March 2019

Appendix A
Data Analysis and GIS Report

Rochester Fire Department
Rochester, New York

Prepared by:

FITCH & ASSOCIATES, LLC
2901 Williamsburg Terrace #G ▪ Platte City ▪ Missouri ▪ 64079
816.431.2600 ▪ www.fitchassoc.com

CONSULTANT REPORT

February 2019

Data Analysis

Rochester Fire Department
Rochester, New York

Prepared by:

FITCH & ASSOCIATES, LLC
2901 Williamsburg Terrace #G ▪ Platte City ▪ Missouri ▪ 64079
816.431.2600 ▪ www.fitchassoc.com

CONSULTANT REPORT

ROCHESTER FIRE DEPARTMENT
DATA ANALYSIS

TABLE of CONTENTS

METHODOLOGY

We collected four full years of Rochester Fire Department (RFD) CAD call-level data spanning January 1, 2014 to December 31, 2017, five full years of RFD unit-level data spanning January 1, 2013 to December 31, 2017, and one full year of AMR data spanning January 1, 2017 to December 3, 2017. All reporting periods were based on the calendar year, from January 1 to December 31. As such, we present four to five full reporting periods of RFD baseline workload and response time performance data, where applicable, in the last section of this report; AMR data were used only to represent one year of performance time metrics for comparison purposes.

We utilize two distinct measures in this report—call volume and workload. Number of requests for service are defined as "incidents" or "calls" (i.e., call volume). Call volume reflects the number of times a distinct incident was created involving one or more RFD units, or calls received in RFD's jurisdiction. Calls were categorized by RFD as EMS, Fire, Hazmat, or Rescue using the "EventTypeDescription" field from the CAD data files. "Responses" are the number of times that an individual unit (or units) responded to a call (i.e., workload).

Audits of the data files were first conducted to identify any anomalies for attention and reconciliation prior to data analysis (see Table 51 through Table 53 in the Appendix for RFD data audit details). No exclusion criteria were applied prior to the identification of unique incidents to reflect call volume, or prior to the identification of unique responses to reflect unit workload. Exclusion criteria were applied prior to the analysis of busy and performance time metrics (e.g., dispatch time; turnout time). All entries with one or more times outside of the logical temporal sequence of events (e.g., reported unit enroute date and time was earlier than reported unit dispatch date and time) were excluded (Table 53). Entries with performance times of 0 minutes, and entries with extremely high performance times (e.g., > 12 hours or > 24 hours) that indicated possible data entry errors in year, month, day, or AM/PM assignment were also excluded. The application of these exclusion criteria for busy and performance time data resulted in slight reductions of call and response volume for each reporting period; these adjusted sample sizes are noted in the report where applicable.

Responses were classified by RFD based on call status and the role of the responding unit. Call status as emergency or non-emergency was assigned per call type by RFD and was based on "EventTypeDescription" from the CAD data files. Units identified by RFD as primary front-line units included all departmental units except for the admin on-call vehicles, Car 1 and Car 2. The majority of analyses related to performance (e.g., travel time) were restricted based on these classifications to include only primary front-line units responding to emergency (lights and sirens) calls and are identified in the report where applicable.

Any reduced sample sizes due to missing data are noted in the report where applicable. Classifications of responses into call categories and program areas appear in Table 54 in the Appendix.

COMMUNITY RESPONSE HISTORY

During the 2017 reporting period (i.e., January 1, 2017 to December 31, 2017; hereinafter referred to as 2017), RFD responded to a total of 34,886 requests for service, or incidents (Figure 1; Table 1). EMS related requests totaled 17,539, accounting for 50.3% of the total call volume, and fire related requests totaled 16,954, accounting for 48.6% of the total call volume. Of the 34,886 total incidents initiated by the community during 2017, 29 were noted as cancelled calls (i.e., "CAN" for "FoundDispositionCode1" in the CAD data file), and 31 were noted as duplicate calls (i.e., "DUP" for "FoundDispositionCode1" in the CAD data file). These calls were still considered part of the community demand and part of the department's workload, as all 60 calls had associated call dispatch and first unit enroute times, and most had first unit onscene times. Classifications of incident types from the CAD data file into program and call category are presented in Table 53 in the Appendix.

Figure 1: Percentage of Total Incidents by Program

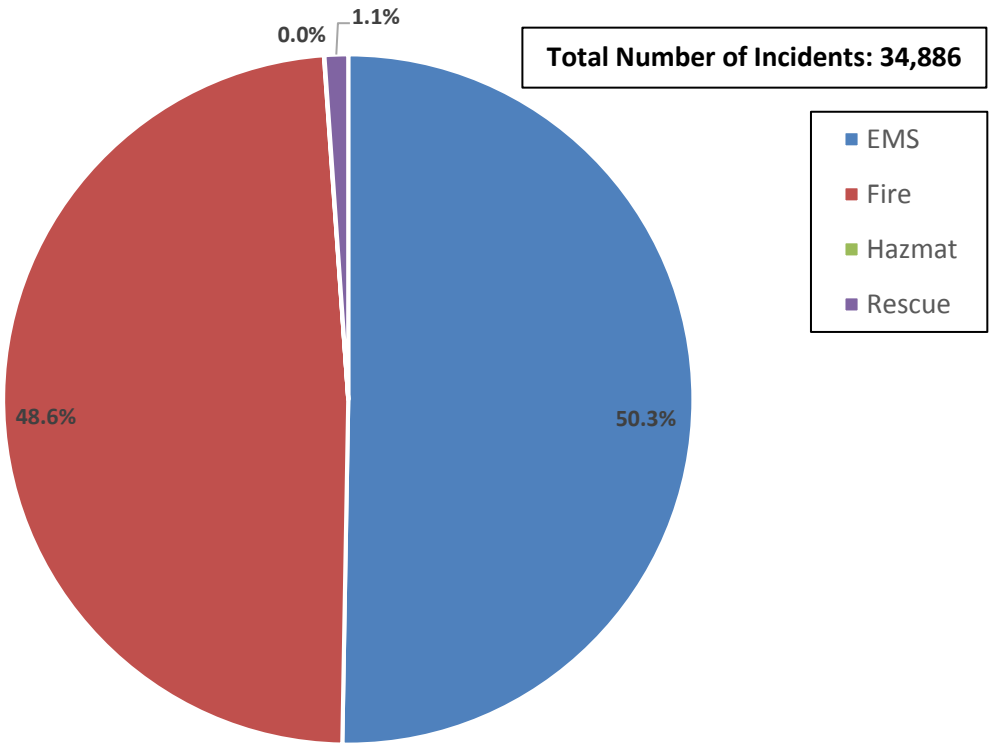


Table 1: Number of Incidents by Program and Call Category

Call Category	Number of Calls	Average Calls per Day	Call Percentage
Cardiac and Stroke	3,127	8.6	9.0
Death	1	0.0	0.0
Difficulty Breathing	4,552	12.5	13.0
Fall and Injury	1,775	4.9	5.1
Illness and Other	2,987	8.2	8.6
MVA	1,907	5.2	5.5
Overdose and Psychiatric	15	0.0	0.0
Seizure and Unconsciousness	3,175	8.7	9.1
EMS Total	**17,539**	**48.1**	**50.3**
Fire Alarm	3,909	10.7	11.2
Fire Other	11,854	32.5	34.0
Outside Fire	334	0.9	1.0
Structure Fire	581	1.6	1.7
Vehicle Fire	276	0.8	0.8
Fire Total	**16,954**	**46.4**	**48.6**
Hazmat	**8**	**0.0**	**0.0**
Rescue	**385**	**1.1**	**1.1**
Total[1]	**34,886**	**95.6**	**100.0**

[1]Entries in the CAD data file with "CAN" or "DUP" noted for the variable "FoundDispositionCode1" were as follows: "CAN" (*n*=29) and "DUP" (*n*=31).

Table 2: Average Call Type Breakdown by NFIRS Category Calendar Years 2014-2018[1]

Call Category	Q1	Q2	Q3	Q4	YR
1. Structure fire	144	161	169	159	634
2. Outside fire	82	215	238	116	652
3. Overpressure, rupture	158	158	133	173	622
4. Rescue & EMS	4,222	4,597	4,883	4,375	18,077
5. Hazardous condition	776	808	753	674	3,011
6. Service call	590	592	625	542	2,350
7. Good intent call	699	763	851	680	2,992
8. False alarm & false call	951	960	1,131	1,020	4,062
9. Severe Weather	14	8	3	6	31
10. Other	455	403	432	477	1,767
Total	**8,091**	**8,665**	**9,219**	**8,223**	**34,197**

[1]Table provided by the department and requested for inclusion here.

Combined, all RFD units made 47,218 responses, and were busy on calls (i.e., from dispatch to release time) for a total of 13,712.1 hours in 2017 (Table 3). The number of individual unit responses will also contribute to understanding total department workload, as 4,584 of 34,446 calls (13.3%) resulted in multiple RFD units responding.

Table 3: Number of Calls, Number of Responses, and Total Busy Time by Program

Program	Number of Calls[1]	Number of Responses[2]	Average Responses per Call	Responses with Time Data[3]	Total Busy Hours	Average Busy Minutes per Response	Percentage of Total Busy Hours
EMS	17,518	18,467	1.1	18,033	4,453.8	14.8	32.5
Fire	16,454	26,272	1.6	24,244	8,666.3	21.4	63.2
Hazmat	8	12	1.5	12	6.2	30.9	0.0
Rescue	383	2,321	6.1	2,241	538.4	14.4	3.9
Not Identified[4]	83	146	1.8	138	47.6	20.7	0.3
Total	**34,446**	**47,218**	**1.4**	**44,668**	**13,712.1**	**18.4**	**100.0**

[1]"Number of Calls" reflects an adjusted number of unique incidents to correspond with data provided in the unit-level data file (as opposed to data provided in the CAD data files that did not contain unit-level data, as represented in the preceding table), regardless of calculated busy time.
[2]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[3]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[4]There were 83 unique incident numbers corresponding to 146 unique responses in the unit-level data file that did not appear in the CAD data files to allow mapping of call details; all call details related to these 83 incidents are unknown.

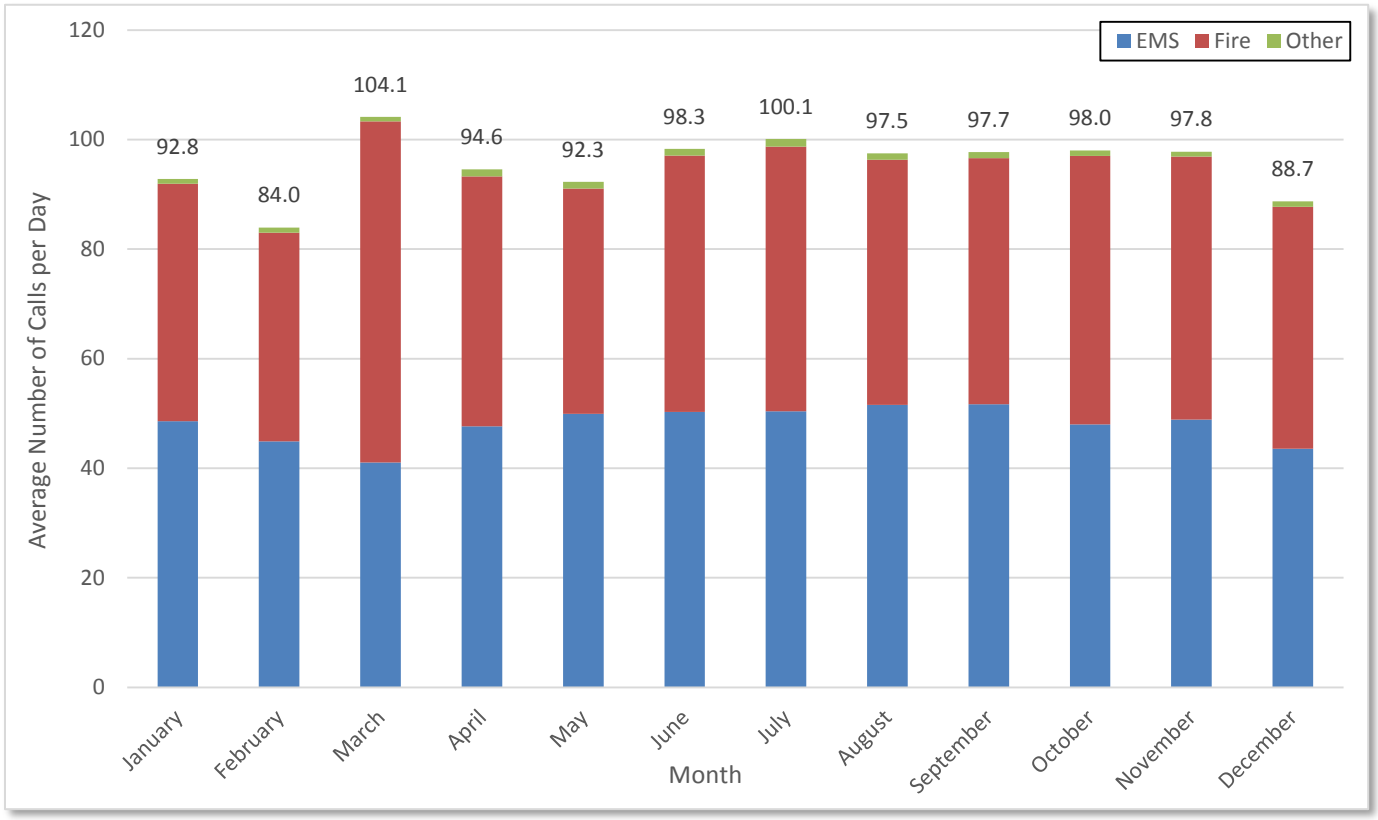
Temporal analyses were conducted to evaluate patterns in community demands. These analyses are based on the 34,886 incidents to which RFD was dispatched, and examine the frequency of requests for service by month, day of week, and hour of day. Month, day of week, and hour of day were derived from "CallReceipt" dates and times in the CAD data file, even though these dates and times are primarily equivalent to the "CallDispatched" dates and times (27,991 of 34,886 are equivalent; 80.2%), because 7,692 incidents (22.0%) were missing entries for "CallReceived" dates and times. In the following analyses, Hazmat and Rescue calls were grouped into an "Other" category for presentation purposes.

Overall, average requests per month ranged from a low of 84.0 calls per day in February to a high of 104.1 calls per day in March (Table 4; Figure 2). The three months with the most requests for service in descending order were: March (104.1 per day), July (100.1 per day), and June (98.3 per day). The three months with the fewest requests for service in ascending order were: February (84.0 per day), December (88.7 per day), and May (92.3 per day).

Table 4: Overall: Total Calls and Average Calls per Day by Month

Month	Number of Calls	Average Calls per Day	Call Percentage
January	2,878	92.8	8.2
February	2,351	84.0	6.7
March	3,228	104.1	9.3
April	2,837	94.6	8.1
May	2,861	92.3	8.2
June	2,950	98.3	8.5
July	3,104	100.1	8.9
August	3,023	97.5	8.7
September	2,931	97.7	8.4
October	3,039	98.0	8.7
November	2,934	97.8	8.4
December	2,750	88.7	7.9
Total	**34,886**	**95.6**	**100.0**

Figure 2: Overall: Average Calls per Day by Month



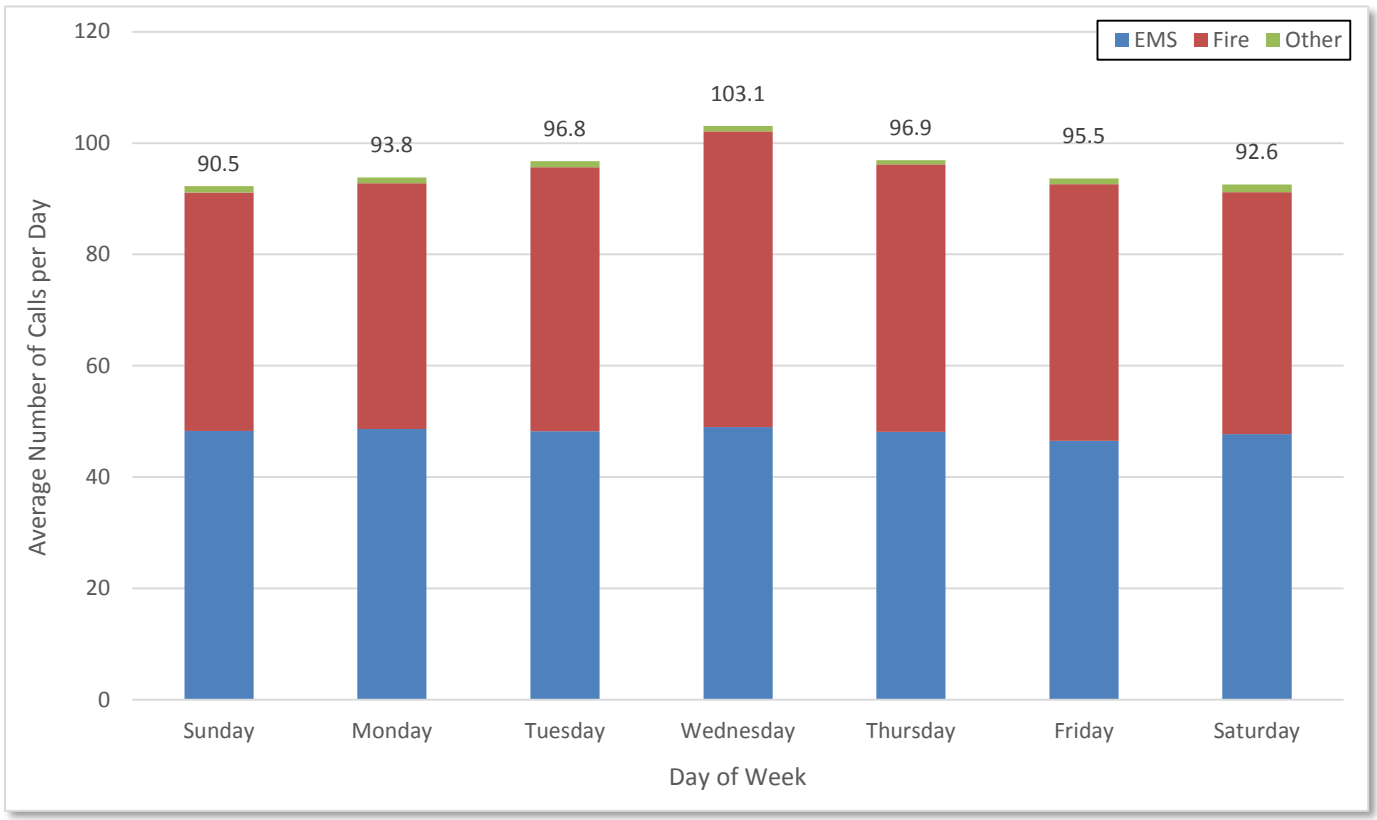
Similar analyses were conducted for requests by day of week (Table 5; Figure 3; 53 Sundays in 2017; 52 of all other days of the week). The lowest average number of calls per day occurred on Sunday (90.5 per day), and the highest average number of calls per day occurred on Wednesday (103.1 per day).

Table 5: Overall: Total Calls and Average Calls per Day by Day of Week

Month	Number of Calls	Average Calls per Day	Call Percentage
Sunday[1]	4,798	90.5	13.8
Monday	4,878	93.8	14.0
Tuesday	5,031	96.8	14.4
Wednesday	5,360	103.1	15.4
Thursday	5,041	96.9	14.4
Friday	4,965	95.5	14.2
Saturday	4,813	92.6	13.8
Total	**34,886**	**95.6**	**100.0**

[1]There were 53 Sundays during 2017, and 52 of all other days of the week during 2017.

Figure 3: Overall: Average Calls per Day by Day of Week



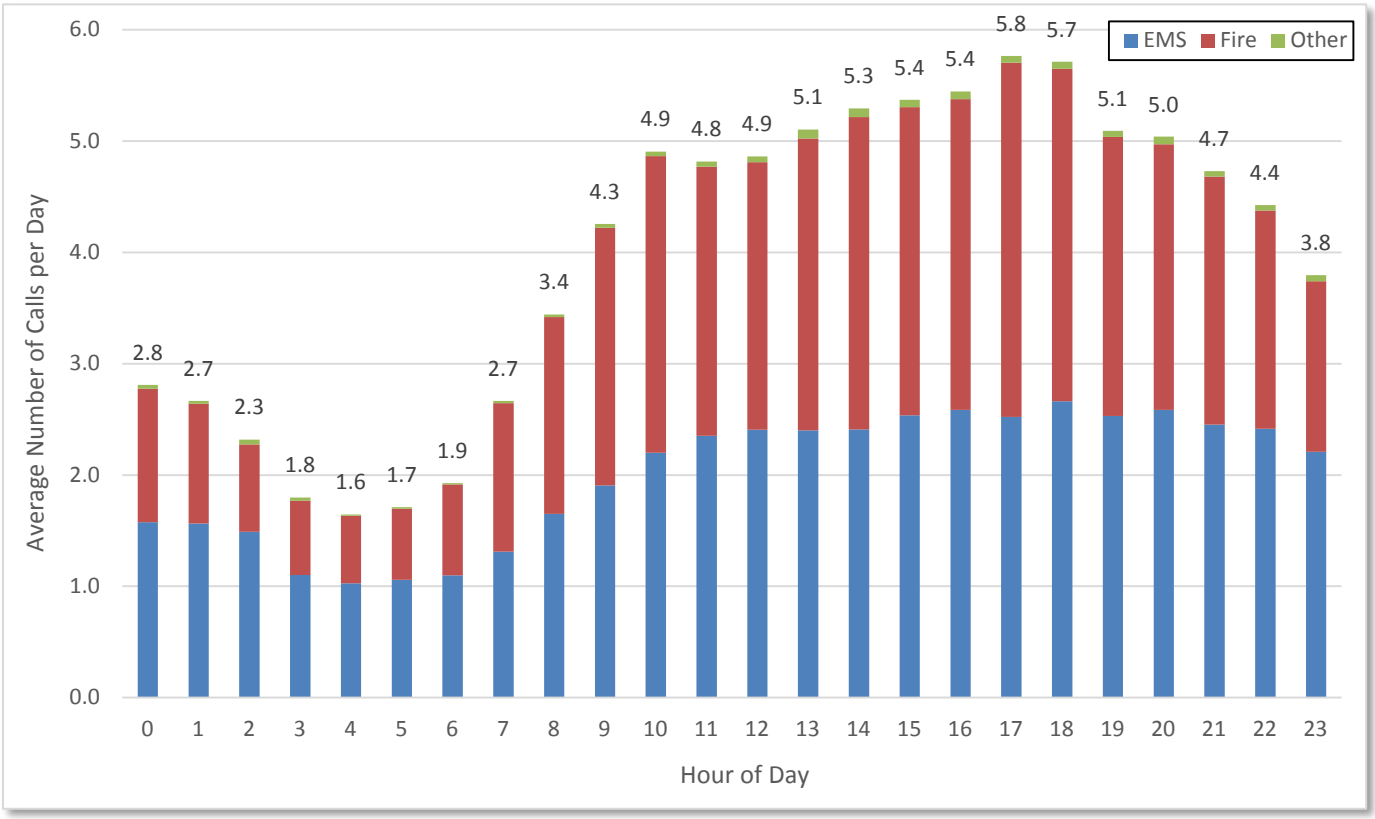
Overall demands were also evaluated by hour of day (Table 6; Figure 4). Variability exists in the time of day that requests for services were received. The hours of the day with the highest average number of calls per day (ranging from 5.0-5.8 per day) were between 1300 and 2000. Peak demand occurred at 1700 (5.8 calls per day). The hours of the day with the lowest average number of calls per day (ranging from 1.6-1.9 per day) were between 0300 and 0600.

Table 6: Overall: Total Calls and Average Calls per Day by Hour of Day

Hour of Day	Number of Calls	Average Calls per Day	Call Percentage
0	1,025	2.8	2.9
1	973	2.7	2.8
2	846	2.3	2.4
3	656	1.8	1.9
4	600	1.6	1.7
5	625	1.7	1.8
6	703	1.9	2.0
7	973	2.7	2.8
8	1,256	3.4	3.6
9	1,553	4.3	4.5
10	1,790	4.9	5.1
11	1,758	4.8	5.0
12	1,774	4.9	5.1
13	1,863	5.1	5.3
14	1,932	5.3	5.5
15	1,960	5.4	5.6
16	1,987	5.4	5.7
17	2,104	5.8	6.0
18	2,085	5.7	6.0
19	1,858	5.1	5.3
20	1,839	5.0	5.3
21	1,726	4.7	4.9
22	1,615	4.4	4.6
23	1,385	3.8	4.0
Total	**34,886**	**95.6**	**100.0**

To provide a more granular understanding of the community's demand for services, this temporal analysis included the average number of calls per hour. In other words, when referring to Figure 4 below, the busiest hour is at 1700 with 2,104 calls occurring during that hour in 2017. The average number of calls per hour is a daily average for those 2,104 calls if they were distributed equally across the year (i.e., 2,104/365 = 5.8). Therefore, the busiest hour per day would be at 1700 with an average hourly call volume at 5.8 calls per day. The second busiest hour occurred at 1800 with 2,085 calls during that hour in 2017, with an average hourly call volume of 5.7 calls per day. For ease of presentation, values displayed in Figure 4 have been rounded to one decimal place.

Figure 4: Overall: Average Calls per Day by Hour of Day



Temporal distributions related to hour of day were created for the department's 16 neighborhood fire stations to better understand each location's unique demand for services (Figure 5 through Figure 20). Physical addresses representing first due unit or company for each incident were identified using the "CarBeat1" codes in the CAD data file; each numeric code represents one or more units as a company and, thus, can be mapped to physical addresses. Figures reflect 34,769 unique incidents (99.7%), as 117 calls were either missing entries for "CarBeat1" code in the CAD data file, or had entries that did not correspond to an RFD company (i.e., numeric codes 002, 004, 013, 016, 020, 021, 025, 029, 300, 311, 312, 313).

Figure 5: Average Calls per Day by Hour of Day – 1051 Emerson Street (E3)

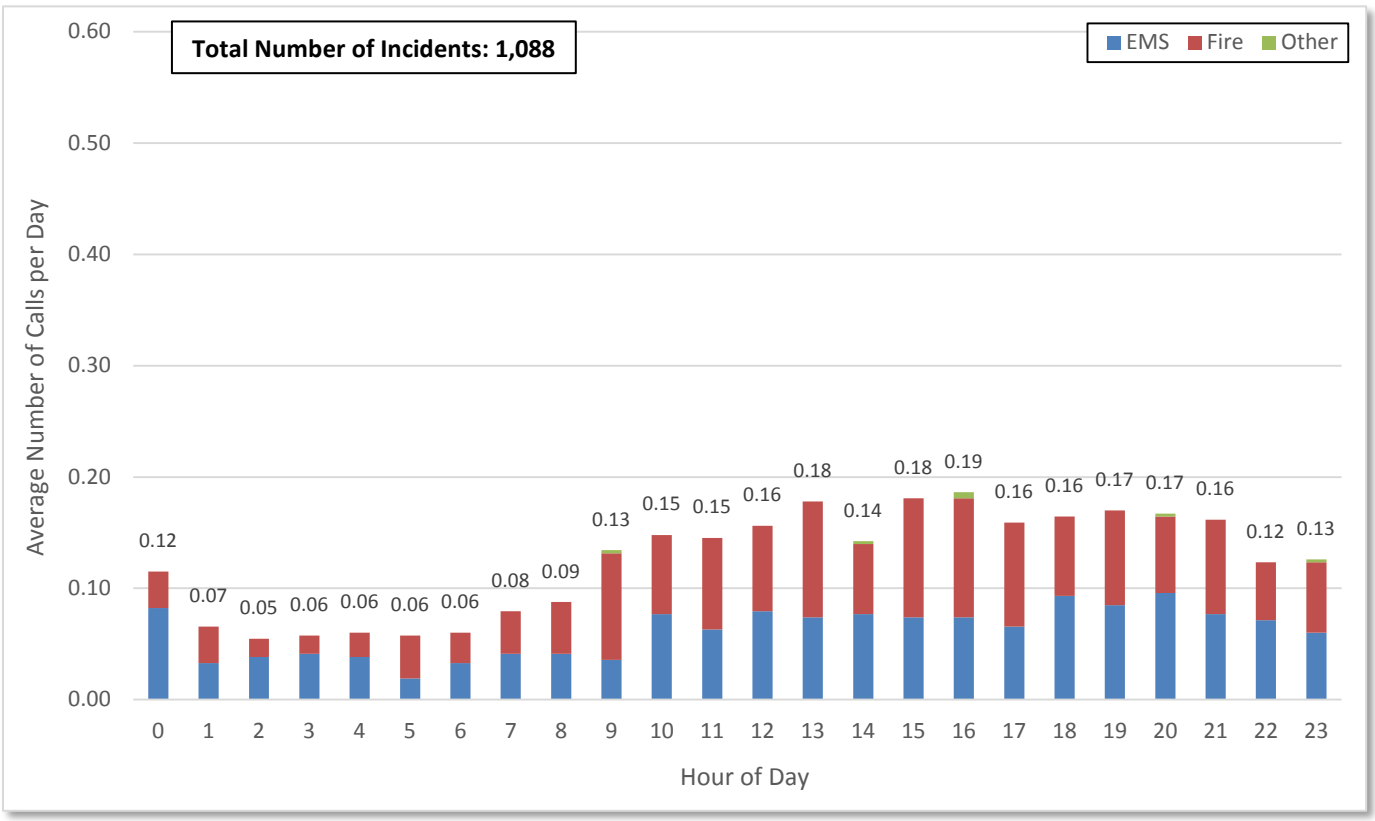


Figure 6: Average Calls per Day by Hour of Day – 1215 N. Clinton Avenue (E2)

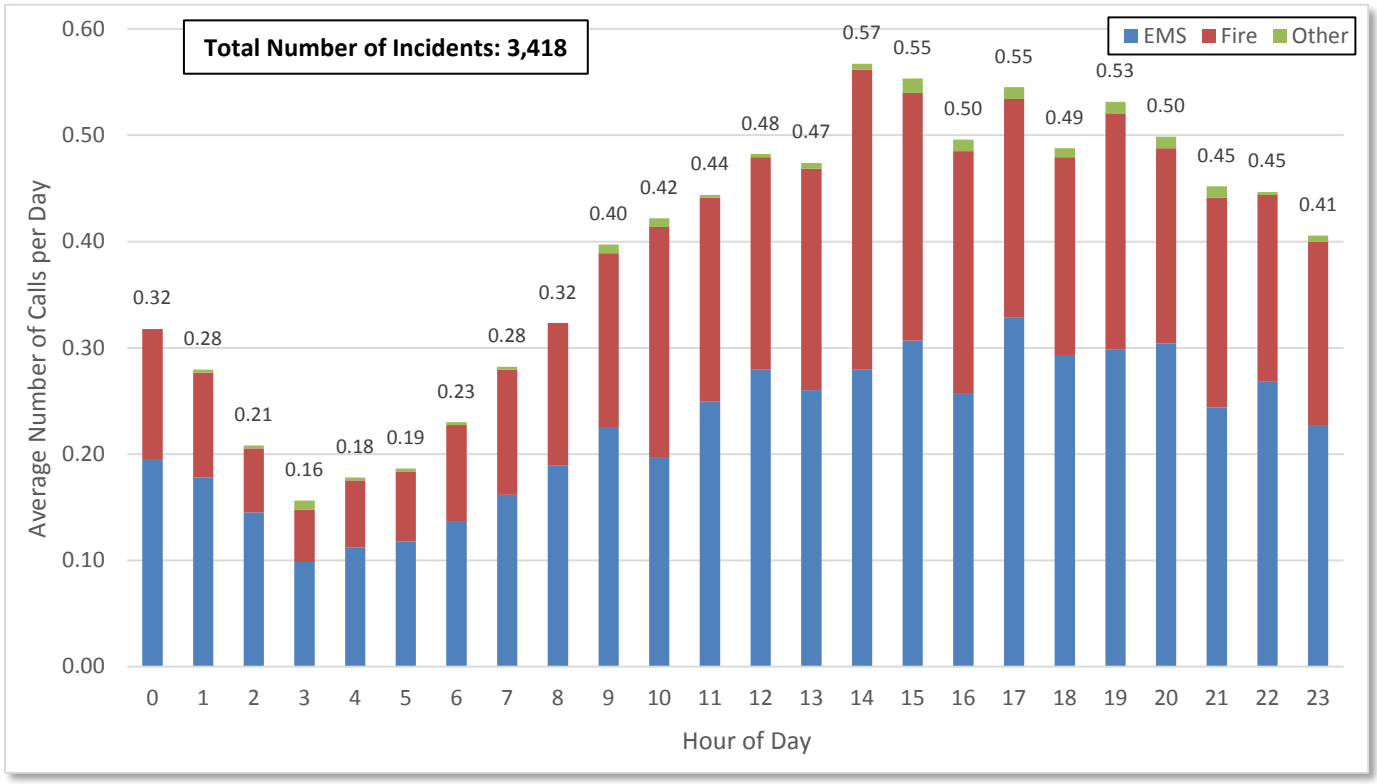


Figure 7: Average Calls per Day by Hour of Day – 1261 South Avenue (T3)

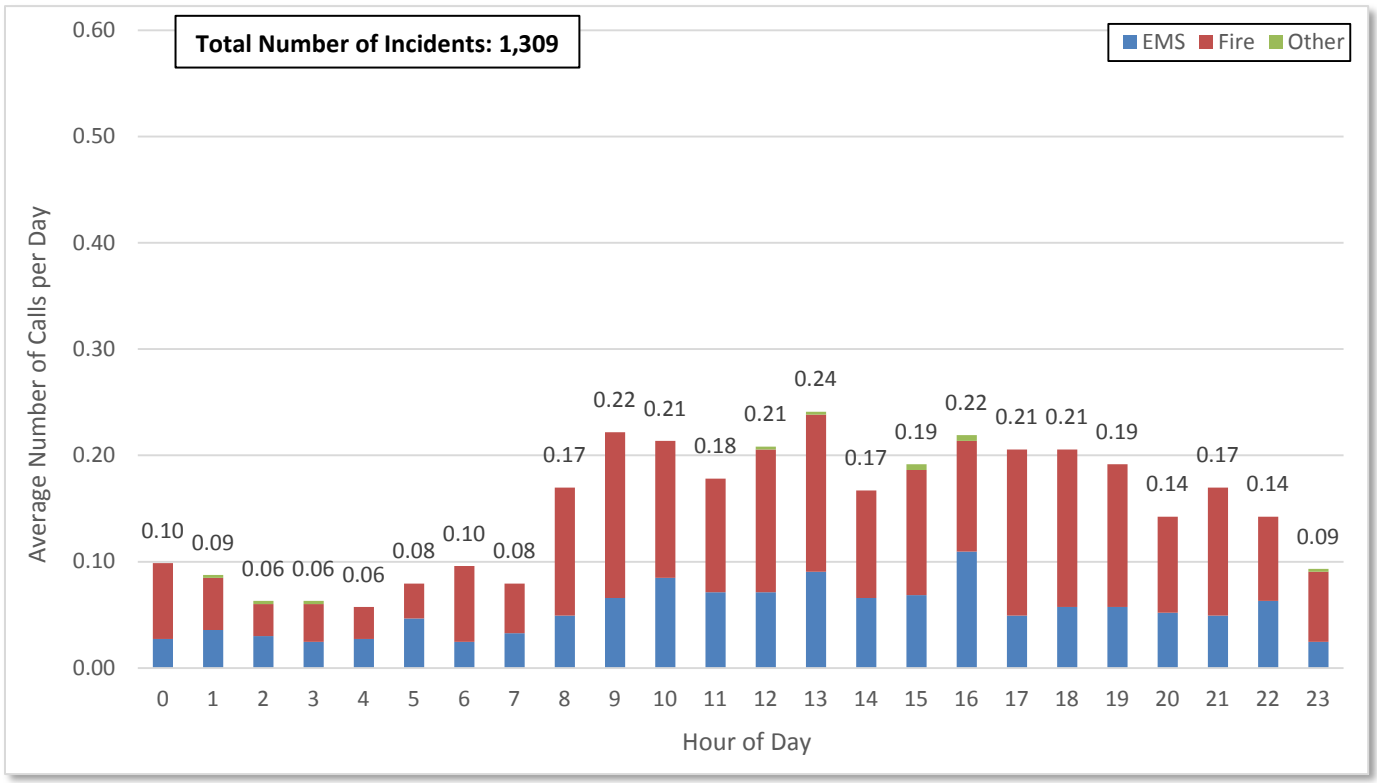


Figure 8: Average Calls per Day by Hour of Day – 1477 Dewey Avenue (E10, T2)

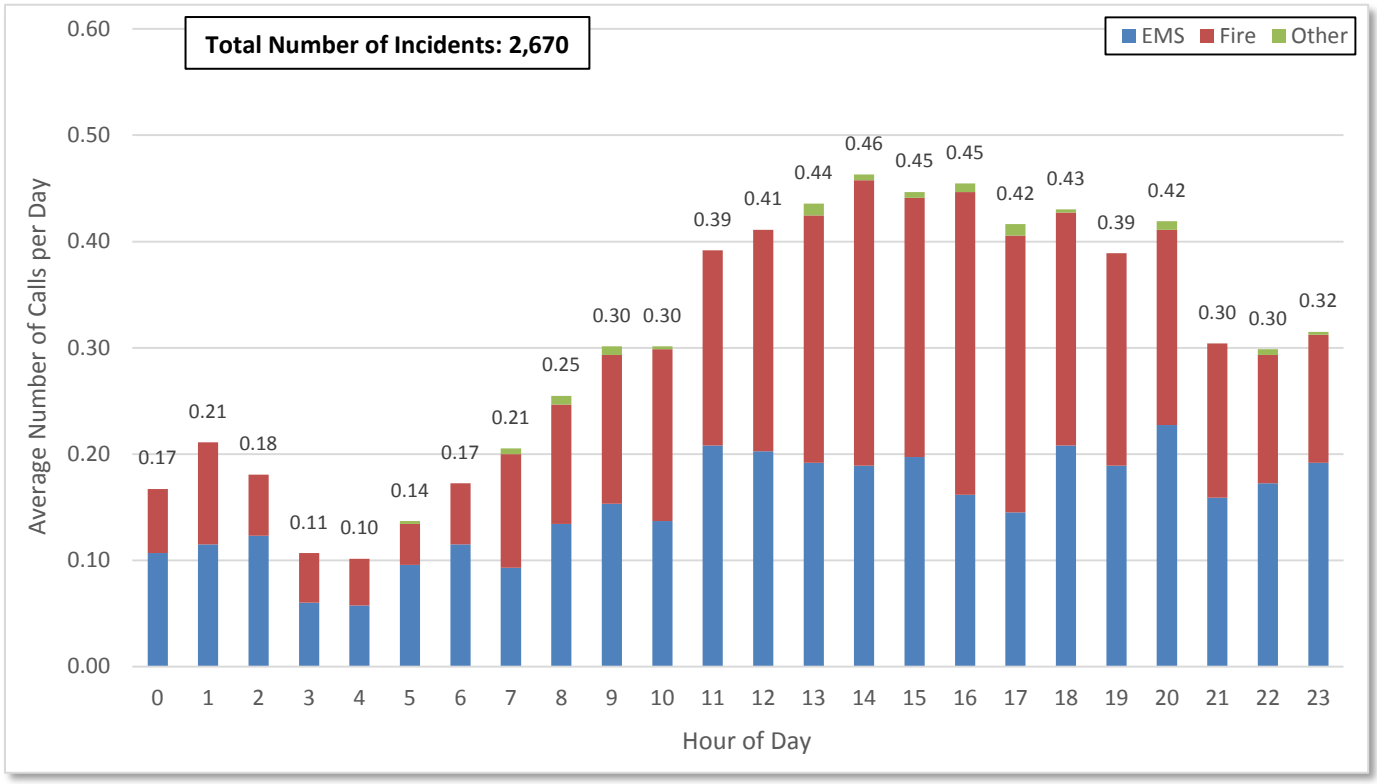


Figure 9: Average Calls per Day by Hour of Day – 160 Wisconsin Street (E12)

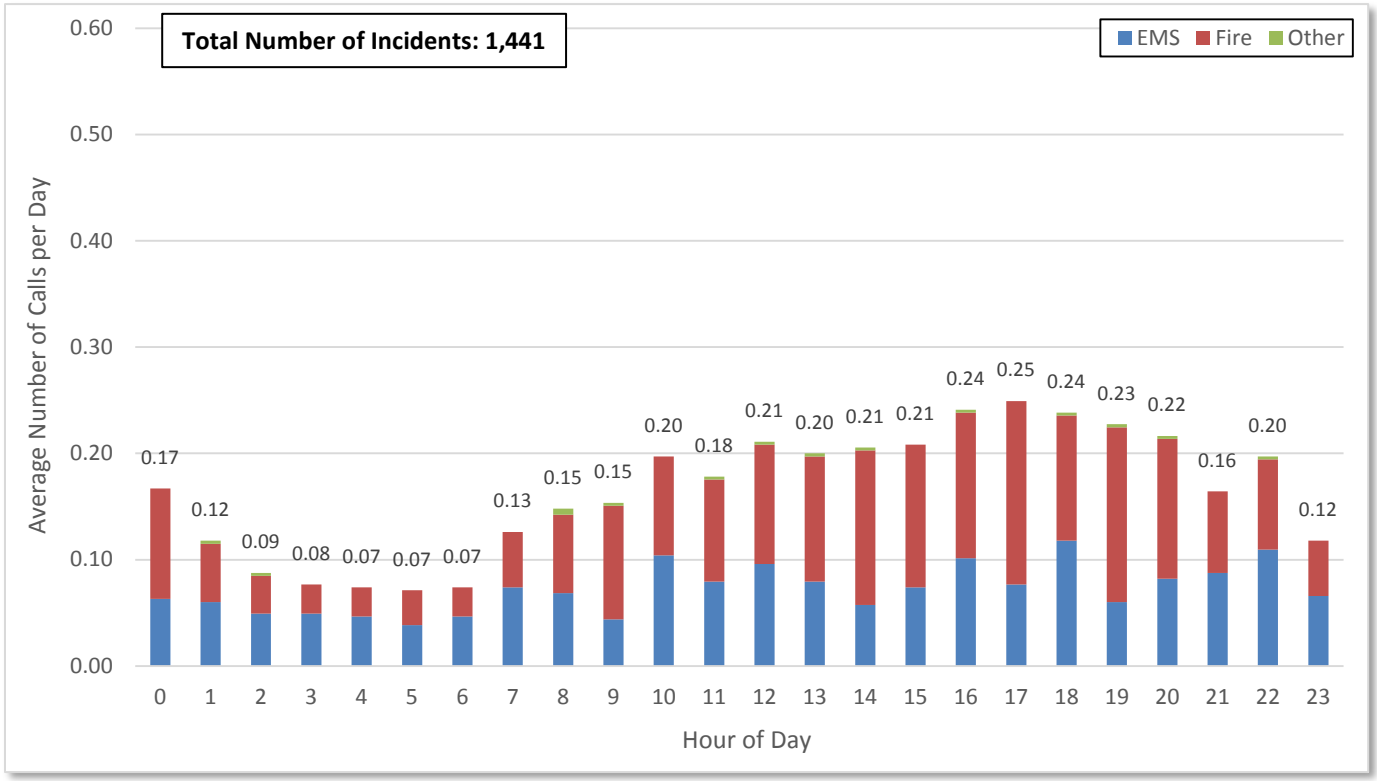


Figure 10: Average Calls per Day by Hour of Day – 185 N. Chestnut Street (DC, E17, R11)

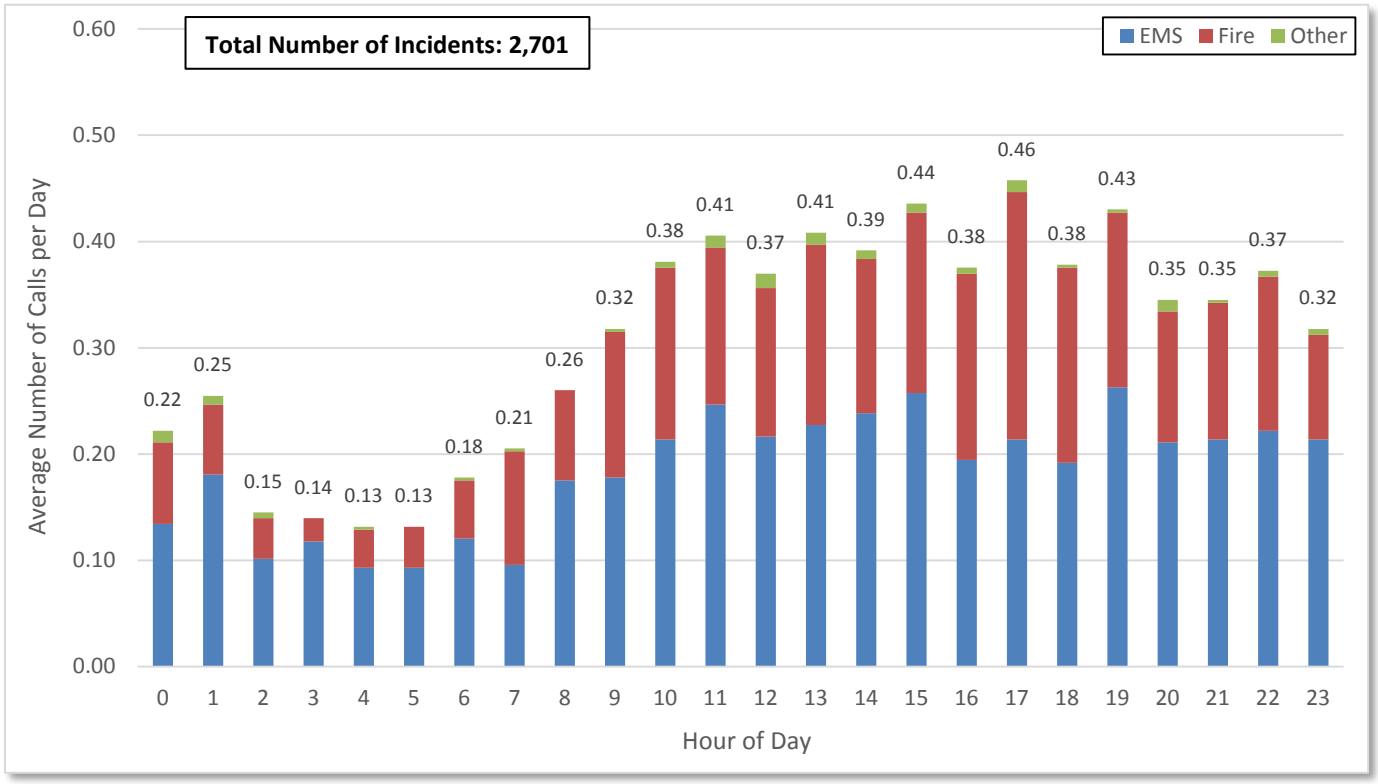


Figure 11: Average Calls per Day by Hour of Day – 2695 W. Henrietta Road (E8)

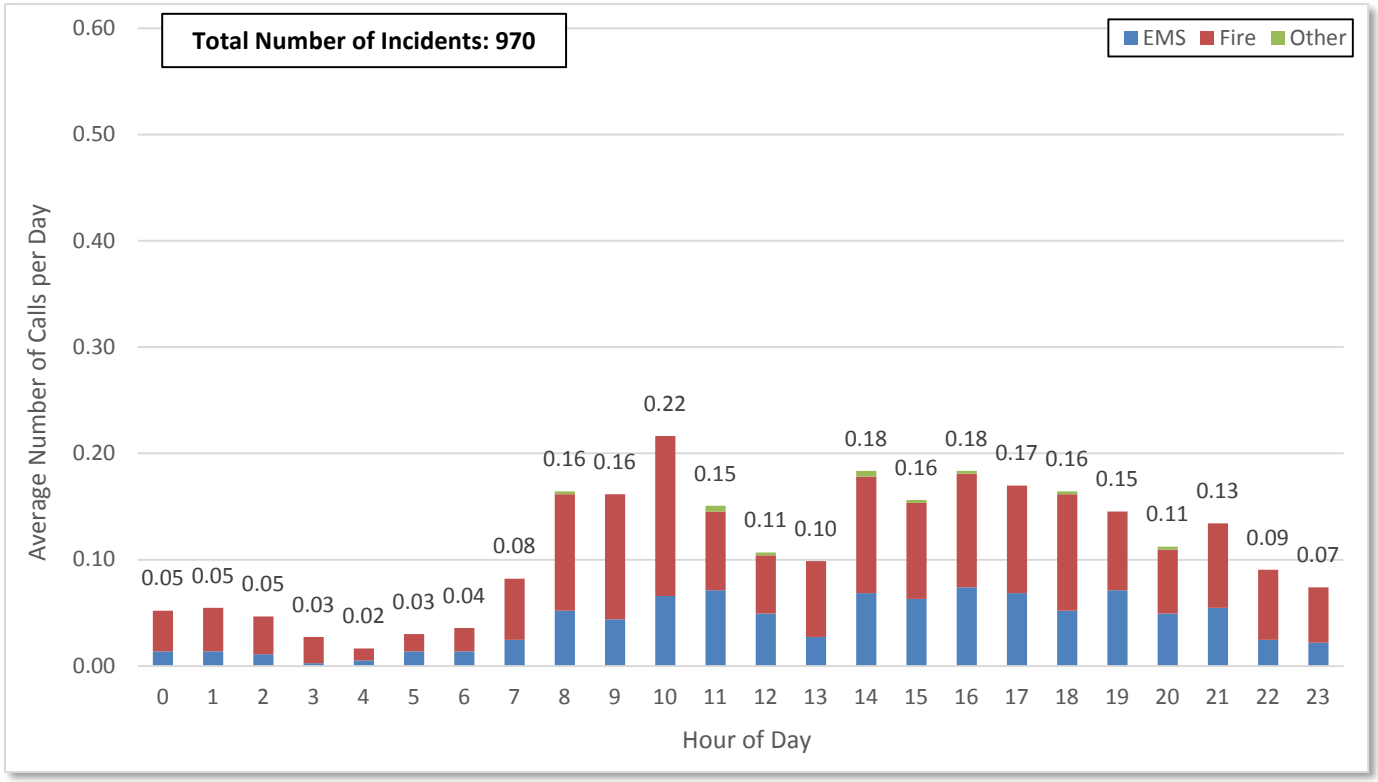


Figure 12: Average Calls per Day by Hour of Day – 272 Allen Street (B2, E13, T10)

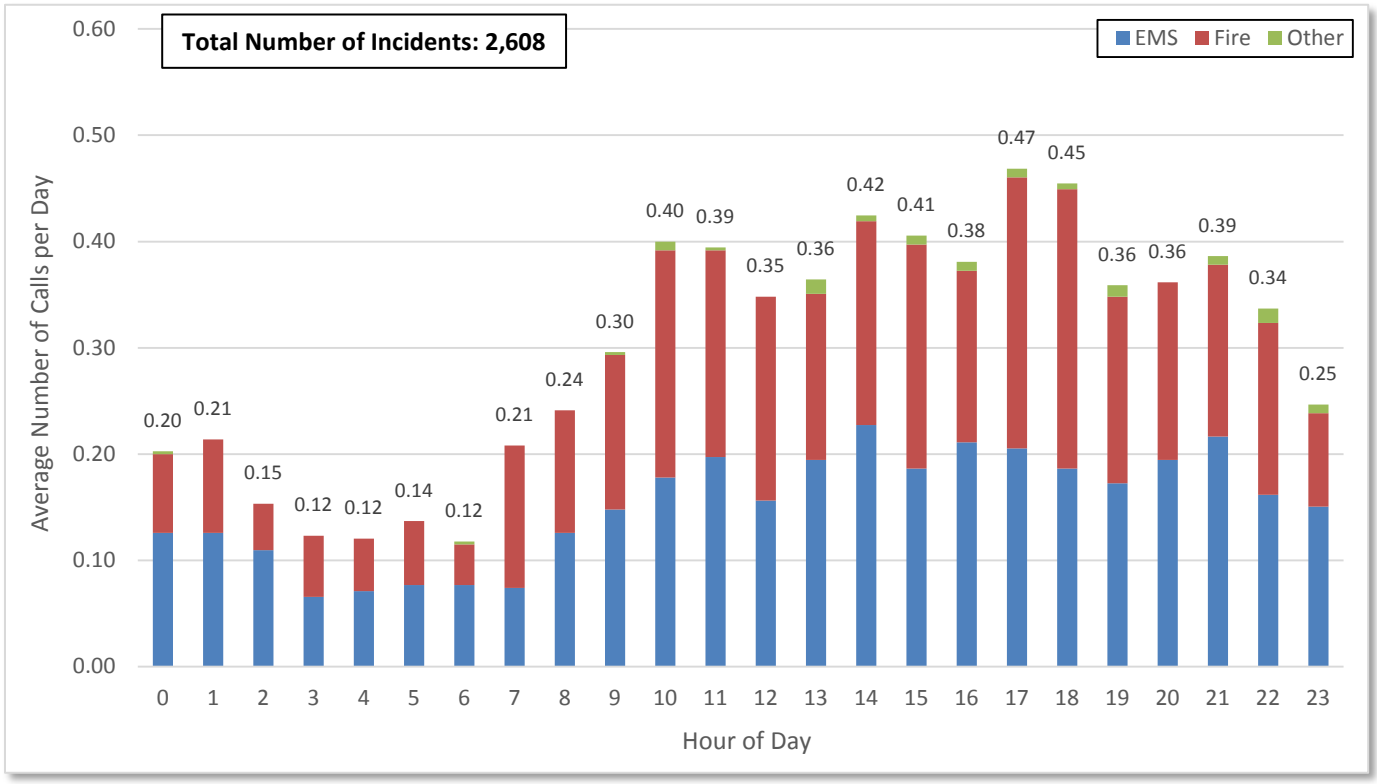


Figure 13: Average Calls per Day by Hour of Day – 315 Monroe Avenue (Car 99, E1)

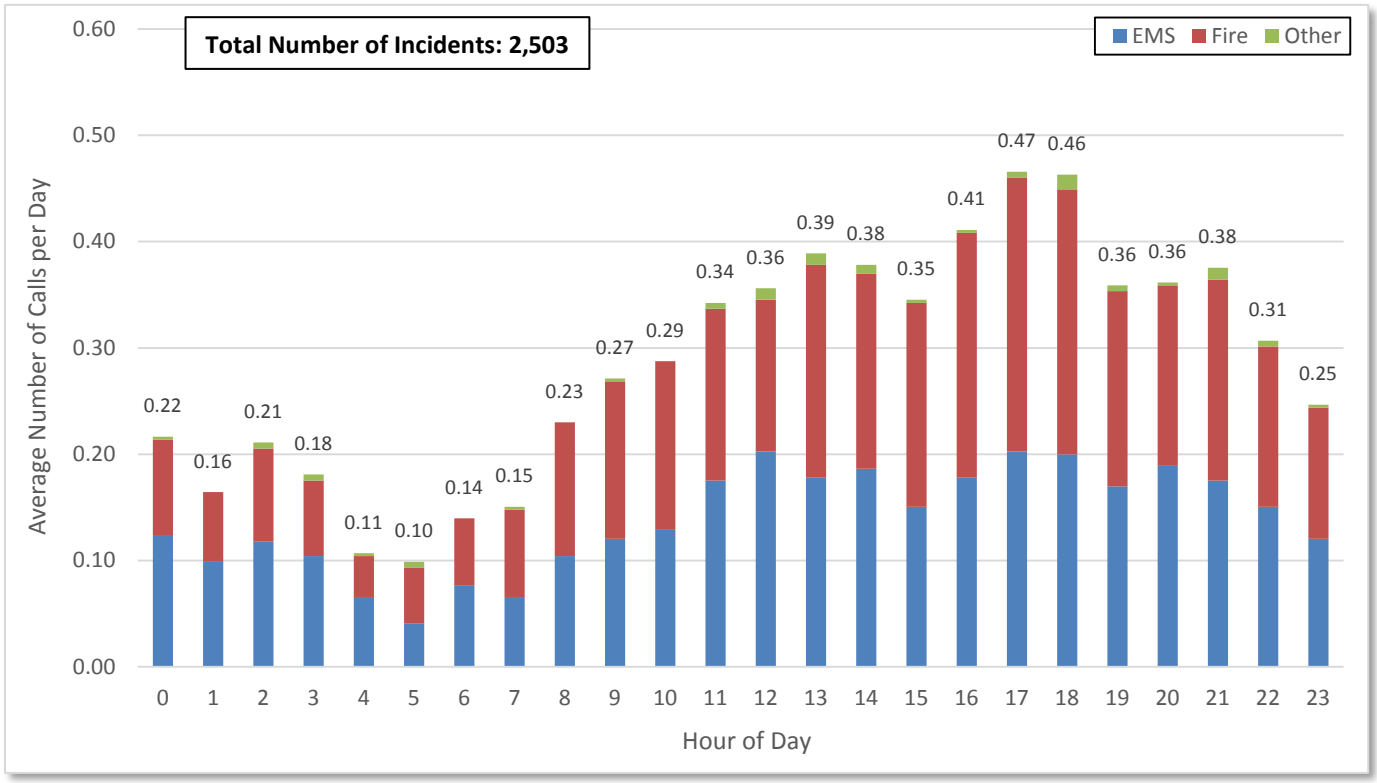


Figure 14: Average Calls per Day by Hour of Day – 4090 Lake Avenue (E19)

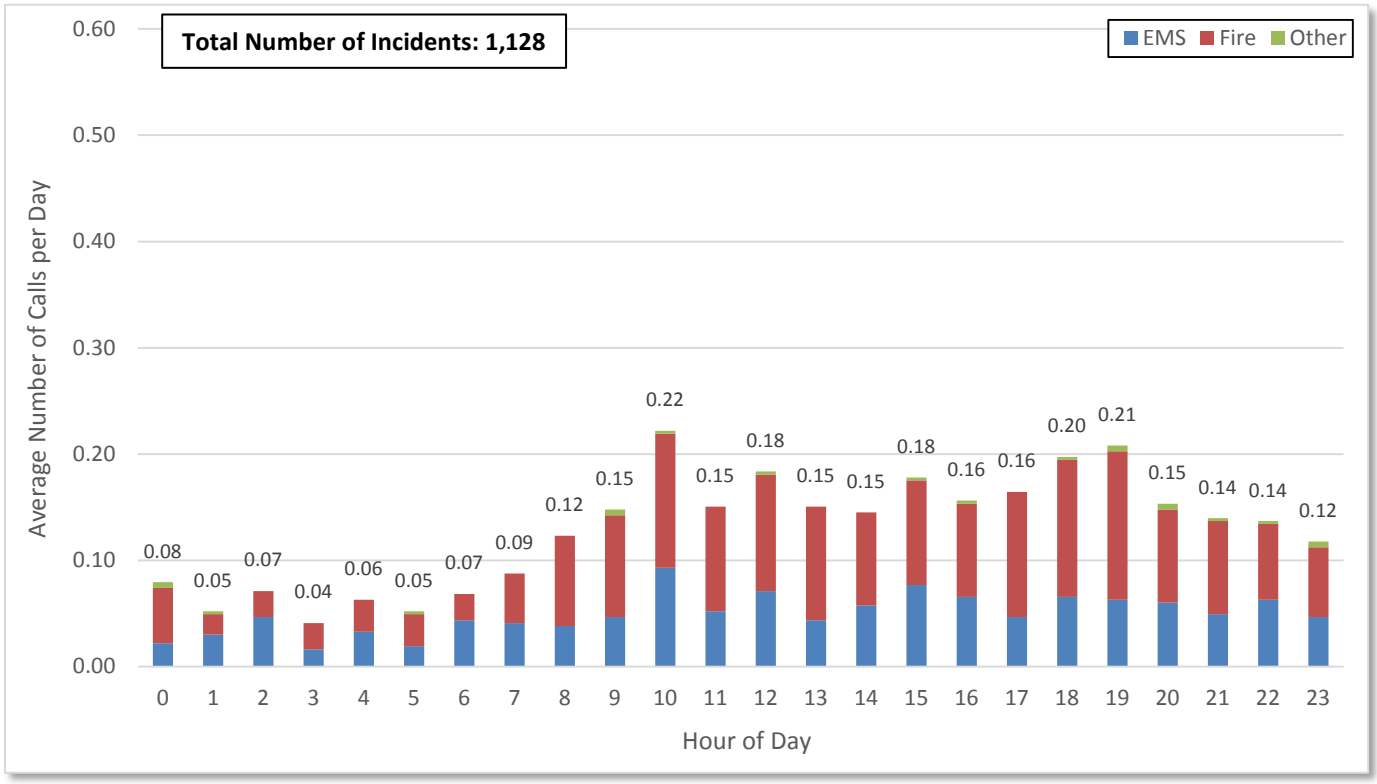


Figure 15: Average Calls per Day by Hour of Day – 450 Lyell Avenue (E5)

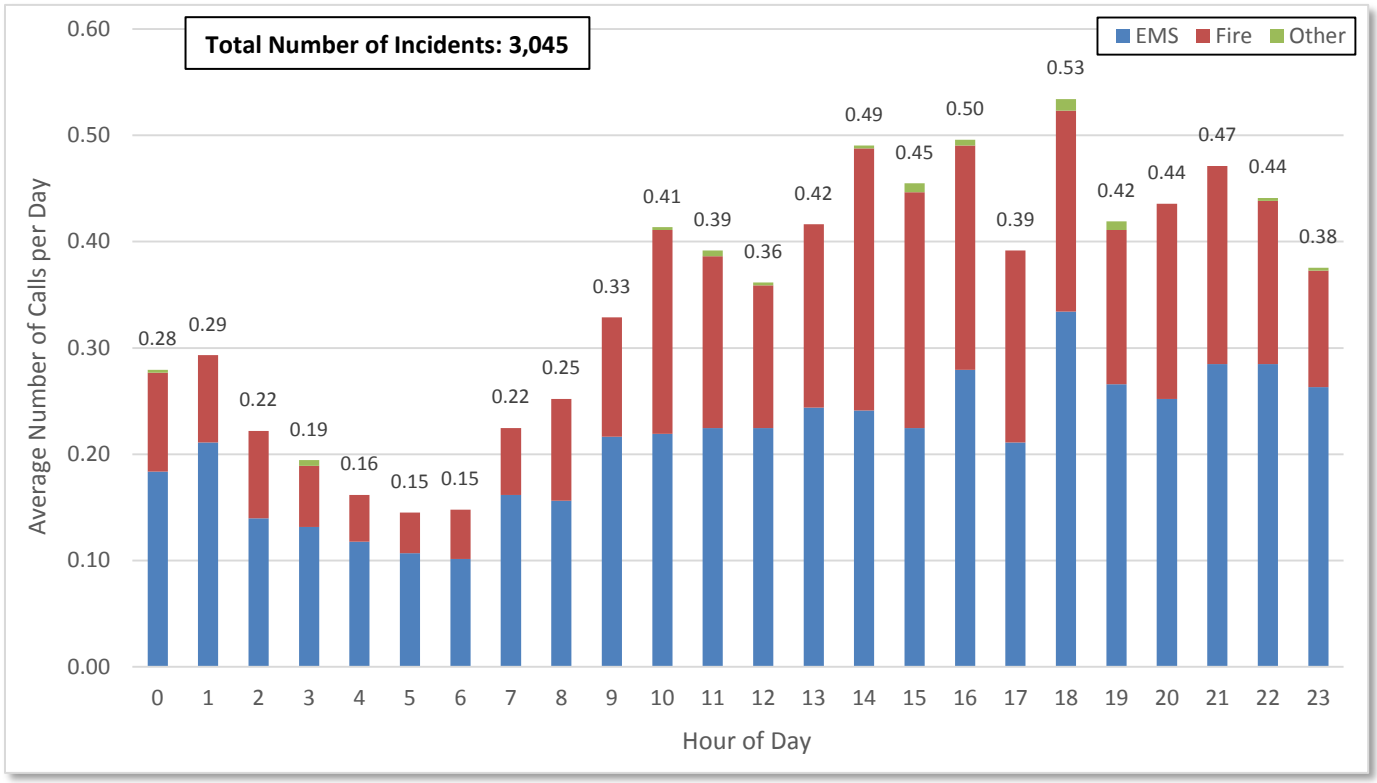


Figure 16: Average Calls per Day by Hour of Day – 57 Gardiner Avenue (T5)

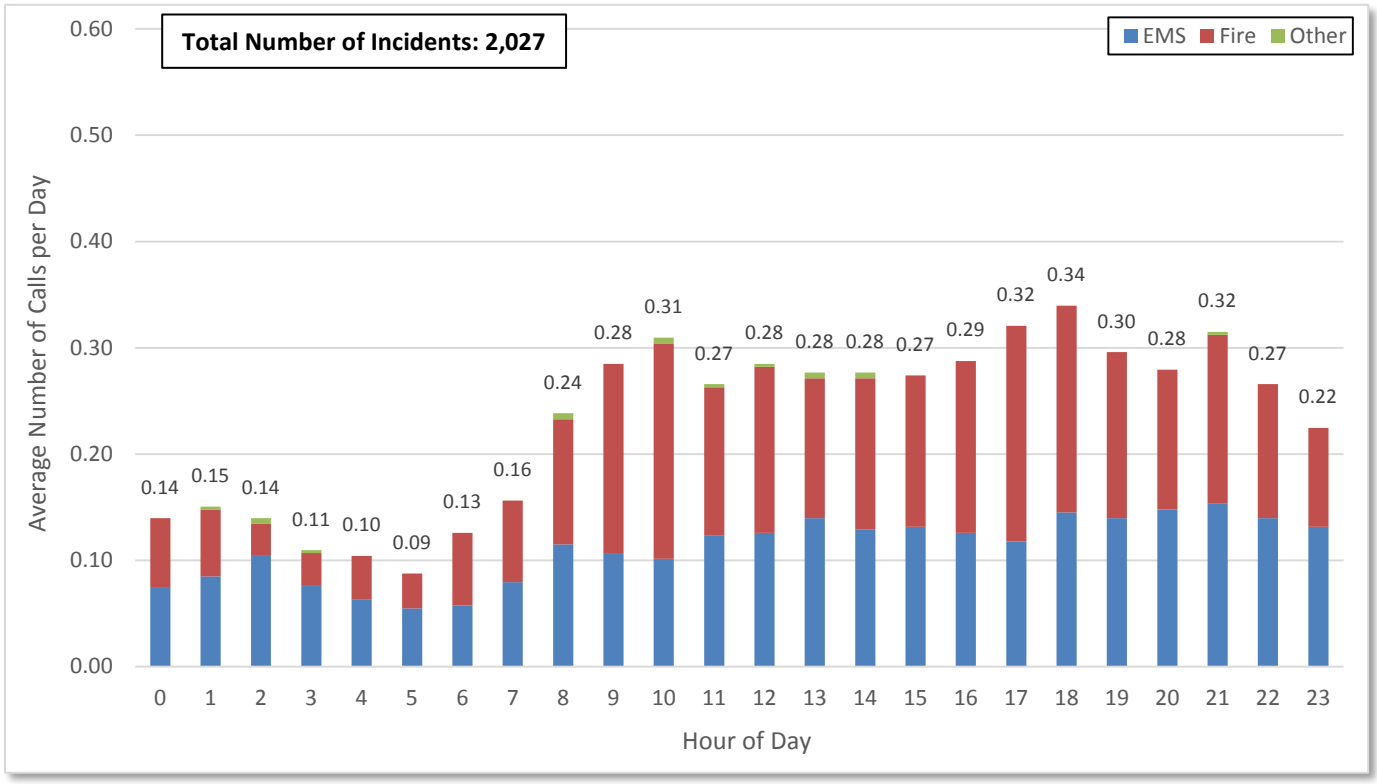


Figure 17: Average Calls per Day by Hour of Day – 704 Hudson Avenue (B1, E16, T6)

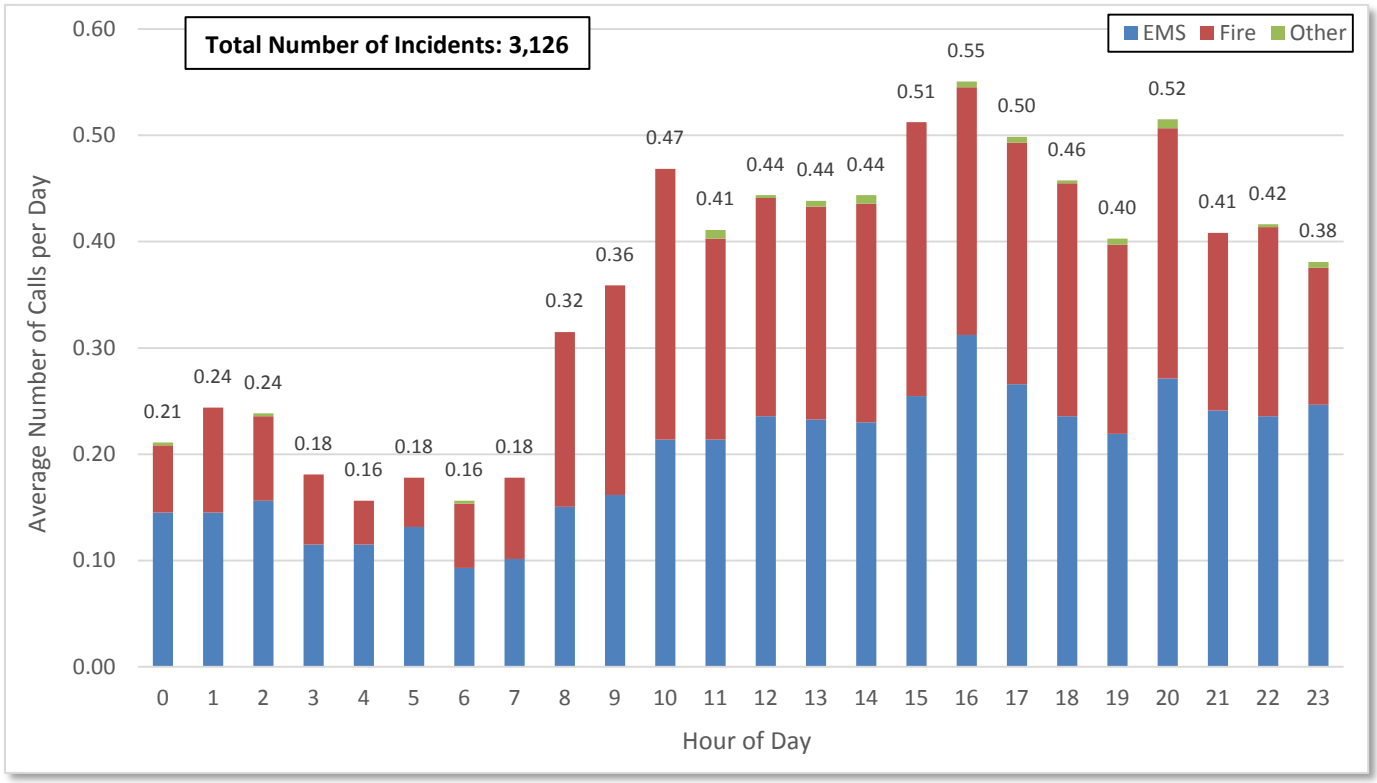


Figure 18: Average Calls per Day by Hour of Day – 740 N. Goodman Street (E9)

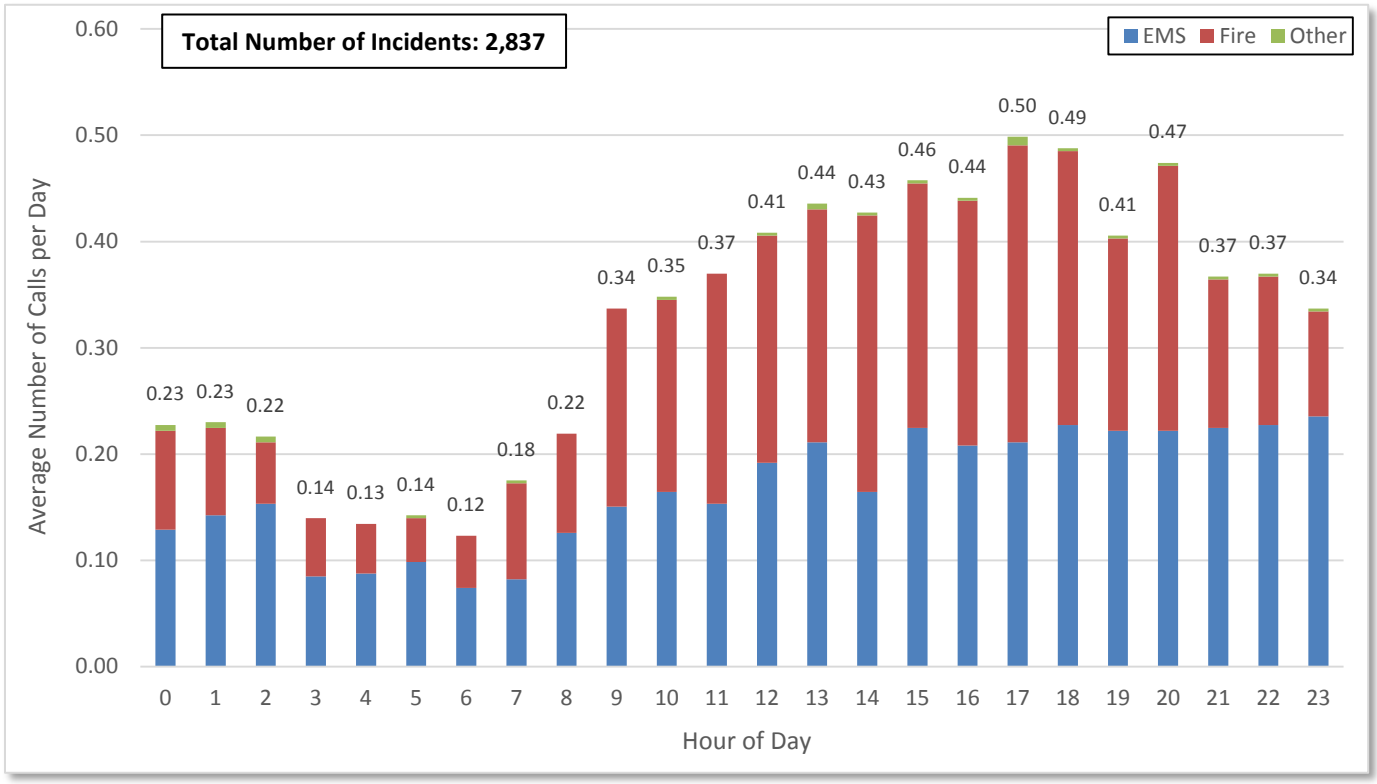


Figure 19: Average Calls per Day by Hour of Day – 873 Genesee Street (E7)

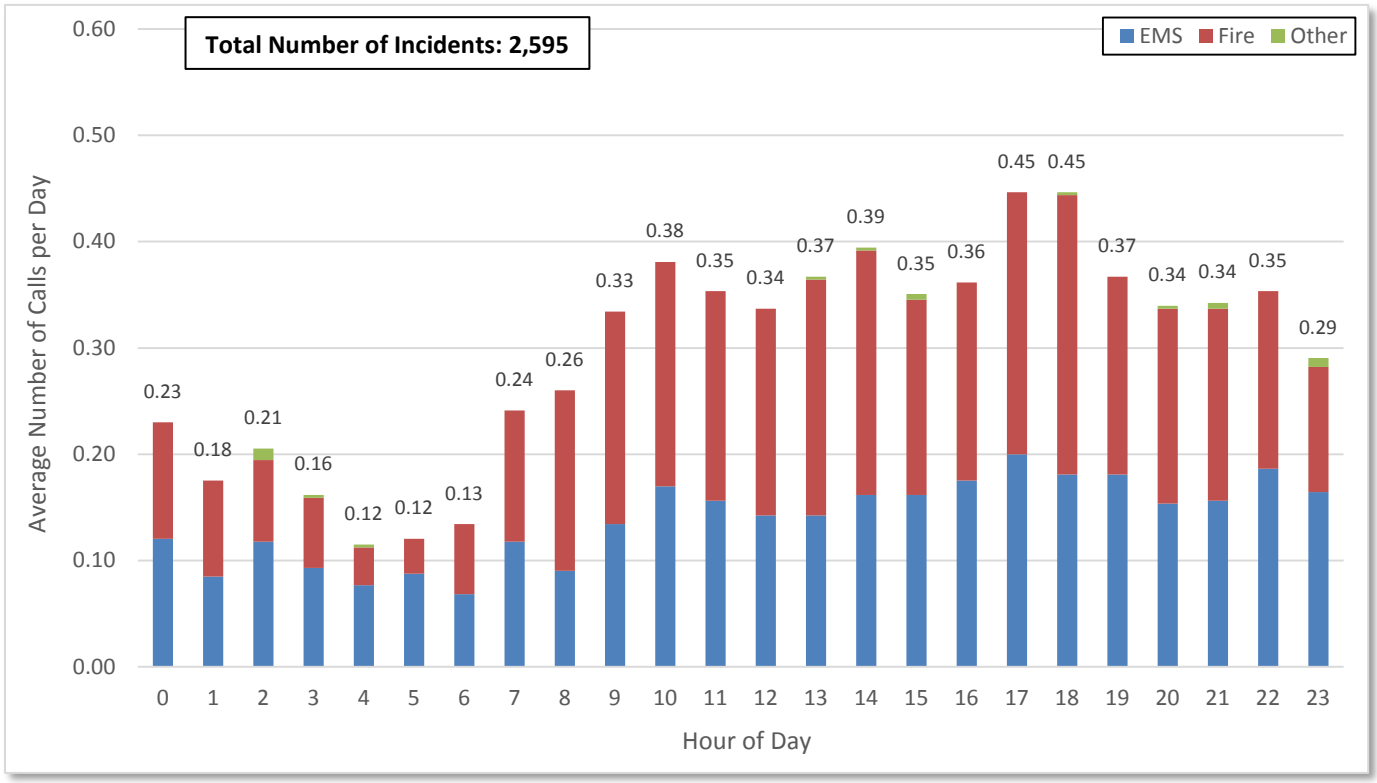
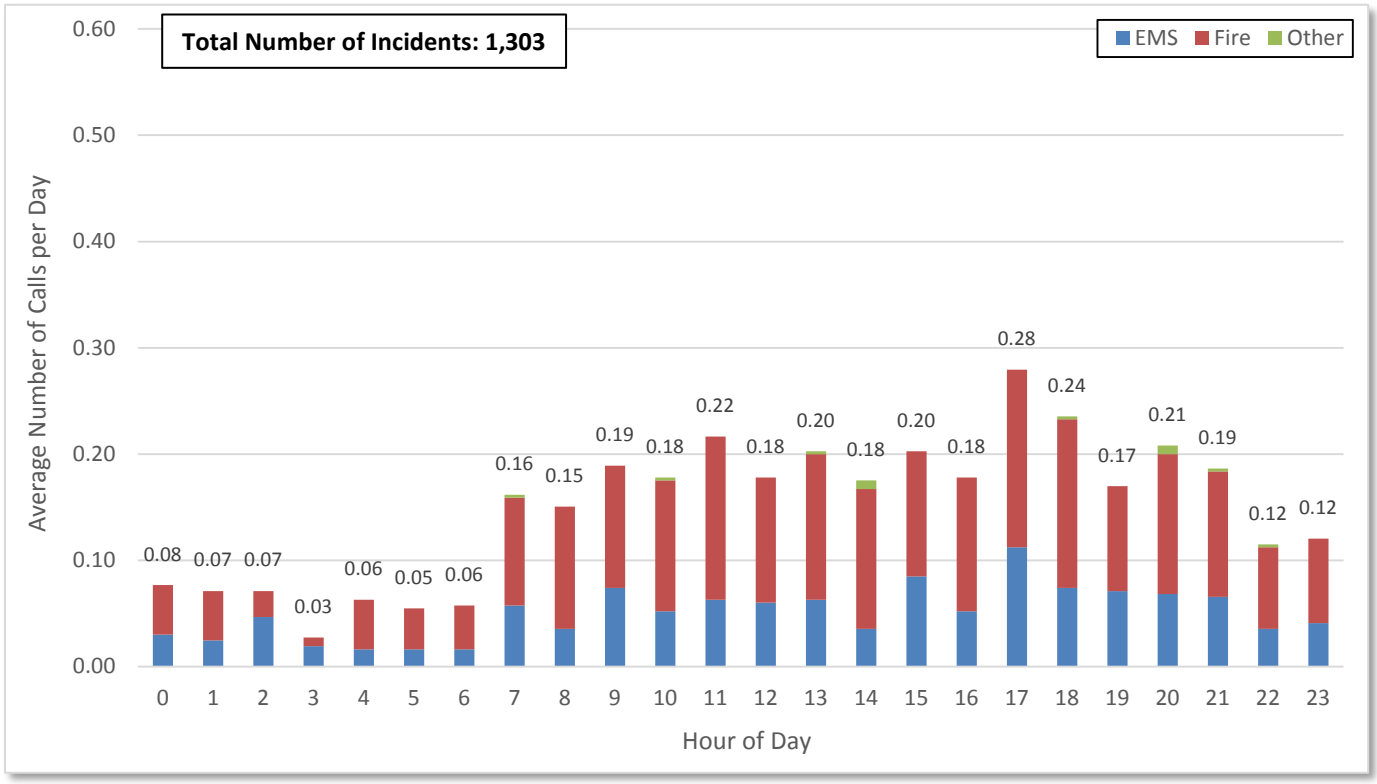


Figure 20: Average Calls per Day by Hour of Day – 977 University Avenue (T4)



Overall, RFD made 47,218 responses, and the total busy hours were 13,712.1 hours during 2017 (Table 3; Table 7). The station-level demand is more reflective for deployment decisions (Table 7), and the unit-level workload will help evaluate the utilization of physical apparatus, and assist with apparatus procurement or maintenance decisions (Table 8).

RFD's station at 1215 N. Clinton Avenue was the busiest station based on number of incoming calls for the station's area (3,394 calls; Table 7). Units assigned to 704 Hudson Avenue responded to the greatest number of calls across the department (4,689 calls), regardless of where the calls originated, whereas units assigned to 272 Allen Street made the greatest number of responses to calls across the department (6,022 responses to 4,631 calls), regardless of where the calls originated. RFD's station at 704 Hudson Avenue had the greatest number of total busy hours during 2017 (1,865.6 hours).

E2 was the top utilized engine based on number of responses (3,415 responses), followed by E5 (3,265 responses) and E16 (3.036 responses; Table 8). E2, E17, and E16 were the top utilized engines based on total busy hours (904.1, 842.4, and 821.1 hours, respectively). T5 and T10 were the top utilized trucks based on number of responses (2,428 and 1,879 responses, respectively) and total busy hours (660.3 and 588.0 hours, respectively).

Table 7: Overall Workload by Station (Company)

Station (Company)	Number of Calls Incoming to Station's Area[1]	Number of Calls Responded to by Units Assigned to Station[1]	Number of Responses Made by Units Assigned to Station[2]	Responses with Time Data[3]	Total Busy Hours	Average Busy Minutes per Response	Percentage of Total Busy Hours
1051 Emerson Street (E3)	1,084	1,421	1,421	1,309	469.2	21.5	3.4
1215 N. Clinton Avenue (E2)	3,394	3,415	3,415	3,253	904.1	16.7	6.6
1261 South Avenue (T3)	1,290	1,637	1,637	1,558	478.1	18.4	3.5
1477 Dewey Avenue (E10, T2)	2,660	3,360	3,792	3,508	1,131.1	19.3	8.2
160 Wisconsin Street (E12)	1,433	1,661	1,661	1,539	487.0	19.0	3.6
185 N. Chestnut Street (DC, E17, R11)	2,619	3,705	4,352	4,184	1,367.0	19.6	10.0
2695 W. Henrietta Road (E8)	968	1,073	1,073	1,042	320.5	18.5	2.3
272 Allen Street (B2, E13, T10)	2,518	4,631	6,022	5,761	1,839.3	19.2	13.4
315 Monroe Avenue (Car 99, E1)	2,434	3,598	3,990	3,832	1,105.9	17.3	8.1
4090 Lake Avenue (E19)	1,124	933	933	858	293.8	20.5	2.1
450 Lyell Avenue (E5)	3,032	3,265	3,265	3,065	780.2	15.3	5.7
57 Gardiner Avenue (T5)	2,023	2,428	2,428	2,246	660.3	17.6	4.8
704 Hudson Avenue (B1, E16, T6)	3,115	4,689	5,882	5,561	1,865.6	20.1	13.6
740 N. Goodman Street (E9)	2,742	2,806	2,806	2,653	759.2	17.2	5.5
873 Genesee Street (E7)	2,577	2,720	2,720	2,560	715.2	16.8	5.2
977 University Avenue (T4)	1,287	1,781	1,781	1,717	516.6	18.1	3.8
Not Identified[4]	146	--	--	--	--	--	--
Admin on Call (Car 1)	--	22	22	11	9.7	52.7	0.1
Admin on Call (Car 2)	--	18	18	11	9.5	51.9	0.1
Total	**34,446**	**--**	**47,218**	**44,668**	**13,712.1**	**18.4**	**100.0**

[1]"Number of Calls" reflects an adjusted number of unique incidents to correspond with data provided in the unit-level data file (as opposed to data provided in the CAD data files that did not contain unit-level data, as represented in the preceding figure series), regardless of calculated busy time.
[2]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[3]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[4]There were 83 unique incident numbers corresponding to 146 unique responses in the unit-level data file that did not appear in the CAD data files to allow mapping of call details; all call details related to these 83 incidents are unknown. There were also 63 unique incident numbers corresponding to 74 unique responses in the unit-level data file that also appeared as unique incidents in the CAD data file, but for which there were no (or no relevant) corresponding "CarBeat1" code entries to allow for identification of first due company or station location.

Table 8: Overall Workload by Unit

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
1051 Emerson Street	E3	Engine	1,421	1,309	469.2	21.5
	Station Total		**1,421**	**1,309**	**469.2**	**21.5**
1215 N. Clinton Avenue	E2	Engine	3,415	3,253	904.1	16.7
	Station Total		**3,415**	**3,253**	**904.1**	**16.7**
1261 South Avenue	T3	Truck	1,637	1,558	478.1	18.4
	Station Total		**1,637**	**1,558**	**478.1**	**18.4**
1477 Dewey Avenue	E10	Engine	2,166	2,007	643.7	19.2
	T2	Truck	1,626	1,501	487.4	19.5
	Station Total		**3,792**	**3,508**	**1,131.1**	**19.3**
160 Wisconsin Street	E12	Engine	1,661	1,539	487.0	19.0
	Station Total		**1,661**	**1,539**	**487.0**	**19.0**
185 N. Chestnut Street	E17	Engine	2,954	2,861	842.4	17.7
	R11	Rescue	1,156	1,098	347.7	19.0
	Station Total		**4,110**	**3,959**	**1,190.1**	**18.0**
2695 W. Henrietta Road	E8	Engine	1,073	1,042	320.5	18.5
	Station Total		**1,073**	**1,042**	**320.5**	**18.5**
272 Allen Street	E13	Engine	2,696	2,555	695.9	16.3
	T10	Truck	1,879	1,810	588.0	19.5
	Station Total		**4,575**	**4,365**	**1,283.9**	**17.6**
315 Monroe Avenue	E1	Engine	2,848	2,721	733.2	16.2
	Station Total		**2,848**	**2,721**	**733.2**	**16.2**
4090 Lake Avenue	E19	Engine	933	858	293.8	20.5
	Station Total		**933**	**858**	**293.8**	**20.5**
450 Lyell Avenue	E5	Engine	3265	3065	780.2	15.3
	Station Total		**3265**	**3065**	**780.2**	**15.3**
57 Gardiner Avenue	T5	Truck	2,428	2,246	660.3	17.6
	Station Total		**2,428**	**2,246**	**660.3**	**17.6**

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
704 Hudson Avenue	E16	Engine	3,036	2,852	821.1	17.3
	T6	Truck	1,797	1,698	533.8	18.9
	Station Total		**4,833**	**4,550**	**1,354.9**	**17.9**
740 N. Goodman Street	E9	Engine	2,806	2,653	759.2	17.2
	Station Total		**2,806**	**2,653**	**759.2**	**17.2**
873 Genesee Street	E7	Engine	2,720	2,560	715.2	16.8
	Station Total		**2,720**	**2,560**	**715.2**	**16.8**
977 University Avenue	T4	Truck	1,781	1,717	516.6	18.1
	Station Total		**1,781**	**1,717**	**516.6**	**18.1**
Admin on Call	Car 1	Car	22	11	9.7	52.7
	Station Total		**22**	**11**	**9.7**	**52.7**
Admin on Call	Car 2	Car	18	11	9.5	51.9
	Station Total		**18**	**11**	**9.5**	**51.9**
Other[3]	B1	Battalion Chief	1,049	1,011	510.8	30.3
	B2	Battalion Chief	1,447	1,396	555.3	23.9
	Car 99	Car	1,142	1,111	372.7	20.1
	DC	Line Deputy	242	225	176.9	47.2
Department Total			**47,218**	**44,668**	**13,712.1**	**18.4**

[1]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[2]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[3]Units were originally assigned by the department to physical address locations, but were subsequently requested by the department to be presented separately here.

The last analyses in this section focus on performance times related to dispatch, turnout, travel, and response times. "Dispatch Time" was calculated as Unit Dispatch Date and Time – Call Received Date and Time (note that 7,328 of 45,139 responses used in 2017 performance time analyses, or 16.2% of data, were missing data for Call Received Date and Time). "Turnout Time" was calculated as Unit Enroute Date and Time – Unit Dispatch Date and Time. "Travel Time" was calculated as Unit Onscene Date and Time – Unit Enroute Date and Time. "Response Time" was calculated as Unit Onscene Date and Time – Call Received Date and Time. "Response Time" may also be calculated by summing relevant dispatch, turnout, and travel times, and "Average Response Time" may be derived by summing relevant average dispatch, turnout, and travel times when the sample data used during calculation of the outcomes are identical for all three outcomes.

Average performance times, median performance times, and performance times at the 90th percentile are reported in this section. The 90th percentile is presented as a more conservative and reliable measure of performance, as this measure is more robust, or less influenced by outliers, than measures of central tendency such as the average. Best practice is to measure at the 90th percentile. In other words, 90% of all performance is captured, expecting that 10% of the time the department may experience abnormal conditions that would typically be considered outliers. For example, if the department were to report an *average* response time of six minutes, then in a normally distributed set of data, half of the responses would be longer than six minutes and half of the responses would be shorter than six minutes. Utilizing six minutes as an example again, a *90th percentile value* of six minutes communicates that 9 out of 10 times, the department performance is six minutes or better (faster) and is therefore more predictable and more clearly articulated to policy makers and the community. Note, however, that the sum of the 90th percentile values for dispatch, turnout, and travel times is not equivalent to the 90th percentile response time.

Analyses of performance times first focused on emergency (lights and sirens) responses from the first arriving primary front-line units for all unique incidents. Call status as emergency or non-emergency was assigned per call type by RFD and was based on "EventTypeDescription" from the CAD data files. Units identified by RFD as primary front-line units included all departmental units except for the admin on-call vehicles, Car 1 and Car 2.

Average performance times are presented in Table 9 and in Figure 21, median values are presented in Table 10, and 90th percentile values are presented in Table 11. Due to the restriction of these analyses to select responses and units, maximum available sample size for these analyses is 31,761. Sample data were not identical across all performance time calculations (i.e., missing data) such that the sum of average dispatch, turnout, and travel times will not necessarily equal average response times in Table 9.

Across all RFD responses made by first arriving primary front-line units to emergency calls, average dispatch time was 2.5 minutes (median = 1.6 minutes; 90th percentile = 3.0 minutes); average turnout time was 1.5 minutes (median = 1.5 minutes; 90th percentile = 2.3 minutes); average travel time was 3.0 minutes (median = 2.7; 90th percentile = 4.7 minutes); and average response time was 6.9 minutes (median = 6.0 minutes; 90th percentile = 8.5 minutes).

Typically, performance varies across call types or categories for a variety of reasons. For example, turnout time may be longer for fire related calls because the crews have to dress in their personal protective ensemble (bunker gear) prior to leaving the station, whereas on an EMS incident, they do not. Similarly, the larger fire apparatus may require longer travel and overall response times due to its size and lack of maneuverability.

Table 9: Average Dispatch, Turnout, Travel, and Response Times by Program – First Arriving Units

Program	Dispatch Time (Minutes)	Turnout Time (Minutes)	Travel Time (Minutes)	Response Time (Minutes)	Sample Size[1]
EMS	1.9	1.5	2.8	6.2	17,084
Fire	3.4	1.6	3.2	7.9	14,299
Hazmat	2.4	1.9	2.1	6.2	8
Rescue	2.8	1.4	2.5	6.5	370
Total	**2.5**	**1.5**	**3.0**	**6.9**	**31,761**

[1]Sample sizes reflect the number of responses made by first arriving primary front-line units to emergency calls; due to missing time data, sample sizes corresponding to individual table metrics may be smaller.

Table 10: Median Dispatch, Turnout, Travel, and Response Times by Program – First Arriving Units

Program	Dispatch Tim (Minutes)	Turnout Time (Minutes)	Travel Time (Minutes)	Response Time (Minutes)	Sample Size[1]
EMS	1.7	1.4	2.7	6.0	17,084
Fire	1.4	1.5	2.8	5.9	14,299
Hazmat	1.9	1.7	2.1	6.2	8
Rescue	2.2	1.4	2.3	5.9	370
Total	**1.6**	**1.5**	**2.7**	**6.0**	**31,761**

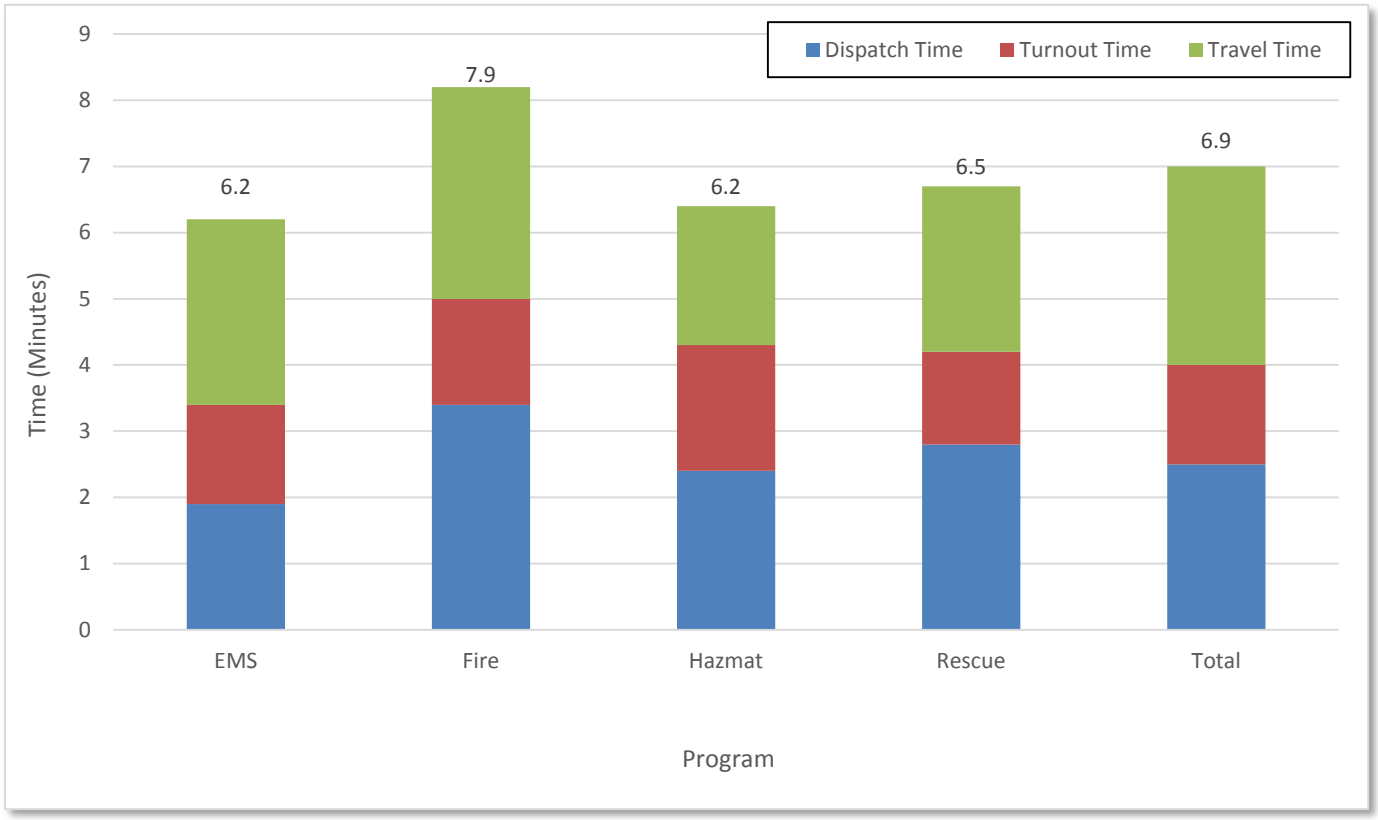
[1]Sample sizes reflect the number of responses made by first arriving primary front-line units to emergency calls; due to missing time data, sample sizes corresponding to individual table metrics may be smaller.

Table 11: 90th Percentile Dispatch, Turnout, Travel, and Response Times by Program – First Arriving Units

Program	Dispatch Time (Minutes)	Turnout Time (Minutes)	Travel Time (Minutes)	Response Time (Minutes)	Sample Size[1]
EMS	2.9	2.3	4.4	8.3	17,084
Fire	3.2	2.4	5.1	8.9	14,299
Hazmat	--	--	--	--	8
Rescue	4.8	2.2	4.0	9.6	370
Total	**3.0**	**2.3**	**4.7**	**8.5**	**31,761**

[1]Sample sizes reflect the number of responses made by first arriving primary front-line units to emergency calls; due to missing time data, sample sizes corresponding to individual table metrics may be smaller.

Figure 21: Average Dispatch, Turnout, Travel, and Response Times by Program – First Arriving Units



Similar analyses using AMR's CAD data were conducted to examine the performance of ambulance unit arrivals in response to 911 calls from the City of Rochester during 2017 (Table 12; Figure 22). Identical exclusion criteria were applied to the AMR CAD data file as were applied to the RFD unit-level data file.

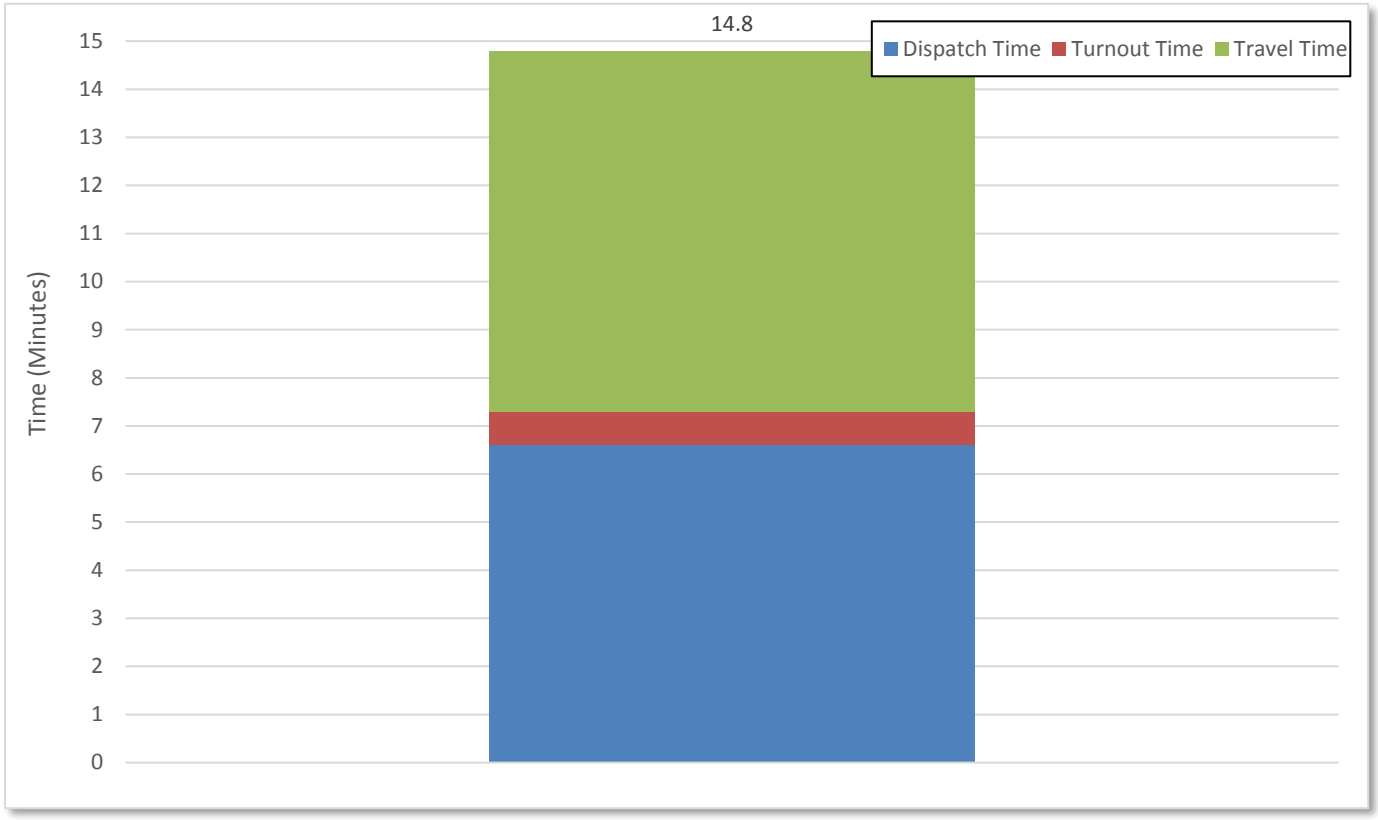
Table 12: AMR Dispatch, Turnout, Travel, and Response Times– All Arriving Units[1,2]

Metric	Dispatch Time (Minutes)	Turnout Time (Minutes)	Travel Time (Minutes)	Response Time (Minutes)	Sample Size
Average	6.6	0.7	7.5	14.8	86,906
Median	0.6	0.1	5.7	7.3	
90th Percentile	8.7	1.7	13.0	23.0	

[1]Dispatch Time = DispTime – CallTime; Turnout Time = EnrTime – DispTime; Travel Time = AtsTime – EnrTime; Response Time = AtsTime – CallTime.

[2]All arriving units were used because different call times were presented for unit-level entries when the incident number was the same; this made every unit response's start time occur at variable points rather than at the same starting point for the overall call.

Figure 22: AMR Average Dispatch, Turnout, Travel, and Response Times– All Arriving Units



Analyses next focused on dispatch times of the first unit dispatched to each call by call status as emergency or non-emergency (Table 13). All calls under the programs EMS, Hazmat, and Rescue were classified by RFD as emergency calls, such that non-emergency calls were only relevant to the Fire program.

Table 13: Average, Median, and 90th Percentile Dispatch Times by Program and Call Status – First Dispatched Units

Program and Call Status	Average Dispatch Time (Minutes)	Median Dispatch Time (Minutes)	90th Percentile Dispatch Time (Minutes)	Sample Size[1]
EMS (Emergency)	**1.9**	**1.7**	**2.8**	**17,349**
Fire	**3.4**	**1.4**	**3.2**	**15,016**
Emergency	3.4	1.4	3.2	14,646
Non-Emergency	2.3	2.0	3.7	370
Hazmat (Emergency)	**2.4**	**1.9**	**--**	**8**
Rescue (Emergency)	**2.7**	**2.2**	**4.5**	**383**
Total	**2.5**	**1.6**	**2.9**	**32,837**
Emergency	**2.5**	**1.6**	**2.9**	**32,386**
Non-Emergency	**2.3**	**2.0**	**3.7**	**370**

[1]Sample sizes reflect the total number of first dispatches made by RFD units during 2017 per program and call status noted; unit dispatch dates and times were missing for eight emergency calls (i.e., three EMS related and five fire related), call received dates and times were missing for 5,789 calls, and event descriptions to permit program classifications were missing for 81 calls.

Fire Services

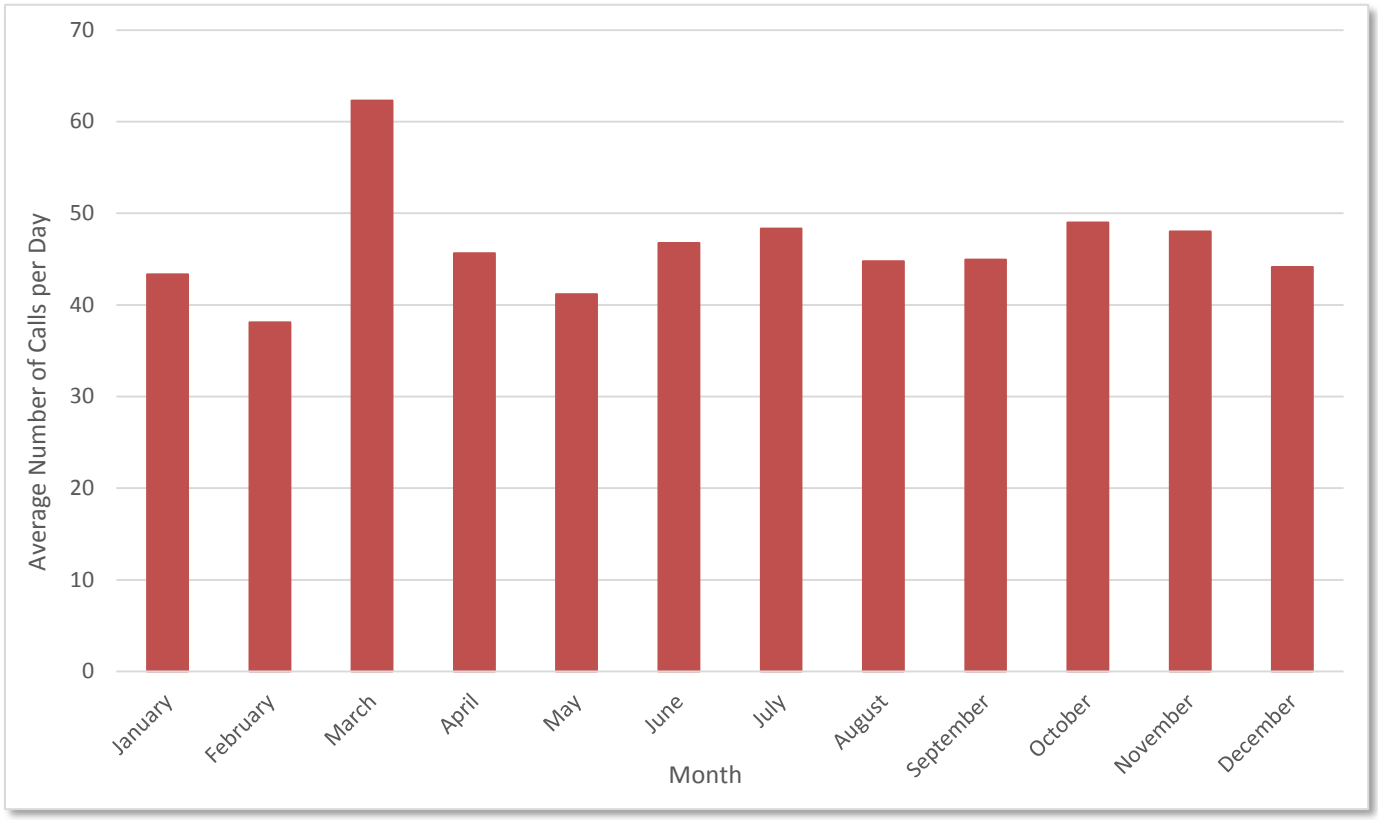
Temporal analyses were conducted to evaluate patterns in community demands for fire related services. These analyses examined the frequency of requests for service in 2017 by month, day of week, and hour of day. Results found that there was variability by month (Table 14; Figure 23). The three months with the most fire related calls in descending order were: March (62.3 per day), October (49.0 per day), and July (48.3 per day). The three months with the fewest fire related calls in ascending order were: February (38.1 per day), May (41.2 per day), and January (43.4 per day).

Table 14: Total Fire Related Calls and Average Calls per Day by Month

Month	Number of Calls	Average Calls per Day	Call Percentage
January	1,344	43.4	7.9
February	1,067	38.1	6.3
March[1]	1,932	62.3	11.4
April	1,369	45.6	8.1
May	1,276	41.2	7.5
June	1,403	46.8	8.3
July	1,498	48.3	8.8
August	1,388	44.8	8.2
September	1,348	44.9	8.0
October	1,519	49.0	9.0
November	1,441	48.0	8.5
December	1,369	44.2	8.1
Total	**16,954**	**46.4**	**100.0**

[1]A great windstorm took place in the Rochester area on March 8, 2017.

Figure 23: Average Fire Related Calls per Day by Month[1]



[1]A great windstorm took place in the Rochester area on March 8, 2017.

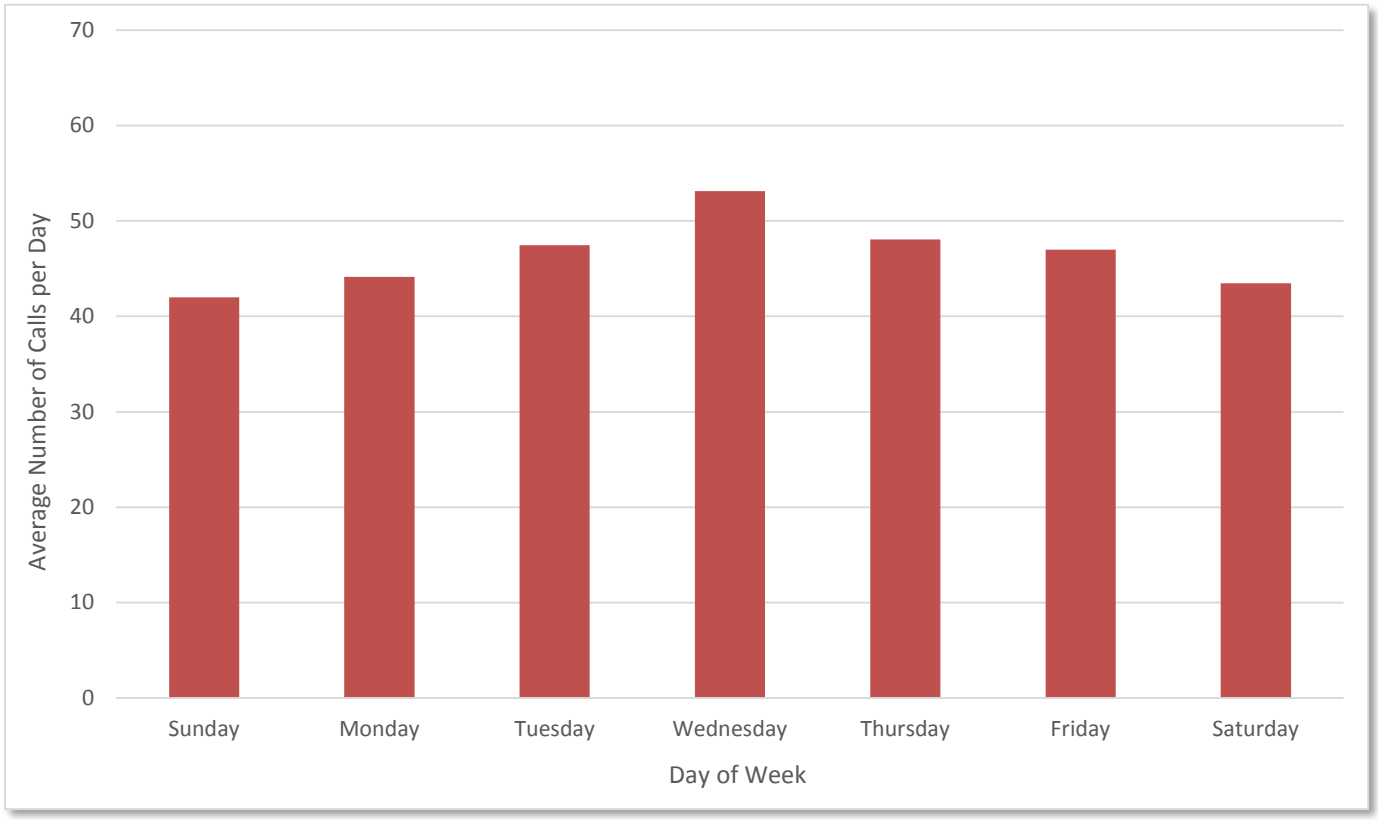
Similar analyses were conducted for fire related calls by day of week (Table 15; Figure 24). The data revealed that there is some variability in the demand for services by day of week. The three days with the most fire related calls in descending order were: Wednesday (53.1 per day), Thursday (48.1 per day), and Tuesday (47.4 per day). The three days with the fewest fire related calls in ascending order were: Sunday (42.0 per day), Saturday (43.5 per day), and Monday (44.2 per day).

Table 15: Total Fire Related Calls and Average Calls per Day by Day of Week

Day of Week	Number of Calls	Average Calls per Day	Call Percentage
Sunday[1]	2,226	42.0	13.1
Monday	2,296	44.2	13.5
Tuesday	2,467	47.4	14.6
Wednesday	2,763	53.1	16.3
Thursday	2,499	48.1	14.7
Friday	2,443	47.0	14.4
Saturday	2,260	43.5	13.3
Total	**16,954**	**46.4**	**100.0**

[1]There were 53 Sundays during 2017, and 52 of all other days of the week during 2017.

Figure 24: Average Fire Related Calls per Day by Day of Week

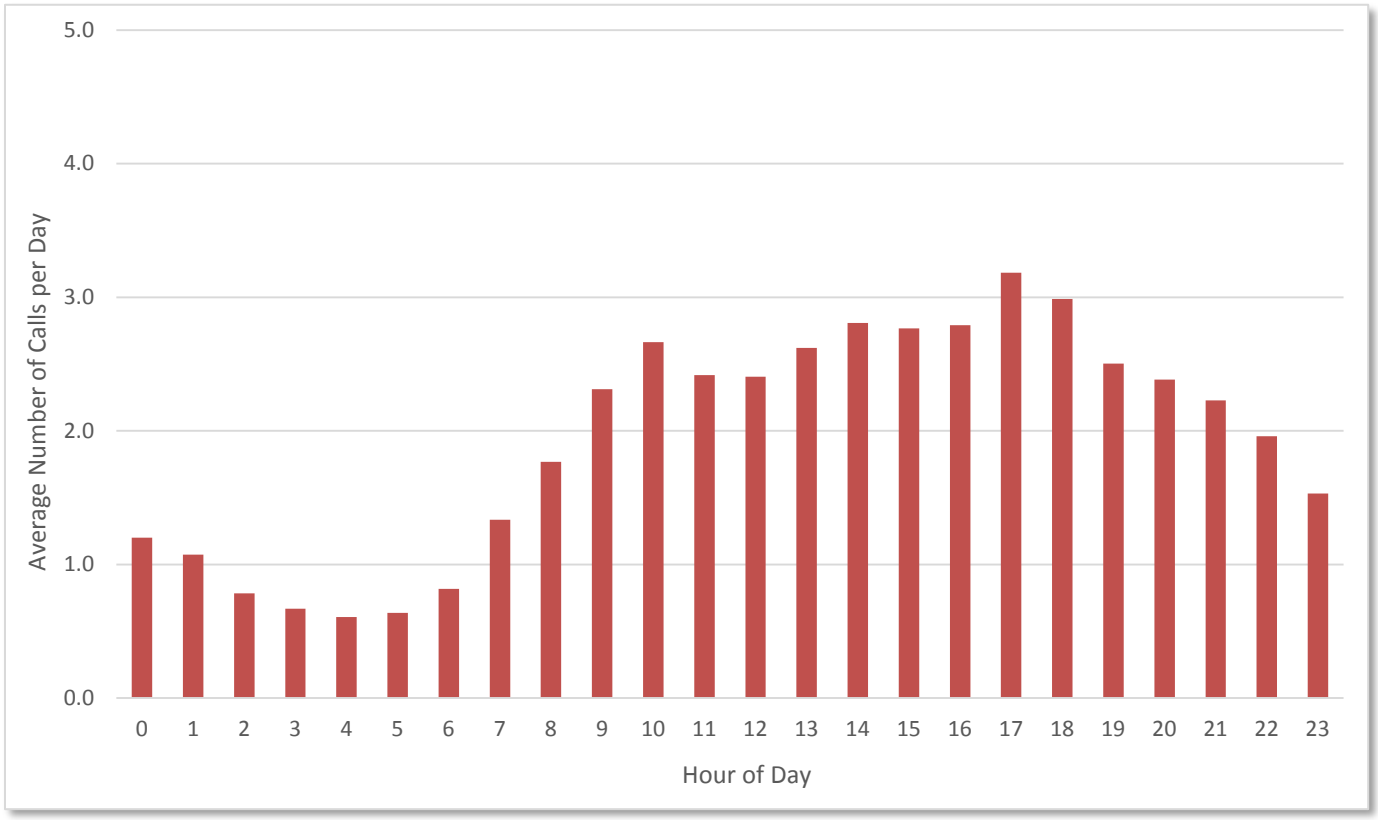


Fire related calls were also evaluated by hour of the day (Table 16; Figure 25). Some variability exists in the time of day that requests for fire related services were received. The hours from 0200 to 0600 had the lowest demands, where average number of calls per day for each of those hours ranged from 0.6 to 0.8. The highest demand for fire related services occurred at 1700 (1,162 total calls during this hour in 2017) and at 1800 (1,090 total calls during this hour in 2017), where average number of calls per day during those hours was 3.2 and 3.0, respectively.

Table 16: Total Fire Related Calls and Average Calls per Day by Hour of Day

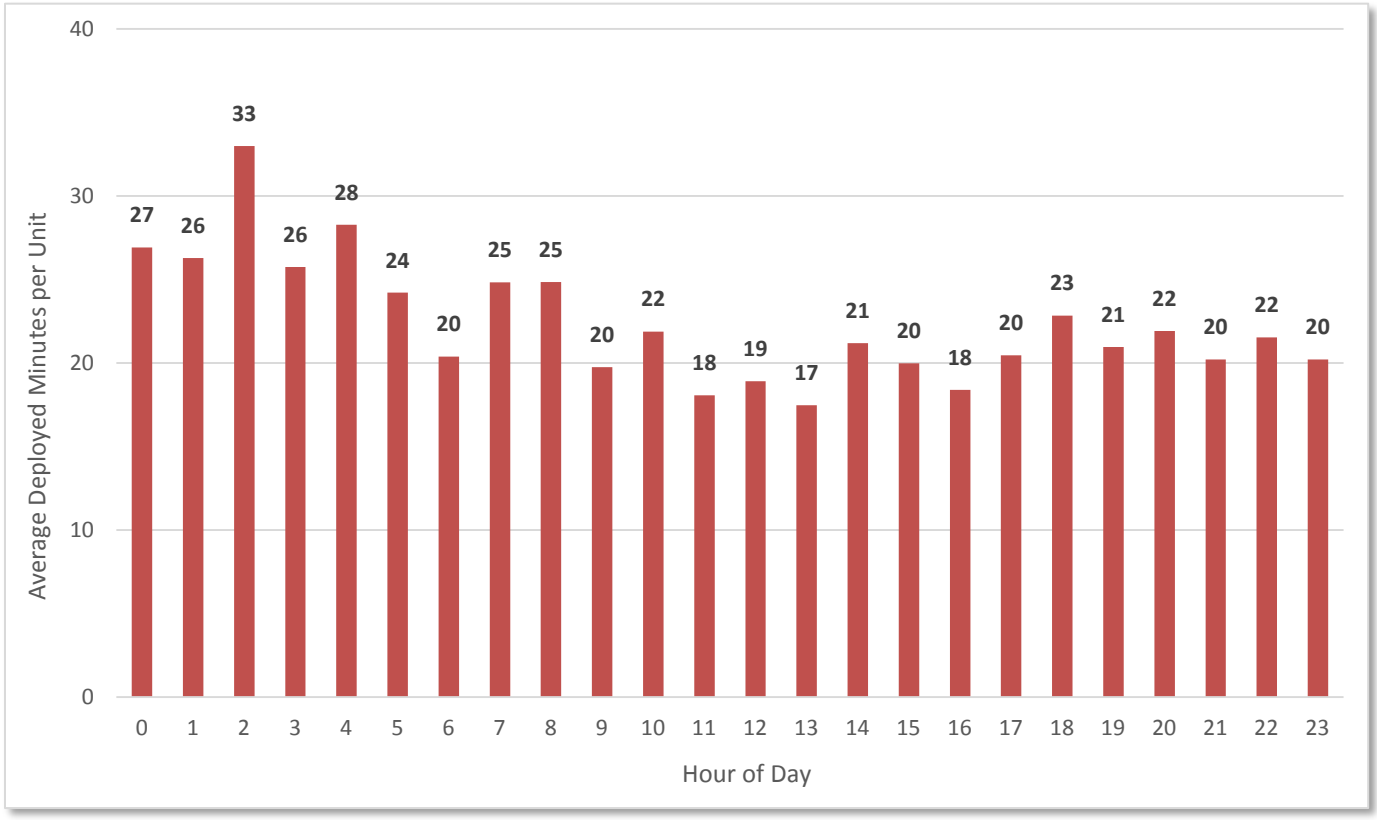
Hour of Day	Number of Calls	Average Calls per Day	Call Percentage
0	438	1.2	2.6
1	392	1.1	2.3
2	286	0.8	1.7
3	244	0.7	1.4
4	221	0.6	1.3
5	233	0.6	1.4
6	298	0.8	1.8
7	487	1.3	2.9
8	645	1.8	3.8
9	844	2.3	5.0
10	972	2.7	5.7
11	882	2.4	5.2
12	878	2.4	5.2
13	957	2.6	5.6
14	1,025	2.8	6.0
15	1,010	2.8	6.0
16	1,019	2.8	6.0
17	1,162	3.2	6.9
18	1,090	3.0	6.4
19	914	2.5	5.4
20	870	2.4	5.1
21	813	2.2	4.8
22	715	2.0	4.2
23	559	1.5	3.3
Total	**16,954**	**46.4**	**100.0**

Figure 25: Average Fire Related Calls per Day by Hour of Day



In addition, the average time on task was evaluated to assess the demand for resources through the lens of time commitment per hour of day (Figure 26). Understanding that many fire related incidents require multi-unit responses, this analysis incorporates unit-level activity. Overall, RFD was busy for an average of 21.4 minutes per unit-level response to fire related calls (Table 2).

Figure 26: Average Deployed Minutes per Unit by Hour of Day for Fire Related Responses



Fire related requests accounted for 48.6% of the total requests for service during 2017 and averaged 46.4 requests per day (Figure 1; Table 1). Fire related incidents are an aggregated category of the various final incident types available in the CAD data file. Table 17 provides details of these fire related incidents by nature of the call (i.e., variable "EventTypeDescription" in the CAD data file). "FIRE RESPONSE / READ REMARKS" was the most frequent community demand (4,500/16,954 or 26.5% of calls), followed by "AUTOMATIC FIRE ALARM" (3,503/16,954 or 20.7% of calls).

Table 17: Total Fire Related Calls by Nature of Call

Nature of Call[1]	Number of Calls	Percentage of Total Fire Service Demands
FIRE RESPONSE / READ REMARKS	4,500	26.5
AUTOMATIC FIRE ALARM	3,503	20.7
FUMES INCIDENT	2,302	13.6
SMOKE/CO DETECTOR INSTALLATION	1,838	10.8
FUMES INCIDENT/CO DETECTOR	878	5.2
SEE/SMELL SMOKE/APPLIANCE FIRE	712	4.2
STRUCTURE FIRE	581	3.4
PROBLEMS / OUTSIDE	578	3.4
FILL-IN REQUEST	454	2.7
FIRE BOX ALARM	406	2.4
WATER PROBLEM	367	2.2
BURNIN TREE/OBJECT/TRANSFORMER	334	2.0
VEHICLE FIRES	276	1.6
REQUEST FOR IMMEDIATE ASST	120	0.7
WATERFLOW ALARM	93	0.5
HYDRANT IN OR OUT OF SERVICE	12	0.1
Total	**16,954**	**100.0**

[1]Entries are presented verbatim from the CAD data file.

RFD made a total of 26,272 responses to fire related calls (Table 2; Table 18). Total busy time was 8,666.3 hours, and the average busy minutes per response was 21.4 minutes. The five most utilized units based on busy hours were B2 (496.8 hours), E17 (461.8 hours), B1 (456.7 hours), E16 (445.2 hours), and T10 (443.8 hours; Table 18). E2, E7, E1, E13, and E16 made the most responses during 2017 with 1,377, 1,375, 1,339, 1,311, and 1,305 responses, respectively.

Table 18: Workload by Unit for Fire Related Calls

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
1051 Emerson Street	E3	Engine	819	724	314.3	26.1
	Station Total		**819**	**724**	**314.3**	**26.1**
1215 N. Clinton Avenue	E2	Engine	1,495	1,377	431.9	18.8
	Station Total		**1,495**	**1,377**	**431.9**	**18.8**
1261 South Avenue	T3	Truck	1,088	1,019	335.7	19.8
	Station Total		**1,088**	**1,019**	**335.7**	**19.8**
1477 Dewey Avenue	E10	Engine	1,105	974	373.8	23.0
	T2	Truck	956	856	307.4	21.5
	Station Total		**2,061**	**1,830**	**681.2**	**22.3**
160 Wisconsin Street	E12	Engine	956	851	294.4	20.8
	Station Total		**956**	**851**	**294.4**	**20.8**
185 N. Chestnut Street	E17	Engine	1,311	1,246	461.8	22.2
	R11	Rescue	754	723	261.4	21.7
	Station Total		**2,065**	**1,969**	**723.2**	**22.0**
2695 W. Henrietta Road	E8	Engine	684	659	210.0	19.1
	Station Total		**684**	**659**	**210.0**	**19.1**
272 Allen Street	E13	Engine	1,431	1,311	419.6	19.2
	T10	Truck	1,249	1,202	443.8	22.2
	Station Total		**2,680**	**2,513**	**863.4**	**20.6**
315 Monroe Avenue	E1	Engine	1,426	1,339	419.6	18.8
	Station Total		**1,426**	**1,339**	**419.6**	**18.8**

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
4090 Lake Avenue	E19	Engine	491	431	143.4	20.0
	Station Total		**491**	**431**	**143.4**	**20.0**
450 Lyell Avenue	E5	Engine	1,432	1,272	377.9	17.8
	Station Total		**1,432**	**1,272**	**377.9**	**17.8**
57 Gardiner Avenue	T5	Truck	1,384	1,218	409.2	20.2
	Station Total		**1,384**	**1,218**	**409.2**	**20.2**
704 Hudson Avenue	E16	Engine	1,442	1,305	445.2	20.5
	T6	Truck	1,060	999	371.6	22.3
	Station Total		**2,502**	**2,304**	**816.8**	**21.3**
740 N. Goodman Street	E9	Engine	1,372	1,242	420.3	20.3
	Station Total		**1,372**	**1,242**	**420.3**	**20.3**
873 Genesee Street	E7	Engine	1,517	1,375	407.3	17.8
	Station Total		**1,517**	**1,375**	**407.3**	**17.8**
977 University Avenue	T4	Truck	1,227	1,174	377.2	19.3
	Station Total		**1,227**	**1,174**	**377.2**	**19.3**
Admin on Call	Car 1	Car	20	9	9.4	62.4
	Station Total		**20**	**9**	**9.4**	**62.4**
Admin on Call	Car 2	Car	17	10	9.3	56.0
	Station Total		**17**	**10**	**9.3**	**56.0**
Other[3]	B1	Battalion Chief	873	841	456.7	32.6
	B2	Battalion Chief	1,179	1,140	496.8	26.1
	Car 99	Car	757	733	297.5	24.3
	DC	Line Deputy	227	214	170.9	47.9
Department Total			**26,272**	**24,244**	**8,666.3**	**21.4**

[1]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[2]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[3]Units were originally assigned by the department to physical address locations, but were subsequently requested by the department to be presented separately here.

We also analyzed number of responding RFD units by fire related call type (Table 19). Overall, 79.7% of fire related calls were responded to by one unit, and 9.7% were responded to by two units. However, for structure fire calls, 84.5% of calls (486/575) were responded to by seven or more units (Table 19; Figure 27; Table 20). The maximum number of units responding to a structure fire call was 19 (Table 20). RFD was busy on structure fire calls for 2,639.2 hours during 2017 (Table 21), making 4,726 responses to 575 structure fire calls and averaging 8.2 responses per call.

Table 19: Number of Responding Units by Fire Related Call Type

Call Category	Number of Responding Units							Total
	1	2	3	4	5	6	7 or more	
Fire Alarm	3,082	710	90	23	1	0	1	3,907
Fire Other	9,514	798	522	229	47	9	244	11,363
Outside Fire	304	28	1	1	0	0	0	334
Structure Fire	13	1	13	51	11	0	486	575
Vehicle Fire	200	61	11	1	1	0	1	275
Total	**13,113**	**1,598**	**637**	**305**	**60**	**9**	**732**	**16,454**
Percentage	**79.7**	**9.7**	**3.9**	**1.9**	**0.4**	**0.1**	**4.4**	**100.0**

Figure 27: Percentage of Structure Fire Calls by Number of Responding Units

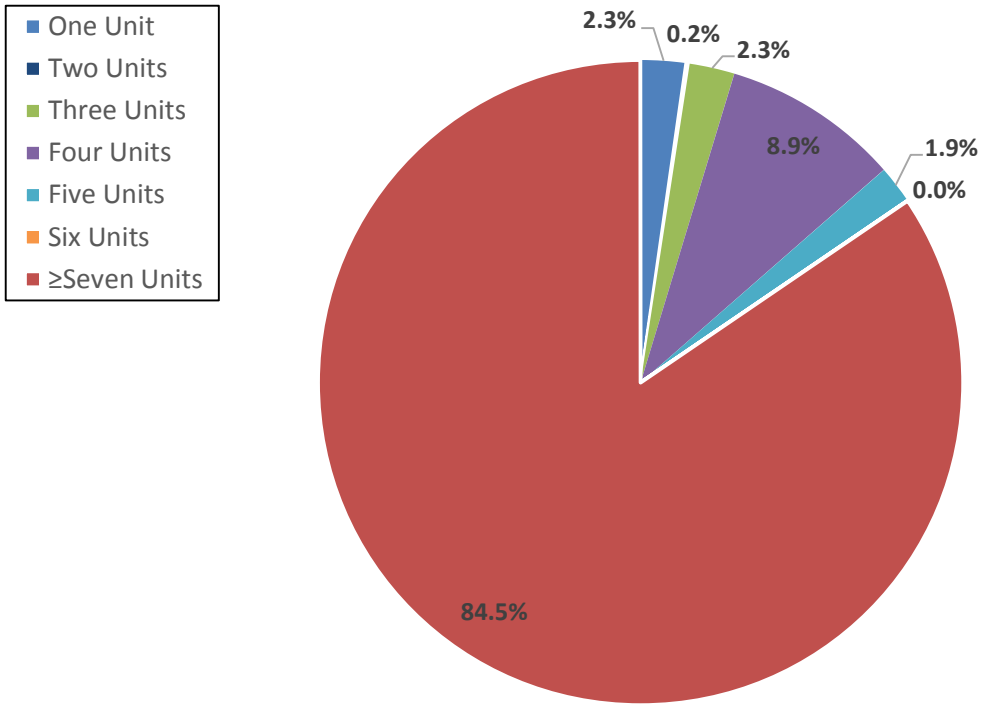


Table 20: Number of Responding Units for Structure Fire Calls

Number of Responding Units	Number of Calls
1	13
2	1
3	13
4	51
5	11
6	0
7	8
8	204
9	161
10	69
11	17
12	6
13	2
14	5
15	4
16	3
17	4
18	2
19	1
Total	**575**

Table 21: Workload by Unit for Fire Related Calls – Structure Fires

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
1051 Emerson Street	E3	Engine	110	108	68.1	37.9
	Station Total		**110**	**108**	**68.1**	**37.9**
1215 N. Clinton Avenue	E2	Engine	172	169	113.3	40.2
	Station Total		**172**	**169**	**113.3**	**40.2**
1261 South Avenue	T3	Truck	85	82	44.8	32.8
	Station Total		**85**	**82**	**44.8**	**32.8**
1477 Dewey Avenue	E10	Engine	117	114	76.4	40.2
	T2	Truck	163	157	96.7	36.9
	Station Total		**280**	**271**	**173.1**	**38.3**
160 Wisconsin Street	E12	Engine	86	83	42.1	30.4
	Station Total		**86**	**83**	**42.1**	**30.4**
185 N. Chestnut Street	E17	Engine	240	232	108.2	28.0
	R11	Rescue	464	450	174.3	23.2
	Station Total		**704**	**682**	**282.5**	**24.9**
2695 W. Henrietta Road	E8	Engine	25	24	14.4	36.1
	Station Total		**25**	**24**	**14.4**	**36.1**
272 Allen Street	E13	Engine	242	235	123.0	31.4
	T10	Truck	299	296	180.0	36.5
	Station Total		**541**	**531**	**303.0**	**34.2**
315 Monroe Avenue	E1	Engine	151	145	69.4	28.7
	Station Total		**151**	**145**	**69.4**	**28.7**
4090 Lake Avenue	E19	Engine	24	20	10.0	30.1
	Station Total		**24**	**20**	**10.0**	**30.1**
450 Lyell Avenue	E5	Engine	215	205	115.6	33.8
	Station Total		**215**	**205**	**115.6**	**33.8**
57 Gardiner Avenue	T5	Truck	159	153	89.6	35.1
	Station Total		**159**	**153**	**89.6**	**35.1**

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
704 Hudson Avenue	E16	Engine	179	174	125.4	43.2
	T6	Truck	260	252	159.9	38.1
	Station Total		**439**	**426**	**285.3**	**40.2**
740 N. Goodman Street	E9	Engine	175	167	102.8	36.9
	Station Total		**175**	**167**	**102.8**	**36.9**
873 Genesee Street	E7	Engine	136	127	65.5	31.0
	Station Total		**136**	**127**	**65.5**	**31.0**
977 University Avenue	T4	Truck	156	150	80.0	32.0
	Station Total		**156**	**150**	**80.0**	**32.0**
Admin on Call	Car 1	Car	17	7	6.8	58.2
	Station Total		**17**	**7**	**6.8**	**58.2**
Admin on Call	Car 2	Car	14	7	8.7	74.3
	Station Total		**14**	**7**	**8.7**	**74.3**
Other[3]	B1	Battalion Chief	258	255	196.7	46.3
	B2	Battalion Chief	318	308	200.4	39.0
	Car 99	Car	478	470	227.1	29.0
	DC	Line Deputy	183	179	140.1	47.0
Department Total			**4,726**	**4,569**	**2,639.2**	**34.7**

[1]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[2]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[3]Units were originally assigned by the department to physical address locations, but were subsequently requested by the department to be presented separately here.

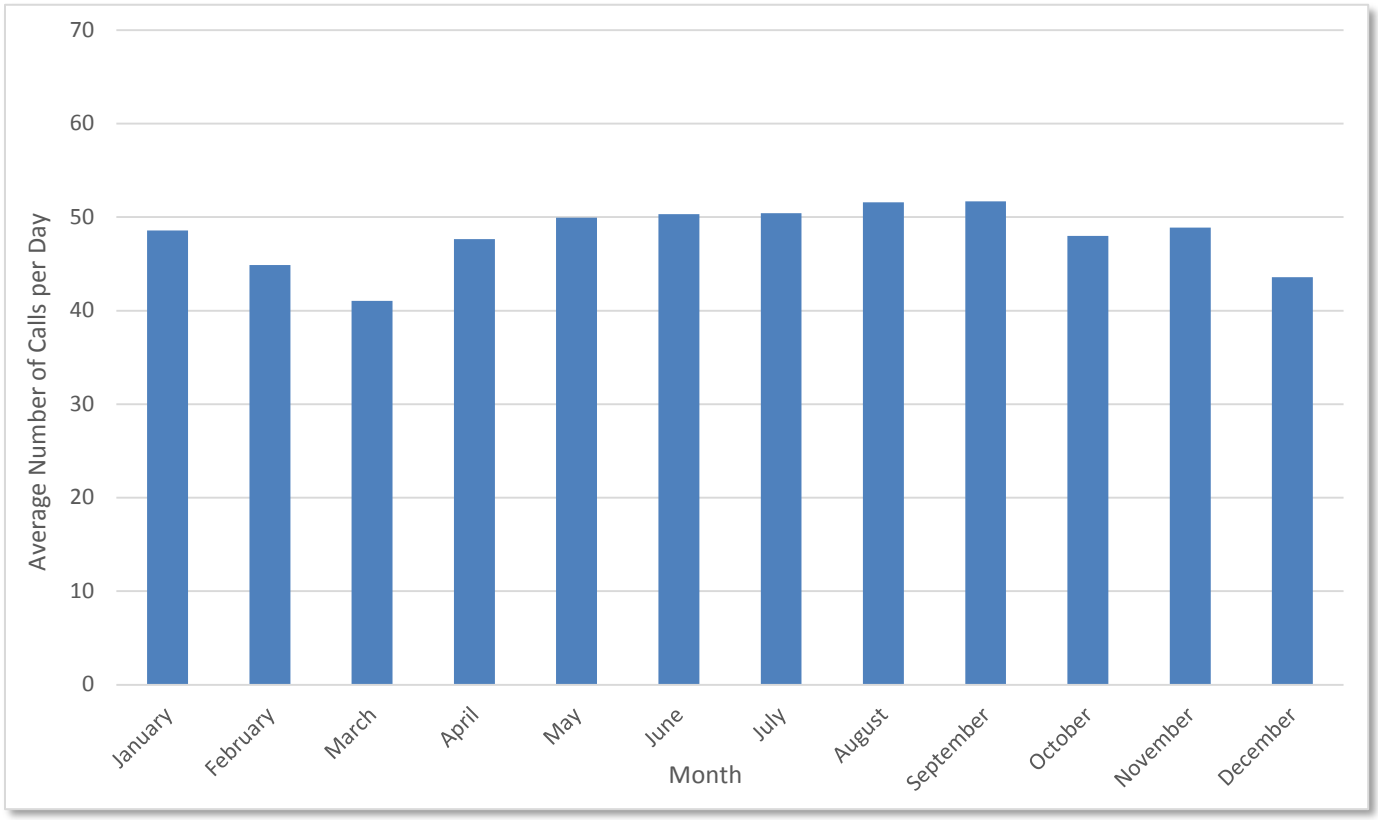
Emergency Medical Services

Temporal analyses were conducted to evaluate patterns in community demands for EMS related services. These analyses examined the frequency of requests for service in 2017 by month, day of week, and hour of day. Results found that there was variability by month (Table 22; Figure 28). The three months with the most EMS related calls in descending order were: September (51.7 per day), August (51.6 per day), and July (50.4 per day). The three months with the fewest EMS related calls in ascending order were: March (41.0 per day), December (43.6 per day), and February (44.9 per day).

Table 22: Total EMS Related Calls and Average Calls per Day by Month

Month	Number of Calls	Average Calls per Day	Call Percentage
January	1,506	48.6	8.6
February	1,257	44.9	7.2
March	1,272	41.0	7.3
April	1,429	47.6	8.1
May	1,548	49.9	8.8
June	1,509	50.3	8.6
July	1,563	50.4	8.9
August	1,599	51.6	9.1
September	1,551	51.7	8.8
October	1,488	48.0	8.5
November	1,466	48.9	8.4
December	1,351	43.6	7.7
Total	**17,539**	**48.1**	**100.0**

Figure 28: Average EMS Related Calls per Day by Month



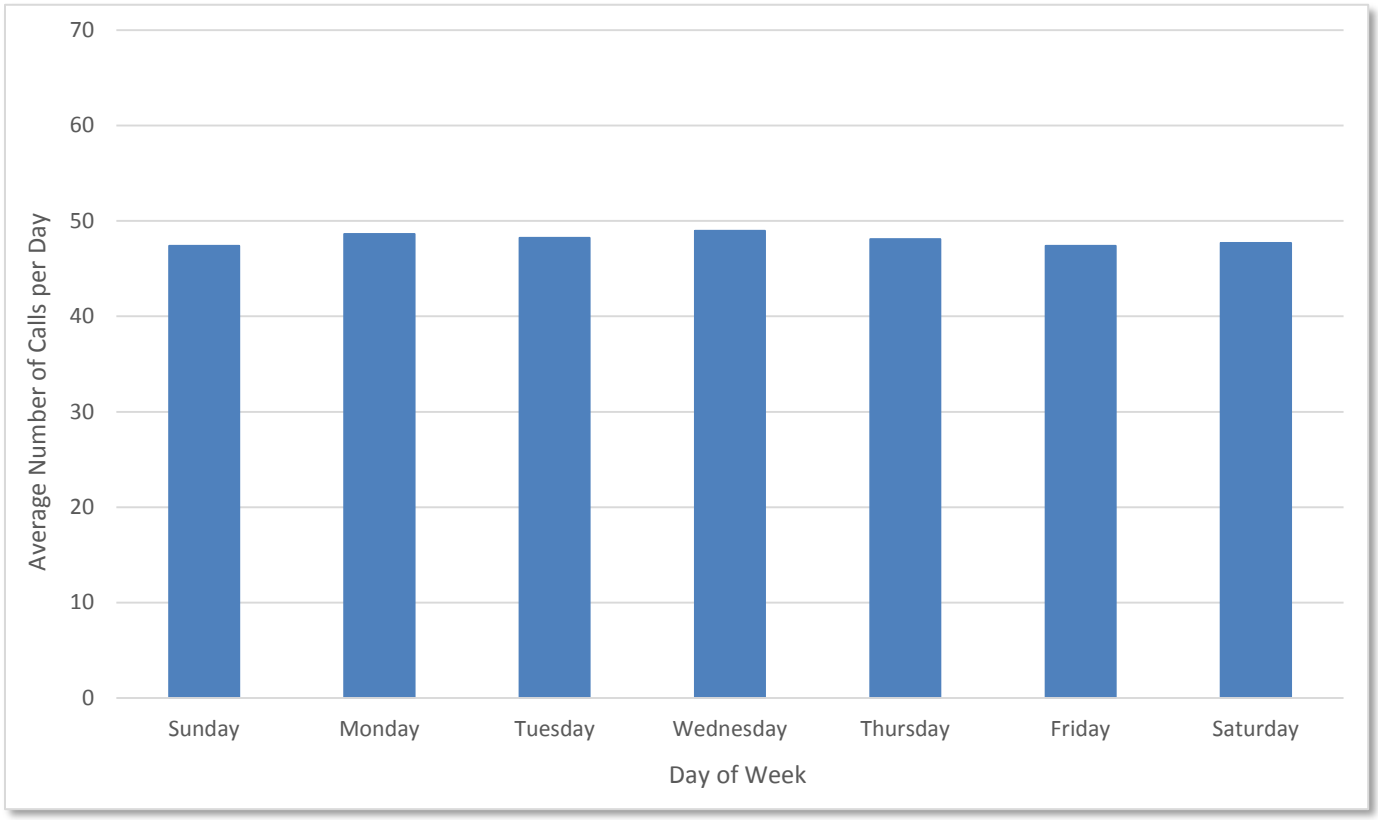
Similar analyses were conducted for EMS related calls by day of week (Table 23; Figure 29). The data revealed that there was slight variability in demand for services by day of week. Wednesday had the highest frequency of requests for EMS related services, averaging 49.0 calls per day and accounting for 14.5% of all EMS related calls. Sunday had the lowest frequency of requests for EMS related services, averaging 47.4 calls per day and accounting for 14.3% of all EMS related calls.

Table 23: Total EMS Related Calls and Average Calls per Day by Day of Week

Day of Week	Number of Calls	Average Calls per Day	Call Percentage
Sunday[1]	2,511	47.4	14.3
Monday	2,528	48.6	14.4
Tuesday	2,508	48.2	14.3
Wednesday	2,546	49.0	14.5
Thursday	2,501	48.1	14.3
Friday	2,465	47.4	14.1
Saturday	2,480	47.7	14.1
Total	**17,539**	**48.1**	**100.0**

[1]There were 53 Sundays during 2017, and 52 of all other days of the week during 2017.

Figure 29: Average EMS Related Calls per Day by Day of Week

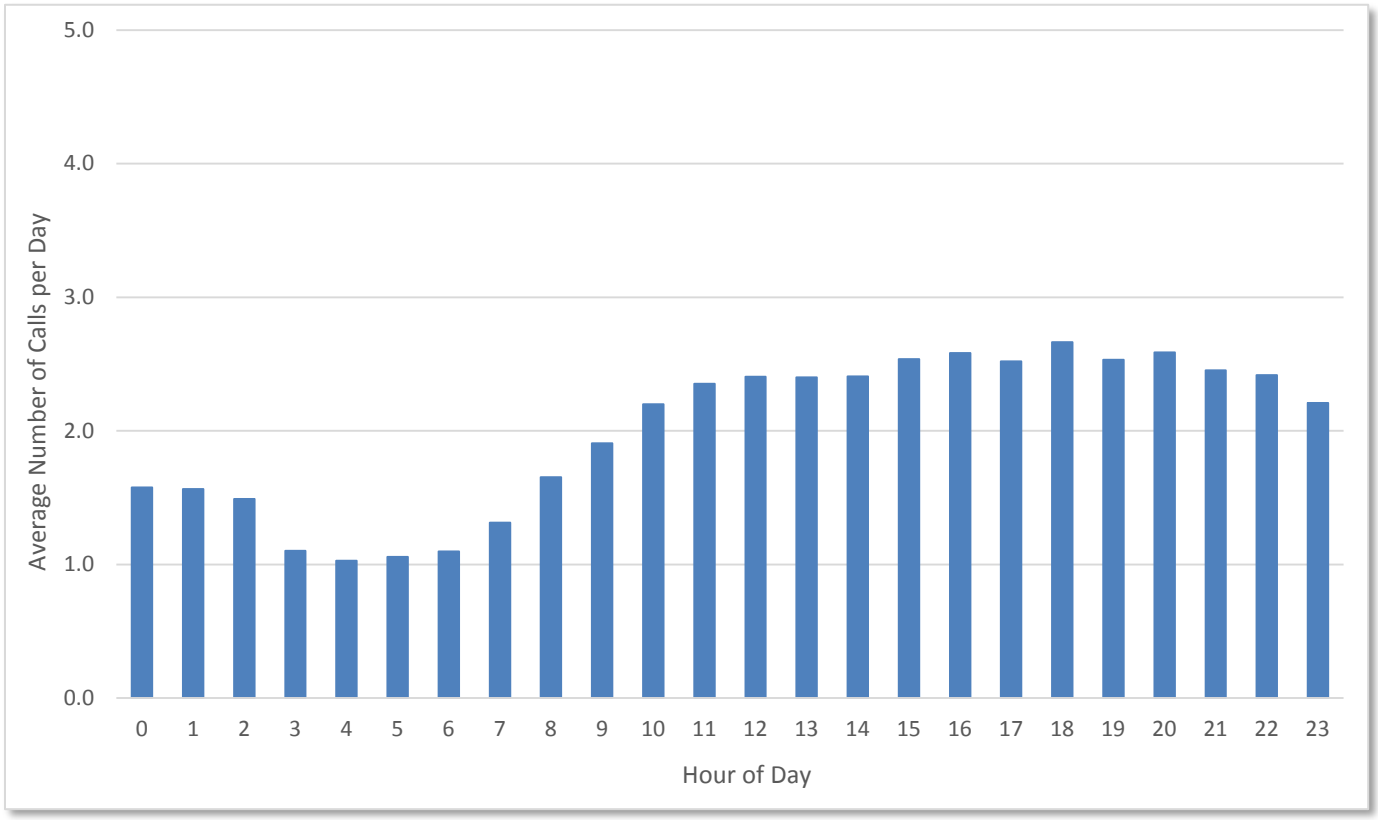


EMS related calls were also evaluated by hour of the day (Table 24; Figure 30). Variability exists in the time of day that requests for EMS related services were received. The hours from 0300 to 0600 had the lowest demands, where average number of calls per day for each of those hours ranged from 1.0 to 1.1. The highest demand for EMS related services occurred at 1800, where average number of calls per day during that hour was 2.7.

Table 24: Total EMS Related Calls and Average Calls per Day by Hour of Day

Hour of Day	Number of Calls	Average Calls per Day	Call Percentage
0	575	1.6	3.3
1	571	1.6	3.3
2	544	1.5	3.1
3	402	1.1	2.3
4	375	1.0	2.1
5	386	1.1	2.2
6	401	1.1	2.3
7	479	1.3	2.7
8	603	1.7	3.4
9	696	1.9	4.0
10	803	2.2	4.6
11	859	2.4	4.9
12	878	2.4	5.0
13	876	2.4	5.0
14	879	2.4	5.0
15	926	2.5	5.3
16	943	2.6	5.4
17	920	2.5	5.2
18	972	2.7	5.5
19	924	2.5	5.3
20	944	2.6	5.4
21	895	2.5	5.1
22	882	2.4	5.0
23	806	2.2	4.6
Total	**17,539**	**48.1**	**100.0**

Figure 30: Average EMS Related Calls per Day by Hour of Day



EMS related requests accounted for 50.3% of the total requests for service during 2017 and averaged 48.1 requests per day (Figure 1; Table 1). EMS related incidents are an aggregated category of the various final incident types available in the CAD data file. Table 25 provides details for these EMS related incidents by nature of the call (i.e., variable "EventTypeDescription" in the CAD data file). "TRB BREATHING- DIFF SPEAKING" was the most frequent community demand (3,035/17,539 or 17.3% of calls). "CHEST PAIN -CLAMMY" was the second most frequent community demand (1,205/17,539 or 6.9% of calls).

Table 25: Total EMS Related Calls by Nature of Call

Nature of Call[1]	Number of Calls	Percentage of Total EMS Demands
TRB BREATHING- DIFF SPEAKING	3,035	17.3
CHEST PAIN -CLAMMY	1,205	6.9
MVAIA - W/INJURIES	1,169	6.7
EMS / FIRST RESPONDER	916	5.2
UNKNOWN PROB-LIFE STATUS	915	5.2
CHEST PAIN- DIFF SPEAKING	827	4.7
TRB BREATHING- CLAMMY	754	4.3
CONV/SEIZURES CONTINOUS/MULT	753	4.3
UNCON/FAINT-NOT ALERT	685	3.9
UNCONSC W/ EFFECTIVE BREATHING	535	3.1
CARDIAC/RESP-NOT BREATHING	512	2.9
TRB BREATHING- NOT ALERT	497	2.8
PREGNANCY - IMMINT DEL/20WKS	467	2.7
OD/POIS - UNCONSIOUS	458	2.6
SICKNESS-NOT ALERT	454	2.6
MVA-AUTO/PEDESTRIAN	396	2.3
HEMORR/LACER-DANGEROUS	369	2.1
FALLS/BACK INJ-NOT ALERT	270	1.5
HEMMOR/LACER-ABNORMAL BREATH	258	1.5
UNCONSCIOUS- AGONAL/INEFF BRTH	257	1.5
CONV/SEIZ->35 BREATH NOT VERIF	229	1.3
STABBING- CENTRAL WOUNDS	206	1.2
MVA-AUTO/BIKE/MOTORCYCLE	182	1.0
CHEST PAIN - NOT ALERT	160	0.9
HEART PROB-CLAMMY	153	0.9
GUNSHOT - CENTRAL WOUNDS	149	0.8
DIABETIC - UNCONSCIOUS	122	0.7
CARDIAC/RESP-BREATHING AGONAL	117	0.7
HEMORR/LACER-NOT ALERT	102	0.6
ALLERGIES - DIFF SPEAKING	99	0.6

Nature of Call[1]	Number of Calls	Percentage of Total EMS Demands
CHOKING-ABNORM BRTH/PART OBS	93	0.5
ASSAULT-NOT ALERT	88	0.5
HEART PROBLEM- DIFF SPEAKING	81	0.5
ABDOM PAIN-NOT ALERT	75	0.4
CARDIAC/RESP-INEFFECT BREATH	64	0.4
MVAIA - NOT ALERT	58	0.3
ASSAULT-UNCON/ARREST	52	0.3
FALLS/BACK INJ-LONG FALL >6FT	48	0.3
HEART PROB-NOT ALERT	44	0.3
ASLT-CHEST/NECK INJ-TRB BREATH	38	0.2
TR/BREATHING-INEFECTIVE BREATH	36	0.2
MVA - W/INJURIES/OTHER HAZARDS	35	0.2
TRAUMATIC INJ- NOT ALERT	35	0.2
OD/POIS-CHANGING COLOR	33	0.2
ASSAULT-MULTIPLE VICTIMS	31	0.2
FALL- UNCONSCIOUS/ARREST	31	0.2
MVA-NOT DANGEROUS INJ	27	0.2
CONV/SEIZ- AGONAL/INEFF BREATH	26	0.1
HEMORR/LACER-THROUGH TUBES	24	0.1
TRAUMATIC INJ-CHEST/NECK INJ	24	0.1
FALLS/CHEST/NECK INJ-TRB BREAT	23	0.1
ALLERGIES-NOT ALERT	22	0.1
MVA- SERIOUS HEMORRHAGE	21	0.1
HEMORRHAGE THRU FISTULA	17	0.1
CHOKING-COMPL OBSTR/INEFF BRTH	16	0.1
STABBING- NOT ALERT	14	0.1
TRB BREATHING- CHANGING COLOR	13	0.1
BACK PAIN / NOT ALERT	11	0.1
UNCON/FAINT-INEFECTIVE BREATH	11	0.1
CARDIAC/RESP-HANGING	10	0.1
CHEST PAIN- CHANGING COLOR	10	0.1
STABBING-MULTIPLE WOUNDS	10	0.1
FAINT- CHANGING COLOR	9	0.1
GUNSHOT - NOT ALERT	9	0.1
INTERFACILITY-CARD/RESP ARRES	9	0.1
FALL >=30 FT	8	0.0
GUNSHOT - UNCONSCIOUS	8	0.0
CARDIAC ARST/OBVIOUS/EXP/QUEST	7	0.0
MVAIA - EJECTED VICTIM	7	0.0

Nature of Call[1]	Number of Calls	Percentage of Total EMS Demands
PYSCH-DANGEROUS HEMMOR	7	0.0
STABBING	7	0.0
CHOKING - NOT ALERT	6	0.0
HEAT/COLD EXP-NOT ALERT	6	0.0
HEMORRHAGE-UNCONS/ARREST	6	0.0
MOTOR VEHICLE ACC W/INJURIES	6	0.0
PREG/BABY BORN W/O COMPLICAT	6	0.0
CONV/SEIZURES NOT BREATHING	5	0.0
EYE PROBLEM/INJ-NOT ALERT	5	0.0
PREGNANCY - BABY HEAD VISIBLE	5	0.0
STABBING- UNCONSCIOUS	5	0.0
MVA-ALL TERRAIN	4	0.0
PREGNANCY - BABY BORN W/ COMPL	4	0.0
PYSCH-DANGEROUS HEMMOR-VIOLENT	4	0.0
SEXUAL ASLT NOT ALERT	4	0.0
TRAUMATIC INJ- UNCONS/ARREST	4	0.0
ALLERGIES-BEE ATT/SWARMING	3	0.0
ANML BITE/ATTACK UNCONSCIOUS	3	0.0
PYSCH-DANG HEMORR-WEAP/VIOLENT	3	0.0
ANML BITE/ATTACK EXOTIC ANIMAL	2	0.0
GUNSHOT-MULTIPLE WOUNDS	2	0.0
MVAIA - BUS	2	0.0
PENETRATE-CENTRAL WOUNDS	2	0.0
SEXUAL ASLT-UNCON/ARREST	2	0.0
ANML BITE/ATTACK NOT ALERT	1	0.0
GUNSHOT - MULTIPLE VICTIMS	1	0.0
HEART PROB/ CHANGING COLORS	1	0.0
HEAT/COLD EXP-MULTIPLE VICTS	1	0.0
OBVIOUS DEATH (GSW TO HEAD)	1	0.0
PREGNANCY-BREECH OR CHORD	1	0.0
PYSCH-DANGEROUS HEMMOR-WEAPON	1	0.0
Total	**17,539**	**100.0**

[1]Entries are presented verbatim from the CAD data file.

RFD made a total of 18,467 responses to EMS related calls (Table 2; Table 26). Total busy time was 4,453.8 hours, and the average busy minutes per response was 14.8 minutes. The five most utilized units based on total busy hours were E2 (422.6 hours), E5 (395.2 hours), E16 (361.0 hours), E17 (357.9 hours), and E9 (327.1 hours; Table 26). E5, E2, E17, E16, and E9 made the most responses during 2017 with 1,765, 1,751, 1,528, 1,540, and 1,379 responses, respectively.

Table 26: Workload by Unit for EMS Related Calls

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
1051 Emerson Street	E3	Engine	574	558	145.8	15.7
	Station Total		**574**	**558**	**145.8**	**15.7**
1215 N. Clinton Avenue	E2	Engine	1,790	1,751	422.6	14.5
	Station Total		**1,790**	**1,751**	**422.6**	**14.5**
1261 South Avenue	T3	Truck	516	507	134.5	15.9
	Station Total		**516**	**507**	**134.5**	**15.9**
1477 Dewey Avenue	E10	Engine	939	917	241.3	15.8
	T2	Truck	590	571	160.2	16.8
	Station Total		**1,529**	**1,488**	**401.5**	**16.2**
160 Wisconsin Street	E12	Engine	664	650	181.7	16.8
	Station Total		**664**	**650**	**181.7**	**16.8**
185 N. Chestnut Street	E17	Engine	1,555	1,528	357.9	14.1
	R11	Rescue	36	25	9.6	23.1
	Station Total		**1,591**	**1,553**	**367.5**	**14.2**
2695 W. Henrietta Road	E8	Engine	364	358	103.6	17.4
	Station Total		**364**	**358**	**103.6**	**17.4**
272 Allen Street	E13	Engine	1,202	1,183	261.3	13.3
	T10	Truck	494	476	112.0	14.1
	Station Total		**1,696**	**1,659**	**373.3**	**13.5**
315 Monroe Avenue	E1	Engine	1,240	1,206	278.9	13.9
	Station Total		**1,240**	**1,206**	**278.9**	**13.9**

Station	Unit	Unit Type	Number of Responses[1]	Responses with Time Data[2]	Total Busy Hours	Average Busy Minutes per Response
4090 Lake Avenue	E19	Engine	422	410	142.5	20.9
	Station Total		**422**	**410**	**142.5**	**20.9**
450 Lyell Avenue	E5	Engine	1,801	1,765	395.2	13.4
	Station Total		**1,801**	**1,765**	**395.2**	**13.4**
57 Gardiner Avenue	T5	Truck	1,004	988	241.6	14.7
	Station Total		**1,004**	**988**	**241.6**	**14.7**
704 Hudson Avenue	E16	Engine	1,549	1,504	361.0	14.4
	T6	Truck	579	546	123.8	13.6
	Station Total		**2,128**	**2,050**	**484.8**	**14.2**
740 N. Goodman Street	E9	Engine	1,401	1,379	327.1	14.2
	Station Total		**1,401**	**1,379**	**327.1**	**14.2**
873 Genesee Street	E7	Engine	1,169	1,152	297.6	15.5
	Station Total		**1,169**	**1,152**	**297.6**	**15.5**
977 University Avenue	T4	Truck	504	494	128.0	15.6
	Station Total		**504**	**494**	**128.0**	**15.6**
Admin on Call	Car 1	Car	2	2	0.3	9.4
	Station Total		**2**	**2**	**0.3**	**9.4**
Admin on Call	Car 2	Car	1	1	0.2	10.9
	Station Total		**1**	**1**	**0.2**	**10.9**
Other[3]	B1	Battalion Chief	26	24	12.4	31.0
	B2	Battalion Chief	20	17	6.6	23.5
	Car 99	Car	21	17	6.5	22.8
	DC	Line Deputy	4	4	1.5	22.5
Department Total			**18,467**	**18,033**	**4,453.8**	**14.8**

[1]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[2]"Responses with Time Data" reflects the number of responses in the unit-level data file with available and logically sequenced dispatch and release times.
[3]Units were originally assigned by the department to physical address locations, but were subsequently requested by the department to be presented separately here.

RFD dispatched multiple units to 4.9% of EMS related calls (855/17,518; Table 27). On average, 1.1 units were dispatched per EMS related call (18,467/17,518; Table 2).

Table 27: Number of Responding Units by EMS Related Call Type

Call Category	Number of Responding Units							Total
	1	2	3	4	5	6	7 or more	
Cardiac and Stroke	2,991	129	5	0	0	1	1	3,127
Death	0	1	0	0	0	0	0	1
Difficulty Breathing	4,382	160	5	0	0	0	0	4,547
Fall and Injury	1,668	99	4	1	0	0	0	1,772
Illness and Other	2,838	134	6	0	0	1	0	2,979
MVA	1,767	120	10	1	1	3	3	1,905
Overdose and Psychiatric	14	1	0	0	0	0	0	15
Seizure and Unconsciousness	3,003	159	6	3	1	0	0	3,172
Total	**16,663**	**803**	**36**	**5**	**2**	**5**	**4**	**17,518**
Percentage	**95.1**	**4.6**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**100.0**

Transport

We analyzed outcomes of EMS calls through an examination of transport dates and times available in the RFD CAD data file. Calls were considered to be RFD transport calls if a transport date and time were reported for the call. Due to this imprecise identification method, data presented in this section are intended to be estimates only to potentially help guide decision making and action planning.

The number of EMS calls with reported dates and times totaled 16,993 (16,993 of 17,539 total EMS calls; 96.9%), averaging 46.6 transport calls per day (Table 28). Two calls were excluded from this analysis due to illogical or extreme call duration times (i.e., incident number 2017029761, call duration = -50.1 minutes, and incident number 2017023696, call duration = 1,676.0 minutes). Other than one obvious death call occurring during 2017, EMS calls classified as "Cardiac and Stroke" had the highest transport rate at 98.0%, followed by calls classified as "Difficulty Breathing" at 97.7%.

Duration of a call is defined as the difference between the call receipt and call closed dates and times. The average duration of a non-transport EMS call was 11.0 minutes, and the average duration of a transport EMS call was 16.0 minutes.

Table 28: EMS Non-Transport and Transport Calls by Call Type

	Non-Transport		Transport			
Call Category	Average Call Duration (Minutes)	Number of Calls[1]	Average Call Duration (Minutes)	Number of Calls[1]	Total Number of Calls[1]	Transport Rate (%)
Cardiac and Stroke	11.1	63	15.9	3,064	3,127	98.0
Death	--	0	17.1	1	1	100.0
Difficulty Breathing	13.2	103	15.2	4,448	4,551	97.7
Fall and Injury	10.8	72	15.9	1,703	1,775	95.9
Illness and Other	9.1	141	14.8	2,846	2,987	95.3
MVA	8.9	85	16.6	1,822	1,907	95.5
Overdose and Psychiatric	46.0	1	17.1	14	15	93.3
Seizure and Unconsciousness	13.7	81	18.1	3,093	3,174	97.4
Total	**11.0**	**546**	**16.0**	**16,991[2]**	**17,537[2]**	**96.9**

[1]"Number of Calls" reflects the original number of unique incidents appearing in the CAD data file as presented in Table 1.
[2]Two calls were excluded from this analysis due to illogical or extreme call duration times (i.e., incident number 2017029761, call duration = -50.1 minutes, and incident number 2017023696, call duration = 1,676.0 minutes).

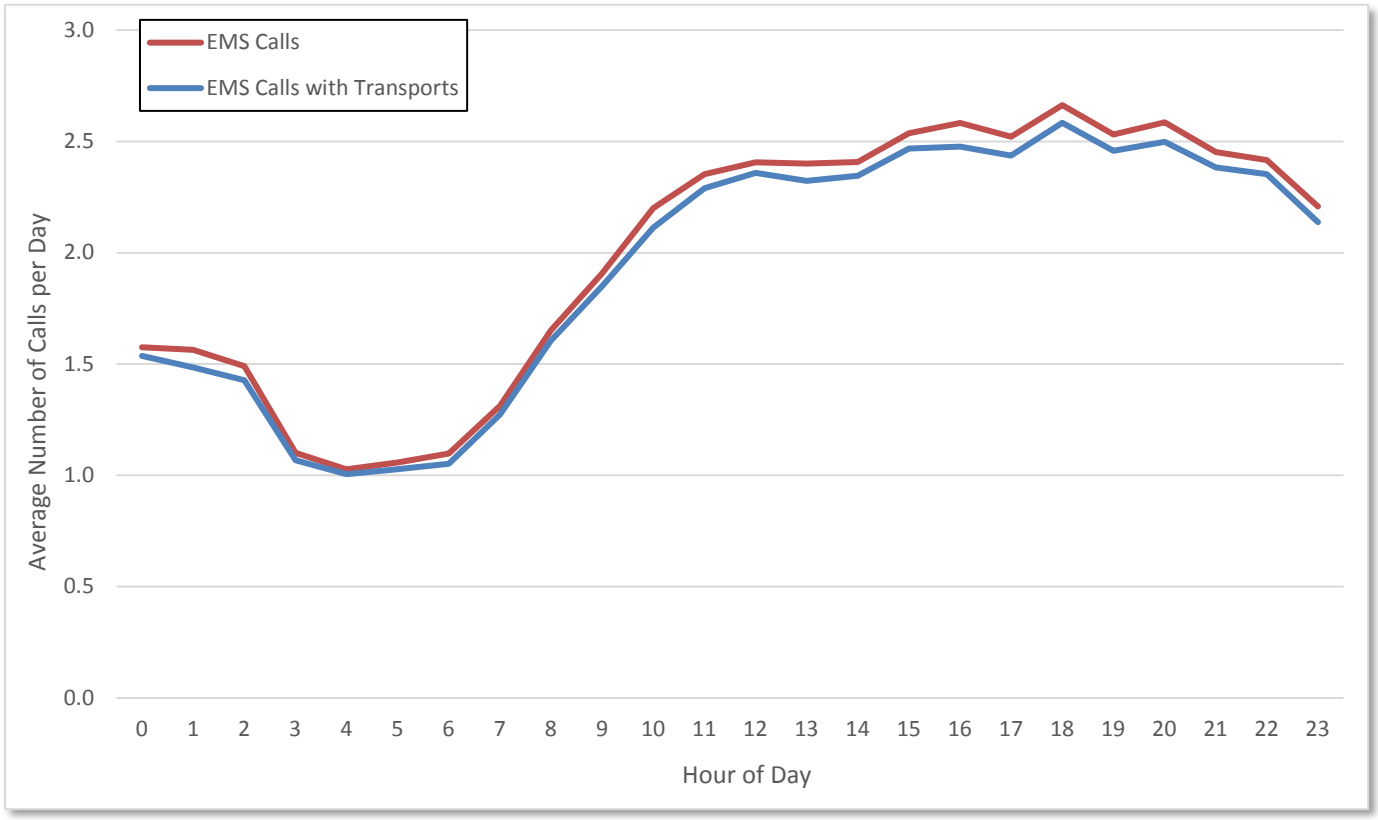
We also analyzed variation of total EMS requests and transport requests by hour of day (Table 29; Figure 31). The variation of total EMS requests and EMS transport requests followed a similar pattern. The busiest period for both EMS and EMS transport requests occurred at 1800, with 972 total EMS calls and 943 EMS transport calls. The peak transport rate occurred at 1200, wherein 861 of 878 EMS calls (98.1%) resulted in one or more patients being transported per call.

Table 29: Total EMS Calls and EMS Calls with Transports and Average Calls per Day by Hour of Day

Hour of Day	Number of EMS Calls[1]	Number of EMS Calls with Transports[1]	Average EMS Calls per Day	Average EMS Calls with Transports per Day	Transport Rate (%)
0	575	561	1.6	1.5	97.6
1	571	542	1.6	1.5	94.9
2	544	521	1.5	1.4	95.8
3	402	390	1.1	1.1	97.0
4	375	367	1.0	1.0	97.9
5	386	375	1.1	1.0	97.2
6	401	384	1.1	1.1	95.8
7	479	465	1.3	1.3	97.1
8	603	586	1.7	1.6	97.2
9	696	675	1.9	1.8	97.0
10	803	771	2.2	2.1	96.0
11	859	836	2.4	2.3	97.3
12	878	861	2.4	2.4	98.1
13	876	848	2.4	2.3	96.8
14	879	856	2.4	2.3	97.4
15	926	901	2.5	2.5	97.3
16	943	904	2.6	2.5	95.9
17	920	889	2.5	2.4	96.6
18	972	943	2.7	2.6	97.0
19	924	897	2.5	2.5	97.1
20	944	912	2.6	2.5	96.6
21	895	870	2.5	2.4	97.2
22	882	859	2.4	2.4	97.4
23	806	780	2.2	2.1	96.8
Total	**17,539**	**16,993**	**48.1**	**46.6**	**96.9**

[1]"Number of Calls" reflects the original number of unique incidents appearing in the CAD data file as presented in Table 1.

Figure 31: Average EMS Calls and EMS Calls with Transports per Day by Hour of Day



REVIEW OF SYSTEM PERFORMANCE

The first step in determining the current state of the system's deployment model is to establish baseline measures of performance. This analysis is crucial to the ability to discuss alternatives to the status quo and in identifying opportunities for improvement. This portion of the analysis will focus efforts on elements of response time and the cascade of events that lead to timely response with the appropriate apparatus and personnel to mitigate the event. Response time goals should be examined in terms of total reflex time, or total response time, which includes the dispatch or call processing time, turnout time, and travel time.

Cascade of Events

The cascade of events is the sum of the individual elements of time beginning with a state of normalcy and continuing until normalcy is once again restored through the mitigation of the event. The elements of time that are important to the ultimate outcome of a structure fire or critical medical emergency begin with the initiation of the event. For example, the first onset of chest pain begins the biological and scientific time clock for heart damage irrespective of when 911 is notified. Similarly, a fire may begin and burn undetected for a period of time before the fire department is notified. The emergency response system does not have control over the time interval for recognition or the choice to request assistance.

Therefore, RFD utilizes quantifiable "hard" data points to measure and manage system performance. These elements include alarm processing, turnout time, travel time, and the time spent prior to unit release. An example of the cascade of events and the elements of performance utilized by RFD is provided on the next page (Figure 32).[1]

Detection

Detection is the element of time between the time an event occurs and someone detects it, and the emergency response system has been notified. This is typically accomplished by calling the 911 Primary Safety Answering Point (PSAP).

Call Processing

This is the element of time measured between when 911 answers the 911 call, processes the information, and subsequently dispatches RFD.

[1] Olathe Fire Department. (2012). Adapted from Community Risk and Emergency Services Analysis: Standard of Cover. Olathe, Kansas: Author.

Turnout Time

This is the element of time that is measured between the time the fire department is dispatched or alerted of the emergency incident, and the time when the RFD unit is enroute to the call.

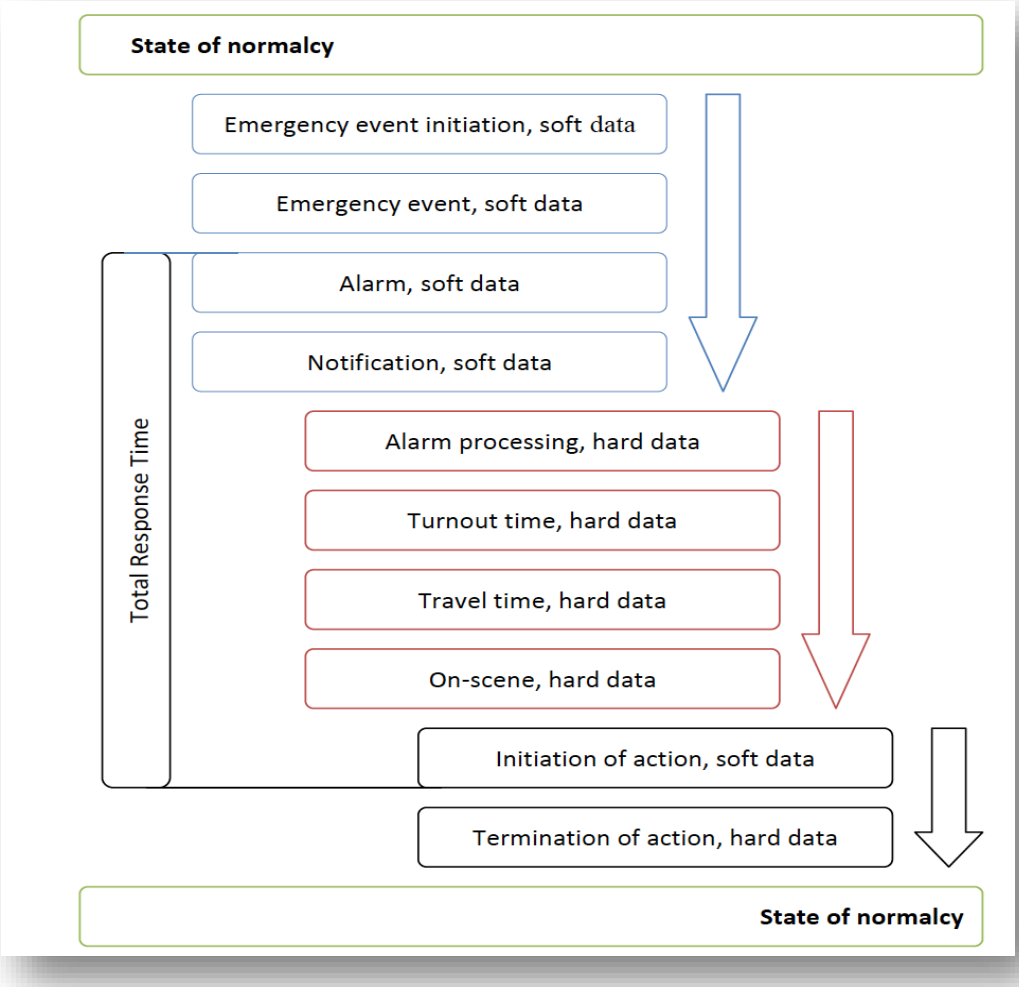
Travel Time

The travel time is the element of time between when the unit went enroute, or began to travel to the incident, and their arrival on scene.

Total Response Time

The total response time, or total reflex time, is the total time required to arrive on scene beginning with 911 answering the phone request for service and the time that the units arrive on scene.

Figure 32: Cascade of Events



Comparison of Workloads by Demand Zone

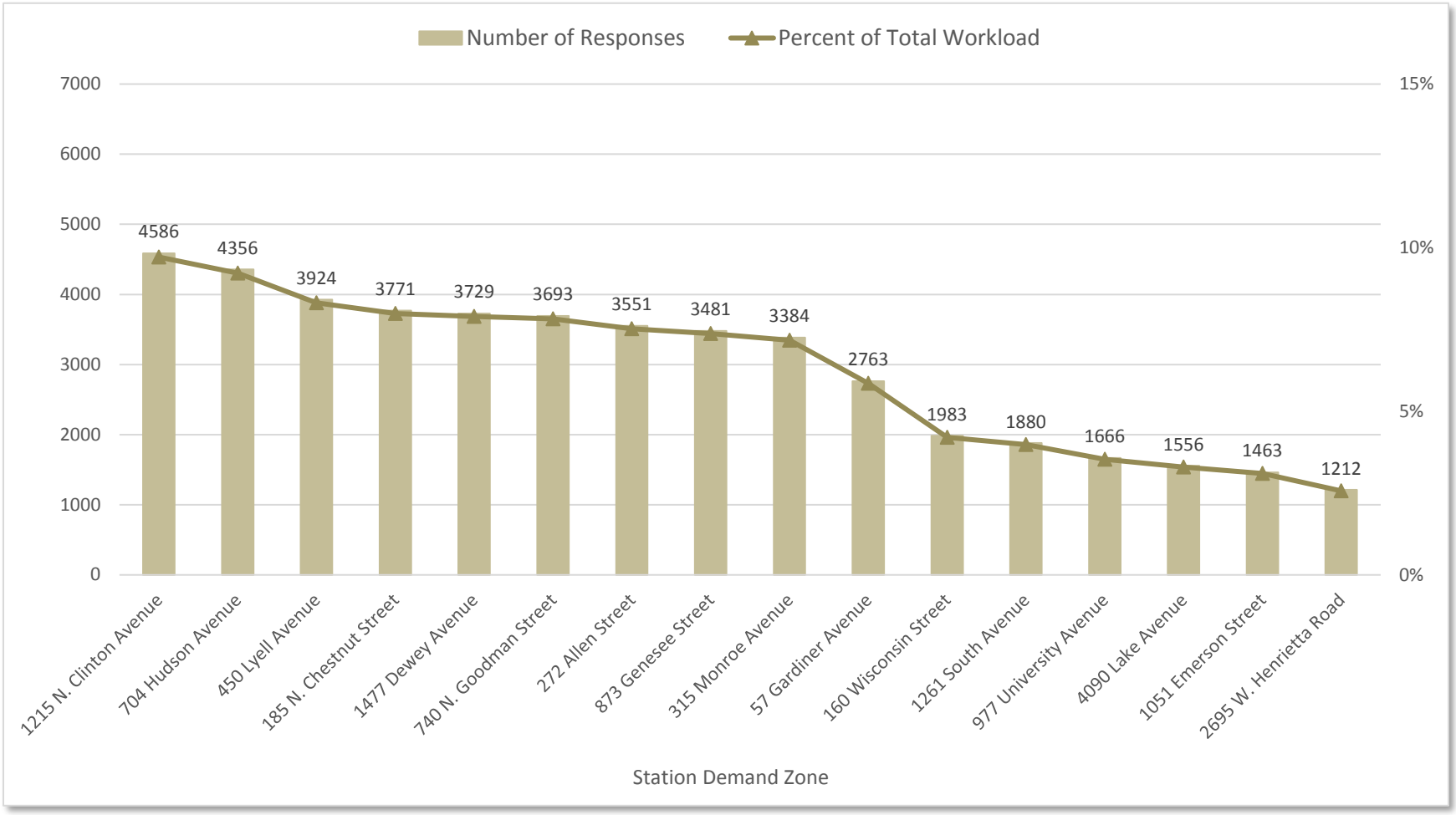
Another method for assessing the effectiveness of the distribution model is to analyze the demand for services across the distribution model. Workload is assessed at the station demand zone level and at the individual unit level. The highest volume of incoming calls occurred for station demand zones 1215 N. Clinton Avenue (3,394 calls), 704 Hudson Avenue (3,115 calls), and 450 Lyell Avenue (3,032 calls). These three station demand zones also had the highest volume of responses made by departmental units to the areas, requiring 9.7%, 9.2%, and 8.3% of RFD's total responses, respectively (Table 30; Figure 33).

Table 30: Department Workload by Station Demand Zone

Station Demand Zone (Company)	Number of Calls Incoming to Station's Area[1]	Number of Responses Made by Department in Station's Area[2]	Percent of Department Workload[3]
1051 Emerson Street (E3)	1,084	1,463	3.1
1215 N. Clinton Avenue (E2)	3,394	4,586	9.7
1261 South Avenue (T3)	1,290	1,880	4.0
1477 Dewey Avenue (E10, T2)	2,660	3,729	7.9
160 Wisconsin Street (E12)	1,433	1,983	4.2
185 N. Chestnut Street (DC, E17, R11)	2,619	3,771	8.0
2695 W. Henrietta Road (E8)	968	1,212	2.6
272 Allen Street (B2, E13, T10)	2,518	3,551	7.5
315 Monroe Avenue (Car 99, E1)	2,434	3,384	7.2
4090 Lake Avenue (E19)	1,124	1,556	3.3
450 Lyell Avenue (E5)	3,032	3,924	8.3
57 Gardiner Avenue (T5)	2,023	2,763	5.9
704 Hudson Avenue (B1, E16, T6)	3,115	4,356	9.2
740 N. Goodman Street (E9)	2,742	3,693	7.8
873 Genesee Street (E7)	2,577	3,481	7.4
977 University Avenue (T4)	1,287	1,666	3.5
Not Identified[4]	146	220	0.5
Total	**34,446**	**47,218**	**100.0**

[1]"Number of Calls" reflects an adjusted number of unique incidents to correspond with data provided in the unit-level data file (as opposed to data provided in the CAD data files that did not contain unit-level data).
[2]"Number of Responses" reflects the total number of entries in the unit-level data file, regardless of calculated busy time.
[3]"Percent of Department Workload" is based on "Number of Responses Made by Department in Station's Area."
[4]There were 83 unique incident numbers corresponding to 146 unique responses in the unit-level data file that did not appear in the CAD data files to allow mapping of call details; all call details related to these 83 incidents are unknown. There were also 63 unique incident numbers corresponding to 74 unique responses in the unit-level data file that also appeared as unique incidents in the CAD data file, but for which there were no (or no relevant) corresponding "CarBeat1" code entries to allow for identification of first due company or station location.

Figure 33: Department Workload by Station Demand Zone



Finally, workload by station demand zone and program was analyzed for both comparative purposes as well as for introspection into potential system failures (Table 31). Station demand zones 1215 N. Clinton Avenue and 450 Lyell Avenue had the highest demand for EMS, requiring 2,076 and 1,923 responses, respectively. Station demand zones 704 Hudson Avenue and 1215 N. Clinton Avenue had the highest demand for fire services, requiring 2,368 and 2,188 responses, respectively.

Table 31: Number of Responses by Station Demand Zone and Program

Station Demand Zone (Company)	Program					
	EMS	Fire	Hazmat	Rescue	Not Identified[1]	Total
1051 Emerson Street (E3)	557	874	1	31	0	1,463
1215 N. Clinton Avenue (E2)	2,076	2,188	0	322	0	4,586
1261 South Avenue (T3)	482	1,335	0	63	0	1,880
1477 Dewey Avenue (E10, T2)	1,433	2,097	6	193	0	3,729
160 Wisconsin Street (E12)	660	1,247	0	76	0	1,983
185 N. Chestnut Street (DC, E17, R11)	1,718	1,734	2	317	0	3,771
2695 W. Henrietta Road (E8)	352	801	1	58	0	1,212
272 Allen Street (B2, E13, T10)	1,408	1,913	0	230	0	3,551
315 Monroe Avenue (Car 99, E1)	1,277	1,847	0	260	0	3,384
4090 Lake Avenue (E19)	449	1,002	1	104	0	1,556
450 Lyell Avenue (E5)	1,923	1,877	0	124	0	3,924
57 Gardiner Avenue (T5)	1,016	1,660	0	87	0	2,763
704 Hudson Avenue (B1, E16, T6)	1,831	2,368	0	157	0	4,356
740 N. Goodman Street (E9)	1,533	2,041	1	118	0	3,693
873 Genesee Street (E7)	1,270	2,112	0	99	0	3,481
977 University Avenue (T4)	470	1,126	0	70	0	1,666
Not Identified[1]	12	50	0	12	146	220
Total	**18,467**	**26,272**	**12**	**2,321**	**146**	**47,218**

[1]There were 83 unique incident numbers corresponding to 146 unique responses in the unit-level data file that did not appear in the CAD data files to allow mapping of call details; all call details related to these 83 incidents are unknown. There were also 63 unique incident numbers corresponding to 74 unique responses in the unit-level data file that also appeared as unique incidents in the CAD data file, but for which there were no (or no relevant) corresponding "CarBeat1" code entries to allow for identification of first due company or station location.

Another measure, time on task, is necessary to evaluate best practices in efficient system delivery and consider the impact workload has on personnel. Unit Hour Utilization (UHU) values represent the proportion of the work period (24 hours) that is utilized responding to requests for service.

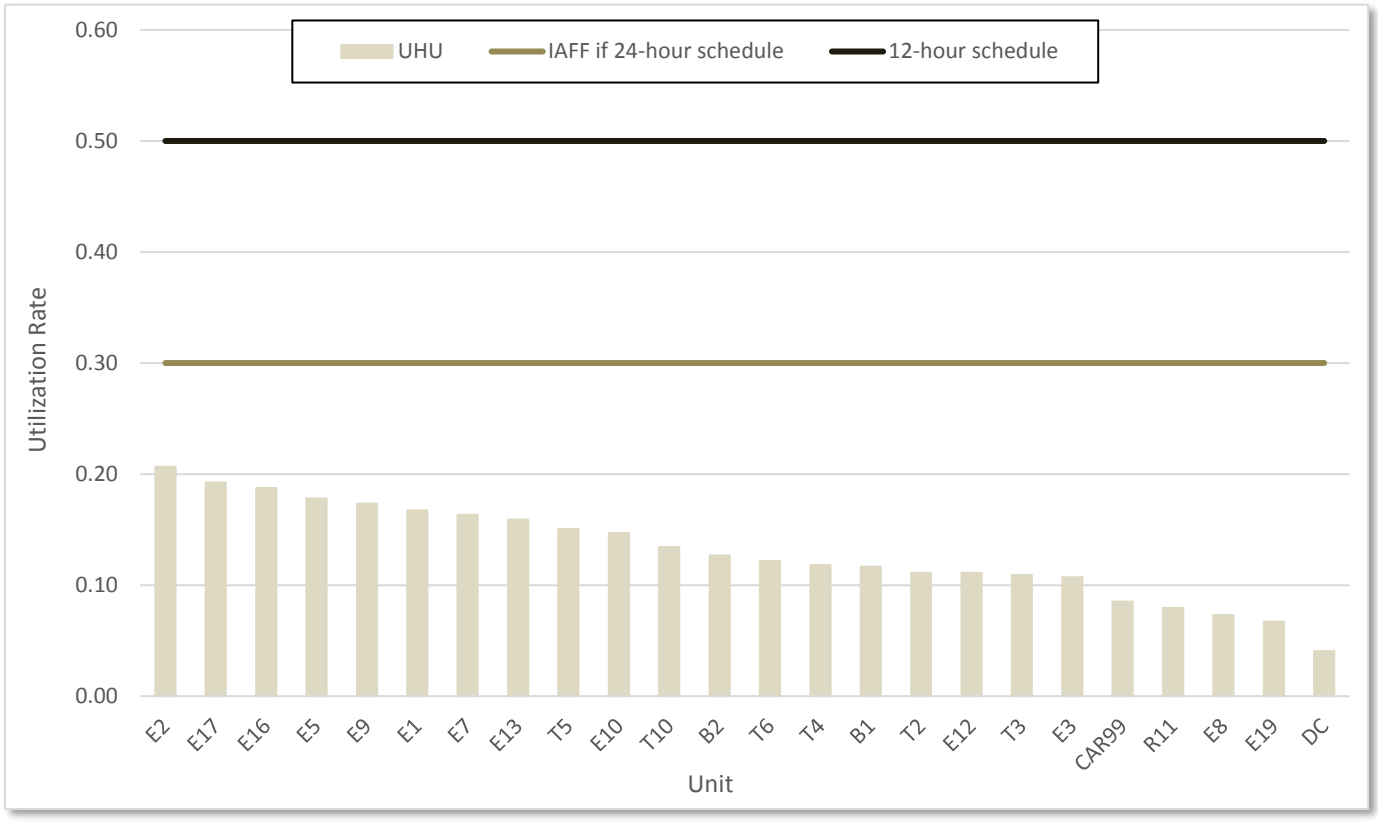
Historically, the International Association of Fire Fighters (IAFF) has recommended that 24-hour units utilize 0.30, or 30% workload as an upper threshold.[2] In other words, this recommendation would

[2] International Association of Firefighters. (1995). Emergency *Medical Services: A Guidebook for Fire-Based Systems.* Washington, DC: Author. (p. 11)

have personnel spend no more than 7.2 hours per day on emergency incidents. These thresholds take into consideration the necessity to accomplish non-emergency activities such as training, health and wellness, public education, and fire inspections. The 4th edition of the IAFF EMS Guidebook no longer specifically identifies an upper threshold. However, *FITCH* recommends that an upper unit utilization threshold of approximately 0.30, or 30%, would be considered best practice. In other words, units and personnel should not exceed 30%, or 7.2 hours, of their work day responding to calls. These recommendations are also validated in the literature. For example, in their review of the City of Rolling Meadows, the Illinois Fire Chiefs Association utilized a UHU threshold of 0.30 as an indication to add additional resources.[3] Similarly, in a standards of cover study facilitated by the Center for Public Safety Excellence, the Castle Rock Fire and Rescue Department utilizes a UHU of 0.30 as the upper limit in their standards of cover due to the necessity to accomplish other non-emergency activities.[4]

UHU analyses included all units except for the admin on-call units, Car 1 and Car 2, and all units were considered to be 12-hour units (Figure 34).

Figure 34: Unit Hour Utilization



[3] Illinois Fire Chiefs Association. (2012). An *Assessment of Deployment and Station Location: Rolling Meadows Fire Department.* Rolling Meadows, Illinois: Author. (pp. 54-55)
[4] Castle Rock Fire and Rescue Department. (2011). Community *Risk Analysis and Standards of Cover.* Castle Rock, Colorado: Author. (p. 58)

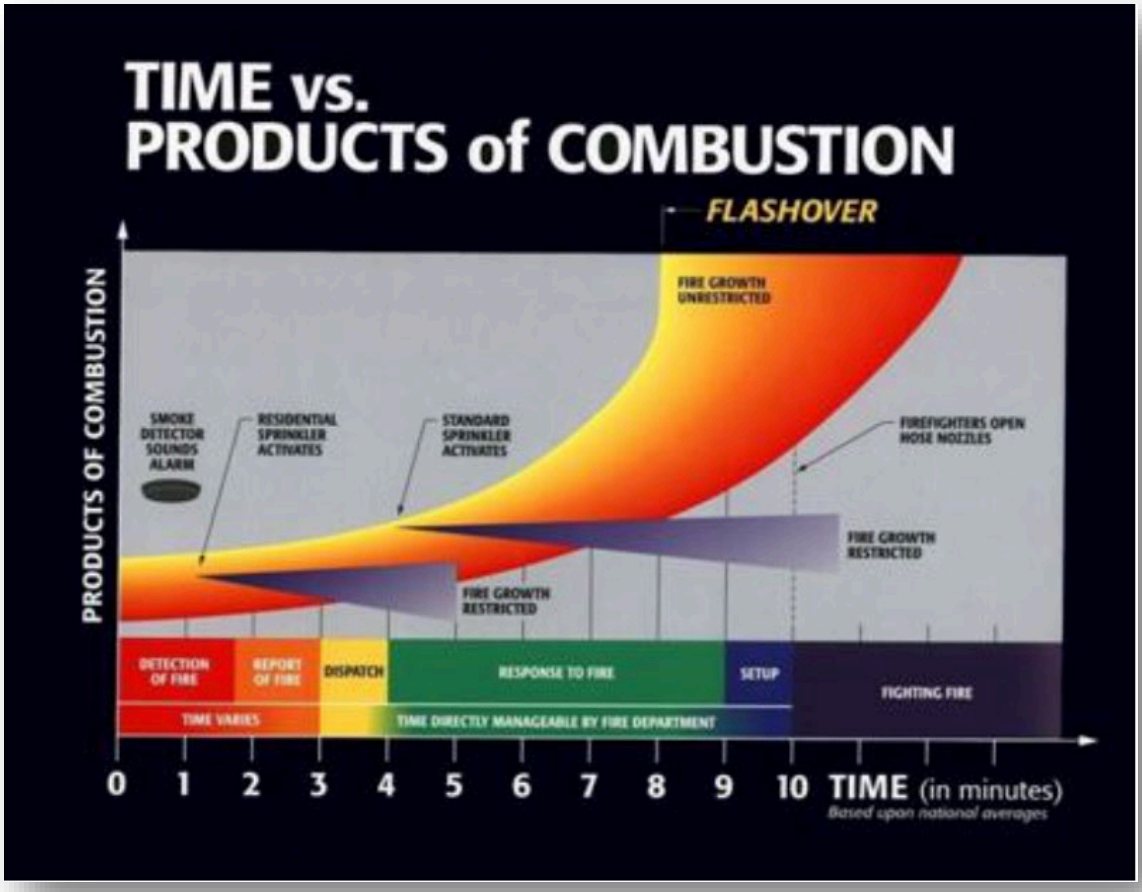
RESPONSE TIME CONTINUUM

Fire

The number one priority with structural fire incidents is to save lives followed by the minimization of property damage. A direct relationship exists between the timeliness of the response and the survivability of unprotected occupants and property damage. The most identifiable point of fire behavior is flashover.

Flashover is the point in fire growth where the contents of an entire area, including the smoke, reach their ignition temperature, resulting in a rapid-fire growth rendering the area un-survivable by civilians and untenable for firefighters. Best practices would result in the fire department arriving and attacking the fire prior to the point of flashover. A representation of the traditional time temperature curve and the cascade of events is provided in Figure 35.[5]

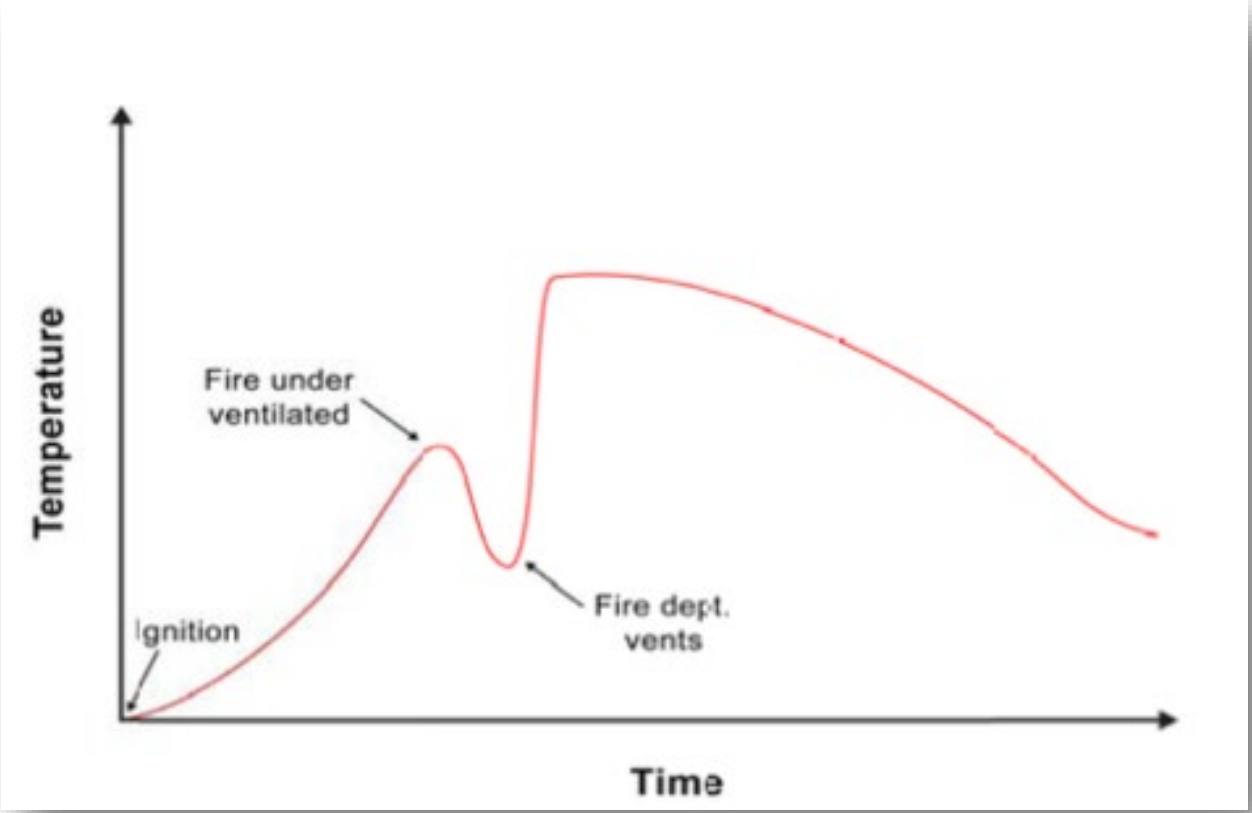
Figure 35: Example of Traditional Time Temperature Curve



[5] Example of Traditional Time Temperature Curve. Retrieved at http://www.usfa.fema.gov/downloads/pdf/coffee-break/time-vs-products-of-combustion.pdf

Recent studies by Underwriter's Laboratories (UL) have found that in compartment fires such as structure fires, flashover occurs within four minutes in modern fire environment. In addition, the UL research has identified an updated time temperature curve due to fires being ventilation-controlled rather than fuel-controlled as represented in the traditional time temperature curve. While this ventilation-controlled environment continues to provide a high risk to unprotected occupants to smoke and high heat, it does provide some advantage to property conservation efforts, as water may be applied to the fire prior to ventilation and the subsequent flashover. An example of UL's ventilation-controlled time temperature curve is provided in Figure 36.[6]

Figure 36: Ventilation-Controlled Time Temperature Curve



EMS

The effective response to EMS incidents also has a direct correlation to the ability to respond within a specified period of time. However, unlike structure fires, responding to EMS incidents introduces considerable variability in the level of clinical acuity. From this perspective, the association of response time and clinical outcome varies depending on the severity of the injury or the illness. Research has demonstrated that the overwhelming majority of requests for EMS are not time sensitive between five minutes and 11 minutes for emergency responses and 13 minutes for non-

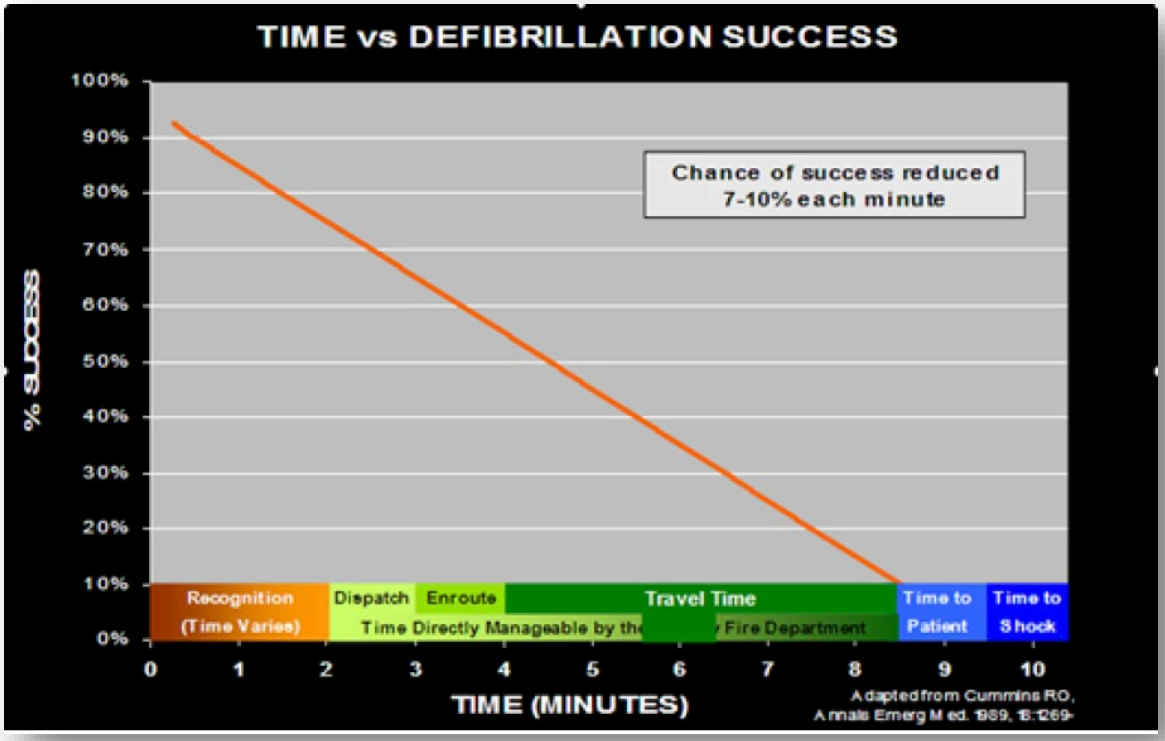
[6] UL/NIST Ventilation Controlled Time Temperature Curve. Retrieved from http://www.nist.gov/fire/fire_behavior.cfm

emergency responses.[7] The 12-minute upper threshold is only the upper limit of the available research and is not a clinically significant time measure, as patients were not found to have a significantly different clinical outcome when the 12-minute threshold was exceeded.[8]

Out-of-hospital sudden cardiac arrest is the most identifiable and measured incident type for EMS. In an effort to demonstrate the relationship between response time and clinical outcome, a representation of the cascade of events and the time to defibrillation (shock) is presented in Figure 37. The American Heart Association (AHA) has determined that brain damage will begin to occur between four and six minutes and become irreversible after ten minutes without intervention.

Modern sudden cardiac arrest protocols recognize that high quality Cardio-Pulmonary Resuscitation (CPR) at the Basic Life Support (BLS) level is a quality intervention until defibrillation can be delivered in shockable rhythms. Figure 37 below[9] is representative of a sudden cardiac arrest that is presenting in a shockable heart rhythm such as Ventricular Fibrillation or Ventricular Tachycardia.

Figure 37: Cascade of Events for Sudden Cardiac Arrest with Shockable Rhythm



[7] Blackwell, T.H., & Kaufman, J.S. (April 2002). Response time effectiveness: Comparison of response time and survival in an urban emergency medical services system. *Academic Emergency Medicine,* 9(4): 289-295.
[8] Blackwell, T.H., et al. (Oct-Dec 2009). Lack of association between prehospital response times and patient outcomes. *Prehospital Emergency Care,* 13(4): 444-450.
[9] Olathe Fire Department. (2012). Adapted from Community Risk and Emergency Services Analysis: Standard of Cover. Olathe, Kansas: Author.

DESCRIPTION OF FIRST ARRIVING UNIT PERFORMANCE

Additional analyses related to the response characteristics of first arriving units were conducted. The analyses in this first section focused on emergency (lights and sirens) responses from primary front-line units arriving first on scene, irrespective of station demand zone, for all distinct incidents. Call status as emergency or non-emergency was assigned per call type by RFD and was based on "EventTypeDescription" from the CAD data files. Units identified by RFD as primary front-line units included all departmental units except for the admin on-call vehicles, Car 1 and Car 2. Due to the restriction of these analyses to select responses and units, maximum available sample size for these analyses is 31,761 (however, 1,878 cases were missing data to permit calculation of turnout time, and 1,698 cases were missing data to permit calculation of travel time).

To first recap the data presented in Table 8, Figure 21, Table 9, and Table 10, RFD had an overall average dispatch time of 2.5 minutes (median = 1.6 minutes), and a dispatch time of 3.0 minutes at the 90th percentile (Table 32). Overall, RFD had an average turnout time of 1.5 minutes (median = 1.5 minutes), and a turnout time of 2.3 minutes at the 90th percentile. A total of 20.9% of calls experienced turnout times of one minute or less, and 80.6% of calls experienced turnout times of two minutes or less (Figure 38). The overall average travel time was 3.0 minutes (median = 2.7 minutes); performance at the 90th percentile for travel time was 4.7 minutes. A total of 59.8% of calls experienced travel times of three minutes or less, and 82.3% of calls experienced travel times of four minutes or less (Figure 39). The average response time was 6.9 minutes (median = 6.0 minutes); performance at the 90th percentile for response time was 8.5 minutes.

Table 32: Description of First Arriving Unit Emergency Response Performance in Minutes

Measure	Average	Median	90th Percentile
Dispatch Time	2.5	1.6	3.0
Turnout Time	1.5	1.5	2.3
Travel Time	3.0	2.7	4.7
Response Time	6.9	6.0	8.5

Figure 38: Distribution of Turnout Time of First Arriving Unit – All Calls

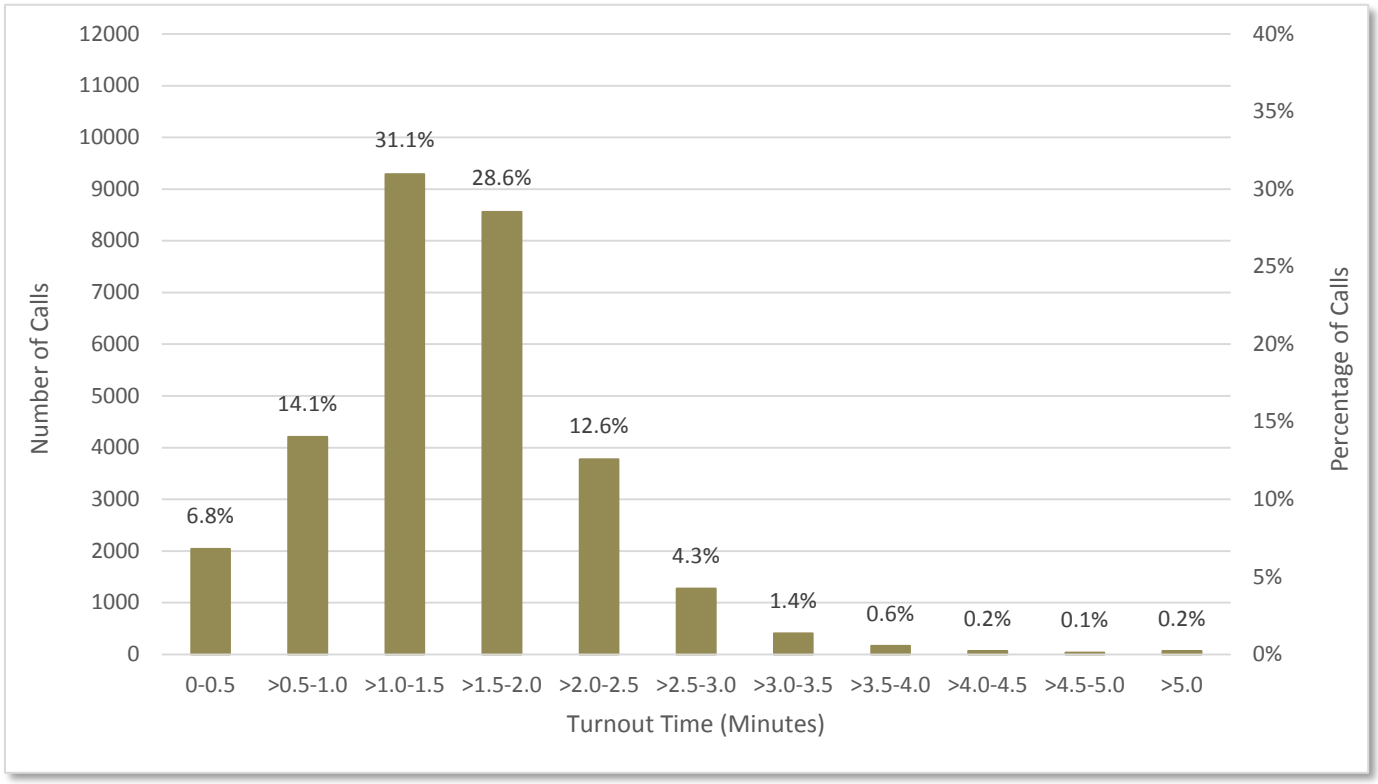
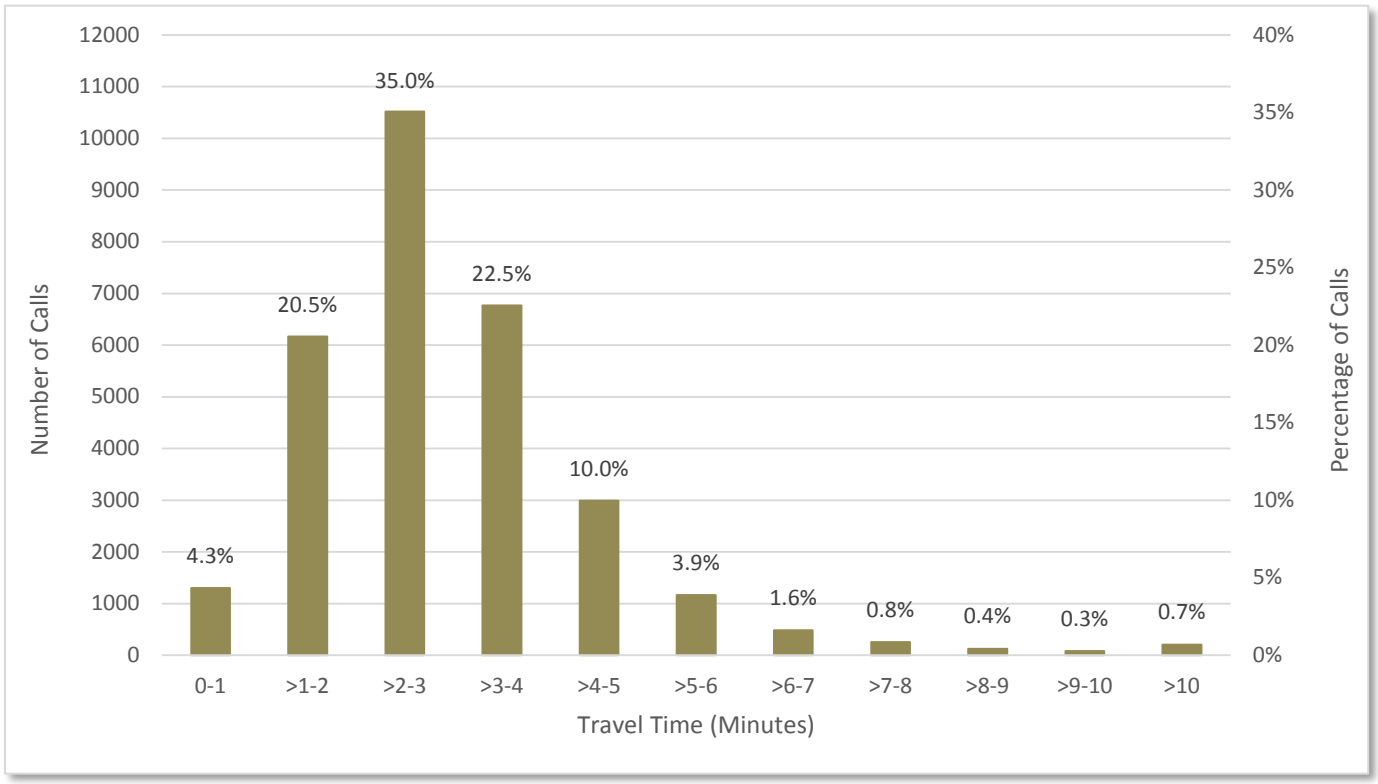


Figure 39: Distribution of Travel Time of First Arriving Unit – All Calls



National recommendations provide differentiation between EMS and fire/special operations incidents. For example, the best practice for an EMS incident is a turnout time of 60 seconds or less 90% of the time. Due to the necessity to don personal protective equipment prior to responding to fire related incidents, best practices provide either 80 seconds (NFPA) or 90 seconds (CFAI) or less at the 90th percentile for turnout times associated with fire calls. Therefore, turnout time and travel time is also reported by the major program areas of EMS and fire.

For EMS incidents, RFD had an average turnout time of 1.5 minutes (Table 8), a median turnout time of 1.4 minutes (Table 9), and a turnout time of 2.3 minutes at the 90th percentile (Table 10). A total of 20.1% of calls experienced turnout times of one minute or less, and 81.7% of calls experienced turnout times of two minutes or less (Figure 40). The average travel time for EMS incidents was 2.8 minutes (median = 2.7 minutes); performance at the 90th percentile for travel time was 4.4 minutes. A total of 62.7% of calls experienced travel times of three minutes or less, and 85.2% of calls experienced travel times of four minutes or less (Figure 41). The average response time for EMS calls was 6.2 minutes (median = 6.0 minutes); performance at the 90th percentile for response time was 8.3 minutes.

For fire related incidents, RFD had an average turnout time of 1.6 minutes (Table 8), a median turnout time of 1.5 minutes (Table 9), and a turnout time of 2.4 minutes at the 90th percentile (Table 10). A total of 21.7% of calls experienced turnout times of one minute or less, and 79.2% of calls experienced turnout times of two minutes or less (Figure 42). The average travel time for fire related incidents was 3.2 minutes (median = 2.8 minutes); performance at the 90th percentile for travel time was 5.1 minutes. A total of 55.9% of calls experienced travel times of three minutes or less, and 78.5% of calls experienced travel times of four minutes or less (Figure 43). The average response time for fire related calls was 7.9 minutes (median = 5.9 minutes); performance at the 90th percentile for response time was 8.9 minutes.

Figure 40: Distribution of Turnout Time of First Arriving Unit – EMS Related Calls

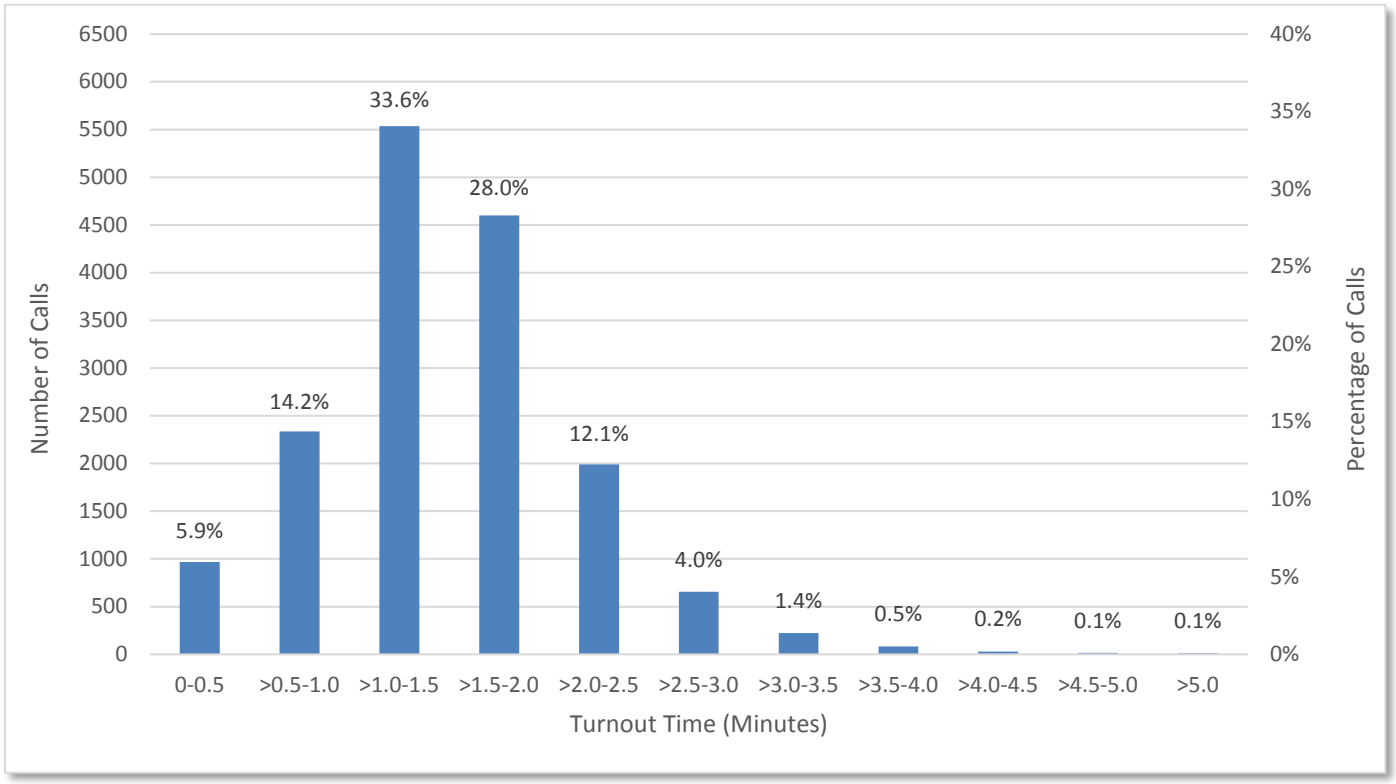


Figure 41: Distribution of Travel Time of First Arriving Unit – EMS Related Calls

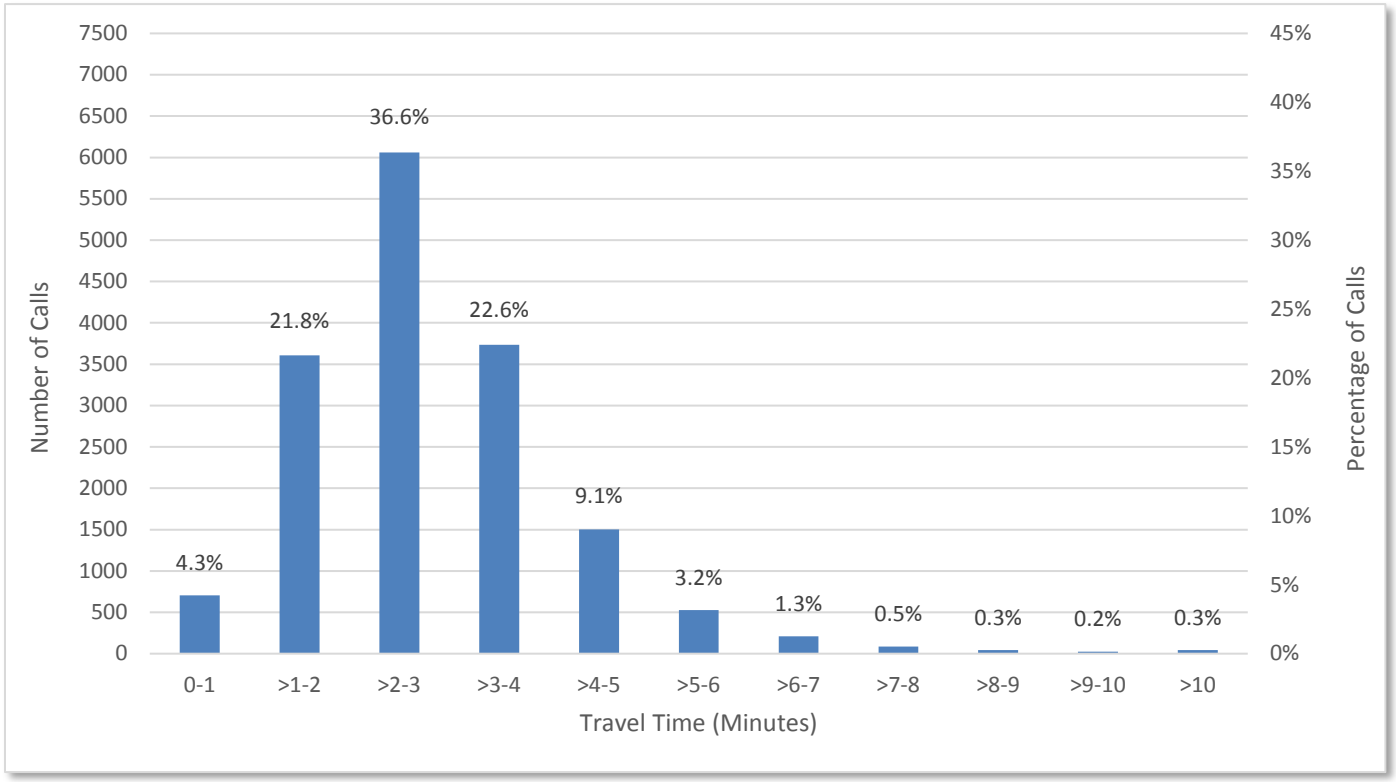


Figure 42: Distribution of Turnout Time of First Arriving Unit – Fire Related Calls

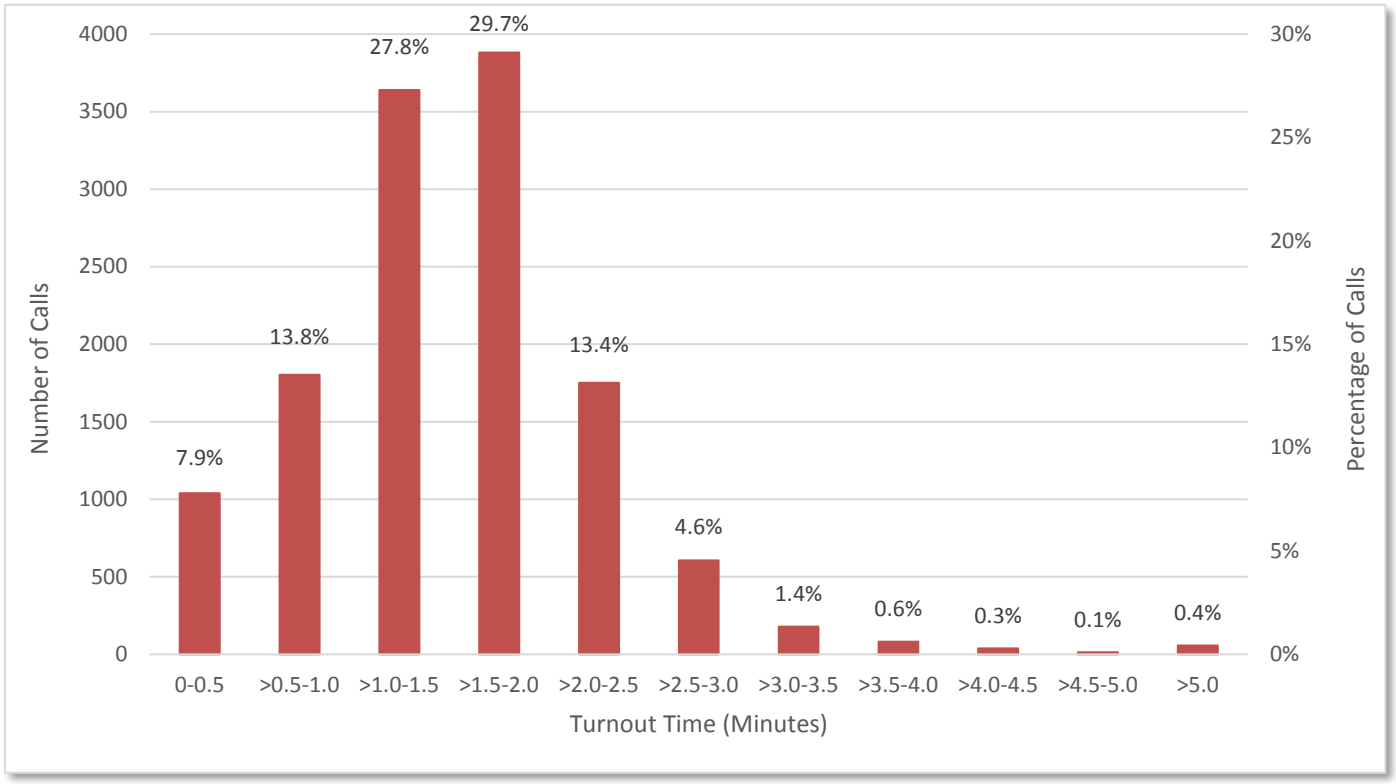
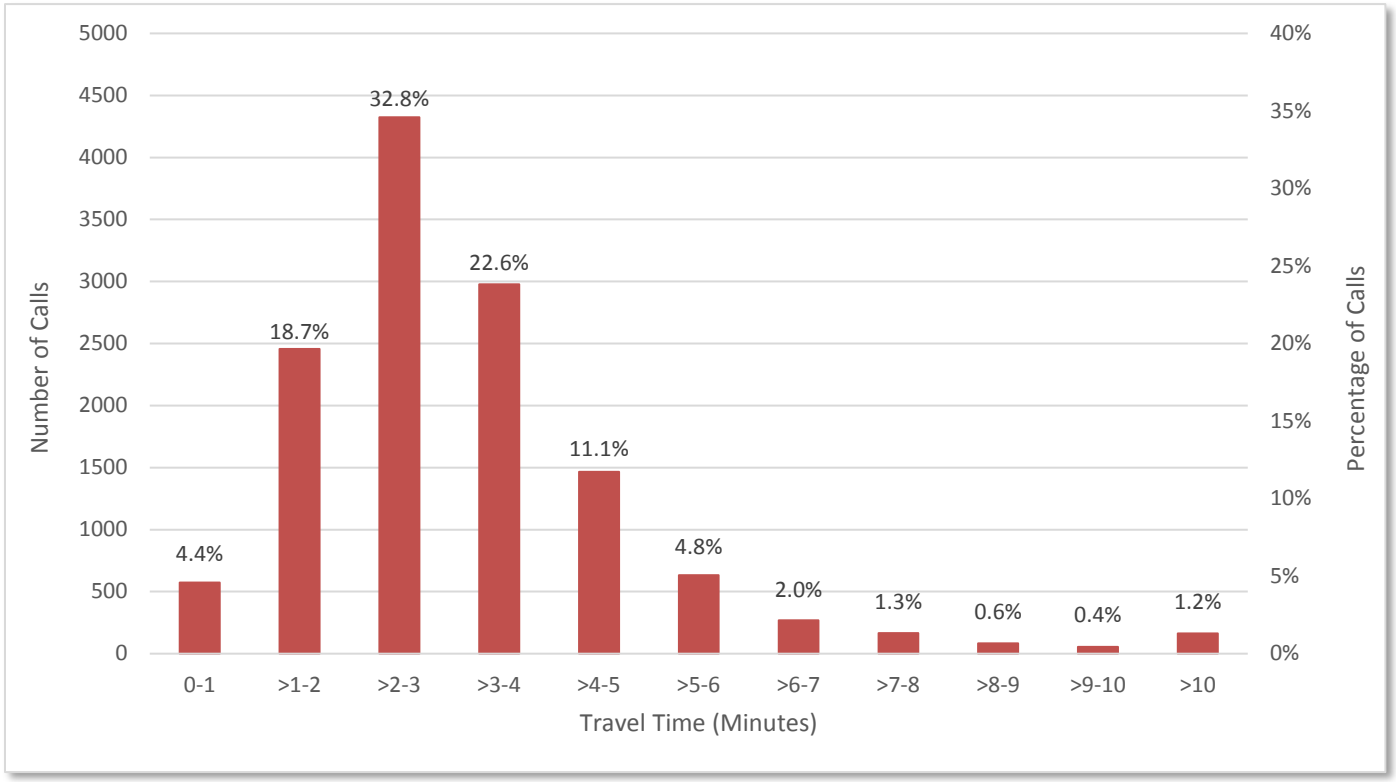


Figure 43: Distribution of Travel Time of First Arriving Unit – Fire Related Calls



First Arriving Unit Response Time by Station Demand Zone

Further analyses were conducted for the 16 neighborhood station demand zones to measure the performance of the first arriving primary front-line units to emergency calls in each demand zone. Responses associated with unidentified station demand zones are not presented individually in the table, but are included in the total values. Response times are reported at the average (Table 33; Figure 44), median (Table 34; Figure 45), and 90th percentile (Table 35; Figure 46) values.

With respect to turnout time, first arriving units responding to calls in the station demand zone for 704 Hudson Avenue had the highest 90th percentile turnout time at 2.7 minutes. With respect to travel time, first arriving units responding to calls in the station demand zone for 4090 Lake Avenue had the highest 90th percentile travel time at 7.2 minutes.

Table 33: Average First Arrival Performance in Minutes by Station Demand Zone

Station Demand Zone	Dispatch Time	Turnout Time	Travel Time	Response Time
1051 Emerson Street	2.8	1.5	3.0	7.3
1215 N. Clinton Avenue	2.3	1.6	2.8	6.6
1261 South Avenue	2.3	1.5	3.5	7.1
1477 Dewey Avenue	2.7	1.6	2.9	7.0
160 Wisconsin Street	3.5	2.1	3.1	8.1
185 N. Chestnut Street	1.9	1.4	2.5	5.8
2695 W. Henrietta Road	3.9	1.7	4.5	9.6
272 Allen Street	2.1	1.5	2.7	6.2
315 Monroe Avenue	2.2	1.3	2.9	6.4
4090 Lake Avenue	3.0	1.6	3.7	7.7
450 Lyell Avenue	2.5	1.3	2.6	6.3
57 Gardiner Avenue	2.5	1.4	2.9	6.8
704 Hudson Avenue	2.6	1.8	3.1	7.3
740 N. Goodman Street	3.0	1.6	3.2	7.6
873 Genesee Street	2.4	1.8	2.8	6.8
977 University Avenue	2.6	1.4	3.4	7.4
Total[1]	**2.5**	**1.5**	**3.0**	**6.9**

[1]Responses associated with unidentified station demand zones are not presented individually in the table, but are included in the total values.

Table 34: Median First Arrival Performance in Minutes by Station Demand Zone

Station Demand Zone	Dispatch Time	Turnout Time	Travel Time	Response Time
1051 Emerson Street	1.6	1.5	2.8	6.1
1215 N. Clinton Avenue	1.7	1.5	2.6	6.0
1261 South Avenue	1.6	1.4	3.3	6.4
1477 Dewey Avenue	1.7	1.5	2.7	6.0
160 Wisconsin Street	1.6	1.5	2.8	6.0
185 N. Chestnut Street	1.6	1.4	2.3	5.5
2695 W. Henrietta Road	1.6	1.6	4.1	7.4
272 Allen Street	1.6	1.5	2.4	5.7
315 Monroe Avenue	1.6	1.3	2.7	5.8
4090 Lake Avenue	1.7	1.6	2.9	6.2
450 Lyell Avenue	1.6	1.2	2.5	5.5
57 Gardiner Avenue	1.6	1.3	2.7	5.8
704 Hudson Avenue	1.6	1.7	2.9	6.4
740 N. Goodman Street	1.6	1.5	3.0	6.3
873 Genesee Street	1.6	1.6	2.5	5.9
977 University Avenue	1.5	1.4	3.1	6.2
Total[1]	**1.6**	**1.5**	**2.7**	**6.0**

[1]Responses associated with unidentified station demand zones are not presented individually in the table, but are included in the total values.

Table 35: 90th Percentile First Arrival Performance in Minutes by Station Demand Zone

Station Demand Zone	Dispatch Time	Turnout Time	Travel Time	Response Time
1051 Emerson Street	3.0	2.4	4.6	8.5
1215 N. Clinton Avenue	3.1	2.4	4.4	8.5
1261 South Avenue	2.9	2.2	5.3	9.1
1477 Dewey Avenue	3.1	2.3	4.5	8.5
160 Wisconsin Street	3.0	2.2	5.1	9.0
185 N. Chestnut Street	2.9	2.2	3.9	7.6
2695 W. Henrietta Road	3.1	2.5	6.7	10.3
272 Allen Street	2.9	2.2	3.9	7.7
315 Monroe Avenue	3.0	2.2	4.5	8.2
4090 Lake Avenue	3.0	2.5	7.2	9.6
450 Lyell Avenue	2.9	2.0	4.0	7.8
57 Gardiner Avenue	3.0	2.1	4.3	8.1
704 Hudson Avenue	3.0	2.7	4.7	8.9
740 N. Goodman Street	3.0	2.3	4.9	8.7
873 Genesee Street	3.0	2.6	4.4	8.4
977 University Avenue	2.9	2.0	5.4	9.0
Total[1]	**3.0**	**2.3**	**4.7**	**8.5**

[1]Responses associated with unidentified station demand zones are not presented individually in the table, but are included in the total values.

Figure 44: Average First Arrival Performance in Minutes by Station Demand Zone

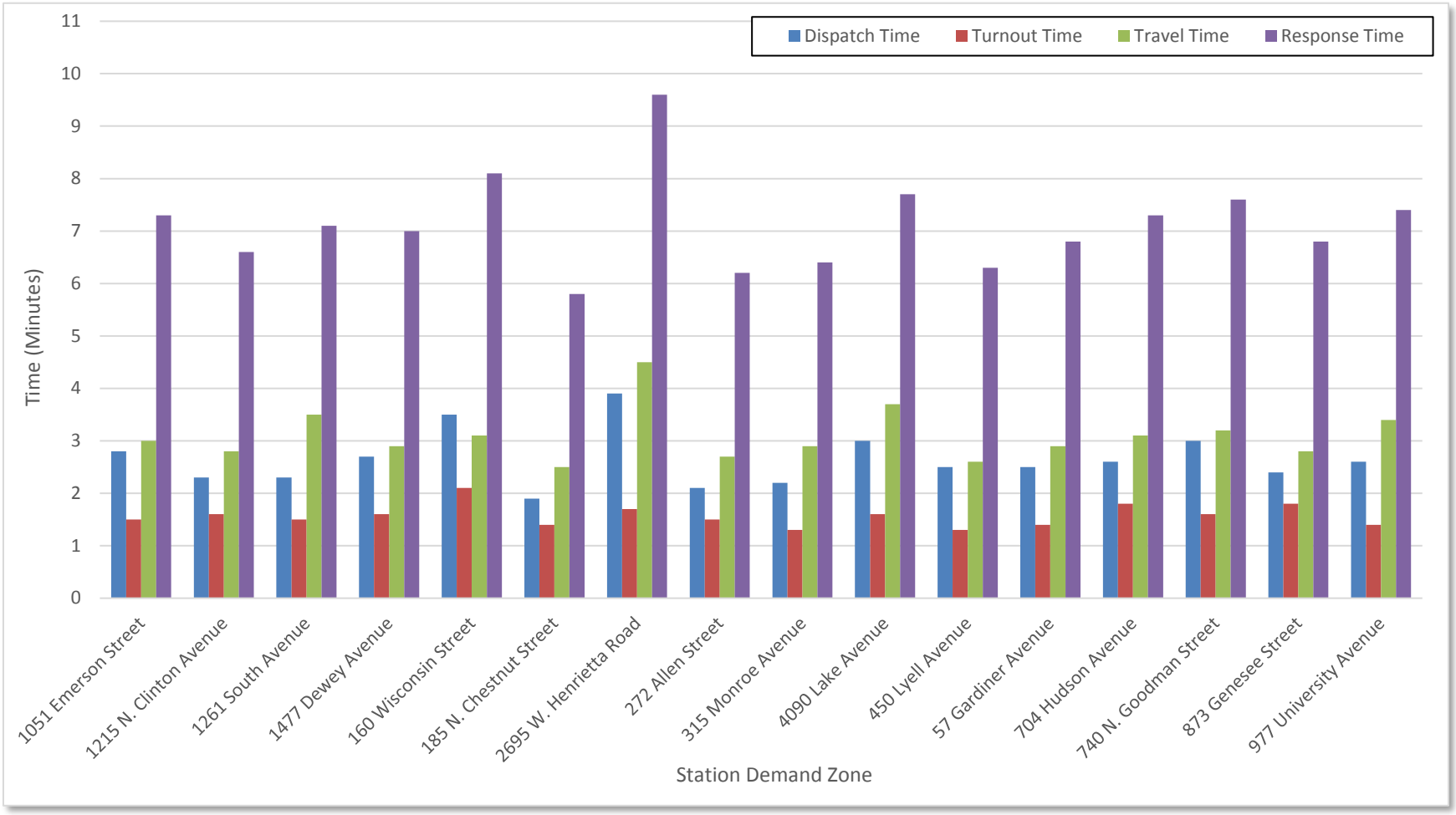


Figure 45: Median First Arrival Performance in Minutes by Station Demand Zone

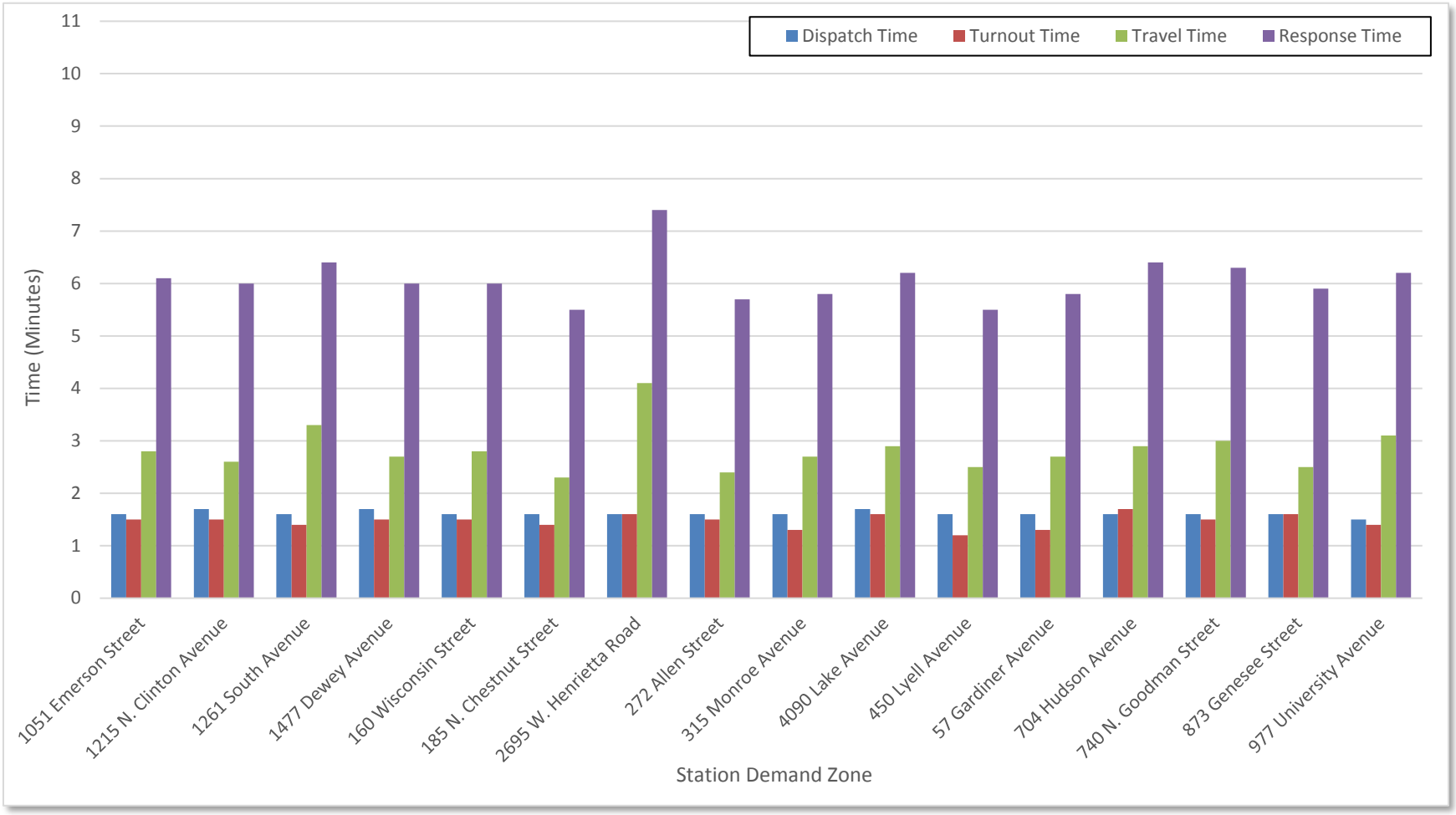
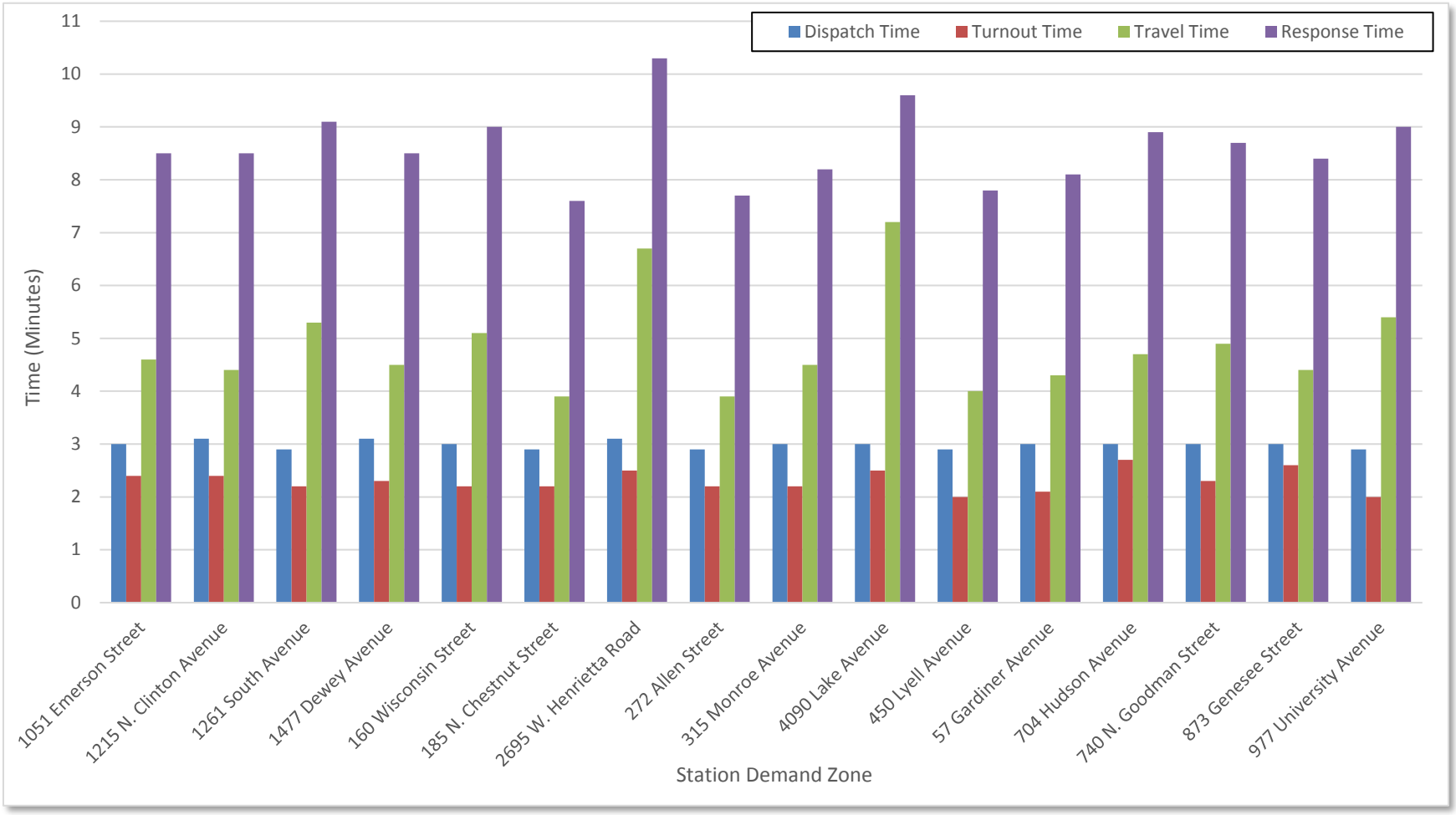


Figure 46: 90th Percentile First Arrival Performance in Minutes by Station Demand Zone



Effective Response Force Capabilities for Structure Fires

The capability of an Effective Response Force (ERF) to assemble in a timely manner with the appropriate personnel, apparatus, and equipment is important to the success of a significant structure fire event. Therefore, it is important to measure the capabilities of assembling an ERF. In most fire departments, the distribution model performs satisfactorily, but it is not uncommon to be challenged to assemble an ERF in the recommended timeframes. Several factors affect the capabilities to assemble an ERF such as the number of fire stations, number of units, and number of personnel on each unit. Each of these policy decisions should be made in relation to the community's specific risks and the willingness to assume risk.

Analyses of performance for RFD's 16 neighborhood station demand zones were based on an examination of travel times by any of the primary front-line units arriving on scene in response to a structure fire call in the station's area (Table 36 through Table 39; Figure 47 and Figure 48). While RFD had times for units arriving up to 19th to the scene, table data are presented up to the 10th arrival only for all station demand zones. In select cases, small or zero sample sizes precluded calculation or presentation of performance metrics. For this reason, limited figure data are presented.

Table 36: Structure Fire: Average Travel Time in Minutes for ERF by Station Demand Zone

Station Demand Zone	Order of Arrival									
	1	2	3	4	5	6	7	8	9	10
1051 Emerson Street	2.3	2.9	4.3	4.2	4.7	4.9	6.0	5.8	6.2	25.4
1215 N. Clinton Avenue	2.2	2.7	3.0	3.3	3.4	3.8	4.4	5.9	7.7	6.3
1261 South Avenue	3.4	4.0	5.2	4.7	5.0	5.1	6.2	6.5	5.5	--
1477 Dewey Avenue	1.9	2.4	3.8	4.5	5.2	5.1	6.6	6.8	8.5	8.0
160 Wisconsin Street	2.3	2.9	4.4	4.9	4.0	4.6	4.7	5.9	7.3	--
185 N. Chestnut Street	1.8	2.1	2.2	2.4	2.9	3.3	3.9	4.2	4.9	8.1
2695 W. Henrietta Road	3.8	5.2	5.6	7.1	7.5	7.6	9.3	7.8	7.2	--
272 Allen Street	2.1	2.2	2.5	2.9	3.5	3.4	5.5	6.0	5.6	5.7
315 Monroe Avenue	2.1	2.4	2.9	3.0	3.4	3.4	4.1	4.7	4.5	4.6
4090 Lake Avenue	2.5	5.8	7.2	9.4	8.3	8.7	9.0	9.7	--	--
450 Lyell Avenue	2.1	2.4	2.7	3.6	3.9	4.7	4.6	5.7	8.0	5.7
57 Gardiner Avenue	2.6	3.1	3.7	3.8	3.9	4.6	5.2	6.6	6.7	8.9
704 Hudson Avenue	2.1	2.3	2.5	3.0	3.5	4.1	4.7	5.8	8.1	4.3
740 N. Goodman Street	2.2	3.0	3.3	3.7	4.0	4.4	4.8	5.3	5.7	5.1
873 Genesee Street	2.1	3.0	4.1	4.0	4.5	5.1	5.3	6.8	15.9	--
977 University Avenue	2.2	3.1	4.1	3.7	3.7	5.0	4.4	5.3	15.3	16.9
Total	**2.2**	**2.8**	**3.4**	**3.7**	**4.0**	**4.4**	**5.0**	**5.8**	**7.5**	**7.6**

Table 37: Structure Fire: Median Travel Time in Minutes for ERF by Station Demand Zone

Station Demand Zone	Order of Arrival									
	1	2	3	4	5	6	7	8	9	10
1051 Emerson Street	2.3	2.7	4.1	3.7	4.2	4.9	5.4	5.9	5.9	25.4
1215 N. Clinton Avenue	2.1	2.7	2.9	3.3	3.5	3.8	4.2	5.7	5.3	4.0
1261 South Avenue	3.2	3.7	4.6	4.9	4.9	5.1	6.5	6.5	5.7	--
1477 Dewey Avenue	1.9	2.3	3.7	4.1	4.9	4.9	6.3	6.7	8.2	8.0
160 Wisconsin Street	2.3	2.8	3.6	4.5	4.1	4.7	5.1	5.7	8.4	--
185 N. Chestnut Street	1.8	2.3	2.2	2.4	2.7	3.3	3.5	3.7	5.5	4.2
2695 W. Henrietta Road	3.7	4.9	5.2	6.7	7.4	7.0	9.8	7.8	7.2	--
272 Allen Street	2.0	2.0	2.4	3.1	3.6	3.7	4.6	5.2	4.8	5.4
315 Monroe Avenue	2.1	2.3	2.8	3.0	3.3	3.3	4.0	4.5	4.1	4.4
4090 Lake Avenue	2.3	5.4	6.7	9.0	8.4	9.1	9.2	10.1	--	--
450 Lyell Avenue	2.0	2.3	2.7	3.1	3.4	4.0	4.7	5.1	6.6	4.6
57 Gardiner Avenue	2.5	2.9	3.5	3.6	3.7	4.3	4.8	6.1	6.4	8.9
704 Hudson Avenue	2.1	2.2	2.5	3.0	3.1	4.0	4.8	5.6	5.0	4.4
740 N. Goodman Street	2.1	2.9	3.2	3.7	4.0	4.5	4.9	5.1	5.4	5.1
873 Genesee Street	2.0	3.0	3.8	3.6	4.2	5.1	5.4	6.4	6.6	--
977 University Avenue	2.4	3.2	3.8	3.9	4.4	4.2	4.6	5.2	8.5	16.9
Total	**2.2**	**2.6**	**3.1**	**3.4**	**3.7**	**4.1**	**4.8**	**5.5**	**6.0**	**5.3**

Table 38: Structure Fire: 90th Percentile Travel Time in Minutes for ERF by Station Demand Zone

Station Demand Zone	Order of Arrival									
	1	2	3	4	5	6	7	8	9	10
1051 Emerson Street	3.1	5.2	6.9	6.6	7.6	8.2	10.6	--	--	--
1215 N. Clinton Avenue	3.4	3.8	4.3	4.6	4.5	5.0	6.9	8.1	10.3	--
1261 South Avenue	5.3	7.1	11.0	6.2	7.4	--	--	--	--	--
1477 Dewey Avenue	2.9	4.1	6.2	6.3	7.7	8.0	9.3	9.2	14.9	--
160 Wisconsin Street	3.8	3.9	7.9	8.9	5.5	6.1	6.0	--	--	--
185 N. Chestnut Street	2.8	2.9	3.4	3.2	4.2	5.0	5.5	6.3	--	--
2695 W. Henrietta Road	--	--	--	--	--	--	--	--	--	--
272 Allen Street	3.4	4.1	3.7	4.6	4.8	5.2	9.1	9.6	11.0	--
315 Monroe Avenue	3.5	3.8	4.1	4.2	5.2	5.0	6.0	5.9	--	--
4090 Lake Avenue	4.5	9.5	10.3	14.6	--	--	--	--	--	--
450 Lyell Avenue	3.2	3.2	4.0	5.9	5.3	5.8	5.8	9.0	--	--
57 Gardiner Avenue	3.8	4.9	4.9	5.5	5.9	6.9	7.8	11.6	--	--
704 Hudson Avenue	3.1	3.6	3.8	4.1	5.1	5.8	6.9	8.5	14.6	--
740 N. Goodman Street	3.1	4.9	4.5	5.1	5.6	5.3	6.3	7.6	8.6	--
873 Genesee Street	3.1	4.1	5.8	5.9	7.0	7.1	7.1	10.3	--	--
977 University Avenue	3.9	5.6	9.2	--	--	--	--	--	--	--
Total	**3.2**	**4.3**	**5.2**	**5.7**	**6.0**	**6.4**	**7.1**	**8.4**	**9.9**	**16.5**

Table 39: Structure Fire: Sample Size for ERF Analysis by Station Demand Zone

Station Demand Zone	Order of Arrival									
	1	2	3	4	5	6	7	8	9	10
1051 Emerson Street	19	19	18	15	13	12	10	8	4	2
1215 N. Clinton Avenue	49	46	47	43	36	34	31	25	19	7
1261 South Avenue	15	15	14	12	11	9	9	7	6	0
1477 Dewey Avenue	41	43	39	29	23	20	17	14	11	2
160 Wisconsin Street	32	27	25	19	12	11	10	6	3	1
185 N. Chestnut Street	33	33	31	30	29	27	25	18	6	4
2695 W. Henrietta Road	5	7	7	6	5	5	5	2	2	1
272 Allen Street	40	36	36	29	21	21	17	17	11	3
315 Monroe Avenue	34	32	31	28	25	24	21	18	8	3
4090 Lake Avenue	19	15	13	10	5	5	4	3	1	1
450 Lyell Avenue	50	48	48	41	30	24	19	16	9	3
57 Gardiner Avenue	36	36	29	23	20	19	17	15	6	2
704 Hudson Avenue	64	61	56	51	43	39	32	26	18	6
740 N. Goodman Street	47	51	45	43	33	32	27	24	12	2
873 Genesee Street	42	39	36	30	25	22	16	13	6	1
977 University Avenue	12	11	10	8	6	5	6	6	3	2
Total	**538**	**519**	**485**	**417**	**337**	**309**	**266**	**218**	**125**	**40**

Figure 47: 90th Percentile ERF Travel Performance for Structure Fires Overall

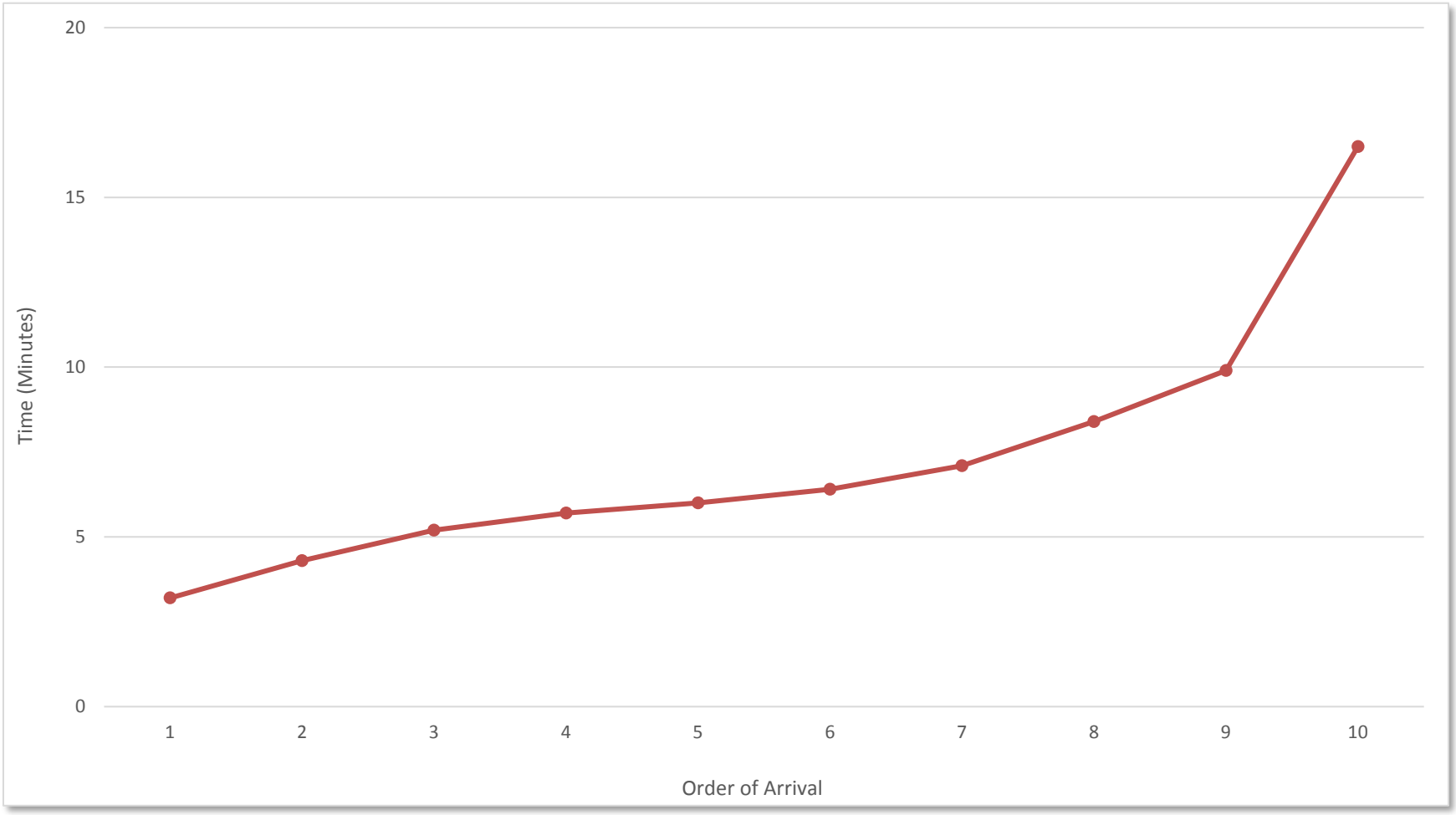
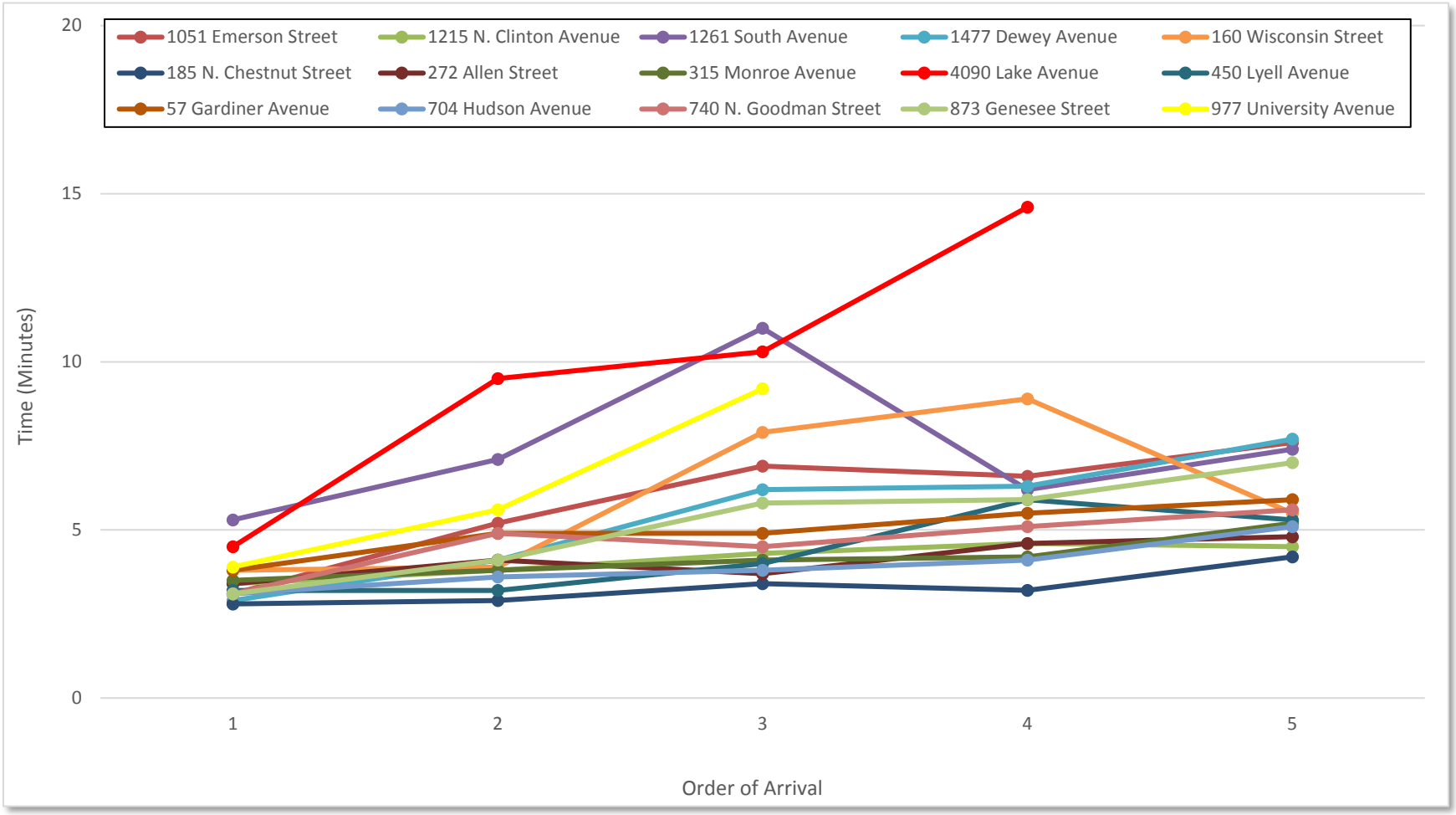


Figure 48: 90th Percentile ERF Travel Performance for Structure Fires by Station Demand Zone



Turnout and Travel Time Performance by Available Vehicles

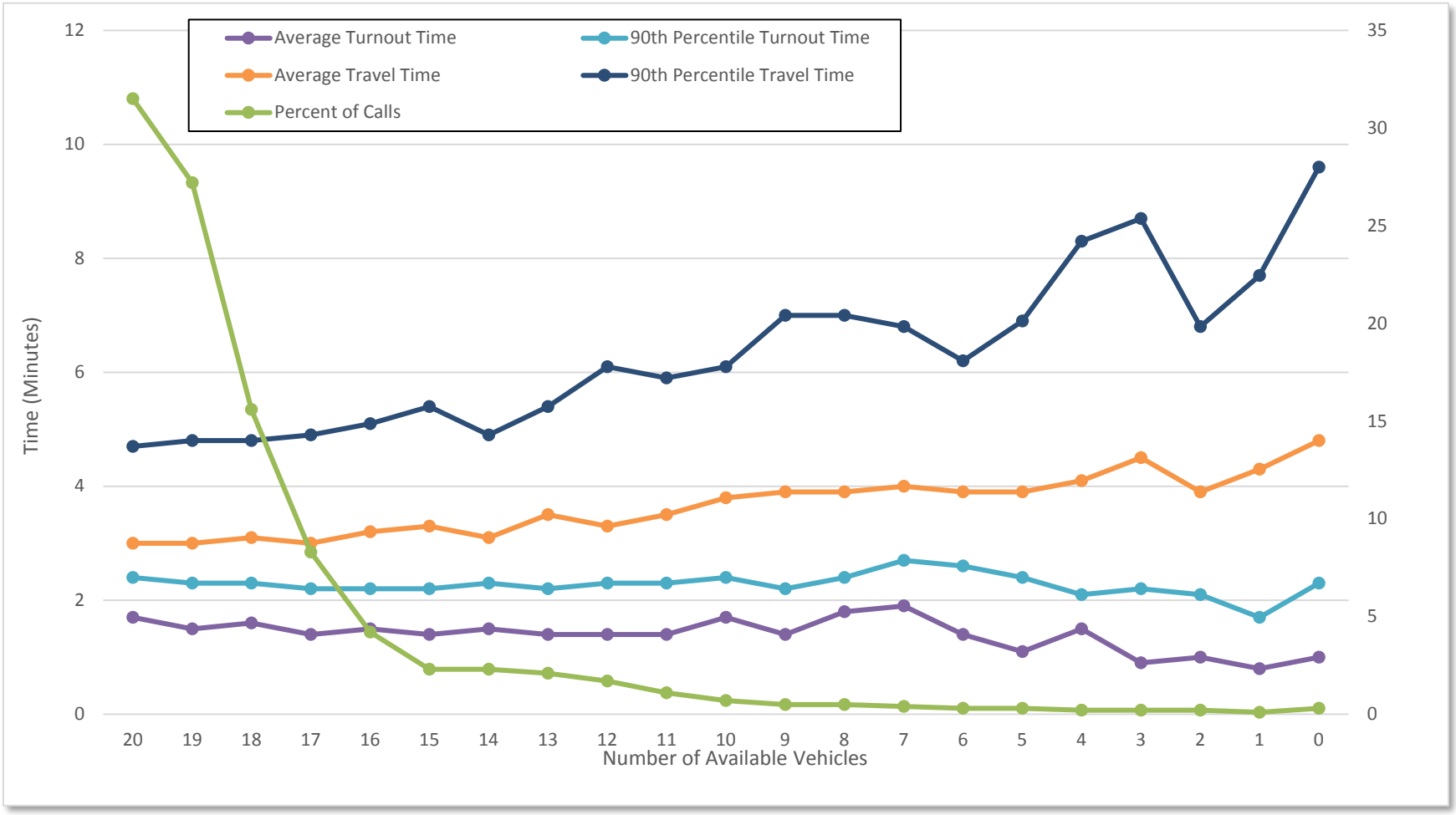
We investigated whether turnout and travel time performance deteriorated when there were fewer primary front-line vehicles available (Table 40; Figure 49). Primary front-line units for these analyses included RFD's 13 engines, one rescue unit, and six trucks (total *n*=20). Calls to which primary front-line units responded in 2017 were used to determine number of available primary front-line units at the time each call was received. Performance times were then based on primary front-line units responding to lights and sirens (emergency) calls only.

Table 40: Average and 90th Percentile Performance Times in Minutes by Number of Available Vehicles

Number of Available Vehicles	Average		90th Percentile			
	Turnout Time	Travel Time	Turnout Time	Travel Time	Sample Size Calls	% of Calls
20	1.7	3.0	2.4	4.7	10,178	31.5
19	1.5	3.0	2.3	4.8	8,794	27.2
18	1.6	3.1	2.3	4.8	5,057	15.6
17	1.4	3.0	2.2	4.9	2,675	8.3
16	1.5	3.2	2.2	5.1	1,374	4.2
15	1.4	3.3	2.2	5.4	738	2.3
14	1.5	3.1	2.3	4.9	740	2.3
13	1.4	3.5	2.2	5.4	670	2.1
12	1.4	3.3	2.3	6.1	535	1.7
11	1.4	3.5	2.3	5.9	340	1.1
10	1.7	3.8	2.4	6.1	241	0.7
9	1.4	3.9	2.2	7.0	169	0.5
8	1.8	3.9	2.4	7.0	146	0.5
7	1.9	4.0	2.7	6.8	142	0.4
6	1.4	3.9	2.6	6.2	88	0.3
5	1.1	3.9	2.4	6.9	86	0.3
4	1.5	4.1	2.1	8.3	62	0.2
3	0.9	4.5	2.2	8.7	64	0.2
2	1.0	3.9	2.1	6.8	55	0.2

Number of Available Vehicles	Average		90th Percentile			
	Turnout Time	Travel Time	Turnout Time	Travel Time	Sample Size Calls	% of Calls
1	0.8	4.3	1.7	7.7	40	0.1
0	1.0	4.8	2.3	9.6	112	0.3

Figure 49: Average and 90th Percentile Turnout and Travel Times by Number of Available Vehicles



Reliability Factors

Percentage of First Due Compliance

The reliability of the distribution model is a factor of how often the response model is available and able to respond to a call within the assigned demand zone. This analysis utilized all dispatched calls within the 16 neighborhood station demand zones, and performance included responses from all units in RFD's jurisdiction. Units assigned to 704 Hudson Avenue, 1477 Dewey Avenue, and 272 Allen Street were able to respond to calls within their respective demand zones > 90% of the time (Table 41; Figure 50).

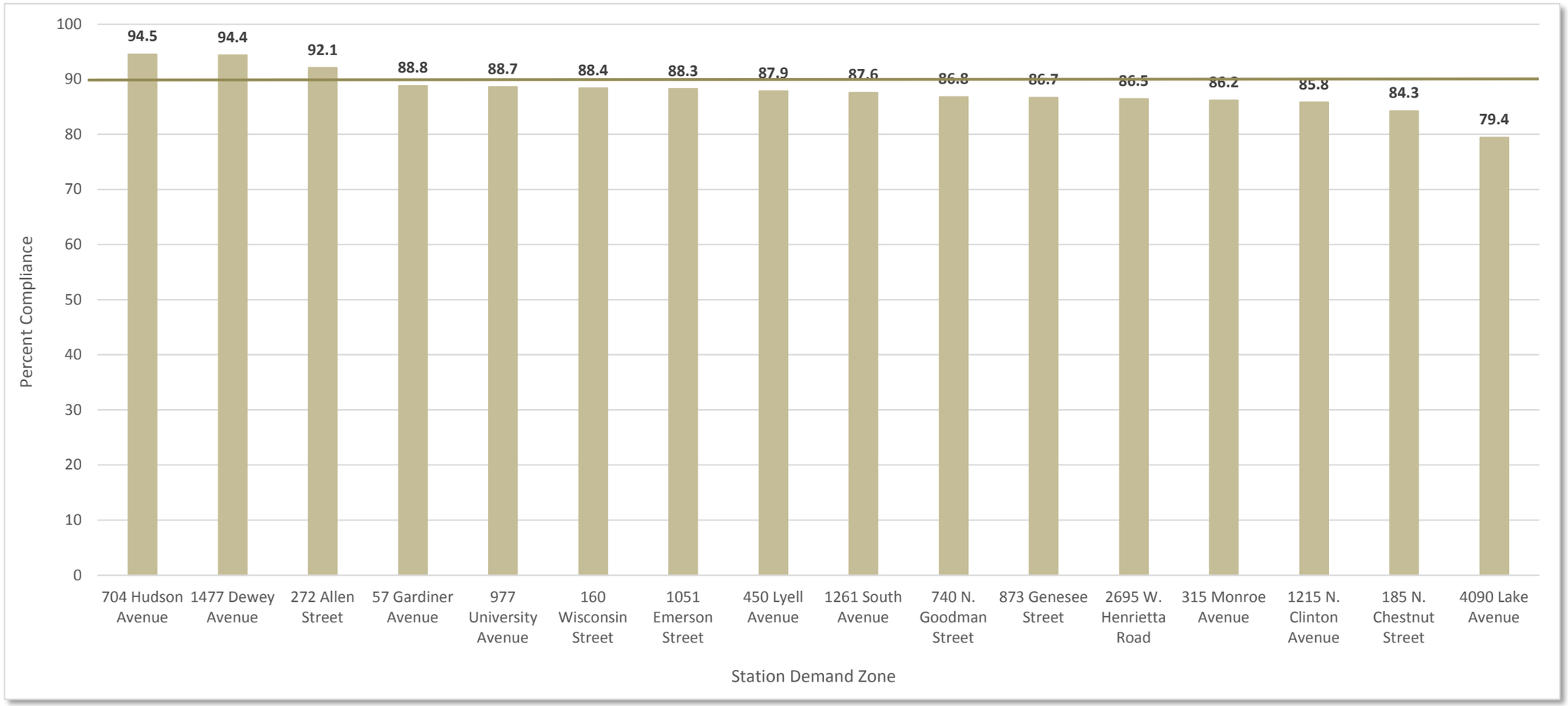
Table 41: First Due Compliance by Station Demand Zone

	Responding Unit's Assigned Station																		
Station Demand Zone (Company)	1051 Emerson Street	1215 N. Clinton Avenue	1261 South Avenue	1477 Dewey Avenue	160 Wisconsin Street	185 N. Chestnut Street	2695 W. Henrietta Road	272 Allen Street	315 Monroe Avenue	4090 Lake Avenue	450 Lyell Avenue	57 Gardiner Avenue	704 Hudson Avenue	740 N. Goodman Street	873 Genesee Street	977 University Avenue	Admin on Call (Car 1)	Admin on Call (Car 2)	Total[1]
1051 Emerson Street (E3)	**957**	4	2	61	1	35	0	83	34	2	115	68	10	0	2	3	2	2	**1,084**
1215 N. Clinton Avenue (E2)	5	**2,913**	1	283	2	170	0	86	117	0	40	0	561	17	0	4	2	2	**3,394**
1261 South Avenue (T3)	2	4	**1,130**	3	3	44	176	122	111	0	3	14	12	4	145	7	1	0	**1,290**
1477 Dewey Avenue (E10, T2)	90	123	2	**2,511**	2	96	0	107	98	32	94	12	154	4	1	3	1	2	**2,660**
160 Wisconsin Street (E12)	2	4	6	6	**1,267**	65	0	29	70	0	1	1	111	134	0	182	0	0	**1,433**
185 N. Chestnut Street (DC, E17, R11)	9	59	5	7	15	**2,207**	2	425	267	0	13	5	232	60	3	59	3	1	**2,619**
2695 W. Henrietta Road (E8)	3	5	79	0	5	24	**837**	104	37	0	6	16	11	4	43	4	0	0	**968**
272 Allen Street (B2, E13, T10)	4	10	27	10	8	131	**0**	**2,319**	126	0	118	108	43	11	62	21	1	0	**2,518**
315 Monroe Avenue (Car 99, E1)	1	12	218	8	13	269	8	224	**2,098**	0	3	3	35	46	11	183	1	1	**2,434**
4090 Lake Avenue (E19)	80	45	0	234	2	42	0	11	40	**893**	6	3	99	2	3	0	1	2	**1,124**
450 Lyell Avenue (E5)	169	36	0	96	1	95	0	409	90	0	**2,664**	74	21	2	5	0	2	2	**3,032**
57 Gardiner Avenue (T5)	60	2	17	8	1	65	3	227	66	0	143	**1,797**	24	2	190	1	0	1	**2,023**
704 Hudson Avenue (B1, E16, T6)	9	171	3	105	13	136	0	53	110	2	2	11	**2,945**	92	0	34	3	2	**3,115**
740 N. Goodman Street (E9)	3	11	2	8	178	177	0	32	98	1	2	4	380	**2,381**	0	123	1	1	**2,742**

Station Demand Zone (Company)	Responding Unit's Assigned Station																		
	1051 Emerson Street	1215 N. Clinton Avenue	1261 South Avenue	1477 Dewey Avenue	160 Wisconsin Street	185 N. Chestnut Street	2695 W. Henrietta Road	272 Allen Street	315 Monroe Avenue	4090 Lake Avenue	450 Lyell Avenue	57 Gardiner Avenue	704 Hudson Avenue	740 N. Goodman Street	873 Genesee Street	977 University Avenue	Admin on Call (Car 1)	Admin on Call (Car 2)	Total[1]
873 Genesee Street (E7)	8	10	107	2	0	85	35	317	100	1	46	293	20	3	**2,234**	3	2	1	**2,577**
977 University Avenue (T4)	4	1	29	4	125	52	0	66	120	0	4	0	18	40	1	**1,141**	2	1	**1,287**
Not Identified[2]	15	6	0	15	26	13	0	18	17	3	6	20	14	5	19	14	0	0	**146**
Total	**1,421**	**3,416**	**1,628**	**3,361**	**1,662**	**3,706**	**1,061**	**4,632**	**3,599**	**934**	**3,266**	**2,429**	**4,690**	**2,807**	**2,719**	**1,782**	**22**	**18**	**34,446**

[1]"Total" values may not equal the sum of the cell values across columns per row because units from multiple stations may have responded to a call within the given station demand zone.
[2]There were 83 unique incident numbers corresponding to 146 unique responses in the unit-level data file that did not appear in the CAD data files to allow mapping of call details; all call details related to these 83 incidents are unknown.

Figure 50: Percentage of First Due Compliance by Station Demand Zone



Overlapped or Simultaneous Call Analysis

Overlapped or simultaneous calls are defined as another call being received for a first due station while one or more calls are already ongoing for the same first due station. For example, if there is an ongoing call in station 1's zone wherein all units have not yet been cleared, and another request for service occurs in station 1's zone, those two calls would be captured as overlapped calls. Understanding the percentage of overlapped calls will help to determine the number of units to staff for each station. In general, the larger the call volume for a first due station, the greater the likelihood of overlapped calls occurring. The distribution of the demand throughout the day will impact the chance of having overlapped calls. Additionally, the duration of a call plays a significant role; the longer it takes to clear a request, the greater the likelihood of having an overlapping request.

Results for these analyses are reported for all calls and by EMS and fire calls. Note that for EMS and fire calls, overlapped calls represent any call classified in its respective program area, but that overlapped with one or more calls from *any* program area. For example, 1051 Emerson Street observed 69 calls during 2017 that overlapped with one or more calls within its demand zone—25 were classified as EMS calls, 43 were classified as fire calls, and one was classified as a rescue call. The 25 calls that were classified as EMS calls could have overlapped with one or more calls from EMS, fire, or other program areas.

RFD's station at 4090 Lake Avenue had the highest percentage of overlapped calls during 2017 for overall calls (14.3%; Table 42; Figure 51) and for fire calls (8.2%; Table 43; Figure 52). RFD's station at 450 Lyell Avenue had the highest percentage of overlapped calls during 2017 for EMS calls (6.1%; Table 44; Figure 53).

Table 42: Overlapped Calls by First Due Station

First Due Station	Overlapped Calls	Total Calls	Percentage of Overlapped Calls
1051 Emerson Street (E3)	69	1,083[1]	6.4
1215 N. Clinton Avenue (E2)	359	3,393[1]	10.6
1261 South Avenue (T3)	88	1,290	6.8
1477 Dewey Avenue (E10, T2)	318	2,654[2]	12.0
160 Wisconsin Street (E12)	121	1,432[1]	8.4
185 N. Chestnut Street (DC, E17, R11)	228	2,619	8.7
2695 W. Henrietta Road (E8)	67	965[3]	6.9
272 Allen Street (B2, E13, T10)	216	2,513[4]	8.6
315 Monroe Avenue (Car 99, E1)	225	2,432[5]	9.3
4090 Lake Avenue (E19)	160	1,118[6]	14.3
450 Lyell Avenue (E5)	296	3,030[7]	9.8
57 Gardiner Avenue (T5)	148	2,021[5]	7.3
704 Hudson Avenue (B1, E16, T6)	332	3,113[5]	10.7
740 N. Goodman Street (E9)	284	2,740[5]	10.4
873 Genesee Street (E7)	247	2,576[1]	9.6
977 University Avenue (T4)	93	1,286[1]	7.2

[1]One call was missing release times for responding units.
[2]Two calls were missing dispatch times and four calls were missing release times for responding units.
[3]Three calls were missing release times for responding units.
[4]One call was missing dispatch times and four calls were missing release times for responding units.
[5]Two calls were missing release times for responding units.
[6]Six calls were missing release times for responding units.
[7]One call was missing dispatch times and one call was missing release times for responding units.

Figure 51: Percentage of Overlapped Calls by First Due Station

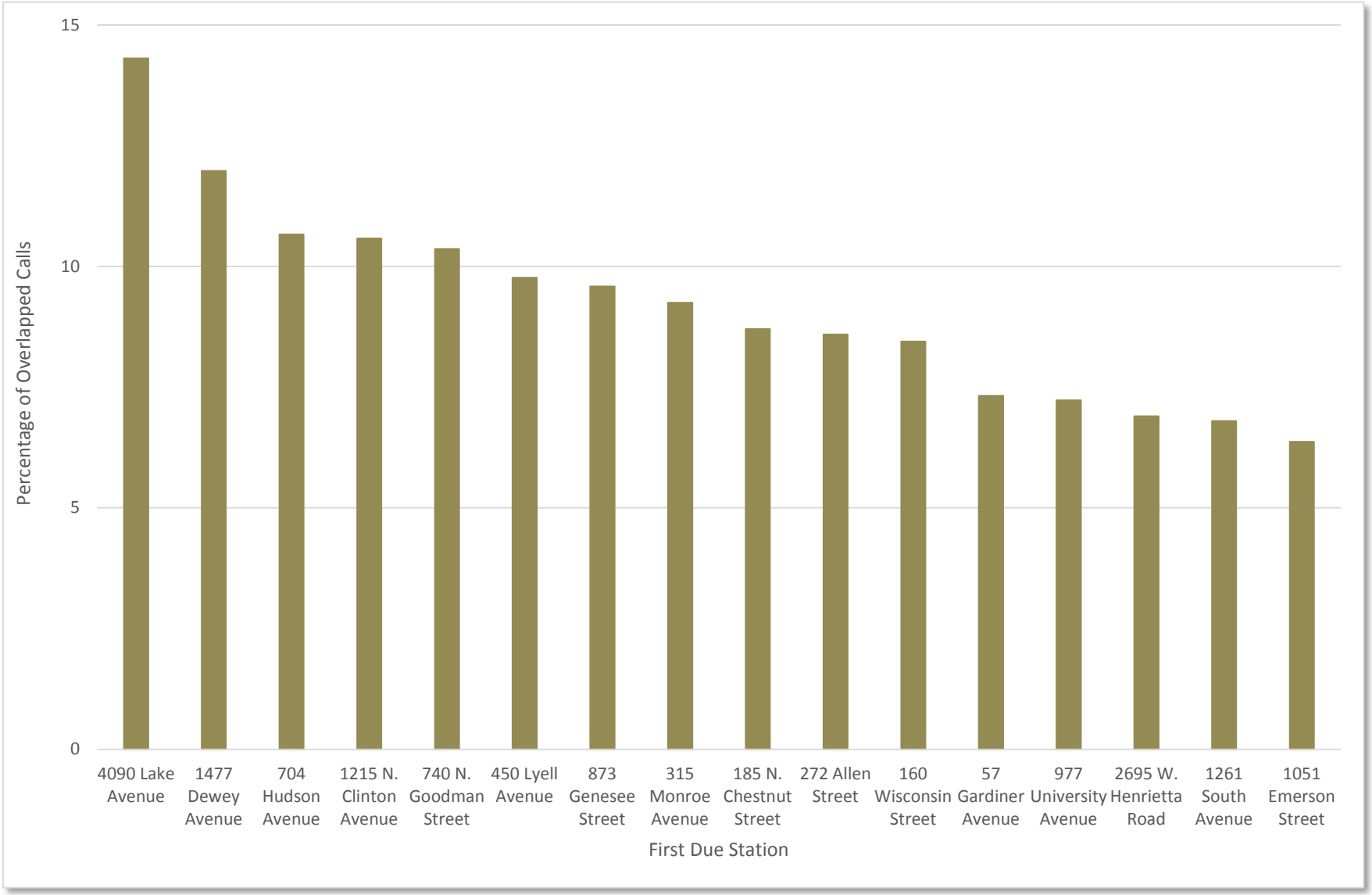


Table 43: Overlapped EMS Calls by First Due Station

First Due Station	Overlapped EMS Calls	Total Calls	Percentage of Overlapped EMS Calls
1051 Emerson Street (E3)	25	1,083[1]	2.3
1215 N. Clinton Avenue (E2)	183	3,393[1]	5.4
1261 South Avenue (T3)	18	1,290	1.4
1477 Dewey Avenue (E10, T2)	126	2,654[2]	4.7
160 Wisconsin Street (E12)	39	1,432[1]	2.7
185 N. Chestnut Street (DC, E17, R11)	113	2,619	4.3
2695 W. Henrietta Road (E8)	15	965[3]	1.6
272 Allen Street (B2, E13, T10)	79	2,513[4]	3.1
315 Monroe Avenue (Car 99, E1)	85	2,432[5]	3.5
4090 Lake Avenue (E19)	62	1,118[6]	5.5
450 Lyell Avenue (E5)	184	3,030[7]	6.1
57 Gardiner Avenue (T5)	52	2,021[5]	2.6
704 Hudson Avenue (B1, E16, T6)	159	3,113[5]	5.1
740 N. Goodman Street (E9)	126	2,740[5]	4.6
873 Genesee Street (E7)	114	2,576[1]	4.4
977 University Avenue (T4)	23	1,286[1]	1.8

[1]One call was missing release times for responding units.
[2]Two calls were missing dispatch times and four calls were missing release times for responding units.
[3]Three calls were missing release times for responding units.
[4]One call was missing dispatch times and four calls were missing release times for responding units.
[5]Two calls were missing release times for responding units.
[6]Six calls were missing release times for responding units.
[7]One call was missing dispatch times and one call was missing release times for responding units.

Figure 52: Percentage of Overlapped EMS Calls by First Due Station

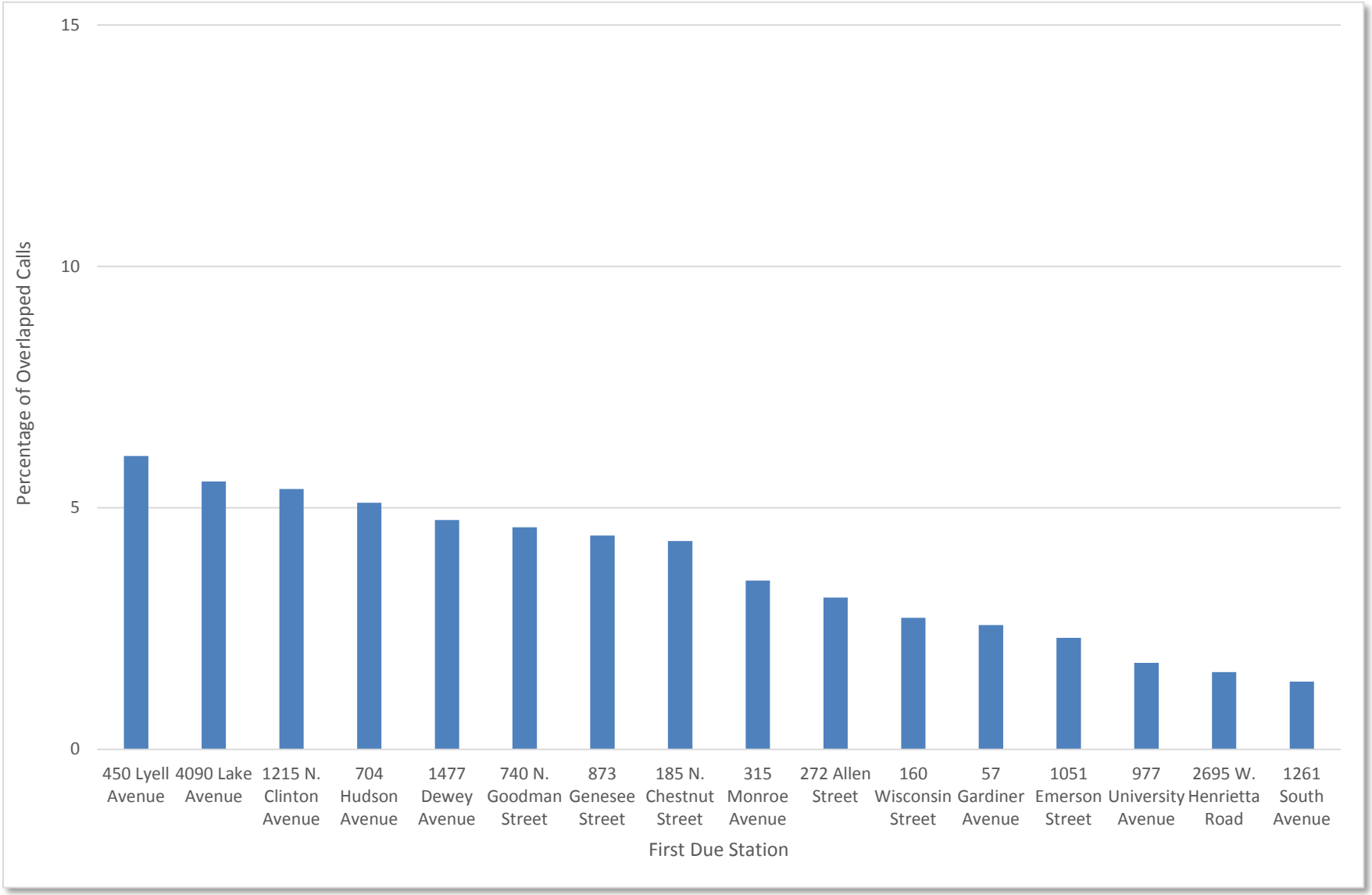
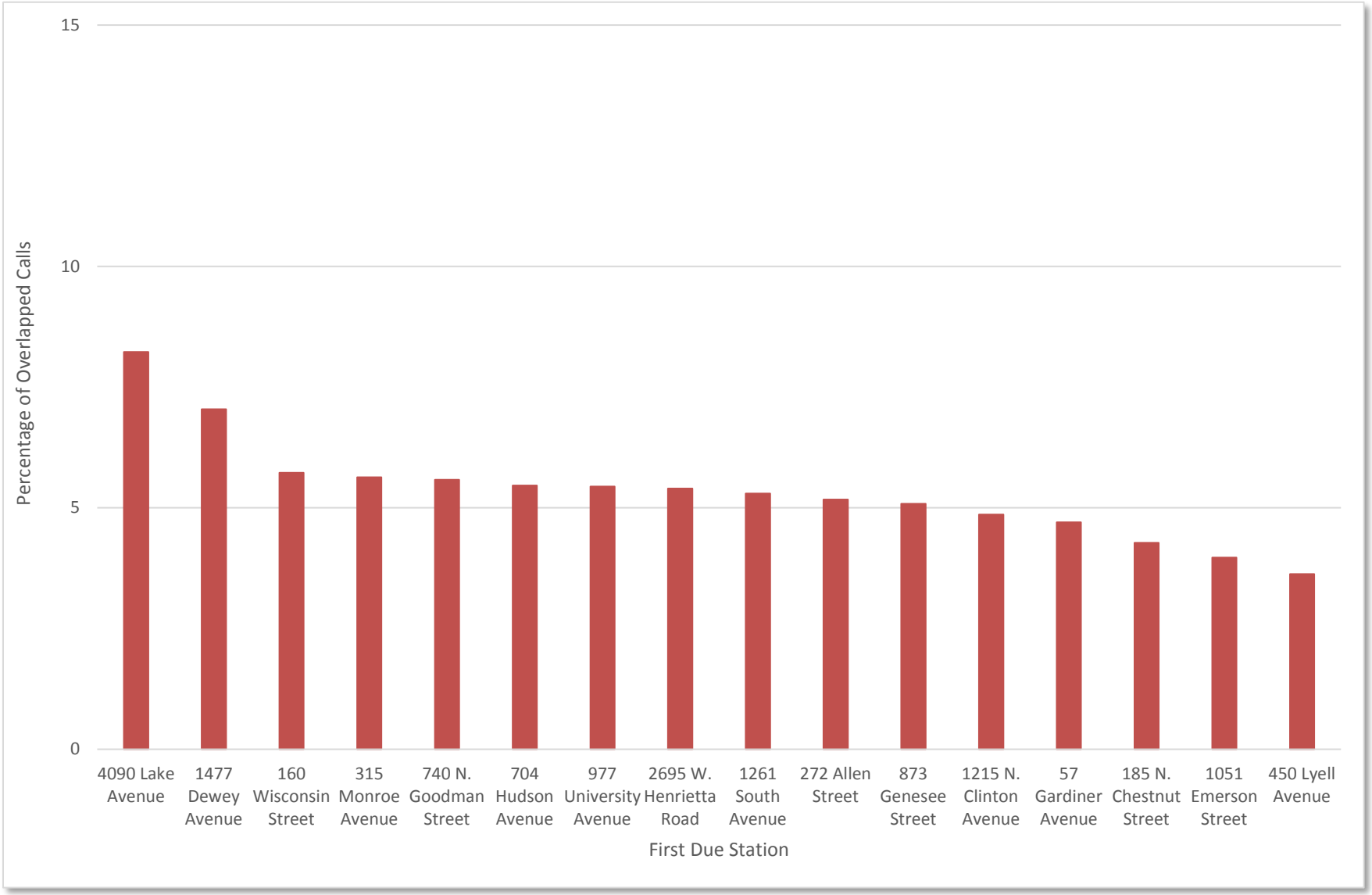


Table 44: Overlapped Fire Calls by First Due Station

First Due Station	Overlapped Fire Calls	Total Calls	Percentage of Overlapped Fire Calls
1051 Emerson Street (E3)	43	1,083[1]	4.0
1215 N. Clinton Avenue (E2)	165	3,393[1]	4.9
1261 South Avenue (T3)	69	1,290	5.3
1477 Dewey Avenue (E10, T2)	187	2,654[2]	7.0
160 Wisconsin Street (E12)	82	1,432[1]	5.7
185 N. Chestnut Street (DC, E17, R11)	112	2,619	4.3
2695 W. Henrietta Road (E8)	52	965[3]	5.4
272 Allen Street (B2, E13, T10)	130	2,513[4]	5.2
315 Monroe Avenue (Car 99, E1)	137	2,432[5]	5.6
4090 Lake Avenue (E19)	92	1,118[6]	8.2
450 Lyell Avenue (E5)	110	3,030[7]	3.6
57 Gardiner Avenue (T5)	95	2,021[5]	4.7
704 Hudson Avenue (B1, E16, T6)	170	3,113[5]	5.5
740 N. Goodman Street (E9)	153	2,740[5]	5.6
873 Genesee Street (E7)	131	2,576[1]	5.1
977 University Avenue (T4)	70	1,286[1]	5.4

[1]One call was missing release times for responding units.
[2]Two calls were missing dispatch times and four calls were missing release times for responding units.
[3]Three calls were missing release times for responding units.
[4]One call was missing dispatch times and four calls were missing release times for responding units.
[5]Two calls were missing release times for responding units.
[6]Six calls were missing release times for responding units.
[7]One call was missing dispatch times and one call was missing release times for responding units.

Figure 53: Percentage of Overlapped Fire Calls by First Due Station



BASELINE PERFORMANCE TABLES

From the reporting periods of 2013 to 2017, the total number of calls increased from 32,185 (average 88.2 calls per day) to 34,886 (average 95.6 calls per day; Table 45). Year-over-year (YoY) growth during this time frame ranged from -0.1% to 4.9%. In Table 45, data for 2013 were available only as unit-level data without corresponding call-level details; data for 2014-17 were derived from the CAD data files.

Table 45: Number of Incidents Dispatched by Category and Reporting Period

Call Category	Reporting Period[1]				
	2013[2]	2014	2015	2016	2017
Cardiac and Stroke	--	3,122	3,303	3,480	3,127
Death	--	0	0	0	1
Difficulty Breathing	--	4,336	4,360	4,246	4,552
Fall and Injury	--	1,552	1,858	1,790	1,775
Illness and Other	--	2,827	2,899	2,865	2,987
MVA	--	1,715	1,817	1,977	1,907
Overdose and Psychiatric	--	36	17	9	15
Seizure and Unconsciousness	--	2,573	2,735	3,011	3,175
EMS Total	**--**	**16,161**	**16,989**	**17,378**	**17,539**
Fire Alarm	--	3,888	3,991	3,947	3,909
Fire Other	--	11,349	11,927	11,650	11,854
Outside Fire	--	165	176	160	334
Structure Fire	--	657	646	621	581
Vehicle Fire	--	270	292	280	276
Fire Total	**--**	**16,329**	**17,032**	**16,658**	**16,954**
Hazmat	**--**	**8**	**8**	**8**	**8**
Rescue	**--**	**326**	**417**	**359**	**385**
Total[3]	**32185**	**32,824**	**34,446**	**34,403**	**34,886**
Average Calls per Day[4]	**88.2**	**89.9**	**94.4**	**94.0**	**95.6**
YoY Growth	**N/A**	**2.0%**	**4.9%**	**-0.1%**	**1.4%**

[1]Reporting periods reflect full calendar years, from January 1 to December 31 of each respective year.
[2]Data for 2013 were available only as unit-level data without corresponding call-level details.
[3]Entries in the CAD data file with "CAN" or "DUP" noted for the variable "FoundDispositionCode1" by reporting year were as follows: 2014, "CAN" (*n*=27), "DUP" (*n*=36); 2015, "CAN" (*n*=27), "DUP" (*n*=33); 2016, "CAN" (*n*=17), "DUP" (*n*=27); 2017, "CAN" (*n*=29), "DUP" (*n*=31).
[4]Reporting period 2016 contained 366 days due to inclusion of leap year date February 29, 2016; all other reporting periods contained 365 days.

From the reporting periods of 2013 to 2017, the total number of responses increased from 43,597 (average 119.4 responses per day) to 47,218 (average 129.4 responses per day; Table 46). Total busy hours increased from 12,878.3 in 2013 to 13,712.1 in 2017. Average number of responses per call has remained consistent across the reporting periods at 1.4.

Table 46: Number of Calls, Number of Responses, and Total Busy Time by Reporting Period

Reporting Period[1]	Number of Calls[2]	Number of Responses[3]	Average Responses per Call	Total Busy Hours	Responses with Time Data[4]	Average Busy Minutes per Response	Average Calls per Day[5]	Average Responses per Day[5]
2013	32,185	43,597	1.4	12,878.3	42,539	18.2	88.2	119.4
2014	32,634	44,530	1.4	12,969.8	41,848	18.6	89.4	122.0
2015	34,244	47,612	1.4	13,965.3	44,721	18.7	93.8	130.4
2016	34,036	47,285	1.4	13,760.2	44,747	18.5	93.0	129.2
2017	34,446	47,218	1.4	13,712.1	44,668	18.4	94.4	129.4

[1]Reporting periods reflect full calendar years, from January 1 to December 31 of each respective year.
[2]"Number of Calls" reflects an adjusted number of unique incidents per reporting year to correspond with data provided in the unit-level data file (as opposed to data provided in the CAD data files that did not contain unit-level data, as presented in the preceding table), regardless of calculated busy time.
[3]"Number of Responses" reflects the total number of entries in the unit-level data file per reporting year, regardless of calculated busy time.
[4]"Responses with Time Data" reflects the number of responses in the unit-level data file per reporting year with available and logically sequenced dispatch and release times.
[5]Reporting period 2016 contained 366 days due to inclusion of leap year date February 29, 2016; all other reporting periods contained 365 days.

This last section presents analyses of baseline performance times separately for EMS (Table 47 and Table 48) and fire related incidents (Table 49 and Table 50) that focus on emergency (lights and sirens) responses from the first arriving primary front-line units for all unique incidents. Call status as emergency or non-emergency was assigned per call type by RFD and was based on "EventTypeDescription" from the CAD data files. Units identified by RFD as primary front-line units included all departmental units except for the admin on-call vehicles, Car 1 and Car 2.

Across the reporting periods of 2014 to 2017, the vast majority of responses associated with arrivals to EMS incidents included one or two arriving units (66,601/66,758; 99.8%), and the vast majority of responses associated with arrivals to fire related incidents also included one or two arriving units (65,348/80,900; 80.8%). As such, we used the 2nd arriving unit as ERF for both EMS and fire related incidents.

The department can reference the historical performances and make reasonable targets to continuously improve the response process to meet recommended targets by industry standards or best practices.

Table 47: Baseline Average Performance of Primary Front-Line Arriving Units for EMS Incidents by Reporting Period

Performance Metric	Arriving Unit	Average Time (Minutes) 2014	2015	2016	2017
Dispatch Time	1st	2.4	2.2	2.0	1.9
	2nd (ERF)	6.6	5.4	4.3	8.1
Turnout Time	1st	1.5	1.5	1.5	1.5
	2nd (ERF)	1.6	1.5	2.0	1.5
Travel Time	1st	2.8	2.8	2.8	2.8
	2nd (ERF)	3.6	3.8	3.2	3.2
Response Time	1st	6.7	6.5	6.3	6.2
	2nd (ERF)	12.0	10.8	9.0	12.8
Sample Size[1]	1st	15,492	16,374	16,994	17,084
	2nd (ERF)	95	211	227	124

[1]Sample sizes presented reflect number of responses; sample sizes corresponding to performance metrics may be slightly smaller due to missing time data.

Table 48: Baseline 90th Percentile Performance of Primary Front-Line Arriving Units for EMS Incidents by Reporting Period

Performance Metric	Arriving Unit	90th Percentile Time (Minutes) 2014	2015	2016	2017
Dispatch Time	1st	3.7	3.4	2.9	2.9
	2nd (ERF)	16.6	12.3	9.2	19.7
Turnout Time	1st	2.3	2.3	2.3	2.3
	2nd (ERF)	2.4	2.4	2.4	2.7
Travel Time	1st	4.2	4.4	4.4	4.4
	2nd (ERF)	6.6	6.6	5.3	5.6
Response Time	1st	8.8	8.7	8.3	8.3
	2nd (ERF)	22.4	19.6	15.2	26.0
Sample Size[1]	1st	15,492	16,374	16,994	17,084
	2nd (ERF)	95	211	227	124

[1]Sample sizes presented reflect number of responses; sample sizes corresponding to performance metrics may be slightly smaller due to missing time data.

Table 49: Baseline Average Performance of Primary Front-Line Arriving Units for Fire Incidents by Reporting Period

Performance Metric	Arriving Unit	Average Time (Minutes) 2014	2015	2016	2017
Dispatch Time	1st	2.1	1.9	1.8	3.4
	2nd (ERF)	3.3	2.9	2.7	3.3
Turnout Time	1st	1.5	1.6	1.6	1.6
	2nd (ERF)	1.7	1.6	1.6	1.5
Travel Time	1st	3.0	3.1	3.2	3.2
	2nd (ERF)	3.6	3.8	3.8	3.7
Response Time	1st	6.5	6.4	6.4	7.9
	2nd (ERF)	8.5	8.2	8.0	8.4
Sample Size[1]	1st	12,819	13,793	14,269	14,299
	2nd (ERF)	2,235	2,696	2,713	2,524

[1]Sample sizes presented reflect number of responses; sample sizes corresponding to performance metrics may be slightly smaller due to missing time data.

Table 50: Baseline 90th Percentile Performance of Primary Front-Line Arriving Units for Fire Incidents by Reporting Period

Performance Metric	Arriving Unit	90th Percentile Time (Minutes) 2014	2015	2016	2017
Dispatch Time	1st	3.5	3.2	3.0	3.2
	2nd (ERF)	6.8	4.8	4.7	5.4
Turnout Time	1st	2.3	2.3	2.3	2.4
	2nd (ERF)	2.5	2.5	2.4	2.3
Travel Time	1st	4.8	4.8	5.0	5.1
	2nd (ERF)	5.9	6.3	5.9	6.1
Response Time	1st	8.9	8.8	8.7	8.9
	2nd (ERF)	13.2	12.3	12.0	12.2
Sample Size[1]	1st	12,819	13,793	14,269	14,299
	2nd (ERF)	2,235	2,696	2,713	2,524

[1]Sample sizes presented reflect number of responses; sample sizes corresponding to performance metrics may be slightly smaller due to missing time data.

APPENDIX

This section reflects the audit, exclusion, and classification activities performed on the four RFD CAD data files spanning January 1, 2014 to December 31, 2017, and on the RFD unit-level data file spanning January 1, 2013 to December 31, 2017, as appropriate. Prior to any exclusion activity, the four CAD data files combined originally contained 147,924 entries, and the unit-level data file originally contained 230,242 entries. Entries in the CAD data files without a "CaseNumber" presented (*n*=11,365) to indicate a relevant RFD event and to allow for mapping to data provided in the unit-level data file were immediately excluded. As such, audit, exclusion, and classification activities on the CAD data were performed beginning with 136,559 entries.

Table 51: Basic Audit of Data File – CAD Data File

Audit Activity[1]	Frequency (*n*)	Percent of Total (%)
Total Entries in Data Set	**136,559**	**--**
Entries with Duplicate Case Numbers[2]	10	0.0
Missing Call Received Date and Time	29,147	21.3
Missing Call Closed Date and Time	1	0.0
Missing CarBeat1 (First Due) Code	235	0.2
Missing X-Y Coordinates (Presented as 0 Entries)	37,246	27.3
Call Receipt Date and Time = Call Dispatch Date and Time	119,329	87.4
Call Received Date and Time = Call Dispatch Date and Time (Call Dispatch Time=0 Minutes)	97	0.1
Call Received Date and Time to Call Dispatch Date and Time (Call Dispatch Time) > 10 Minutes	210	0.2

[1]Audit activities were independent of one another, such that frequency and percent data are not intended to be additive.
[2]These ten entries related to five case numbers in 2014 (i.e., 2014006080, 2014020488, 2014024507, 2014024508, 2014024509); each case number had two corresponding entries that appeared to be unique based on incident address, event description, and other data; these ten entries were later coded with "A" or "B" following the case number to identify them as unique incidents and to contribute to overall call volume for 2014.

Table 52: Basic Audit of Data File – Unit-Level Data File

Audit Activity[1]	Frequency (*n*)	Percent of Total (%)
Total Entries in Data Set	**230,242**	--
Missing Unit Dispatch Date and Time When Enroute Date and Time Provided	2,036	0.9
Missing Unit Release Date and Time	1,971	0.9
Unit Dispatch Date and Time < Call Receipt Date and Time (Unit Dispatch Time < 0 Minutes)	689	0.3
Unit Dispatch Date and Time = Call Receipt Date and Time (Unit Dispatch Time = 0 Minutes)	4,852	2.1
Call Receipt Date and Time to Unit Dispatch Date and Time (Unit Dispatch Time) > 10 Minutes	2,343	1.0
Unit Enroute Date and Time < Unit Dispatch Date and Time (Unit Turnout Time < 0 Minutes)	91	0.0
Unit Enroute Date and Time = Unit Dispatch Date and Time (Unit Turnout Time = 0 Minutes)	1,454	0.6
Unit Dispatch Date and Time to Unit Enroute Date and Time (Unit Turnout Time) > 10 Minutes	124	0.1
Unit Onscene Date and Time < Unit Enroute Date and Time (Unit Travel Time < 0 Minutes)	810	0.4
Unit Onscene Date and Time = Unit Enroute Date and Time (Unit Travel Time = 0 Minutes)	1,147	0.5
Unit Enroute Date and Time to Unit Onscene Date and Time (Unit Travel Time) > 30 Minutes	95	0.0
Unit Onscene Date and Time < Call Receipt Date and Time (Unit Response Time < 0 Minutes)	562	0.2
Unit Onscene Date and Time = Call Receipt Date and Time (Unit Response Time = 0 Minutes)	1,452	0.6
Call Receipt Date and Time to Unit Onscene Date and Time (Unit Response Time) > 24 Hours	54	0.0
Unit Release Date and Time < Unit Dispatch Date and Time (Unit Busy Time < 0 Minutes)	158	0.1
Unit Release Date and Time = Unit Dispatch Date and Time (Unit Busy Time = 0 Minutes)	129	0.1
Unit Dispatch Date and Time to Unit Release Date and Time (Unit Busy Time) > 24 Hours	32	0.0
Unit Busy Time Not Calculated Due to Missing Unit Dispatch and/or Release Date and Time	3,986	1.7

[1]Audit activities were independent of one another, such that frequency and percent data are not intended to be additive.

Table 53: Exclusions for Busy and Performance Time Analyses

Audit Activity[1]	Frequency (*n*)	Percent of Total (%)
Total Entries in Data Set	**230,242**	--
Unit Dispatch Date and Time < Call Receipt Date and Time (Unit Dispatch Time < 0 Minutes)	689	0.3
Unit Dispatch Date and Time = Call Receipt Date and Time (Unit Dispatch Time = 0 Minutes)	4,852	2.1
Call Receipt Date and Time to Unit Dispatch Date and Time (Unit Dispatch Time) > 12 Hours[2]	40	0.0
Unit Enroute Date and Time < Unit Dispatch Date and Time (Unit Turnout Time < 0 Minutes)	84	0.0
Unit Enroute Date and Time = Unit Dispatch Date and Time (Unit Turnout Time = 0 Minutes)	899	0.4
Unit Dispatch Date and Time to Unit Enroute Date and Time (Unit Turnout Time) > 12 Hours[3]	11	0.0
Unit Onscene Date and Time < Unit Enroute Date and Time (Unit Travel Time < 0 Minutes)	783	0.3
Unit Onscene Date and Time = Unit Enroute Date and Time (Unit Travel Time = 0 Minutes)	291	0.1
Unit Enroute Date and Time to Unit Onscene Date and Time (Unit Travel Time) > 12 Hours[4]	15	0.0
Unit Onscene Date and Time < Call Receipt Date and Time (Unit Response Time < 0 Minutes)	17	0.0
Unit Onscene Date and Time = Call Receipt Date and Time (Unit Response Time = 0 Minutes)	3	0.0
Call Receipt Date and Time to Unit Onscene Date and Time (Unit Response Time) > 24 Hours[5]	12	0.0
Unit Release Date and Time < Unit Dispatch Date and Time (Unit Busy Time < 0 Minutes)	97	0.0
Unit Release Date and Time = Unit Dispatch Date and Time (Unit Busy Time = 0 Minutes)	73	0.0
Unit Dispatch Date and Time to Unit Release Date and Time (Unit Busy Time) > 24 Hours[6]	8	0.0
Total Entries Remaining in Data Set	**222,368**	**96.6**

[1]Exclusion activities were sequential, such that frequency and percent data are additive.

[2]Threshold of > 12 hours was selected to allow for possible data entry errors introduced into the year, month, or day, and errors in entering AM vs PM; e.g., incident number 2017027914, call receipt date and time 10/17/2017 5:04:10 AM, unit dispatch date and time 10/17/2020 5:05:34 AM; incident number 2017000417, call receipt date and time 1/05/2017 5:55:50 PM, unit dispatch date and time 2/05/2017 5:56:07 PM; incident number 2017005260 call receipt date and time 3/01/2017 4:45:10 AM, unit dispatch date and time 3/05/2017 4:45:20 AM; incident number 2017025496 call receipt date and time 9/23/2017 12:39:02 AM, unit dispatch date and time 9/23/2017 12:39:05 PM.

[3]Threshold of > 12 hours was selected to allow for possible data entry errors introduced into the year, month, or day, and errors in entering AM vs PM; e.g., incident number 2017032319, unit dispatch date and time 11/30/2017 10:46:31 PM, unit enroute date and time 12/30/2017 10:48:23 PM; incident number 2017015535, unit dispatch date and time 6/13/2017 11:36:06 PM, unit enroute date and time 6/14/2017 11:37:00 PM.

[4]Threshold of > 12 hours was selected to allow for possible data entry errors introduced into the year, month, or day, and errors in entering AM vs PM; e.g., incident number 2017034234, unit enroute date and time 12/22/2017 12:55:00 PM, unit onscene date and time 1/22/2018 1:10:00 PM; incident number 2017007708, unit enroute date and time 3/22/2017 1:41:50 PM, unit onscene date and time 4/22/2017 1:49:18 PM; incident number 2017027205, unit enroute date and time 10/10/2017 12:13:58 PM, unit onscene date and time 10/12/2017 12:17:00 PM.

[5]Threshold of > 24 hours was selected to allow for possible data entry errors introduced into the year, month, or day; e.g., incident number 2016019834, call receipt date and time 7/29/2016 9:19:12 AM, unit onscene date and time 8/29/2016 9:20:20 AM; incident number 2017018928, call receipt date and time 7/18/2017 5:34:23 AM, unit onscene date and time 7/28/2017 5:35:00 AM.

[6]Threshold of > 24 hours was selected to allow for possible data entry errors introduced into the year, month, or day; e.g., incident number 2017002163, unit dispatch date and time 1/24/2017 1:42:31 AM, unit release date and time 2/24/2017 1:58:17 AM; incident number 2017006883, unit dispatch date and time 3/13/2017 9:27:18 AM, unit release date and time 3/17/2017 9:40:45 AM.

Table 54: Classification of Incident Type from CAD Data File into Program and Call Category

Program	Call Category	"EventTypeDescription" from CAD Data File
EMS	Cardiac and Stroke	CARDIAC ARST/OBVIOUS/EXP/QUEST
		CARDIAC/RESP - NOT BREATHING
		CARDIAC/RESP-BREATHING AGONAL
		CARDIAC/RESP-HANGING
		CARDIAC/RESP-NOT BREATHING
		CARDIAC/RESP-STRANGULATION
		CHEST PAIN - ABNORMAL BREATH
		CHEST PAIN - ANGINA/HEART HIST
		CHEST PAIN - CLAMMY
		CHEST PAIN - NORMAL BREATH <35
		CHEST PAIN - NORMAL BREATH >35
		CHEST PAIN - NOT ALERT
		CHEST PAIN- CHANGING COLOR
		CHEST PAIN -CLAMMY
		CHEST PAIN- DIFF SPEAKING
		HEART PROB/ CHANGING COLORS
		HEART PROB-CLAMMY
		HEART PROB-FIRING AICD
		HEART PROBLEM - NOT ALERT
		HEART PROBLEM- DIFF SPEAKING
		HEART PROBLEM-CLAMMY
		HEART PROB-NOT ALERT
		STROKE - NOT ALERT
		STROKE-NOT ALERT < 5HR ONSET
		STROKE-NUMB/TINGLNG <5HR ONSET
	Death	OBVIOUS DEATH (GSW TO HEAD)
	Difficulty Breathing	ALLERGIES-INEFECTIVE BREATHING
		ASLT-CHEST/NECK INJ-TRB BREATH
		CARDIAC/RESP-INEFFECT BREATH
		CHOKING - NOT ALERT
		CHOKING-ABNORM BRTH/PART OBS
		CHOKING-COMPL OBSTR/INEFF BRTH
		DIABETIC - ABNORM BREATH
		ILLNESS/ABNORMAL BREATHING
		STROKE-ABNML BREATH <5HR ONSET
		TR/BREATHING-INEFECTIVE BREATH
		TRB BREATHING - DIFF SPEAKING
		TRB BREATHING- CHANGING COLOR
		TRB BREATHING- CLAMMY
		TRB BREATHING- DIFF SPEAKING
		TRB BREATHING- NOT ALERT
		TRB BRTHNG - ABNORMAL BREATHIN
		TROUBLE BREATHING- CLAMMY

Program	Call Category	"EventTypeDescription" from CAD Data File
EMS	Fall and Injury	ANML BITE/ATTACK DANG AREA
		ANML BITE/ATTACK EXOTIC ANIMAL
		ANML BITE/ATTACK NOT ALERT
		ANML BITE/ATTACK UNCONSCIOUS
		ASSAULT-MULTIPLE VICTIMS
		ASSAULT-NOT ALERT
		BURNS/EXPL - BURNS > 18% BODY
		EYE PROBLEM/INJ-NOT ALERT
		FALL >=30 FT
		FALL- UNCONSCIOUS/ARREST
		FALLS/BACK INJ - NOT ALERT
		FALLS/BACK INJ-LONG FALL >6FT
		FALLS/BACK INJ-NOT ALERT
		FALLS/BACK INJ-NOT DANGEROUS
		FALLS/CHEST/NECK INJ-TRB BREAT
		GUNSHOT - CENTRAL WOUNDS
		GUNSHOT - MULTIPLE VICTIMS
		GUNSHOT - NOT ALERT
		GUNSHOT - UNCONSCIOUS
		GUNSHOT-MULTIPLE WOUNDS
		HEAT/COLD EXP-MULTIPLE VICTS
		HEAT/COLD EXP-NOT ALERT
		HEMMOR/LACER -ABNORMAL BREATH
		HEMMOR/LACER-ABNORMAL BREATH
		HEMMORRHAGE THRU FISTULA
		HEMMORRHAGE/ UNCONS/ARREST
		HEMORR/LACER-DANGEROUS
		HEMORR/LACER-NOT ALERT
		HEMORR/LACER-SERIOUS HEMORR
		HEMORR/LACER-THROUGH TUBES
		HEMORRHAGE THRU FISTULA
		HEMORRHAGE-UNCONS/ARREST
		PENETRATE-CENTRAL WOUNDS
		PENETRATE-MULTIPLE WOUNDS
		SEXUAL ASLT NOT ALERT
		SEXUAL ASLT-UNCON/ARREST
		STABBING
		STABBING - CENTRAL WOUNDS
		STABBING- CENTRAL WOUNDS
		STABBING- MULTIPLE VICTIMS
		STABBING- NOT ALERT
		STABBING- UNCONSCIOUS
		STABBING-MULTIPLE WOUNDS

Program	Call Category	"EventTypeDescription" from CAD Data File
		TRAUMATIC INJ- NOT ALERT
EMS	Fall and Injury	TRAUMATIC INJ- UNCONS/ARREST
		TRAUMATIC INJ-CHEST/NECK INJ
		TRAUMATIC INJ-SERIOUS HEMORRHA
	Illness and Other	ABDOM PAIN-NOT ALERT
		ABDOMINAL PAINS
		ALLERGIES - DIFF SPEAKING
		ALLERGIES-BEE ATT/SWARMING
		ALLERGIES-NOT ALERT
		BACK PAIN / NOT ALERT
		DIABETIC - ABNORM BEHAVIOR
		DIABETIC-ALERT & BEHAVE NORMAL
		EMS / FIRST RESPONDER
		HEADACHE-NOT ALERT
		HEADACHE-SPEECH/MOVEMENT PROB
		HEADACHE-SUDDEN ONSET/SEV PAIN
		ILLNESS/ALTERED LVL OF CONSC
		ILLNESS/NON PRIORITY COMPL
		INTERFACILITY - EMERG RESP REQ
		INTERFACILITY/NOT ALERT
		INTERFACILITY-ACUTE SEVER PAIN
		INTERFACILITY-CARD/RESP ARRES
		INTERFACILITY-POSS ACUTE HEART
		PREG/BABY BORN W/O COMPLICAT
		PREG/BABY BORN/COMPLIC W/MOTHR
		PREGNANCY - BABY BORN W/ COMPL
		PREGNANCY - BABY HEAD VISIBLE
		PREGNANCY - IMMINT DEL/20WKS
		PREGNANCY- BABY BORN W/ COMPL
		PREGNANCY-1ST TRIM HEMORRHAGE
		PREGNANCY-3RD TRIM BLEEDING
		PREGNANCY-BABY HEAD VISIBLE
		PREGNANCY-BREECH OR CHORD
		PREGNANCY-IMMINT DEL/20WKS
		SICKNESS - NOT ALERT
		SICKNESS-NOT ALERT
		UNKNOWN PROB-LIFE STATUS
		UNKNOWN PROB-MEDICAL ALERT
	MVA	MOTOR VEHICLE ACC W/INJURIES
		MVA - AUTO/BIKE/MOTORCYCLE
		MVA - AUTO/PEDESTRIAN
		MVA - NOT DANGEROUS INJ
		MVA - W/INJURIES/OTHER HAZARDS

Program	Call Category	"EventTypeDescription" from CAD Data File
		MVA- SERIOUS HEMORRHAGE
		MVA-ALL TERRAIN
EMS	MVA	MVA-AUTO/BIKE/MOTORCYCLE
		MVA-AUTO/PEDESTRIAN
		MVAIA - BUS
		MVAIA - EJECTED VICTIM
		MVAIA - NOT ALERT
		MVAIA - W/INJURIES
		MVA-NOT DANGEROUS INJ
	Overdose and Psychiatric	PSYCH - SERIOUS HEMORRAGHE
		PSYCH-THREAT SUIC-VIOLENT
		PYSCH - NOT ALERT
		PYSCH - NOT ALERT - VIOL/WEAP
		PYSCH - NOT ALERT - VIOLENT
		PYSCH-DANG HEMORR-WEAP/VIOLENT
		PYSCH-DANGEROUS HEMMOR
		PYSCH-DANGEROUS HEMMOR-VIOLENT
		PYSCH-DANGEROUS HEMMOR-WEAPON
		PYSCH-NEAR HANG/STRANG/SUFF
	Seizure and Unconsciousness	ASSAULT-UNCON/ARREST
		CONV/SEIZ- AGONAL/INEFF BREATH
		CONV/SEIZ->35 BREATH NOT VERIF
		CONV/SEIZURES - CONTINOUS/MULT
		CONV/SEIZURES CONTINOUS/MULT
		CONV/SEIZURES NOT BREATHING
		DIABETIC - UNCONSCIOUS
		FAINT - ALERT>35 W/ CARDIAC HX
		FAINT- CHANGING COLOR
		OD/POIS - UNCONSIOUS
		OD/POIS-CHANGING COLOR
		OD/POIS-UNCONSIOUS
		OVERDOSE - NOT ALERT
		SEIZURE - FOCAL - NOT ALERT
		UNCON/FAINT - NOT ALERT
		UNCON/FAINT-INEFECTIVE BREATH
		UNCON/FAINT-NOT ALERT
		UNCONSC W/ EFFECTIVE BREATHING
		UNCONSCIOUS- AGONAL/INEFF BRTH
Fire	Fire Alarm	AUTOMATIC FIRE ALARM
		FIRE BOX ALARM
	Fire Other	DANGEROUS CONDITION - (1 UNIT)
		FILL-IN REQUEST
		FIRE RESPONSE / READ REMARKS

Program	Call Category	"EventTypeDescription" from CAD Data File
		FOLLOW UP
		FUMES INCIDENT
		FUMES INCIDENT/CO DETECTOR
Fire	Fire Other	HYDRANT IN OR OUT OF SERVICE
		PROBLEMS / OUTSIDE
		REBROADCAST EVENT
		REQUEST FOR IMMEDIATE ASST
		SEE/SMELL SMOKE/APPLIANCE FIRE
		SMOKE/CO DETECTOR INSTALLATION
		WATER PROBLEM
		WATERFLOW ALARM
	Outside Fire	BURNIN TREE/OBJECT/TRANSFORMER
	Structure Fire	STRUCTURE FIRE
	Vehicle Fire	VEHICLE FIRES
Hazmat	Hazmat	HAZMAT INCIDENT
		MOTOR VEHICLE ACC-HAZMAT
		SUSP MAIL RECEIVED
		TRAIN INC.(GIVE WND SPD & DIR)
Rescue	Rescue	DROWNING INCIDENT
		JUMPER-FALL >=30 FT
		MAJOR INCIDENT/WATER CRAFT
		MVA- SINKING VEHICLE
		MVA W/PEOPLE TRAPPED
		MVA-VEH OFF BRIDGE/HEIGHTS
		MVA-VEH ROLLOVERS
		PERSON THREATING OR HAS JUMPED
		PSYCH - JUMPER (THREATENING)
		PSYCH-JUMPER (THREAT)-VIOLENT
		PSYCH-JUMPER(THREAT)-VIOL/WEAP
		RESCUE:DRWN/MACH/TRENCH/ROPE

February 2019

GIS Analysis

Rochester Fire Department
City of Rochester, New York

Prepared by:

FITCH & ASSOCIATES, LLC
2901 Williamsburg Terrace #G ▪ Platte City ▪ Missouri ▪ 64079
816.431.2600 ▪ www.fitchassoc.com

CONSULTANT REPORT

GIS Analysis
Rochester Fire Department, NY

TABLE of CONTENTS

ESTABLISHING BASELINE PERFORMANCE

The first step in completing GIS planning analyses is to establish the desired performance parameters. Measures of total response time can be significantly influenced by both internal and external influences. For example, the dispatch time, defined as the time from pick up at the 911-center to the dispatching of units, contributes to the customer's overall response time experience. Another element in the total response time continuum is the turnout time, defined as the time from when the units are notified of the incident until they are actually responding. Turnout time can have a significant impact to the overall response time for the customer and is generally considered under management's control. However, the travel time, defined as the period from when the units are actually responding until arrival at the incident is a factor of the number of fire stations, the ability to travel unimpeded on the road network, the existing road network's ability to navigate the community, and the availability of the units. Largely, travel time is the most stable variable to utilize in system design regarding response time performance.

Therefore, these GIS planning analyses will focus on travel time capability as the unit of measure. The calendar year 2017 (January 1, 2017 – December 31, 2017) performance for travel time across program area is provided below. Overall, the travel time is 4.7 minutes or less for 90% of the incidents.

Table 1: 90th Percentile Dispatch, Turnout, Travel, and Response Times by Program – First Arriving Units

Program	Dispatch Time (Minutes)	Turnout Time (Minutes)	Travel Time (Minutes)	Response Time (Minutes)	Sample Size[1]
EMS	0.4	2.3	4.4	6.3	17,084
Fire	0.9	2.4	5.1	7.5	14,299
Hazmat	--	--	--	--	8
Rescue	1.9	2.2	4.0	6.3	370
Total	**0.7**	**2.3**	**4.7**	**6.7**	**31,761**

[1]Sample sizes reflect the number of responses made by first arriving primary front-line units to emergency calls; due to missing time data, sample sizes corresponding to individual table metrics may be smaller.

Comparison to National References

There are two notable references for travel time available to the fire service in National Fire Protection Association (NFPA) 1710[1] and the Commission on Fire Accreditation International (CFAI)[2]. NFPA 1710 suggests a 4-minute travel time at the 90th percentile for first due arrival of Basic Life Support (BLS) and Fire incidents and the CFAI recommends a 5 minute and 12 seconds travel time for first due arrival in an urban/Suburban population density and 13-minutes travel time for rural

[1] National Fire Protection Association. (2010). NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. Boston, MA: National Fire Protection Association.

[2] CFAI. (2009). Fire & emergency service self-assessment manual, (8th ed.). Chantilly, Virginia: Author. (page 71)

populations of less than 1,000 per square mile. The arrival of an Advanced Life Support (ALS) unit is recommended at 8-minutes travel time by NFPA 1710. It is important to note that the latest edition (9th edition) of the CFAI guidelines have de-emphasized response time and only reference the legacy standards with a separately provided companion document[3].

Validation of Planning Analysis

The first step in this validation analysis is to utilize the historical performance to validate the planning analyses utilized by the GIS system. The historical performance demonstrated a 4.7 overall department performance and a 5.1-minute fire travel time capability from the existing fire stations at the 90th percentile. Utilizing average road speeds, the planning assessments estimated approximately 90% of the incidents could be responded to within 4-minutes travel time from the existing fire stations. With respect to a 5-minute travel time, the department should be able to respond to nearly 98% of the incidents with 5-minutes or less. In other words, there is a high degree of agreement between the quantitative analyses and the GIS planning analyses. Therefore, considerable confidence can be maintained across the various GIS modeling. Results are provided below.

Table 2: Marginal Fire Station Contribution for 4-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST01	6,072	6,072	17.44%
2	ST16	5,873	11,945	34.30%
3	ST05	4,633	16,578	47.61%
4	ST07	3,144	19,722	56.64%
5	ST10	2,556	22,278	63.98%
6	ST09	1,987	24,265	69.68%
7	ST02	1,562	25,827	74.17%
8	STT5	1,382	27,209	78.14%
9	ST12	1,072	28,281	81.22%
10	ST08	1,019	29,300	84.14%
11	ST19	1,002	30,302	87.02%
12	STT4	509	30,811	88.48%
13	STT3	426	31,237	89.70%
14	ST17	60	31,297	89.88%
15	ST03	52	31,349	90.03%

[3] CFAI. (2016). Fire & emergency service self-assessment manual, (9th ed.). Chantilly, Virginia: Author.

Figure 1: Current Fire Station Bleed Maps for 4-Minute Travel Time

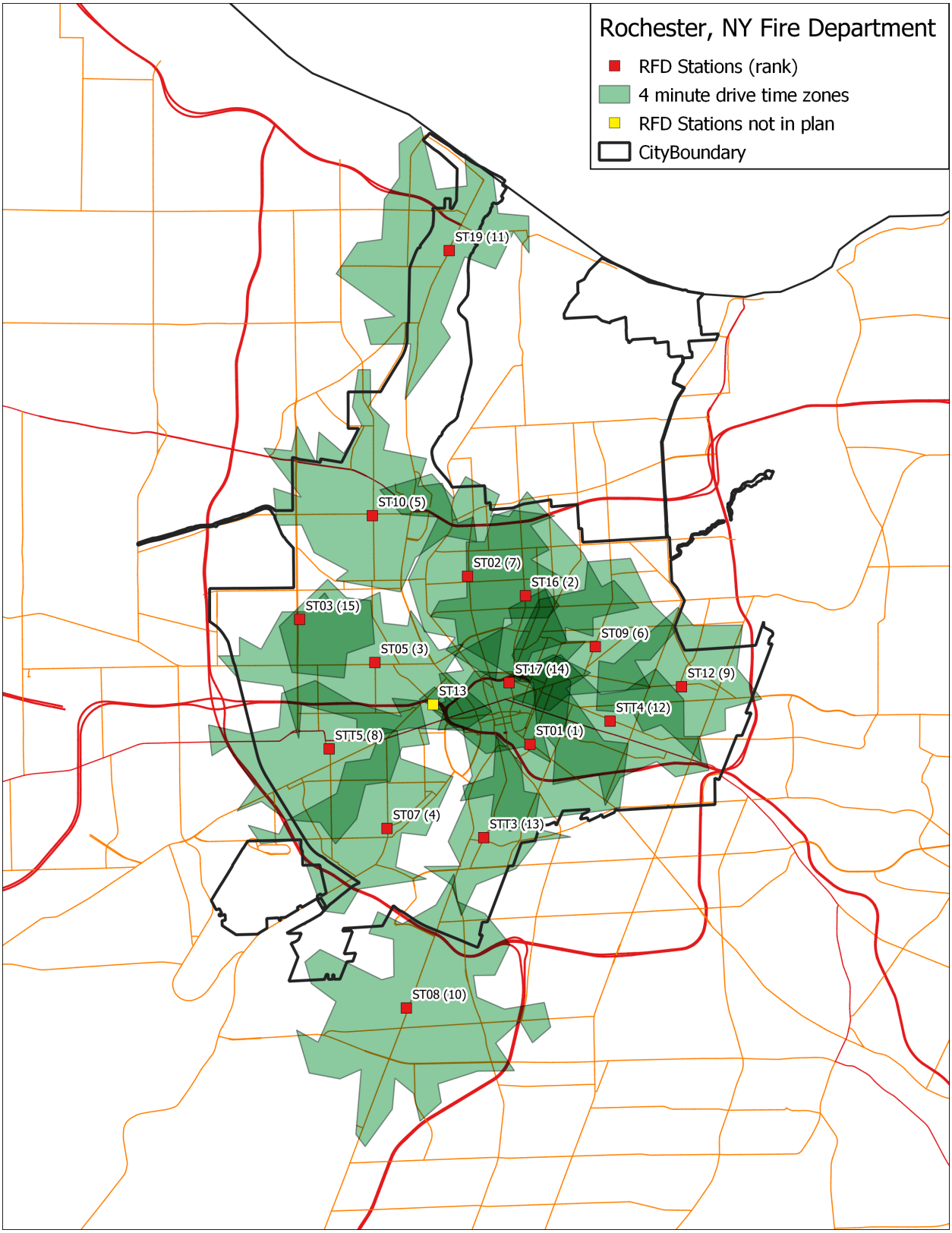
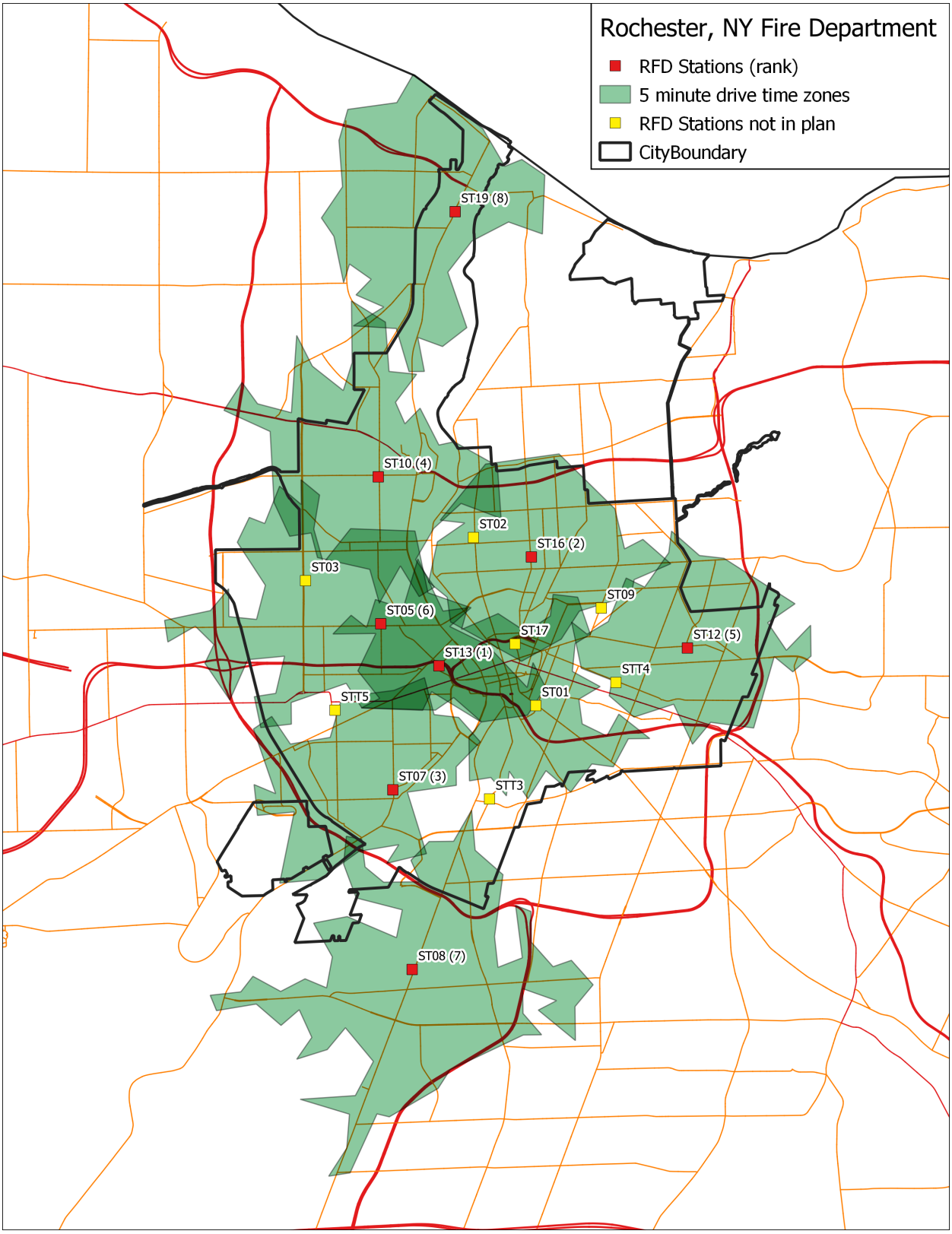


Table 3: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST13	9,550	9,550	27.43%
2	ST16	7,487	17,037	48.93%
3	ST07	4,213	21,250	61.02%
4	ST10	3,873	25,123	72.15%
5	ST12	2,705	27,828	79.91%
6	ST05	2,095	29,923	85.93%
7	ST08	1,376	31,299	89.88%
8	ST19	1,072	32,371	92.96%
9	ST01	681	33,052	94.92%
10	STT5	332	33,384	95.87%
11	ST09	232	33,616	96.54%
12	STT3	205	33,821	97.13%
13	ST02	163	33,984	97.59%
14	STT4	109	34,093	97.91%
15	ST03	1	34,094	97.91%

Figure 2: Current Fire Station Bleed Maps for 5-Minute Travel Time



Internal Performance Objectives

The Rochester Fire Department does not currently utilize an internal performance objective. However, the department is considering adopted service levels for the future. Therefore, the following alternatives are provided for consideration by the department.

EVALUATION OF VARIOUS DISTRIBUTION MODELS

As previously discussed, these analyses utilized 2017 historical performance as the desired performance for system designs. Therefore, 4, 5, 6, and 8-minute travel times were completed to consider opportunities for improvement and incremental alternatives compared to the current performance of 4.7 minutes overall and 5.1 minutes for fire related responses. The following analyses are utilized to compare and contrast the various potential distribution models.

Current Stations Configurations- 4, 5, 6, and 8 Minute Travel Times

When referring to the marginal utility analysis provided below, the ascending rank order is the station's capability to cover risk (incidents) in relation to the total historical call volume of the sample period (CY 2017). The Station number is the current Rochester Fire Department (RFD) fire station identifier. The station capture is the number of calls the station would capture within a 4-minute travel time. The total capture is the cumulative number of calls captured with the addition of each fire station. The percent capture is the total cumulative percentage of risk covered by each station. The goal would be to achieve at least 90 percent capture.

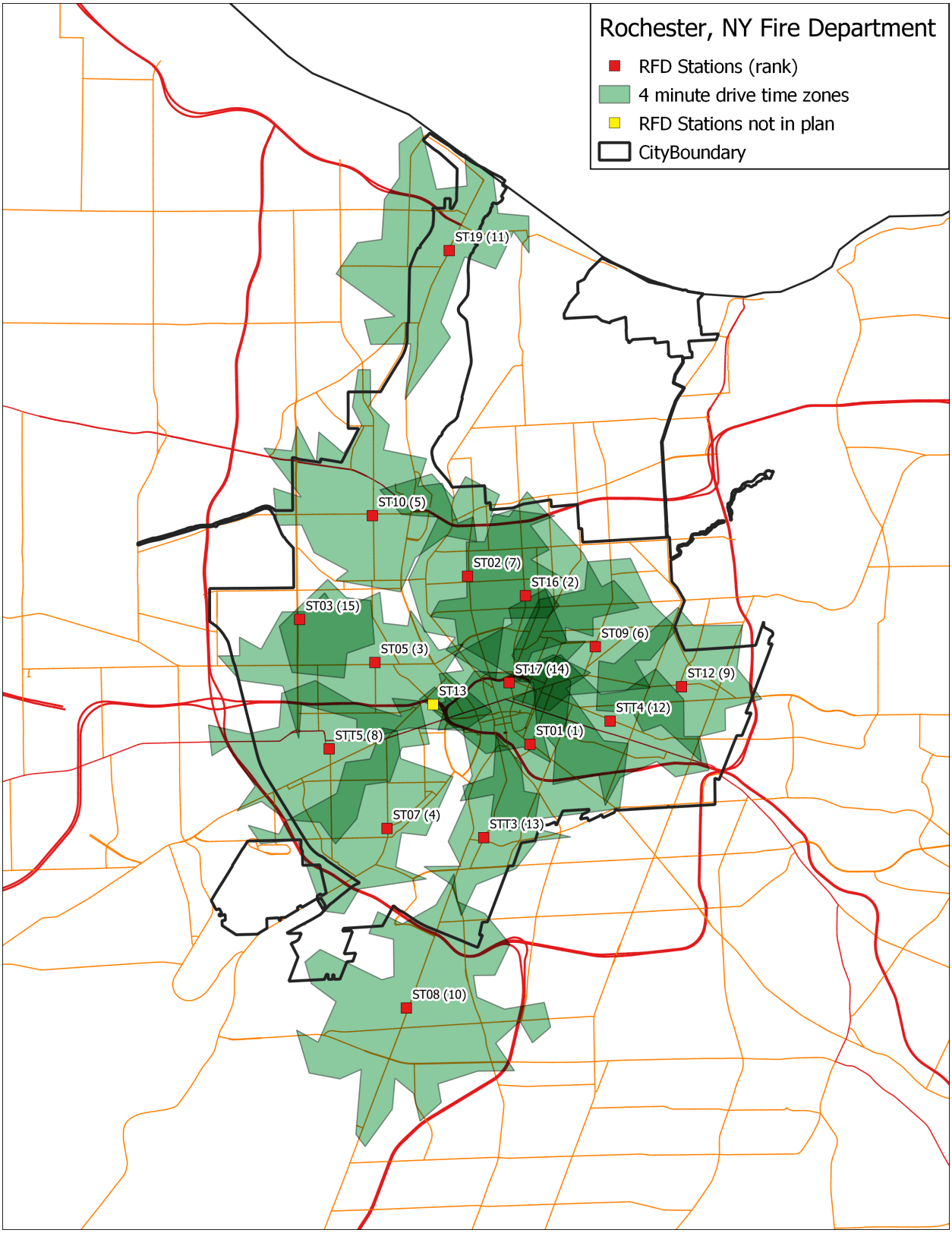
Therefore, the station that contributed the most to the overall system's performance was Station 1 in the first row and would capture 17.44% of the risks within 4 minutes. Station 16 would cover an additional 16.86% of the risk bringing the cumulative total to 34.3% between Stations 1 and 16. In total, with all 15 fixed fire stations, 90.03% of the incidents could be responded to within 4 minutes travel time.

In other words, within the current configuration of stations, the department could achieve a 4-minute travel time, as recommended by NFPA 1710 without additional stations. Results are provided as Table 4 and in drive time mapping format as Figure 3 below.

Table 4: Marginal Fire Station Contribution for 4-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST01	6,072	6,072	17.44%
2	ST16	5,873	11,945	34.30%
3	ST05	4,633	16,578	47.61%
4	ST07	3,144	19,722	56.64%
5	ST10	2,556	22,278	63.98%
6	ST09	1,987	24,265	69.68%
7	ST02	1,562	25,827	74.17%
8	STT5	1,382	27,209	78.14%
9	ST12	1,072	28,281	81.22%
10	ST08	1,019	29,300	84.14%
11	ST19	1,002	30,302	87.02%
12	STT4	509	30,811	88.48%
13	STT3	426	31,237	89.70%
14	ST17	60	31,297	89.88%
15	ST03	52	31,349	90.03%

Figure 3: Current Fire Station Bleed Maps for 4-Minute Travel Time



5-Minute Travel Time

The analysis demonstrates that the current station configuration could capture approximately 93% of the incidents within 5 minutes with the utilization of 8 fire stations. More conservatively, if the department elected to cover at least 97% of the incidents within 5-minutes, then a total of 12 stations would be required. Stations 2, 3, and T4 collectively improve performance by less than 1%.

Therefore, the city and department could consider the following policy options:

- Operate out of 8 stations at 93%
- Operate out of 12 stations at 97%
- Operate out of 15 stations and maintain current performance with a one-unit reduction
- Continue to operate out of all 16 stations to cover the geographic area irrespective of the current community demands
- Continue to operate out of all 16 stations, but utilize Stations 2, 3, and T4 as a flexible resource when needed
- Utilize this analysis to codify a move-up policy to ensure the greater coverage at all times. For example, if only two stations are available to respond to calls during busy times, Stations 13 and 16 would cover the greatest number of calls, 48.93%, within the performance objective of 5 minutes.

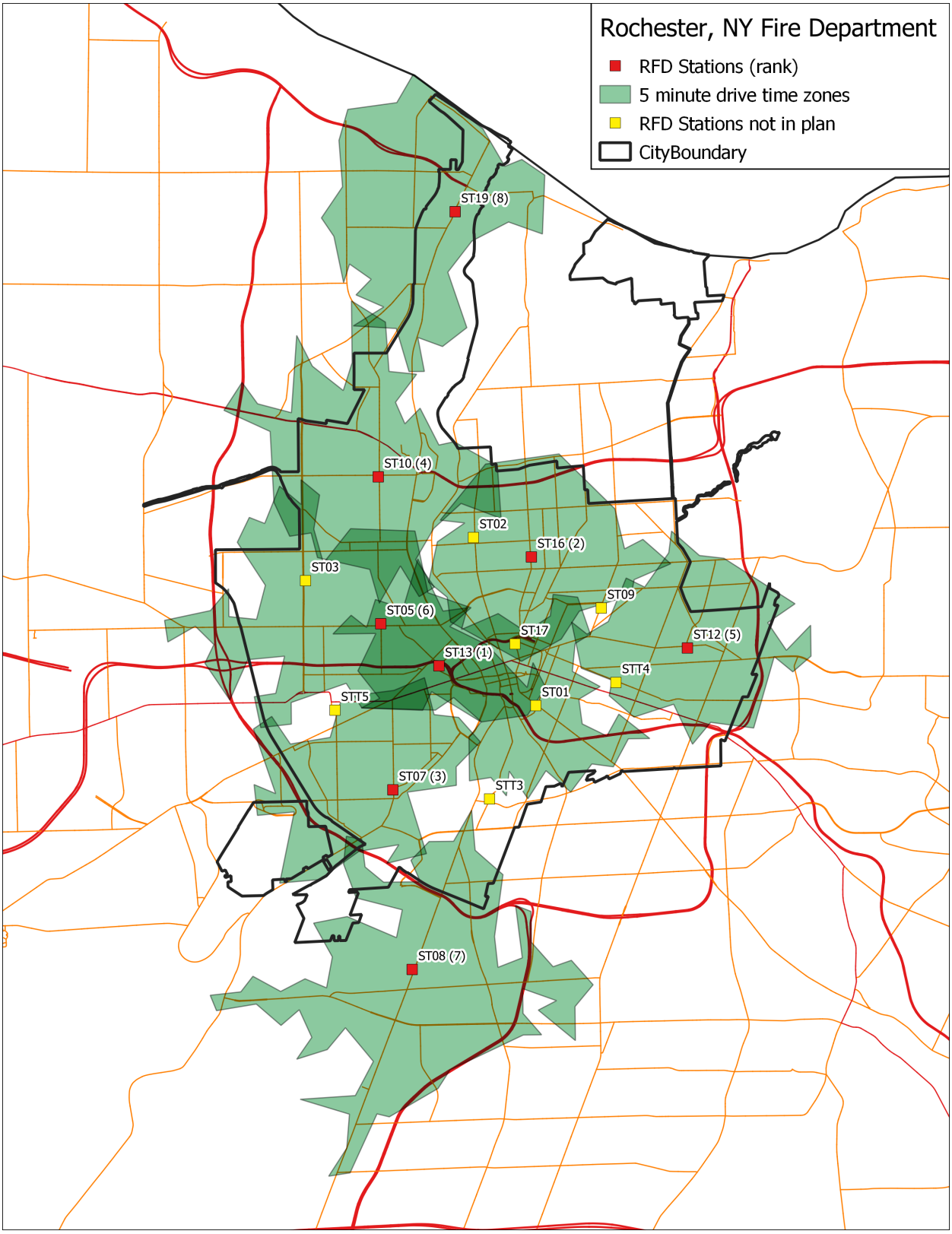
Table 5: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST13	9,550	9,550	27.43%
2	ST16	7,487	17,037	48.93%
3	ST07	4,213	21,250	61.02%
4	ST10	3,873	25,123	72.15%
5	ST12	2,705	27,828	79.91%
6	ST05	2,095	29,923	85.93%
7	ST08	1,376	31,299	89.88%
8	ST19	1,072	32,371	92.96%
9	ST01	681	33,052	94.92%
10	STT5	332	33,384	95.87%
11	ST09	232	33,616	96.54%
12	STT3	205	33,821	97.13%
13	ST02	163	33,984	97.59%
14	STT4	109	34,093	97.91%
15	ST03	1	34,094	97.91%

When referring to the mapping output below, the areas of the city that are not shaded with green, represent a maximum of 7% of the incidents that would not be responded to within 5-minutes. All requests for service would be answered, but they may be answered between 5:01 and 8:00 minutes. Finally, any areas that is shaded with progressively darker shades of green represent areas where

more than one station can cover the same territory within the respective travel time being evaluated.

Figure 4:Current Fire Station Bleed Maps for 5-Minute Travel Time



6-Minute Travel Time

The analysis demonstrates that the current station configuration could capture 91% of the incidents within 6 minutes with the utilization of 6 fire stations and 99% with 11 stations. Stations T3, 3, and 1 collectively improve coverage by approximately 0.15%.

Therefore, the city and department could consider the following policy options:

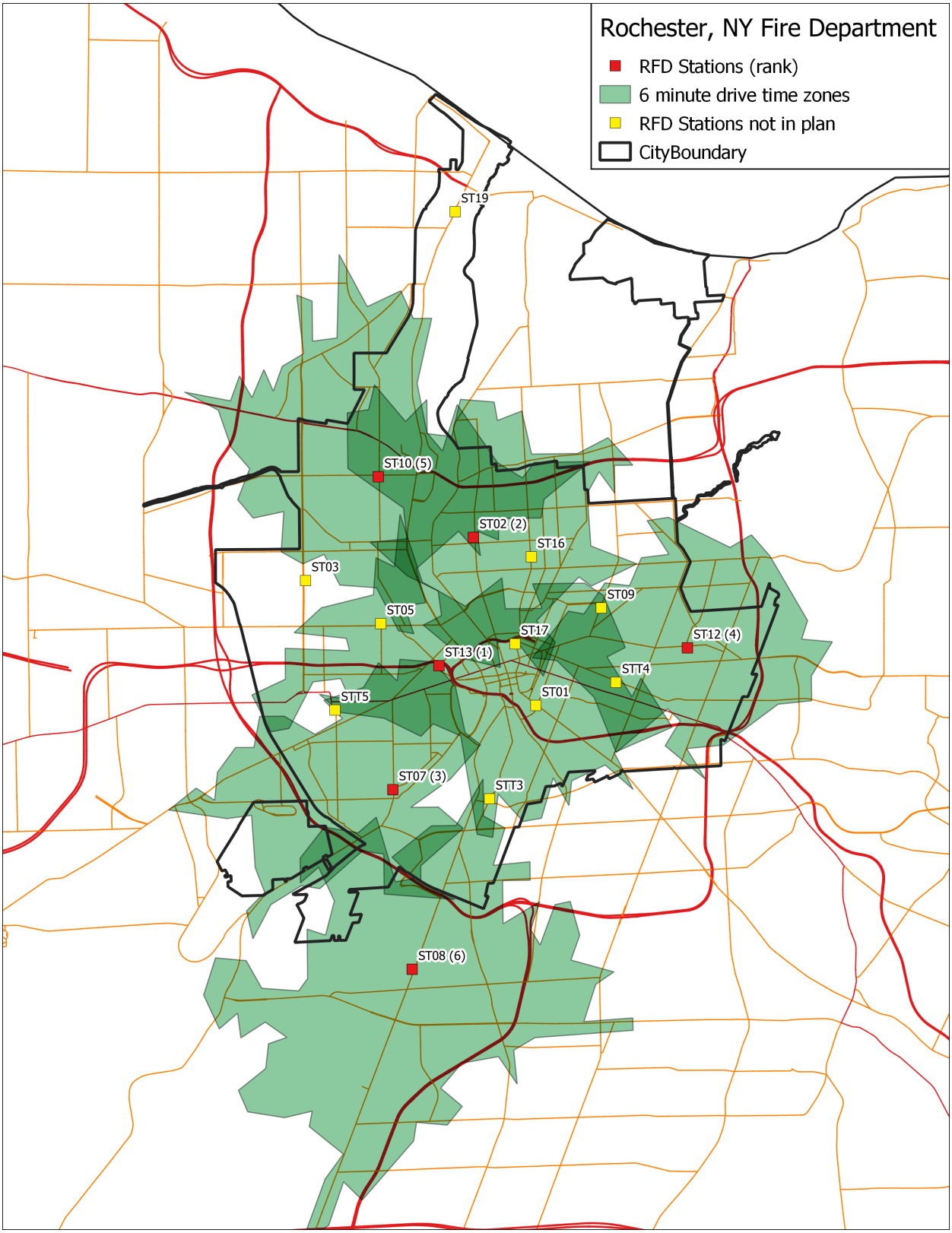
- Operate out of 6 stations at 91%
- Operate out of 11 stations at 99%
- Continue to operate out of all 16 stations to cover the geographic area irrespective of the current community demands
- Continue to operate out of all 16 stations, but utilize Stations T3, 3, and 1 as flexible resources when needed
- Utilize this analysis to codify a move-up policy to ensure the greater coverage at all times. For example, if only two stations are available to respond to calls during busy times, Stations 13 and 2 would cover the greatest number of calls, 64%, within the performance objective of 6 minutes.

Table 6: Marginal Fire Station Contribution for 6-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST13	14,399	14,399	41.35%
2	ST02	7,872	22,271	63.96%
3	ST07	3,748	26,019	74.72%
4	ST12	2,634	28,653	82.28%
5	ST10	1,788	30,441	87.42%
6	ST08	1,331	31,772	91.24%
7	ST19	1,059	32,831	94.28%
8	ST05	767	33,598	96.48%
9	ST09	693	34,291	98.48%
10	STT5	107	34,398	98.78%
11	STT4	83	34,481	99.02%
12	STT3	30	34,511	99.11%
13	ST03	17	34,528	99.16%
14	ST01	4	34,532	99.17%

When referring to the mapping output below, the areas of the city that are not shaded with green, represent a maximum of 9% of the incidents that would not be responded to within 6-minutes. All requests for service would be answered, but they may be answered between 6:01 and 8:00 minutes. Finally, any areas that is shaded with progressively darker shades of green represent areas where more than one station can cover the same territory within the respective travel time being evaluated.

Figure 5: Current Stations with a 6-Minute Travel Time at the 90th Percentile



8-Minute Travel Time

The analysis demonstrates that the current station configuration could capture nearly 93% of the incidents within 8 minutes with the utilization of 3 fire stations and 99% with 5 stations. Stations 1, 5, 7, and 10 collectively improve coverage by less than 1%.

Therefore, the city and department could consider the following policy options:

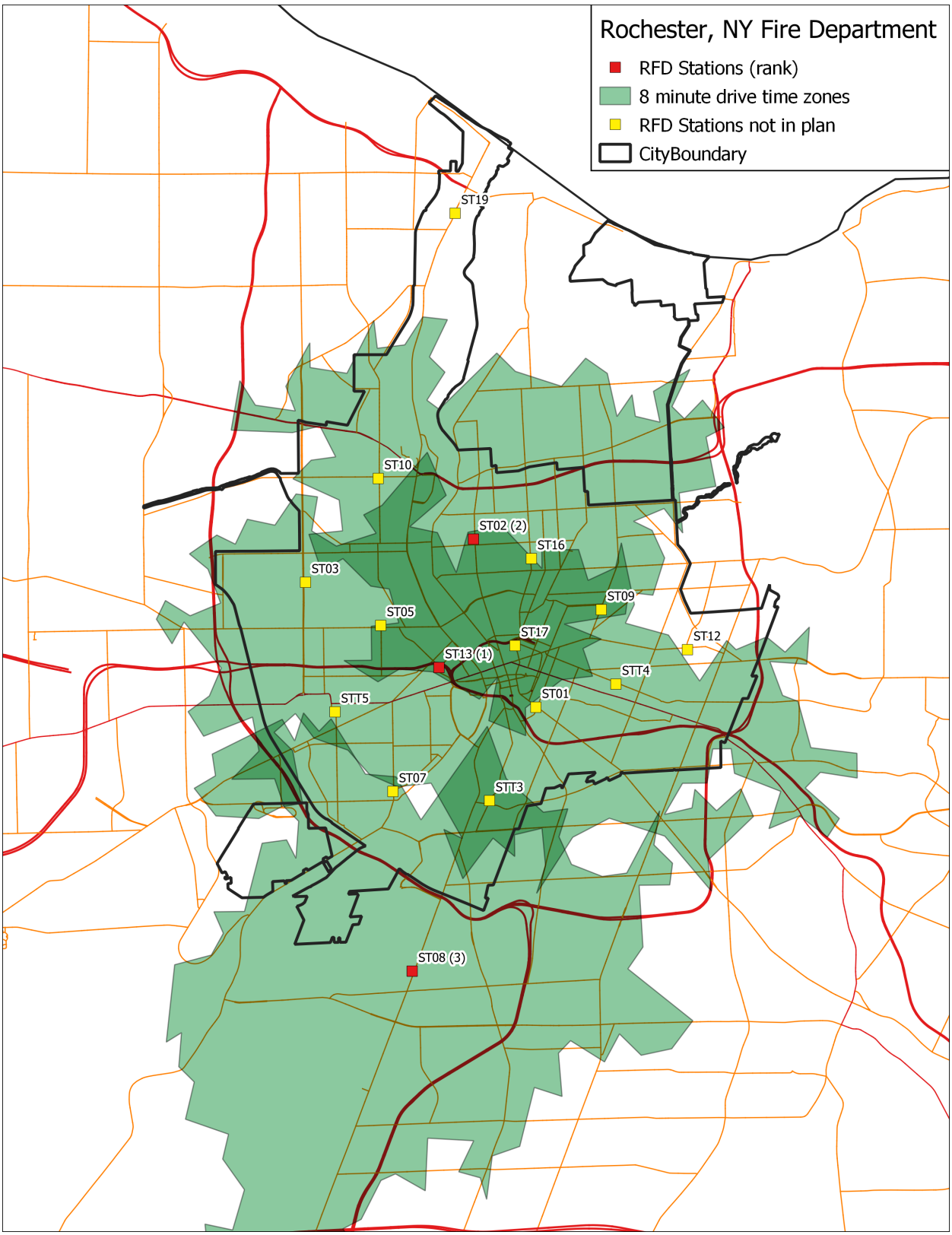
- Operate out of 3 stations and adjust response time objectives from 4.7 (fire) to 8 minutes
- Operate out of 5 stations and respond to 99% of the incidents within 8 minutes
- Continue to operate out of 9 stations to cover the geographic area irrespective of the current community demands
- Continue to operate out of all 9 stations, but utilize Stations 1, 5, 7, and 10 as a flexible resources when needed
- Utilize this analysis to codify a move-up policy to ensure the greater coverage at all times. For example, if only two stations are available to respond to calls during busy times, Stations 13 and 2 would cover the greatest number of calls, 85%, within the performance objective of 8 minutes.

Table 7: Marginal Fire Station Contribution for 8-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	ST13	23,642	23,642	67.89%
2	ST02	5,839	29,481	84.66%
3	ST08	2,750	32,231	92.56%
4	ST12	1,172	33,403	95.92%
5	ST19	1,087	34,490	99.05%
6	ST05	163	34,653	99.51%
7	ST07	96	34,749	99.79%
8	ST10	11	34,760	99.82%
9	ST01	6	34,766	99.84%

When referring to the mapping output below, the areas of the city that are not shaded with green, represent a maximum of 8% of the incidents that would not be responded to within 8-minutes. All requests for service would be answered, but they may be answered greater than 8:00 minutes. Finally, any areas that is shaded with progressively darker shades of green represent areas where more than one station can cover the same territory within the respective travel time being evaluated.

Figure 6: Current Stations with an 8-Minute Travel Time at the 90th Percentile



Optimized Station Distribution Plans

Optimized locations were created for the department's consideration. Optimized plans utilize a "white board" approach where all existing locations are disregarded and we allow the data to indicate the best station locations. It is understood that stations are placed for a variety of reasons and that few agencies would have the flexibility in land availability, purchase price, capital investment, and political considerations to build a brand new deployment model.

However, these analyses are beneficial for validating existing stations where applicable and identifying potential areas of future need for either new stations or station relocations.

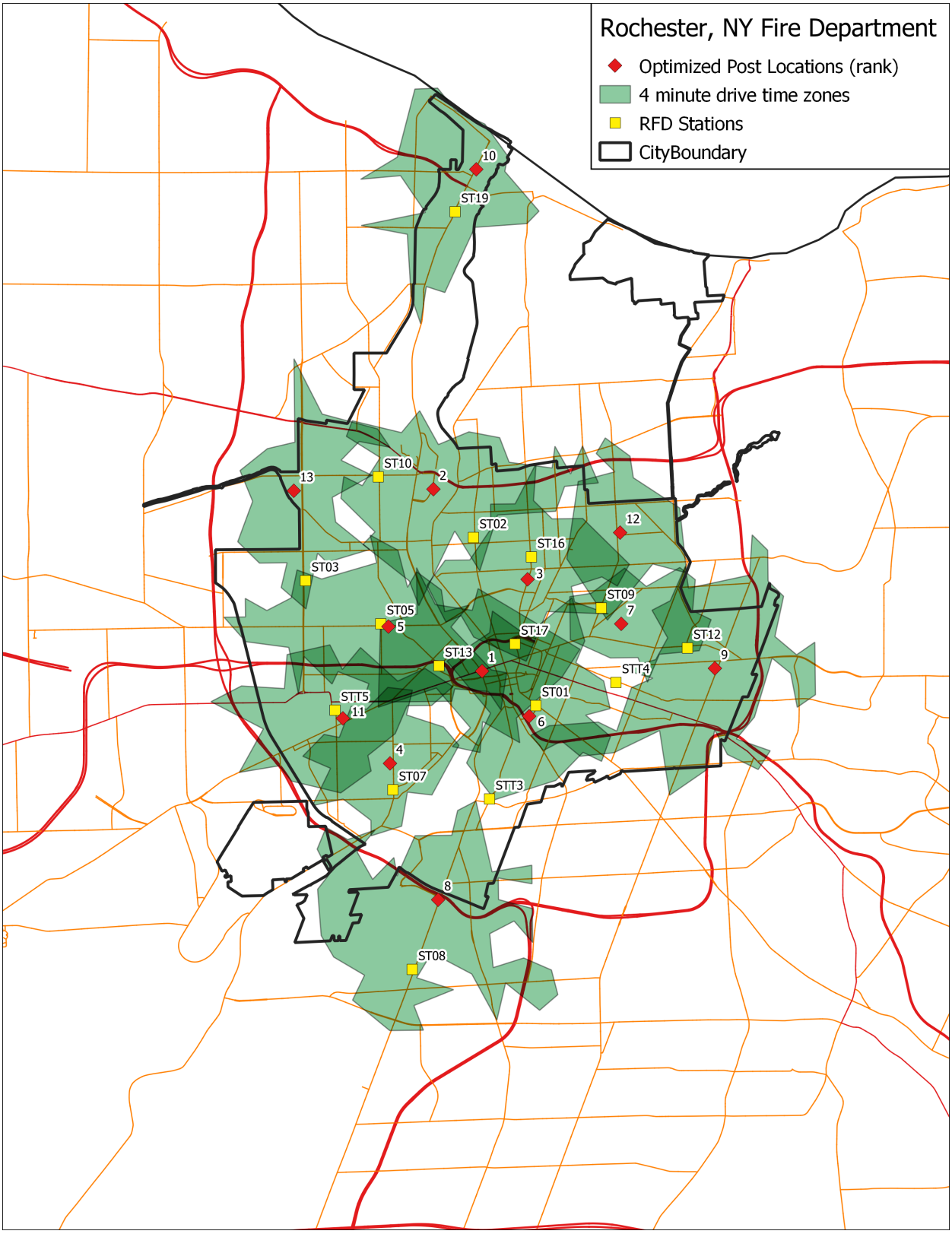
4-Minute Travel Time

Analyses were completed to develop an optimized station distribution model for a 4-minute travel time consistent with NFPA 1710. This evaluation suggests, that an optimized 13-station model can provide for greater than 91% effectiveness covering all incidents within 4-minutes or less travel time. In comparison, the current 15-station configuration achieved 4 minutes or less approximately 90% of the time, or an improvement of approximately 1%, but with 3 fewer fixed facilities.

The analysis confirms optimal placement of the current stations of Station T5, Station 1, and Station 5 within the context of a 4 minute travel time.

A graphic illustration is presented below that includes the proposed station locations as well as the existing facilities.

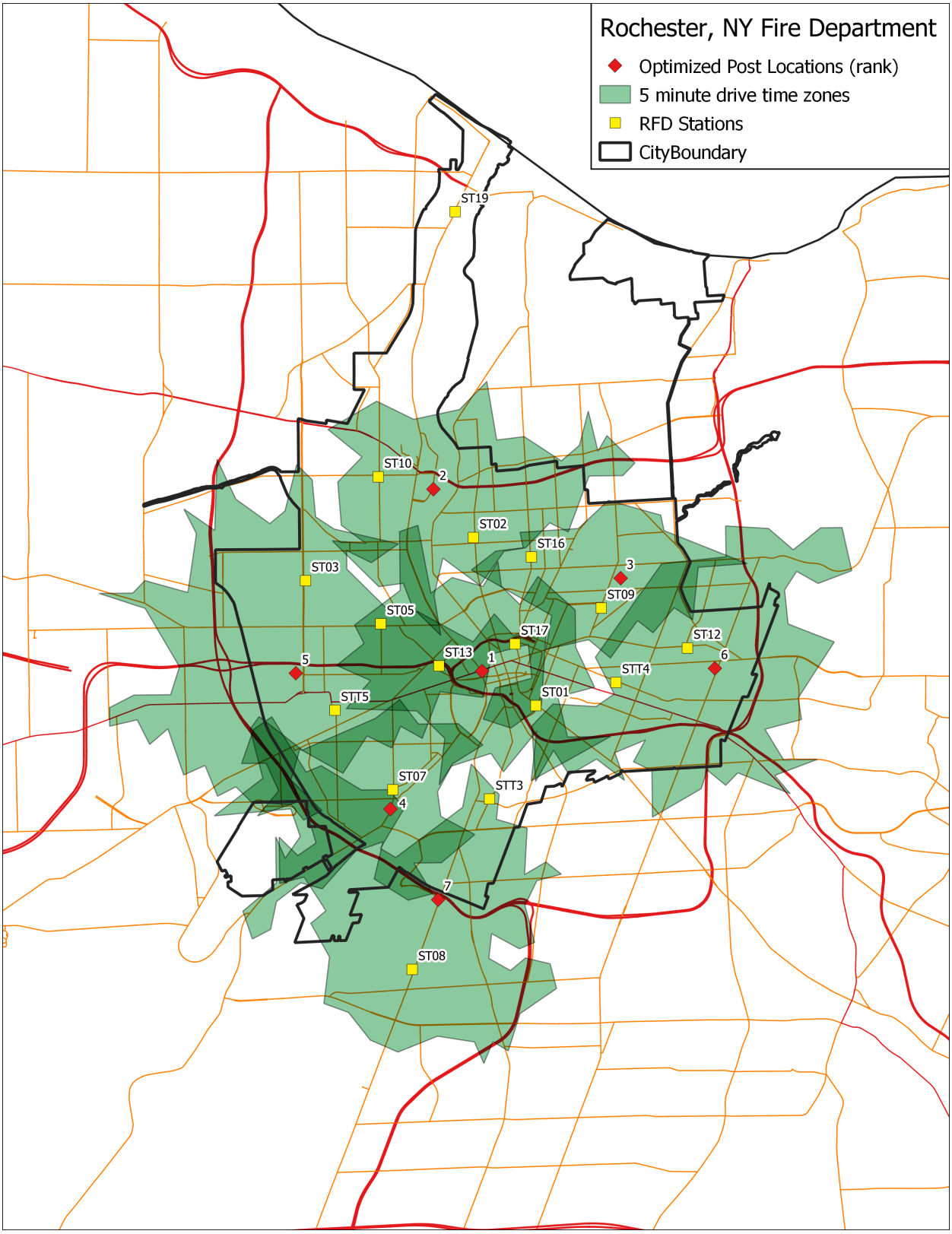
Figure 7: Optimized Station Deployment Plan - 4-Minute Travel Time



Optimized 5-Minute Travel Time

Analyses were completed to develop an optimized station distribution model for a 5-minute travel time. This evaluation suggests, that an optimized 7-station model can provide for approximately 91% effectiveness covering all incidents within 5-minutes. This optimized configuration maintains greater than 90% effectiveness compared to the current station configuration but only requires 7 stations. Considering the current 16-station deployment, this model would maintain the same performance with 7-stations at 91%. A graphic illustration is presented below.

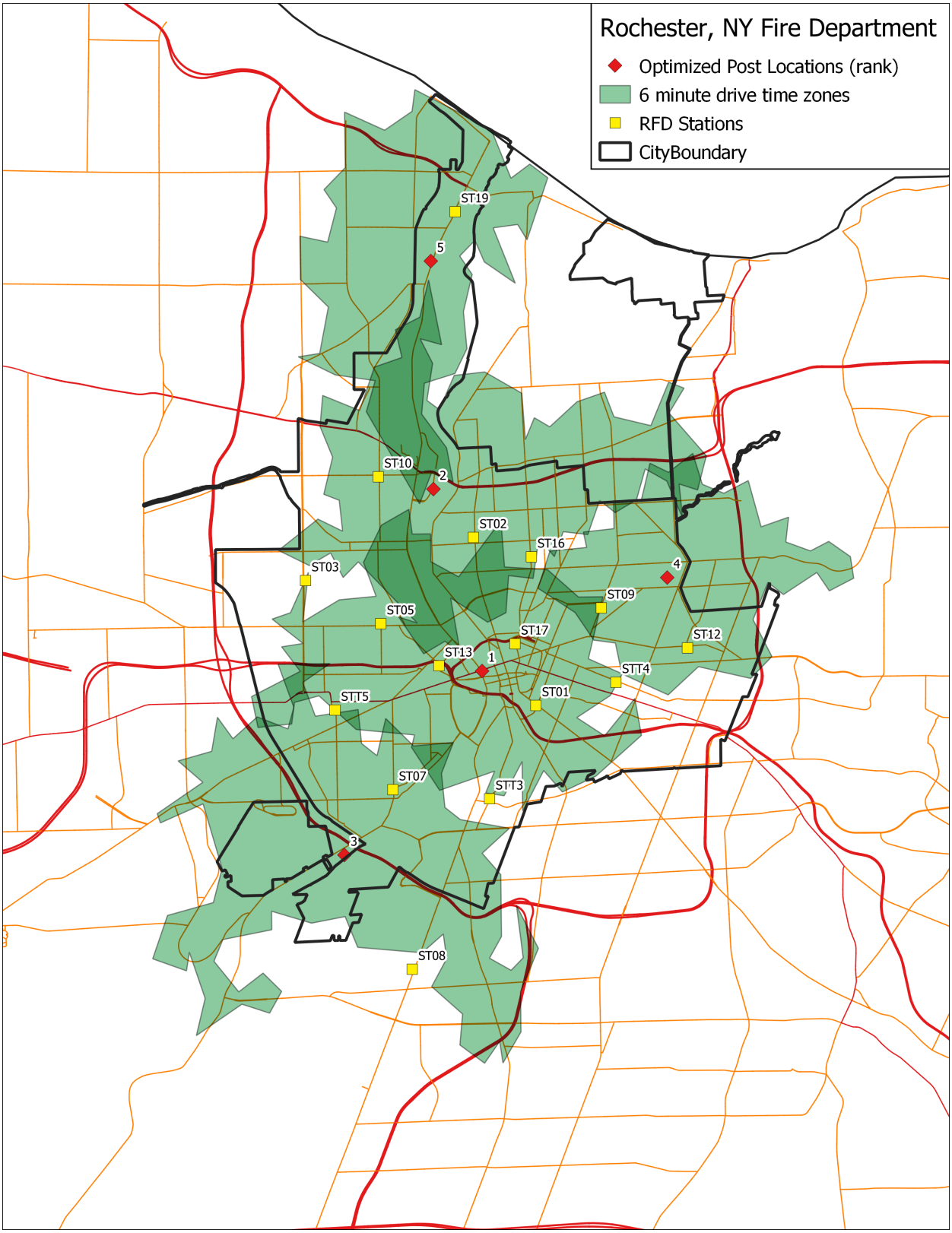
Figure 8: Optimized Station Deployment Plan – 5--Minute Travel Time



Optimized 6-Minute Travel Time

Analyses were completed to develop an optimized station distribution model for a 6-minute travel time. This evaluation suggests, that an optimized 5-station model can provide for approximately 92% effectiveness covering all incidents within 6-minutes. This optimized configuration maintains greater than 90% effectiveness, compared to the current station configuration presented previously. A graphic illustration is presented below.

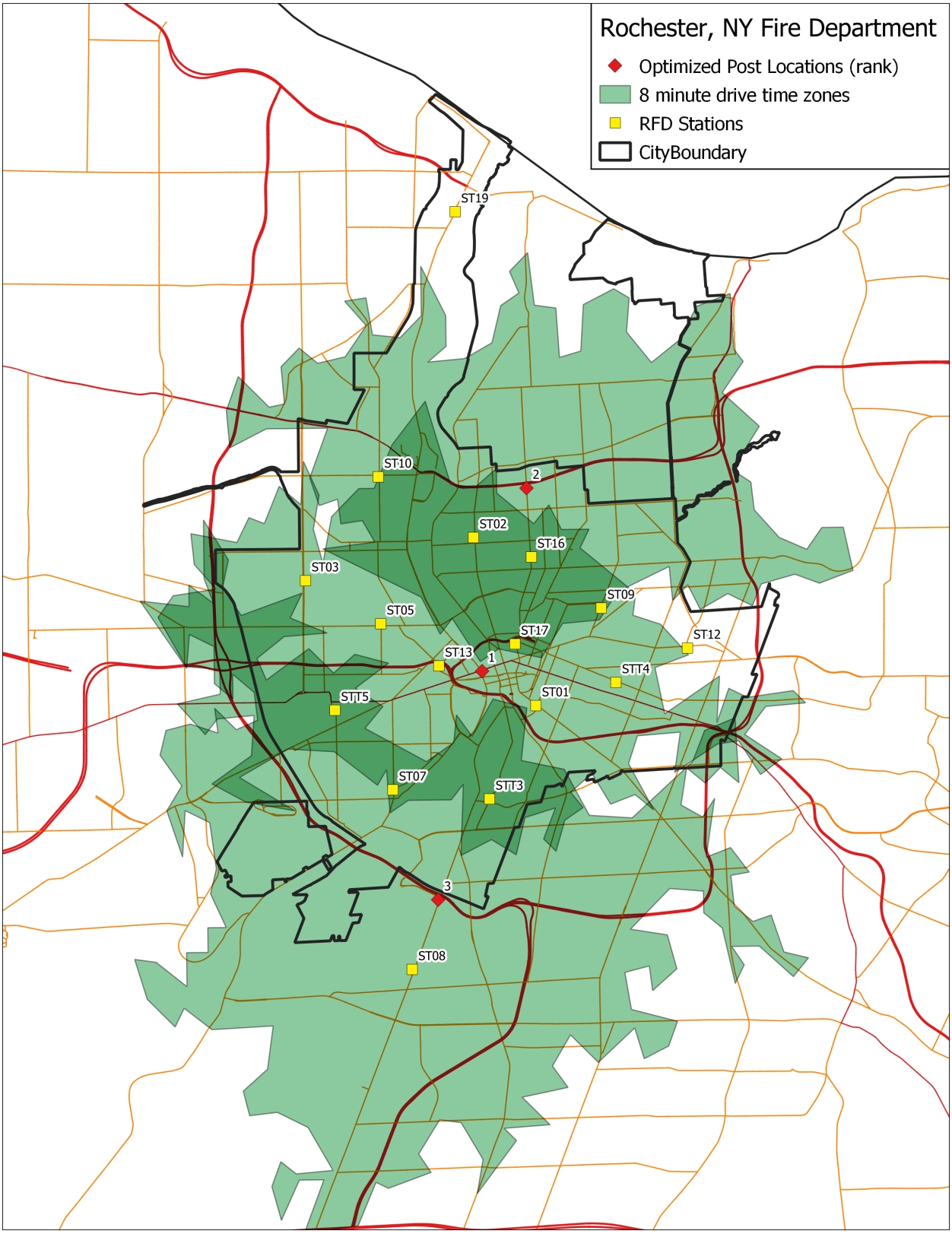
Figure 9: Optimized Station Deployment Plan – 6--Minute Travel Time



Optimized 8-Minute Travel Time

Analyses were completed to develop an optimized station distribution model for an 8-minute travel time. This evaluation suggests, that an optimized 3-station model can provide for approximately 93% effectiveness covering all incidents within 8-minutes. The optimized configuration does not materially improve performance or require less fixed facilities than the current station capability at 8-minutes travel time. Therefore, the additional capital investment may not provide the desired return on investment. A graphic illustration is presented below.

Figure 10: Optimized Station Deployment Plan – 8--Minute Travel Time



Geographic Coverage without Consideration for Call Distribution

While there are multiple deployment strategies that may be adopted, two clear policy positions emerge in communities. First, position stations that are best prepared to meet the community's historical distribution of calls or demand for services. The advantage to this approach is that it is a more efficient model to address meeting 90% of the risk within the desired performance. This is a very stable outlook for communities that are established and are growing in density or in-fill rather than through significant annexations or urban growth.

A second strategy is to provide station response coverage purely through a geographic lens without any consideration for how calls are distributed throughout the community. In addition, this analysis utilized distance without consideration to the relative impendence and/or the robustness of the road network. For example, when time is the unit of measure, a station could travel a farther distance on a highway then through a school zone but this approach caps the coverage area at 1.5 miles regardless of available travel speeds. This strategy more closely follows the recommendations of the Insurance Services Office (ISO). Therefore, the following analyses examine the current coverage areas through the lens of ISO utilizing 1.5-mile engine and 2.5-mile truck polygons.

Engine Coverage

All analyses utilize the existing road network and average travel impedance for the jurisdiction. When examining the 1.5-mile polygons for engine coverage, it is evident that all 16 stations maintain contiguous road miles within 1.5-mile drive times with the exception of Station 19 (Figure 11).

Where the road networks are not as robust a less efficient drive time capability emerges. For example, in more traditional metropolitan areas, the polygons will have a diamond shape, as the road network is equally accessible and efficient in all directions.

Analyses also reveal that there is some duplication with the context of 1.5 mile coverage areas. The analysis suggests that either Station 13 or Station 5 is duplicative in nature as well as Stations 1 and 16, independently. Therefore, a mapping illustration is provided with all stations excluding Stations 1, 5, and 16 (figure 12).

As with previous mapping output, each successfully darker shade represents another station that can cover the same area within the 1.5 mile travel distance.

Figure 11: 1.5 Mile Engine Polygons – All Stations

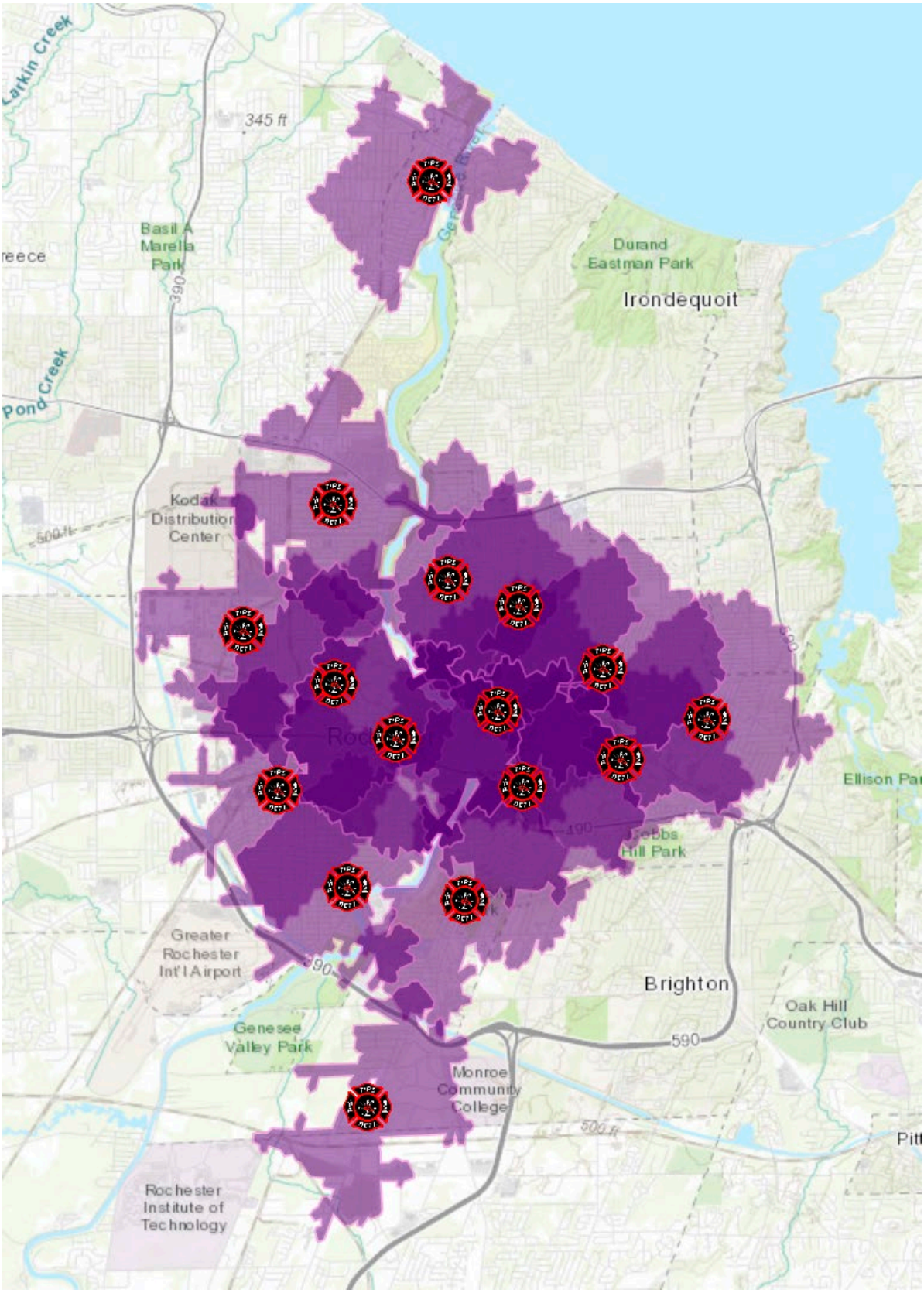
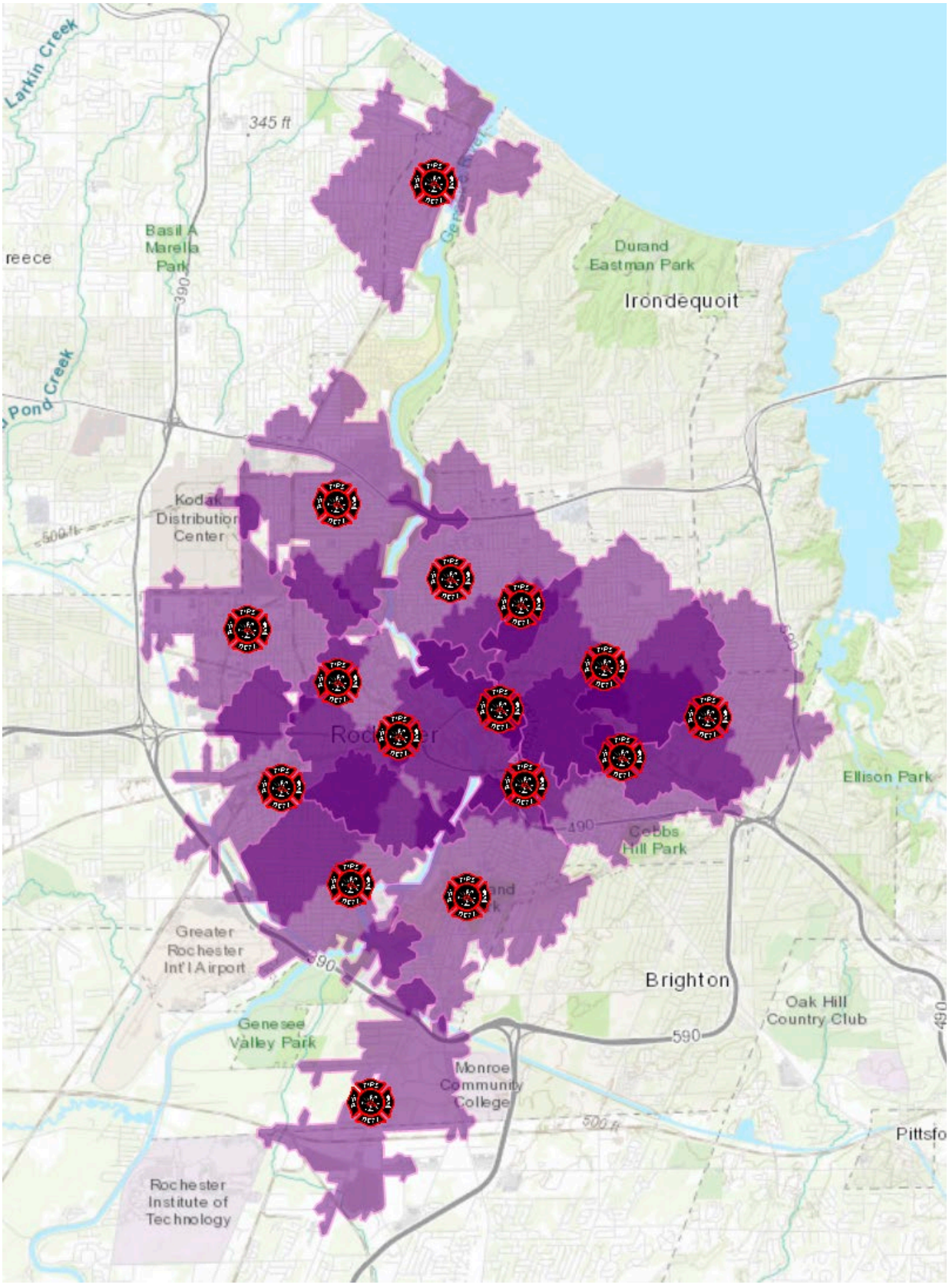


Figure 12: 1.5 Mile Engine Polygons – All Stations Excluding Stations 1, 5, and 16



Ladder Truck Coverage

When examining the 2.5-mile polygons for truck coverage, the Department is challenged with ladder truck coverage based on the potential geographic coverage only and without consideration for the distribution of risk. ISO will afford additional points for having either a ladder/tower truck or quint at more than 50% of the stations. Therefore, the department may benefit from a restructure of distribution strategies that if additional points are needed in the future. Results are provided below.

The following mapping includes a view of stations through the 2.5-mile attribute. The first map includes the current stations with aerial devices (Station 10 – T2; Station T3; Station T4; Station T5; Station 13 – T10; and Station 16 – T6). If the department is desirous of having 50% of the stations with aerial capacity then the department would require 2 additional aerial apparatus.

The mapping illustrates that the greatest degree of coverage is provided through this strategy and that the ladder coverage areas do have contiguous road network with the exceptions of Stations 8 and 19. Conversely, Station 13 – T10 is highly duplicative to the coverage other 2.5 mile coverage areas.

The mapping illustrates that the utilization of Station 13 provides nearly 100% duplication of service area and the geographic coverage may be improved by moving T10 from Station 13 to Station 3. Finally, adding aerial capacity at Stations 8 and 19 may be beneficial and would then meet the 50% threshold if that is the Department's desire.

Figure 13: Current Stations Ladder Trucks - ISO 2.5 Mile

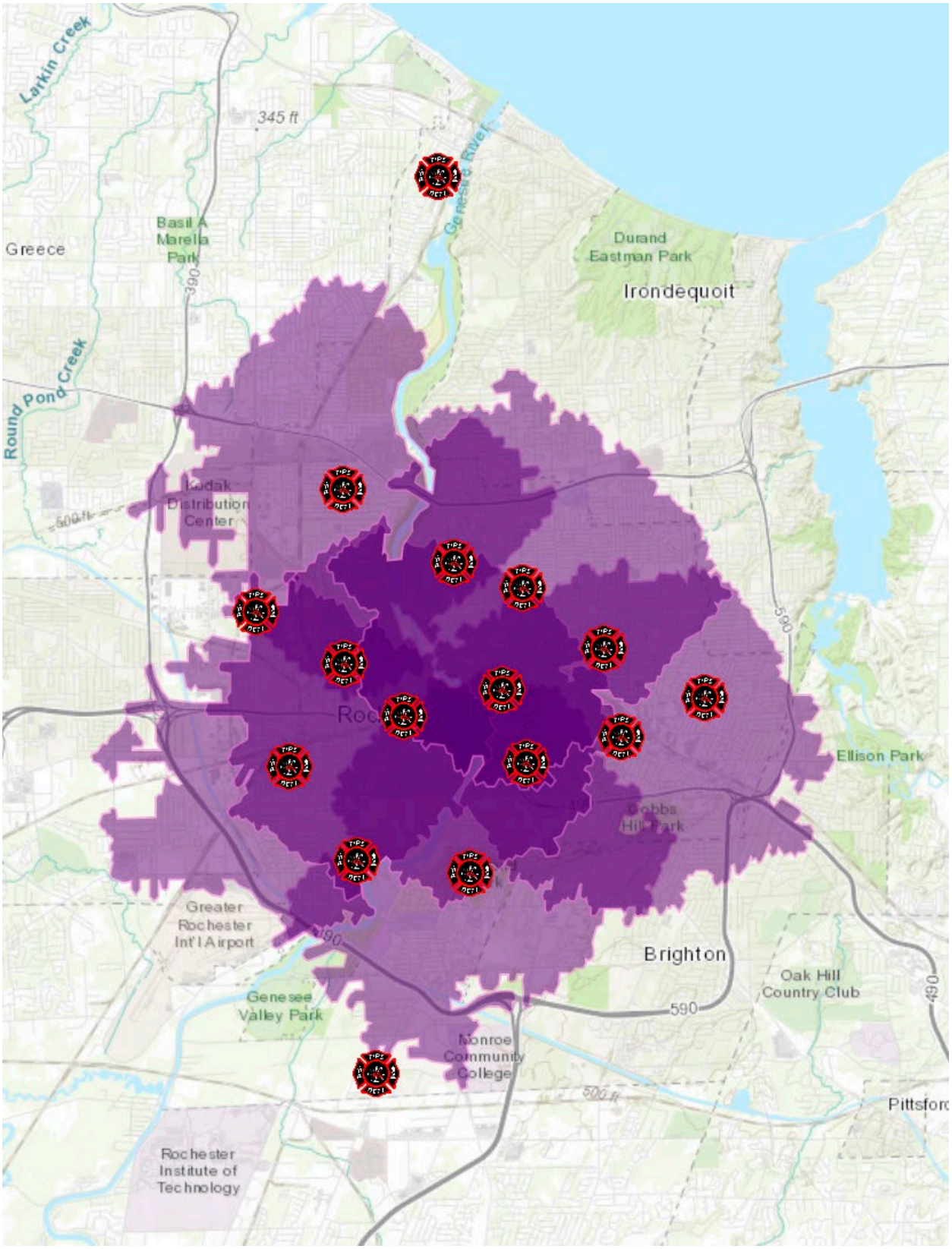


Figure 14: Current Stations with Ladder Trucks – Move T10 from Station 13 to Station 3 - ISO 2.5 Mile

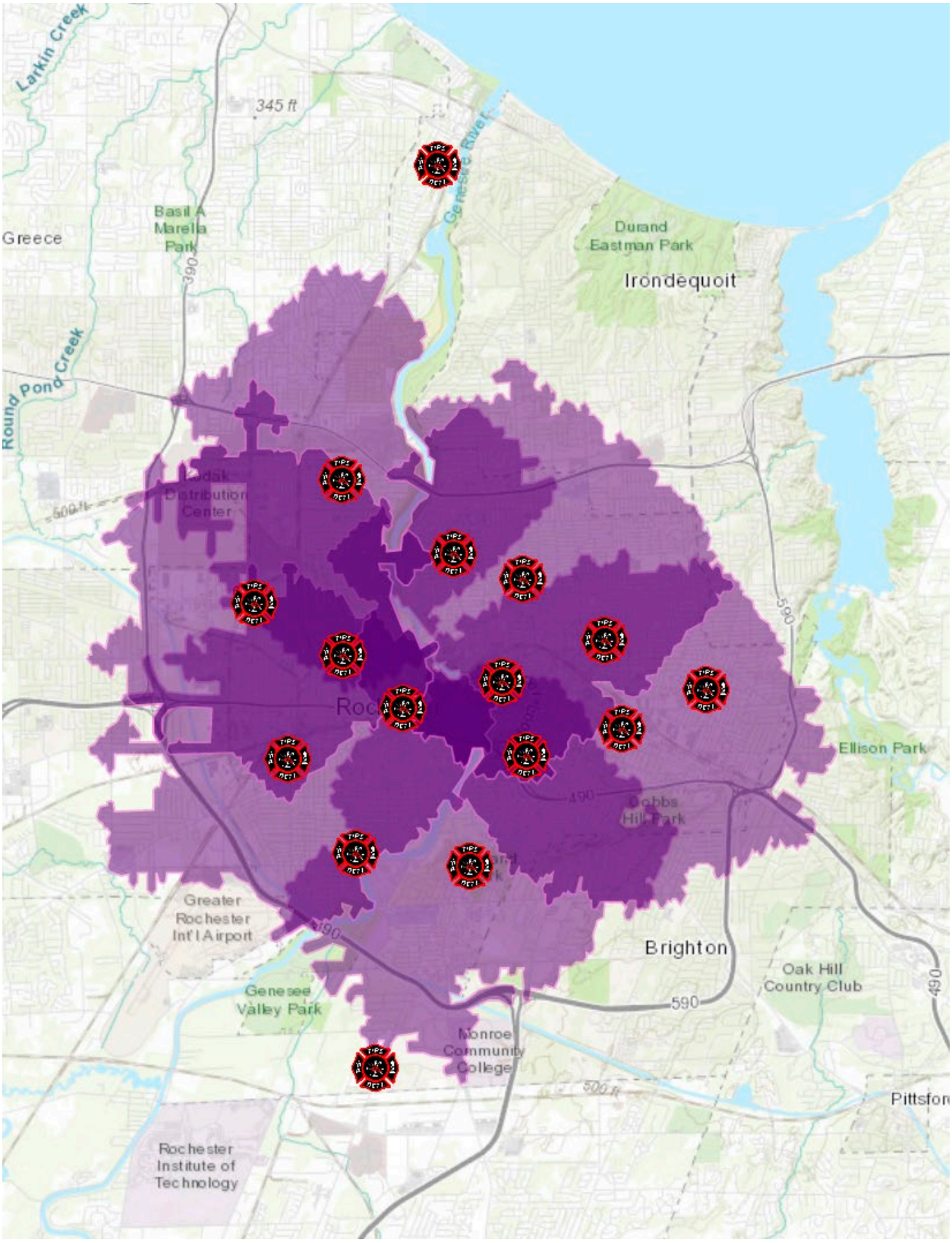
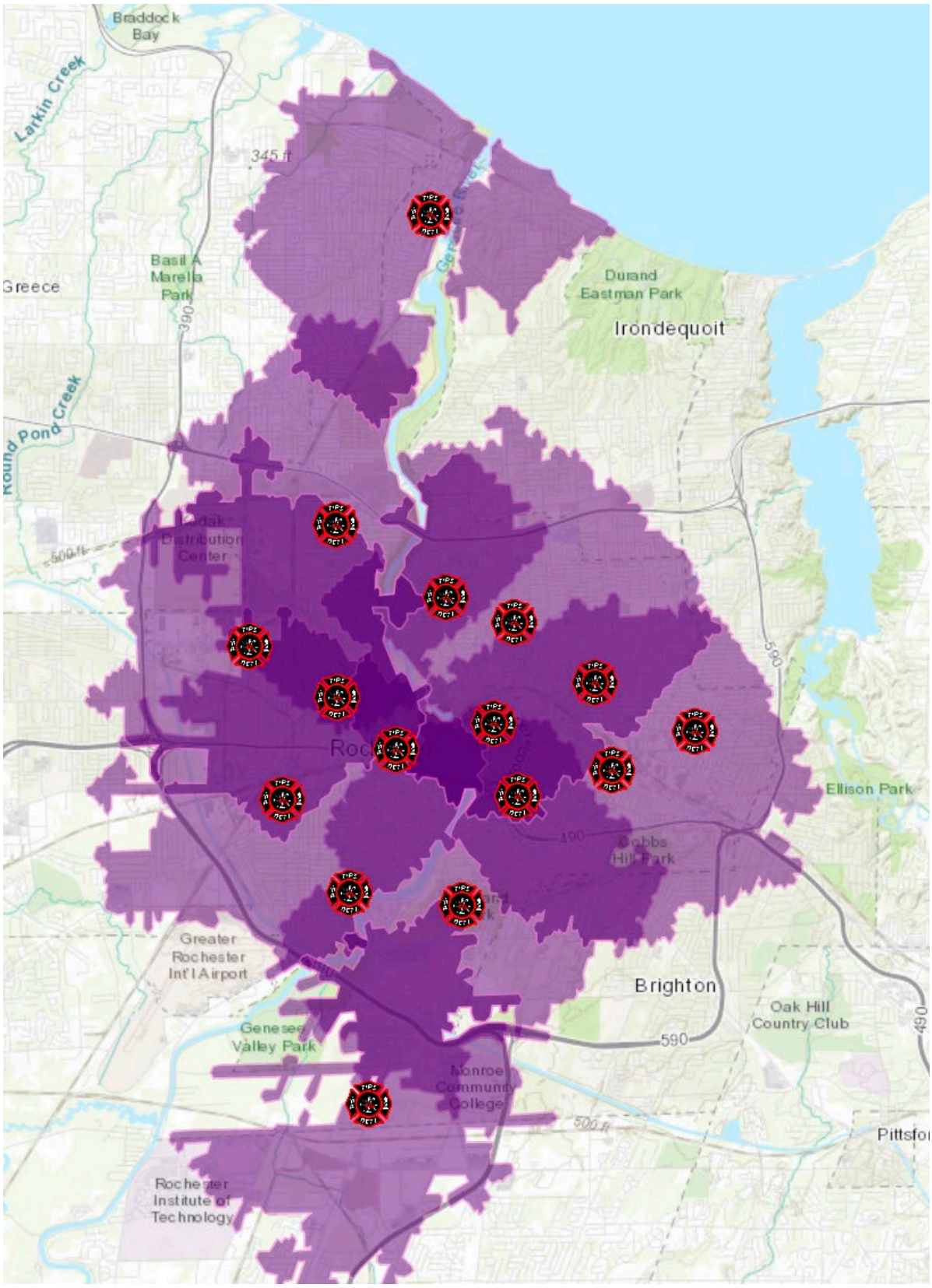


Figure 15: Current Stations with Ladder Trucks – Move T10 from Station 13 to Station 3 and Add Stations 8 and 19 - ISO 2.5 Mile



EFFECTIVE RESPONSE FORCE MAPPING

Similar to previous discussions, there are two prevailing recommendations for the time to assemble an effective response force for structure fires. First, NFPA 1710 suggests that the Effective Response Force (ERF) should arrive in eight (8) minutes travel time or less. Second, the CFAI provides a baseline travel time performance objective of 10 minutes and 24 seconds 90% of the time or less for urban densities as well as a 13-minute travel time ERF for suburban areas and 18-minutes for rural areas. Since the current first due travel time performance is at approximately 5 to 6-minutes minutes; 8, 10, and 13-minute travel times were created to demonstrate the relative ERF coverage throughout the jurisdiction.

For these purposes ERF was defined as the arrival of four units (approximating 16 personnel) and is restricted to the city jurisdiction. The ability of the department to respond in such a short travel time overcomes changes in the system and continues to perform similarly. In other words, the next closest unit could respond in a reasonably similar fashion at 4-units. The greatest variability was approximately 6%, with most of the 8-minute variability at approximately 3%. The variation at 10 and 13 minutes is less than 2%.

Table 8: Comparisons of Effective Response Force Configurations

Travel Time Objective	Current	w/o St 13	w/o St. 2, STT4, St. 3	w/o T2 and R11	w/o T2 and T11	w/o R11 and T10
8-Minute	74.43%	68.09%	71.63%	72.88%	71.66%	73.22%
10-Minute	88.73%	88.44%	86.17%	86.39%	86.39%	88.73%
13-Minute	97.11%	97.11%	96.24%	96.24%	96.24%	97.11%

Overall, the ERF has more robust coverage in the core of the City where the greatest historical demand exists. Mapping outputs are provided below.

Figure 16: 8-Minute ERF from Current Stations – Current Staffing

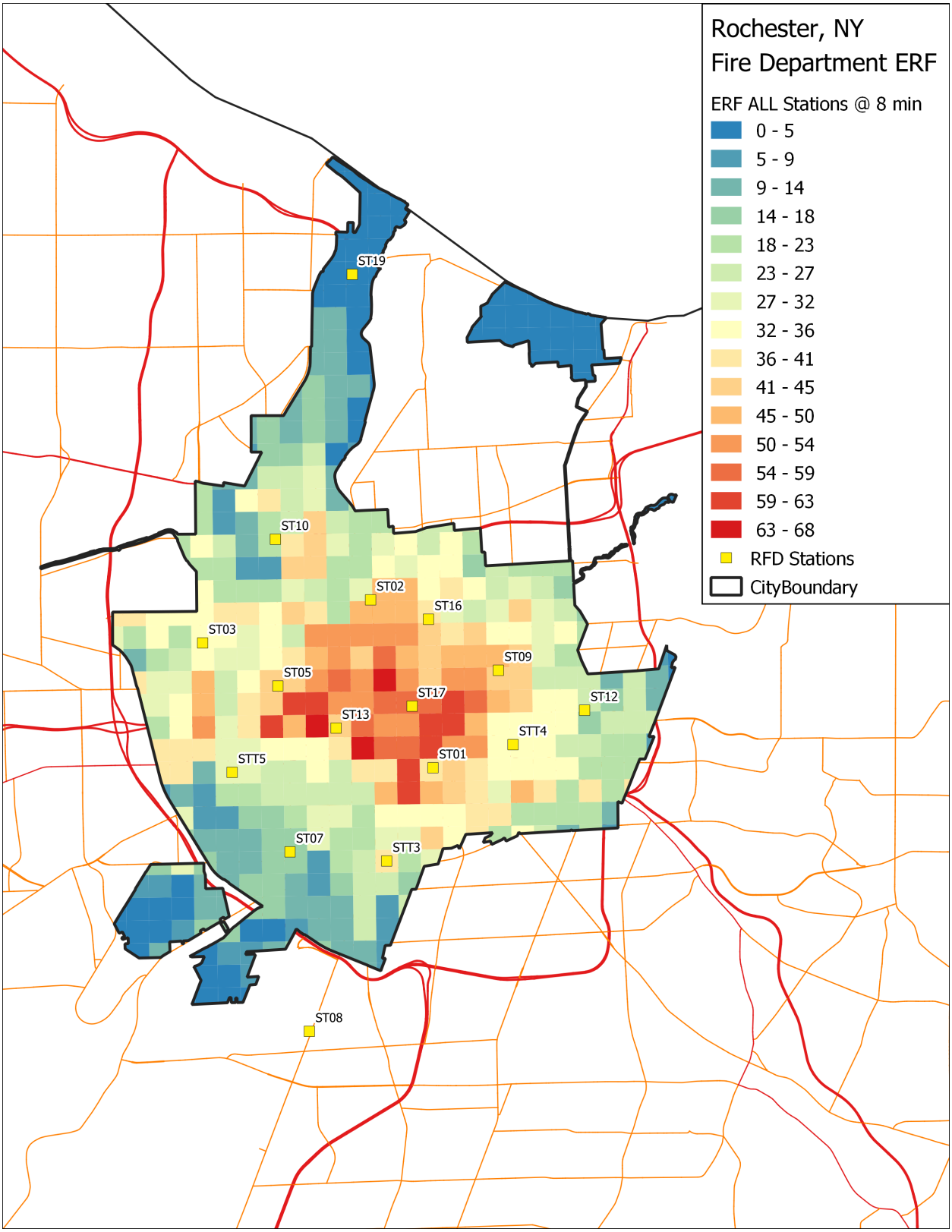


Figure 17: 10-Minute ERF from All Current Stations – Current Staffing

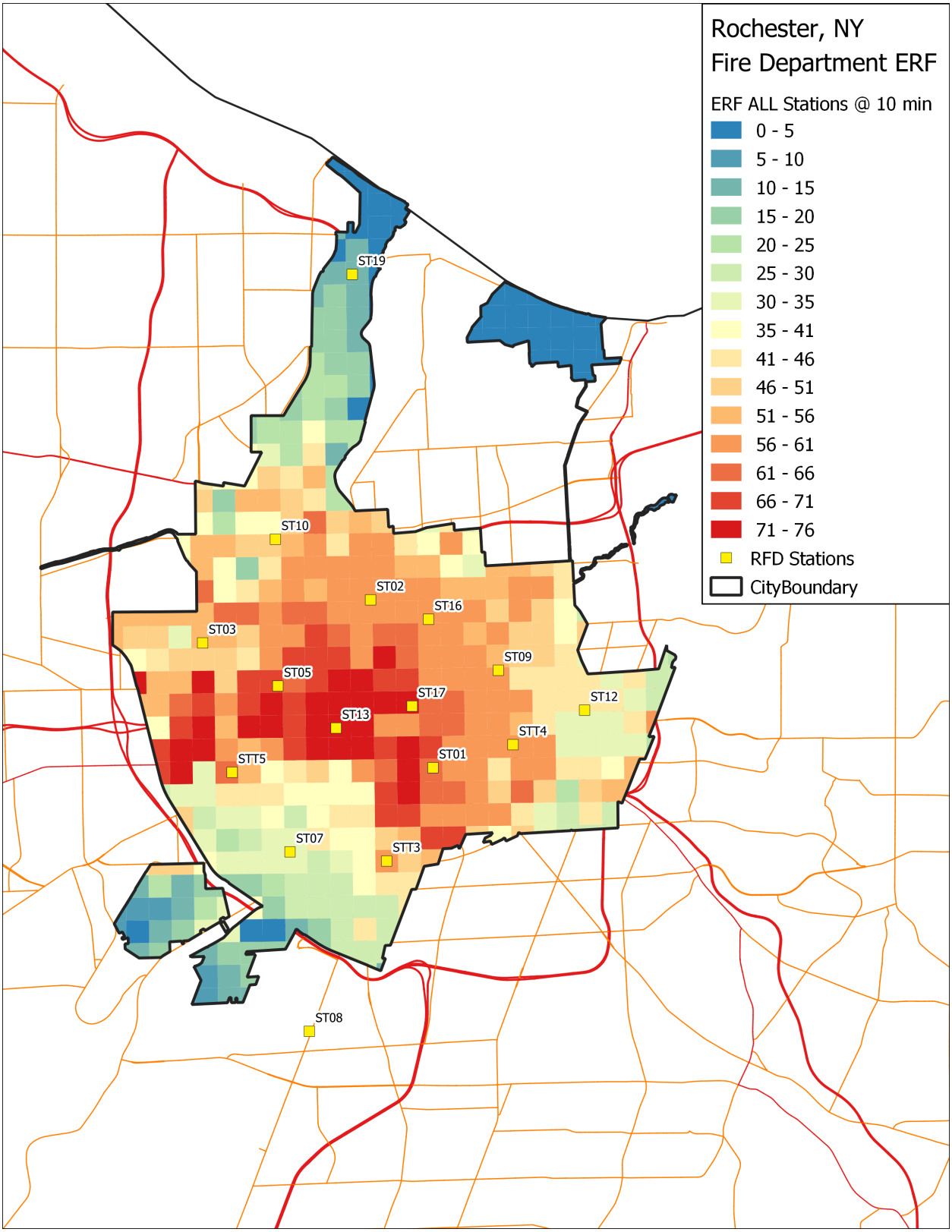
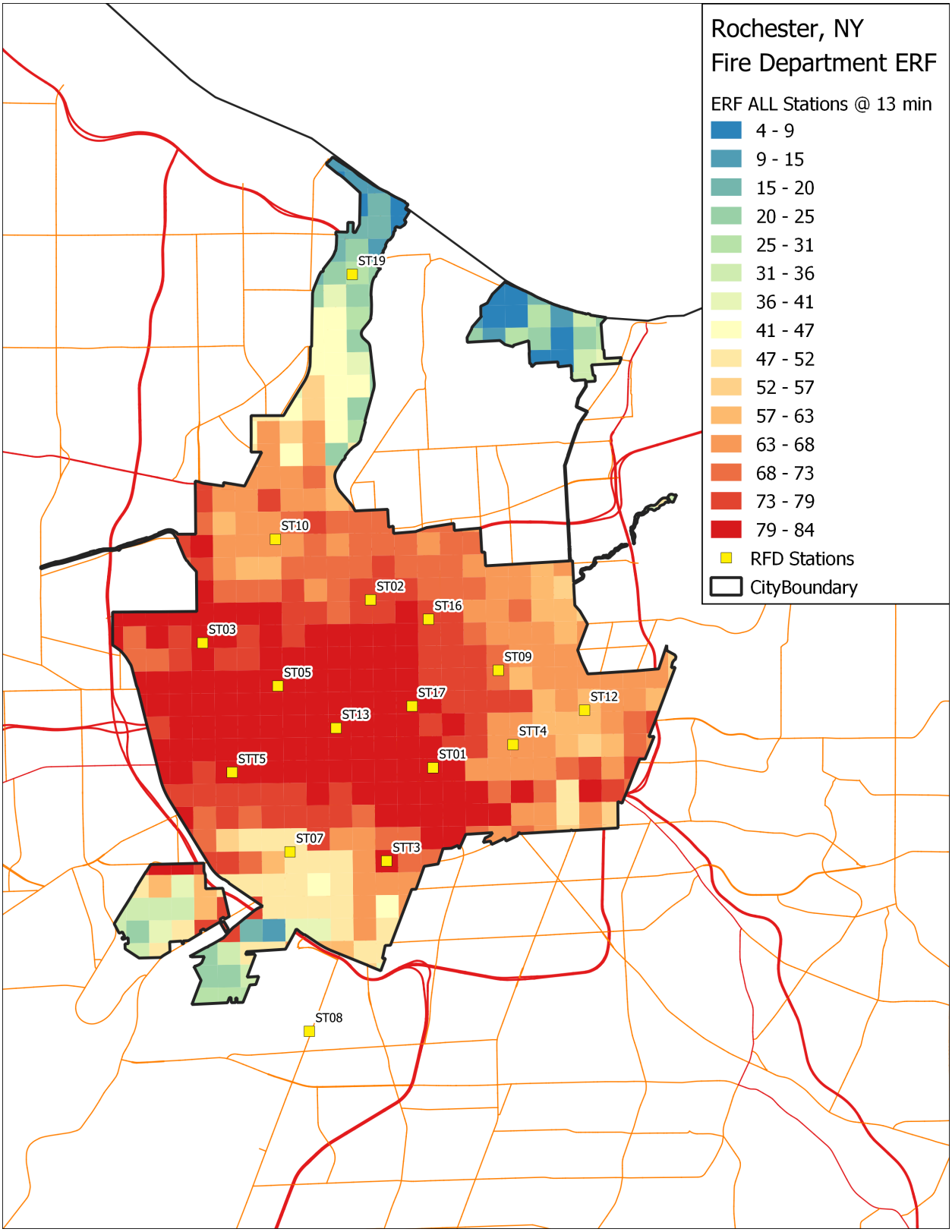


Figure 18: 13-Minute ERF from All Current Stations – Current Staffing



DISTRIBUTION OF RISK ACROSS THE JURISDICTION

Distribution of Demand by Program Areas

Heat maps were created to identify the concentration of the historic demand for services by program area. Therefore, the following mapping will present the relative concentration of service demands by fire, EMS, Rescue, HAZMAT, and All calls respectively. The Blue areas have the least demand and the dark red areas have the highest concentration of demand.

When reviewing the heat maps, it is clear that the greatest relative density of service demands is generally located near the downtown area, with little variation over the program areas.

Figure 19: Heat Map for Fire Related Incidents

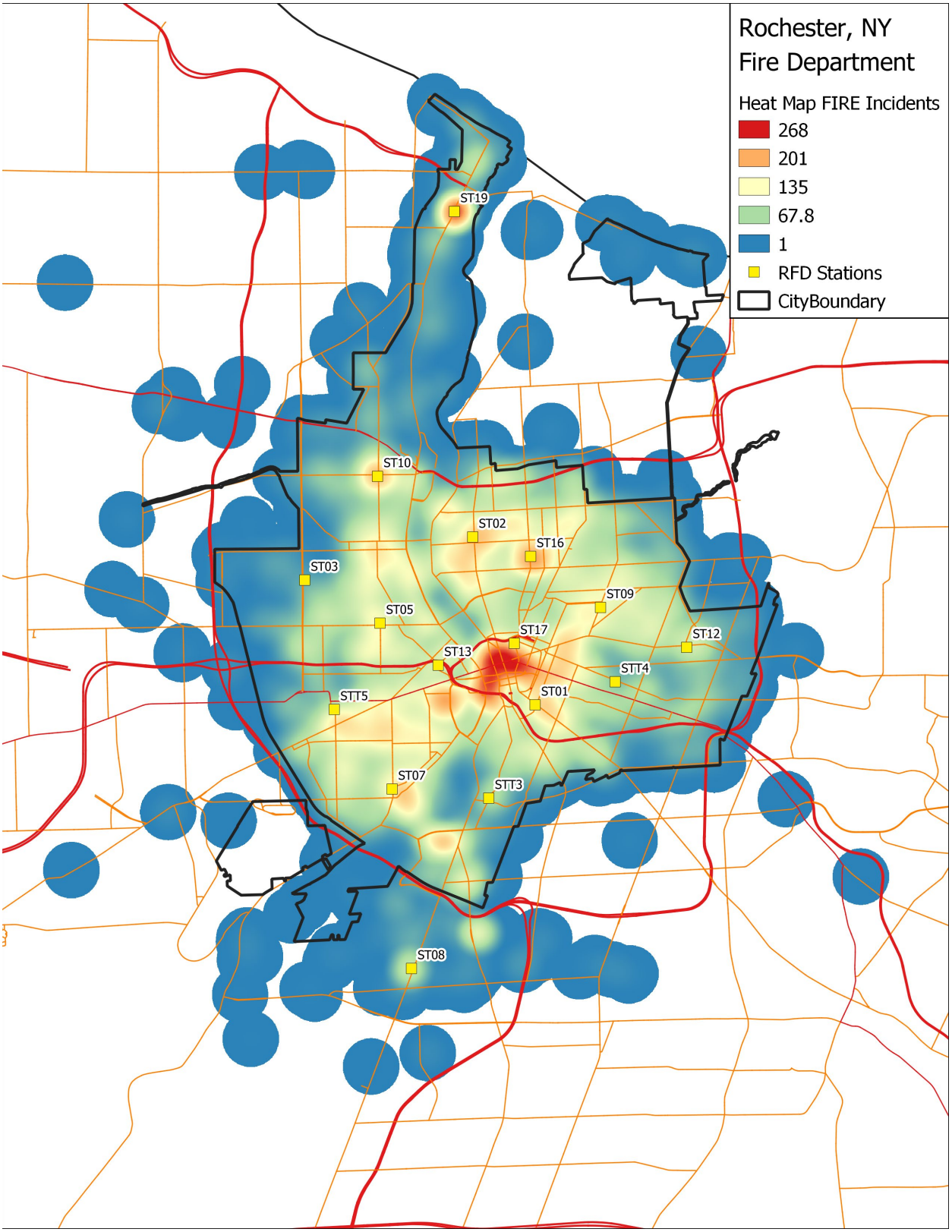


Figure 20: Heat Map for EMS Related Incidents

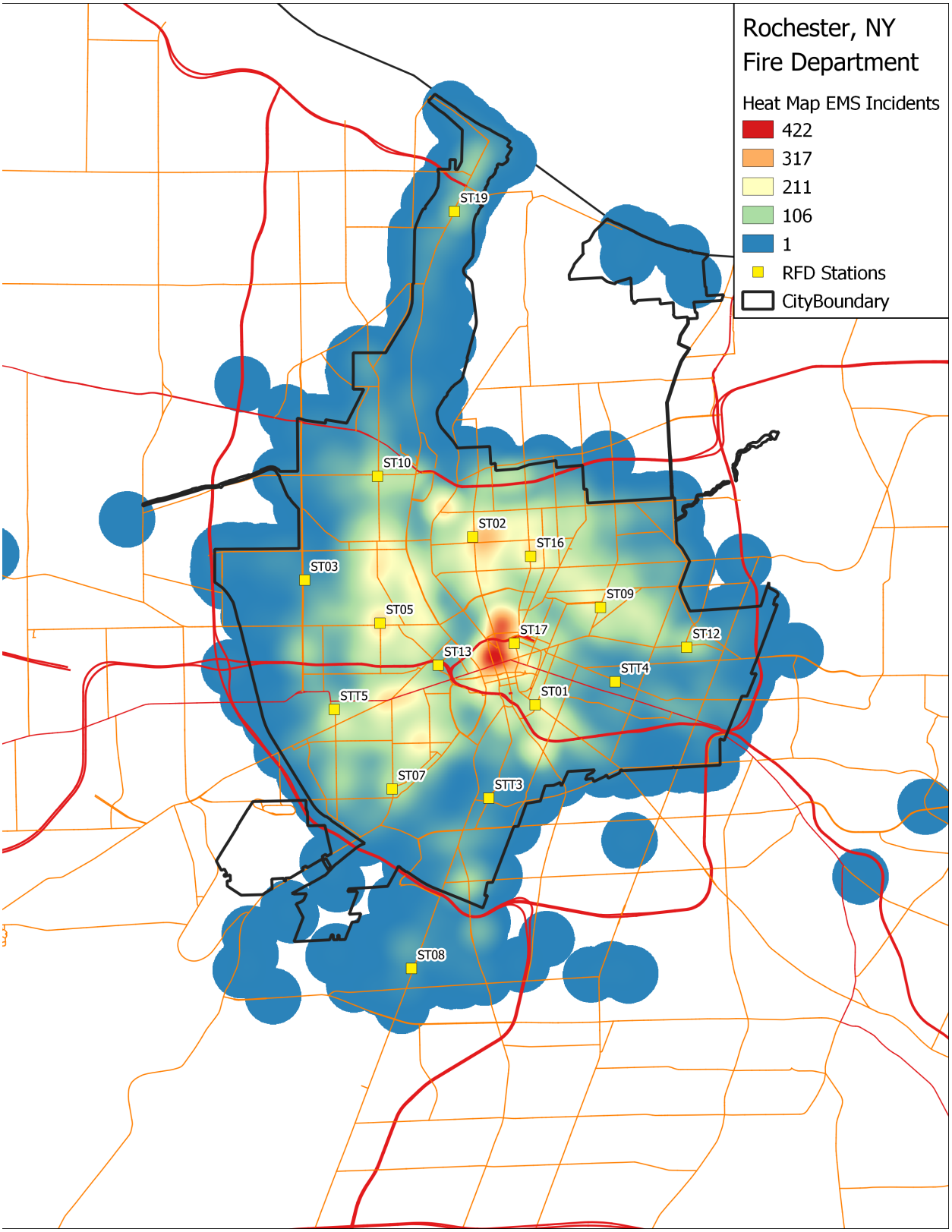


Figure 21: Heat Map for HazMat Related Incidents

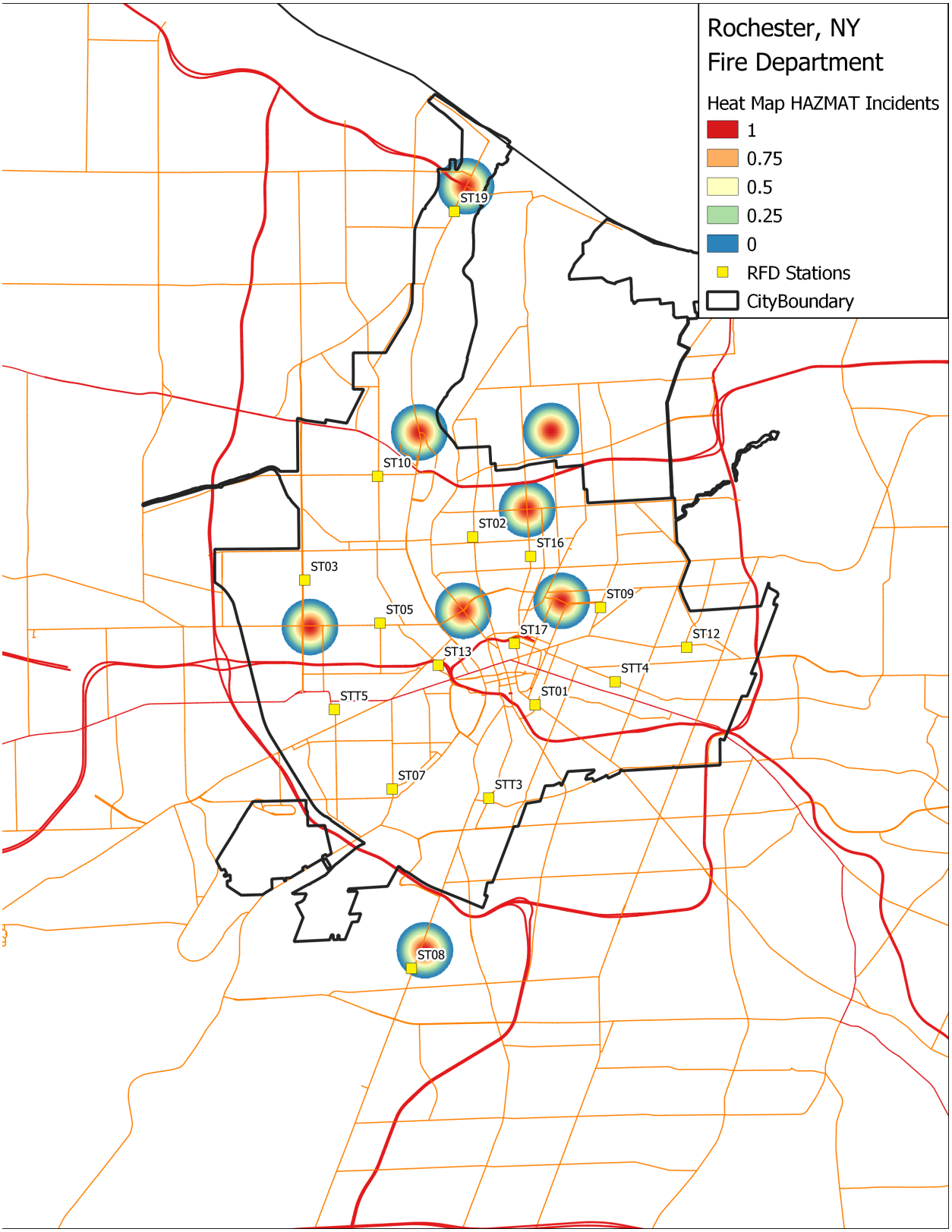


Figure 22: Heat Map for Rescue Related Incidents

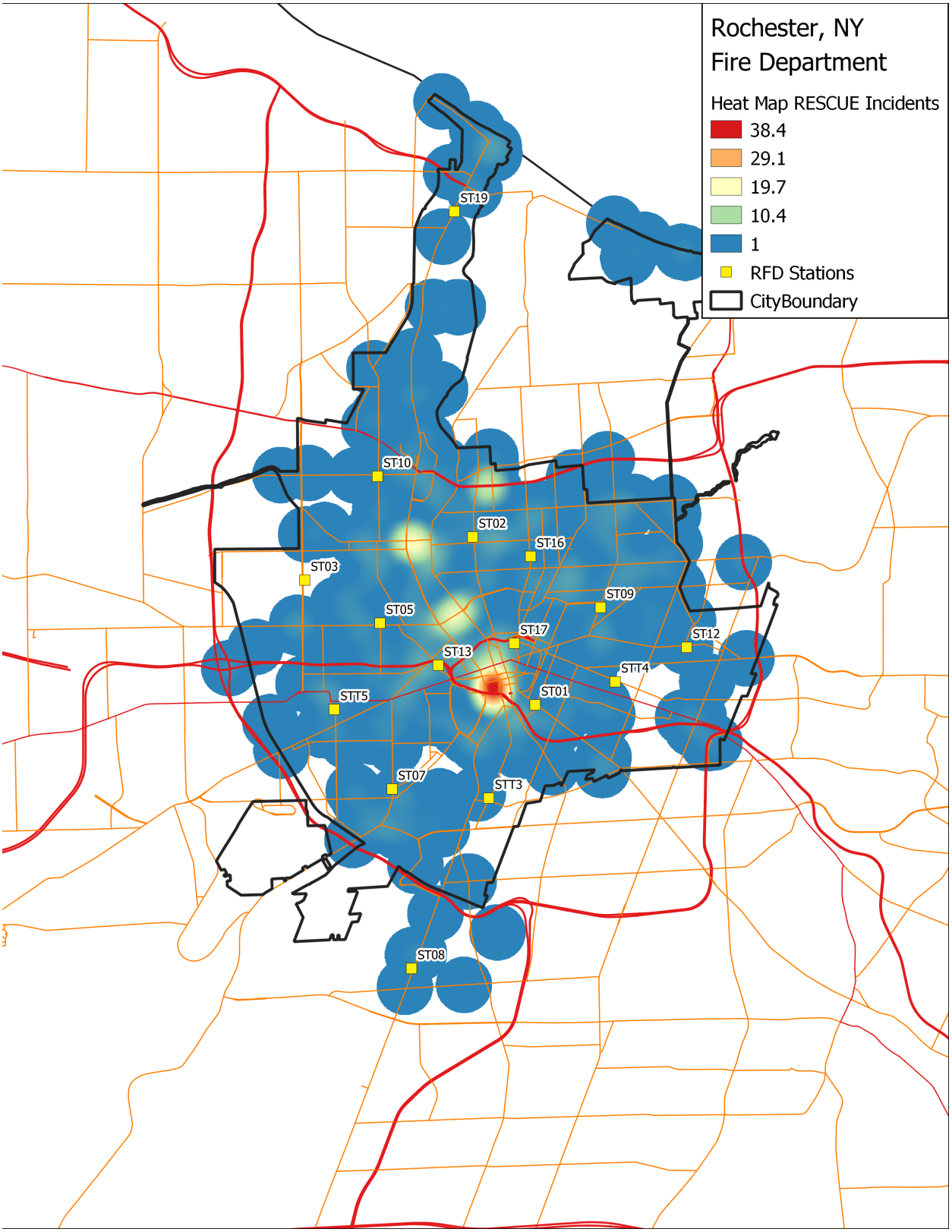
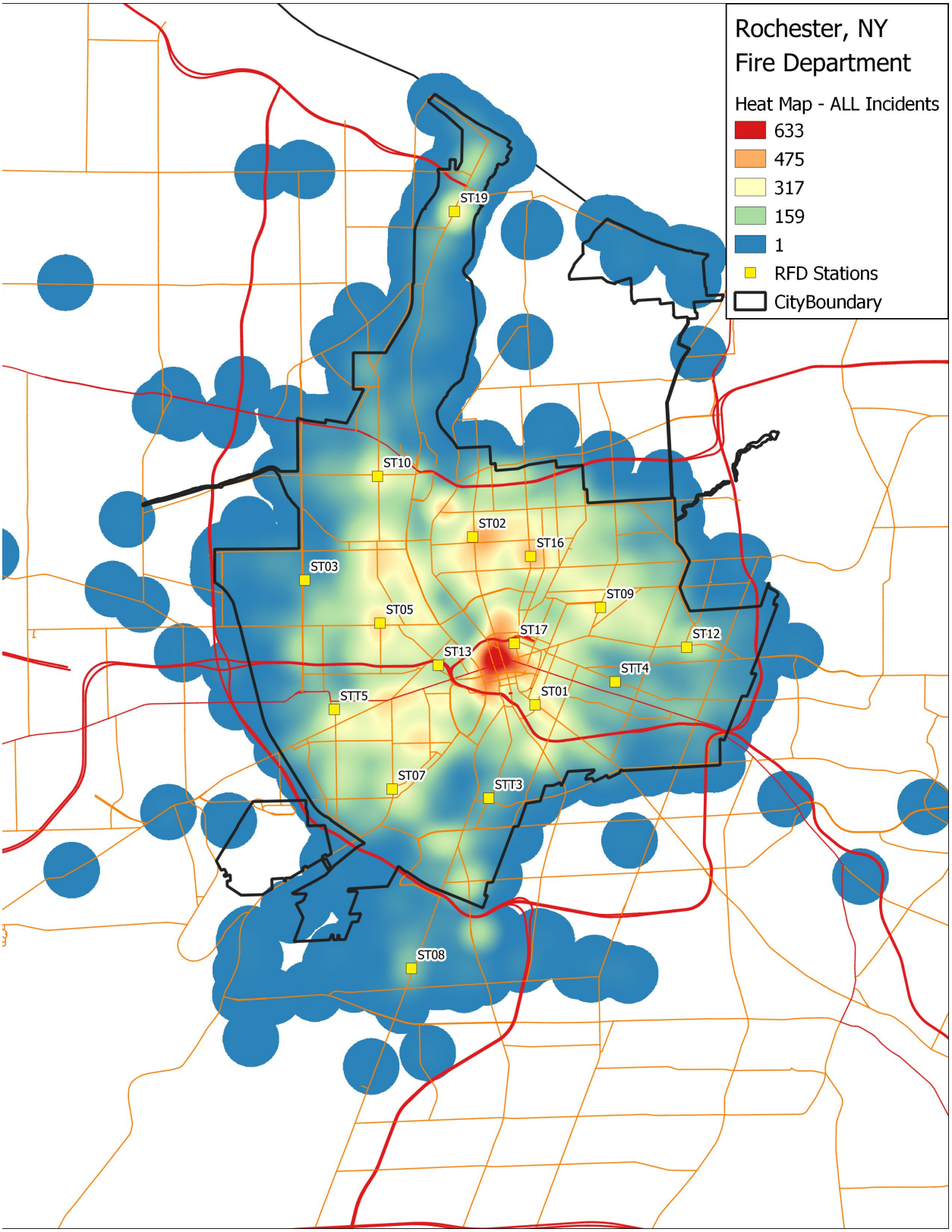
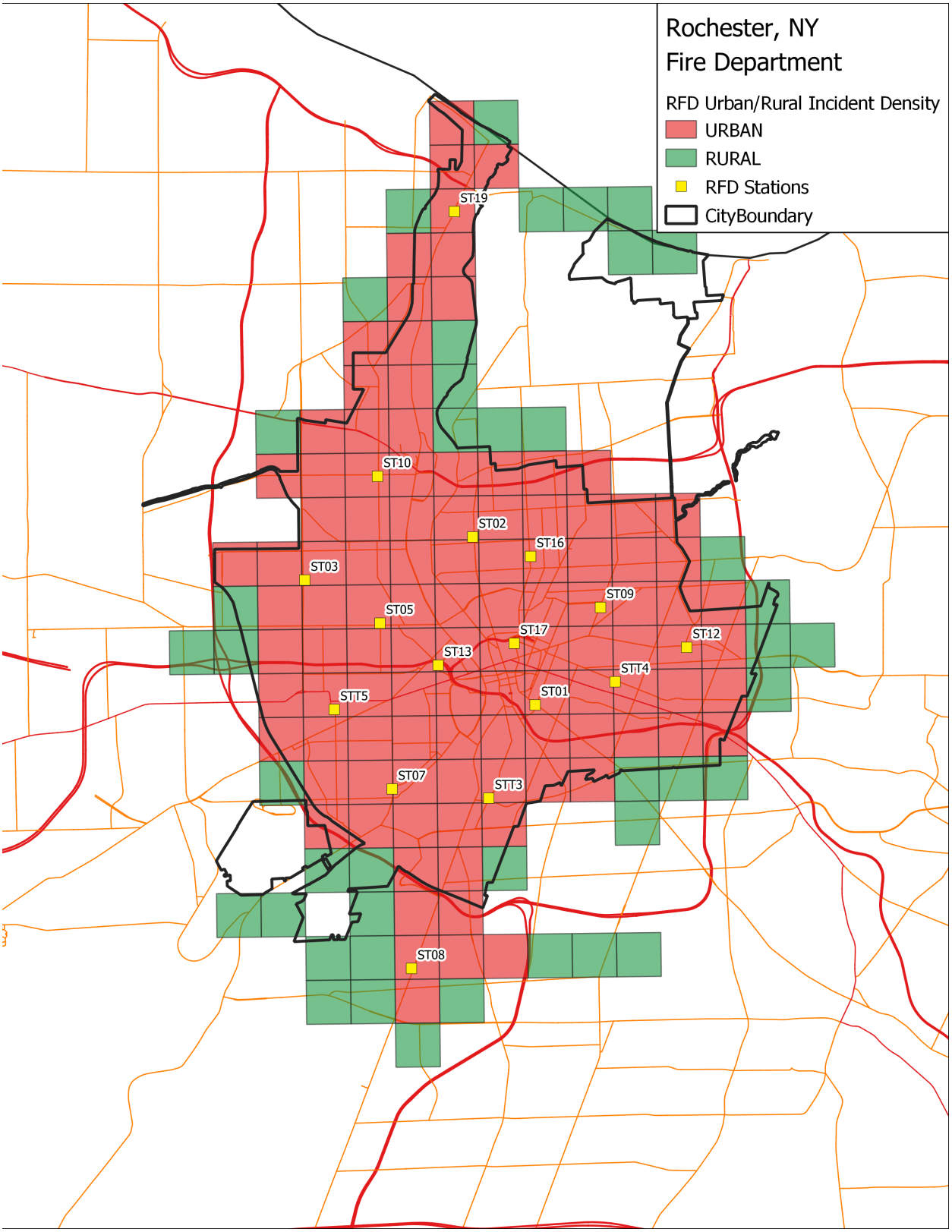


Figure 23: Heat Map for HazMat Related Incidents



Finally, we calculate call density based on the relative concentration of incidents based on approximately 0.5-mile geographic areas as well as the adjacent 0.5-mile areas. The results demonstrate an urban and rural designation based on call density for services and not based on population. The red areas are designated as urban service areas and the green areas are designated as rural service areas. Any area that is not colored has less than one call every six months in the 0.5-mile area and the adjacent areas.

Figure 24: Urban and Rural Call Density Map with Current Stations



Long-Term Sustainability of the Models Presented

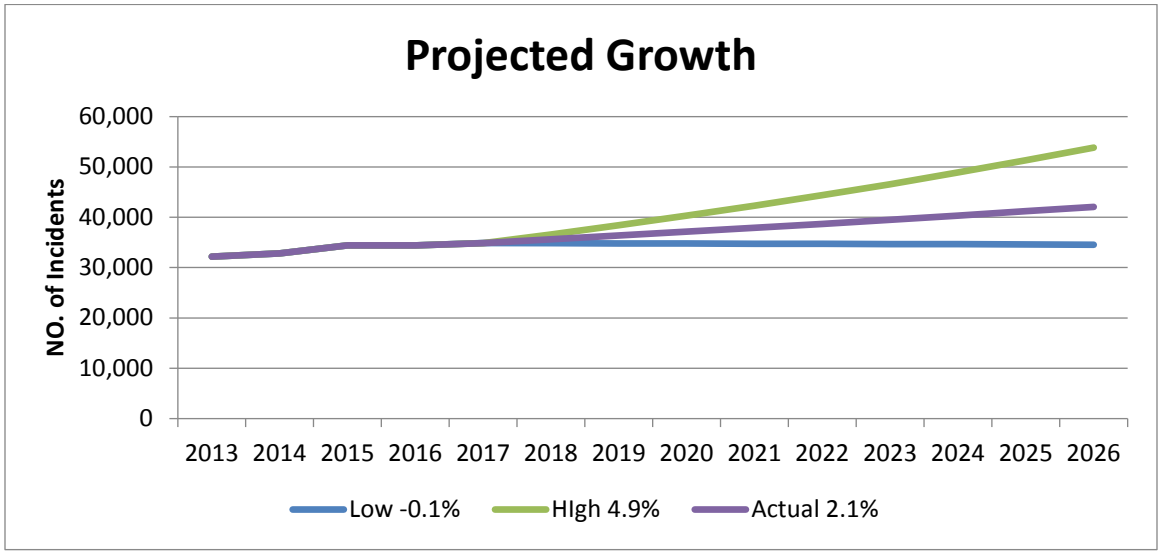
It is important to understand that the distribution models are restrictive to the geographic limitations of the jurisdiction and the historical demand for services. Therefore, the number of stations is descriptive of the number of fixed facilities required from which to deploy resources. These analyses do not specifically describe the concentration of resources required at each fire station facility to adequately handle the demand for services. For example, some stations may require two or more units in order to handle the demand for services.

With respect to the long-term sustainability of the deployment models presented here, the models will remain accurate for as long as the jurisdictions' overall coverage area has not expanded. In other words, if the City's square mileage remains, then the deployment strategy will be sustainable indefinitely with respect to the coverage area. As other variables such as population density or changes in socioeconomic status change over time, there may be a need for a higher concentration of resources necessary to meet the growing demand for services, but not additional stations. The most prominent reason that the geographic distribution model would need to be updated is for changes in traffic impedance that significantly limit the historical average travel speed. Monitoring travel time performance, system reliability, and call concurrency will provide timely feedback for changes in the environment that could impact the distribution model.

Projected Growth

The available data set was restricted to 5 years with an annualized growth of 2.1%. The following straight-line projection should be used with caution due to the variability across years. However, in all cases, data must be reviewed annually to ensure timely updates to projections. The overall year over year growth between 2013 and 2017 data includes a -0.1% drop in incidents between 2015 and 2016. The highest rate of growth was 4.94% that occurred between 2014 and 2015.

Figure 25: Projected Growth of 2.1%

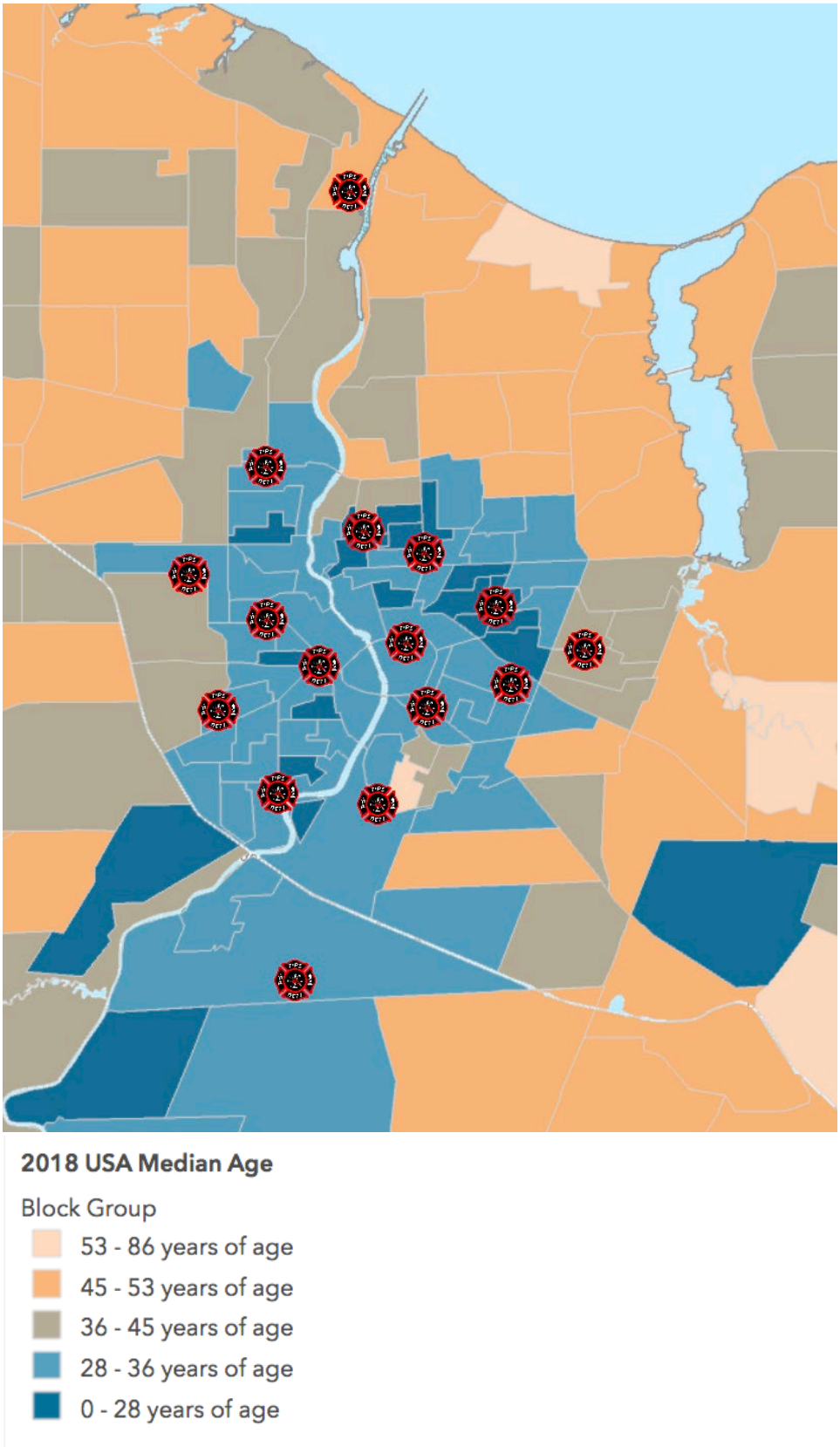


Assuming that future demands may not be reasonably distributed across the various stations in the system, the system may require a redistribution of workload and ultimately reinvestment in resources to meet the growing demand in the future. While the system should be evaluated continuously for performance and desired outcomes, the department should specifically re-evaluate workload and performance indicators for every 1,000-call increase to ensure system stability.

Population Characteristics

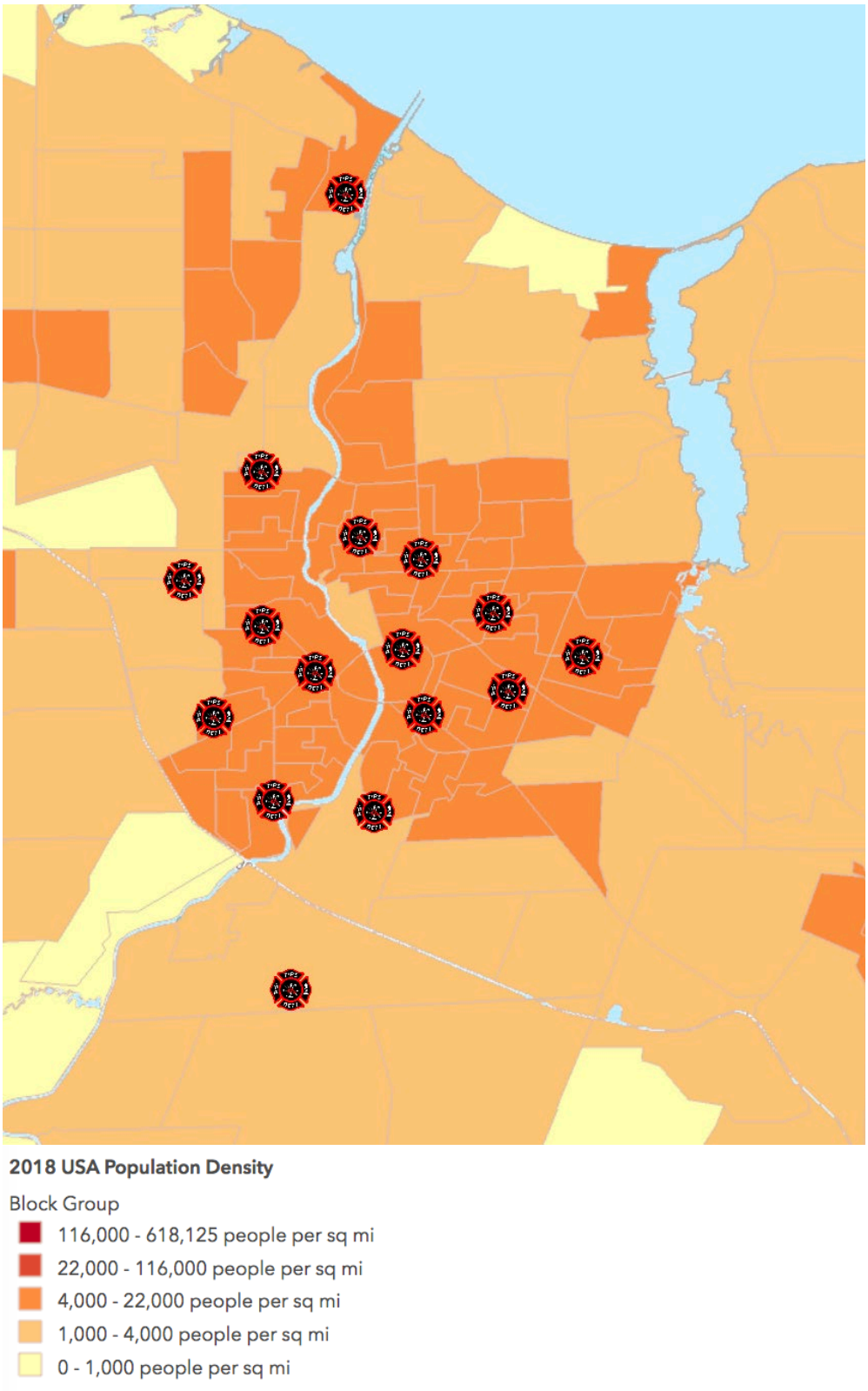
Generally, older populations and very young populations are considered to be most vulnerable to the frequency and incidents of fire. In addition, older populations historically utilize EMS services with greater frequency. It is important to understand, what field crews often recognize intuitively, is that the distribution of population risks are not uniform across the jurisdiction. The median age is provided below.

Figure 26: Median Age - 2018



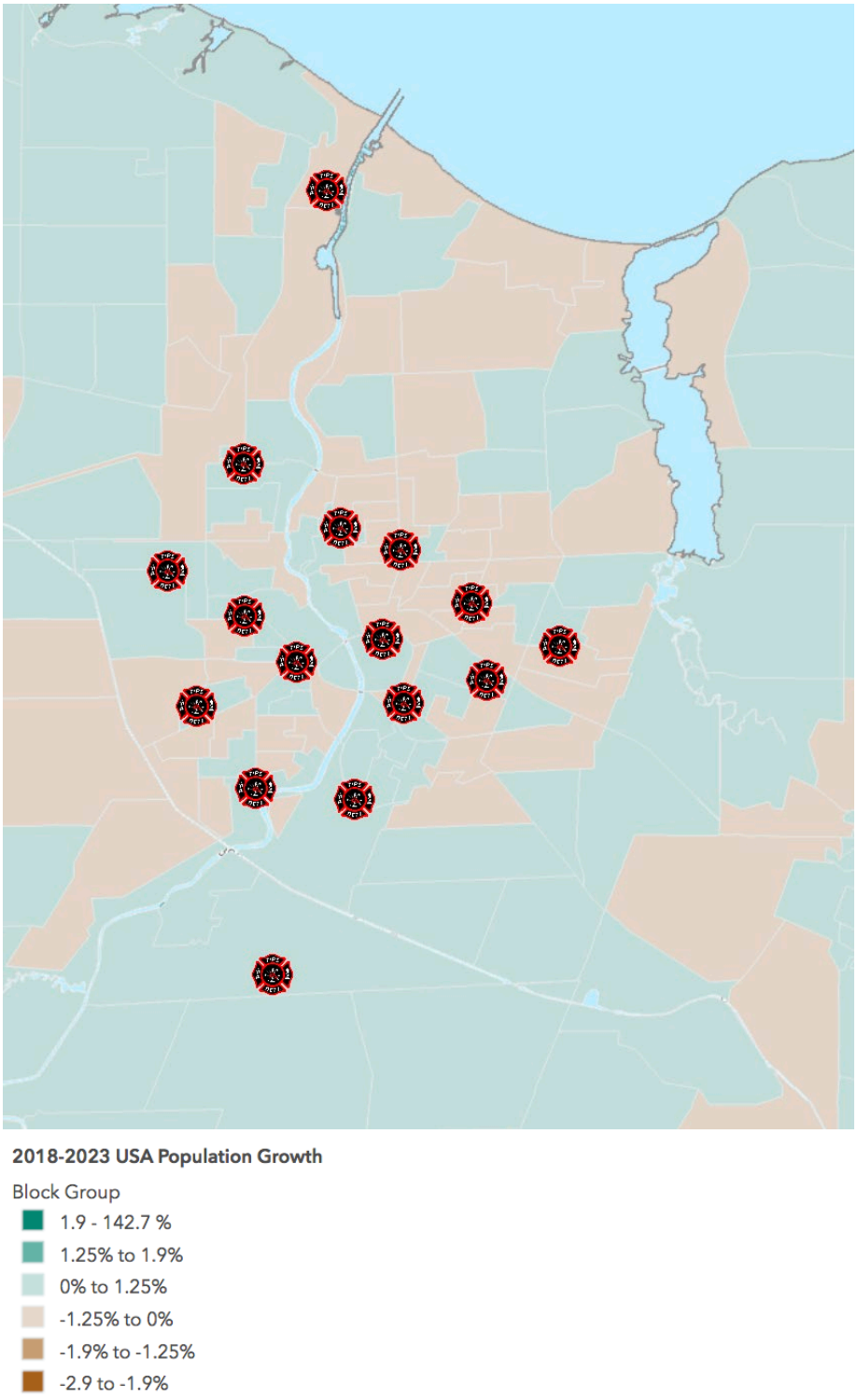
For the majority of the jurisdiction, the population density is urban or suburban.

Figure 27: Population Density by Census Block - 2018



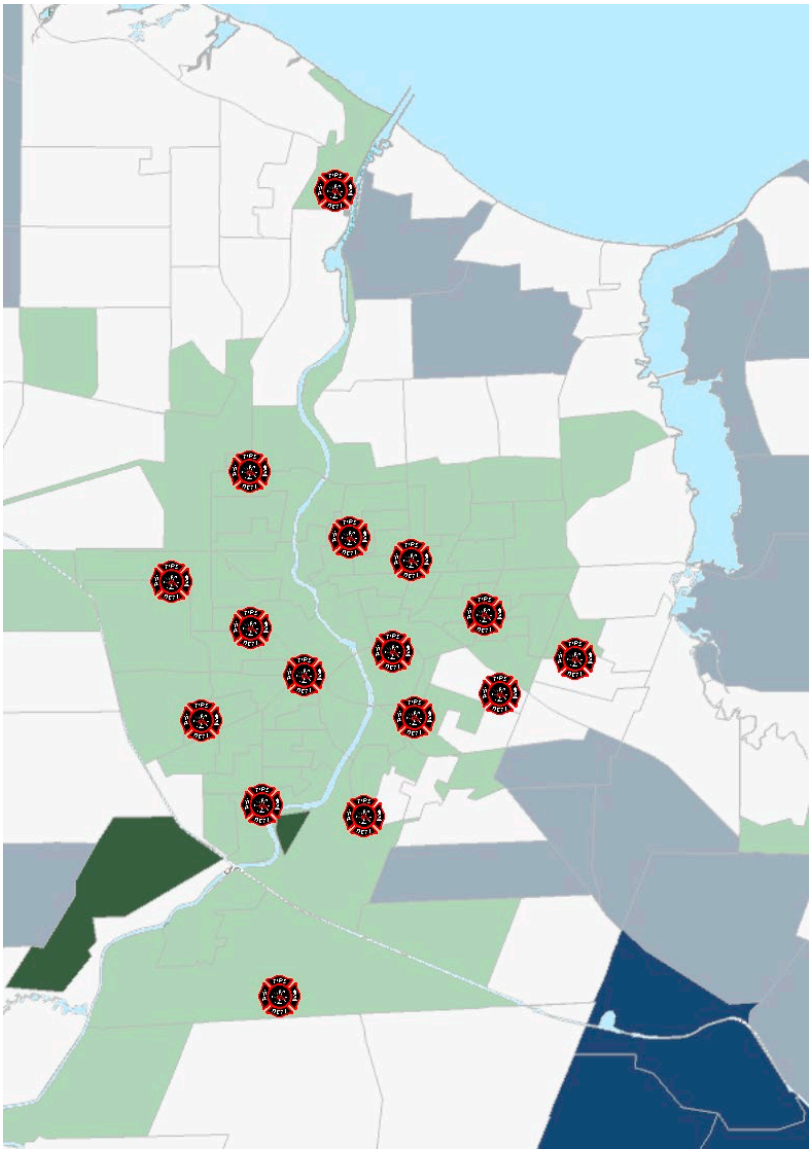
The population change is either holding static or reducing by 1.25% or growing slowly between 0 and 1.25%. Overall, the projected changes to population should be relatively stable.

Figure 28: Annual Population Change 2018-2023



Finally, population alone is not the sole variable that influences the demand for services as socioeconomic and demographic factors have greater influence over demand. The median household income was evaluated to determine the degree to which the community had underprivileged populations. The majority of census blocks were at or below the national median household income. The national median household income is reported at $58,100.

Figure 29: Median Household Income -2018



RISK ANALYSES

Occupancy Level Risk

Occupancy risk was evaluated across the jurisdiction utilizing the most recent ISO batch reports. The ISO Batch report provided specific building occupancy information for the needed fire flow, the number of stories, location, construction classification, and square footage. Ultimately, a quantifiable risk-rating matrix was developed that categorized 3,503 occupancies within the jurisdiction into high, moderate, and low risks. The risk matrix is presented in Table 8 below.

Due to the relatively higher demands for personnel and apparatus required for fire events that have a large square footage, higher elevation (stories), and greater water demands, the risks garnished the highest numeric values. The results of the risk assessment process categorized the 3,503 occupancies into 13 high-risk structures, 3,100 moderate structures, and 390 low risk structures.

Geospatial analyses were completed to map the locations of each of the commercial occupancies included in the risk matrix process and specifically overlaid within each of the fire station locations. This analysis lends validity to the risk assessment matrix and the process utilized by the Department as the concentration of risks is correlated with the historical demand for fire related services. The results of the geospatial analyses of all, high, moderate, and low risk structures are presented below as Figures 28 - 30, respectively. From a broad perspective, this provides validation to the risk assessment process developed with the Department as well as the necessary deployment strategy to cover the historical demand for services.

Table 9: Summary of Occupancy Risk Matrix

Risk Class	Fire Flow		Number of Stories		Square Footage		Construction Class		Total Risk Score
	Value	Scale	Value	Scale	Value	Scale	Value	Scale	Scale
High	3	≥ 1500 gpm	5	≥ 4	5	>=100k Sq. Ft.	5	Combustible or Frame	≥ 16
Moderate	2	> 499 and < 1500 gpm	3	> 1 and < 4	3	> 10k < 100k Sq. Ft.	3	Joisted Masonry	>5 and <16
Low	1	≤ 499 gpm	1	1	1	< 10k Sq. Ft.	1	Non-Combustible Masonry Non-Combustible, Fire Resistive	≤ 5

Figure 30: High Risk Occupancies by Station Demand Zone

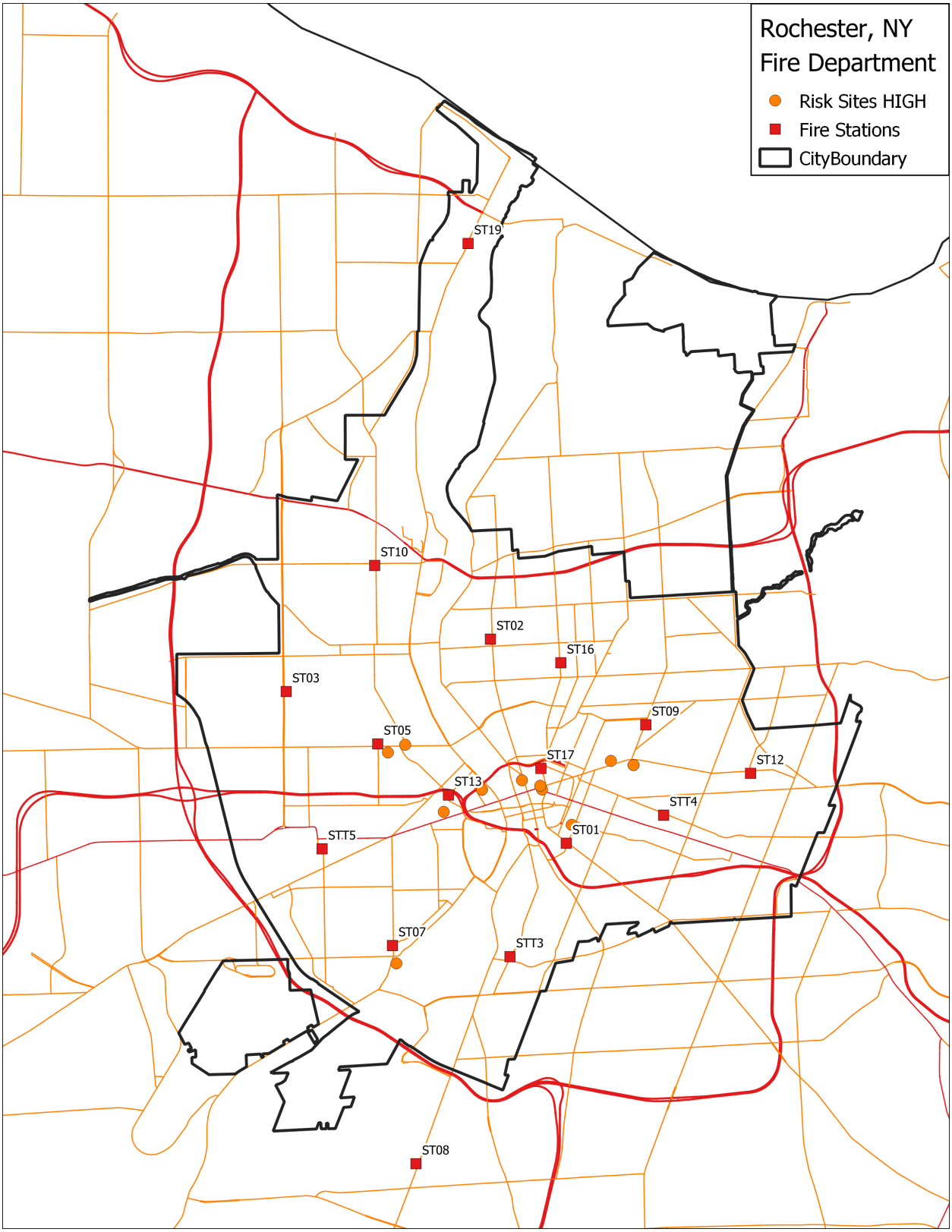


Figure 31: Moderate Risk Occupancies by Station Demand Zone

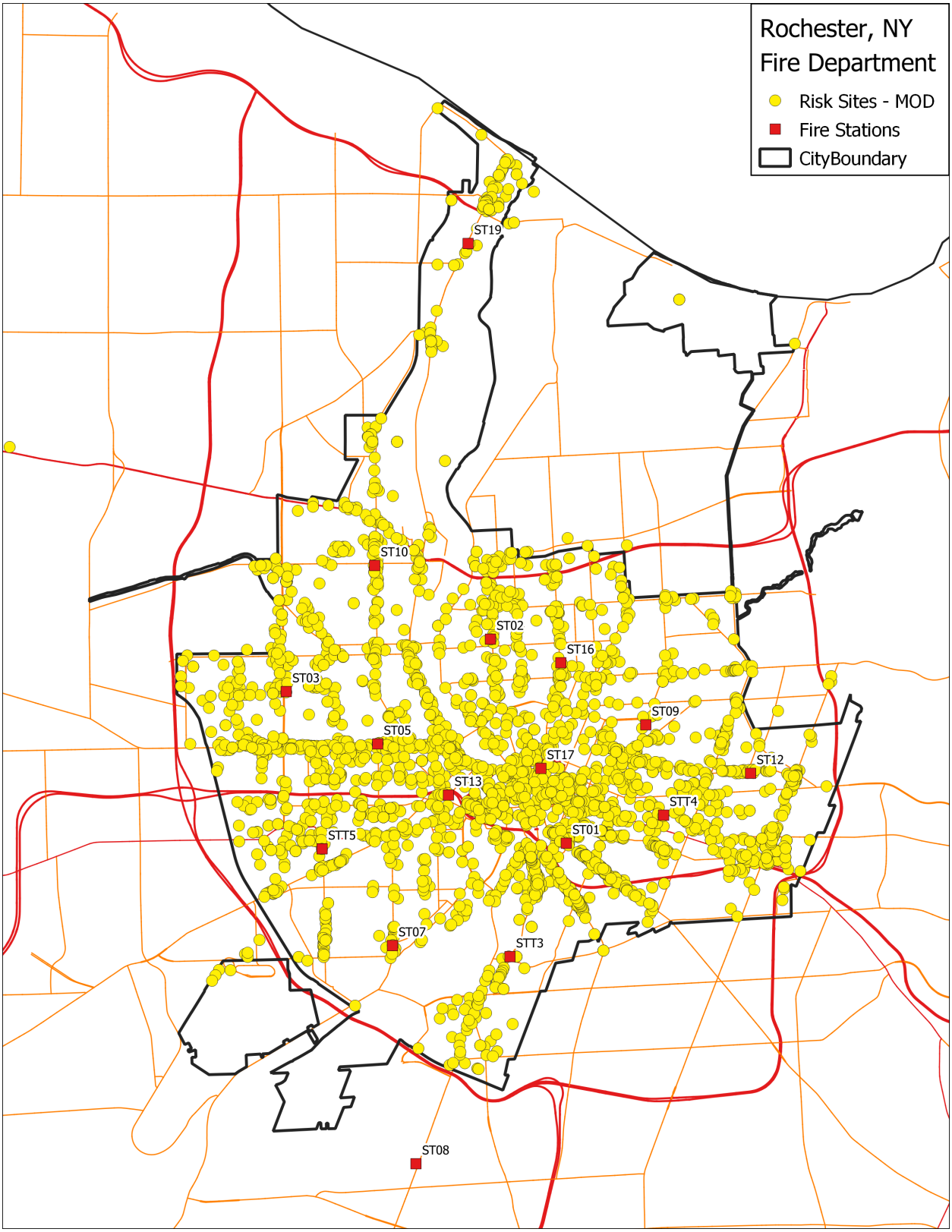
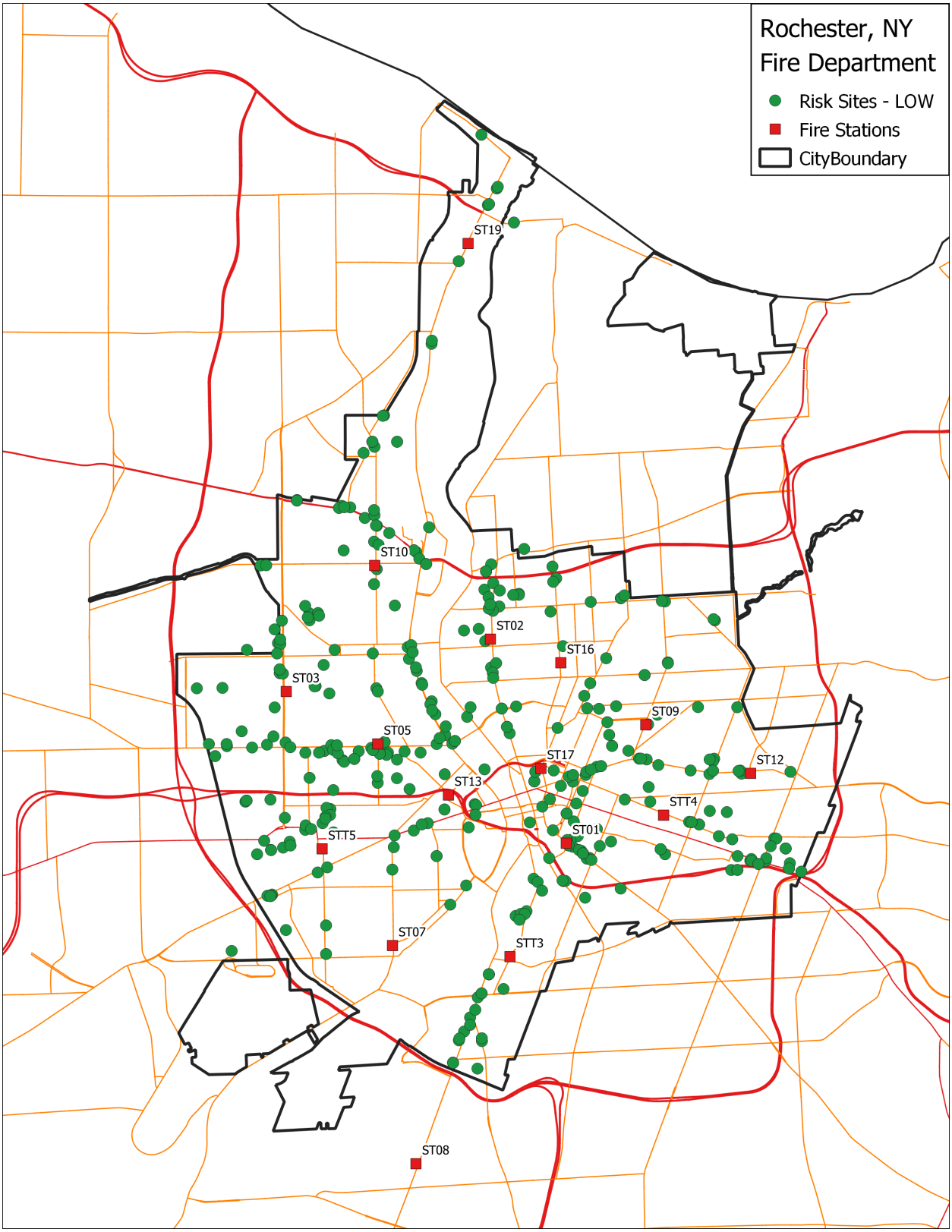


Figure 32: Low Risk Occupancies by Station Demand Zone



Concentration of Risks by Demand Zone

Analyses were conducted to describe and measure the relative concentration of risks in each of the fire station demand zones. Therefore, a station demand zone risk matrix was developed to quantitatively evaluate the relative risk by including measures for the frequency of moderate and high risk occupancies in each fire demand zone that are directly correlated to the necessity of higher concentrations of resources. In addition, several measures that both serves the distribution aspect of the risk evaluation, but also contributes to the need for higher concentrations of resources. For example, a higher call volume may serve to drive the need for additional resources to cover the community's demand.

The variables included in the risk matrix are the demand for services for each station demand zone, the number of high and moderate-risk occupancies, and the impact of simultaneous events in each station demand zone. All measures were weighted equally, however, two variables have surrogate relationships with historical community demands and one variable is dedicated to prospective occupancy risk. Community demands were rated more heavily in an effort to provide a realistic balance between the risk potential with historical experience. The risk tool and the scoring template are provided below.

Table 10: Station Demand Zone Risk Concentration Matrix

Station FDZ	Community Demand	Call Concurrency	High/Moderate Risk Occupancies	Total risk Score	Risk Rating
1	7	3	10	55.86	High
2	6	4	4	26.53	Moderate
3	3	2	4	11.05	Low
5	6	3	8	40.02	High
7	5	3	3	16.29	Low
8	5	4	1	14.85	Low
9	5	3	4	19.61	Moderate
10	7	4	6	39.52	High
12	3	3	5	16.29	Low
13	10	3	2	25.85	Moderate
16	10	4	4	41.57	High
17	8	3	3	24.83	Moderate
19	2	5	3	13.44	Low
T3	5	4	3	19.61	Moderate
T4	3	3	3	11.02	Low
T5	5	3	5	23.18	Moderate

Overall, the risk assessment identified that Stations 1 , 5, 10, and 16 are high-risk station and Stations 2, 9, 13, 17, T3, and T5 are moderate risk stations. The remaining stations were categorized as lower risk. This would indicate that higher risk stations would have a higher concentration of resources than the lower risk stations.

Table 11: Summary of Station Fire Demand Zone Risk Concentration Matrix

Risk Class	Community Demand (D)		Call Concurrency (C)		High/Moderate Risk Occupancies (R)		Total Risk Score
	Value	Scale (Calls)	Value	Scale (%)	Value	Scale (Occupancies)	$\sqrt{\frac{(CD)^2 + (CR)^2 + (RD)^2)}{2}}$
Maximum	≥10	≥4,050	≥10	≥ 27	≥10	≥500	≥72
High	7 – 9	≥ 2,700 and < 4,049	7	≥ 18 and < 27	7 to 9	≥ 300 and <449	≥ 39.35 and < 72
Moderate	4 to 6	≥ 1,350 and < 2,700	5	≥ 9 and < 18	4 to 6	≥ 150 and < 300	≥ 16.49 and < 39.35
Low	1 to 3	< 1,350	1	<9	1 to 3	< 150	< 16.49

***** *Definitions for Occupancy Risk Type were provided as part of the full risk assessment previously.*

These analyses result in a three-dimensional model that illustrates the representativeness of each of the variables as they contribute to each station's risk profile. For example, one station may score heavily in potential risk and have moderate or low demand for services and another station may have little potential risk but have high demand and call concurrency that drives the necessity for a greater concentration of resources.

Graphic representations of the three axis risk matrices are provided below. When reviewing these radar figures, the larger the shaded area, the greater the risk. In addition, each axis is labeled so that the reader can determine the relationship between the risk drivers for each station area.

Figure 33: Station 1 Risk Profile

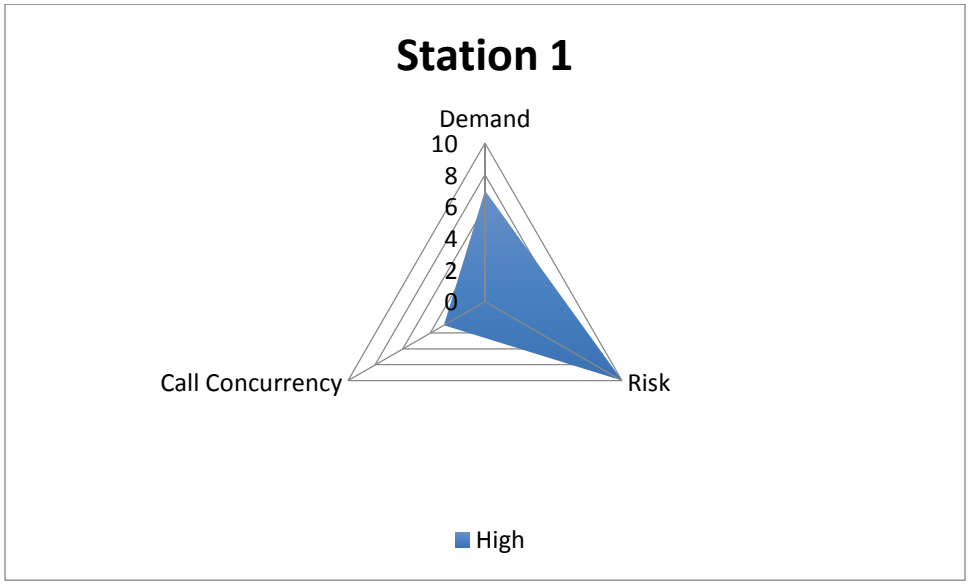


Figure 34: Station 2 Risk Profile

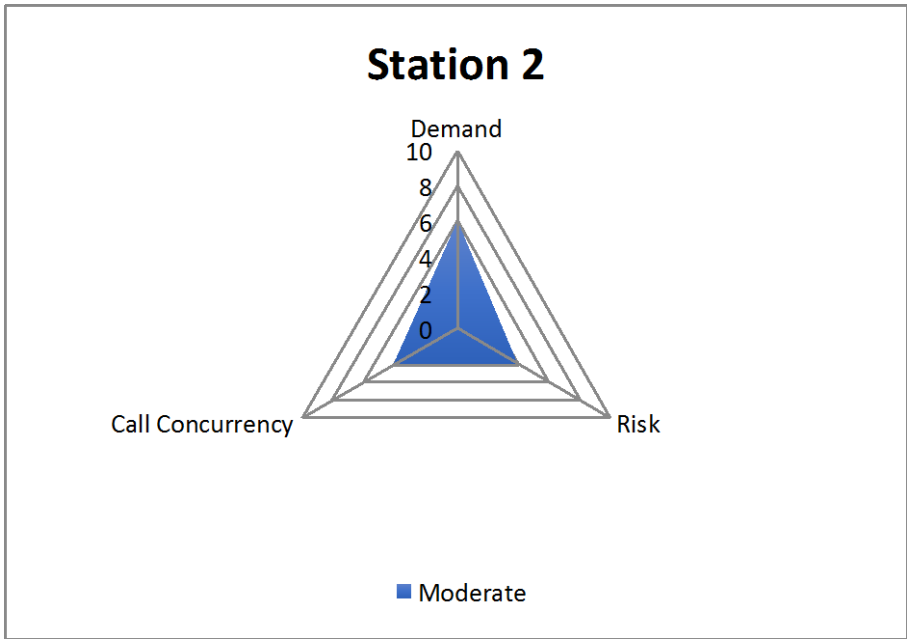


Figure 35: Station 3 Risk Profile

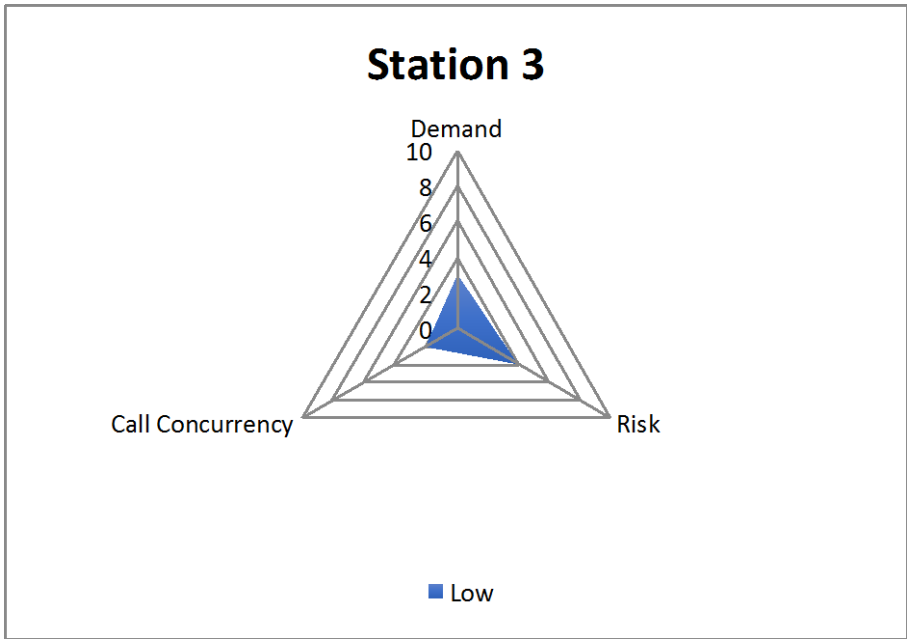


Figure 36: Station 5 Risk Profile

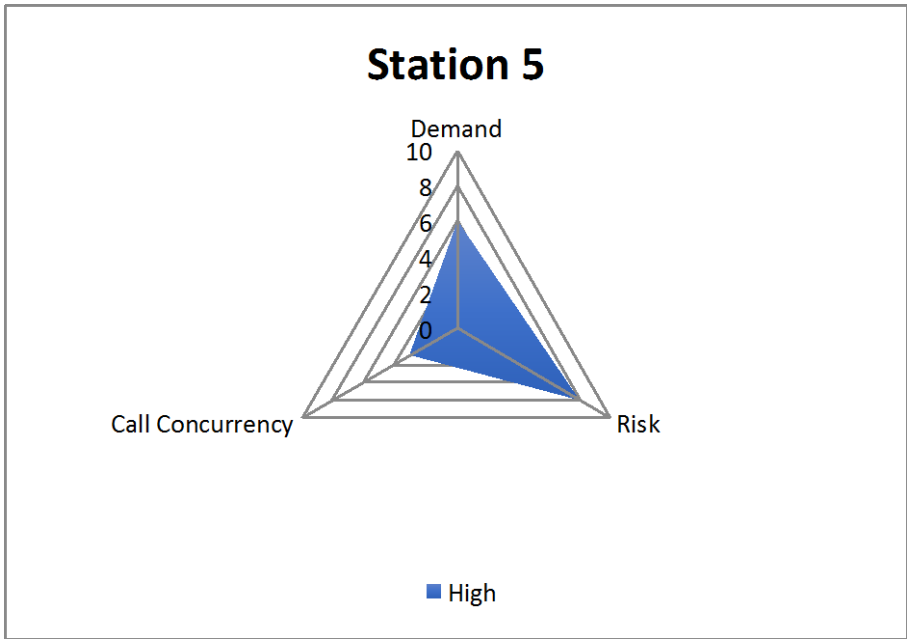


Figure 37: Station 7 Risk Profile

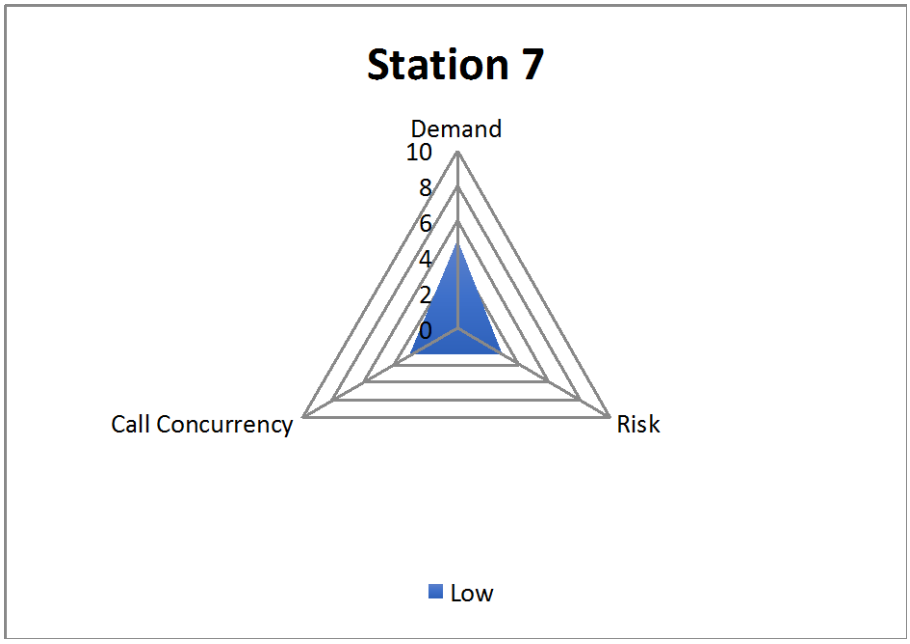


Figure 38: Station 8 Risk Profile

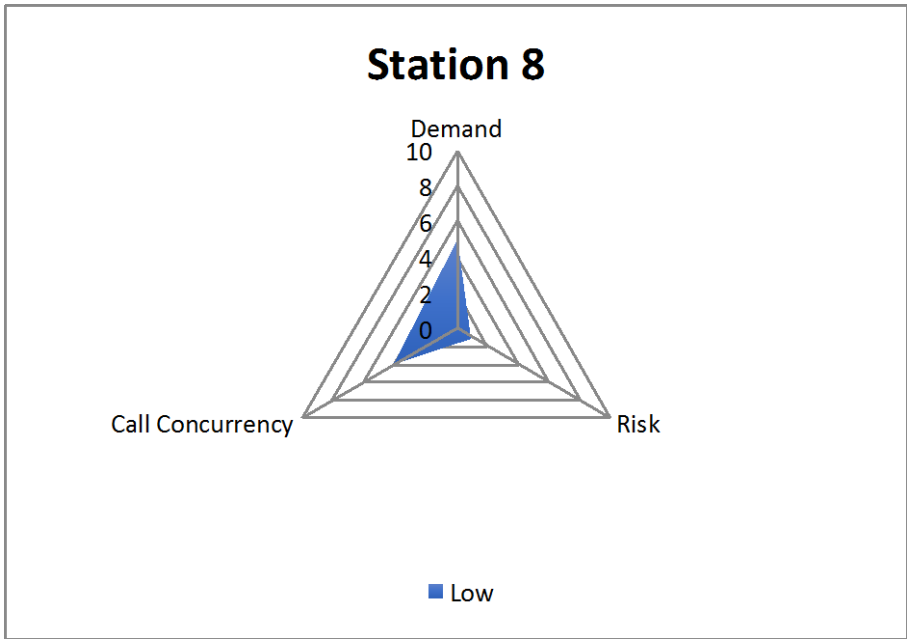


Figure 39: Station 9 Risk Profile

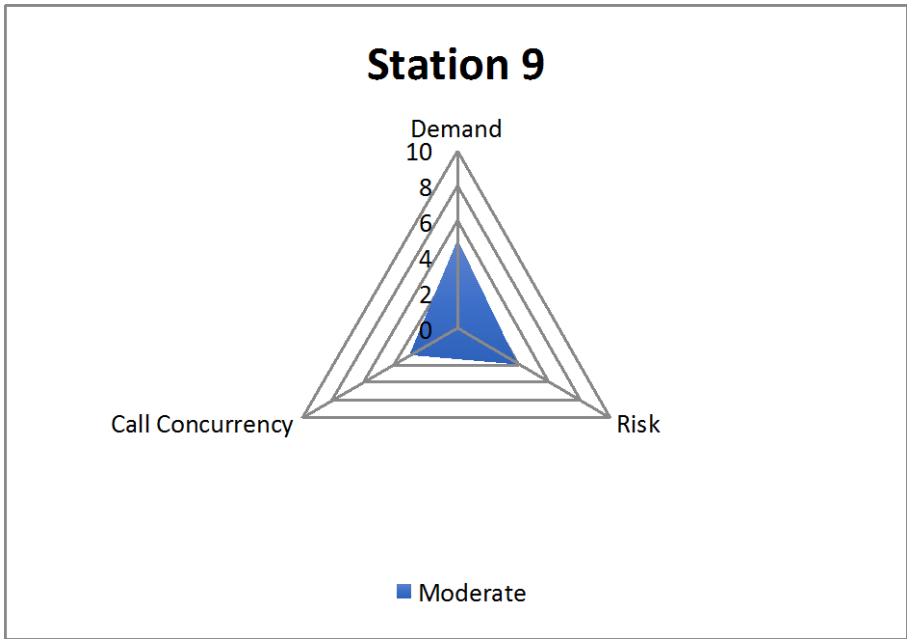


Figure 40: Station 10 Risk Profile

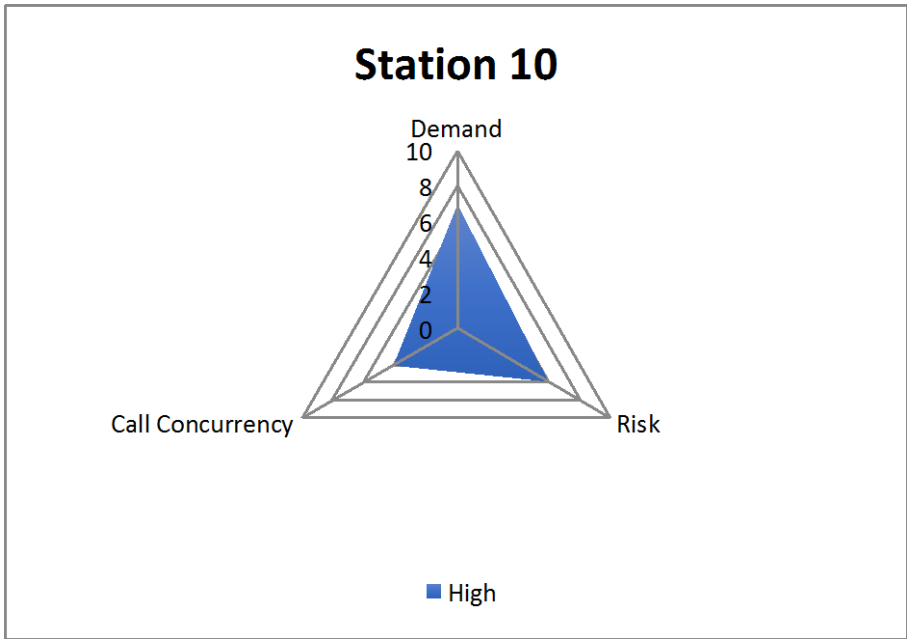


Figure 41: Station 12 Risk Profile

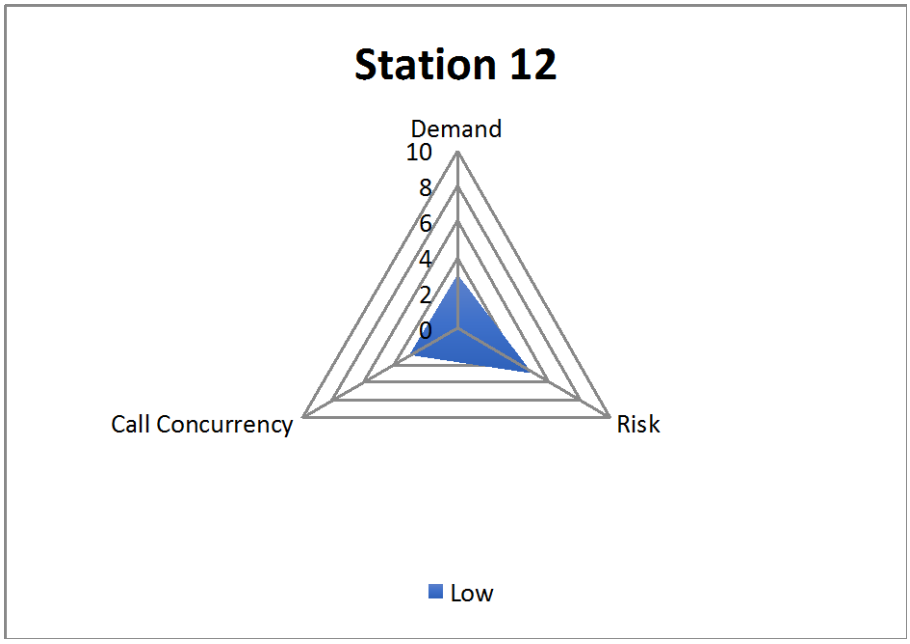


Figure 42: Station 13 Risk Profile

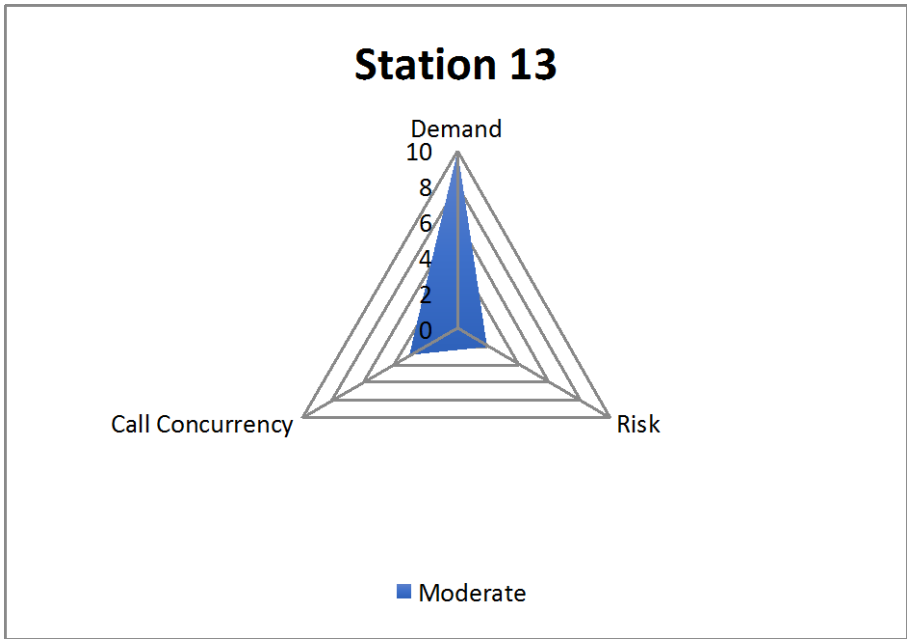


Figure 43: Station 16 Risk Profile

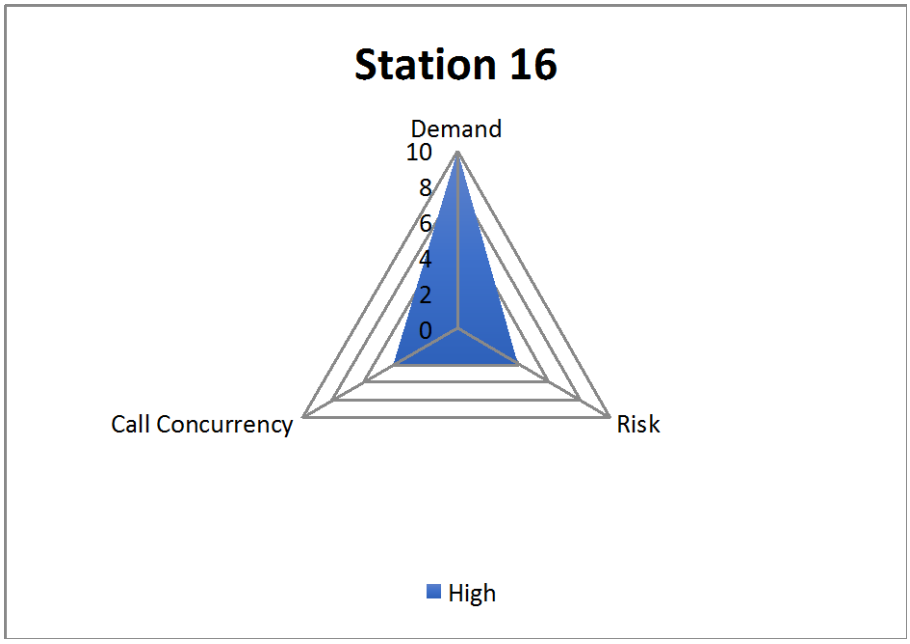


Figure 44: Station 17 Risk Profile

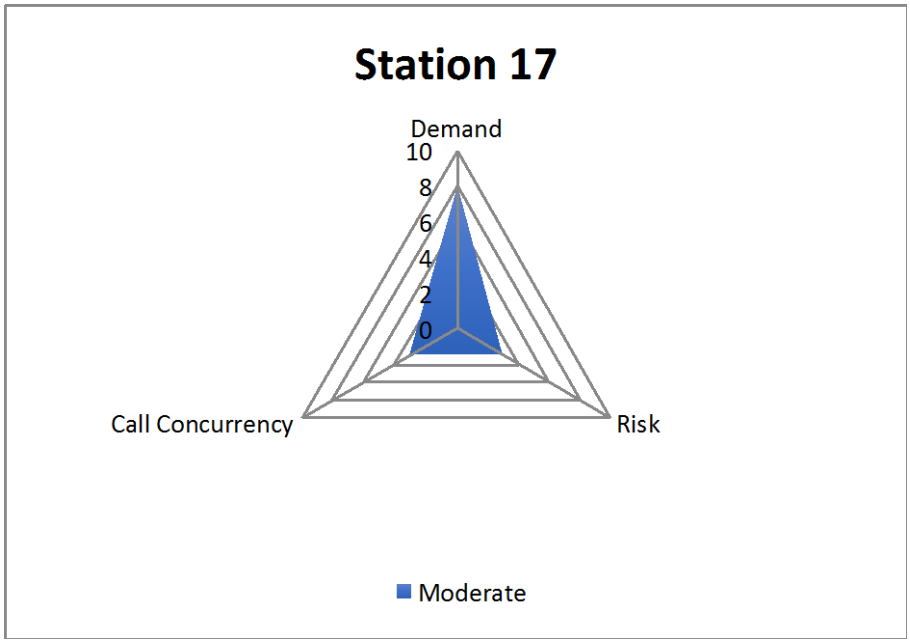


Figure 45: Station 19 Risk Profile

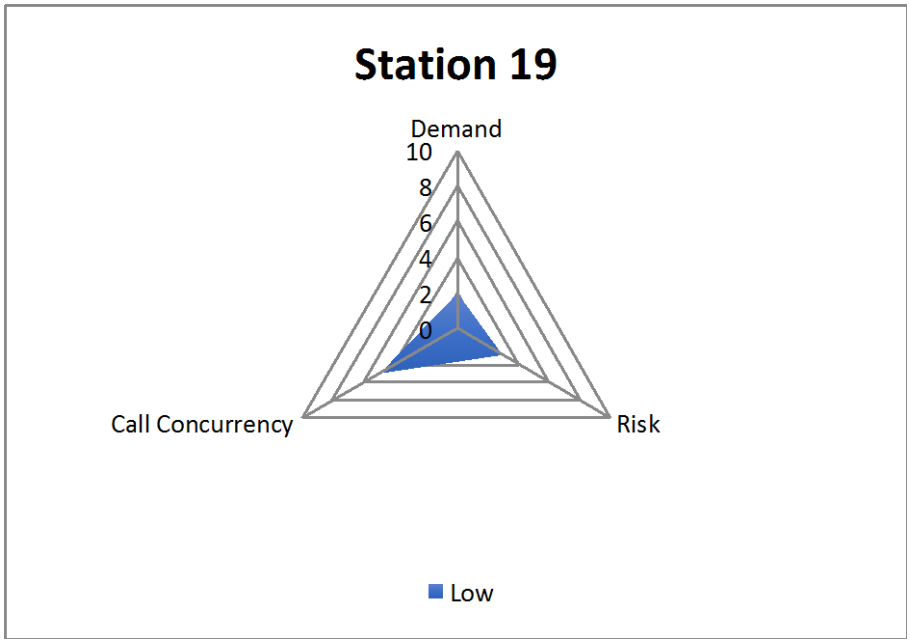


Figure 46: Station T3 Risk Profile

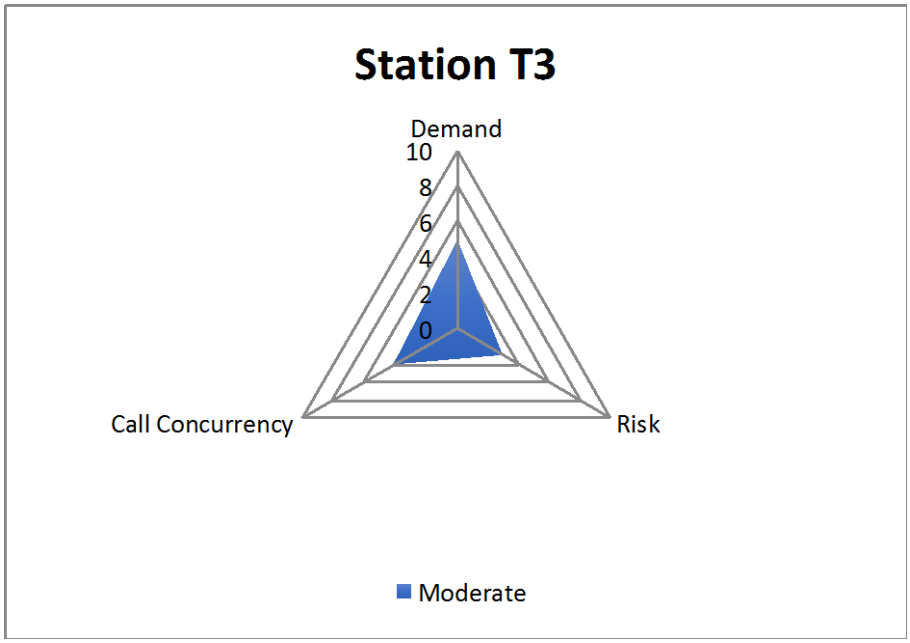


Figure 47: Station T4 Risk Profile

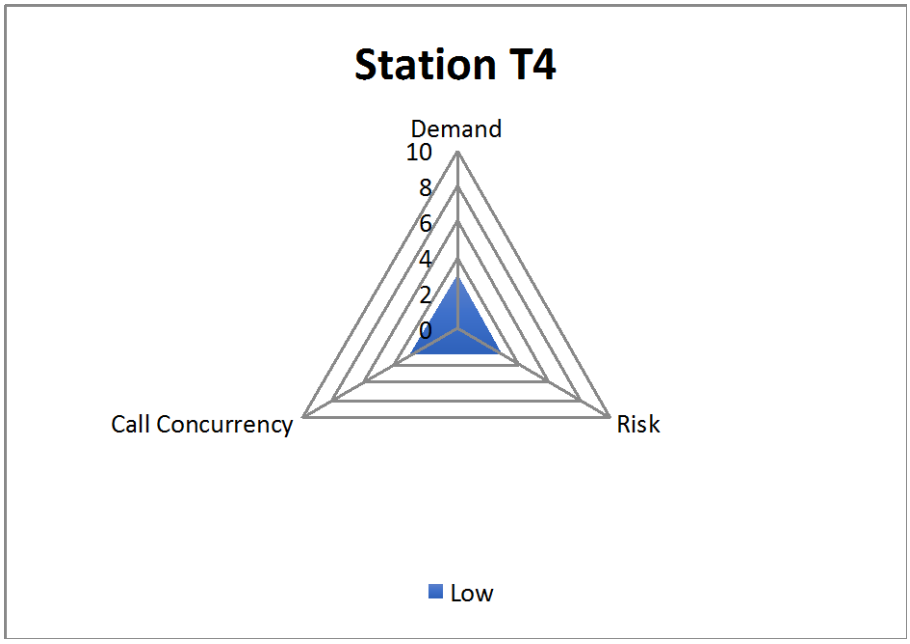
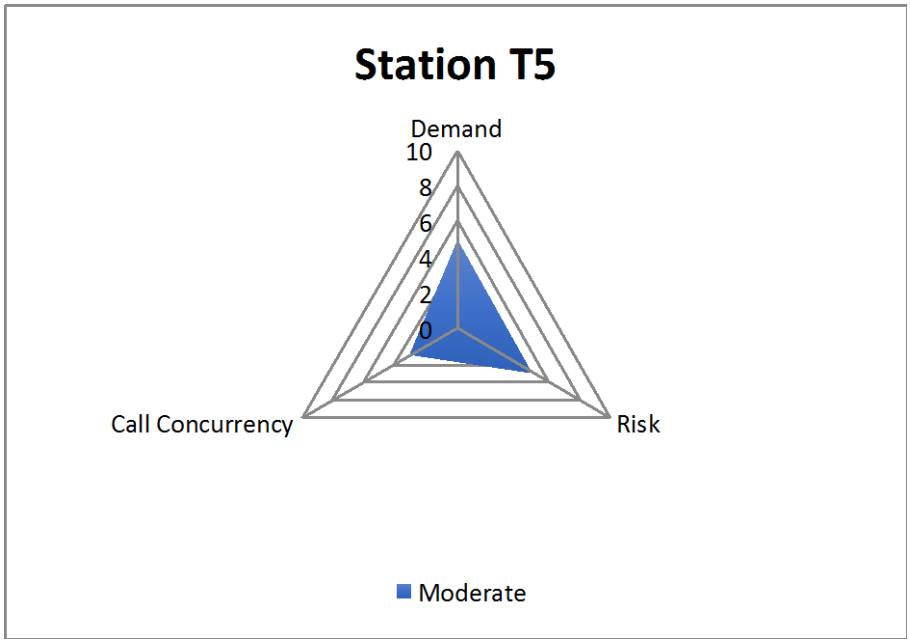


Figure 48: Station T5 Risk Profile



www.fitchassoc.com