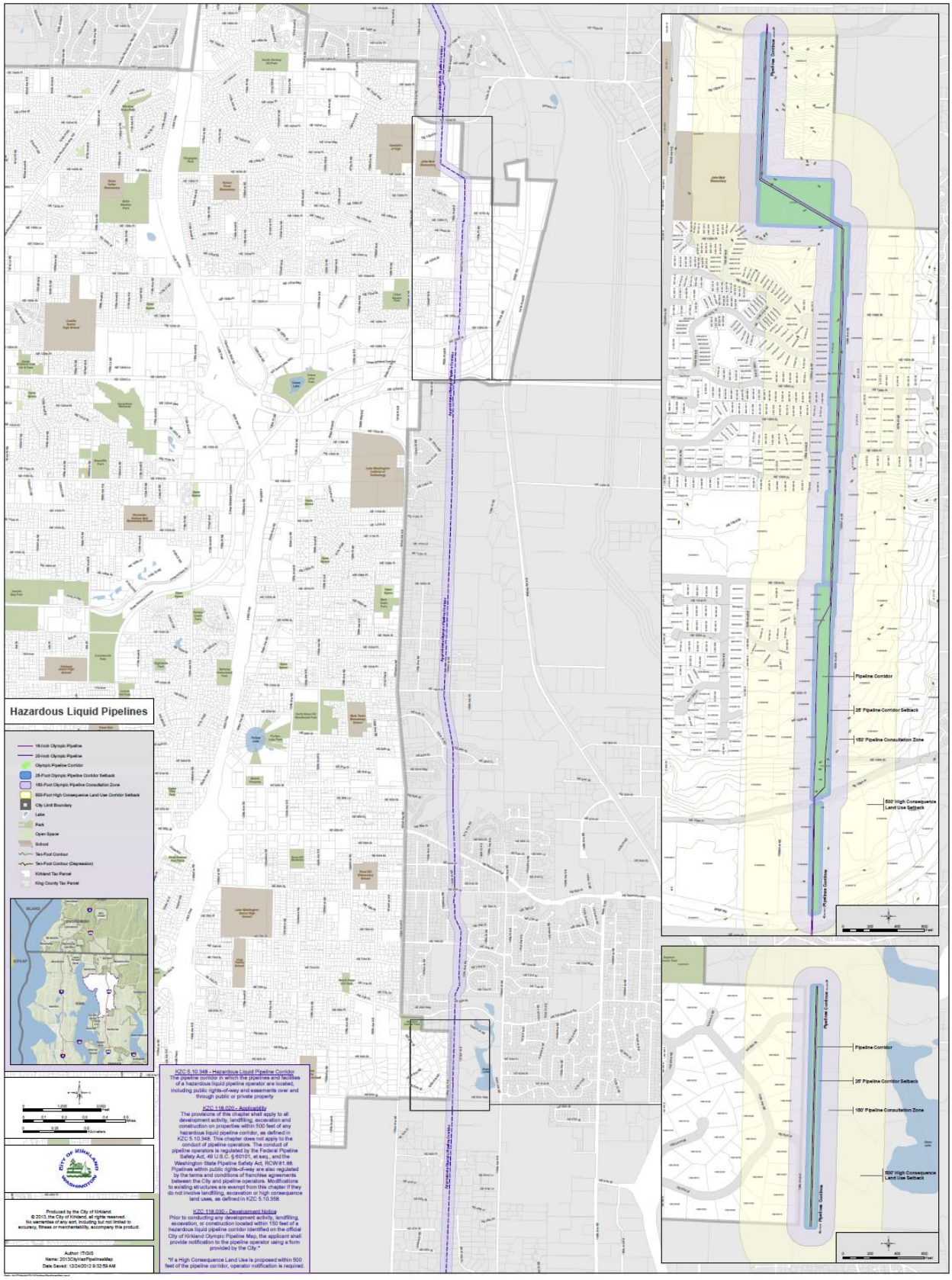
The following figure shows the locations of many of the power, water, and energy facilities in Kirkland.

Figure 23: Power, Water, and Other Utility Facilities



There is also a flammable liquids pipeline that passes along the eastern edge of Kirkland, and in two places through the city's eastern territory. This pipeline, though well protected, if ruptured could cause an emergency of considerable significance. The following figure show this pipelines route as it passes by and through the city.

Figure 24: Olympic Pipeline

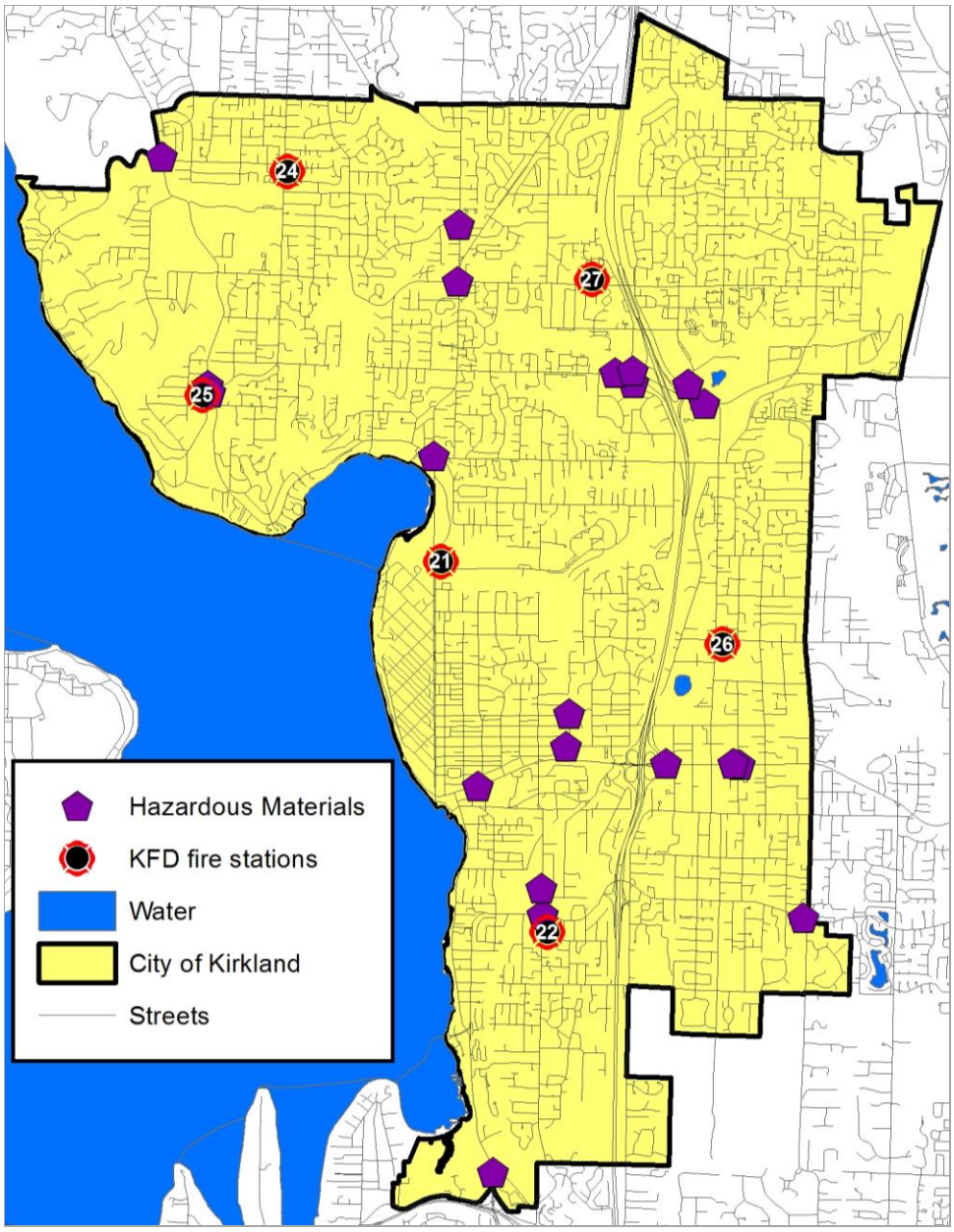


Structural Risks

The protection of property in most cases refers to a building and its contents. This has been the basic mission of the fire department since its inception. Certain buildings, their contents, functions, and size present a greater firefighting challenge and require special equipment, operations, and training.

Buildings containing hazardous materials can create a dangerous environment to the community as well as the firefighters during a spill or fire. Special equipment, protective clothing, and sensors, along with specialized training, are necessary to successfully mitigate a hazardous materials incident. KFD is a partner in a regional hazardous materials response system. KFD provides personnel and equipment to the region as needed. The following figure shows the locations of facilities classified as using more than small quantities of hazardous materials.

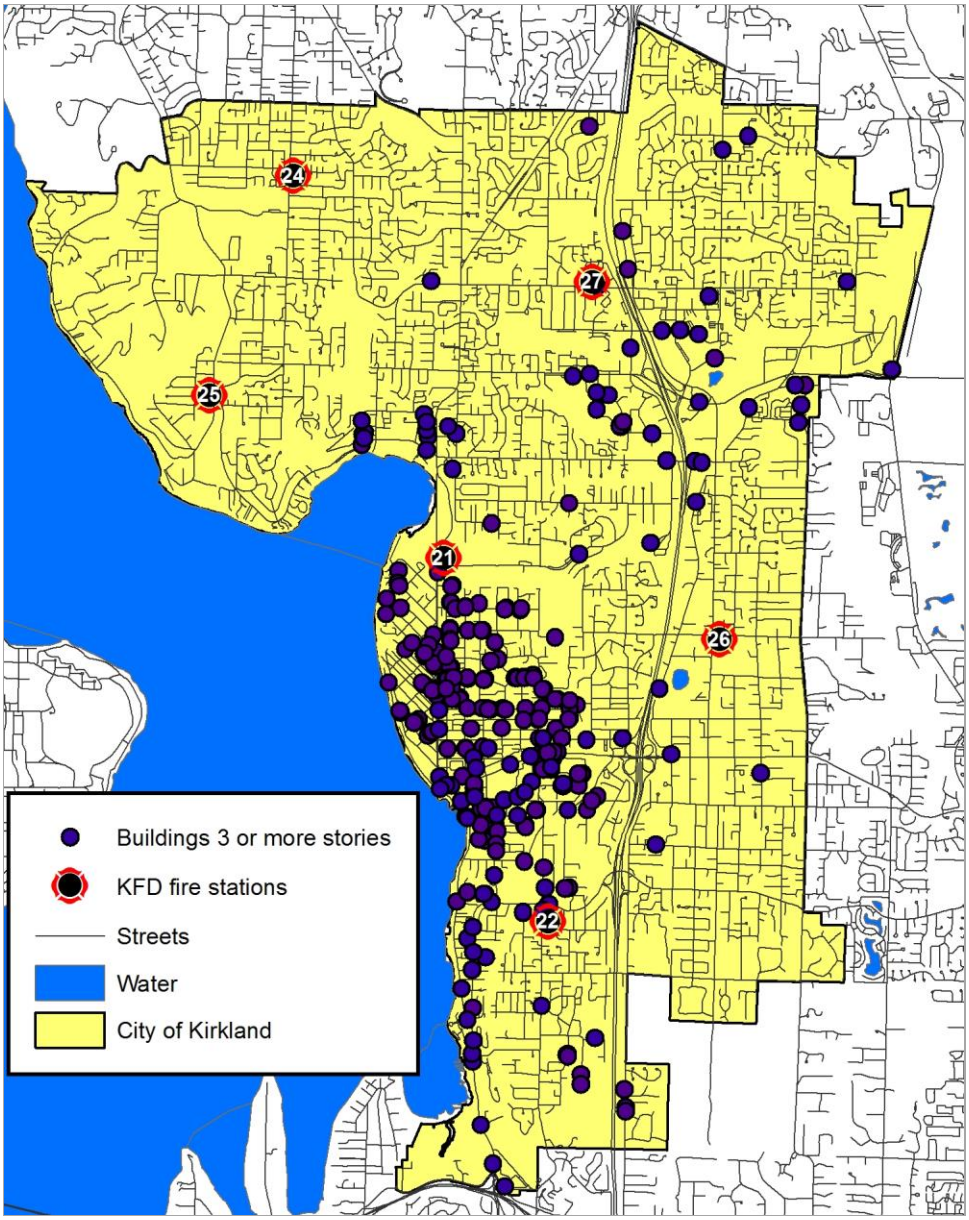
Figure 25: Hazardous Material Use Locations



Multi-Storied Buildings

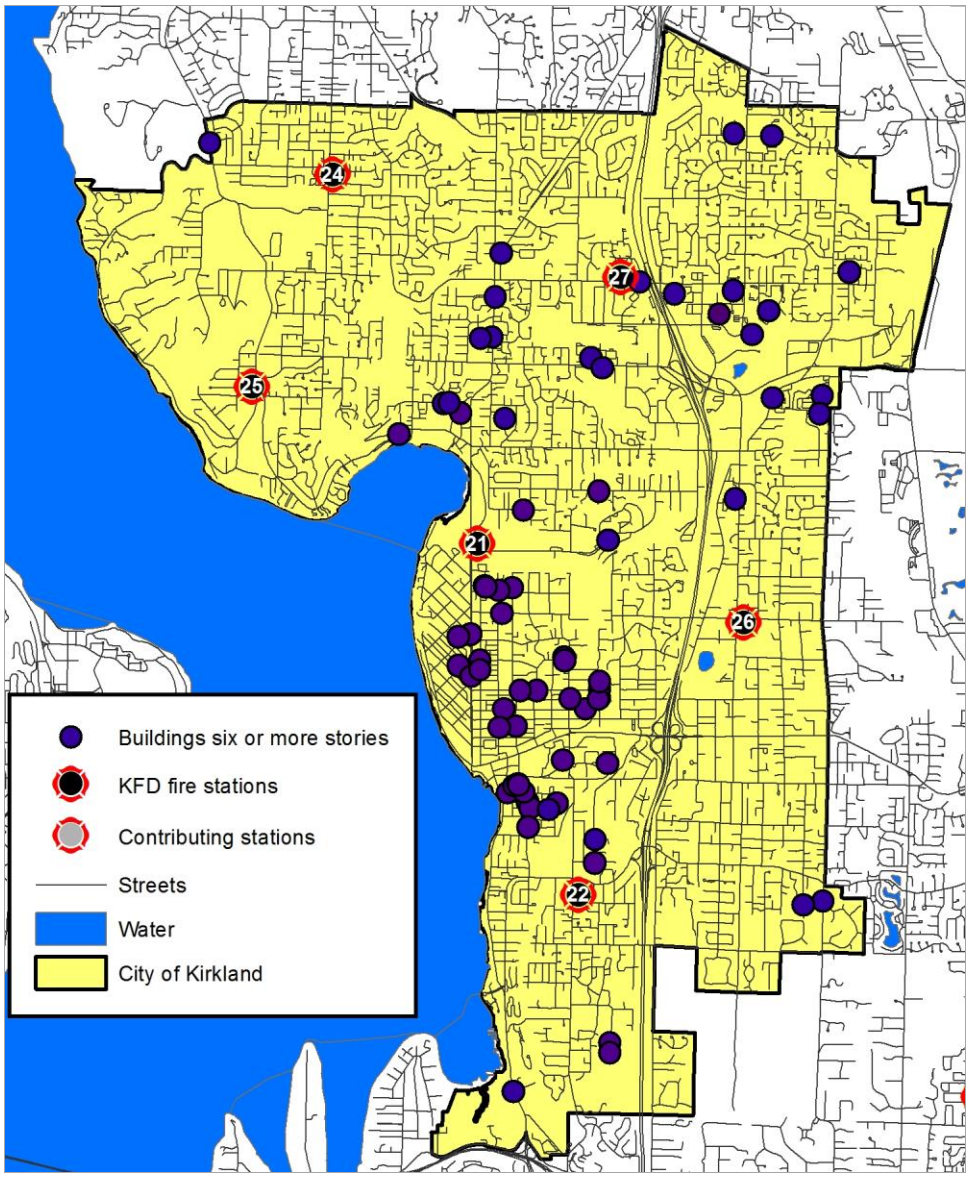
Buildings more than three stories in height pose a special risk in an emergency. Fire on higher floors may require an aerial fire truck to be able to deliver water into a building that does not have standpipe systems. For victims trapped on higher floors, a ladder truck may be their only option for escape. The following figure shows the locations of building more than three stories in height as listed in the King County Assessment data.

Figure 26: Buildings – More Than Three Stories in Height



Buildings six or more floors in height also present challenges to the fire department. Most aerial ladder trucks cannot reach beyond the fifth or sixth floor. Thus rescue and firefighting activities must be conducted from the interior stairwells. This requires additional personnel to transport equipment up to higher floors. The following figure shows the locations of buildings six or more stories high as listed in the King County Assessment data.

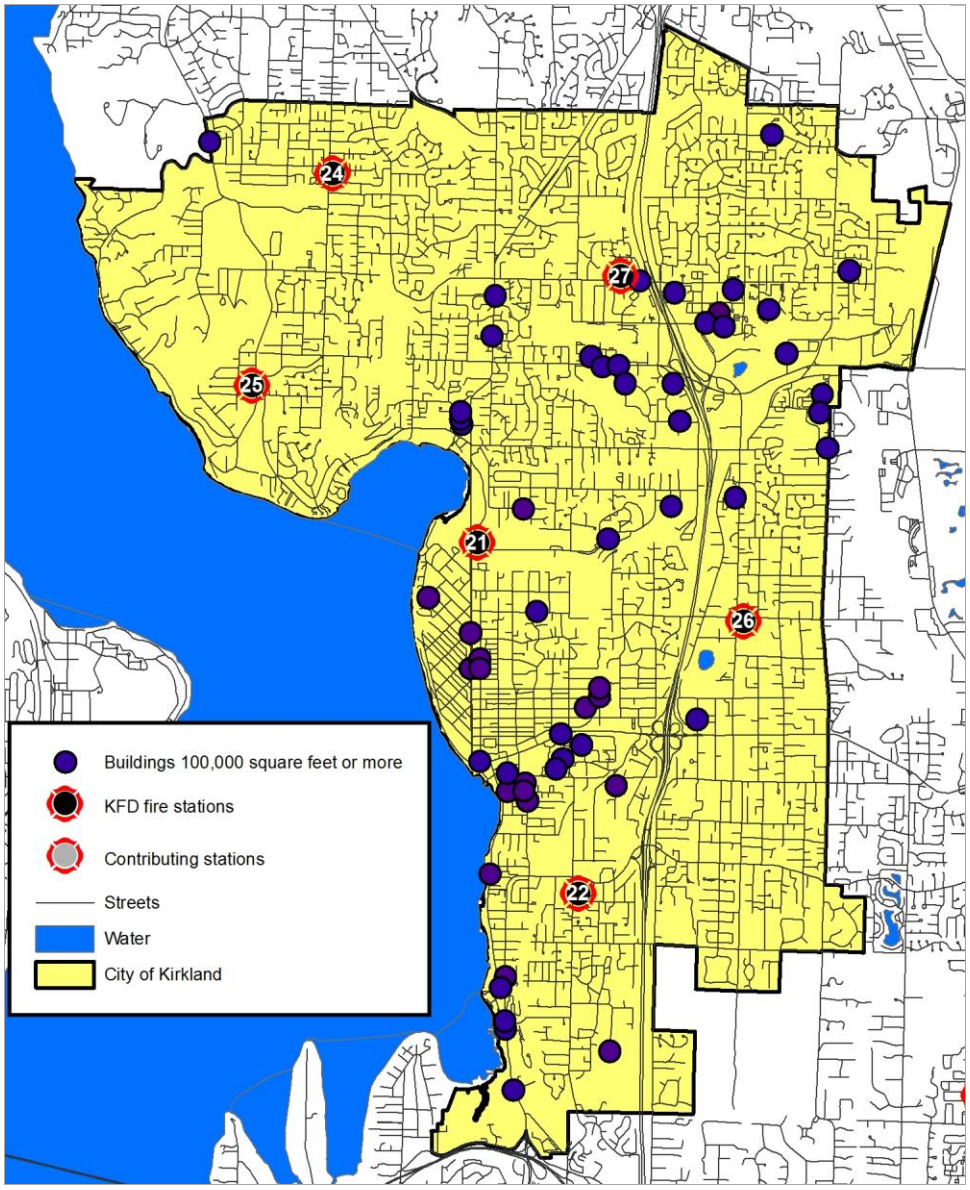
Figure 27: Buildings Six or More Stories in Height



Large Square Footage Buildings

Large buildings, such as warehouses, malls, and large "box" stores typically require greater volumes of water for firefighting and require more firefighters to advance hose lines long distances into the building. The following figure shows the locations for buildings 100,000 square feet and larger as listed in the King County Assessment data.

Figure 28: Buildings – 100,000 Square Feet and Larger

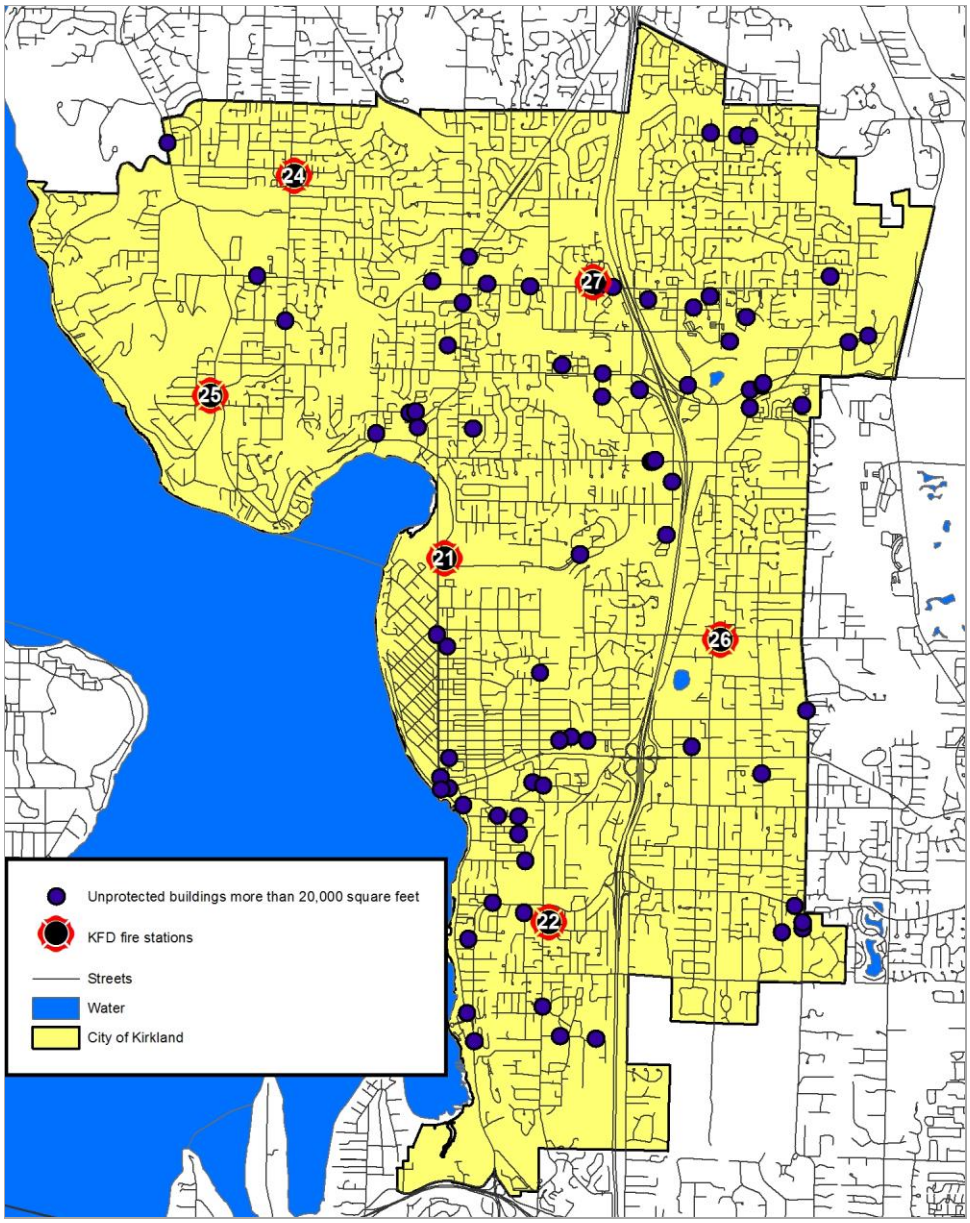


Built-in fire protection (fire sprinklers) provides significant benefit to a building's fire resistance. Modern building codes require fire suppression systems in many buildings. In many communities, developers and builders are given "credit" for built-in protection by allowing narrower streets, longer cul-de-sacs,

larger buildings, and/or smaller water mains for new residential developments. While built-in fire protection should significantly reduce the spread of fire, it may not extinguish the fire. Firefighters still need to complete the extinguishment and perform ventilation, overhaul, and salvage operations.

Kirkland contains some larger buildings that do not have built-in fire suppression systems. The following figure shows buildings 20,000 square feet and larger that are not protected by fire suppression sprinkler systems as listed in the King County Assessment data for commercial properties.

Figure 29: Unprotected Buildings 20,000 Square Feet and Larger



Terrorism

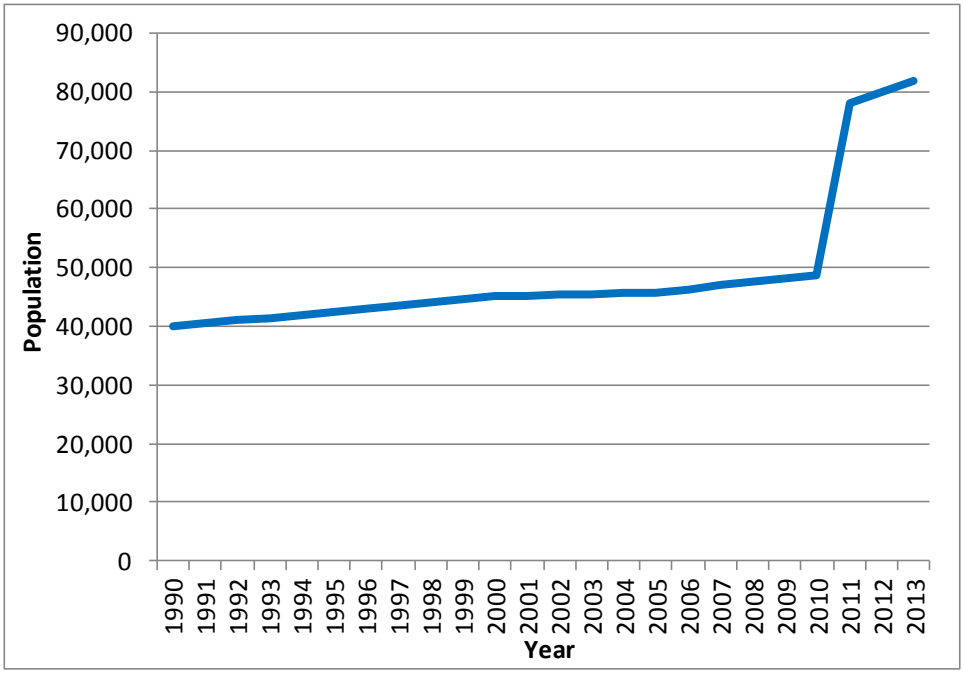
Kirkland is a potential target for terrorism. Most of the previous categorized risks in the community are targets for such activity. In addition, Kirkland is in close proximity to the City of Seattle, which has a greater terrorism risk. KFD may either be impacted by the consequence of a terrorist act in Seattle or be asked to support Seattle in the aftermath of such an event. The fire department needs to be vigilant in its training and preparedness in the event one or more coordinated acts of terror occur in the region.

Development and Population Growth

Current Population Information

Kirkland's population has grown steadily, with an average annual growth rate of 1.1 percent between 1990 and 2010. A significant annexation in 2011 of the Inglewood-Finn Hill and Kingsgate areas increased the city's population by 60 percent. KFD was already serving approximately 80 percent of the new population at the time of annexation. The current city population (2013) is 81,730. It is estimated that employment increases Kirkland's daytime population by about 6,000.[4]

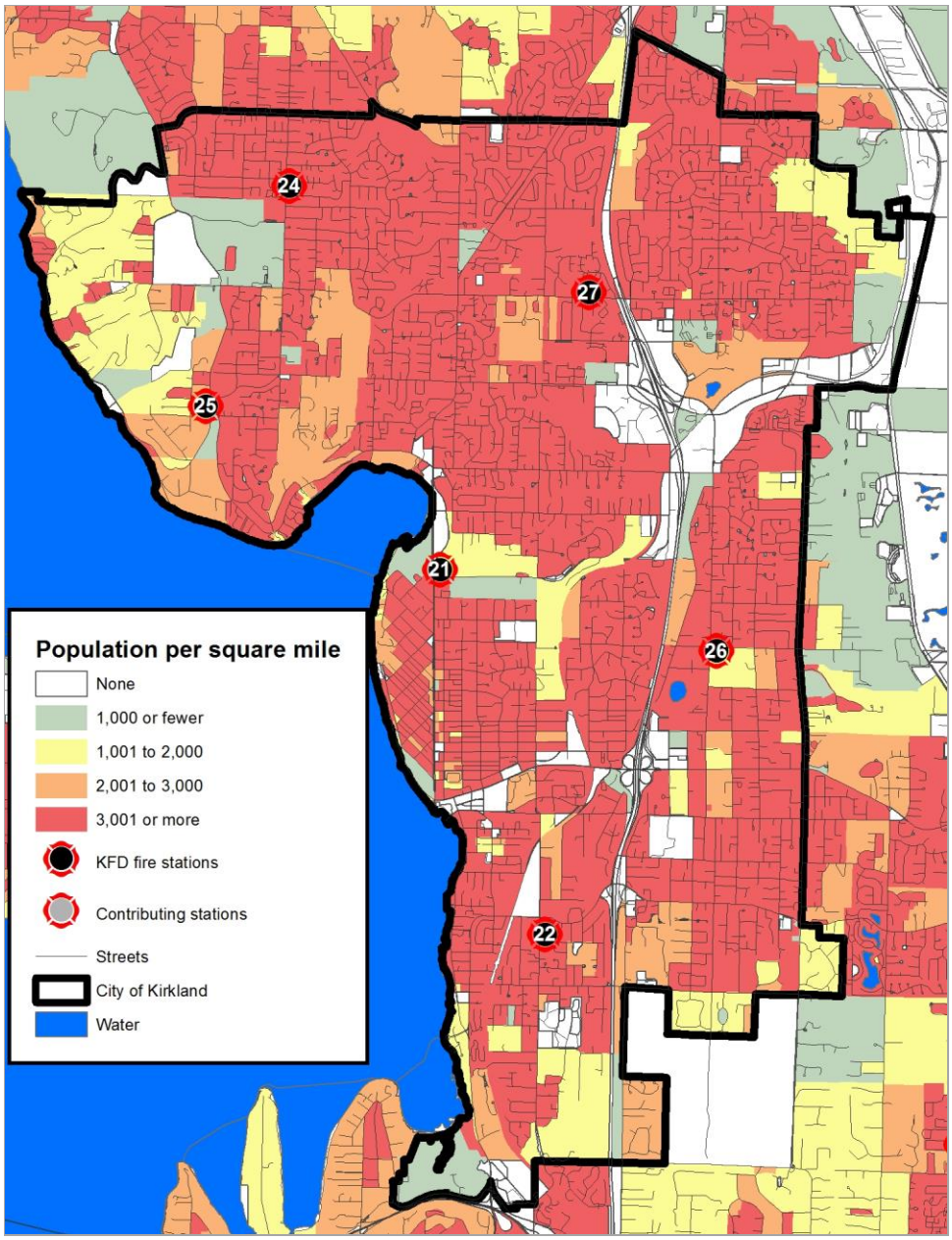
Figure 30: Population History



[4] Source: city-data.com

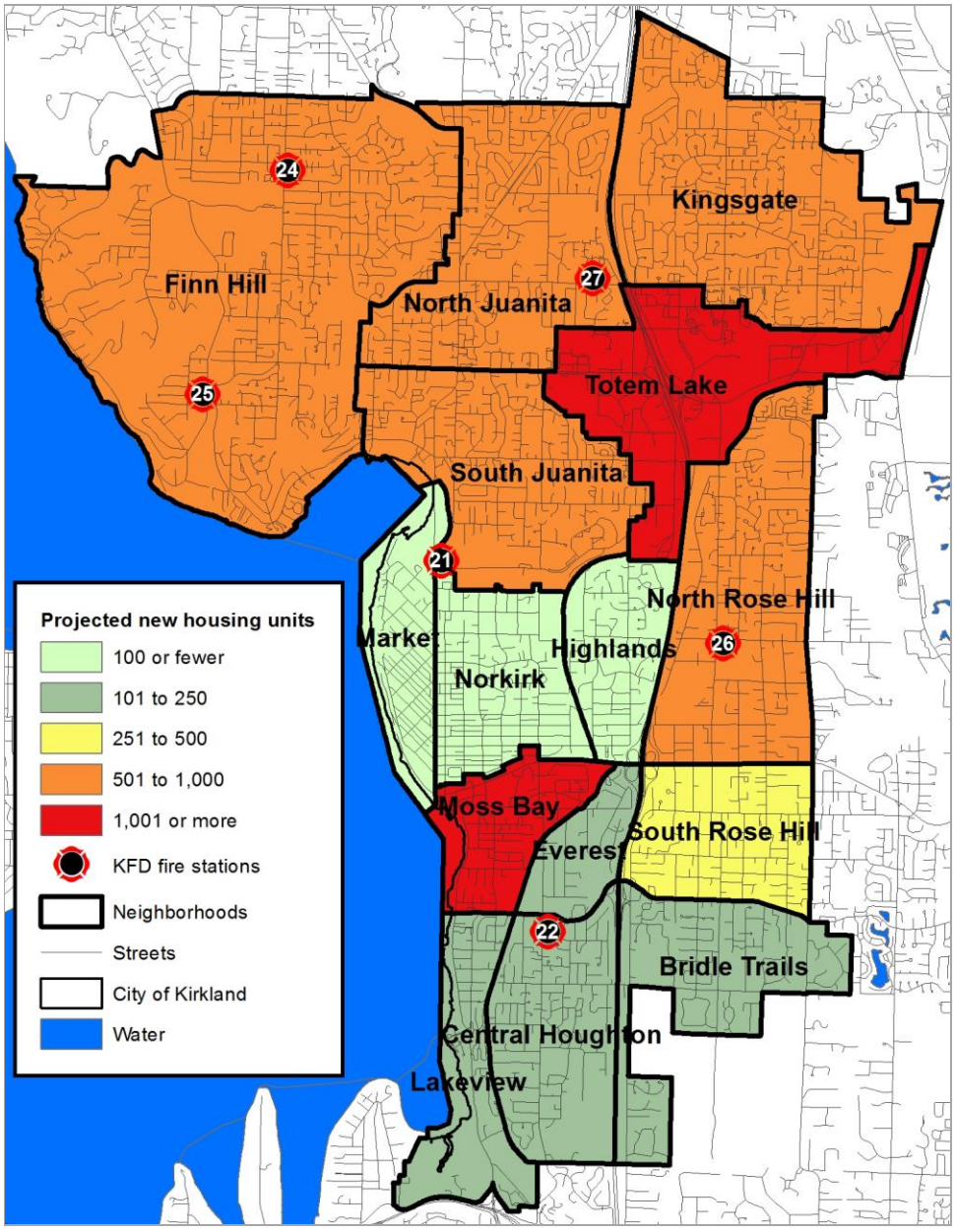
It is useful to assess the distribution of the population within the region, since there is a direct correlation between population density and service demand. The following figure displays the population density in and near the City of Kirkland, based on Census 2010 data, the most current information available.

Figure 31: Population Density – 2010



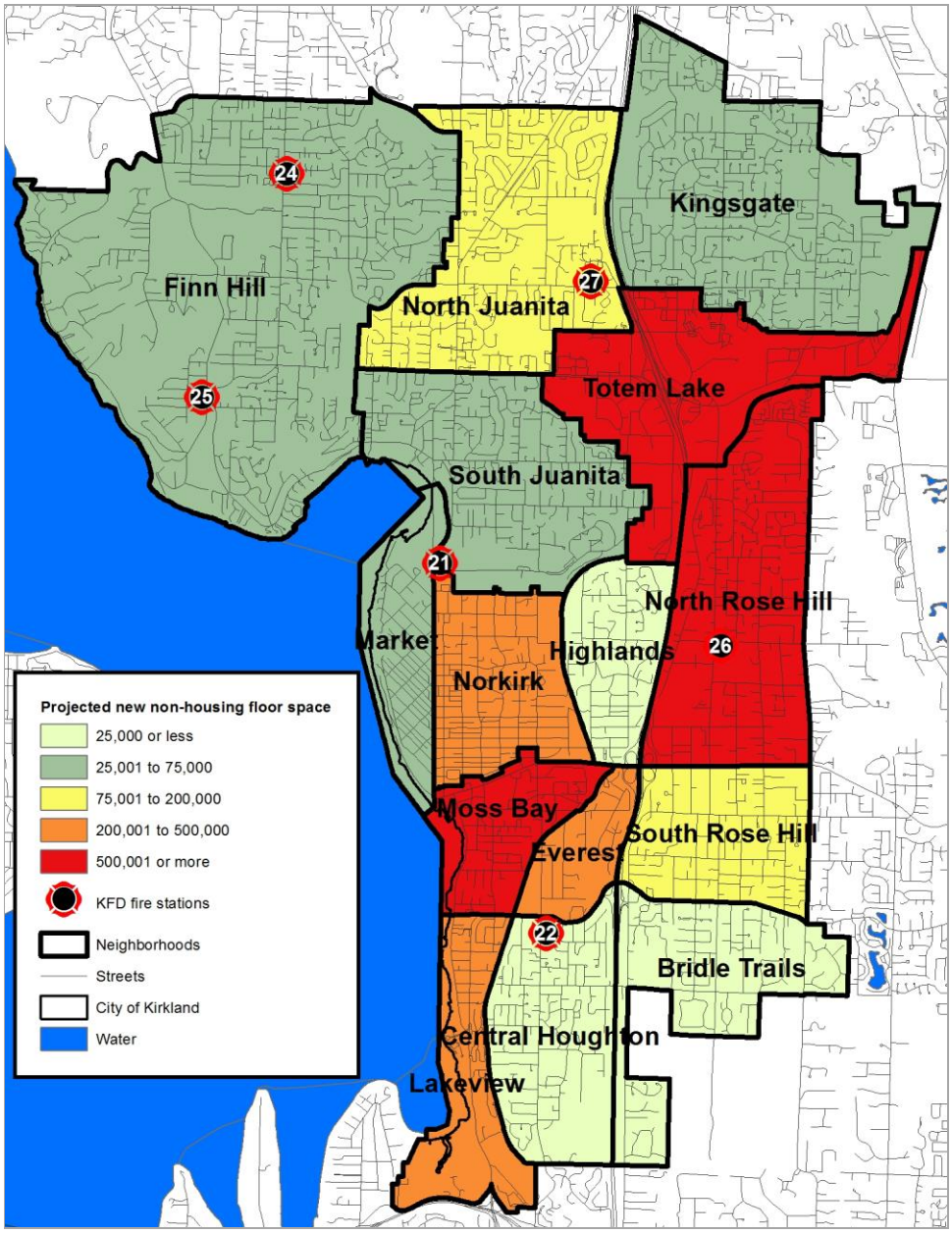
Community growth is expected to be very modest until the recovery of the local and national economy. Residential development could add over 19,000 housing units during the next 20 years. Most areas in the city have existing capacity. The Totem Lake, Moss Bay, Finn Hill, and Kingsgate neighborhoods alone may add as many as 6,000 housing units.

Figure 32: Projected New Housing Units by Neighborhood



Non-residential capacity exists as well. Over the next twenty years as much as 1 million square feet of commercial floor area could be added, mostly in the Totem Lake and Moss Bay neighborhoods. 4.8 million square feet of office floor area is anticipated focused in the Totem Lake, North Rose Hill, and Moss Bay neighborhoods. Little additional industrial and institutional development is anticipated.

Figure 33: Projected New Commercial/Office/Industrial Floor Space by Neighborhood



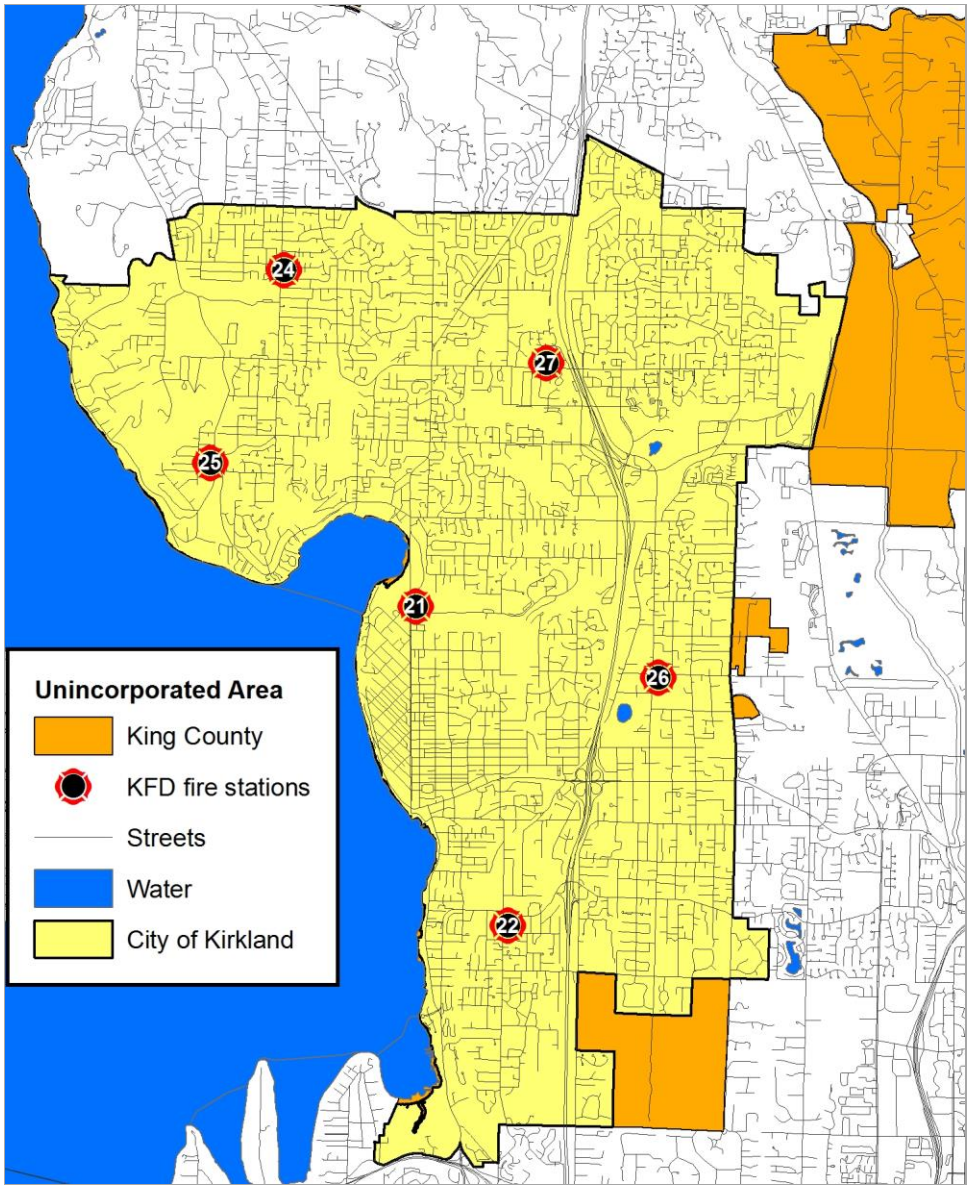
The City of Kirkland expects its population to increase by 15,000 people by the year 2035 for a total resident population of 96,730. Added commercial/office space could increase employment population

by 22,500 people by 2035. This could increase KFD's total service population to just over 125,000 people.

Future Geographic Growth Potential

Annexation of unincorporated territory into the city limits occurs on occasion, usually when a property owner wishes to develop land in a manner that requires urban services. There is land not currently in a city bordering the City of Kirkland. The following figure shows area that lies could be annexed to Kirkland in the future. Of these areas only the area to the city's south is under consideration.

Figure 34: Future Geographic Growth Areas



Risk Classification

Areas of higher fire risk require greater numbers of personnel and apparatus to effectively mitigate emergencies. Areas with a higher incident activity require additional response units to ensure reliable response. Staffing and deployment decisions for different regions of the city should be made in consideration of the level of risk.

Most communities contain areas with different population densities and property risk allowing the community's policy makers to specify different response performance objectives by geographic area. The categories are identified as:[5]

- **Metropolitan**—Geography with populations of over 200,000 people in total and/or a population density of over 3,000 people per square mile. These areas are distinguished by mid-rise and high-rise buildings, often interspersed with smaller structures.
- **Urban**—Geography with a population of over 30,000 people and/or a population density of over 2,000 people per square mile.
- **Suburban**—Geography with a population of 10,000 to 29,999 and/or a population density of between 1,000 and 2,000 people per square mile.
- **Rural**—Geography with a total population of less than 10,000 people or with a population density of less than 1,000 people per square mile.
- **Wilderness/Frontier/Undeveloped**—Geography that is both rural and not readily accessible by a publicly or privately maintained road.

The City of Kirkland, based on population density, is primarily urban.

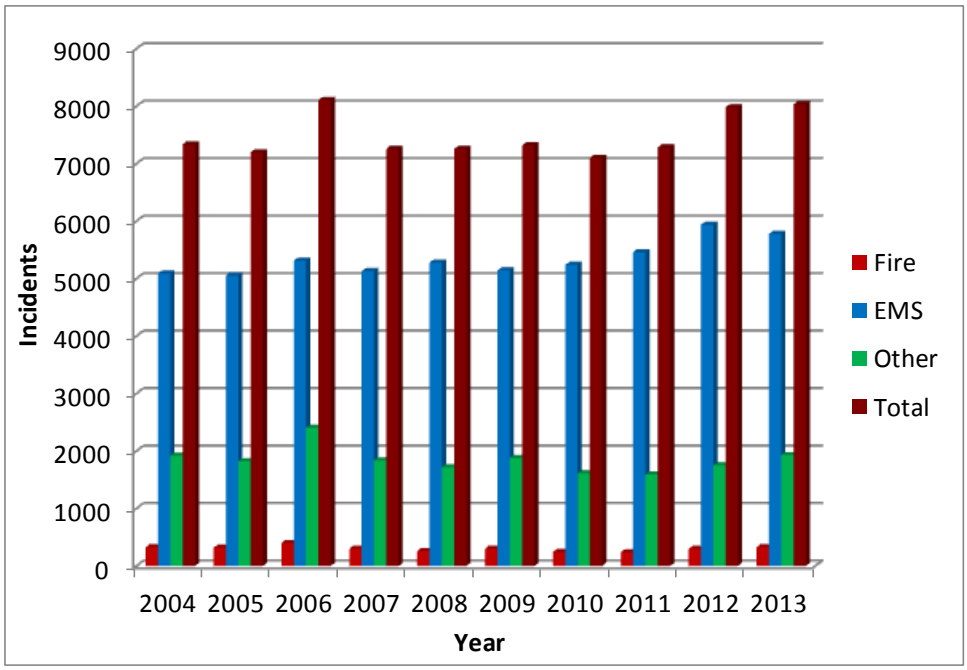
[5] CFAI *Standards of Cover, 5th edition*, pages 20-21.

Historic System Response Workload

Before a full response performance analysis is conducted, it is important to examine the level of workload (service demand) that a fire department experiences. Higher service demands can strain the resources of a department and may have a negative effect on response time performance.

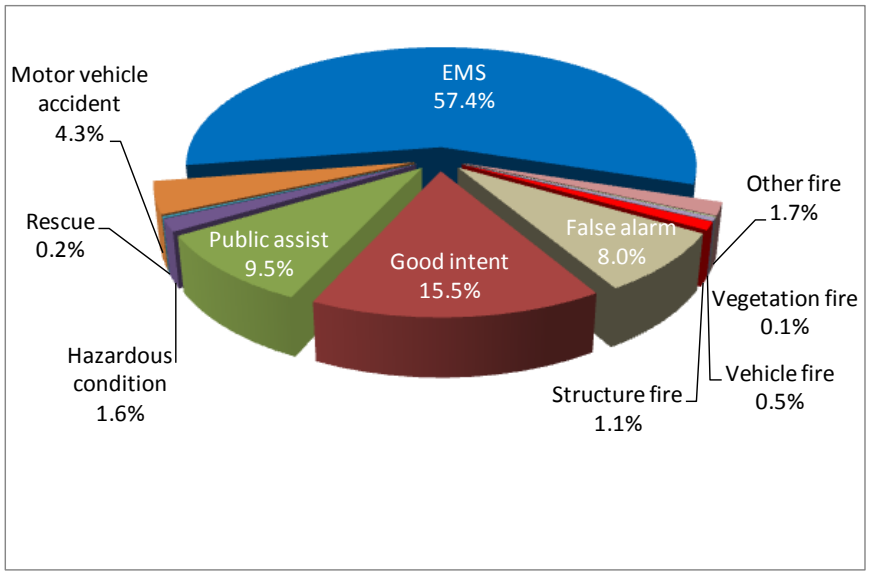
The following figure shows response workload for ten previous calendar years. Response workload increased by almost nine percent between January 1, 2004, and December 31, 2013, an average of 0.8 percent per year.

Figure 35: Workload History, 2004-2013



The next figure shows responses by type of incident found for the time period July 1, 2012 through June 30, 2013 (study period). Emergency medical responses are the most common at 57.4 percent of total responses.

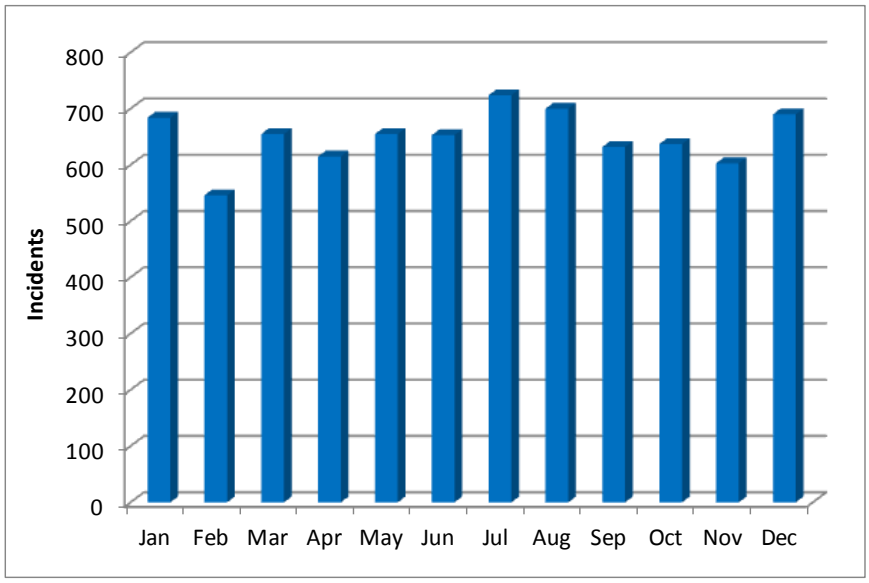
Figure 36: Responses by Type of Incident – Study Period



Temporal Analysis

A review of incidents by time of occurrence reveals much about response demand. The following figures show how activity and demand changes for KFD based on various measures of time. The following figure shows response activity for the study period by month.

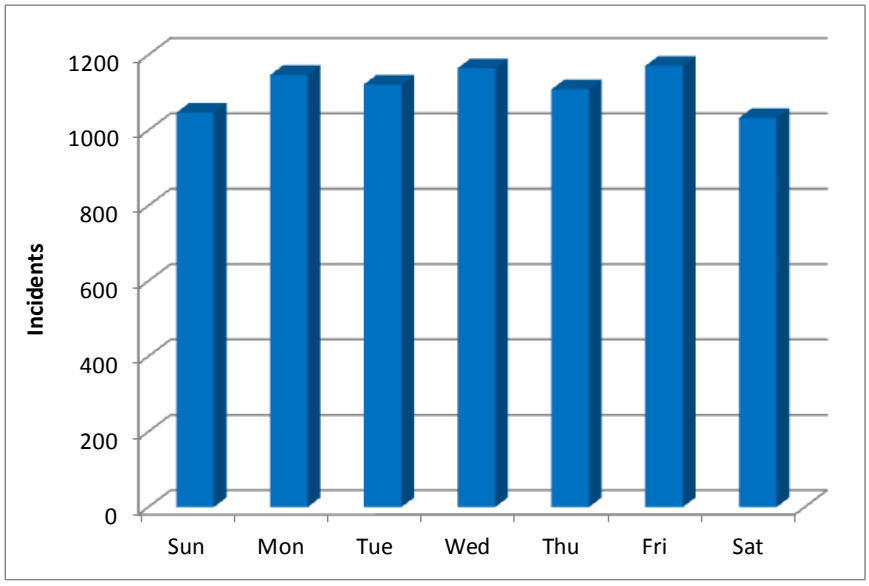
Figure 37: Monthly Workload – Study Period



During the study period, there was 32 percent more incident activity in the busiest month, July, than the slowest month, February.

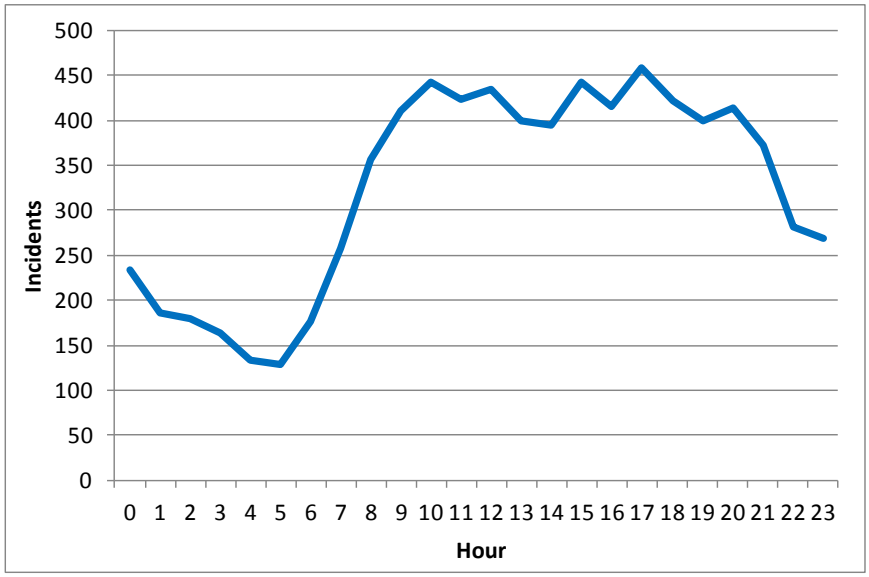
Next, response workload is compared by day of week. In this case there is 13 percent more incident activity on the busiest day, Friday, than the slowest day, Saturday.

Figure 38: Daily Workload – Study Period



The time analysis that always shows significant variation is response activity by hour of day. Response workload directly correlates with the activity of people, with workload increasing during daytime hours and decreasing during nighttime hours as shown in the following figure. Incident activity is at its highest between 9:00 AM and 9:00 PM.

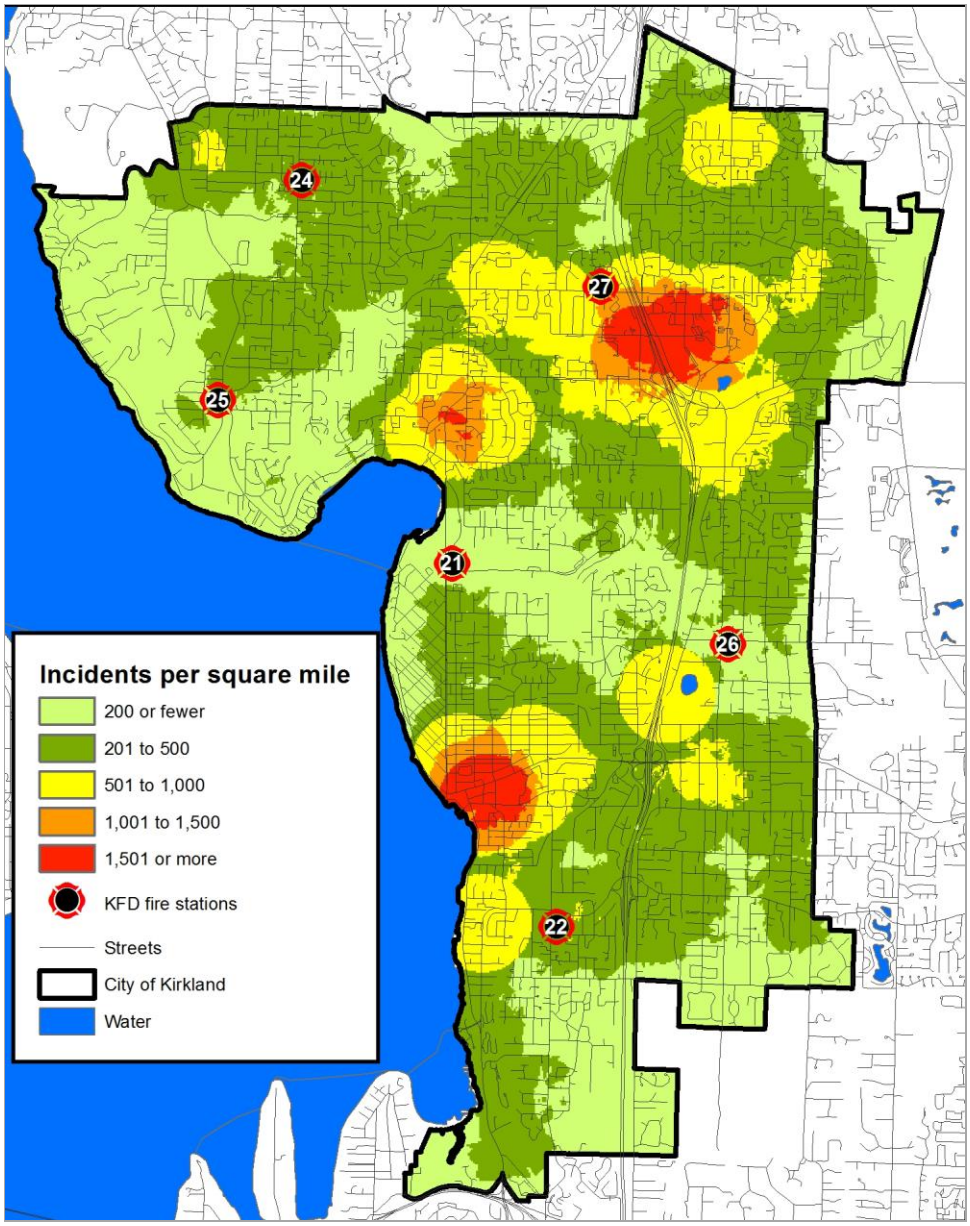
Figure 39: Hourly Workload – Study Period



Spatial Analysis

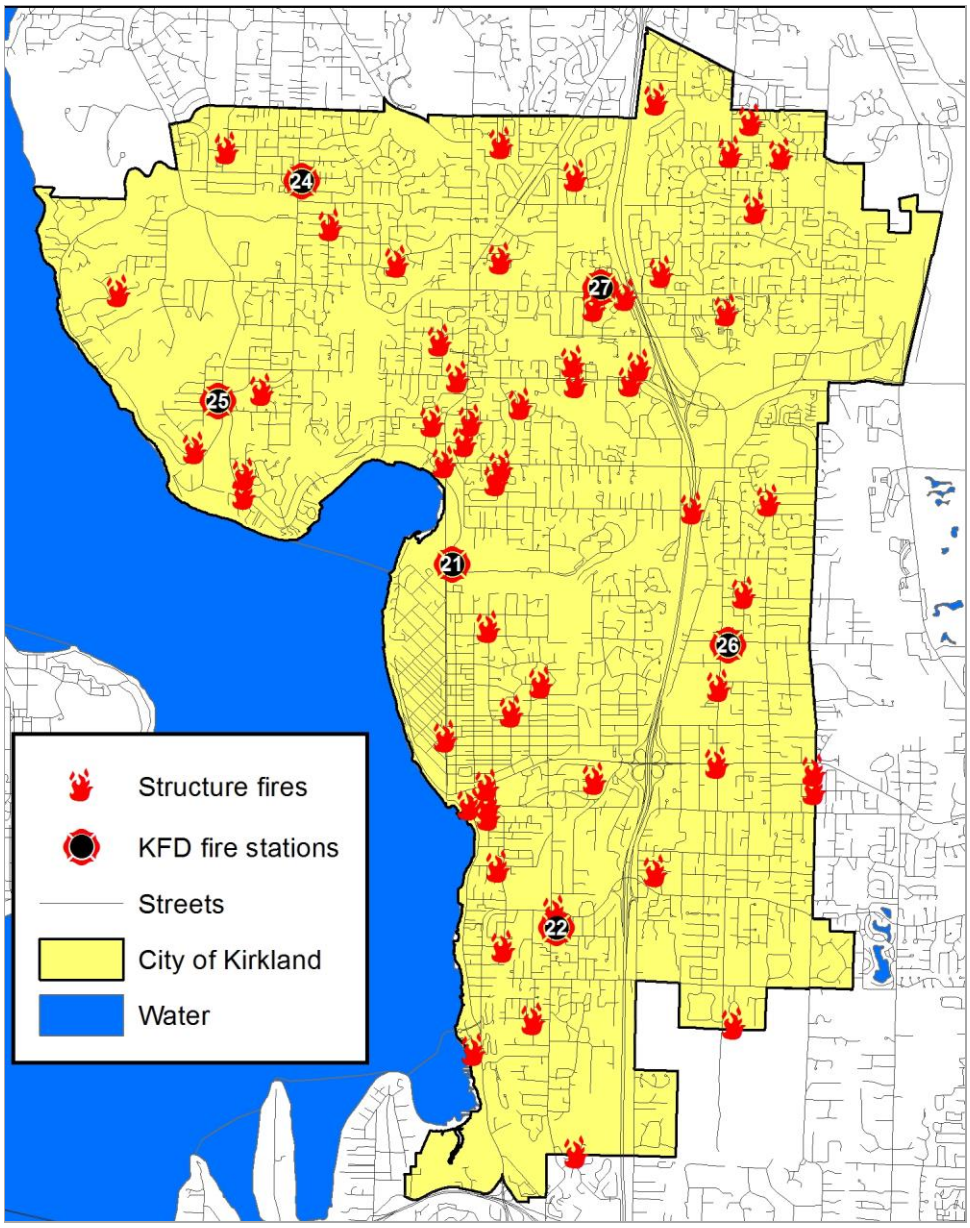
In addition to the temporal analysis of the current service demand, it is useful to examine geographic distribution of service demand. The following figure series indicates the distribution of emergency incidents in Kirkland during the study period. The first figure displays the density of incidents per square mile within various parts of the city. The area of greatest service demand is southeast of Station 27 and north of Station 22.

Figure 40: Service Demand Density – Study Period



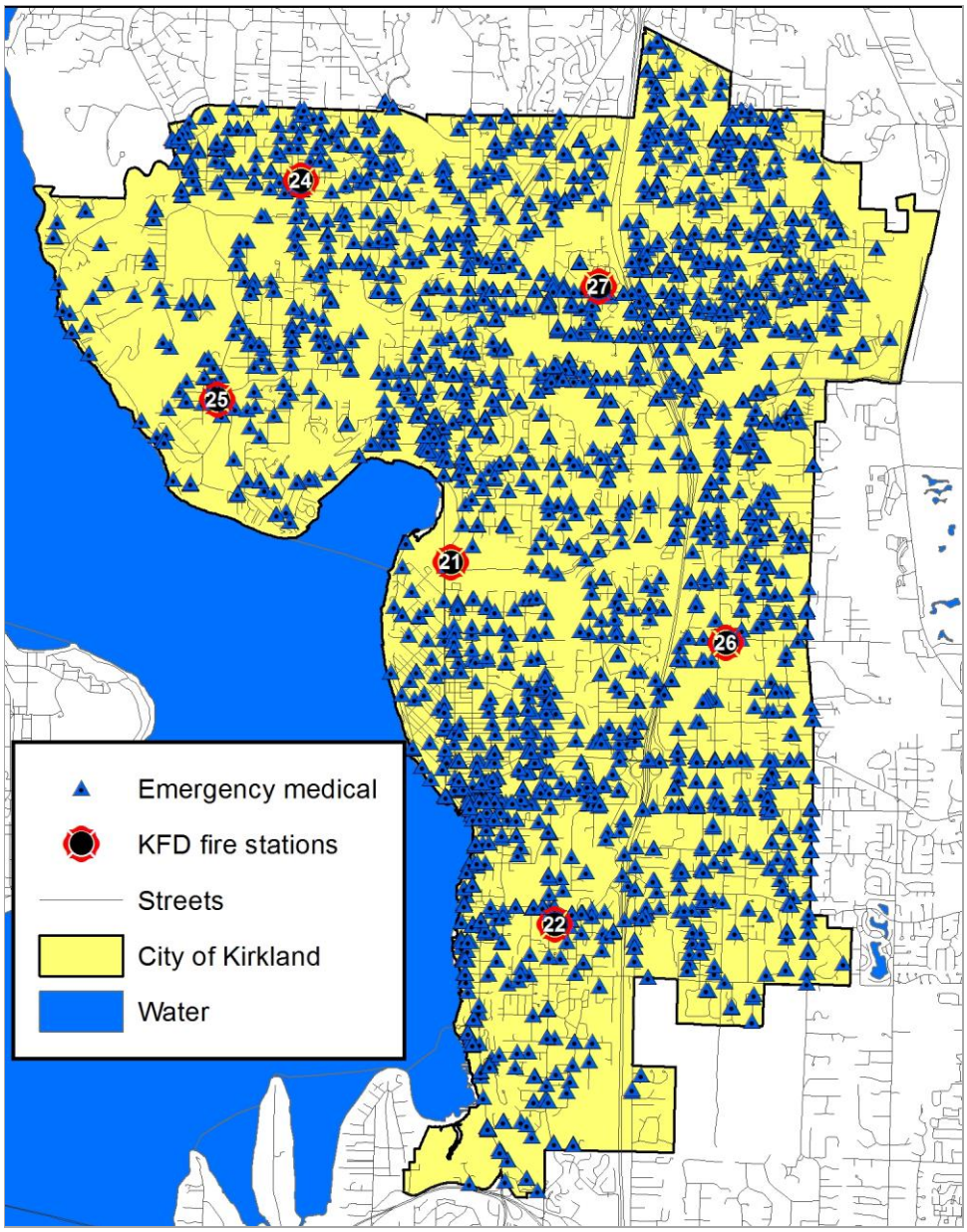
The preceding figure reflects all calls served by KFD. Service demand can vary by area based on incident type. The following figure displays the location of structure fires during this time period.

Figure 41: Structure Fires – Study Period



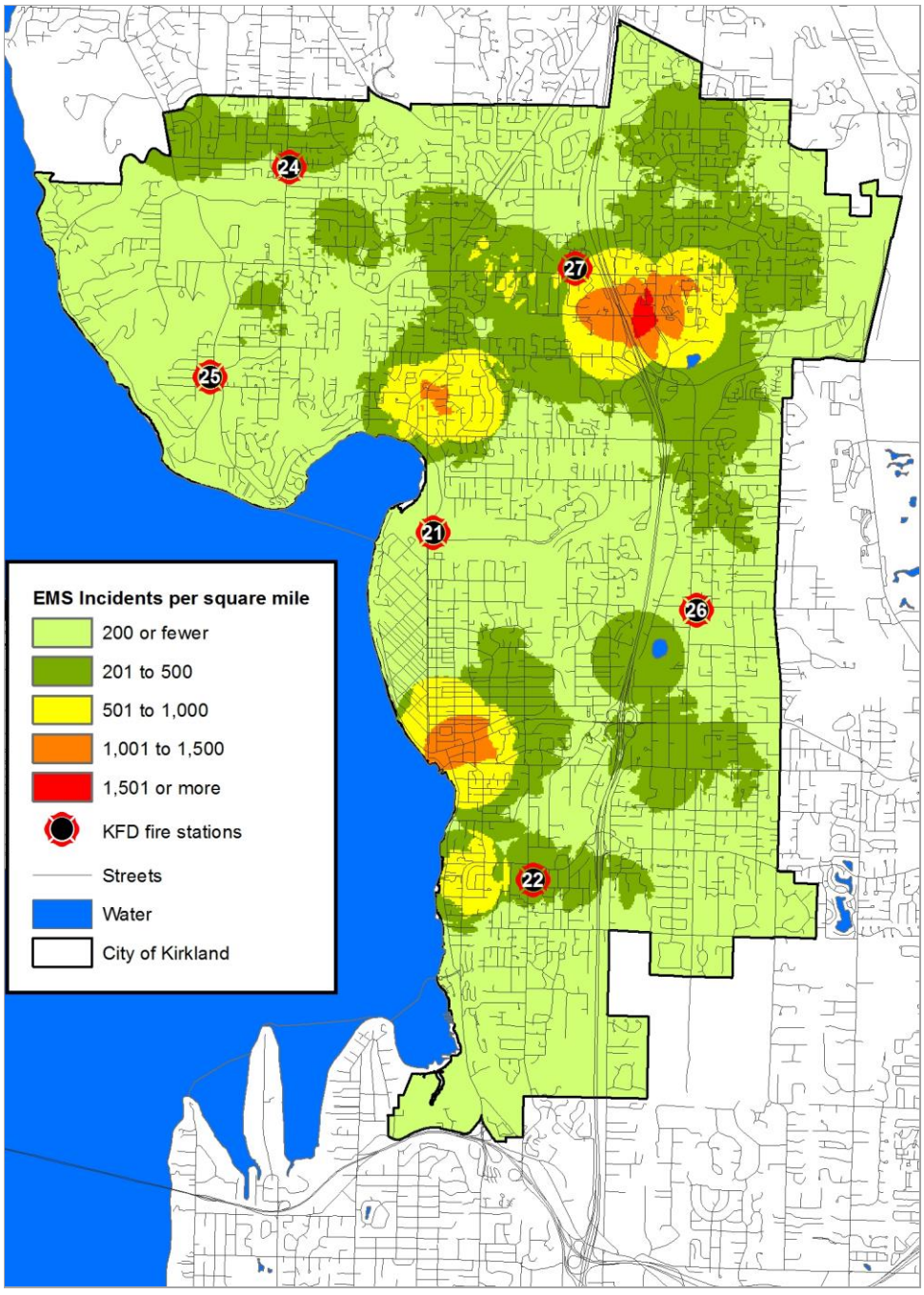
Similarly, emergency medical incidents also occur in greater concentration in areas of higher population density. The following figure displays emergency medical incidents during the study period.

Figure 42: Emergency Medical Incidents – Study Period



Emergency medical incident density closely resembles total incident density. The following figure displays emergency medical incidents per square mile.

Figure 43: Emergency Medical Incidents per Square Mile



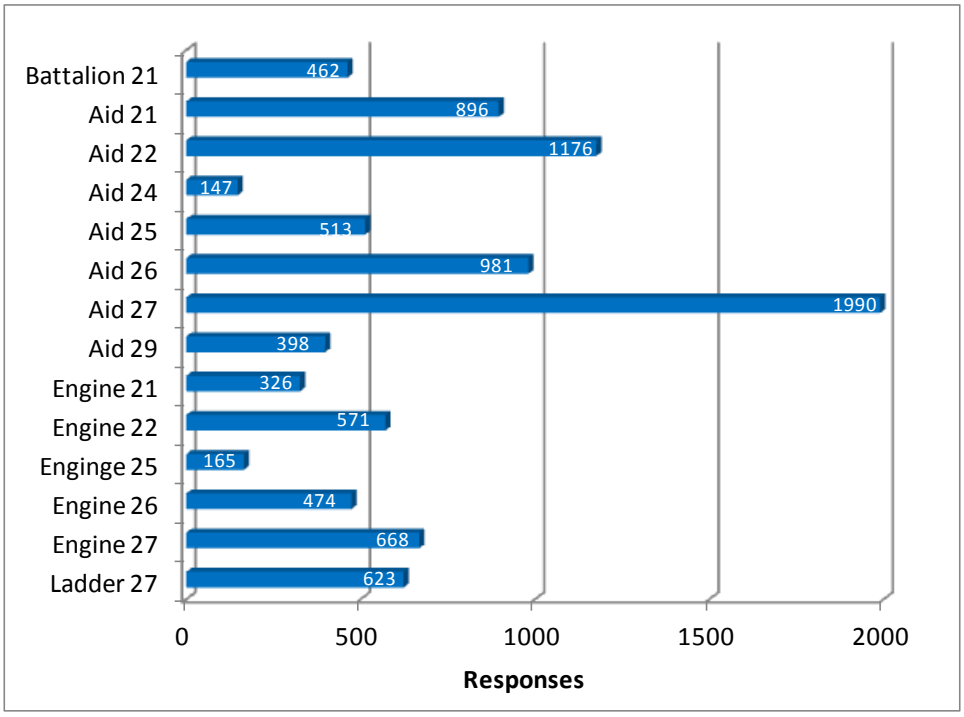
Response Unit Workload Analysis

A review of workload by response unit can reveal much about why response performance may be as it is. Although fire stations and response units may be distributed in a manner to provide quick response, that level of performance can only be obtained when the response unit is available within a reasonable distance of the incident. If a response unit is already on an incident and a concurrent request for service is received, a more distant response unit will need to be dispatched. This will increase response times.

Response Unit Workload

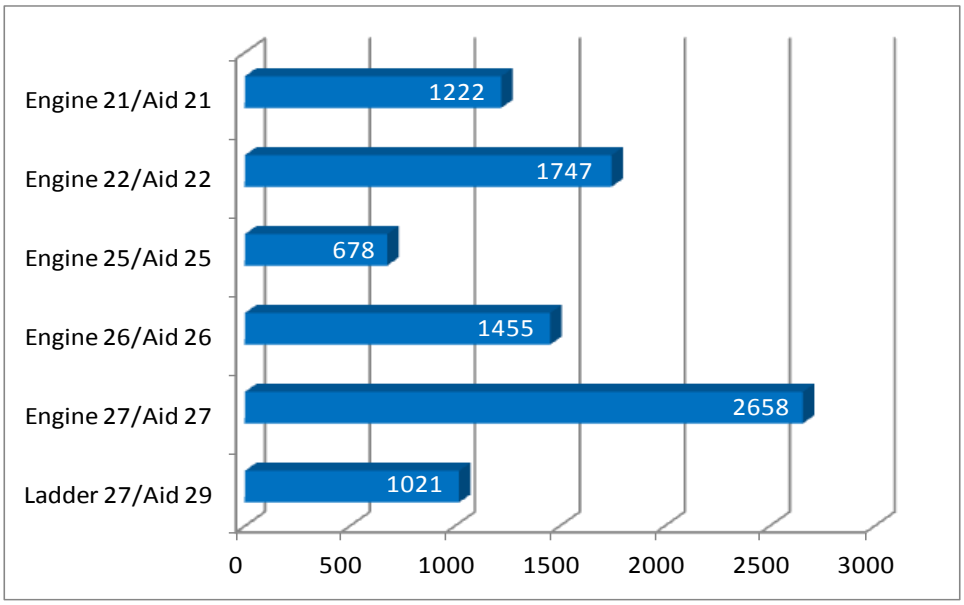
The workload on individual response units during the study period is shown in the following figure. Total response unit workload is greater than the total number of incidents. Many incidents, such as structure fires, require more than one response unit.

Figure 44: Response Unit Workload – Study Period



12 of these units are operated by the same response crews. The same crew that operates an engine or ladder truck also operates aid units. The combined workload on each of these engine/aid and ladder/aid combined response crews are shown in the following figure.

Figure 45: Response Crew Workload



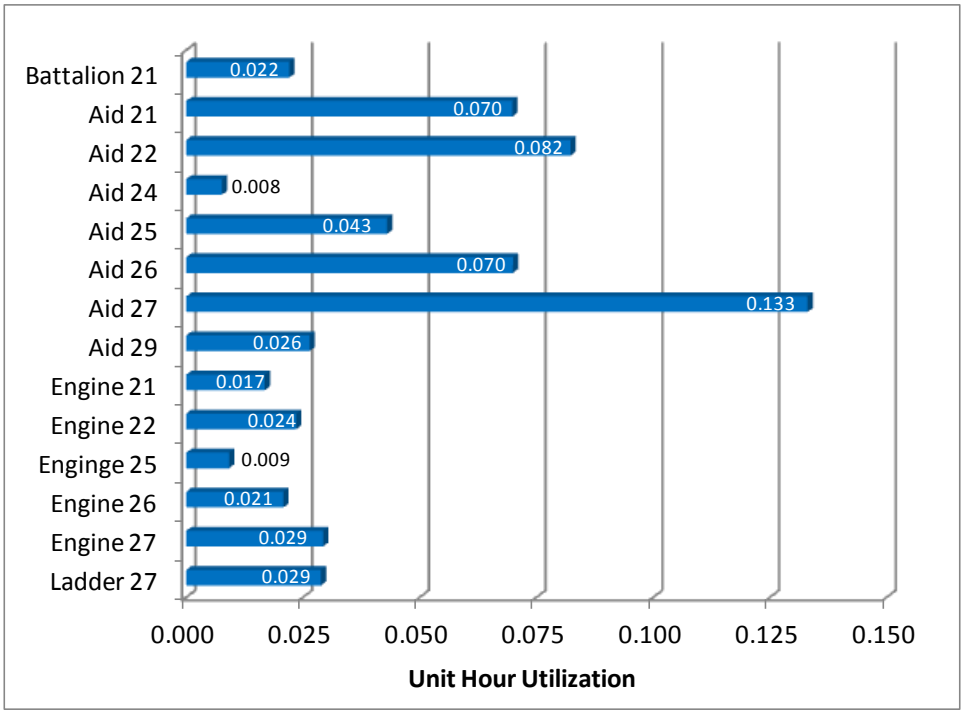
The amount of time a given unit is committed to an incident is also an important workload factor. The following figure illustrates the average time each unit was committed to an incident, from initial dispatch until it cleared the scene.

Figure 46: Average Time Committed to an Incident by Unit

Unit	Responses	Average Minutes per Response
Battalion 21	462	25.1
Aid 21	896	41.0
Aid 22	1176	36.8
Aid 24	147	27.3
Aid 25	513	44.1
Aid 26	981	37.5
Aid 27	1990	35.1
Aid 29	398	34.9
Engine 21	326	27.1
Engine 22	571	21.7
Engine 25	165	29.2
Engine 26	474	23.1
Engine 27	668	23.1
Ladder 27	623	24.3

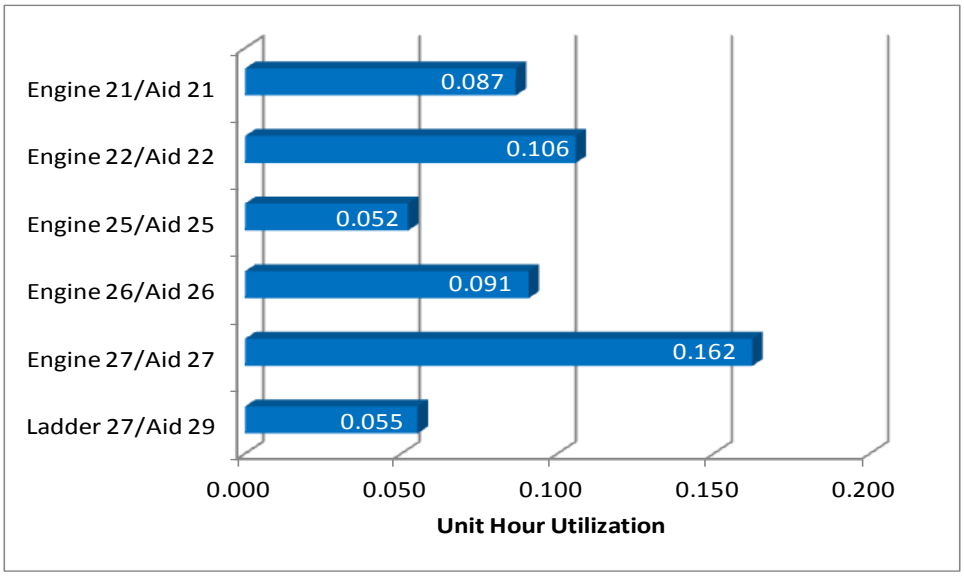
Unit hour utilization is an important workload indicator. It describes the amount of time a unit is not available for response since it is already committed to an incident. The larger the number, the greater a unit's utilization and the less available it is for assignment to an incident.

Figure 47: Unit Hour Utilization, 2012



The next figure shows unit hour utilization by response crew.

Figure 48: Response Crew Unit Hour Utilization



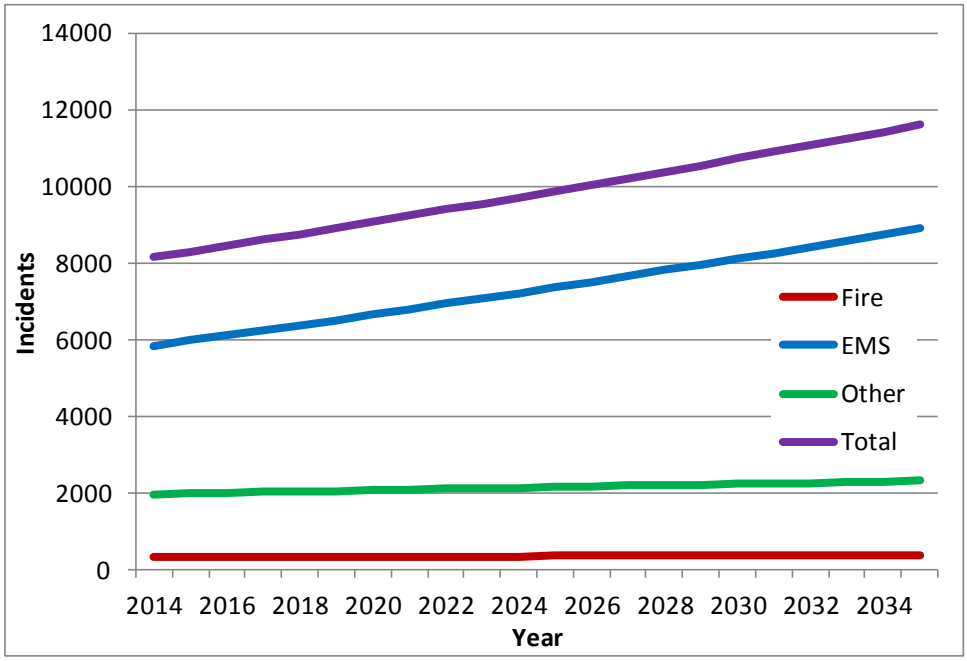
Unit hour utilization is an important statistic to monitor for those fire agencies using percentile-based performance standards, as does KFD. In Kirkland's case, where performance is measured at the 90th percentile, unit hour utilization greater than 0.10 means that the response unit will not be able to provide on-time response to its 90 percent target even if response is its only activity. Aid 27 by itself exceeds unit hour utilization of 0.10. Two response crews exceed 0.10 unit hour utilization and one is approaching that point.

Incident Workload Projection

The most significant predictor of future incident workload is population; 100 percent of requests for emergency medical service are people-driven. The National Fire Protection Association reports that approximately 70 percent of all fires are the result of people either doing something they should not have (i.e., misuse of ignition source) or not doing something they should have (i.e., failure to maintain equipment). Thus it is reasonable to use future population growth to predict future fire department response workload.

The current fire department services utilization rate is 97.8 incidents per 1,000 population. Future fire department services utilization is predicted to grow modestly over time at a rate of about one percent per year. Most workload growth will be emergency medical incidents. This plus expected population growth will increase KFD's workload as shown in the following figure. Response workload by the year 2035 could reach 11,600 responses per year.

Figure 49: Response Forecast



Component E – Critical Tasking and Alarm Assignments

The KFD service area has a densely populated urban environment and, as such, contains an elevated number, density, and distribution of risk. Further, its suburban and rural areas present unique challenges such as wildland fires. The fire department should have the resources needed to effectively mitigate the incidents that have the highest potential to negatively impact the community. As the actual or potential risk increases, the need for higher numbers of personnel and apparatus also increases. With each type of incident and corresponding risk, specific critical tasks need to be accomplished and certain numbers and types of apparatus should be dispatched. This section considers the community's identified risks and illustrates the number of personnel that are necessary to accomplish the critical tasks at an emergency.

Tasks that must be performed at a fire can be broken down into two key components: life safety and fire flow. Life safety tasks are based on the number of building occupants and their location, status, and ability to take self-preservation action. Life safety-related tasks involve the search, rescue, and evacuation of victims. The fire flow component involves delivering sufficient water to extinguish the fire and create an environment within the building that allows entry by firefighters.

The number and types of tasks needing simultaneous action will dictate the minimum number of firefighters required to combat different types of fires. In the absence of adequate personnel to perform concurrent action, the command officer must prioritize the tasks and complete some in chronological order, rather than concurrently. These tasks include:

- Command
- Scene safety
- Search and rescue
- Fire attack
- Water supply
- Pump operation
- Ventilation
- Backup/rapid intervention

Critical task analysis also applies to non-fire type emergencies including medical, technical rescue, and hazardous materials emergencies. Numerous simultaneous tasks must be completed to effectively control an emergency. The department's ability to muster needed numbers of trained personnel quickly enough to make a difference is critical to successful incident outcomes.

The following figure illustrates the emergency incident staffing recommendations of the Commission on Fire Accreditation, International. The following definitions apply to the figure:

- **Low Risk** – Minor incidents involving small fires (fire flow less than 250 gallons per minute), single patient non-life threatening medical incidents, minor rescues, small fuel spills, and small wildland fires without unusual weather or fire behavior.
- **Moderate Risk** – Moderate risk incidents involving fires in single-family dwellings and equivalently sized commercial office properties (fire flow between 250 gallons per minute to 1,000 gallons per minute), life threatening medical emergencies, hazardous materials emergencies requiring specialized skills and equipment, rescues involving specialized skills and equipment, and larger wildland fires.
- **High Risk** – High risk incidents involving fires in larger commercial properties with sustained attack (fire flows more than 1,000 gallons per minute), multiple patient medical incidents, major releases of hazardous materials, high risk rescues, and wildland fires with extreme weather or fire behavior.

Figure 50: Staffing Recommendations Based on Risk

Incident Type	High Risk	Moderate Risk	Low Risk
Structure Fire	29	14	6
Emergency Medical Service	12	4	2
Rescue	15	8	3
Hazardous Materials	39	20	3
Wildland Fire	41 (Red Flag level)	20	7

KFD has developed the following Critical Task analyses for various incident types. Further it has defined, based on current unit staffing levels, the number and type of apparatus needed to deliver sufficient numbers of personnel to meet the critical tasking identified. ESCI's review of the Critical Task analysis concludes that all are in keeping with industry standards and provide the minimum number of personnel needed for effective incident operations.

Critical Tasking

Critical tasks are those activities that must be conducted in a timely manner by firefighters at emergency incidents in order to control the situation. KFD is responsible for assuring that responding companies are capable of performing all of the described tasks in a prompt, efficient, and safe manner. The following are the minimum number of personnel needed by incident type.

Structure Fire – Moderate Risk

Task	Number of Personnel
Command/Safety	2
Attack Line	2
Pump Operator	1
Back-up Line	2
Search and Rescue	2
Line Support	2
RIT	2
Other (exposures, etc.)	2
Total	**15**

Structure Fire – High Risk

Task	Number of Personnel
Command	2
Safety Officer	1
Attack Line	2
Exposure Line	2
Pump Operator	1
Back-up Line	2
Search and Rescue	2
Ventilation	2
RIT	2
Other (hydrant)	4
Total	**20**

Non-Structure Fire High Risk

Task	Number of Personnel
Command	1
Safety	1
Pump Operations	1
Attack Line	2
Back-up Line	2
Hydrant-Water Supply	1
Exposure Lines	2
Structure Protection	3
Total	**13**

Aircraft Emergency

Task	Number of Personnel
Command	1
Safety	1
Aircraft Fire Suppression	2
Pump Operations	1
Back-up Line	2
Rescue	2
Emergency Medical Care	2
Water Supply	1
Total	12

Non-Structure Fire Low Risk

Task	Number of Personnel
Command/Safety	1
Pump Operations	1
Attack Line	1
Total	3

Odor of Smoke

Task	Number of Personnel
Command/Safety	1
Pump Operations	1
Interior Investigation	2
Ventilation	3
Total	7

Smoke in Structure

Task	Number of Personnel
Command/Safety	1
Interior Investigation	4
Ventilation	2
Total	7

Outdoor Smoke Investigation

Task	Number of Personnel
Command/Safety	1
Pumper Operator	1
Investigation	1
Total	3

Hazardous Materials- Level I

Task	Number of Personnel
Command/Safety	1
Research/Support	2
Total	3

Hazardous Materials- Level III

Task	Number of Personnel
Command	1
Safety	1
Decontamination	3
Research Support	2
Team leader, safety, entry team, and backup team	6
Total	**13**

Emergency Medical Aid

Task	Number of Personnel
Patient Care	1
Documentation	1
Total	**2**

Major Medical Response (10+ Patients)

Task	Number of Personnel
Incident Command	1
Safety	1
Triage	2
Treatment Manager	1
Patient Care	12
Transportation Manager	1
Documentation	1
Total	**19**

Motor Vehicle Accident (Non Trapped)

Task	Number of Personnel
Incident Command/Safety	1
Patient Care/Extrication	4
Total	**5**

Motor Vehicle Accident (Trapped)

Task	Number of Personnel
Command/Safety	1
Patient Care	2
Extrication	3
Pump Operator/Suppression Line	2
Extrication/Vehicle Stabilization	3
Total	**11**

Technical Rescue – Water

Task	Number of Personnel
Command/Safety	1
Rescue Team	2
Backup Team	2
Patient Care	2
Rope Tender	2
Total	**9**

Technical Rescue – Rope

Task	Number of Personnel
Command/Safety	1
Rescue Team	3
Backup/support team	2
Patient Care	2
Ground Support	4
Edge Person	1
Total	**13**

Technical Rescue – Confined Space

Task	Number of Personnel
Command/Safety	1
Rescue Team	3
Backup/support team	2
Patient Care	2
Attendant	1
Ground Support	4
Total	**13**

Technical Rescue – Trench

Task	Number of Personnel
Command/Safety	1
Rescue Team	2
Backup/support team	2
Patient Care	3
Shoring	5
Total	**14**

Alarm Assignments

In order to ensure sufficient personnel and apparatus are dispatched to an emergency event, the following is the minimum number of apparatus and personnel that should be sent on the first alarm. "Total Staffing Needed" is the number identified in the Critical Tasking analysis above.

Structure Fire – Moderate Risk

Unit Type	Number of Units	Total Personnel
Ladder	1	3
Engine	3	9
Aid Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**15**
Total Staffing Needed		**15**

Structure Fire – High Risk

Unit Type	Number of Units	Total Personnel
Ladder	2	6
Engine	4	12
Aid Unit	1	2
Battalion Chief	2	2
Total Staffing Provided		**22**
Total Staffing Needed		**20**

Non-Structure Fire High Risk

Unit Type	Number of Units	Total Personnel
Ladder	1	3
Engine	3	9
Battalion Chief	1	1
Total Staffing Provided		**13**
Total Staffing Needed		**13**

Aircraft Emergency

Unit Type	Number of Units	Total Personnel
Engine	2	6
Ladder	1	3
Aid Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**12**
Total Staffing Needed		**12**

Non-Structure Fire Low Risk

Unit Type	Number of Units	Total Personnel
Engine or Ladder	1	3
Total Staffing Provided		**3**
Total Staffing Needed		**3**

Odor of Smoke

Unit Type	Number of Units	Total Personnel
Engine or Ladder	2	6
Battalion Chief	1	1
Total Staffing Provided		**7**
Total Staffing Needed		**7**

Smoke in Structure

Unit Type	Number of Units	Total Personnel
Engine or Ladder	2	6
Battalion Chief	1	1
Total Staffing Provided		**7**
Total Staffing Needed		**7**

Outdoor Smoke Investigation

Unit Type	Number of Units	Total Personnel
Engine or Ladder	1	3
Total Staffing Provided		**3**
Total Staffing Needed		**3**

Hazardous Materials – Level I

Unit Type	Number of Units	Total Personnel
Engine	1	3
Total Staffing Provided		**3**
Total Staffing Needed		**3**

Hazardous Materials – Level III

Unit Type	Number of Units	Total Personnel
Engine	2	6
Ladder	1	3
Aid Unit	1	2
Battalion Chief	2	2
Total Staffing Provided		**13**
Total Staffing Needed		**13**

Emergency Medical Service

Unit Type	Number of Units	Total Personnel
Aid Unit	1	2
Total Staffing Provided		**2**
Total Staffing Needed		**2**

Major Medical (10+ Patients)

Unit Type	Number of Units	Total Personnel
Engine	3	9
Ladder	1	3
Aid Unit	2	4
Medic	1	2
MSO	1	1
Battalion Chief	1	1
Total Staffing Provided		**19**
Total Staffing Needed		**19**

Motor Vehicle Accident (Non-Trapped)

Unit Type	Number of Units	Total Personnel
Ladder	1	3
Aid Unit	1	2
Total Staffing Provided		**5**
Total Staffing Needed		**5**

Motor Vehicle Accident (Trapped)

Unit Type	Number of Units	Total Personnel
Engine	1	3
Ladder	1	3
Aid Unit	1	2
Medic Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**11**
Total Staffing Needed		**11**

Technical Rescue – Water

Unit Type	Number of Units	Total Personnel
Engine	1	3
Aid Units	2	4
Battalion Chief	1	1
Medic	1	2
Total Staffing Provided		**10**
Total Staffing Needed		**9**

Technical Rescue – Rope

Unit Type	Number of Units	Total Personnel
Engine	2	6
Ladder	1	3
Medic	1	2
Aid Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**14**
Total Staffing Needed		**13**

Technical Rescue – Confined space

Unit Type	Number of Units	Total Personnel
Engine	2	6
Ladder	1	3
Medic	1	2
Aid Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**14**
Total Staffing Needed		**13**

Technical Rescue – Trench

Unit Type	Number of Units	Total Personnel
Engine	2	6
Ladder	1	3
Medic	1	2
Aid Unit	1	2
Battalion Chief	1	1
Total Staffing Provided		**14**
Total Staffing Needed		**13**

Component F – Review of Historical System Performance

Incident data for the time period July 1, 2012 through June 30, 2013 (study period) was evaluated in detail to determine KFD's current performance. Data was obtained from department incident reports and the dispatch center's computer-aided dispatch system. Only incidents that were dispatched as a "priority" incident within the City of Kirkland are included in the analysis (6,037 total incidents). Priority incidents involve emergencies to which the fire department responded "Code 3" (using warning lights and sirens). Incidents initially dispatched as non-emergency responses and responses outside the city were excluded.

Each phase of the incident response sequence was evaluated to determine current performance. This allows an analysis of each individual phase to determine where opportunities might exist for improvement.

Current performance is compared to KFD's response performance objectives and the response performance goals recommended in Component I. In all cases KFD is meeting its response performance objectives. It is not meeting the recommended response performance goals. Performance improvement initiatives are offered later in this report that will help KFD achieve the recommended response performance goals.

Performance is reported in a number of different ways. Performance by type of incident is based on the final incident type. Performance is also reported by time of day, and the frequency at which performance was accomplished at various time intervals.

The total incident response time continuum consists of several steps, beginning with initiation of the incident and concluding with the appropriate mitigation of the incident. The time required for each of the components varies. The policies and practices of the fire department directly influence some of the steps. What follows is a detailed description and review of each phase of the response time continuum.

In accordance with KFD's performance objectives and in keeping with National Fire Protection Association Standard 1710 all response time elements are reported at the 90th percentile. Percentile (fractal) reporting is a methodology by which response times are sorted from least to greatest, and a "line" is drawn at a certain percentage of the calls to determine the percentile. The point at which the

"line" crosses the 90th percentile is the percentile time performance. Thus, 90 percent of times were at or less than the result. Only 10 percent were longer.

Percentile differs greatly from average. Averaging calculates response times by adding all response times together and then dividing the total number of minutes by the total number of responses (mean average). Measuring and reporting average response times is not recommended. Using averages does not give a clear picture of response performance because it does not clearly identify the number and extent of events with times beyond the stated performance objective.

Detection

The detection of a fire or other emergency may occur immediately if someone happens to be present or if an automatic system is functioning. Otherwise, detection may be delayed, sometimes for a considerable period. The time period for this phase begins with the inception of the emergency and ends when the emergency is detected. It is largely outside the control of the fire department and not a part of the event sequence that is reliably measurable.

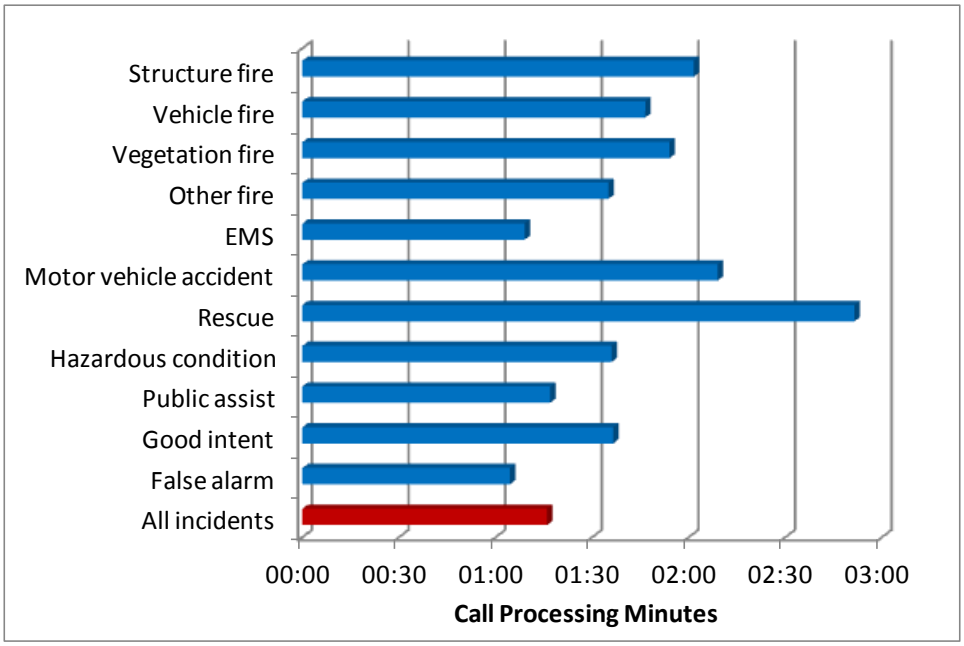
Call Processing

Today most emergency incidents are reported by telephone to the 9-1-1 center. Call takers must quickly elicit accurate information about the nature and location of the incident from people who are likely to be excited. A citizen well-trained in how to report emergencies can reduce the time required for this phase. The dispatcher must identify the correct units based on incident type and location, dispatch them to the emergency, and continue to update information about the emergency while the units respond. This phase typically begins when the 9-1-1 call is answered at the dispatch center and ends when response personnel are notified of the emergency. This phase is labeled "call processing time."

KFD's current performance objective for call processing time is within 75 seconds, 90 percent of the time. Its call processing time goal is within 60 seconds, 90 percent of the time.

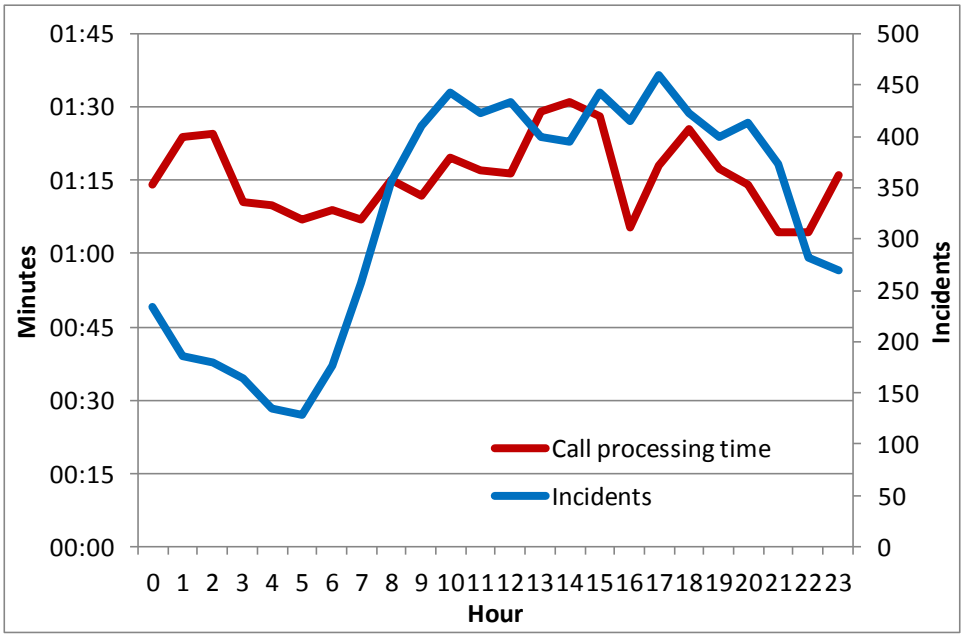
The following figure lists the call processing time for all priority incidents during the study period within the city as well as specific incident types. Overall, the time from first notification to the dispatch center until notification of response personnel is within 75 seconds, 90 percent of the time. The goal of 60 seconds was achieved 83 percent of the time.

Figure 51: Call Processing Performance, Study Period



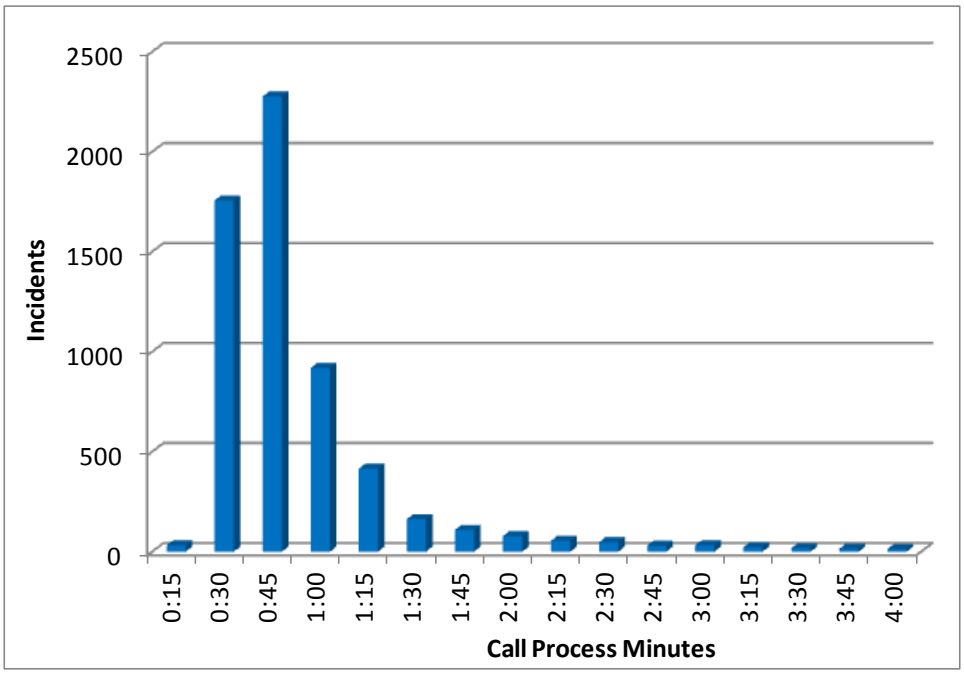
Activity levels at the dispatch center can affect the time it takes to receive, process, and dispatch a request for service. The following figure shows call processing time by hour of day. Performance varies somewhat throughout the day, but is not strongly correlated to fire department incident activity.

Figure 52: Call Processing Time by Hour of Day, Study Period



The next figure shows the frequency of incidents during the study period at various minutes of call processing time. 82 percent of incidents have call processing times of between 15 seconds and 60 seconds.

Figure 53: Call Processing Time Frequency, Study Period



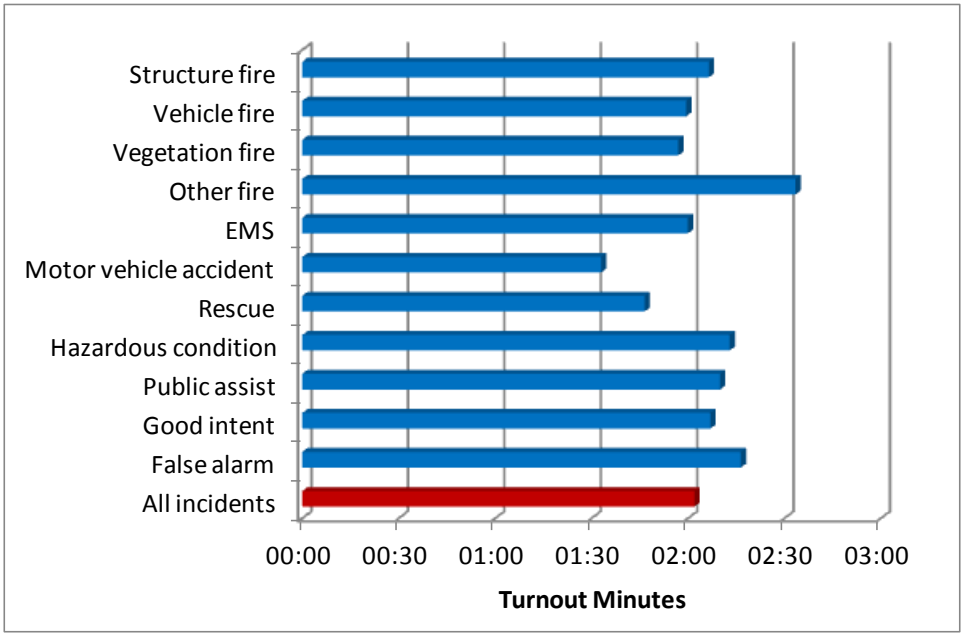
Turnout Time

Turnout time is the first of the response phases controllable by the fire department. This phase begins at notification of an emergency in progress by the dispatch center and ends when personnel and apparatus begin movement toward the incident location. Personnel must don appropriate equipment, assemble on the response vehicle, and begin travel to the incident. Good training and proper fire station design can minimize the time required for this step.

KFD's current performance objective for turnout time is within two minutes seven seconds, 90 percent of the time for incidents requiring full personal protective equipment and within two minutes 0 seconds for all other incidents. Its recommended turnout time goal is within 80 seconds, 90 percent of the time for incidents requiring full personal protective equipment and within 60 seconds, 90 percent of the time for all other incidents.

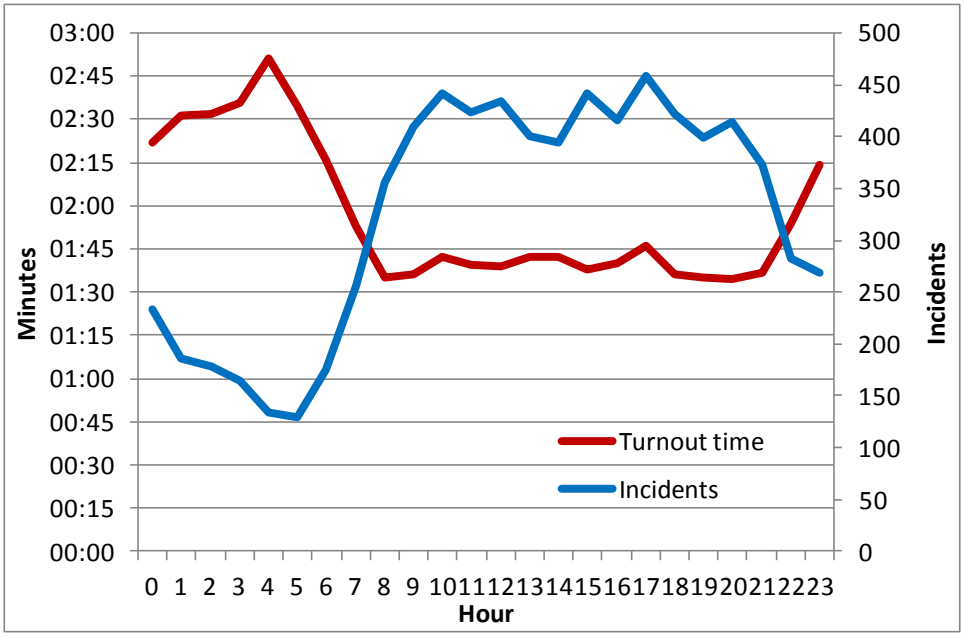
The following figure lists recorded turnout time for all incidents as well as specific incident types. Overall, turnout time for all incidents is within two minutes two seconds, 90 percent of the time. For incidents requiring full personnel protective equipment it was within two minutes seven seconds, 90 percent of the time. For all other incidents it was within two minutes 0 seconds, 90 percent of the time. KFD met its goal for incidents requiring full personal protective equipment 49 percent of the time. It met its goal for all other incidents 38 percent of the time.

Figure 54: Turnout Time Performance, Study Period



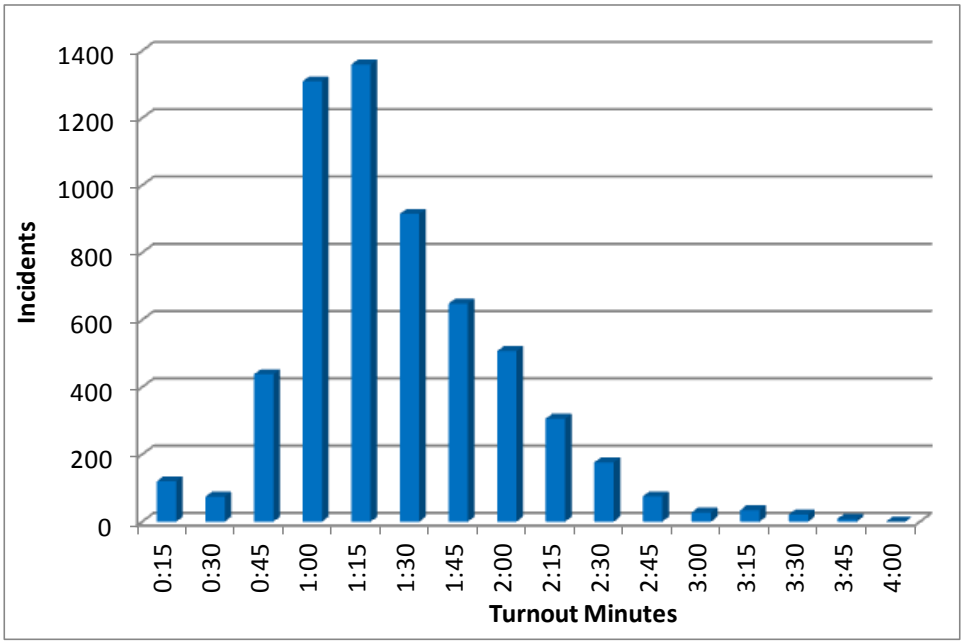
Turnout time can vary by hour of day. In this case turnout time varies by 1 minute and 16 seconds between the early morning hours and daytime hours.

Figure 55: Turnout Time by Hour of Day, Study Period



The next figure shows the frequency of incidents during the study period at various minutes of turnout time. 77 percent of incidents have turnout times of between 30 and 90 seconds.

Figure 56: Turnout Time Frequency, Study Period

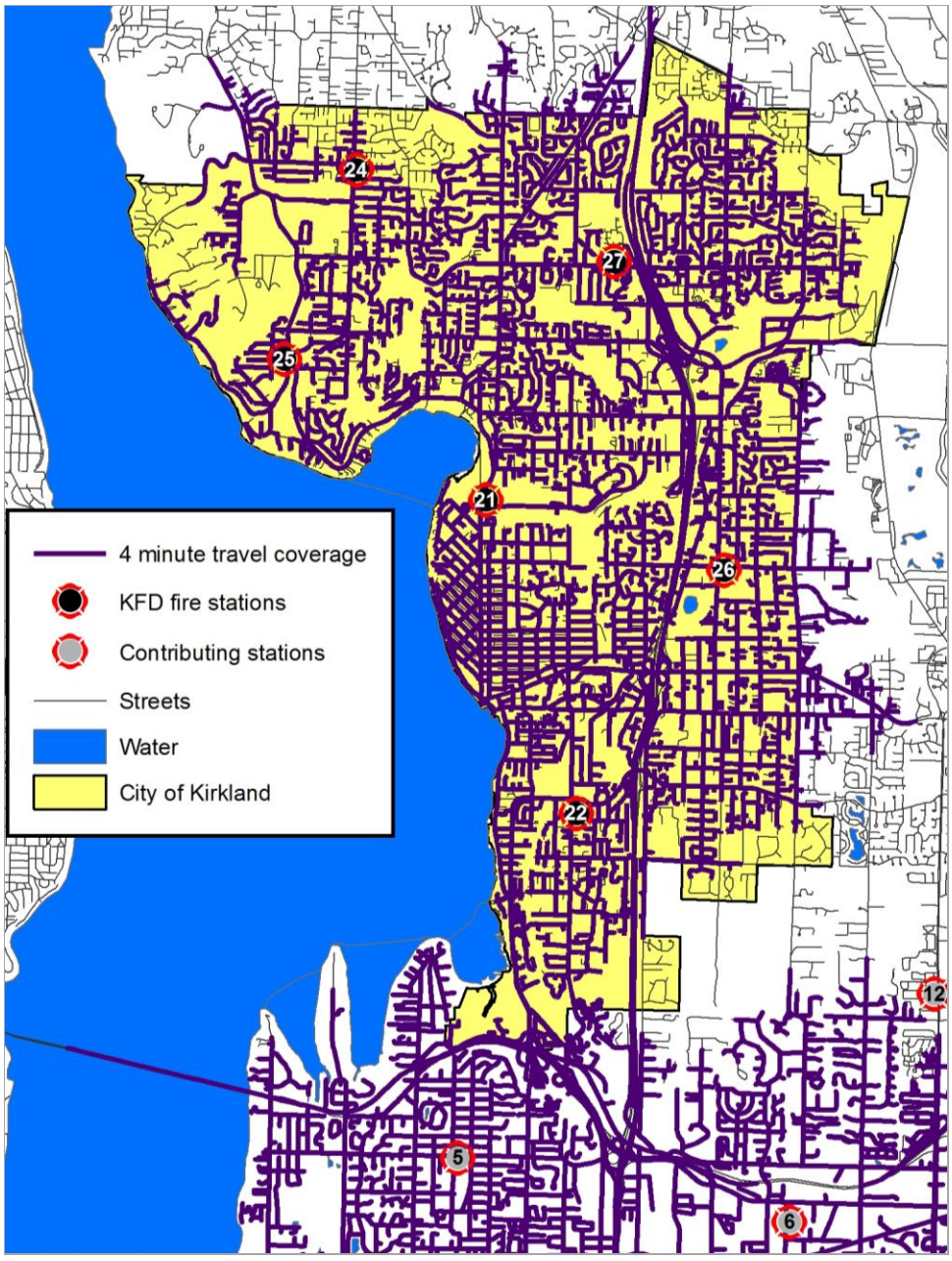


Distribution and Initial Arriving Unit Travel Time

Travel time is typically the longest of the response phases. The distance between the fire station and the location of the emergency influences total response time the most. The quality and connectivity of streets, traffic, driver training, geography, and environmental conditions are also factors. This phase begins with initial apparatus movement towards the incident location and ends when response personnel and apparatus arrive at the emergency's location. Within KFD's response performance goal, four minutes is allowed for travel time to incidents within the City of Kirkland.

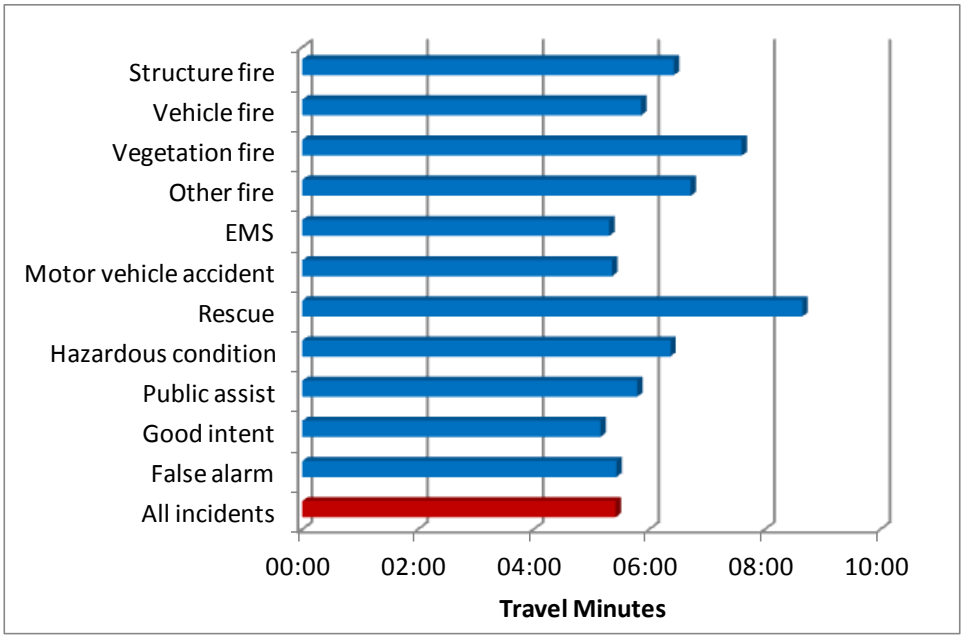
The following figure illustrates the area that can be reached from all active Kirkland fire stations and adjacent agency stations in four minutes of travel time, the time allowed by the KFD response time performance goal. Station 24 is not included since it is not staffed full time. It is based on actual travel speeds along roadways, adjusted for turning maneuvers. Adequate coverage is provided except small areas on the city's north and south periphery. Only Bellevue stations 5 and 6 provide coverage inside Kirkland within four travel minutes.

Figure 57: Initial Unit Travel Time Capability – KFD and Adjacent Stations



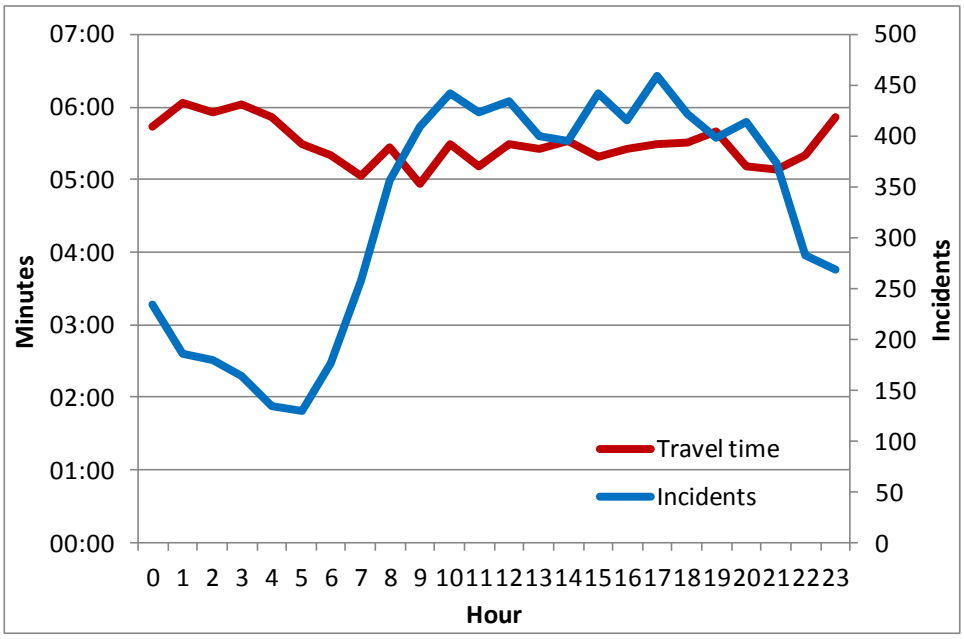
The following figure lists travel time for all priority city incidents as well as specific incident types. Overall, travel time for all incidents within the City of Kirkland is within five minutes 19 seconds, 90 percent of the time. KFD achieved four minute travel times on 75 percent of priority incidents.

Figure 58: Travel Time Performance – First Arriving Unit, Study Period



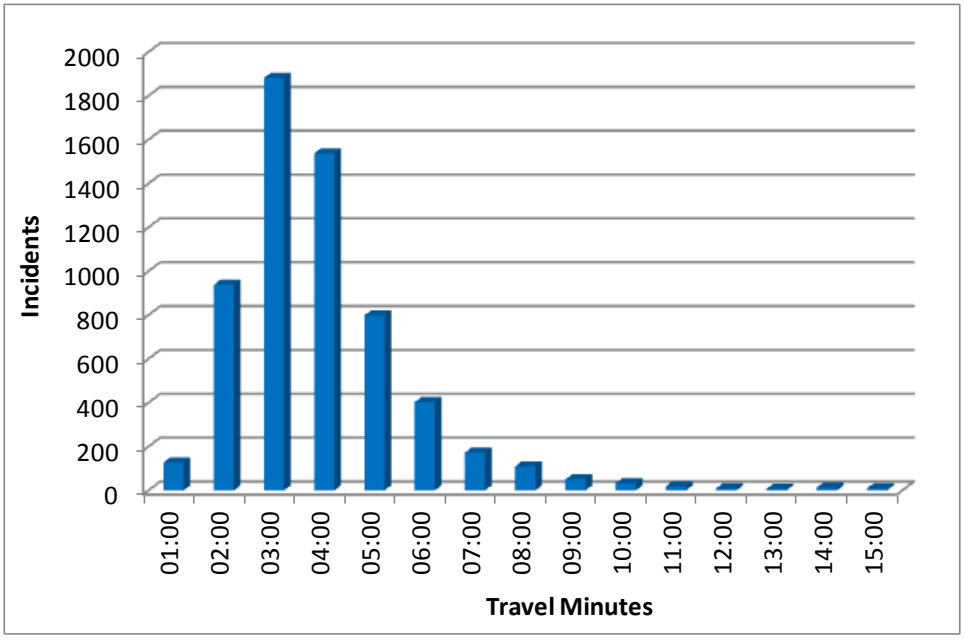
Travel time can, in some situations, vary considerably by time of day. Heavy traffic at morning and evening rush hour can slow fire department response. Travel time varies by one minute six seconds during the course of the day.

Figure 59: Overall Travel Time by Hour of Day – First Arriving Unit, Study Period



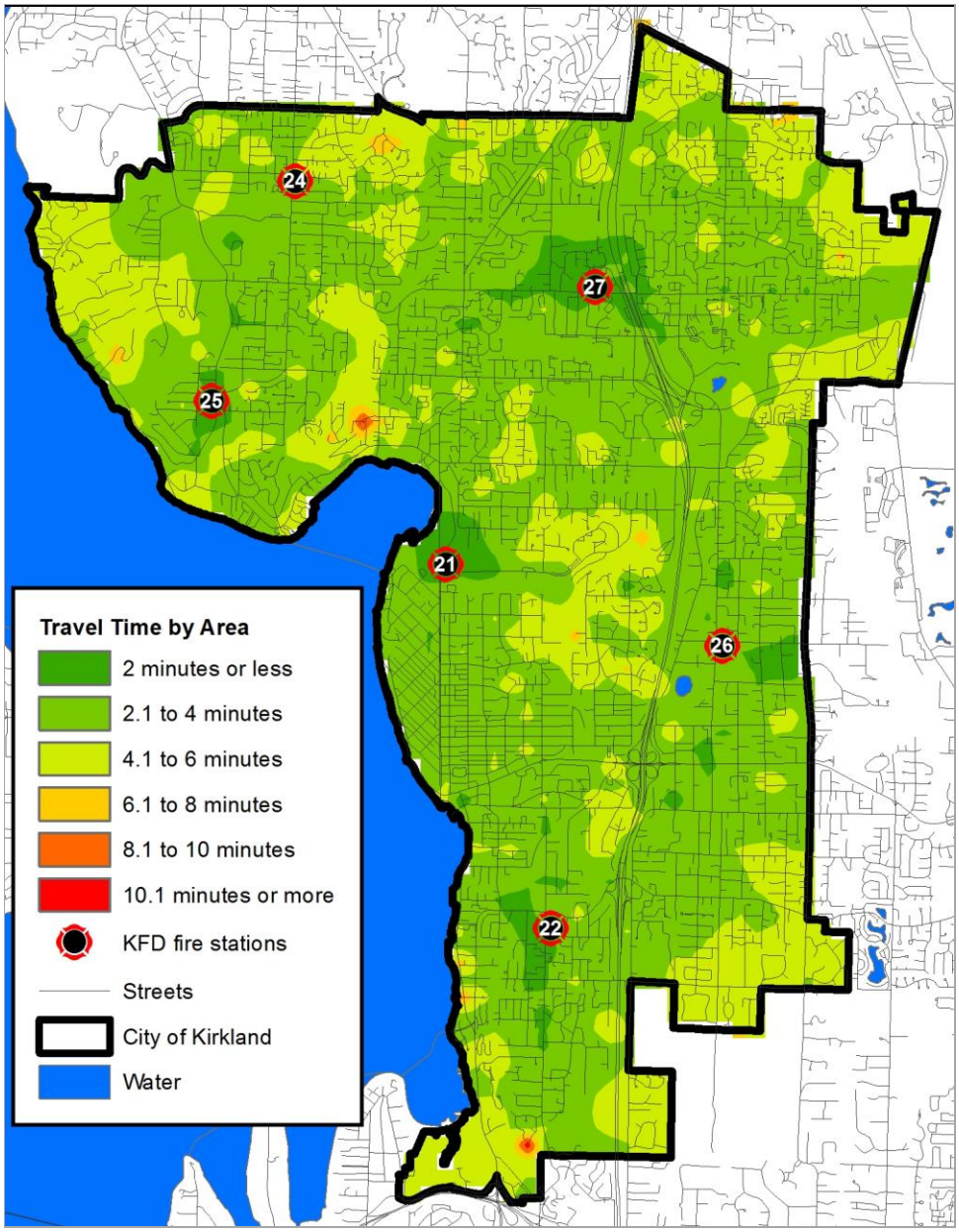
The next figure shows the frequency of incidents during the study period at various minutes of travel. 71 percent of incidents have travel times of between two and five minutes.

Figure 60: Travel Time Frequency, Study Period



Travel time performance by region is highly variable. This is influenced by a number of factors including individual station area workload, the number of times a station must cover another station's area, the size of the station area and the street system serving it. More highly connected, grid patterned, street systems contribute to faster response times than do areas with meandering streets with numerous dead-ends. The following figure graphically displays travel time performance for priority incidents by area.

Figure 61: Travel Time Performance by Area



The next analysis compared coverage of incidents that occurred during the study period. The following figure shows the results of this analysis. The vast majority of actual responses occurred within four travel minutes of fire stations.

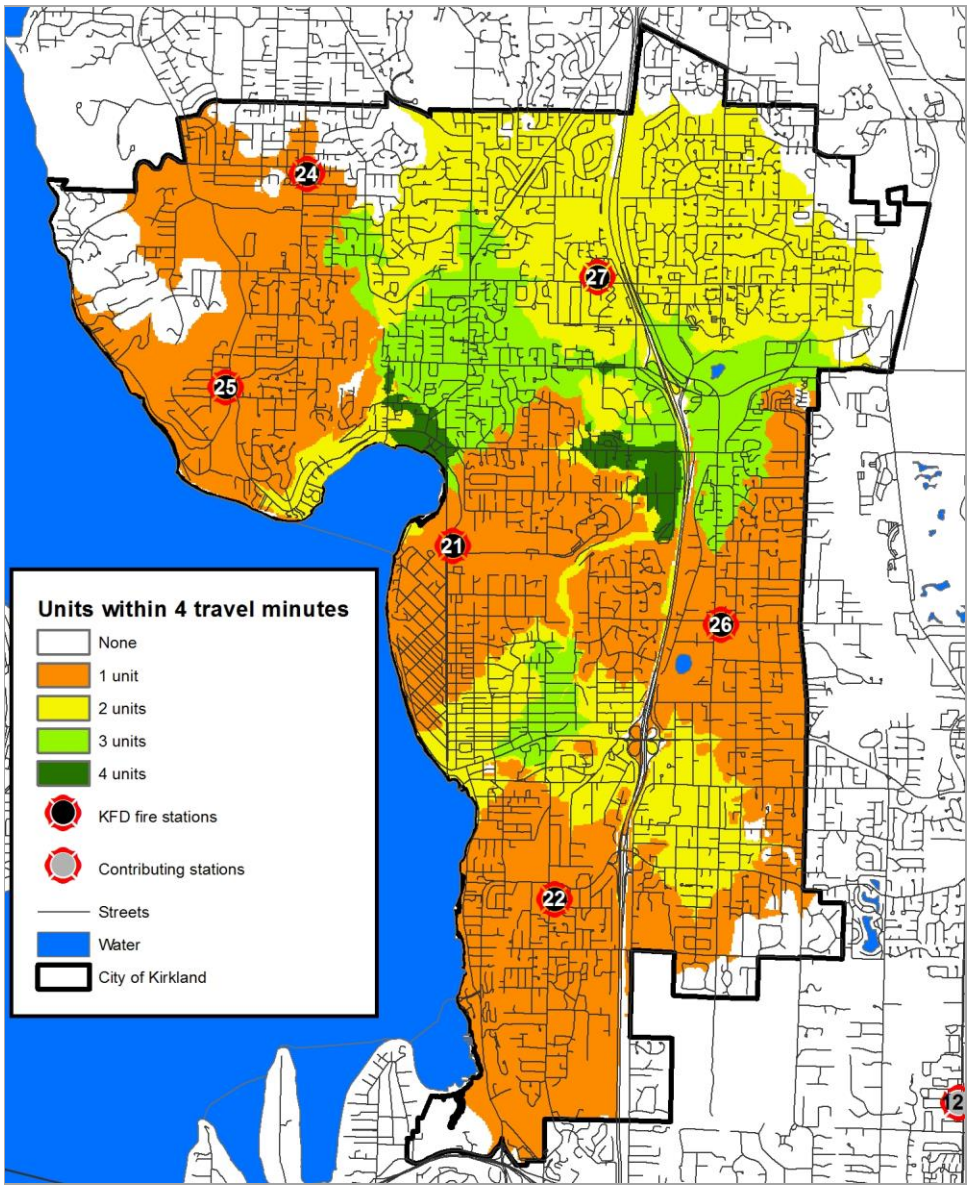
Figure 62: Incidents Within Four-Travel Minute Coverage

	Total	Percent of Total
Total incidents in city	6,895	100.0%
Total city incidents inside station 4-minute travel coverage	6,664	96.6%

As important as it is to ensure that all portions of the service area are within the target travel time of a fire station, it is equally important to provide some degree of redundancy, or overlap, in areas of high incident activity. Figure 40 in this report illustrates the portions of the service area with higher incident activity. The likelihood of concurrent incidents is greater in several neighborhoods due to the number of incidents that occur in that area. Some degree of overlap in these areas is helpful to better serve concurrent incidents and minimize travel time.

The following figure illustrates the service area and shows where the four-minute travel areas of two or more active Kirkland fire stations overlap. Adjacent agency stations contribute very little to overlapping coverage.

Figure 63: Overlapping Four-Minute Travel Area – KFD Stations



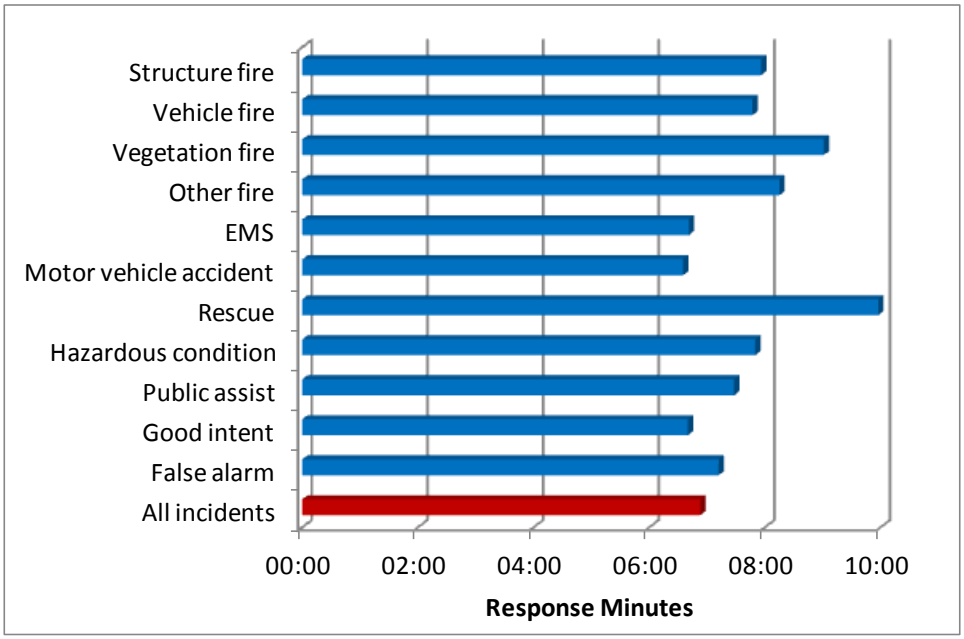
First Arriving Unit Response Time

Response time is defined as that period between notification of response personnel by the dispatch center that an emergency is in progress until arrival of the first fire department response unit at the emergency.

KFD's current target for response time is within seven minutes 40 seconds, 90 percent of the time for fire incidents and within six minutes 36 seconds for emergency medical incidents. Its response time target is within five minutes 20 seconds, 90 percent of the time for fire incidents and within five minutes 0 seconds, 90 percent of the time for emergency medical incidents.

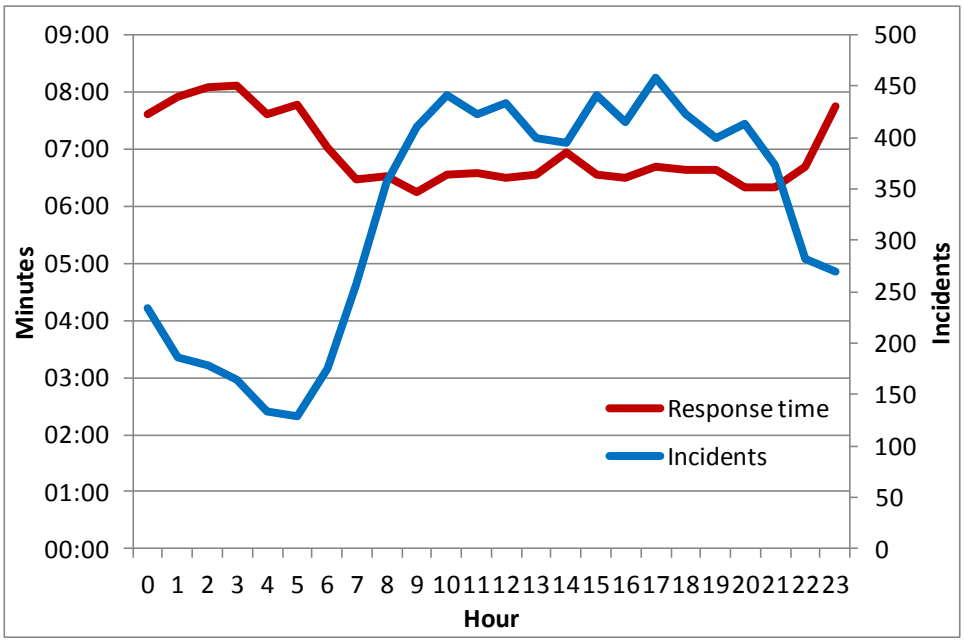
The following figure illustrates response time for all priority incidents as well as specific incident types. Overall, response time for all priority incidents is within six minutes 44 seconds, 90 percent of the time. Response time for fire incidents was within seven minutes 40 seconds, 90 percent of the time and within six minutes 36 seconds, 90 percent of the time for emergency medical incidents. KFD met its target for fire incidents 62 percent of the time. It met its target for emergency medical incidents 69 percent of the time.

Figure 64: Response Time Performance – First Arriving Unit, Study Period



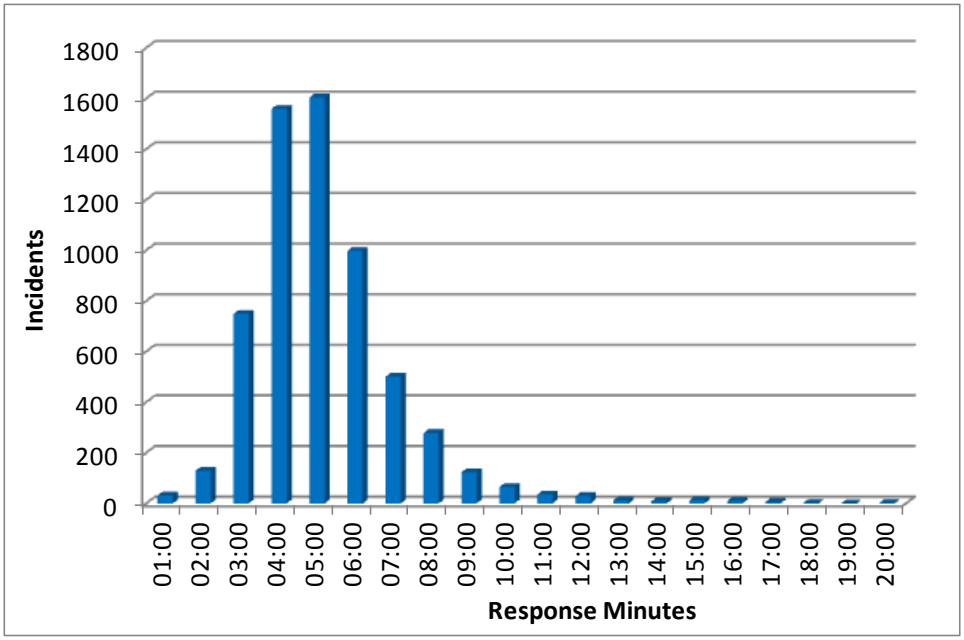
The next figure shows response time by hour of day for all incidents. Response time is slowest during the night-time hours and fastest during the day. Generally, KFD's best response times occur during the period of the day when response activity is at its highest.

Figure 65: Hourly Response Time Performance, Study Period



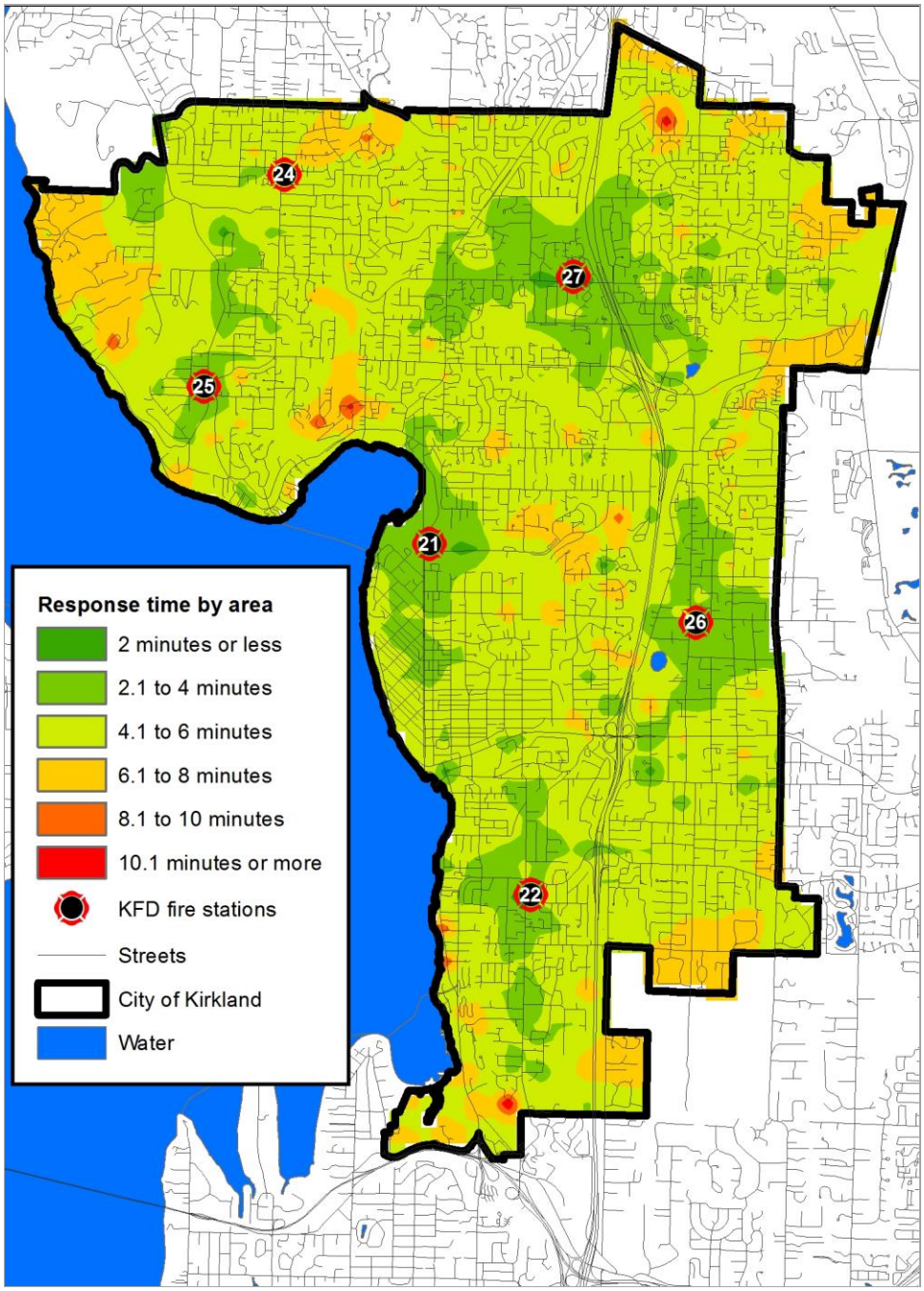
The next figure shows the frequency of incidents during 2012 at various minutes of response time. 79 percent of incidents have response times of between two and six minutes.

Figure 66: Response Time Frequency, 2012



The following figure illustrates response time performance by area.

Figure 67: Response Time by Area

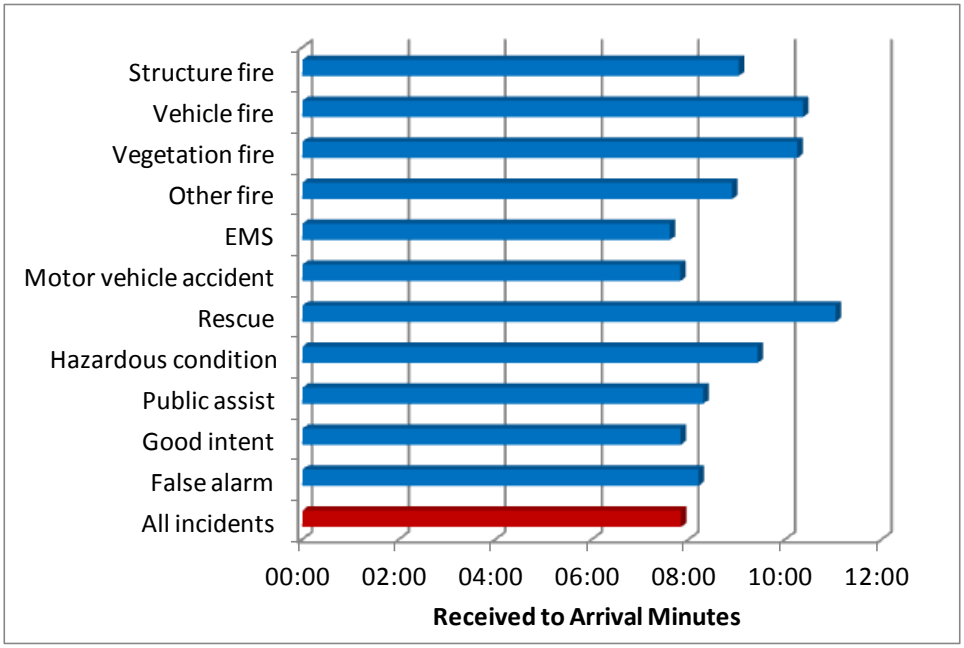


First Arriving Unit Received to Arrival Time (Total Response Time)

From the customers' standpoint, time begins when the emergency occurs. Their first contact with emergency services is when they call for help, usually by dialing 9-1-1. The combination of call processing time and response time is called received to arrival time, or total response time. The received to arrival time goals recommended for KFD are within six minutes 20 seconds, 90 percent of the time for fire incidents and within six minutes 0 seconds, 90 percent of the time for emergency medical incidents.

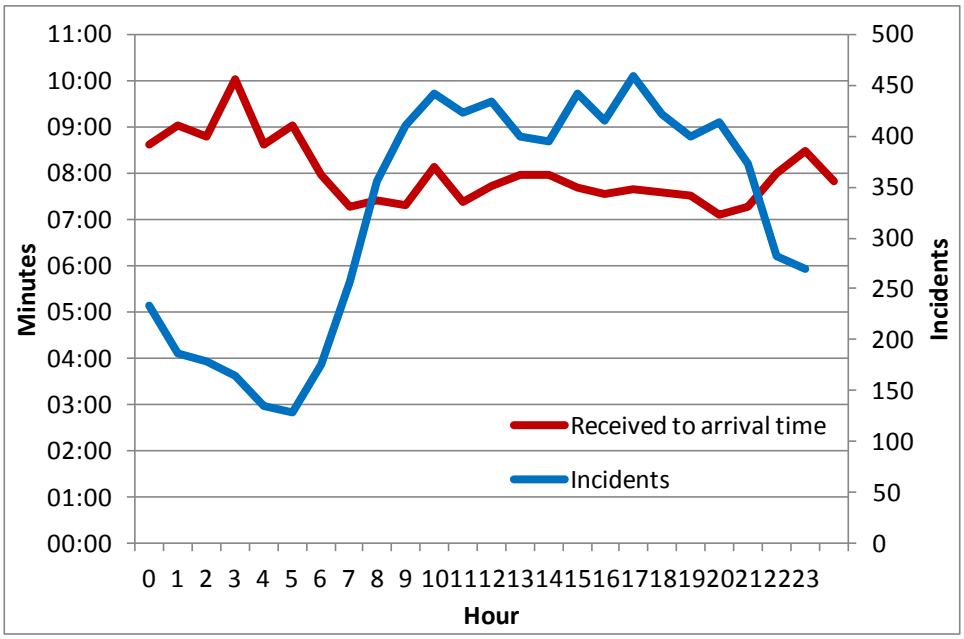
The next figure shows response performance at the 90th percentile from the time the phone rings at the dispatch center until the first unit arrives at the incident location. Overall, received to arrival time for all priority incidents is within 7 minutes 44 seconds, 90 percent of the time. Total response time for fire incidents was within eight minutes 55 seconds, 90 percent of the time and within seven minutes 34 seconds, 90 percent of the time for emergency medical incidents. KFD met its recommended goal for fire incidents 62 percent of the time and for emergency medical incidents 74 percent of the time.

Figure 68: Received to Arrival Time – First Arriving Unit, Study Period



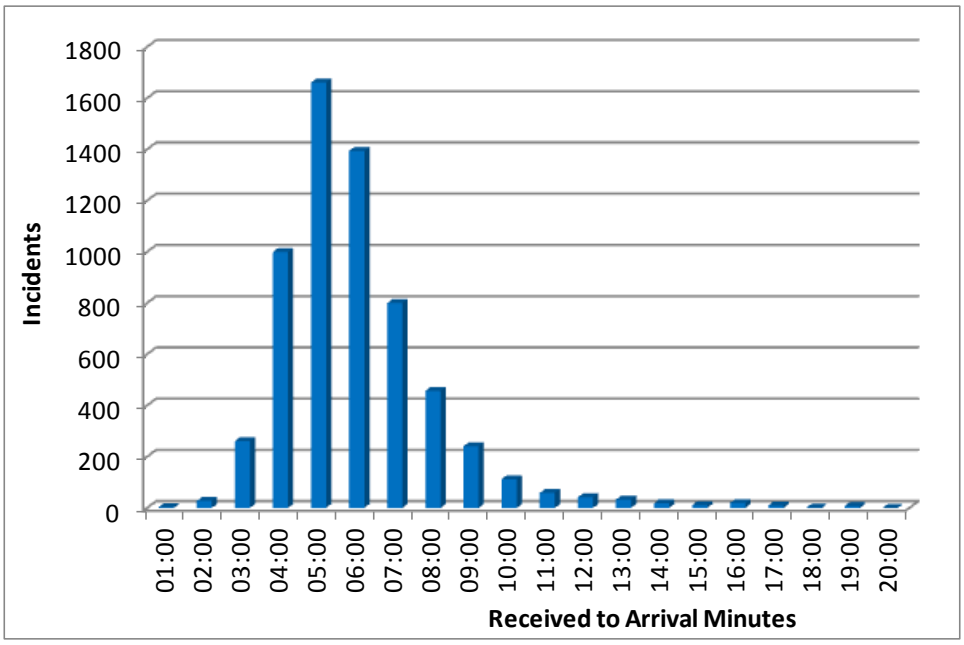
The next figure shows received to arrival performance by time of day also compared to incident activity by time of day. Total response time, from the customer's standpoint, is quickest during the day and slowest during the late night and early morning hours.

Figure 69: Hourly Received to Arrival Performance, Study Period



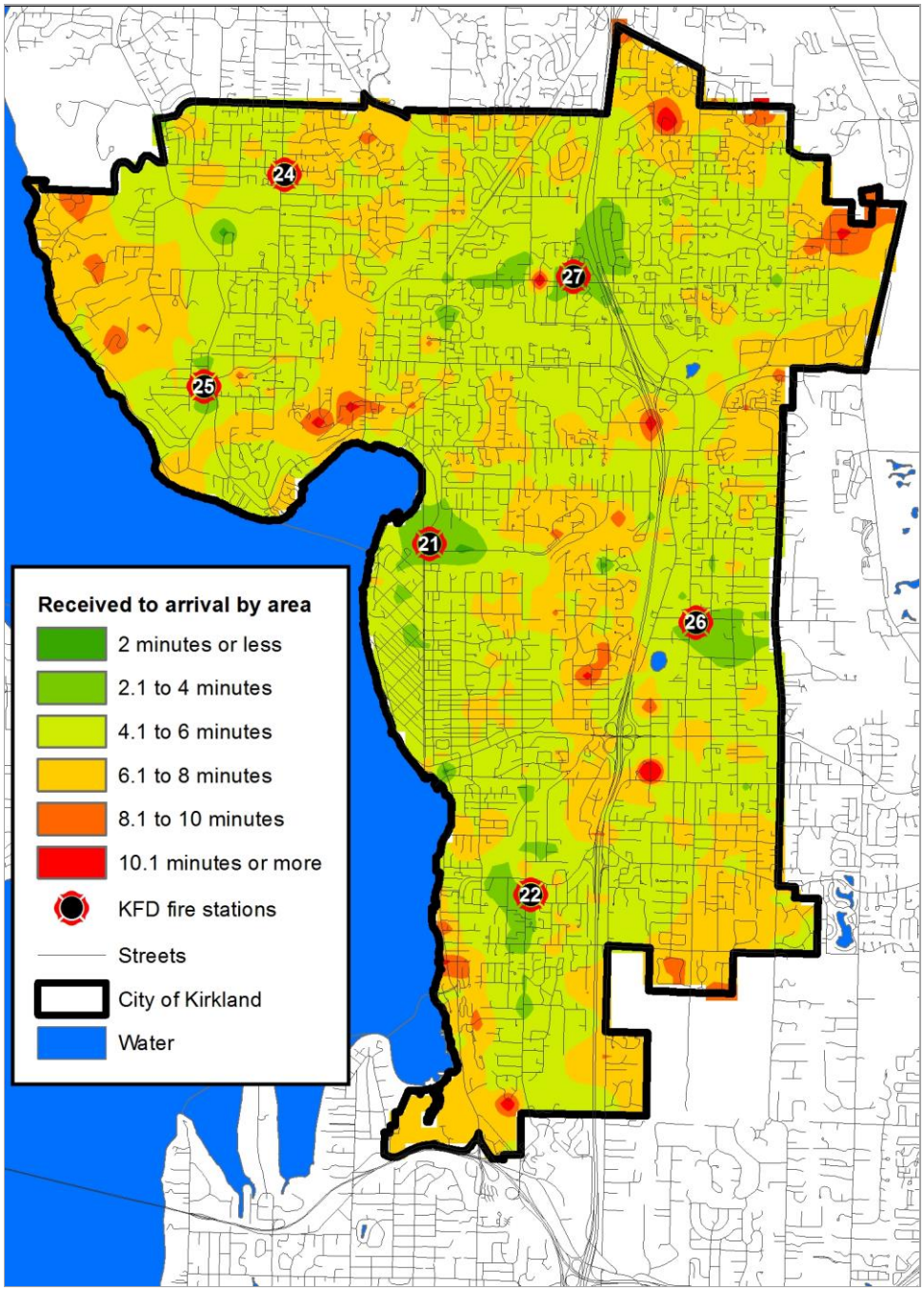
The next figure shows the frequency of incidents during the study period at various minutes of received to arrival time. 79 percent of incidents have received to arrival times of between three and seven minutes.

Figure 70: Received to Arrival Time Frequency, Study Period



The next figure illustrates received to arrival time by area.

Figure 71: Received to Arrival Time by Area



Concentration and Current Effective Response Force Capability Analysis

Effective Response Force (ERF) is the number of personnel and apparatus required to be present on the scene of an emergency incident to perform the critical tasks in such a manner to effectively mitigate the incident without unnecessary loss of life and/or property. The ERF is specific to each individual type of incident, and is based on the critical tasks that must be performed. Both moderate and high risk structure fires are used as the primary risk category for this analysis as these present the most frequent type of incidents requiring multiple response units and greater numbers of firefighters assigned to the incident.

KFD currently dispatches four fire engines, two ladder trucks, two battalion chiefs, and an aid car to all reported building fires regardless of level of risk. It does so knowing that it is easier to return apparatus not needed than to add additional response units during the course of the emergency. So long as incident commanders are diligent in returning unneeded response units to service quickly this strategy can be effective.

KFD has identified the following recommended response performance goals for the delivery of the full effective response force to moderate and high risk incidents:

- *For moderate risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within ten minutes 20 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*
- *For high risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within ten minutes 20 seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*

Data was not available to differentiate a given structure fire incident as either moderate risk or high risk. The evaluation of current performance reviewed the time required to deliver the minimum effective response force for moderate risk and for high risk.

Actual performance for structure fires that occurred within the City of Kirkland during the study period is:

- **Moderate Risk –** Within 13 minutes 0 seconds, 90 percent of the time.
- **High Risk –** Within 16 minutes three seconds, 90 percent of the time.

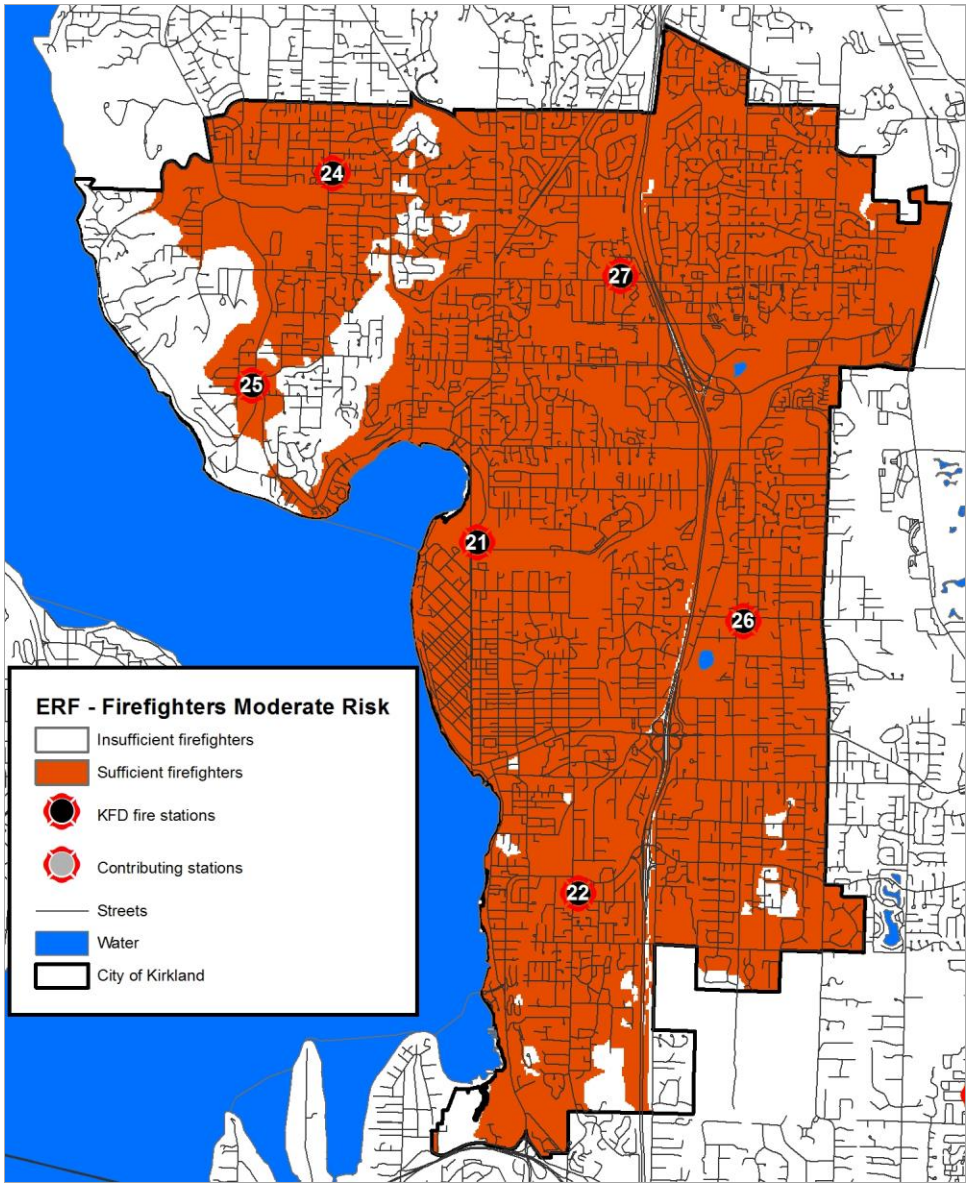
For the purpose of this analysis, 60 seconds is allowed for call processing time and 80 seconds is allowed for turnout time. Thus to achieve delivery of an effective response force within ten minutes 20 seconds for both moderate and high risk structure fires, eight minutes of travel time is available.

Finally, for the purpose of this analysis, a full effective response force to a high risk structure fire is two battalion chiefs, two ladder trucks, an aid unit, and four fire engines with total staffing of 20 firefighters. For a moderate risk structure fire it is one battalion chief, one ladder truck, one aid unit, and three fire engines with total staffing of 15 firefighters.

KFD's current ability to deliver the minimum resources needed for moderate and high risk structure fires was evaluated. The following figures depict the current capability of KFD to assemble various concentrations of apparatus and firefighters within each area. The modeled analysis shown assumes that all response units are available and includes the resources of adjacent agencies as appropriate.

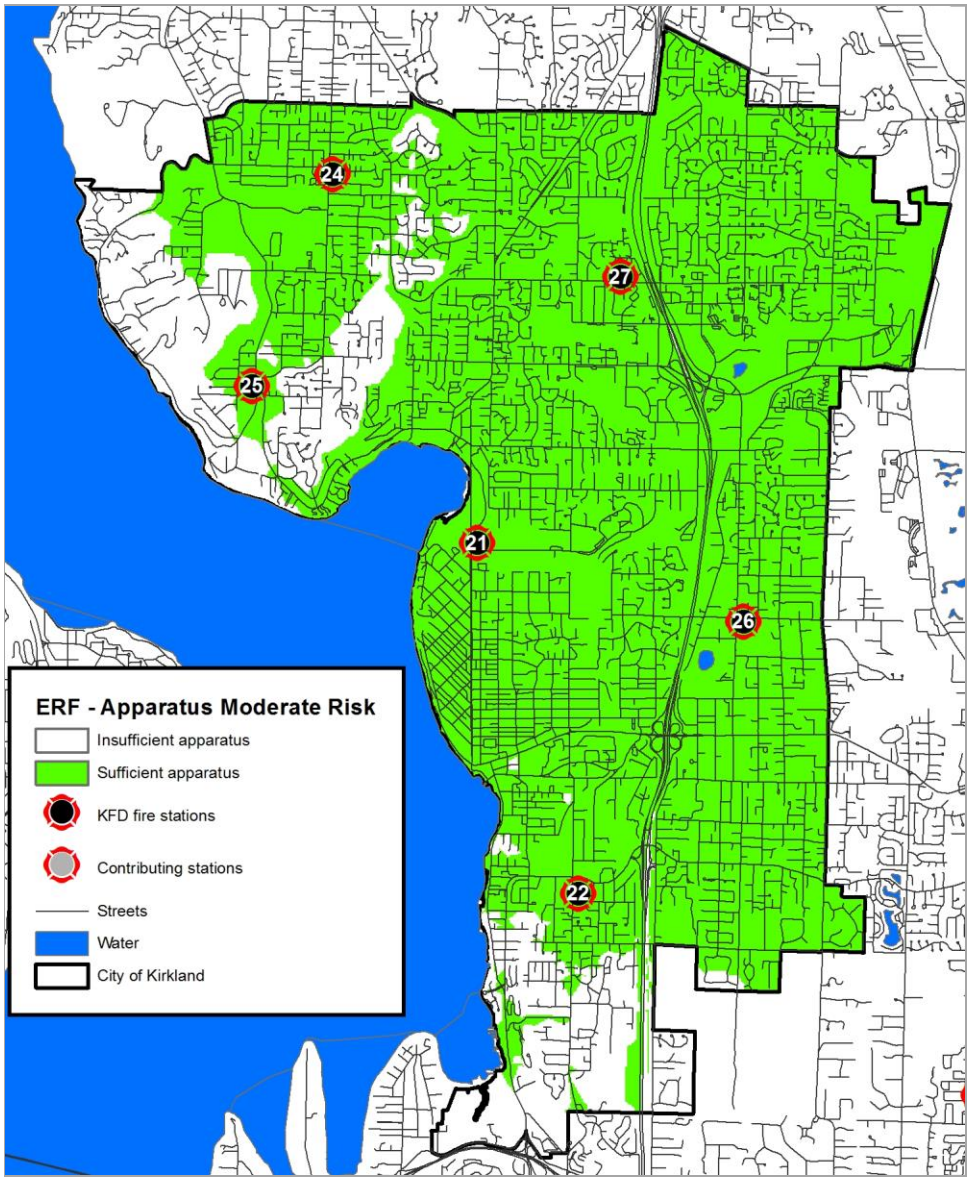
The first figure shows the area that can be reached by 15 firefighters within eight minutes travel. Moderate risk firefighter effective response force is not available to some areas around Stations 25.

Figure 72: Effective Response Force – Firefighters – Moderate Risk



The next figure shows the area that can be served by one battalion chief, one ladder truck, and three fire engines within the eight minute travel time target. This illustrates that the city is well served by current resources for a moderate risk structure fire. Only an area around Station 25 has insufficient resources.

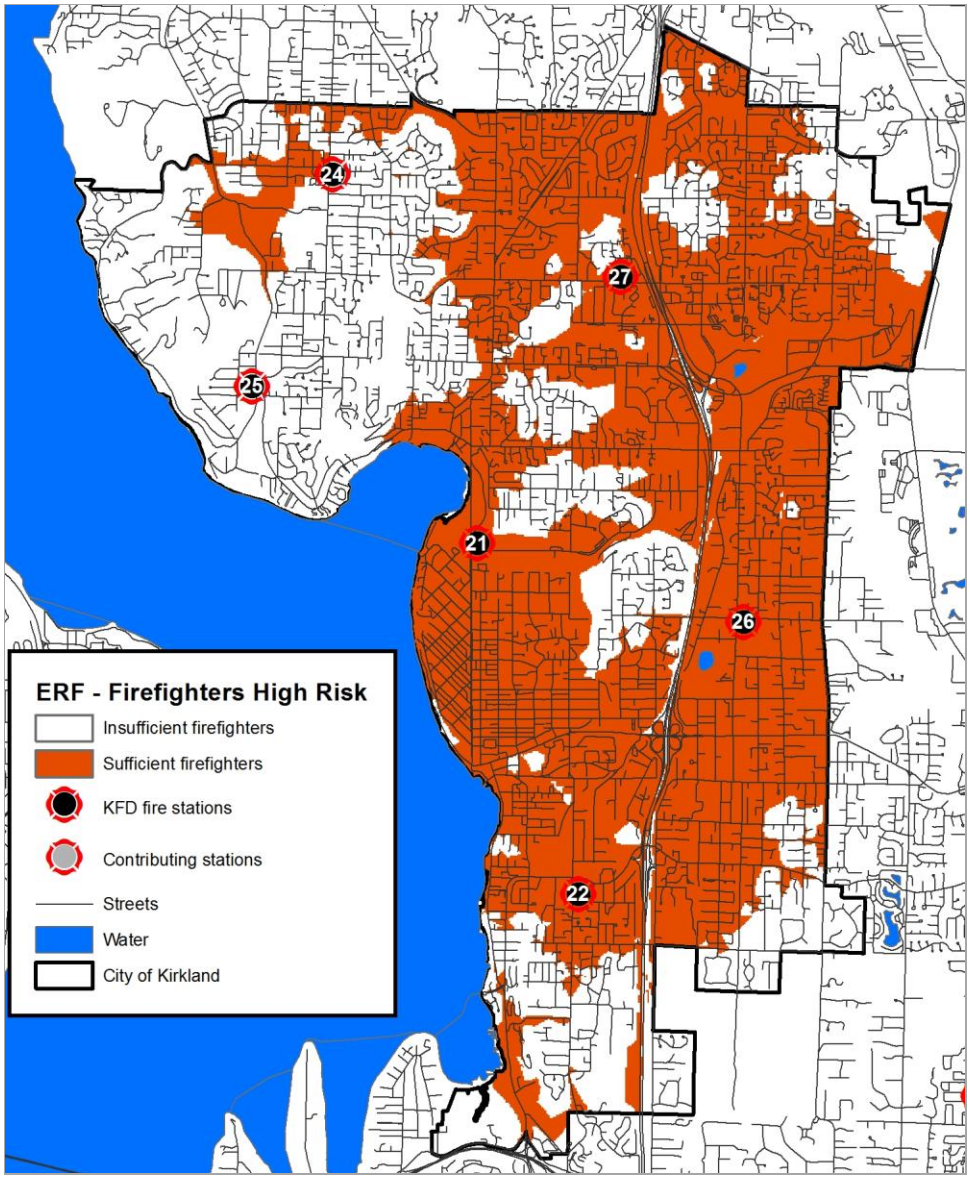
Figure 73: Effective Response Force – Apparatus – Moderate Risk



KFD's current ability to deliver the minimum resources needed for a high risk structure fire was also evaluated. The following figures depict the current capability of KFD to assemble various concentrations of apparatus and firefighters within each area. Again, the modeled analysis shown assumes that all response units are available and includes the resources of adjacent agencies as appropriate.

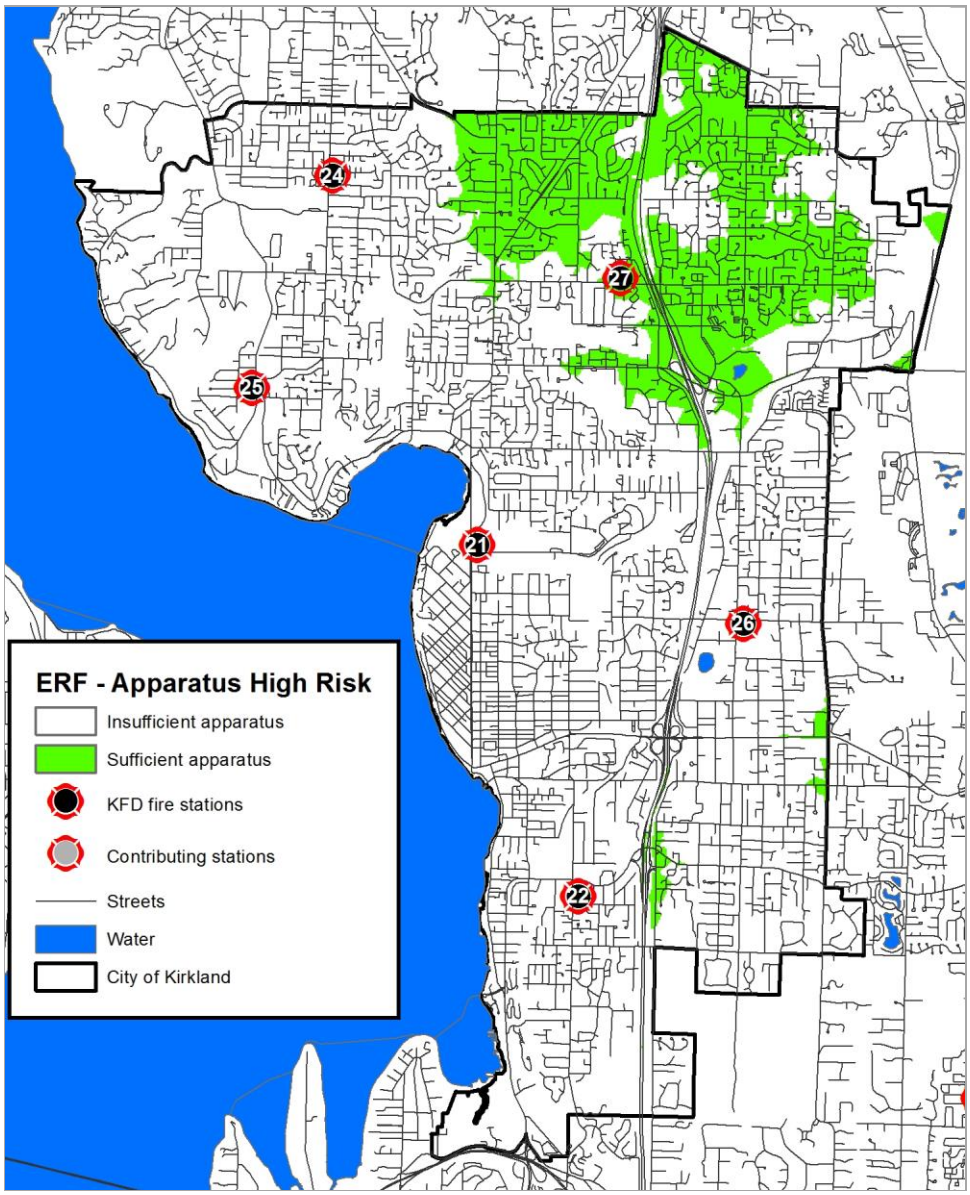
The first figure shows the area that can be reached by 20 firefighters within eight minutes travel. High risk firefighter effective response force is available to less of the city than moderate risk.

Figure 74: Effective Response Force – Firefighters – High Risk



The next figure shows the area that can be served by two battalion chiefs, two ladder trucks, and four fire engines within the eight minute travel time target. This illustrates that very little of the city is served by current resources for a high risk structure fire.

Figure 75: Effective Response Force – Apparatus – High Risk



Second Unit Arrival Time

Four KFD fire engines and the ladder truck are staffed with three personnel; one fire engine is temporarily staffed with four personnel. Safety regulations require that at least four firefighters be on scene before firefighters can enter a burning building. The only exception is if it is known that a person is

inside the building and needs rescue or the fire is still in the incipient stage. Consequently, the arrival of a second response unit is normally required before interior firefighting activities can be initiated.

The same group of structure fires was reviewed to determine the time the second response unit arrived on the scene. According to the data, the second unit arrived on scene of a building fire in the City of Kirkland within two minutes 59 seconds, 90 percent of the time after the arrival of the first unit.

Emergency Medical Services

KFD provides emergency medical first-response and ambulance service at the basic life support level. Advanced life support care and ambulance service is provided by the King County Medic One system.

A call for emergency medical assistance is received first at the regional dispatch center. Incident information is obtained from the caller, and both the fire department and Medic One units are dispatched.

KFD arrives first or at the same time as the Medic unit at emergency medical incidents 94.4 percent of the time. The following figure lists the percentage of time each unit type arrived first.

Figure 76: Arrival Order Percentage

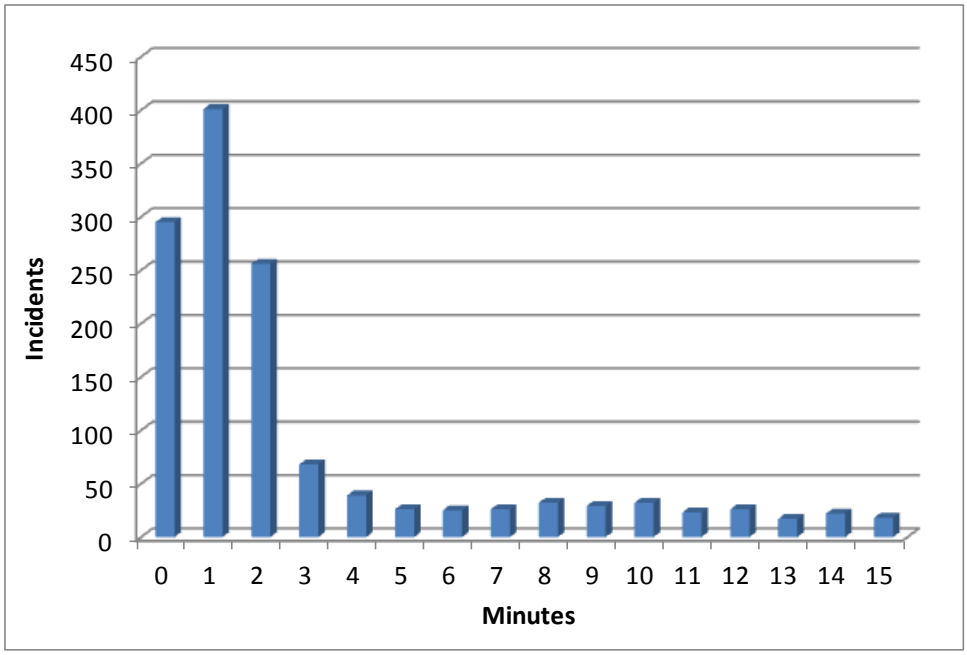
Arrival Order	Incidents	Percentage
Fire unit arrived first	1,216	89.1%
Medic unit arrive first	63	4.6%
Fire and Medic arrived at same time	72	5.3%
Fire unit cancelled	13	1.0%
TOTAL INCIDENTS	**1,364**	**100%**

KFD arrives first most often and within four minutes 10 seconds 90 percent of the time earlier than the Medic unit *when both units are dispatched at about the same time*. For those incidents to which the Medic unit arrived first it arrived within three minutes 15 seconds 90 percent of the time before the fire department.

The dispatch of the Medic unit was delayed by an average of four minutes 20 seconds during the study period (11 minutes 23 seconds, 90 percent of the time). The dispatch of the Medic unit was delayed by more than one minute on 50 percent of all incidents. Sometimes this is because a Medic unit was not requested until after the arrival of a KFD response unit. However, in most cases it is because a Medic

unit is not dispatched until completion of the call taking process. The following figure illustrates the frequency of incidents in which the dispatch of the Medic unit was delayed compared to the KFD unit.

Figure 77: Frequency of Delay in Medic One Unit Dispatch



This delay in dispatching the Medic unit contributes to a significant delay in the arrival of advanced life support care. When arrival of a KFD unit is compared to arrival of a Medic unit from the initial time the call was received at the dispatch center, the KFD unit arrived within seven minutes 16 seconds before the Medic unit, 90 percent of the time.

Call Concurrency and Reliability

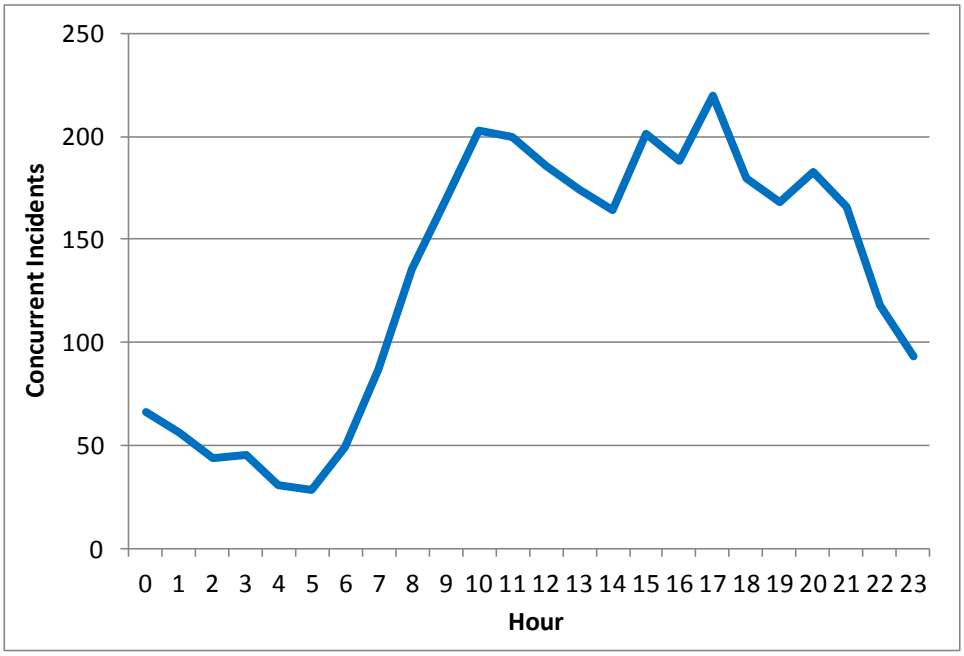
When evaluating the effectiveness of any resource deployment plan, it is necessary to evaluate the workload of the individual companies to determine to what extent their availability for dispatch is affecting the response time performance. In simplest terms, a response unit cannot make it to an incident across the street from its own station in four minutes if it is unavailable to be dispatched to that incident because it is committed to another call.

Concurrency

One way to look at resource workload is to examine the number of times multiple incidents happen within the same time frame. Incidents during 2012 were examined to determine the frequency of concurrent calls within the KFD service area. This is important because concurrent calls can stretch

available resources and extend response times. During the study period, 40.4 percent of incidents occurred concurrently with another incident.

Figure 78: Incident Concurrency by Hour



Reliability

The ability of a fire station's first-due unit(s) to respond to an incident within its assigned response area is known as unit *reliability*. The reliability analysis is normally done by measuring the number of times response units assigned to a given fire station were available to respond to a request for service within that fire station's primary service area.

KFD does not dispatch response units based on a particular geographic service area. Instead, the computer aided dispatch system assigns the closest unit to an incident based on calculated travel time. This is a far superior way to select response units for an incident.

To determine reliability under this system, data should be collected to determine the number of times any response unit was available for an incident within the target travel time, in KFD's case four minutes. Data is not available to make that calculation.

Component H – Factors Influencing Incident Outcomes

Dynamics of Fire in Buildings

Most fires within buildings develop in a predictable fashion, unless influenced by highly flammable material. Ignition, or the beginning of a fire, starts the sequence of events. It may take several minutes or even hours from the time of ignition until a flame is visible. This smoldering stage is very dangerous, especially during times when people are sleeping, since large amounts of highly toxic smoke may be generated during this phase.

Once flames do appear, the sequence continues rapidly. Combustible material adjacent to the flame heats and ignites which in turn heats and ignites other adjacent materials if sufficient oxygen is present. As the objects burn, heated gases accumulate at the ceiling of the room. Some of the gases are flammable and highly toxic.

The spread of the fire from this point continues quickly. Soon the flammable gases at the ceiling as well as other combustible material in the room of origin reach ignition temperature. At that point, an event termed “flashover” occurs; the gases and other material ignite, which in turn ignites everything in the room. Once flashover occurs, damage caused by the fire is significant and the environment within the room can no longer support human life.

Flashover usually occurs about five to eight minutes from the appearance of flame in typically furnished and ventilated buildings. Since flashover has such a dramatic influence on the outcome of a fire event, the goal of any fire agency is to apply water to a fire before flashover occurs.

Although modern codes tend to make fires in newer structures more infrequent, today’s energy-efficient construction (designed to hold heat during the winter) also tends to confine the heat of a hostile fire. In addition, research has shown that modern furnishings generally burn hotter (due to synthetics).

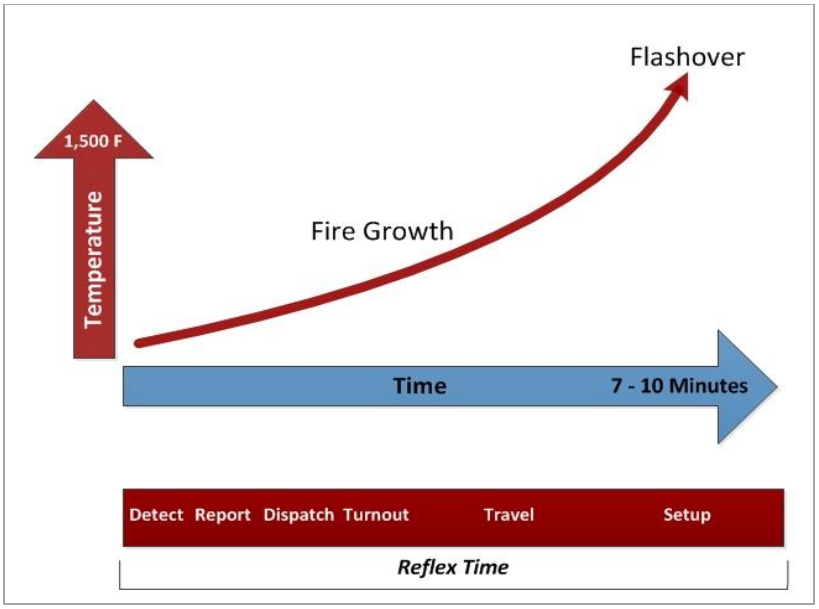
In the 1970s, scientists at the National Institute of Standards and Technology found that after a fire broke out, building occupants had about 17 minutes to escape before being overcome by heat and

smoke. Today, that estimate is as short as three minutes.[6] The necessity of effective early warning (smoke alarms), early suppression (fire sprinklers), and firefighters arriving on the scene of a fire in the shortest span of time is more critical now than ever.

Perhaps as important as preventing flashover is the need to control a fire before it does damage to the structural framing of a building. Materials used to construct buildings today are often less fire resistive than the heavy structural skeletons of older frame buildings. Roof trusses and floor joists are commonly made with lighter materials that are more easily weakened by the effects of fire. "Light weight" roof trusses fail after five to seven minutes of direct flame impingement. Plywood I-beam joists can fail after as little as three minutes of flame contact. This creates a dangerous environment for firefighters.

In addition, the contents of buildings today have a much greater potential for heat production than in the past. The widespread use of plastics in furnishings and other building contents rapidly accelerate fire spread and increase the amount of water needed to effectively control a fire. All of these factors make the need for early application of water essential to a successful fire outcome. A number of events must take place quickly to make it possible to achieve fire suppression prior to flashover. Figure 79 illustrates the sequence of events.

Figure 79: Fire Growth vs. Reflex Time



[6] Bukowski, Richard, et al. *Performance of Home Smoke Alarms, Analysis of the Response of Several Available Technologies in Residential Fire Settings,* National Institute of Standards and Technology.

As is apparent by this description of the sequence of events, application of water in time to prevent flashover is a serious challenge for any fire department. It is critical, though, as studies of historical fire losses can demonstrate.

The National Fire Protection Association found that fires contained to the room of origin (typically extinguished prior to or immediately following flashover) had significantly lower rates of death, injury, and property loss when compared to fires that had an opportunity to spread beyond the room of origin (typically extinguished post-flashover). As evidenced in the following figure, fire losses, casualties, and deaths rise significantly as the extent of fire damage increases.

Figure 80: Fire Extension in Residential Structures

Consequence of Fire Extension In Residential Structures 2003 - 2007			
	Rates per 1,000 Fires		Average Dollar Loss
Extension	Civilian Deaths	Civilian Injuries	Per Fire
Confined to room of origin or smaller	2.17	25.75	$4,228
Confined to floor of origin	16.86	82.56	$35,581
Confined to building of origin or larger	27.90	61.30	$65,450

Source: National Fire Protection Association, "Home Structure Fires," March 2010.

Emergency Medical Event Sequence

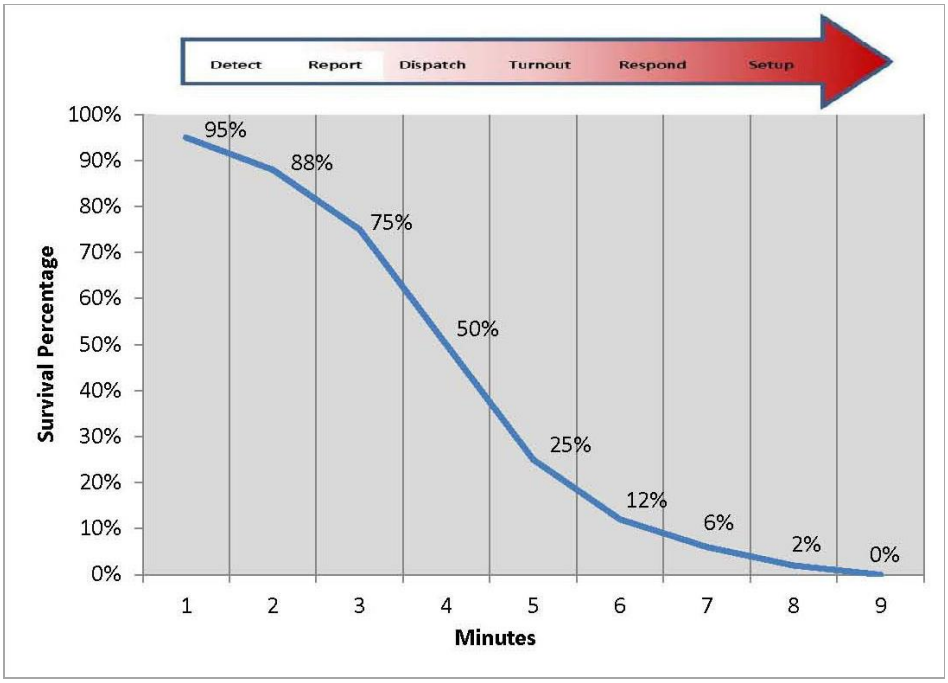
Cardiac arrest, also known as sudden cardiac arrest, is the abrupt loss of heart function. This can occur with or apart from the diagnosis of heart disease. The time and mode of death are unexpected; occurring instantly or shortly after symptoms appear. Cardiac arrest is the most significant life-threatening medical event in emergency medicine today. A victim of cardiac arrest has mere minutes in which to receive lifesaving care if there is to be any hope for resuscitation.

The American Heart Association (AHA) issued a set of cardiopulmonary resuscitation (CPR) guidelines designed to streamline emergency procedures for heart attack victims, and to increase the likelihood of survival. Hands-only CPR is the current recommendation by dispatchers for all 9-1-1 cardiac arrest calls. The AHA guidelines include goals for the application of cardiac defibrillation to cardiac arrest victims.

Cardiac arrest is reversible in most victims if it is treated within a few minutes, however survival chances fall by 7 to 10 percent for every minute between collapse and defibrillation. Consequently, the AHA recommends rapid application of an automated external defibrillator (AED) as early as possible and within five minutes of cardiac arrest.

As with fires, the sequence of events that lead to emergency cardiac care can be graphically illustrated, as in the following figure.

Figure 81: Cardiac Arrest Event Sequence



The percentage of opportunity for recovery from cardiac arrest drops quickly as time progresses. The stages of medical response are very similar to the components described for a fire response. Recent research stresses the importance of rapid cardiac defibrillation and administration of certain medications as a means of improving the opportunity for successful resuscitation and survival.

People, Tools, and Time

Time matters a great deal in the achievement of an effective outcome to an emergency event. Time, however, is not the only factor. Delivering sufficient numbers of properly trained, appropriately equipped personnel within the critical time period completes the equation.

For medical emergencies this can vary based on the nature of the emergency. Many medical emergencies are not time critical. However, for serious trauma, cardiac arrest, or conditions that may lead to cardiac arrest, a rapid response is essential.

Equally critical is delivering enough personnel to the scene to perform all of the concurrent tasks required to deliver quality emergency care. For a cardiac arrest, this can be up to six personnel; two to perform CPR, two to set up and operate advanced medical equipment, one to record the actions taken by emergency care workers, and one to direct patient care. Thus, for a medical emergency, the real test of performance is the time it takes to provide the personnel and equipment needed to deal effectively with the patient's condition, not necessarily the time it takes for the first person to arrive.

Fire emergencies are even more resource critical. Again, the true test of performance is the time it takes to deliver sufficient personnel to initiate application of water to a fire. This is the only practical method to reverse the continuing internal temperature increases and ultimately prevent flashover. The arrival of one person with a portable radio does not provide fire intervention capability and should not be counted as "arrival" by the fire department.

Component I – Overall Evaluation and Recommendations

Overall Evaluation

This Fire Services Master Plan, based on the *CFAI Standards of Cover 5th Edition,* required the completion of an intensive analysis on all aspects of the KFD deployment and staffing practices. The analysis used various tools to review workload, historical performance, evaluate risk, and validate response and non-response service performance. The analysis relied on the experience of staff officers and their historical perspective combined with historical incident data captured by both the dispatch center and the department's in-house records management system.

The Description of Community Served section provided a general overview of the organization, including governance, lines of authority, finance, and capital and human resources, as well as an overview of the service area including population and geography served. The Review of Services Provided section detailed a brief overview of the core services the organization provides based on general resource/asset capability and basic staffing complements.

An overview of community risk was provided to describe the risks KFD is charged with protecting. Geospatial characteristics, topographic and weather risks, transportation network risks, physical assets, and critical infrastructure were reviewed. As a factor of risk, community populations and demographics are evaluated against historic and projected service demand. Population and service demand, over the past decade, has increased.

Evaluating risk using advanced geographic information systems (GIS) provided an increased understanding of community risk factors, which can lead to an improved deployment policy.

During the analysis of service level objectives, critical tasking assignments were completed for incident types ranging from a basic medical emergency to a high risk structure fire. Critical tasking required a review of on-scene staffing capability to mitigate the effects of an emergency. These tasks ultimately determine the resource allocation necessary to achieve a successful operation. The results of the analysis indicate that a moderate risk structure fire required 15 personnel, including command and assistants.

The Review of Historical System Performance evaluated each component of the emergency incident sequence. Total response time included a number of components such as call processing, turnout, and travel. Beyond the response time of the initial arriving units, the additional components of concentration and effective response force, reliability, call concurrency, and resource drawdown were evaluated.

Based on the analysis and considering community expectations, recommendations are offered to improve the delivery of fire and emergency services to the City of Kirkland. It is not expected that all will be implemented in the short-term. Some may wait until economic conditions allow their implementation. However, all the recommendations offered chart a course to improved capability and service.

Recommendations

During the course of this study a number of issues, concerns, and opportunities were identified. The following recommendations are intended to accomplish three primary objectives:

1. Define clearly the expected level of performance provided by KFD.
2. Improve service delivery with no or minimal expenditure of funds.
3. Identify service level improvement opportunities that can be implemented as funding becomes available.

The recommendations are described as improvement goals and should be implemented as funding allows. Each will improve KFD's ability to provide effective service to the community.

Improvement Goal A: Adopt New Response Performance Goals

A community's desired level of service is a uniquely individual decision. No two communities are exactly alike. Performance goals must be tailored to match community expectations, community conditions, and the ability to pay for the resources necessary to attain the desired level of service.

Levels of service and resource allocation decisions are the responsibility of the community's elected officials, in this case the Kirkland City Council. The policy making body must carefully balance the needs and expectations of its citizenry when deciding how much money to allocate to all of the services each provides.

The City of Kirkland has adopted response performance goals for its fire department. They are aggressive, in some cases more so than the guidance provided by National Fire Protection Association Standard 1710. An alignment of the city's goals with national guidance is suggested.

With this in mind the following are recommended as KFD's fire and life safety response performance goals. These are not levels of service that must be achieved immediately but, instead, are targets for achievement when resources are available to do so.

Call-Processing Performance Goal

Call processing time is the first phase of overall response time. Though much information must be gathered to properly identify the resources needed to respond to the emergency, keeping this time as short as possible has a direct impact on response time. The City of Kirkland has not adopted a goal for call processing time.

Although National Fire Protection Association Standard 1221 recommends a call be processed and dispatched within 60 seconds 80 percent of the time, the recommended performance goal sets a higher standard at 90 percent.

Recommended Call Processing Goal:

Response resources shall be notified of a priority incident within 60 seconds of receipt of the call at the dispatch center, 90 percent of the time.

- Current performance – Within 60 seconds, 83 percent of the time

Turnout Time Performance Goal

Turnout time is one area over which the fire department has total control and is not affected by outside influences. Turnout time, or the time between when the call is received by the response units (dispatched) and when the unit is actually en route to the scene (responding), can have dramatic effects on overall response times. Reducing this response time component reduces total response time.

National Fire Protection Association Standard 1710 recommends turnout time performance of 80 seconds or less, 90 percent of the time for fire response and 60 seconds or less, 90 percent of the time for all other priority responses. This extra 20 seconds for a fire response recognizes the time required to don protective clothing. KFD is not meeting the turnout time recommended in the national standard for either fires or other incidents. The City of Kirkland's current goal is within 60 seconds, 90 percent of the time. Given that turnout time is one area in which field personnel can improve overall response time, an aggressive objective is recommended.

Recommended Turnout Goal:

Response personnel shall assemble on apparatus and initiate movement towards a priority emergency within 80 seconds of notification by the dispatch, 90 percent of the time for incidents requiring full personal protective equipment and within 60 seconds from notification by the dispatch center, 90 percent of the time for all other incidents.

- Current performance for incidents requiring personal protective equipment – Within 80 seconds, 49 percent of the time
- Current performance for incidents not requiring personal protective equipment – Within 60 seconds, 38 percent of the time

Total Response Time for the First-due Unit

The time required to deliver the first response unit capable of intervening in the emergency includes call processing time, turnout time and travel time. Travel time is normally the longest phase of this response interval.

National Fire Protection Association Standard 1710 recommends four minute travel times for the first arriving response unit. The city's current goals call for either a three minute 0 second travel time for EMS incidents or a three minute 30 second travel time for fire incidents. Currently, travel time for all incidents is within five minutes 19 second, 90 percent of the time.

Like turnout time, there are two recommended goals for this performance measure.

Recommended Response Time Goals:

- **Total Response time of the first arriving response unit at a priority fire incident**
  The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within six minutes 20 seconds (6:20) from receipt of the call at the dispatch center, 90 percent of the time.
    - Current performance – Within six minutes 20 seconds, 62 percent of the time

- **Total Response time for arrival of the first response unit at a priority emergency medical incident**
  The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within six minutes 0 seconds (6:00) from receipt of the call at the dispatch center 90 percent of the time.
    - Current performance – Within six minutes 0 seconds, 74 percent of the time

Concentration Performance Goal

A fire department's *concentration* is the spacing of multiple resources close enough together so that an initial "Effective Response Force" (ERF) for a given risk can be assembled on the scene of an emergency within the specific time frame identified in the community's performance goals for that risk type. An initial effective response force is defined as that which will be most likely to stop the escalation of the emergency.

The ERF for high risk structure fires in Kirkland is identified as the arrival of at least four fire engines, two ladder trucks, an aid unit, and two battalion chiefs (20 firefighters total). For moderate risk structure fires it is three fire engines, one ladder truck, one battalion chief and one aid unit (15 firefighters total). This initial ERF does not necessarily represent the entire alarm assignment, as additional units may be assigned based on long-term incident needs and risks. Additional engines, ladders, or other specialty companies are assigned to higher risk responses in order to accomplish additional critical tasks that are necessary beyond the initial attack and containment. Current performance to deliver resources required for moderate risk structure fires is within 13 minutes 0 seconds, 90 percent of the time. Current performance to deliver resources required for high risk structure fires is within 16 minutes three seconds, 90 percent of the time.

Recommended Concentration Goal:

- For moderate risk incidents, KFD shall assemble an effective response force (ERF), consisting of personnel sufficient to effectively mitigate the incident based on risk, within ten minutes 20 seconds from receipt of the call at the dispatch center, 90 percent of the time.
    - Current performance – Within ten minutes 20 seconds, 41 percent of the time

- For high risk incidents, KFD shall assemble an effective response force (ERF), consisting of personnel sufficient to effectively mitigate the incident based on risk, within ten minutes 20 seconds from receipt of the call at the dispatch center, 90 percent of the time.
    - Current performance – Within ten minutes 20 seconds, zero percent of the time

The following figure summarizes the current and recommended response performance goals.

Figure 82: Current and Recommended Response Performance Goals

Performance Goal	KFD Current Goal	Recommended Goal
Dispatch Performance Goal: *Response resources shall be notified of a priority emergency within X seconds of receipt of the call at the dispatch center, 90 percent of the time.*	60 seconds	60 seconds
Turnout Time Performance Goal: *Response personnel shall assemble on apparatus and initiate movement towards a priority emergency within X seconds of notification by the dispatch center, 90 percent of the time.*	60 seconds for all incidents	80 seconds for all incidents requiring personal protective equipment 60 seconds for all others
First-Due Total Response Time Performance Goal – Fire: *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within X minutes Y seconds **from receipt of call at the dispatch center**, 90 percent of the time.*	5 minutes 30 seconds (allows 3:30 for travel time)	6 minutes 20 seconds
First-Due Total Response Time Performance Goal – EMS: *The first response unit capable of initiating effective incident intervention shall arrive at a priority emergency within X minutes Y seconds **from receipt of the call at the dispatch center**, 90 percent of the time.*	5 minutes 0 seconds (allows 3:00 for travel time)	6 minutes 0 seconds
Concentration Performance Goal: *For moderate risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within X minutes **from receipt of the call at the dispatch center**, 90 percent of the time.*	10 minutes (allows 8 minutes for travel time)	10 minutes 20 seconds
*For high risk incidents, KFD shall assemble an Effective Response Force (ERF) consisting of personnel sufficient to effectively mitigate the incident based on risk within X minutes **from receipt of the call at the dispatch center**, 90 percent of the time.*	10 minutes (allows 8 minutes for travel time)	10 minutes 20 seconds

The following figures list KFD's recommended performance goals and those of other agencies within the region. It also lists the degree to which each agency is meeting their goals. If no information is listed it means either the agency has not adopted a goal or information is not available about its degree of accomplishment.

Figure 83: Current or Recommended Response Performance Goals

Response Performance Goals at 90th Percentile										
Department	**Call Processing Time**	**Turnout Time - Fire**	**Turnout Time - EMS**	**Travel Time**	**Response Time - Fire**	**Response Time - EMS**	**Received to Arrival Time - Fire**	**Received to Arrival Time - EMS**	**Effective Response Force - Moderate Risk**	**Effective Response Force - High Risk**
Kirkland	60 sec	60 sec	80 sec	4 min	5 min 20 sec	5 min 0 sec	6 min 20 sec	6 min	10 min 20 sec	10 min 20 sec
Bellevue	60 sec	60 sec		4 min	5 min	5 min	6 min	6 min		
Seattle	60 sec	60 sec		4 min	5 min	5 min	6 min	6 min		
Northshore	60 sec	120 sec			6 min	6 min	NA	NA	14 minutes	
Redmond Suburban	90 sec	120 sec			8 min	8 min	9 min 30 sec	9 min 30 sec		
Redmond Rural	90 sec	120 sec			12 min	12 min	13 min 30 sec	13 min 30 sec		
Bothell							8 min	7 min 15 sec		

Figure 84: Current Performance

Percentage of Responses Meeting Goal										
Department	**Call Processing Time**	**Turnout Time - Fire**	**Turnout Time - EMS**	**Travel Time**	**Response Time - Fire**	**Response Time - EMS**	**Received to Arrival Time - Fire**	**Received to Arrival Time - EMS**	**Effective Response Force - Moderate Risk**	**Effective Response Force - High Risk**
Kirkland	83 percent	49 percent	38 percent	75 percent	62 percent	69 percent	62 percent	74 percent	41 percent	0 percent
Bellevue					60 percent	69 percent	74 percent	74 percent		
Seattle	50 percent	45 percent		83 percent			83 percent	85 percent		
Northshore		87 percent			66 percent	77 percent	NA	NA	100 percent	
Redmond Suburban										
Redmond Rural										
Bothell							9 min 21 sec 90%	7 min 26 sec 90%		

Improvement Goal B: Reduce Call Processing Time

NORCOM, Kirkland's dispatch center, is performing relatively well by notifying response personnel of an incident within 60 seconds, 83 percent of the time. However, this can be improved. High performance dispatch centers elsewhere are able to receive and process a call and notify response personnel as quickly as 45 seconds, 90 percent of the time. A review of procedures at NORCOM is recommended.

NORCOM already has much of the technology needed to produce quick call processing times. It has automatic phone number and address identification. It has computer-voice dispatch that allows quick notification of response personnel even while the call taker is gathering additional information.

A review of procedures to ensure that early notification of responders is occurring as soon as possible, including both KFD and Medic One, is recommended. As was noted earlier in this report, only 50 percent of Medic One dispatches occurred within one minute of KFD dispatches. 50 percent took longer.

Improvement Goal C: Reduce Turnout Time

The recommended turnout time goal is within 60 seconds, 90 percent of the time, to initiate response for emergency responses not requiring full personal protective equipment (PPE) and within 80 seconds, 90 percent of the time for those incidents requiring full PPE. This is the time period between when dispatchers notify response personnel of the incident and when response crews begin travel towards the incident location. KFD's current turnout time performance is much longer.

Like call processing time, shortening the time required for this phase of the response also reduces overall response time. Though certain technology and other physical modifications can help, rapid turnout time is largely a function of response crew performance.

KFD should review fire station configuration to determine if there are obstacles to rapid turnout. Solutions could include adding doors between rooms, rearranging furnishings, and adding dispatch alerting system speakers to improve audibility.

KFD should acquire technology that will support rapid turnout time. This can include in-vehicle routing information so that directions to the incident are immediately available.

Response personnel performance must also be addressed. Fire department management should regularly prepare information that describes current turnout time performance by individual response crews. Performance expectations should be reinforced and periodic monitoring conducted to determine if improvements are being made and sustained.

Improvement Goal D: Reduce Travel Time

Travel time is typically the longest of the response phases. It is influenced by a variety of factors including street connectivity, traffic, and road design. Response unit workload is also a factor in that if a response unit is not close to a request for service, travel time is extended. The busier a response system the more likely travel times will be longer.

Improve Street Connectivity

Lack of street connectivity can cause a response unit to travel greater distances in order to reach an emergency. Well-gridded interconnected street systems provide faster travel times than those with numerous dead-end and meandering streets.

Kirkland, for the most part, is served by interconnected streets. There are exceptions. Interstate 405 presents a significant barrier to east-west travel.

The 100th Street pedestrian bridge represents an innovative approach to improving emergency response. This bridge was designed to carry the weight of fire apparatus and is used routinely for emergency response. Its existence provides neighborhoods to the west of Interstate 405 much quicker response than would otherwise be possible.

Other similar opportunities include:

- Completion of NE 132nd Street between Juanita Drive NE and 76th Avenue NE.
- Construct a connection on NE 132nd Street between 72 Avenue NE and NE 130th Place.
- Completion of NE 124th Street between 88th Place NE and 93 Place NE.
- Completion of NE 100th Street between 111th Avenue NE and 6th Street.
- Construct a connection between Forbes Creek Drive and 111th Avenue NE.
- Construct a connection between the switchback on Goat Hill located at NE 116th Place and NE 117th Place and 86th Avenue NE.
- Remove several of the barricades located on Finn Hill.
- Review the speed humps and roundabouts placed in the Norkirk neighborhood.

These road segments, if completed, would significantly improve response times to the neighborhoods west and east of the uncompleted street sections.

Relocate Two Fire Stations; Staff Station 24 with Full-time Personnel

Fire Station 24 is staffed by volunteers only during nighttime hours. This facility is too small to house modern fire engines. Its accommodations for 24-hour personnel are limited at best. It is also located at the far north end of the city. A great deal of its response capability lies outside the city.

Fire Station 27 is well located to serve a very busy area but is on the west side of Interstate 405. Only one Kirkland fire station lies on the freeway's east side.

Relocating both stations and staffing Station 24 with full-time personnel would improve service to Kirkland. The following locations are recommended:

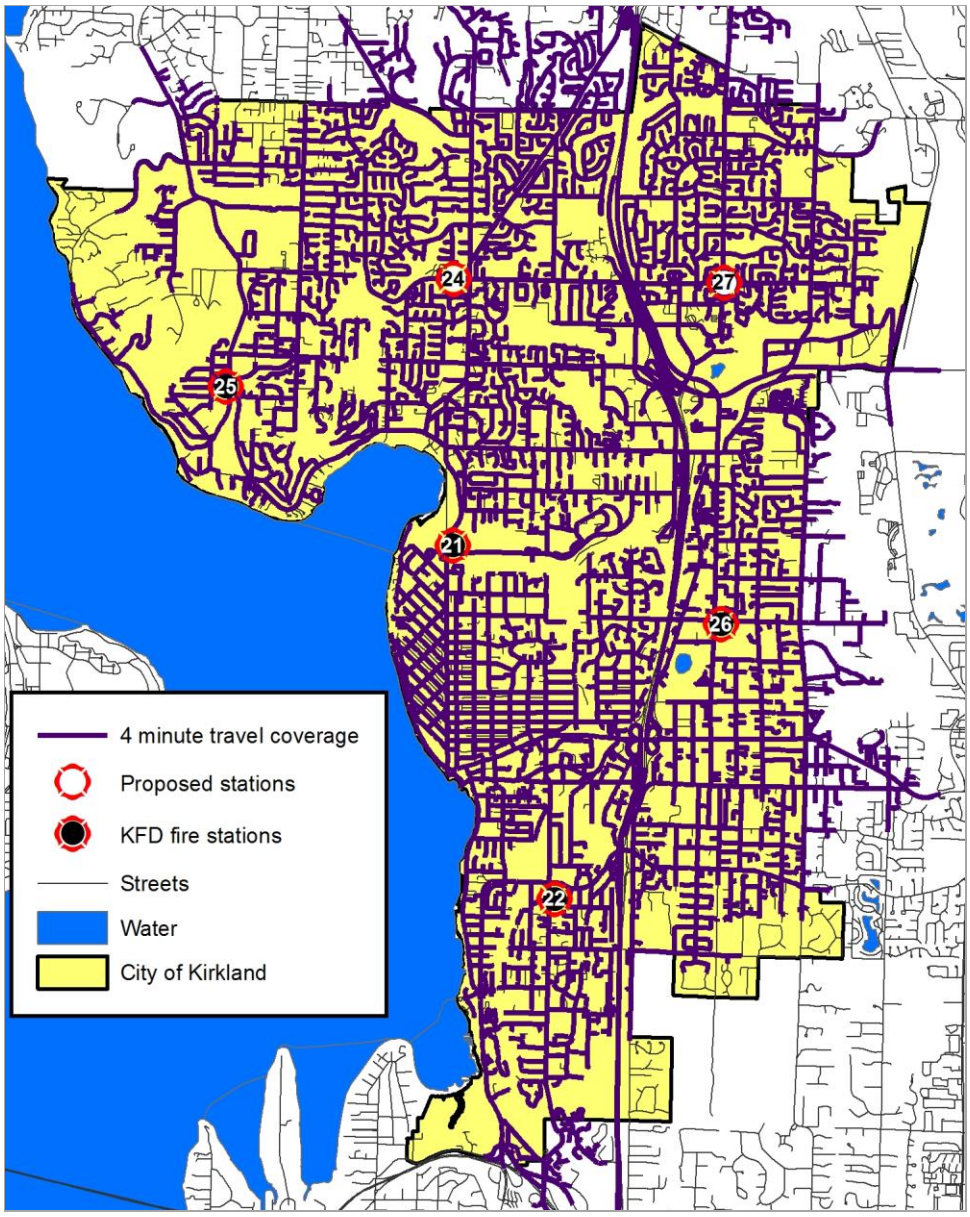
- Station 24 – NE 132nd Street and 98th Avenue NE
- Station 27 – NE 132nd Street and 124th Avenue NE

Moving Station 24 places most of its service capability within Kirkland. It also moves it closer to an area of greater incident density. Moving Station 27 keeps it in an area of great incident density and provides an additional fire station on the east side of the freeway.

Fire Station 24 should be staffed with full-time personnel and equipped with one fire engine and one aid car. This will help reduce the workload on Station 27 response resources, already operating at combined average unit hour utilization over 0.10. The population of the northern portion of Kirkland is expected to grow at a faster pace than the southern portion. Additional response resources will be needed to serve this growing population.

The following figure illustrates four minute travel coverage provided if these two stations are relocated and Station 24 is staffed with full time personnel.

Figure 85: Proposed Station Relocations and Four Minute Travel Coverage



Staff All Fire Engines with Four Personnel

Response personnel from each of the five fire engines and one ladder truck also staff an aid car. The aid car is used for emergency medical incidents and the fire engine or ladder truck for all other incidents. Given KFD's role as first responder and BLS patient transportation provider in the emergency medical system this is an appropriate and efficient operating practice.

When personnel respond to an emergency medical incident with the aid car, the fire engine or ladder truck is unavailable for a subsequent emergency. Adding one additional firefighter to each engine would

allow it to remain in service for the next emergency. Though it would not have the operational capability of a three or four person staffed engine on a fire incident, it would have full capability to respond to another emergency medical incident or other minor request for service.

Implementation of this recommendation would add five additional firefighters per shift based on current staffing. The response system will benefit by nearly doubling the number of available response units from six to eleven. This is possible because engines will remain in service even when its associated aid car is dispatched to a medical emergency.

Staffing the ladder truck with four personnel does not provide the same benefit. Because of its configuration, no less than three firefighters must operate the ladder truck.

Currently, 4.8 full-time equivalent personnel (FTE) are required to staff one 24-hour position. To fully implement this recommendation an additional 24 FTE would be needed. This recommendation can be phased in over time as funding is available. Station 22 should be the first to gain the additional staffing because of its distance from other stations and service area workload. Engine 27 should be the next unit to receive increased staffing and then Stations 26, 25, and 24 (when staffed).

Improvement Goal E: Improve the Quality of Emergency Medical Services

Emergency medical care is the service most requested of KFD by the community. In total numbers of requests it far exceeds any other type of request for service. The current system utilizes KFD resources for first response and basic life support care and the King County Medic One system for advanced life support care as needed.

In the Review of Historic Response Performance section of this report, it was noted that KFD arrives at an emergency medical incident first the vast majority of the time and by a significant time margin (seven minutes 16 seconds, 90 percent of the time). It was also noted that this is primarily caused by a delay in dispatching a Medic One advanced life support unit. More than 50 percent of the time the Medic One unit was dispatched more than one minute after the dispatch of the KFD unit.

First, KFD, NORCOM, and Medic One should review dispatch procedures to determine if Medic unit dispatch can be completed much more quickly than is currently the case. The review should identify if

delaying the dispatch of advanced life support care to complete the call triage process is justified as compared to delivering advanced care more quickly. While it is reasonable to not want to overuse this scarce resource, the patient's quality of care interests should be the primary consideration.

Next, KFD should consider upgrading its level of care to advanced life support. Staffing each response unit with a paramedic and the necessary equipment, supplies, and medications should be explored. Doing so will provide advanced life support care to the patient far more quickly than is the case now.

Along with the benefit to individual requests for emergency medical service, upgrading KFD units to advanced life support care also provides improved capability during mass casualty and disaster level events.

Improvement Goal F: Improve Water-based Fire and Rescue Capability

The City of Kirkland has service responsibility for approximately eight miles of the Lake Washington shoreline. This area is well-developed with homes, large buildings, and dock facilities. Large boats are moored along the shoreline. Several buildings on wooden piers are built over the water. Fire in the support structure of these buildings requires water-based firefighting capability. The city recently began issuing permits allowing businesses to rent kayaks, paddle boards and jet skis from three city parks.

KFD does not have water based rescue or firefighting capability. It relies exclusively on outside agencies for rescues that cannot be accomplished from shore.

The city has a contract with King County Sheriff's Office Marine Patrol (KCSO) for water rescue and water-based policing. KCSO staffs their boats by calling personnel in from patrol duty or from home. This contributes to a delay in response. KCSO has a larger boat moored at Carrillon Point, at the city's southern most shoreline. This boat has limited firefighting capability, not sufficient for the water based risks present along the city's waterfront or for larger vessel fires.

The closest fire boat is operated by the Seattle Fire Department and is based in Lake Union. Though close enough to provide support, this resource is too far away to provide effective initial response to a water-based fire or rescue incident.

KFD responds regularly to water based incidents. The following figure illustrates water based responses for the past six years. "Commandeered boats" means KFD used a boat owned by a private party to affect the water based response.

Figure 86: Water Based Incidents, 2009 – 2014

Incident Type	2009	2010	2011	2012	2013	2014
Water Rescue Responses	17	15	23	27	32	13
Fatalities	4	5	3	6	5	3
Boat fires	3	4	3	14	4	2
Sinking boats	13	9	7	17	12	3
Hazardous spill	16	11	9	5	14	7
Commandeered boats	3	4	1	5	6	6

KFD experiences numerous water based incidents each year. The numbers of incidents will likely increase over time as public aquatic recreation increases, such as the new opportunity to rent paddle boards, kayaks and jet skis. Existing resources are not adequate to provide effective and prompt response throughout the entire year. KFD should consider adding water-based fire and rescue capability. A thorough review of risk should be completed to determine the size and capability of a fire and rescue boat. This would include a review of expected firefighting water delivery demand, potential water rescue needs, and others. Adding a fire and rescue boat will also require personnel receive specialized training in its operation.

Improvement Goal G: Improve Community Fire Risk Mitigation

National model building and fire codes have recognized the value of automatic fire suppression equipment (fire sprinklers). Model codes now require fire sprinklers be installed in all residential occupancies including single family and multi-family dwellings.

In Washington, new multi-family dwellings are required to install fire sprinkler systems. However, those same building codes do not require fire sprinkler installation in single family homes. There is a process by which local jurisdictions can create the authority to add this important fire safety provision to its local building requirements.

Fire sprinkler technology has improved considerably over the years. The cost of installation in many communities has decreased to as little as $0.60 per square foot and is typically around $1.30 to $1.60

per square foot. At the high cost, a 2,000 square foot home can be protected with fire sprinklers for around $3,200.

Residential fire sprinklers have an excellent track record nationally. A 15-year study completed in Scottsdale, Arizona, a community that has required fire sprinklers in homes before that time, proves the value. Fire losses have decreased dramatically and fire fatalities have been virtually eliminated. The only fatalities reported were people "intimate to the fire" (i.e. the initial material ignited was the clothing being worn by the person).

Residential fire sprinklers are a relatively simple technology. It takes only a small amount of training to understand how to design the system and install it. Licensed plumbers already understand the requirements for potable water connections and pipe installation. Other communities have had success training plumbers to do residential fire sprinkler design and installation. KFD should consider providing training to local plumbing contractors on the design and installation of residential fire sprinklers. Increasing the number of installers increases competition and reduces prices.

Improvement Goal H – Improve Effective Response Force Capability

There are two recommended response performance goals for the delivery of the full effective response force; one for moderate risk structure fires and one for high risk structure fires. Both goals recommend the same time standard; within nine minutes 20 seconds, 90 percent of the time.

Achieving the moderate risk structure fire effective response force goal can be accomplished if many of the previous recommendations in this report are implemented. Achieving this level of performance for high risk structure fires is not possible without additional resources.

As discussed previously, a moderate risk fire requires three fire engines, one ladder truck, and one battalion chief for a total of 15 firefighters. Current and recommended distribution of resources, as well as other improvement initiatives, will be sufficient to achieve the nine minute 20 second goal 90 percent of the time. A high risk structure fire, however, requires four fire engines, two ladder trucks, and two battalion chiefs (a total of 20 personnel) to deliver sufficient personnel and apparatus to initiate effective fire suppression operations. Even with full implementation of all improvement goals listed

previously, delivery of the full effective response force for a high risk structure fire will not be possible within nine minutes 20 seconds, 90 percent of the time.

To achieve this goal, two additional ladder trucks and two additional battalion chiefs would need to be deployed within the City of Kirkland. This is necessary in order to ensure that enough engines, ladder trucks, and battalion chiefs are available within eight minutes travel to nearly the entire city. The significant cost for these additional resources is well recognized. The Kirkland City Council will need to determine if and when this cost can be incurred. Alternatively, the City Council can decide to adopt a longer response performance goal for high risk structure fires.

If adopting a longer goal is the choice, the following response performance goal is recommended. It is achievable with current resources along with those recommended earlier in this report.

- For high risk incidents, KFD shall assemble an effective response force (ERF), consisting of personnel sufficient to effectively mitigate the incident based on risk, within 14 minutes 20 seconds from notification of response personnel, 90 percent of the time.

Component J – Appendices, Exhibits, and Attachments

Appendix A – Kirkland Fire Department Compared to Others

The following figures provide a comparison of KFD to other fire service agencies serving similar populations. Comparable information is derived from several sources including the National Fire Protection Association and the U. S. Census Bureau. Regional data includes fire agencies from the states of Alaska, Arizona, Washington, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Figure 87: Comparison of Career Firefighters per 1,000 Population

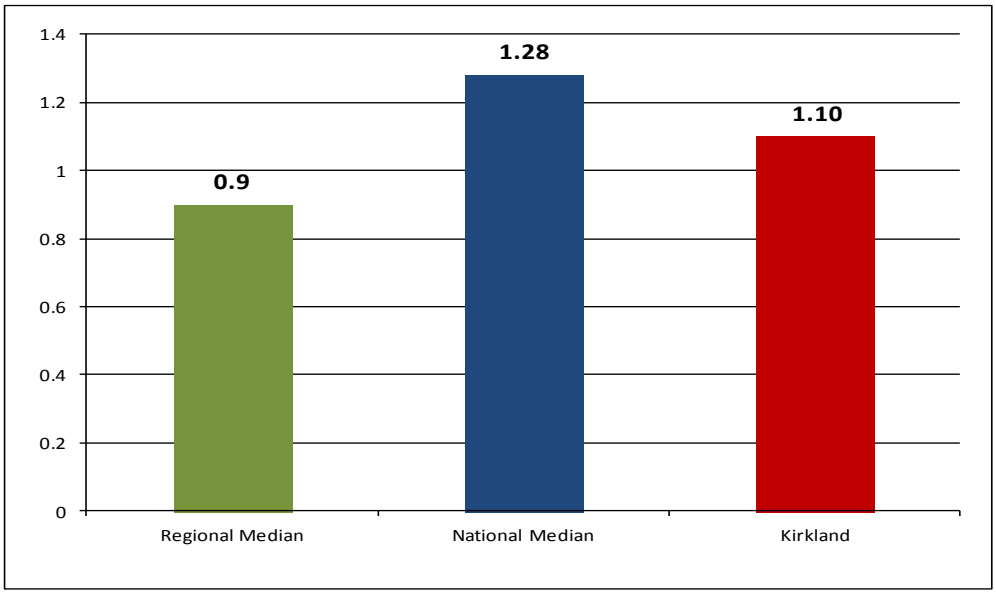


Figure 88: Local Comparison of Fire Agencies

Fire Department	Population Served	2013 Fire Budget	FTE's	Line Fire Fighters	FTE's Per 1,000 Population
City of Redmond, WA*	78,840	$20,150,000	128	109	1.62
City of Bellevue, WA	150,420	$30,838,083	190	159	1.26
City of Kirkland, WA	**81,730**	**$18,640,241**	**104**	**90**	**1.27**
City of Renton, WA*	121,812	$24,293,143	156	130	1.28
City of Everett, WA	104,200	$19,890,180	143	117	1.37

Figures provided do not include ALS funding or staffing of firefighter/paramedics on Medic One ambulances.
* Includes fire district territory served by the city.

Figure 89: Comparison of Stations and Apparatus

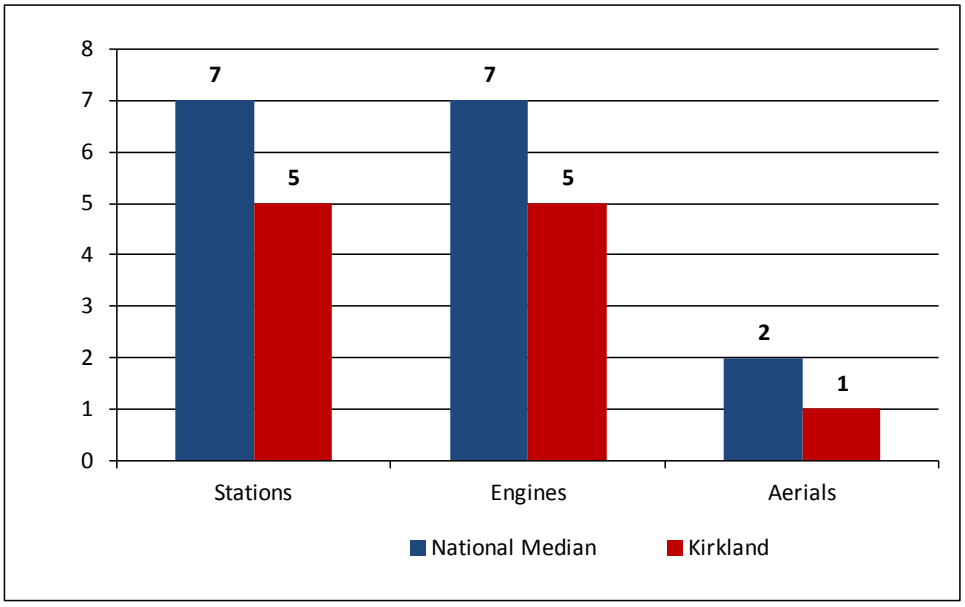


Figure 90: Comparison of Incidents per 1,000 Population

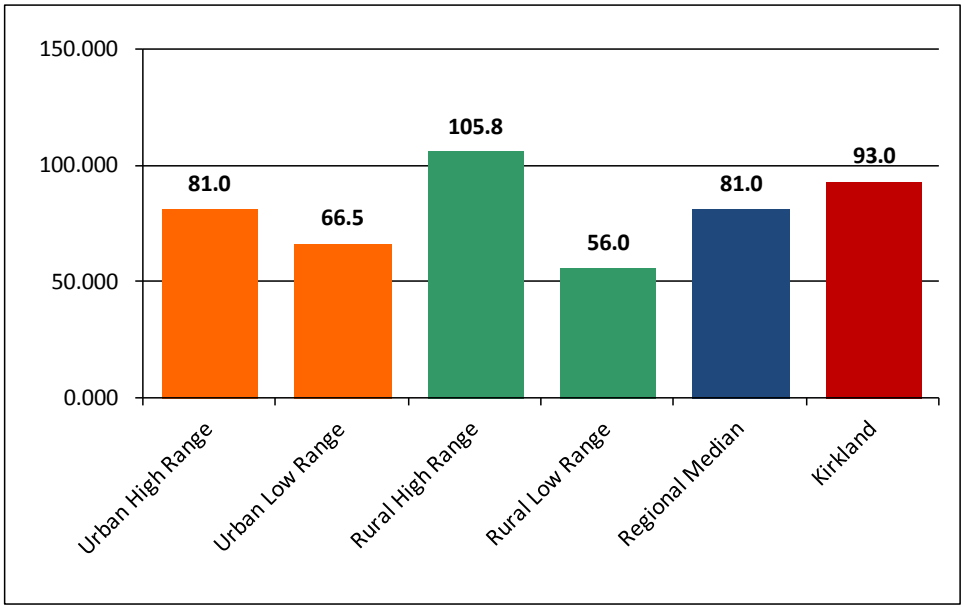
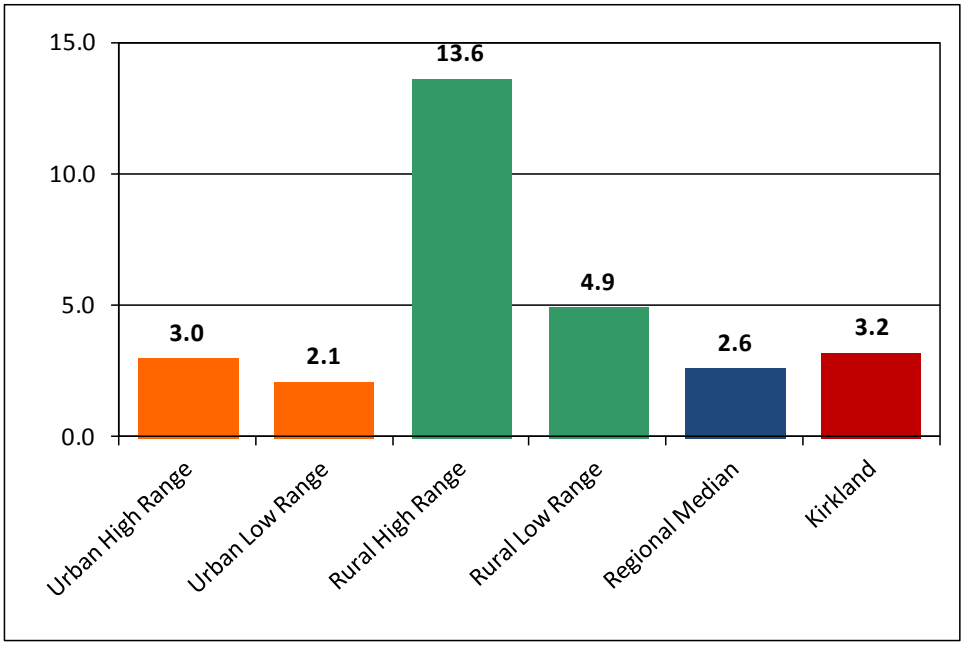


Figure 91: Comparison of Fires per 1,000 Population



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