May 2019

Final Executive Summary Report

Peoria Fire Department
Peoria, Illinois

Prepared by:

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CONSULTANT REPORT

PEORIA FIRE DEPARTMENT
Executive Summary Report

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FITCH
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INTRODUCTION

Fitch & Associates (*FITCH*) was engaged by the City of Peoria to evaluate the operational performance of the Peoria Fire Department (PFD) and the overall performance in emergency medical services by also assessing the performance of Advanced Medical Transport (AMT) as the EMS transport provider.

FITCH employs a two-pronged approach in undertaking this engagement. First is a quantitative perspective – derived largely from Computer Aided Dispatch (CAD) data to evaluate the current system performance based on historical demand. Employing this data, Geographic Information System (GIS) modeling was performed to validate and model response time and coverage performance within the department's service area. Finally, a separate assessment of risk, as embodied within an Insurance Services Office (ISO) batch report of independently evaluated properties within the City, were used to quantify potential risk, as contrasted with actual demand that was derived from CAD and fire incident level data. Second, from a qualitative perspective, FITCH spent significant time meeting with key stakeholders. These included members of the city council, city manager's office, fire department command staff, and representatives of the fire fighter bargaining unit. Several meetings also took place with a city-appointed stakeholder group during our first site visit.

During this initial assessment, *FITCH* provided an interim project briefing to City officials and the stakeholder group at the City's request during October 2018 - in large part because of budgetary issues that required discussion during the City's annual budget development process.

As will be noted later in this summary section, during its data analysis, *FITCH* identified opportunities in the dispatch process which will permit the City to be more efficient through a revised medical deployment plan which focuses on sending the right resources to the right call. Employing EMS stakeholders over a period of weeks, a revised Medical Deployment Plan was defined. However, in order to fully implement these changes, additional analaysis of the total workload within the 911 center must be completed to ensure the dispatch center is properly staffed and trained; and required changes to the City's computer-aided dispatch system are programmed to take advantage of the revisied deployment plan. The summary report and accompanying sections reflect the Phase 1 analysis and findings for all components described above. However once the dispatch issues were identified, the City requested FITCH also complete a Phase 2 engagement which will complete a full dispatch center analysis. This final component is underway - but not reported here.

This report contains a high-level summary of methodology, relevent findings, and recommendations from Phase 1. The second section contains an updated PowerPoint presentation derived from the one made to the City Council at their meeting of March 26, 2019. Sections three and four contain the detailed data analysis of historical performance and the GIS modeling employed to consider alternative deployment configurations. Finally, the fifth section provides details on the process and recommendations derived from the Medical Deployment Plan revisions.

METHODOLOGY

The Consultants were provided five years of data output for the City of Peoria Fire Department (PFD) and Advanced Medical Transport of Central Illinois (AMT). The data was provided by the City of Peoria's Emergency Communications Center (Peoria 911) and AMT's Computer Aided Dispatch (CAD) systems, spanning 2013 through 2017. The primary analyses of this report are based on the City's 12-month fiscal year, from January 1 through December 31, 2017 (CY2017). Baseline incident counts and workloads for all five years are presented in the last section of this report.

In this report we use three measures of operations—counts of incidents, counts of vehicle responses, and time-on-task for these vehicle responses.

- An "incident" is a record in the CAD that was created as a result of an in-coming request for service. One, or more, vehicles in the Peoria fleet may be tasked with providing the required service.
- The assignment of these vehicles is a "response".
- The interval of time that these vehicles require to execute the task is "time-on-task".

Incidents were categorized as EMS, Fire, Rescue, or non-Fire, non-Medical. The term "cancellation" may refer to either an incident or a vehicle response. An incident was considered cancelled when the CAD showed the existence of an incident record and no vehicles arrived OnScene. A vehicle response was considered cancelled when a vehicle received an assignment and did not arrive OnScene.

COMMUNITY RESPONSE HISTORY

Figure 1 below indicates the incident categories for the Peoria Fire Department and includes AMT's responses to emergency medical incidents. The figure represents the 12-month reporting period from January 1, 2017 through December 31, 2017, hereinafter referred to as CY2017. As expected, EMS incidents represented the largest portion of all incident types. Based on the consultant's experience with similar systems, cancelled incidents appear under-represented.

Figure 1: Percentage of Total Incidents Dispatched by Incident Category

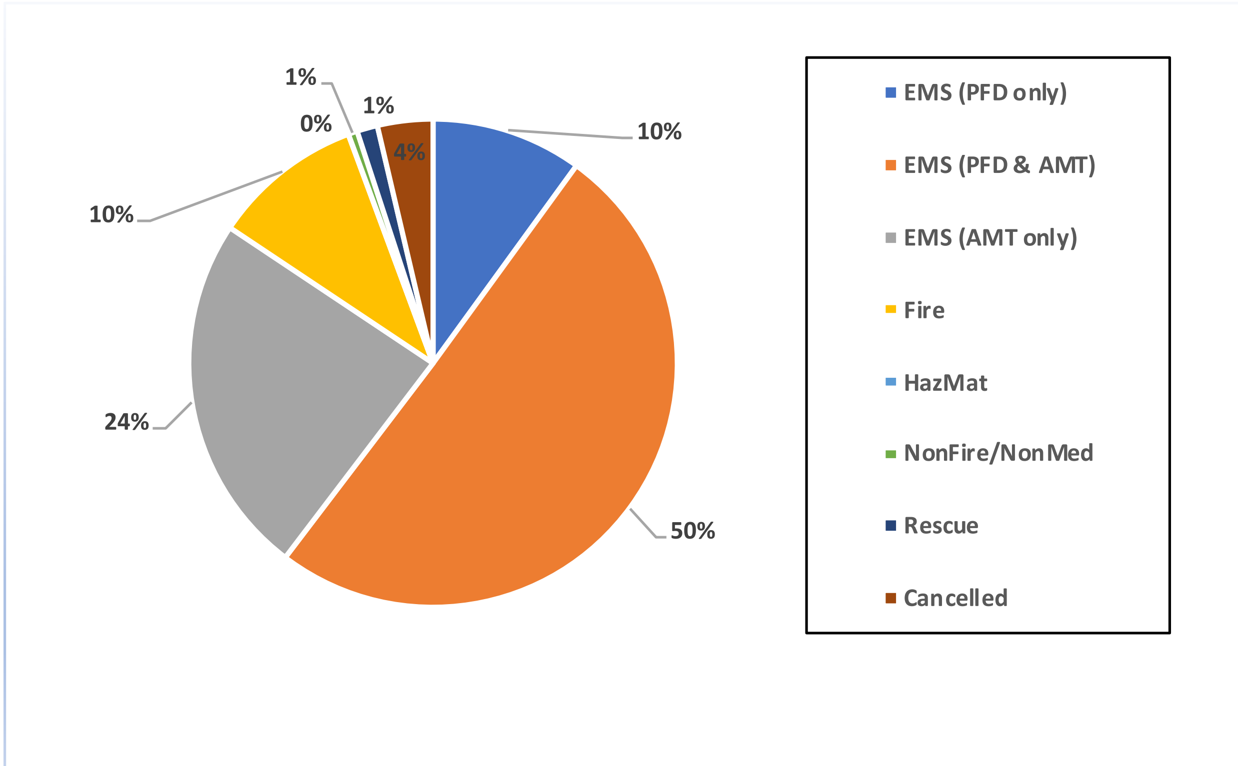


Figure 2 provides counts of incidents in the categories of EMS, Fire, Rescue, non-Fire/non-Medical, and HazMat. Incidents that had vehicles assigned but no vehicles arrived OnScene are included in these totals. The descriptors assigned by the Peoria Fire Department to these incidents were used as much as possible. However, PFD is not rigorously consistent in the use of these descriptors. Some, mostly minor, inconsistencies in incident counts do appear.

Figure 2: Number of Incidents Dispatched by Category

Incident Category	Number of Incidents	Average Incidents per Day	Incident Percentage
Falls	2,742	7.5	10.1
Breathing Problem	2,556	7.0	9.4
Sick Person (Specific Diagnosis)	1,876	5.1	6.9
Traffic/Transportation Incidents	1,508	4.1	5.6
Chest Pain/Chest Discomfort	1,142	3.1	4.2
Unconscious/Fainting (Near)	1,105	3.0	4.1
Convulsions/Seizures	983	2.7	3.6
Unknown Problem (Person Down)	952	2.6	3.5
Overdose/Poisoning	580	1.6	2.1
Stroke (CVA)/Transient Ischemic Attack (TIA)	416	1.1	1.5
Hemorrhage/Lacerations	364	1.0	1.3
Traumatic Injuries (Specific)	343	0.9	1.3
Assault/Sexual Assault/Stun Gun	327	0.9	1.2
Diabetic Problem	323	0.9	1.2
Pregnancy/Childbirth/Miscarriage	261	0.7	1.0
Abdominal Pain/Problems	248	0.7	0.9
Heart Problem/AICD	167	0.5	0.6
Stab / Gunshot/Penetrating Trauma	151	0.4	0.6
Psychiatric/Abnormal Behavior/Suicide Attempt	143	0.4	0.5
Allergies/Envenomations (stings, Bites)	79	0.2	0.3
Choking	76	0.2	0.3
Headache	63	0.2	0.2
Cardiac or Respiratory Arrest/Death	56	0.2	0.2
Back Pain (Non-Traumatic) or Non-Recent Trauma	47	0.1	0.2
Eye Problem/Injuries	21	0.1	0.1
Animal Bites/Attacks	15	0.0	0.1
Carbon monoxide/Inhalation Hazmat/CBRN	12	0.0	0.0
Burns/Explosion	7	0.0	0.0
Heat/Cold Exposure	7	0.0	0.0
Drowning/Near Drowning/Diving/SCUBA Accident	5	0.0	0.0
Electrocution/Lightning	3	0.0	0.0
AMT Priority 1	2,989	8.2	11.0
AMT Priority 2	4,053	11.1	14.9
EMS Total	**23,620**	**64.7**	**87.1**
Reported Structure Fire	1,473	4.0	5.4
One Engine Response	828	2.3	3.1
Fire Alarm	242	0.7	0.9
Brush or Rubbish Fire	135	0.4	0.5
Vehicle Fire	94	0.3	0.3
Smoke Alarm	84	0.2	0.3
One Truck Company Response	60	0.2	0.2
Fire Total	**2,916**	**8.0**	**10.8**
Waterflow Alarm	145	0.4	0.5
Carbon Monoxide Alarm Code 2	140	0.4	0.5
Building Rescue	35	0.1	0.1
Elevator Rescue No Injury	23	0.1	0.1
Gas Leak Inside	27	0.1	0.1

Incident Category	Number of Incidents	Average Incidents per Day	Incident Percentage
River Rescue	9	0.0	0.0
Bridge Jumper	3	0.0	0.0
Building Collapse	2	0.0	0.0
Rescue Total	**384**	**1.1**	**1.4**
Non-Fire/Non-Medical	**198**	**0.5**	**0.7**
HazMat	**4**	**0.0**	**0.0**
Total Incidents (with PFD Codes)	**27,122**	**74.3**	**100.0**

The number of individual vehicle responses is provided in the Figure 3. A more comprehensive picture of the resources required to meet the requests for service is given by the annual Time-on-Task.

Figure 3: Number of Incidents, Number of Responses, and Total Time-on-Task by Category

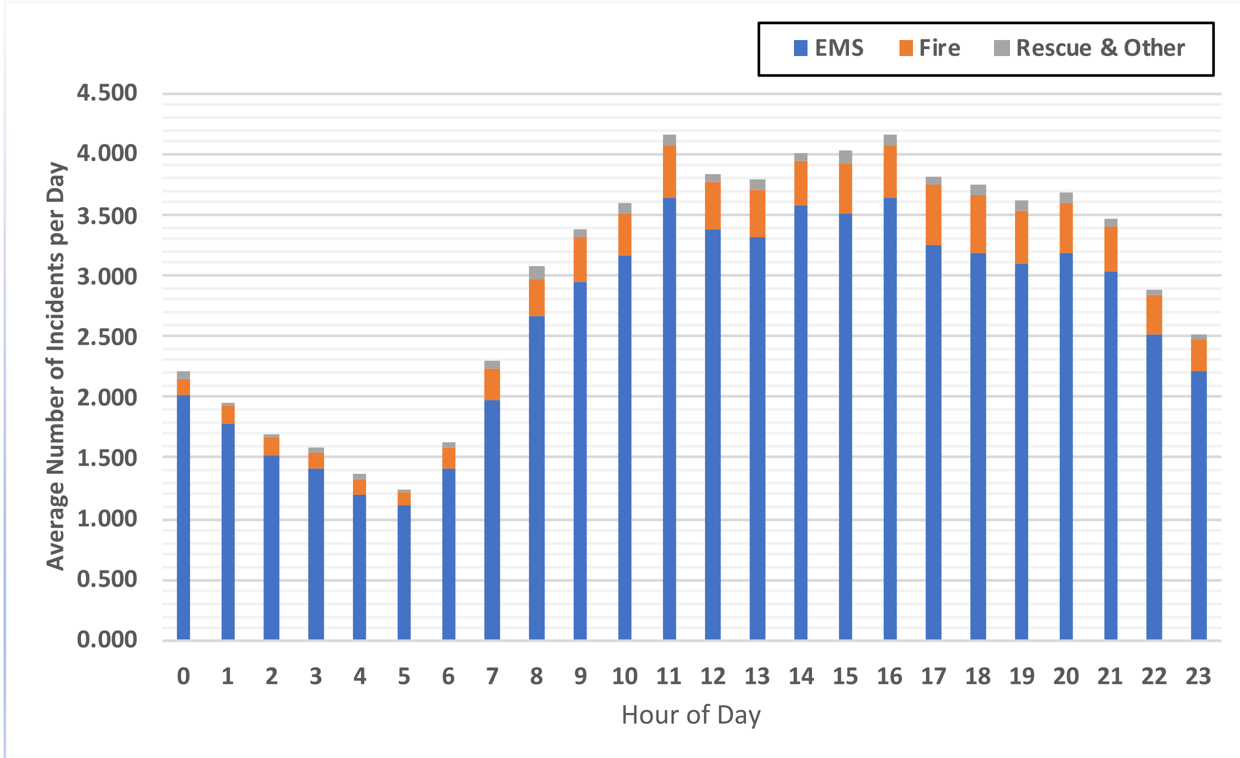
Category	Number of Incidents	Vehicles Arrived OnScene	Time-on-Task (hrs) / Year	Average Time-on-Task (min) / Vehicle	Percentage Annual Time on Task PFD & AMT	Percentage Annual Time on Task PFD
EMS	22,978		17,835.5			
EMS AMT vehicles		20,479	12,887.3	37.76	62.30	
EMS PFD vehicles		16,956	4,948.2	17.51	23.92	63.44
Fire	2,721	6,118	2,521.0	24.72	12.19	32.32
Rescue	371	779	265.3	20.43	1.28	3.40
Non-Fire/Non-Med	164	199	56.0	16.88	0.27	0.72
Hazmat	3	8	9.0	67.50	0.04	0.12

The higher Time-on-Task for AMT vehicles on EMS incidents is a consequence of the transports conducted by AMT. The functions of transporting the patient to the hospital and conducting drop off of the patient consumes time that is not required of PFD vehicles on EMS incidents.

The average number of incidents by hour of day are presented in the Figure 4 that follows.

The hourly incident count tapers off after midnight and reaches a minimum at 0500 hours. The hourly incident count builds up through the morning and reaches a broad, but irregular, plateau from 1000 hours through 2100 hours.

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



Stations that house multiple response units will typically respond to more incidents and accrue more annual Time-on-Task than do stations that house only one unit. The data for each PFD response unit is provided in the Figure 5 below, organized by station. The Unit Hour Utilization, UHU, is the ratio of the unit's annual Time-on-Task divided by 8,760 hours, the number of hours in one year.

Annual Time-on-Task at the unit level is relevant to measure the utilizations of physical apparatus, and helps inform apparatus procurement or maintenance decisions.

Figure 5: Overall Workload by Unit

Sta.	Unit	Unit Type	Annual Responses	Annual Time on Task	Time on Task / Response	Unit Hour Utilization
1	E1	ENGINE	2,289	506:21:46	00:13:16	0.058
	T1	TRUCK	1,033	264:49:33	00:15:23	0.030
	R1	RESCUE	3,144	719:16:53	00:13:44	0.082
	B1	BATT	1,162	293:16:11	00:15:09	0.033
	MR1	MARINE	19	13:14:26	00:41:49	0.002
	HM1	HAZMAT	5	03:40:03	00:44:01	0.000
	Station 1 Total		**7,652**	**1800:38:52**	**00:14:07**	
3	E3	ENGINE	2,544	594:29:51	00:14:01	0.068
	T3	TRUCK	1,154	237:21:24	00:12:20	0.027
	Station 3 Total		**3,698**	**831:51:15**	**00:13:30**	
4	E4	ENGINE	2,843	682:00:04	00:14:24	0.078
	T4	TRUCK	836	226:21:54	00:16:15	0.026
	Station 4 Total		**3,679**	**908:21:58**	**00:14:49**	
8	E2	ENGINE	2,032	510:55:40	00:15:05	0.058
	Station 8 Total		**2,032**	**510:55:40**	**00:15:05**	
10	E10	ENGINE	2,376	584:38:15	00:14:46	0.067
	Station 10 Total		**2,376**	**584:38:15**	**00:14:46**	
11	R2	RESCUE	2,151	504:38:52	00:14:04	0.058
	Station 11 Total		**2,151**	**504:38:52**	**00:14:04**	
12	E12	ENGINE	1,166	360:16:46	00:18:32	0.041
	Station 12 Total		**1,166**	**360:16:46**	**00:18:32**	
13	E13	ENGINE	2,880	756:16:01	00:15:45	0.086
	Station 13 Total		**2,880**	**756:16:01**	**00:15:45**	
15	E15	ENGINE	869	253:34:19	0:17:30	0.029
	Station 15 Total		**869**	**253:34:19**	**00:17:30**	
16	E16	ENGINE	2,211	548:04:50	00:14:52	0.063
	T14	TRUCK	1,205	292:06:30	00:14:32	0.033
	Station 16 Total		**3,416**	**840:11:20**	**00:14:45**	
19	E19	ENGINE	1,386	384:11:55	00:16:38	0.044
	Station 19 Total		**1,386**	**384:11:55**	**00:16:38**	
20	E20	ENGINE	820	236:48:46	00:17:20	0.027
	Station 20 Total		**820**	**236:48:46**	**00:17:20**	
	Totals		**32,125**	**7972:23:59**	**00:14:53**	

The last analysis of this section is in the Figure 6. Data is specifically for vehicles first arrived OnScene for the various incident categories. Four time intervals are included that describe the conduct of the incident. Response time is calculated as the interval from when an incident was received until a unit first arrived OnScene.

For a single unit and a single incident, response time is equal to the sum of dispatch, turnout, and travel intervals. Rigorous additivity does not hold when dealing with average values for these intervals because the list of instances that went into calculating each average value are not all exactly the same. These differences show up in the sample counts.

Figure 6: Average Dispatch, Turnout, Travel, and Response Intervals in Minutes:Seconds of First Arriving Units by Incident Category

Incident	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
Category	Sample	Average	Sample	Average	Sample	Average	Sample	Average
EMS	11,646	01:46	11,877	01:24	11,794	02:31	12,185	05:58
Fire	2,446	01:38	2,539	01:26	2,501	02:54	2,602	06:17
Rescue	330	01:44	347	01:24	347	02:48	350	06:13
nFnM	136	01:15	82	01:16	81	02:59	146	03:39
HazMat	1	03:52	1	04:33	1	05:54	1	14:19
All	14,559	01:45	14,846	01:24	14,724	02:35	15,284	06:00

Figure 7 presents durations for Dispatch, Turnout, Travel, and Response intervals, but at the 90th percentile. This metric is another way to characterize the distribution of response intervals that are encountered even under normal operations. For example, if a response interval is reported as 06:00 at the 90th percentile, first responders will arrive OnScene in 6 minutes, zero seconds or less, nine incidents out of ten.

Figure 7: 90th Percentile Dispatch, Turnout, Travel, and Response Intervals of First Arriving Units by Incident Category

Incident Category	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]
EMS	11,646	03:01	11,877	02:05	11,794	04:22	12,185	08:43
Fire	2,446	02:57	2,539	02:08	2,501	05:06	2,602	09:46
Rescue	330	03:05	347	02:05	347	04:44	350	08:54
Other	136	02:47	82	01:56	81	05:00	146	08:33
HazMat	1		1		1		1	
All	14,559	03:02	14,846	02:06	14,724	04:32	15,284	08:53

Data indicate that both the average and 90th percentile travel times and total response times for fire incidents were slightly longer than for EMS incidents. As expected, significant variability is introduced in responses for hazmat and rescue Incidents due to their small sample sizes.

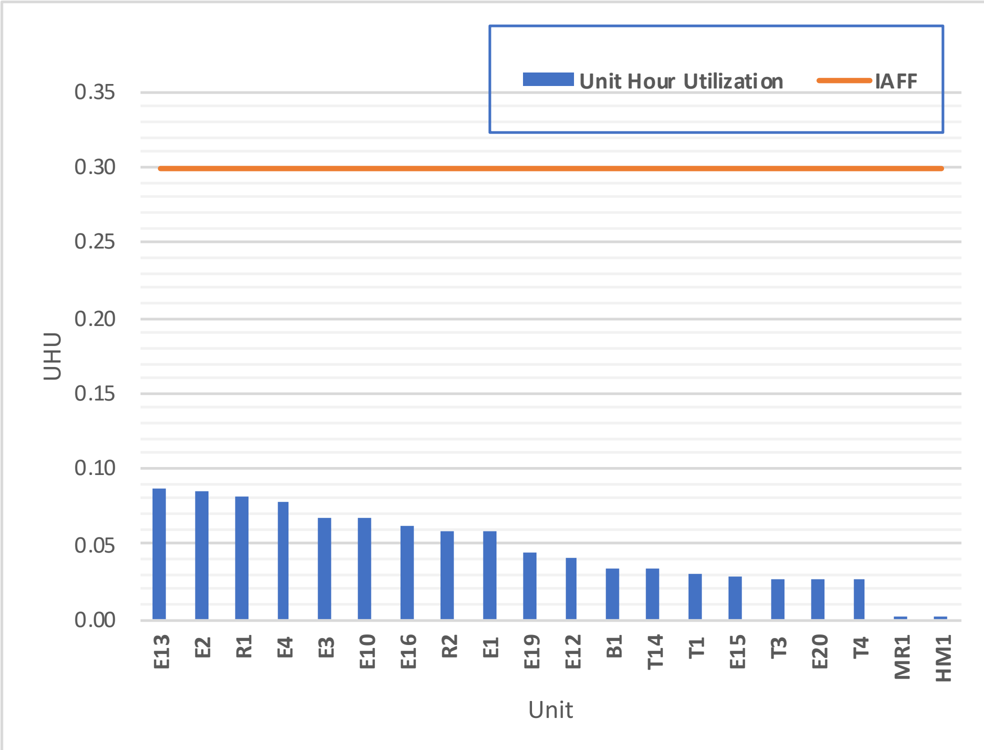
Workload – Unit Hour Utilization

In order to evaluate a system's ability to deliver quality emergency services, it is necessary to consider the impact that workload has on personnel, particularly personnel on 24-hour shifts. An evaluation of workload begins with a unit's annual Time-on-Task, that is, the sum of hours logged into the CAD between the unit's assigned and cleared timestamps. Evaluation then proceeds to Unit Hour Utilization, UHU, which is the metric most commonly used to quantify crew workloads. The UHU is the ratio of a unit's annual Time-on-Task divided by 8,760 hours per year.

Historically, the International Association of Fire Fighters (IAFF) has recommended that 24-hour units utilize 0.30, or 30% workload as an upper threshold.[1] In other words, this recommendation would have personnel spend no more than eight hours per day directly working 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 eight hours, of their workday responding to incidents. 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.[2] 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.[3] Figure 8 is a graphic representation of the PFD units and the respective unit hour utilization for CY2017.

[1] International Association of Firefighters. (1995). Emergency *Medical Services: A Guidebook for Fire-Based Systems.* Washington, DC: Author. (p. 11)
[2] Illinois Fire Chiefs Association. (2012). An *Assessment of Deployment and Station Location: Rolling Meadows Fire Department.* Rolling Meadows, Illinois: Author. (pp. 54-55)
[3] Castle Rock Fire and Rescue Department. (2011). Community *Risk Analysis and Standards of Cover.* Castle Rock, Colorado: Author. (p. 58)

Figure 8: Unit Hour Utilization by Unit



All PFD units had a UHU of less than 0.10. None of the PFD units approach the IAFF's recommended maximum unit hour utilizations of 0.30.

DESCRIPTION OF FIRST ARRIVING UNIT PERFORMANCE

Analyses of the response characteristics of the first arriving units were conducted. This analysis focused on lights and sirens responses. Figure 9 indicates PFD performance at both the average and 90th percentile for dispatch, turnout, travel, and total response intervals.

Figure 9: Incident Response Intervals for Vehicles First Arrived OnScene

Measure	Average [mm:ss]	90th Percentile [mm:ss]
Dispatch Interval	01:45	03:02
Turnout Interval	01:24	02:06
Travel Interval	02:35	04:32
Response Interval	06:00	08:53

System Performance by Available Vehicles

During normal operations, varying numbers of the department's units are committed to responses, Vehicles Already OnTask. During normal operations incoming requests for service continue to arrive.

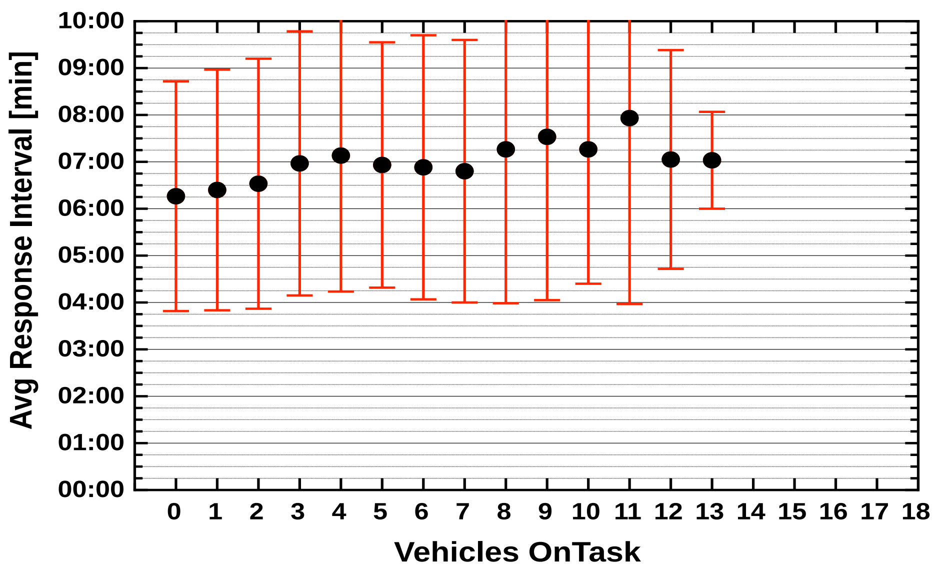
The analyses of this section examine how the number of vehicles already OnTask affects the performance of the system in servicing these next incoming requests. The appropriate metric for measuring the performance of the system is the total response interval experienced by these next incoming requests, that is the time interval from ring-in until arrived OnScene. Such an analysis is presented in the Figure 10 below for the Peoria system for CY2017. The data included incoming requests for service in all incident categories.

Figure 10: Average Response Intervals for Incoming Incidents by Vehicles Already OnTask

Number of Vehicles Already on Task	Incoming Incidents	Average Response Interval (Min:Sec)	Average Response Interval (Seconds)	Response Time Standard Deviation (Min:Sec)	Response Time Standard Deviation (Seconds)
0	8,272	06:16	376	02:27	147
1	6,241	06:24	384	02:34	154
2	3,310	06:32	392	02:40	160
3	1,760	06:58	418	02:49	169
4	1,182	07:08	428	02:54	174
5	897	06:56	416	02:37	157
6	616	06:53	413	02:49	169
7	378	06:48	408	02:48	168
8	202	07:16	436	03:17	197
9	113	07:32	452	03:29	209
10	62	07:16	436	02:52	172
11	20	07:56	476	03:58	238
12	16	07:03	423	02:20	140
13	4	07:02	422	01:02	62
14	-	00:00	0	00:00	0
15	-	00:00	0	00:00	0
16	-	00:00	0	00:00	0
17	-	00:00	0	00:00	0

As can be seen in the Figure 11 below, the distribution of average response intervals experienced by the "next incoming requests" show little systematic dependence on the number of vehicles already OnTask. The whiskers above and below the dots present the standard deviation around the average response interval.

Figure 11: Average Response Intervals for Incoming Incidents by Vehicles Already OnTask



GIS MODELING

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.

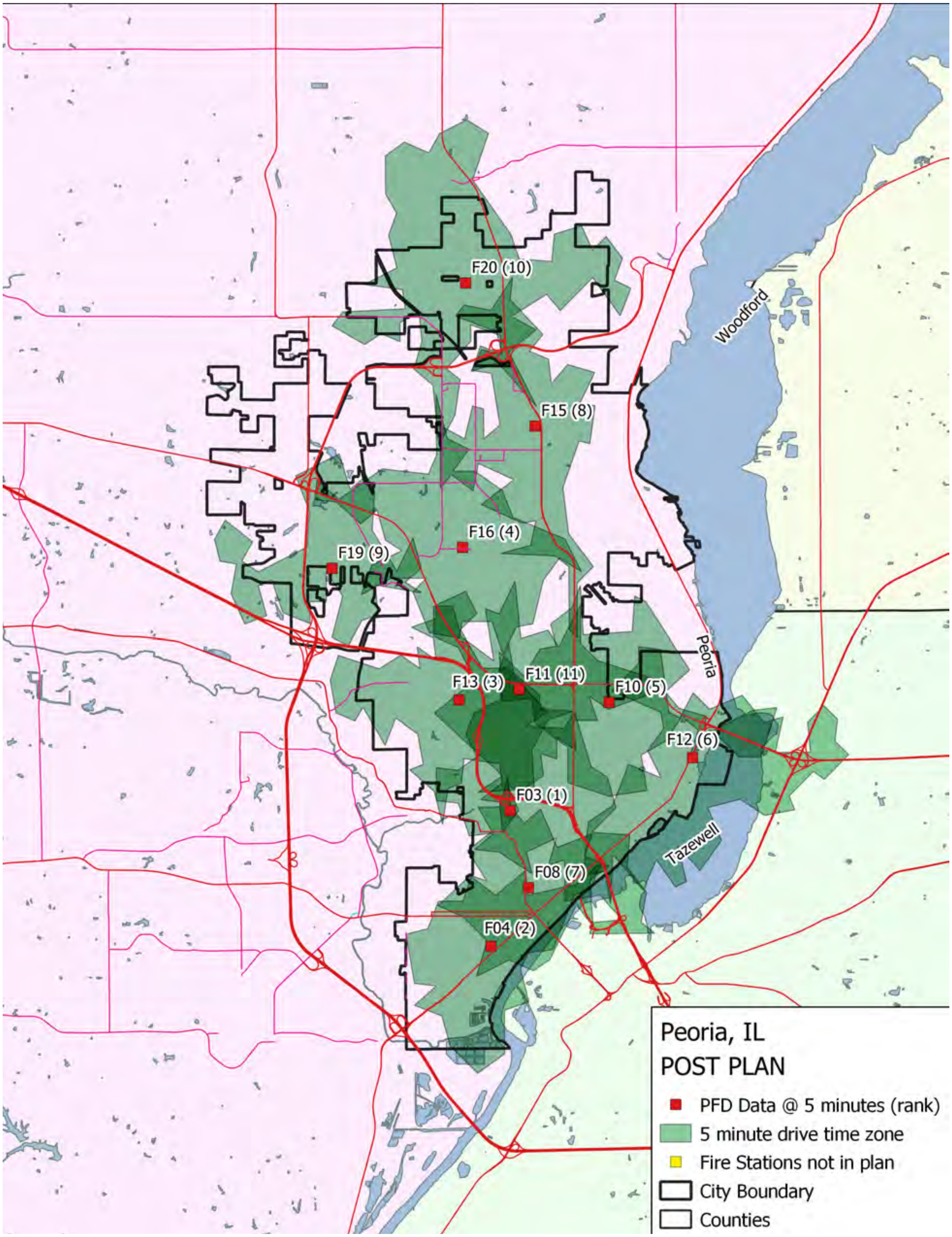
Validation of Planning Analysis

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 minute and 32 second overall department performance and a 5 minute and 6 second fire travel time capability from the existing fire stations at the 90th percentile. Utilizing average road speeds, the planning assessments estimated greater than 87% of the incidents could be responded to within 5-minutes travel time from eleven of the existing fire stations. Station 1 did not capture any additional calls in the analysis and therefore is not reflected below. Comparing the historical performance to the GIS planning analysis does suggest the agency is responding to incidents on the road network quicker than average road speeds suggesting the percentage of calls captured are slightly higher than indicated below. 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.

Figure 12: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	5,322	5,322	28.62%
2	S4	2,607	7,929	42.65%
3	S13	2,064	9,993	53.75%
4	S16	1,737	11,730	63.09%
5	S10	1,552	13,282	71.44%
6	S12	829	14,111	75.89%
7	S8	730	14,841	79.82%
8	S15	643	15,484	83.28%
9	S19	348	15,832	85.15%
10	S20	276	16,108	86.63%
11	S11	91	16,199	87.12%

Figure 13: Current Fire Station Bleed Maps for 5-Minute Travel Time



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 minutes and 32 seconds overall and 5 minutes and 6 seconds for fire related responses. The following analyses are utilized to compare and contrast the various potential distribution models.

Current Stations Configurations-Minute Travel Time

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 Peoria Fire Department (PFD) 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.

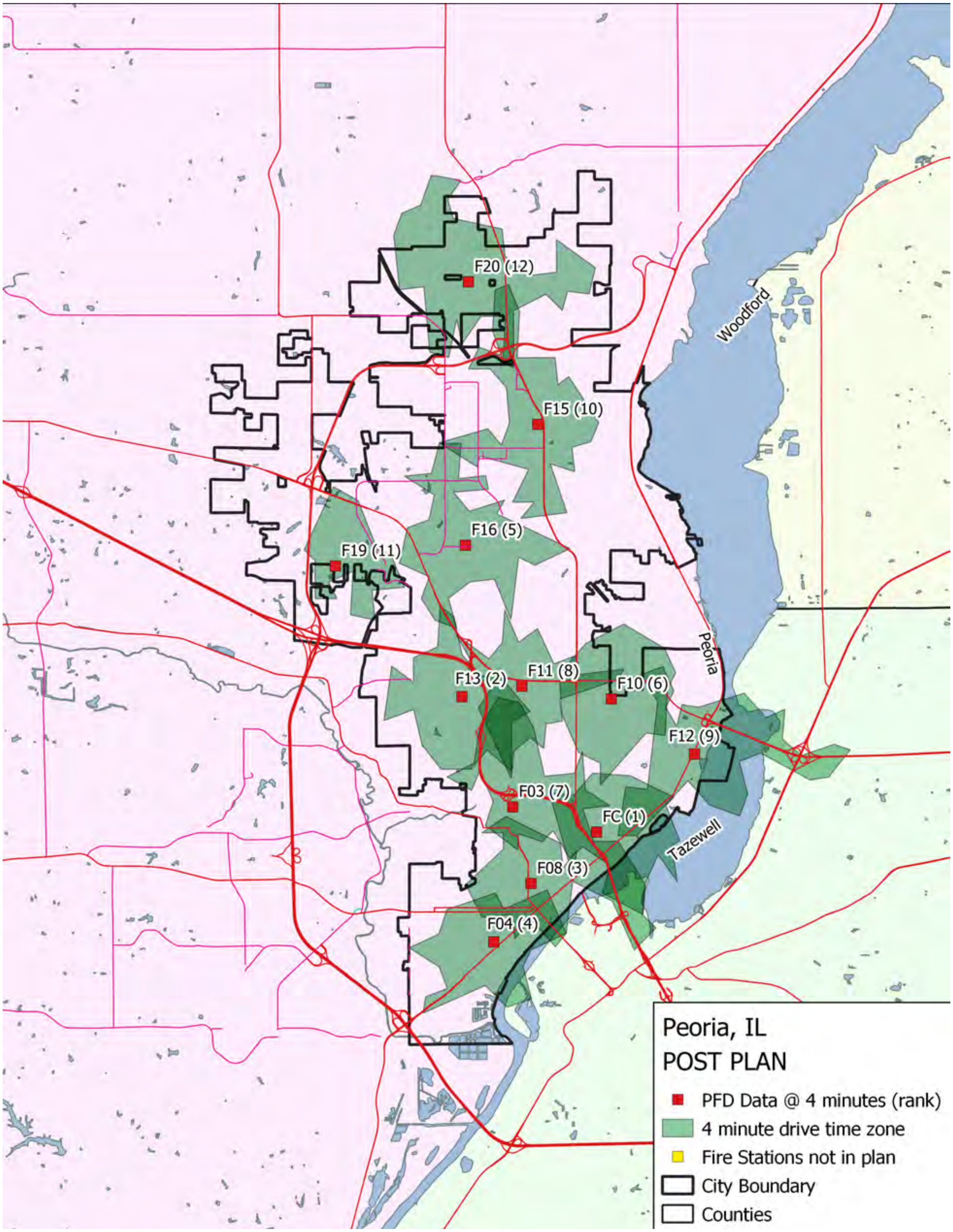
Therefore, the station that contributed the most to the overall system's performance was Station 1 in the first row and would capture 16.70% of the risks within 4 minutes. Station 13 would cover an additional 10.98% of the risk bringing the cumulative total to 27.68% between Stations 1 and 13. In total, with all 12 fixed fire stations, 73.48% of the incidents could be responded to within 4 minutes travel time.

In other words, within the current configuration of stations, the department could not achieve a 4-minute travel time, as recommended by NFPA 1710 without additional stations and resources. Results are provided in tabular and in drive time mapping format below.

Figure 14: Marginal Fire Station Contribution for 4-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	FC1	3,105	3,105	16.70%
2	S13	2,042	5,147	27.68%
3	S8	1,946	7,093	38.15%
4	S4	1,539	8,632	46.43%
5	S16	1,111	9,743	52.40%
6	S10	1,041	10,784	58.00%
7	S3	923	11,707	62.96%
8	S11	634	12,341	66.37%
9	S12	430	12,771	68.69%
10	S15	411	13,182	70.90%
11	S19	274	13,456	72.37%
12	S20	206	13,662	73.48%

Figure 15: Current Fire Station Bleed Maps for 4-Minute Travel Time



5-Minute Travel Time

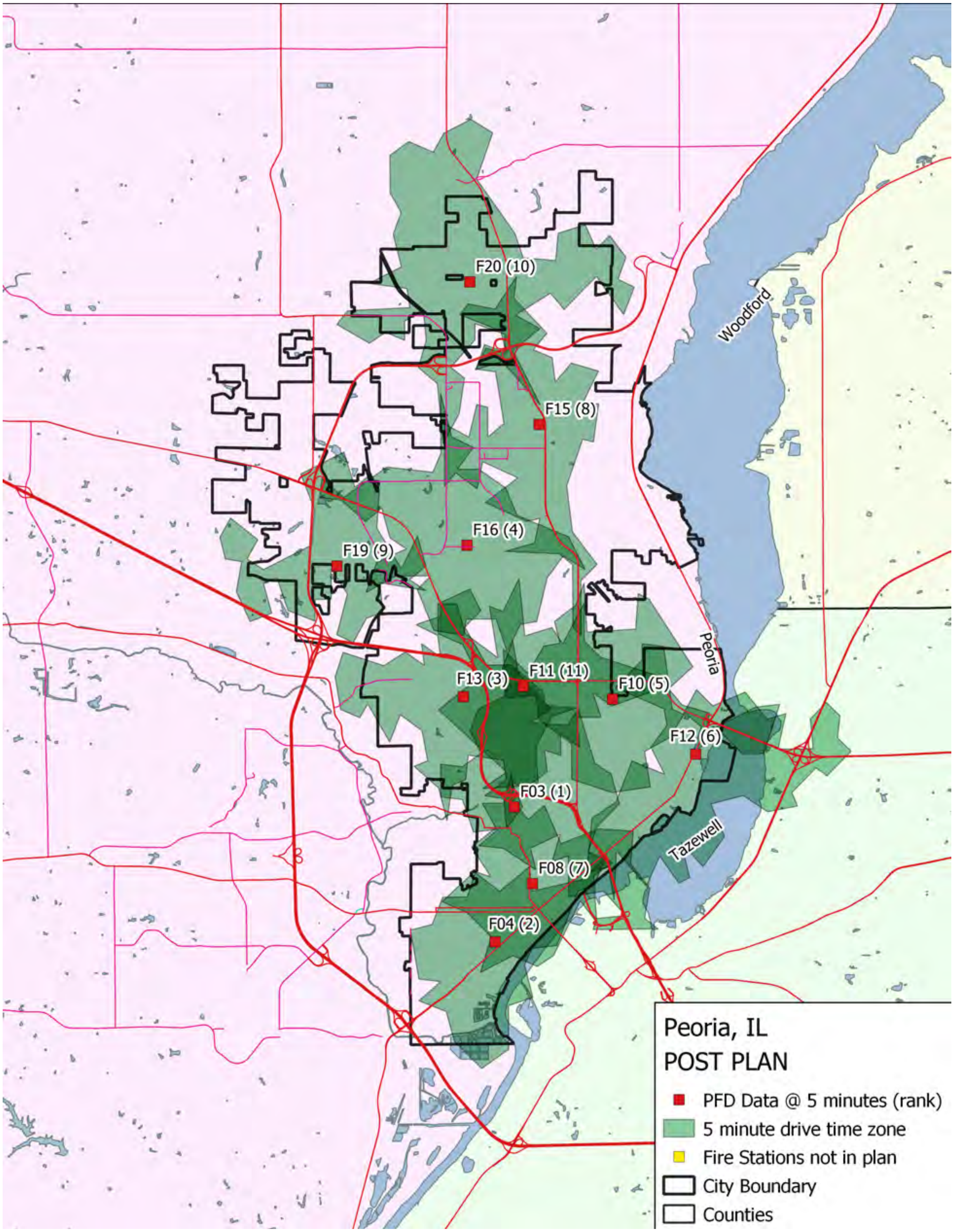
The analysis demonstrates that the current station configuration could capture greater than 87% of the incidents within 5 minutes utilizing the department's current station configuration. As indicated in above, the same performance could be achieved strictly from a geographic perspective with eleven stations without consideration for occupancy risk or call concurrency.

Figure 16: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	5,322	5,322	28.62%
2	S4	2,607	7,929	42.65%
3	S13	2,064	9,993	53.75%
4	S16	1,737	11,730	63.09%
5	S10	1,552	13,282	71.44%
6	S12	829	14,111	75.89%
7	S8	730	14,841	79.82%
8	S15	643	15,484	83.28%
9	S19	348	15,832	85.15%
10	S20	276	16,108	86.63%
11	S11	91	16,199	87.12%

When referring to the mapping output in the figure below, the areas of the city that are not shaded with green, represent a maximum of 13% 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 area 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 17: Current Fire Station Bleed Maps with a 5-Minute Travel Time



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. 8, 10, 12, and 14-minute travel times were created to demonstrate the relative ERF coverage throughout the jurisdiction.

In addition, 2 alternatives were evaluated as reflected below. The options were based on conversation with the Fire Department's administration and reflected the following changes from the current deployment described elsewhere:

Option 1:
Station 8 would be closed and E-2 shuttered
Station 4 rebuilt in new location and house E-4 & T-4
Station 3 would house E-3 and R-1
Station 11 would shutter R-2 and house T-3 and B-3

Option 2:
Shutter R-1 currently stationed at central house
Shutter R-2 currently stationed at St 11
Move T-4 to Station 8 to be with E-2
Move T-3 to Station 11 to replace R-2

For these purposes ERF was defined as the arrival of 5 apparatus with three-person staffing and is restricted to the city jurisdiction.

Figure 18: Comparisons of Effective Response Force Configurations

Travel Time Objective	Current ERF	Option 1 ERF	Option 2 ERF
8-Minute	31.95%	30.76%	28.62%
10-Minute	58.91%	57.99%	58.15%
12-Minute	79.99%	79.88%	79.55%
14-Minute	96.21%	96.21%	96.21%

Overall, the ERF has more robust coverage in the core of the City where the greatest historical demand exists.

AMT OPERATIONS

Advanced Medial Transport (AMT) is a private ambulance operator that works with the Peoria Fire Department (PFD) and provides transportation for those patients requiring hospital services. An emergency medical incident will have one of three configurations of units assigned to it: a response by PFD units only; a response by AMT units only; or a response that includes PFD and AMT units. The average performance intervals for these configurations are presented in the figure below.

Figure 19 Average Performance Intervals for AMT & PFD on EMS Incidents

EMS Ops by Agency	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	average	Sample	average	Sample	average	Sample	average
AMT [only responder]	6,206	01:19	5,790	00:15	6,579	04:40	6,177	06:58
PFD [only responder]	2,945	01:45	2,748	01:24	2,515	02:59	2,655	06:31
AMT [responded w PFD]	13,752	01:32	11,877	00:18	13,760	05:01	13,524	07:29
PFD [responded w AMT]	14,079	01:52	13,914	01:24	13,261	02:38	13,641	06:17
AMT [1st Arrvd w PFD]	3,637	01:28	3,087	00:16	3,750	03:29	3,703	05:33
PFD [1st Arrvd w AMT]	9,237	01:48	9,422	01:23	9,391	02:25	9,636	05:50

The 90th percentile performance intervals for the three emergency medical response configuration are presented in the figure below.

Figure 20 90th Percentile Performance Intervals for AMT & PFD on EMS Incidents

EMS Ops by Agency	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile
AMT [only responder]	6,206	01:35	5,790	00:29	6,579	08:26	6,177	12:17
PFD [only responder]	2,945	03:08	2,748	02:12	2,515	05:19	2,655	09:55
AMT [responded w PFD]	13,752	01:52	11,877	00:38	13,760	08:03	13,524	11:06
PFD [responded w AMT]	14,079	03:15	13,914	02:07	13,261	04:33	13,641	09:14
AMT [1st Arrvd w PFD]	3,637	01:41	3,087	00:33	3,750	05:40	3,703	07:50
PFD [1st Arrvd w AMT]	9,237	03:02	9,422	02:03	9,391	04:07	9,636	08:24

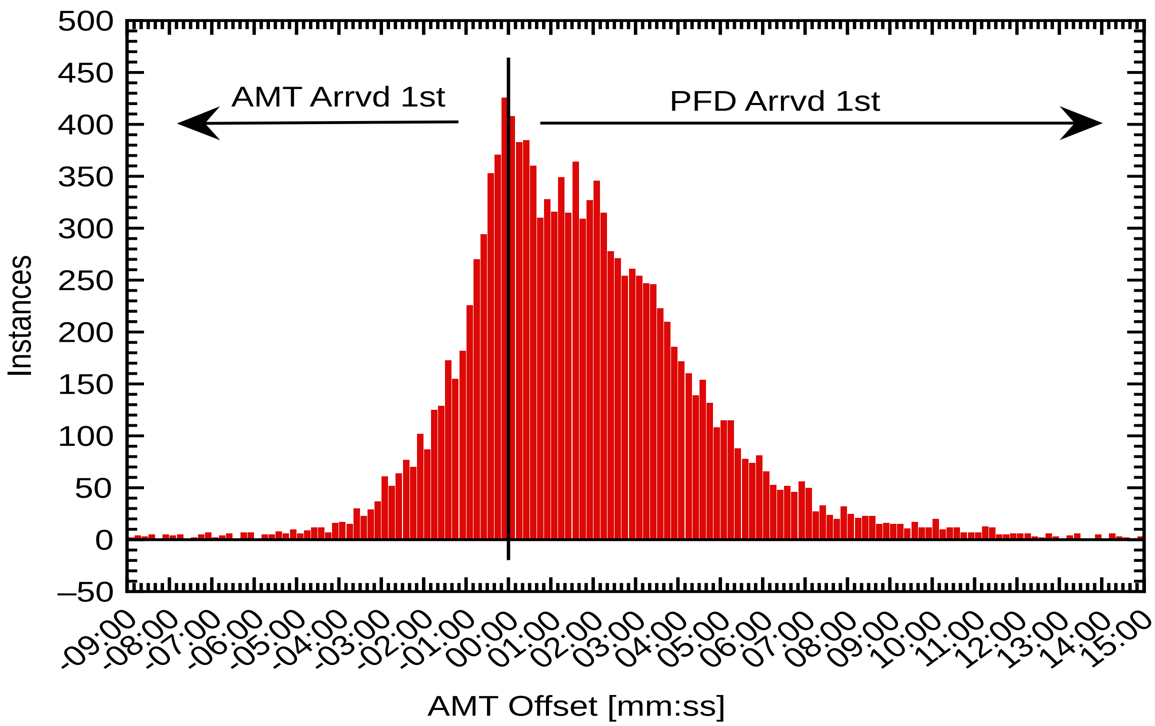
The figure below presents the average arrival offsets experienced in the system when both AMT and PFD vehicles were assigned to an incident. In this presentation, positive values for the offset means that the PFD vehicle was first arrived OnScene. In all years, PFD has arrived, on average, first at scene.

Figure 21 Average AMT / PFD Arrival Offsets on EMS Incidents

Year	Average AMT / PFD Arrival Offset [mm:ss]
CY2013	02:11
CY2014	02:25
CY2015	02:05
CY2016	01:46
CY2017	01:46
2018 (Jan thru Jun)	01:55

A complete frequency distribution histogram of AMT/PFD arrival offsets for CY2017 is presented in the figure below. Again, positive values for the offset means that the PFD vehicle was first arrived OnScene. Approximately 13,000 data pairs are represented in this histogram.

Figure 22 Frequency Distribution of AMT/PFD Arrival Offset for CY2017



The data in the figure below show counts and percentages for AMT 1st Arrived versus PFD 1st Arrived. These numbers are the areas under the distribution histogram to the left and right of the line at 00:00 [mm:ss] offset.

Figure 23 Percentage of AMT/PFD First Arrived

Arrival Order	Count	Percentage
AMT 1st Arrvd	3,598	26.96%
PFD 1st Arrvd	9,750	73.04%
Total Incidents	13,348	100.00%

The data in the figure below show how many instances are captured within windows of varying width, centered at 00:00 [mm:ss] offset. The ± 2 minute window of offsets captures 52.72% of the incidents.

Figure 24 Range of Offsets for AMT/PFD First Arrived

Range of AMT Offsets [mm:ss]	Instances	Cumulative Percent Capture	Increment Percent Capture
-00:30 to +00:30	2,356	17.78%	0.00%
-01:00 to +01:00	4,145	31.29%	13.50%
-02:00 to +02:00	6,984	52.72%	21.43%
-03:00 to +03:00	9,132	68.93%	16.21%
-04:00 to +04:00	10,638	80.30%	11.37%
-05:00 to +05:00	11,556	87.23%	6.93%
-09:00 to +15:00	13,348	100.00%	12.77%

MEDICAL RESPONSE DEPLOYMENT PLAN REVISIONS

The Peoria Fire Department, Advance Medical Transport (AMT), 911 Director, Medical Director, and facilitated by Fitch, developed a white paper to update the medical response system in the community. Specific members of the committee included:

- Dr. Mathew Jackson - System Medical Director
- Greg Chance - AMT Vice-President of Development
- Tom Geraci - AMT Vice-President of Operations
- Assistant Chief Anthony Ardis – Peoria Fire Department
- Battalion Chief Roland Tenley – Peoria Fire Department
- David Tuttle – 911 Director

The committee reviewed literature that outlined several key developments in emergency services system design. The key findings are outlined below:

1) Peoria dispatch center uses a call prioritization process known as Medical Priority Dispatch System (MPDS), initially developed back in 1976 by Dr. Jeff Clawson.
2) Advanced Care versus Basic Care has greater value in diagnostic knowledge than in patient outcome for the most acute patients, particularly in cases where transport times to definitive care (hospital) is short. Peoria is quite unusual in that the community has high levels of Primary Care hospitals with a very short transport time from most areas.
3) Response times do not correlate with patient outcomes in most instances; therefore, system response times must be tempered to reflect community expectations and medical best practice. EMS systems are based on clinical outcomes, operational needs, and fiscal sustainability.
4) First responders must be able to utilize their skills set, or their competency begins to erode. System design must create the opportunity for this to happen – therefore, first response and transport components must have enough separation for each party to practice their skills while at the same time, when required, have a synergistic existence.

Medical Priority Dispatch System (MPDS)

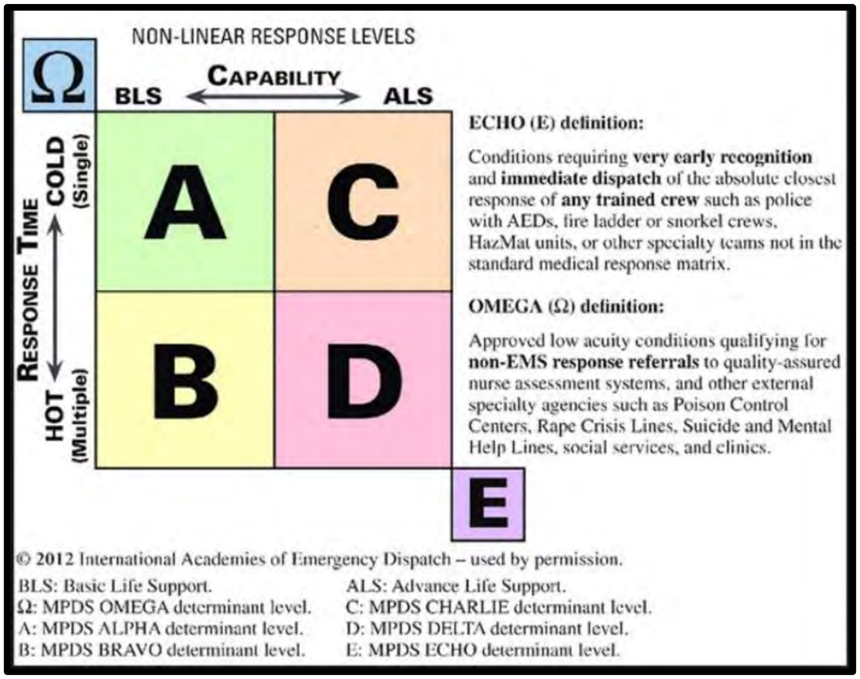
Medical Priority Dispatch System (MPDS) is a best practice protocol that is intended to get the right resources to the right calls. Historically, Peoria has not maximized the use of this process due to a multitude of constraints. The International Academy of Emergency Dispatch makes specific recommendations for the level of care that should respond to incidents, and if those responses should occur with lights and sirens or not.

The Academy purposely designed the protocol to be non-linear to recognize three key points:

- Recognizing that seriously ill patients can be appropriately treated by basic life support if it is done quickly
- Advance care is more about diagnostic skill versus treatment
- Only high acuity incidents benefit from dual response (multiple units – either ALS or BLS)

These underlying principals are reflected in the figure below.

Figure 25: Response Types by Determinant



In addition, while the Academy makes general recommendations on response modes and capabilities, they recognize that local medical oversight and operational requirements supersede any general recommendations. In addition, the Academy makes no response time recommendations. Following current literature and best practice, they purposefully leave response time criteria as a local issue. What it does suggest is that the system be consistent in the response type and response time criteria for the same level of acuity.

Revised Call Categories

Taking full advantage of MPDS allows for agencies to send the right resource – in the right mode – to the right call. The Committee went through all 1,326 MPDS determinant codes and categorized calls into 14 categories of response mode. These revised response categories make a distinction between the first responder unit (Fire Department) and the transport unit (AMT). In the following table the terms "hot" and "cold" refer to the unit if responding to the incident with lights and siren (hot), or responding without such emergency warning devices (cold). Historical problems with serious vehicle accidents involving emergency responders has led most agencies to limit a hot response to those incidents requiring such a response – a best practice in fire and EMS systems. As will be noted below, over two-thirds of determinant codes require both the first response unit and ambulance to respond with emergency lights and siren engaged.

Figure 26: Response Modes

Response Mode	Count of MPDS Determinant Codes
ALS Ambulance Cold	45
ALS Ambulance Cold & First Response Cold	9
ALS Ambulance Cold & First Response Hot	67
ALS Ambulance Hot	23
ALS Ambulance Hot & First Response Hot	877
BLS Ambulance Cold	120
BLS Ambulance Cold & First Response Cold	11
BLS Ambulance Cold & First Response Hot	67
BLS Ambulance Hot	5
BLS Ambulance Hot & First Response Hot	14
First Response Cold	19
First Response Hot	16
QRV (Quick Response Vehicle) Cold	13
No response (Police Only)	40
Grand Total	1,326

Utilizing the distribution reflected above, the projected distribution of Alpha, Bravo, and Charlie categories were adjusted. The figure below reflects the projected demand for each category, as well as the variance from current demand.

Figure 27: Impact of Revised Dispatch Program for the Peoria Fire Department

Complain Severity	CY2017	CY2017 %	Proposed	Proposed %	Difference	Difference %
Omega	141	0.86%	0	0.00%	(141)	-100.00%
Alpha	2,780	16.93%	454	3.25%	(2,326)	-83.67%
Bravo	4,173	25.41%	4711	33.73%	538	12.89%
Charlie	5,413	32.96%	4884	34.97%	(529)	-9.77%
Delta	3,640	22.16%	3640	26.06%	-	0.00%
Echo	278	1.69%	278	1.99%	-	0.00%
Total	**16,425**	**100%**	**13,967**	**85.04%**	**(2,458)**	**-14.96%**

Establishing Systemwide Response Times

The balance is to set response times that are medically defensible, allow for all practitioners to fully participate, and are cost responsible. The Fire Department under the revised model will have increased capacity due to their reduction in responding to low acuity calls. This must be offset by having the department play its full role as a first response agency. AMT must have increased capacity in order to be sustainable over time without any cost to the residents.

Current Fire Performance

Figure 28: 90th Percentile Dispatch, Turnout, Travel, Crew, and Response Intervals of First Arriving Units by Incident Category

Incident Category	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]
EMS	11,646	03:01	11,877	02:05	11,794	04:22	12,185	08:43
Fire	2,446	02:57	2,539	02:08	2,501	05:06	2,602	09:46
Rescue	330	03:05	347	02:05	347	04:44	350	08:54
Other	136	02:47	82	01:56	81	05:00	146	08:33
HazMat	1		1		1		1	
All	14,559	03:02	14,846	02:06	14,724	04:32	15,284	08:53

Figure 29: Response Time Interval Definitions

Interval	Timestamps
Dispatch	TS_Rcvd -> TS_Assgn
Turnout	TS_Assgn -> TS_Enroute
Travel	TS_Enroute -> TS_Arrvd
Crew	TS_Assgn -> TS_Arrvd
Response	TS_Rcvd -> TS_Arrvd

From assignment until arrival on-scene, the Fire Department takes 6 minutes or less 90 percent of the time. AMT take 8 minutes or less 90 percent of the time. This means the system is built with less than 2-minute differential.

The committee recommended a 5-minute differential from current performance. Therefore, the committee recommended a 10:59 target for AMT at the 90th percentile. The committee also recommended a 5:59 target at the 90th percentile objective for the Fire Department.

Figure 30: Response Time Targets at 90th Percentile

	Current	Recommended
Fire - First Response Hot	5:59	5:59
Fire - First Response Cold		9:59
AMT BLS Hot		10:59
AMT BLS Cold		14:59
AMT ALS Hot	8:59	10:59
AMT ALS Cold		14:59
QRV Hot		10:59
QRV Cold		14:59

From a system perspective the new design accomplishes several items:

1) Follows best practice guidelines
2) Reduces unnecessary duplication of resources on low acuity calls
3) Uses the MPDS protocol wholly
4) Reduces the use of lights and sirens from many calls
5) Introduces BLS resources into the system which are easier to train and maintain
6) Creates a purposeful response differential between first response and the ambulance service so all practitioners can fully use their skills

OVERALL CONCLUSIONS AND ALTERNATIVES

By all respects, there is no evidence to suggest that the department isn't performing at a relatively high level. Fire department travel times are at 4:32 for 90% of incidents. When evaluating call concurrency, unit hour utilizations, and system performance by available vehicles, it is clear the system is quite resilient – and capable of handling additional workload without the need to invest in further resources for some time. The department's current deployment strategies have significant long-term sustainability from an operational standpoint.

From time to time, fiscal constraints must be considered, and adjustments realized within an acceptable political environment. During *FITCH's* interim project briefings in October 2018 held with stakeholders and council members, we articulated a framework based on the City's risk tolerance – utilizing a framework which balances system performance with fiscal realities. Alternatives discussed included leaving the system in a status quo posture; or a significant adjustment changing system performance to a level of 6:00 travel time at the 90th percentile which could allow for a reduction of 6 fire apparatus.

- At that time, FITCH offered an alternative which employed a measured adjustment to the system keeping the citizen's perspective of performance largely the same with a limited reduction of 3 apparatus. The City Council, as part of the budget process, elected to adjust the Fire Department budget based on this alternative by a reduction of two apparatus.

A component of this measured adjustment included additional analysis of the 911 center processes to improve their performance by 1 minute – essentially blunting the need to alter travel time performance – while still offering improved service to the community. Subsequent to those decisions, the City requested *FITCH* undertake the additional analysis related to improving the 911 dispatch process – a component which is still underway. Working with stakeholders from the Fire Department, AMT, and the EMS Medical Director, the decision was made to update the existing EMS deployment plan to reflect current thinking in EMS system design while simultaneously adding additional capacity back into the Fire Department to limiting their medical responses to those incidents that truly require a paramedic first response. These steps are still underway and include the implementation of the following alternatives.

- The City should undertake a full evaluation on the staffing and operations in the 911 center with the goal of improving performance and most closely aligning with best practices.
- The City should revise and implement an EMS deployment plan which reflects best practices in EMS system design.

SECTION 2: SUMMARY POWERPOINT

FITCH

& ASSOCIATES

CITY OF PEORIA

Fire Department / AMT Review

City Council Briefing

Updated April 2019

FITCH & ASSOCIATES

Introduction & Methodology

Process Overview

- ✓ Meetings with stakeholders
  - ✓City Council
  - ✓City administration
  - ✓Fire Department
  - ✓Labor Group (IAFF)
  - ✓AMT
  - ✓9-1-1 Dispatch
  - ✓Peoria Area EMS Office
  - ✓Unity Point – EMS
  - ✓OSF Healthcare
  - ✓Peoria County Health Department

- ✓Collect & Analyze Data
  - ✓Solicit feedback on initial data analysis
- ✓GIS validation & modeling
- ✓Define policy alternatives – Bookend options
- ✓Policy decision by City Council - 2019 Budget

Process Overview

- ✓ Engage Stakeholders to revise medical response system
  - ✓EMS System Medical Director
  - ✓Peoria Fire Department
  - ✓AMT
  - ✓911 Dispatch

- ❖*Analyze 911 Dispatch & recommend changes to facilitate implementation of revised medical response protocols*

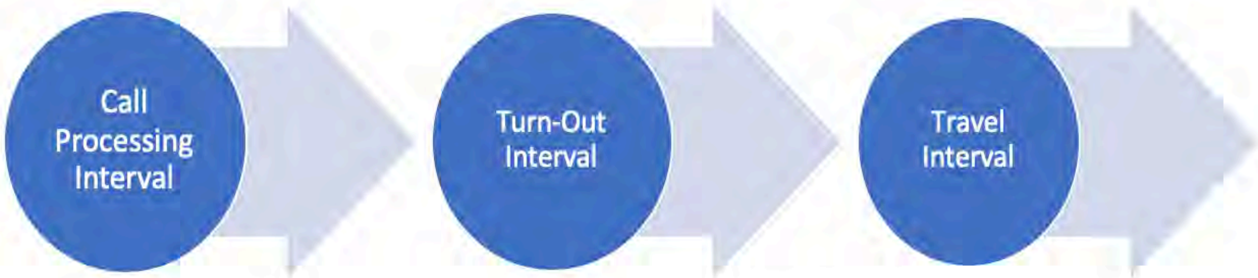
Methodology: Draft Data Report

5-years of CAD data from both Peoria 911 & AMT

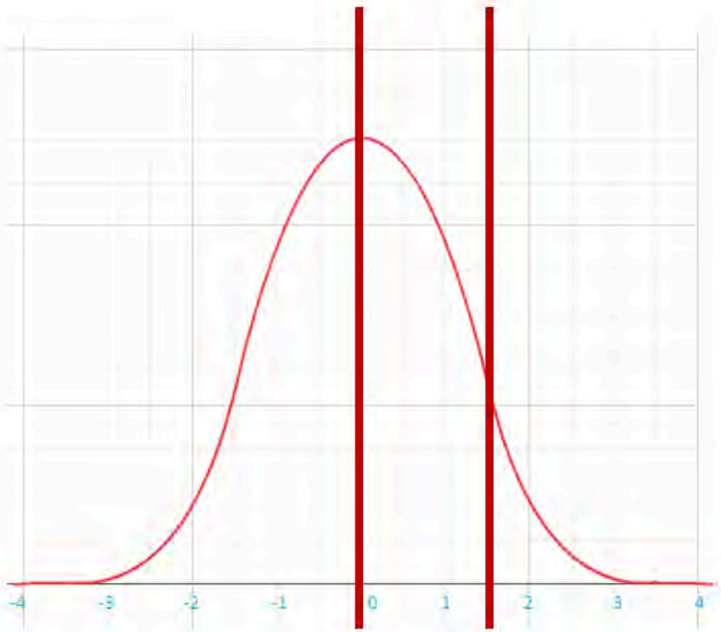
- Built into a single database

Mostly focused on 2017 data (January thru December)

Averages versus 90th Percentile



- Various national groups endorse or mandate the use of percentile / fractile evaluations when assessing public safety departments.
    - National Fire Protection Association (NFPA)
        - NFPA 1221
        - NFPA 1710
    - National Emergency Number Association's Standard
        - NENA 56-005
    - Center for Public Safety Excellence's Standard of Cover document.
- By framing the performance goal at a 90th percentile, policy makers are ensuring that 9 out of 10 times the performance will be achieved.



Response Times & 90th Percentile Standard

Data Report vs. Internal Reporting

Data analysis was done by one of the Firm's three doctoral-level statisticians – Dr. Erwin Stedronsky, PhD

- A graduate of MIT
- Previously served as the Senior Research Specialist for the Monsanto Corporation and as a special consultant to NASA.

Analysis was reviewed by the Firm's Fire Practice Partner, Dr. Steven Knight, PhD; Project Consultant, Dr. Bruce Moeller, PhD; and Chief Operating Officer Guillermo Fuentes, MBA

- Combined experience of over 70 years leading large fire departments & EMS agencies
- University teaching experience at several public institutions
- Experience accrediting fire rescue and 911 agencies

Data Report vs. Internal Reporting

November 2018 - Draft data report provided to Fire Department

- Requested to “identify any obvious / suspected errors or omissions in the” data report
- Department replied they had “no way of confirming or denying any of the [response] times”, though they did question:
  - Effective response force calculations – we replied a different methodology would work better and employed such in the GIS analysis

In January 2019 Fitch requested internal analysis from the Fire Department related to their accreditation efforts.

- Fire Department utilized a different data source – RMS (retrospective view), rather than original CAD data (prospective view), which has only been in use since October 2016
- Fire Department analysis yielded unusual findings for 2017:
  - Call processing times for “Low-Risk EMS” was reported as 1:07 at 90th percentile (n=13,797)
  - Call processing times for “Moderate-Risk EMS” was reported as 3:18 at 90th percentile (n=332)
  - Fitch’s reported time for EMS call processing was 3:01 at 90th percentile (n=11,646)

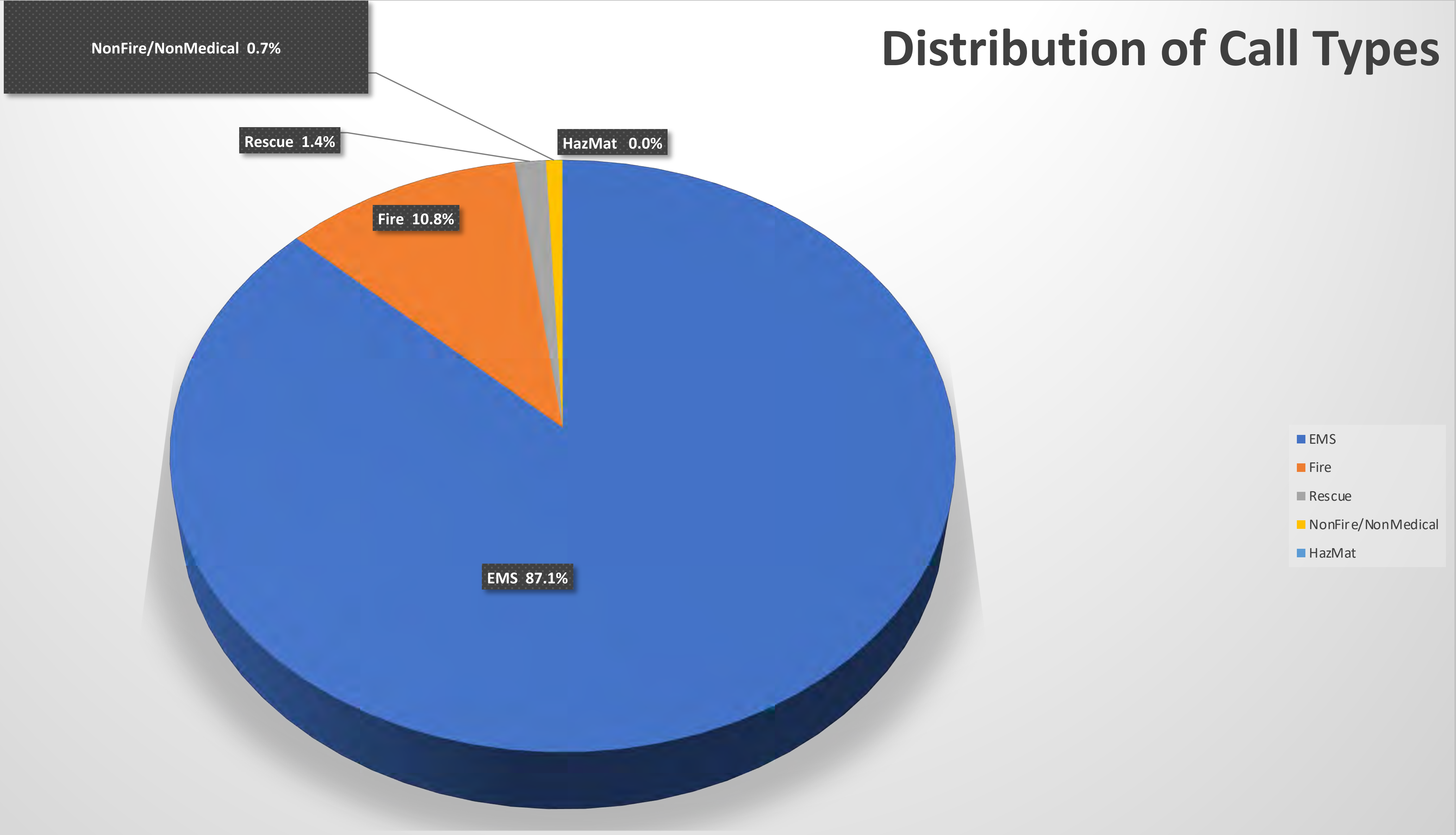
Current System Assessment

Incidents – Responses - Workload

- 27,154 Total Incidents

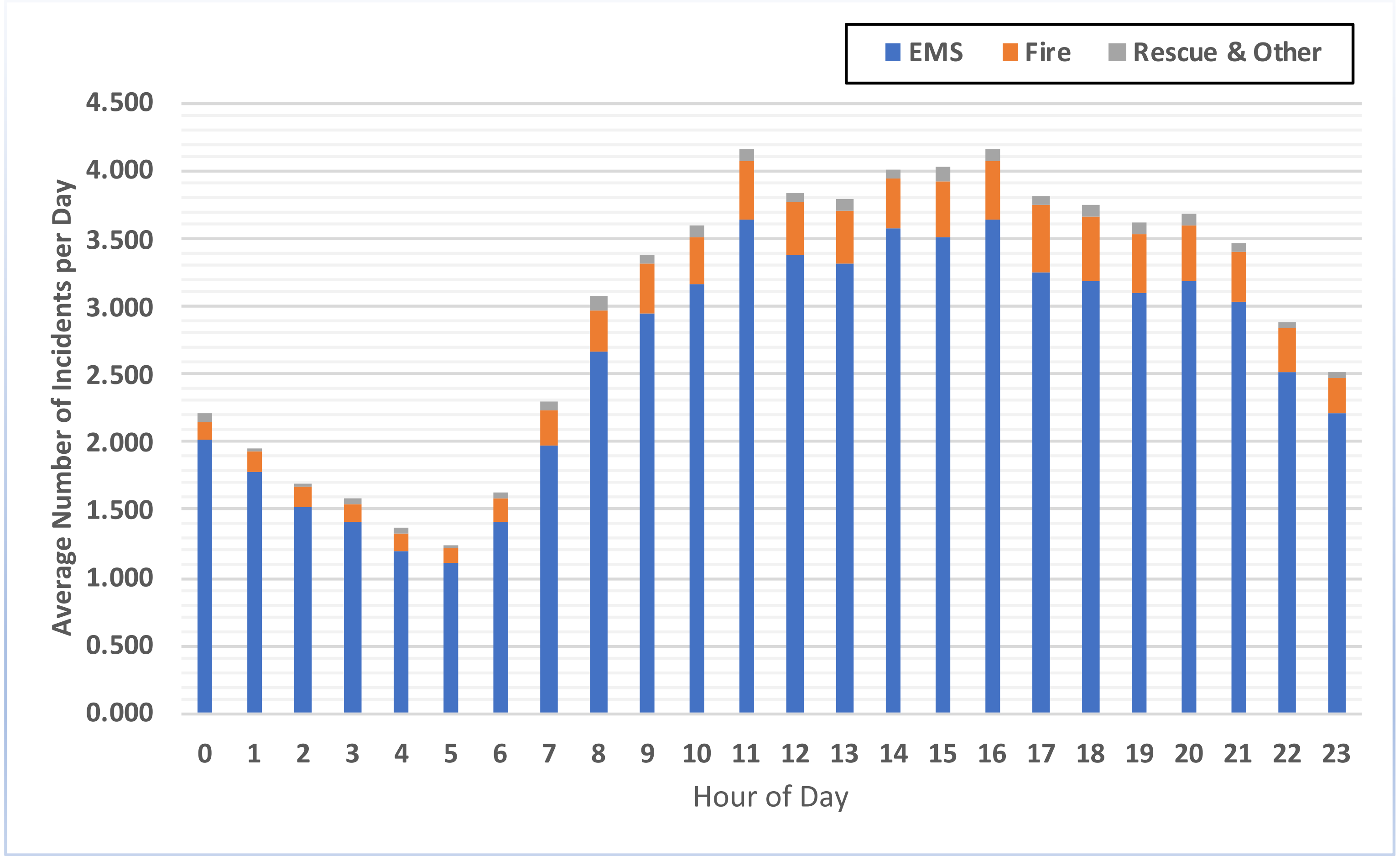
Category	Number of Incidents	Vehicles Arrived OnScene
EMS	22,978	
EMS AMT vehicles		20,479
EMS PFD vehicles		16,956
Fire	2,721	6,118
Rescue	371	779
Non-Fire/Non-Med	164	199
Hazmat	3	8

Distribution of Call Types

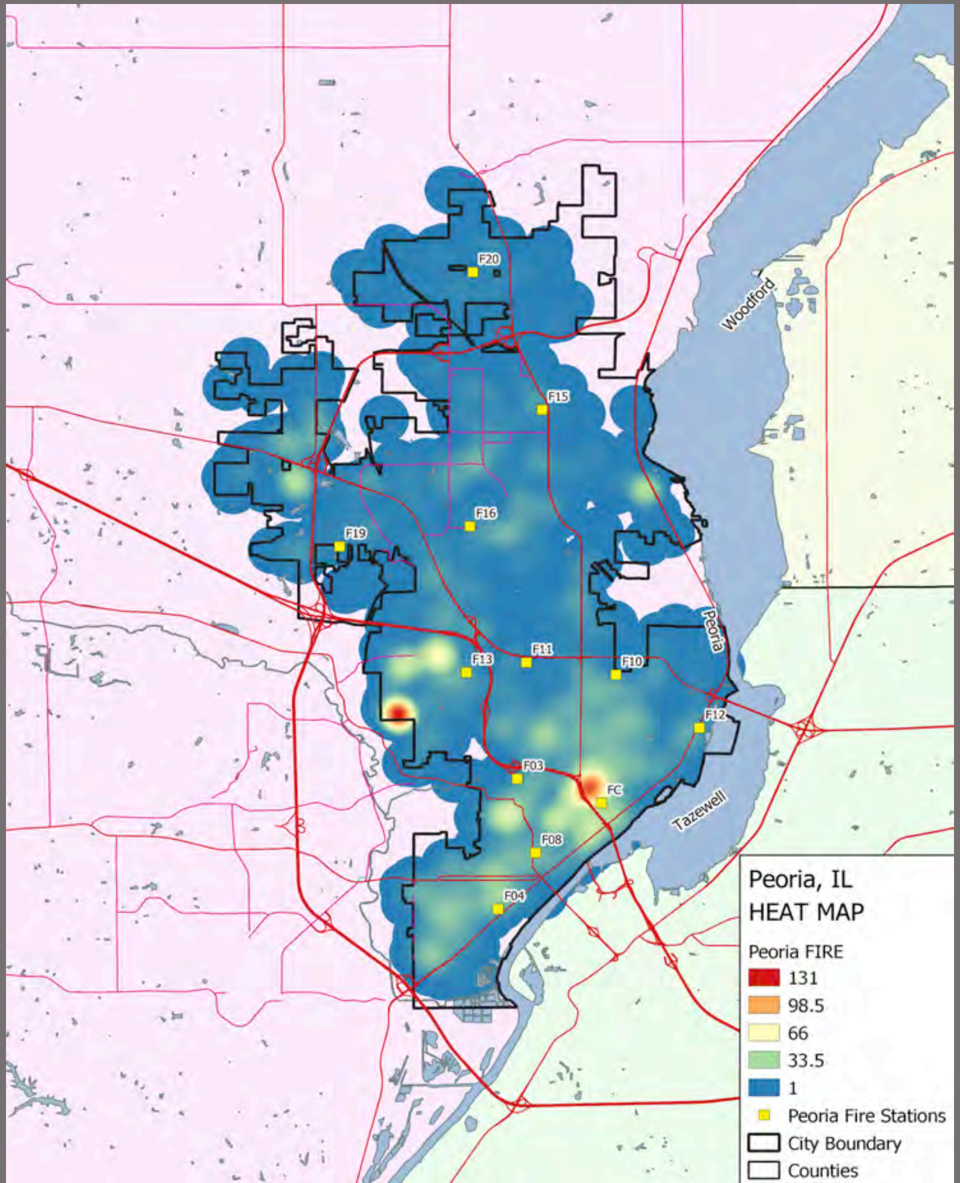


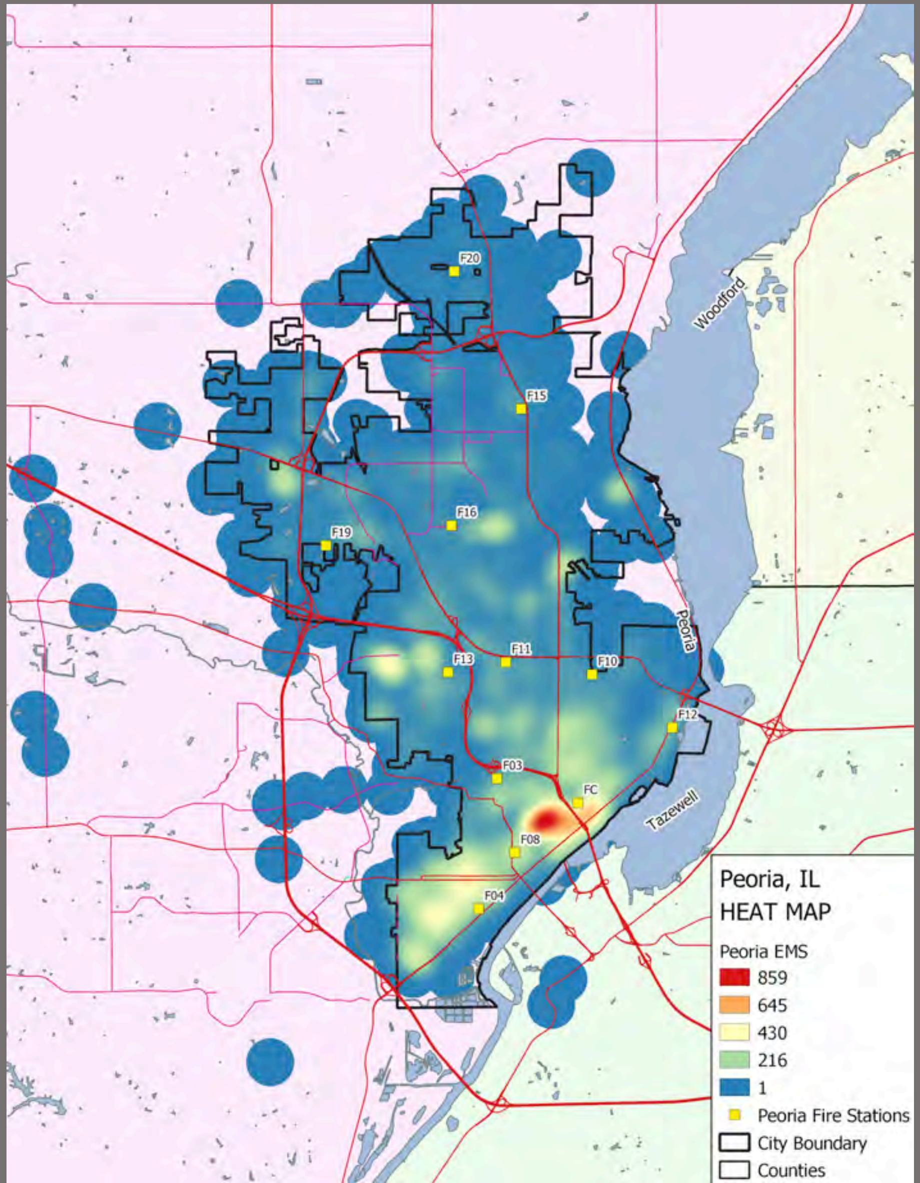
Temporal Distribution

- Similar pattern seen across nation
- Typical for fire, police or EMS



Heat Maps


Woodford
Peoria
Tazewell
F20
F15
F16
F19
F13
F11
F10
F12
F03
FC
F08
F04
Peoria, IL
HEAT MAP
Peoria FIRE
131
98.5
66
33.5
1
Peoria Fire Stations
City Boundary
Counties


Woodford
Peoria
Tazewell
F20
F15
F16
F19
F13
F11
F10
F12
F03
FC
F08
F04
Peoria, IL
HEAT MAP
Peoria EMS
859
645
430
216
1
Peoria Fire Stations
City Boundary
Counties

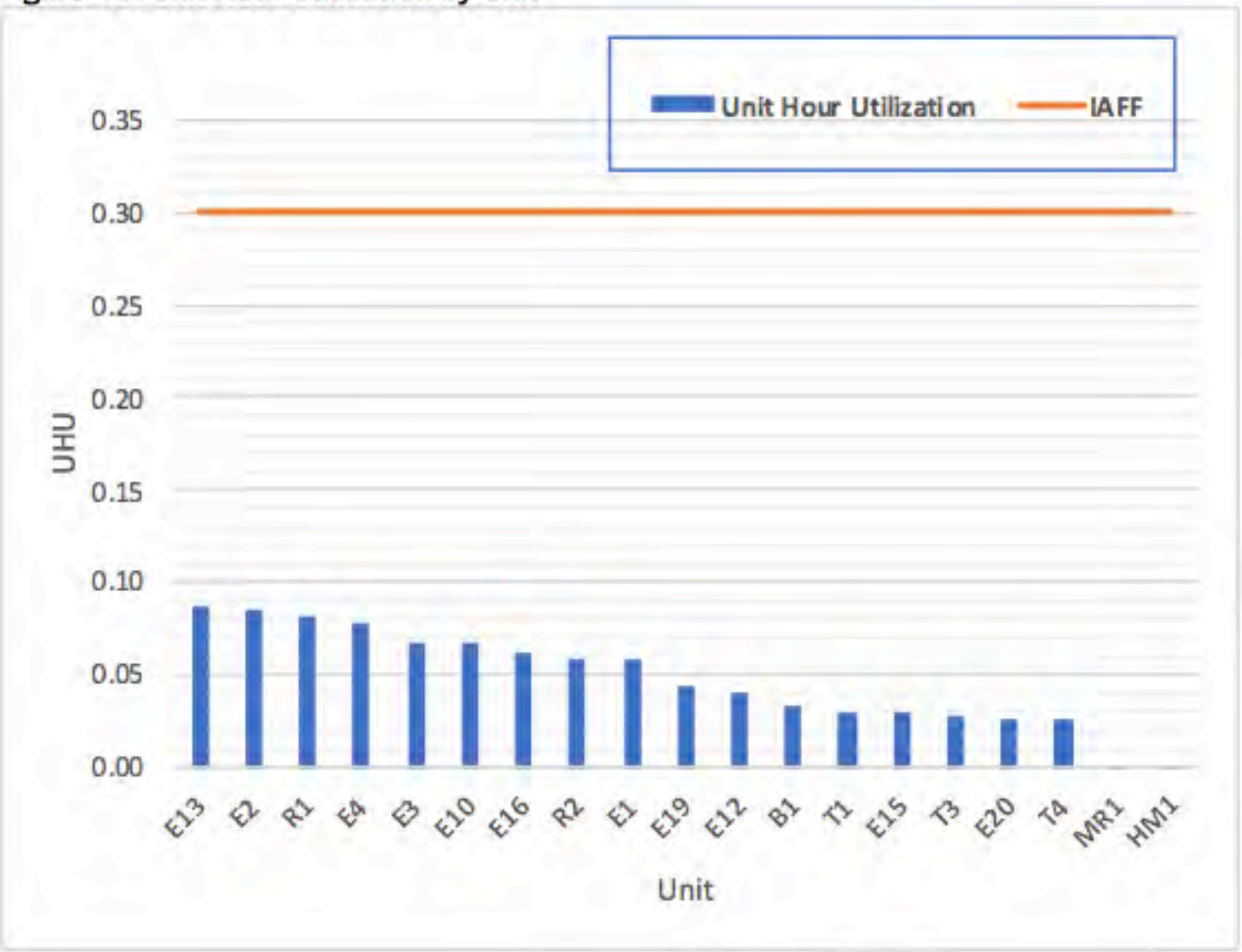
Measure	Average [mm:ss]	90th Percentile [mm:ss]
Dispatch Interval	01:45	03:02
Turnout Interval	01:24	02:06
Travel Interval	02:35	04:32
Response Interval	06:00	08:53

Response Times

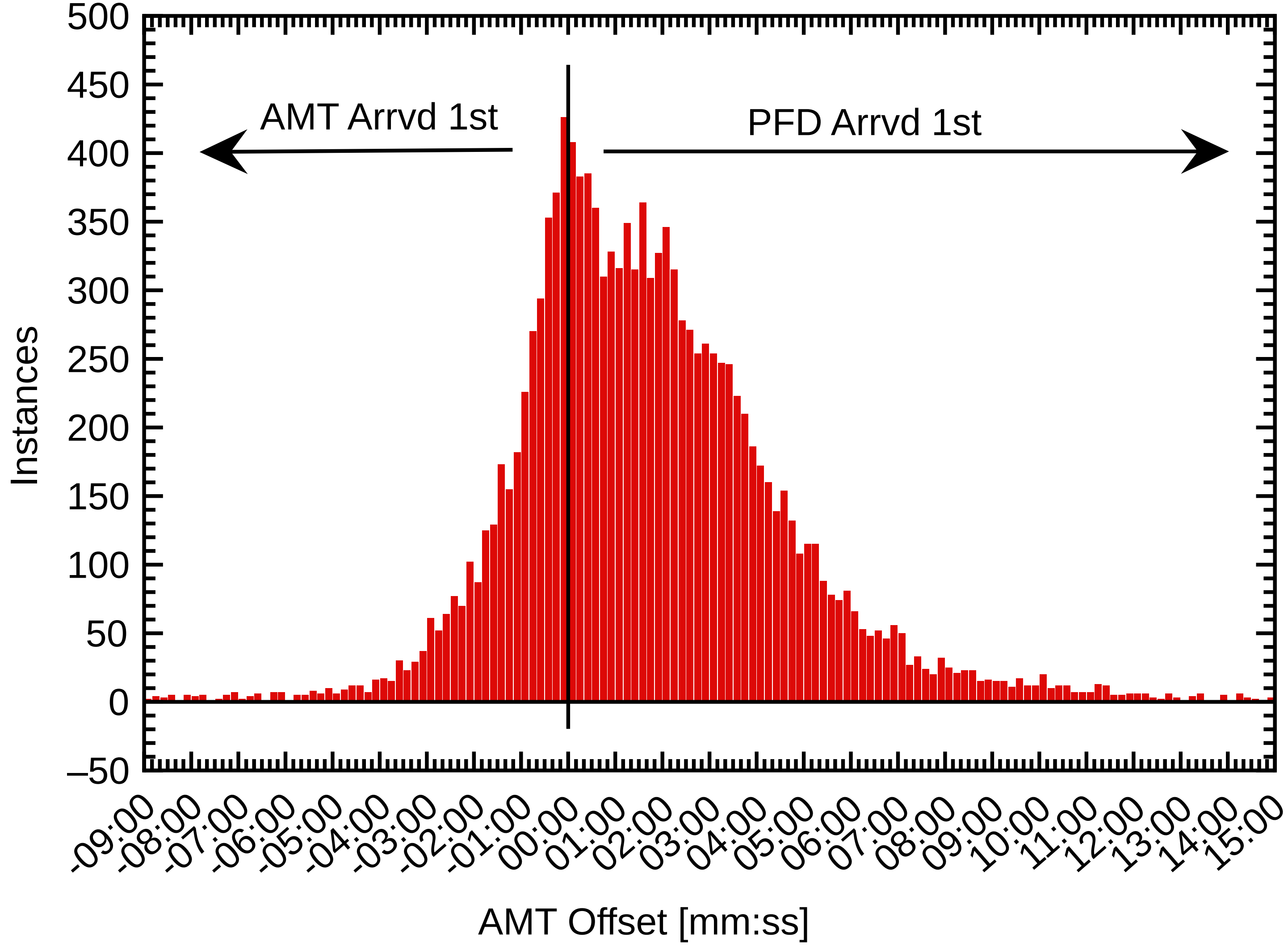
Unit Hour Utilization

- For 24-hour shifts
  - Upon reaching 25% UHU need to consider mitigating strategies
  - Upon reaching 30% UHU deploy mitigating strategies

Figure 48: Unit Hour Utilization by Unit



Fire Department vs. AMT Arrival Offset



Significant Findings

System is performing well !

Responses times are generally strong - especially travel times

Significant capacity in current system

AMT averages 1:46 behind fire department arrival

Science Behind System Design

Fire Operational Timeframes

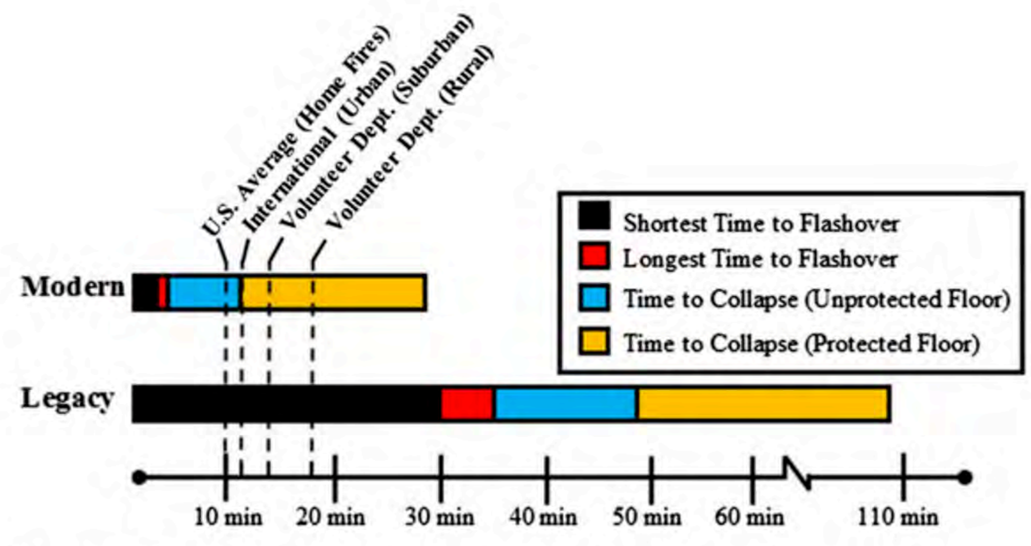
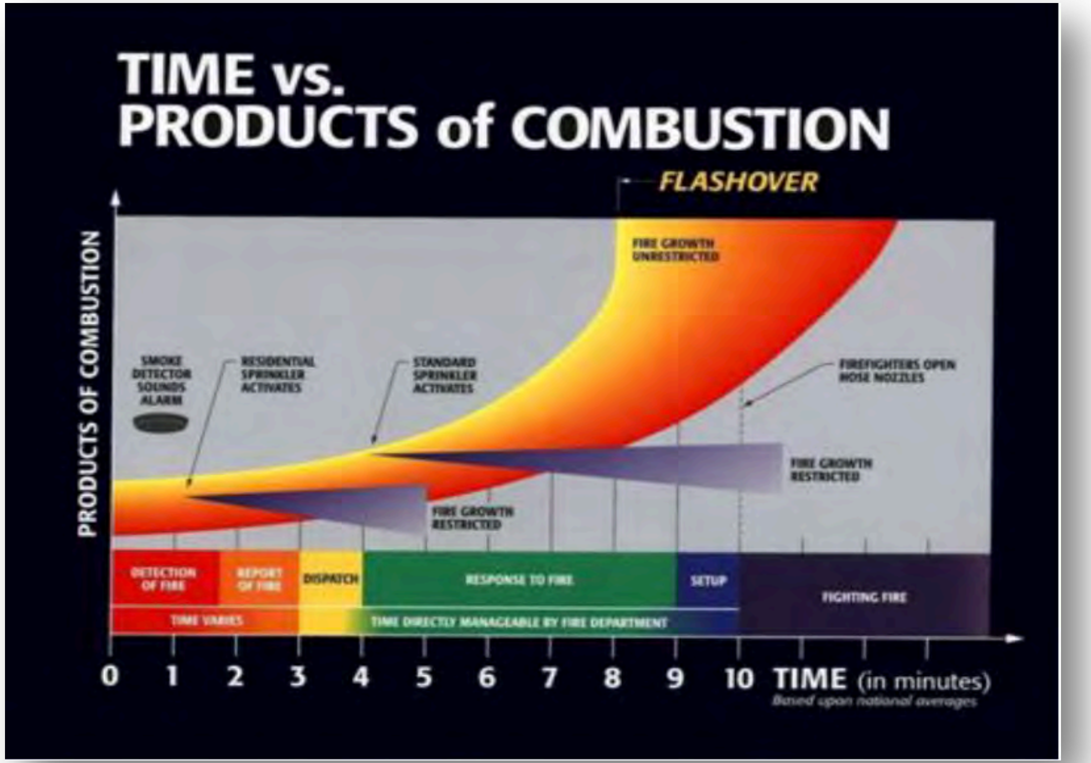


Figure 27: Fire service arrival times versus fire development

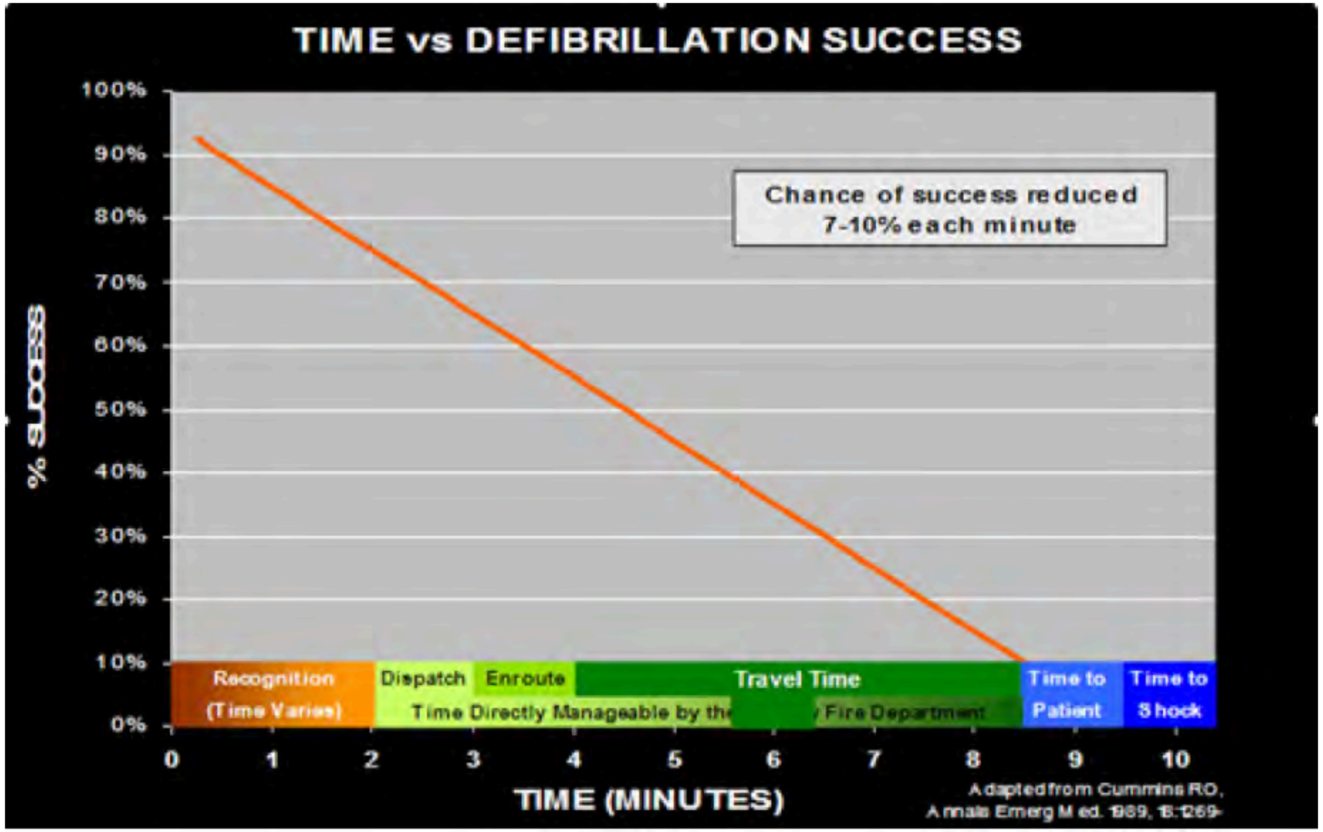
Kerber, S. (2014). Analysis of Changing Residential Fire Dynamics and Its Implications of Firefighter Operational Timeframes/ Retrieved at https://newscience.ul.com/wp-content/uploads/2014/04/Analysis_of_Changing_Residential_Fire_Dynamics_and_Its_Implications_on_Firefighter_Operational_Timeframes.pdf



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

EMS Timeframes

- 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-emergency responses.



Significant Findings

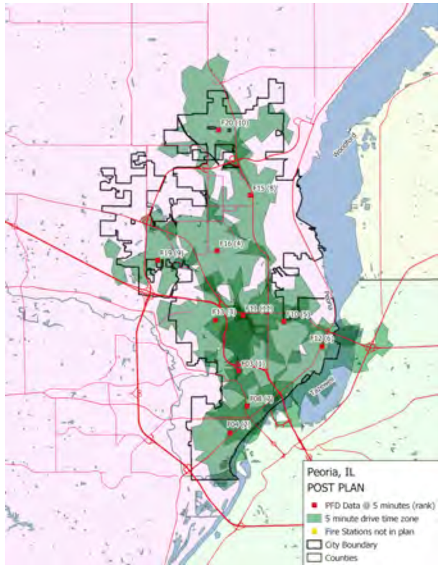
Total responses times *(discovery, call processing; turnout; travel)* generally must be within 5 minutes from when the event begins ***at the 90th percentile*** to provide the best possible outcomes in critical fire & EMS related events – these represent less than 15% of incidents

For the majority of incidents (approximately 85% of incidents), total response times up to 12 minutes have been shown to not impact a patient's clinical outcome.

GIS & Marginal Utility Modeling

5-Minute Modeling

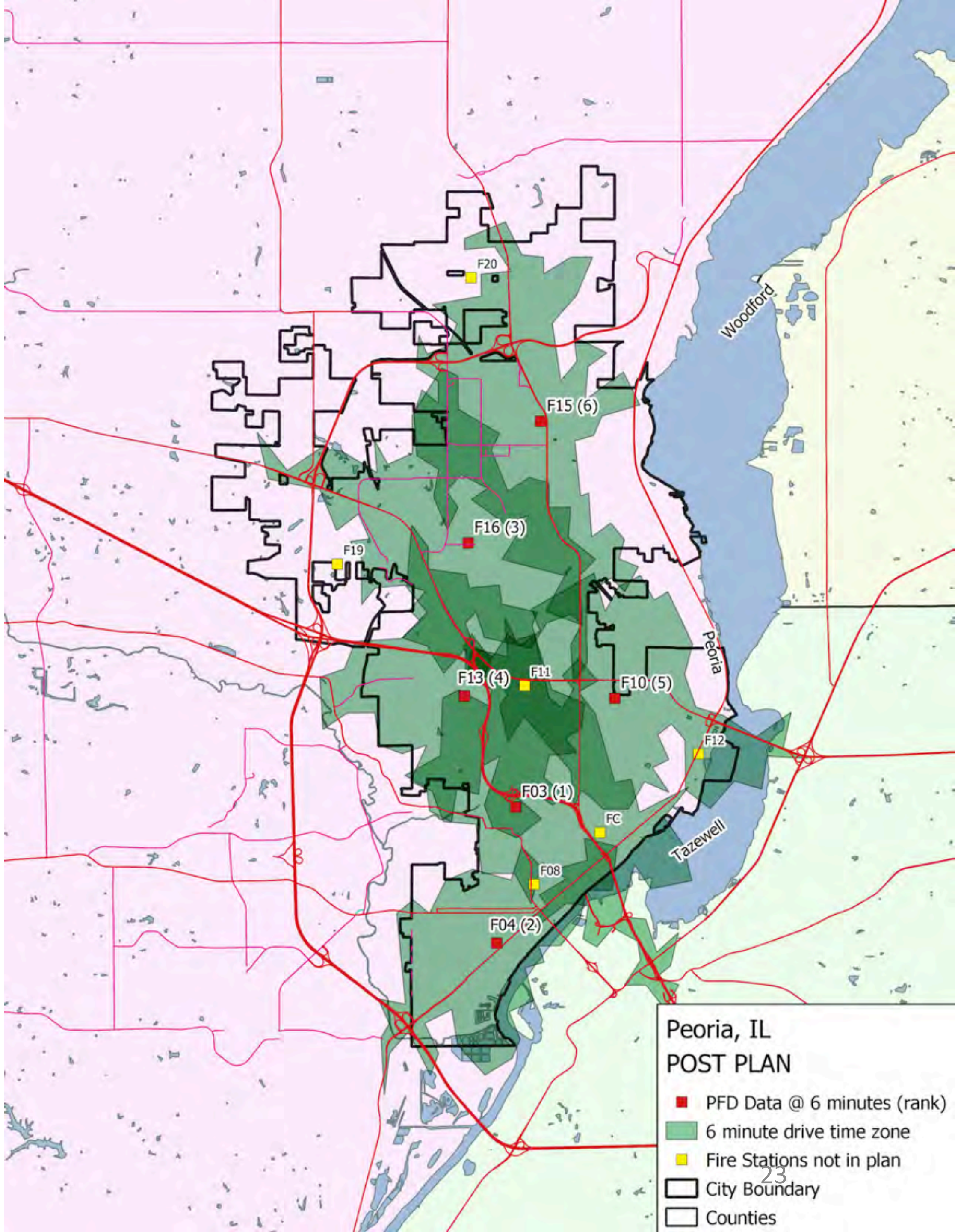
- Considers ***<u>only travel time</u>***
- Closely aligns with actual performance of 4:32 @ 90th
    - Fire Central Station geographically redundant
- Modeling assumes normal traffic impedance
- Captures 87.12%



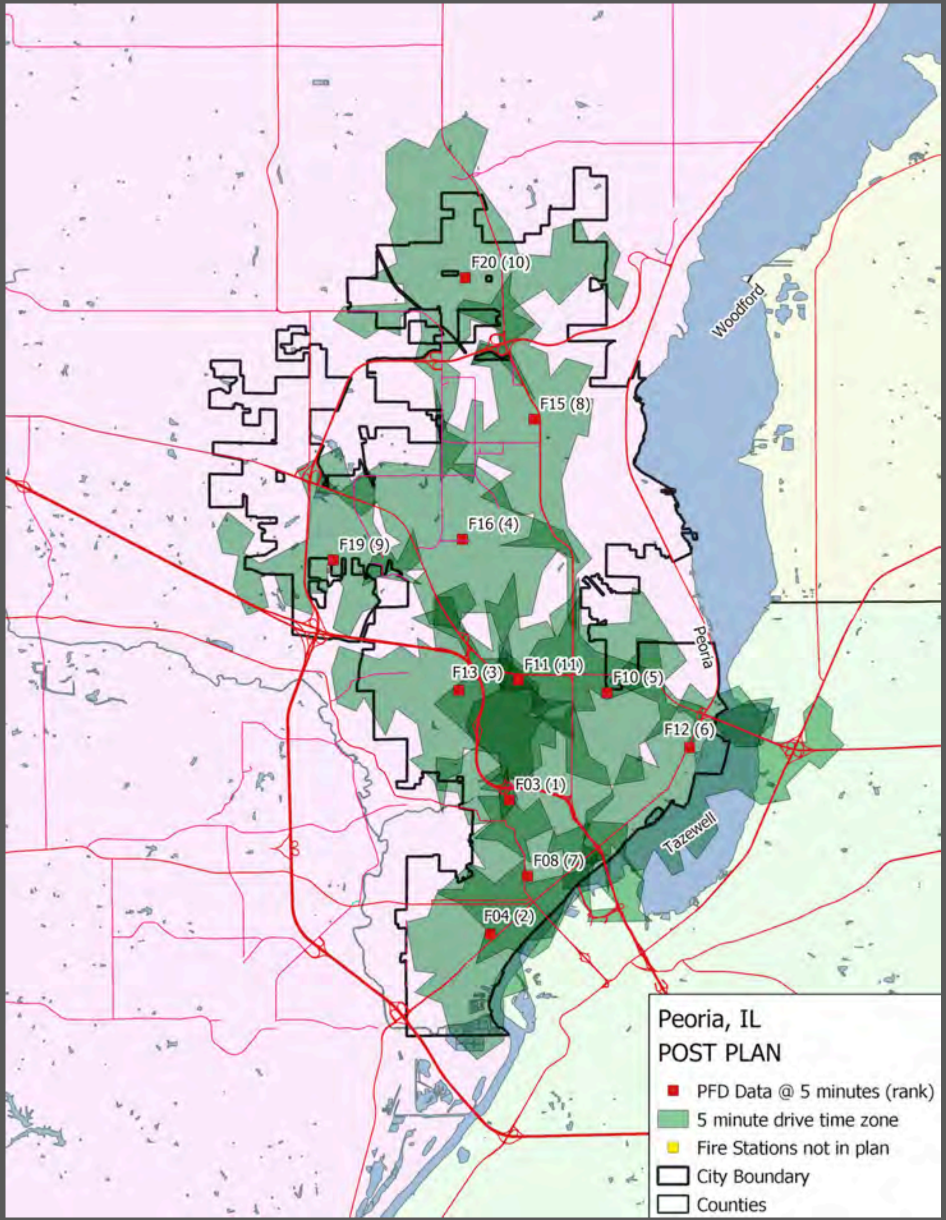
Rank	PostNumber	PostCapture	TotalCapture	PercentCapture
1	F03	5322	5322	28.62%
2	F04	2607	7929	42.65%
3	F13	2064	9993	53.75%
4	F16	1737	11730	63.09%
5	F10	1552	13282	71.44%
6	F12	829	14111	75.89%
7	F08	730	14841	79.82%
8	F15	643	15484	83.28%
9	F19	348	15832	85.15%
10	F20	276	16108	86.63%
11	F11	91	16199	87.12%

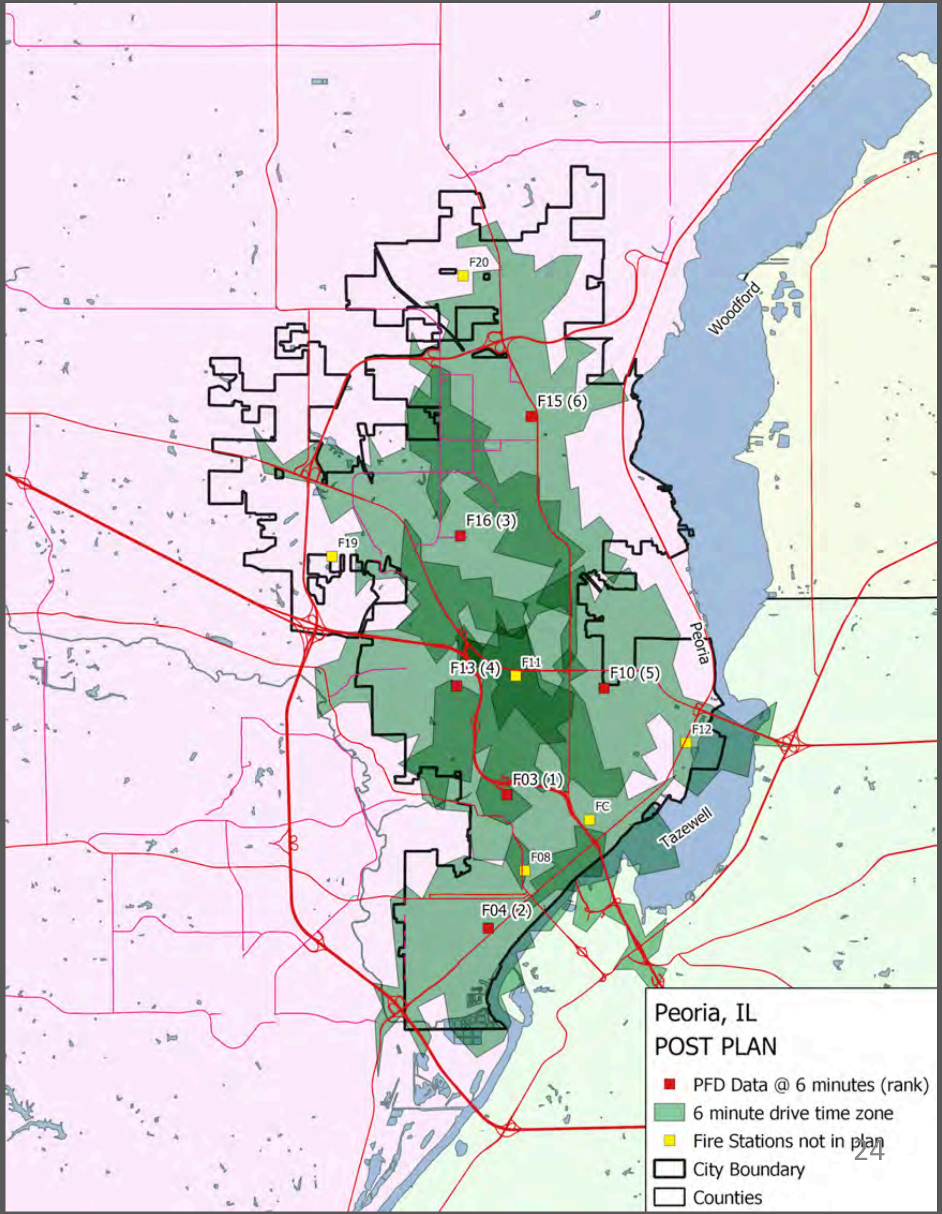
6-Minute Modeling

Rank	PostNumber	PostCapture	TotalCapture	PercentCapture
1	F03	7160	7160	38.51%
2	F04	3074	10234	55.04%
3	F16	2964	13198	70.98%
4	F13	1664	14862	79.93%
5	F10	1572	16434	88.39%
6	F15	652	17086	91.89%
7	F12	256	17342	93.27%
8	F19	211	17553	94.41%
9	F20	91	17644	94.90%
10	F08	53	17697	95.18%



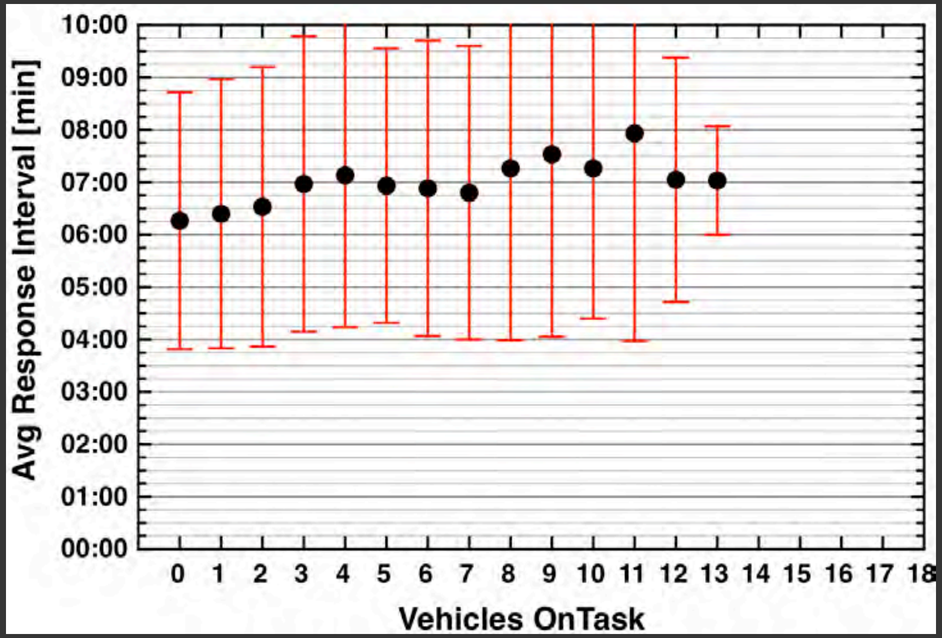
FD – 5 vs. 6 minutes





Units Impact on Response Time

- Total response interval is minimally impacted by increased workload
  - Not statistically significant until 12 units are unavailable
  - In current system, loss of:
    - 1 unit = 8 seconds on average
    - 2 units = 16 seconds on average
    - 3 units = 42 seconds on average
    - 4 units = 52 seconds on average



Number of Vehicles Already on Task	Incoming Incidents	Average Response Interval (Min:Sec)	Average Response Interval (Seconds)	Response Interval Standard Deviation (Min:Sec)	Response Interval Standard Deviation (Seconds)
0	8272	06:16	376	02:27	147
1	6241	06:24	384	02:34	154
2	3310	06:32	392	02:40	160
3	1760	06:58	418	02:49	169
4	1182	07:08	428	02:54	174
5	897	06:56	416	02:37	157
6	616	06:53	413	02:49	169
7	378	06:48	408	02:48	168
8	202	07:16	436	03:17	197
9	113	07:32	452	03:29	209
10	62	07:16	436	02:52	172
11	20	07:56	476	03:58	238
12	16	07:03	423	02:20	140
13	4	07:02	422	01:02	62
14	-	00:00	0	00:00	0
15	-	00:00	0	00:00	0
16	-	00:00	0	00:00	0
17	-	00:00	0	00:00	0

Effective Response Force Analysis

- ERF defined as 5 apparatus with 3-person staffing each
- Drawing from national recommendations, analysis was done based on 8, 10, 12, and 14-minute travel times
- Two options were defined by the Fire Department and assessed:
  - Option 1 closed Station 8 and rebuilt Station 4 at a new location
  - Both Options reduced 2 apparatus

Table 7: Comparisons of Effective Response Force Configurations

Travel Time Objective	Current ERF	Option 1 ERF	Option 2 ERF
8-Minute	31.95%	30.76%	28.62%
10-Minute	58.91%	57.99%	58.15%
12-Minute	79.99%	79.88%	79.55%
14-Minute	96.21%	96.21%	96.21%

Medical Response System

Medical Response System Revisions

The Peoria Fire Department; Advance Medical Transport (AMT), 911 Director; Medical Director, and facilitated by Fitch, developed a white paper to update the medical response system in the community. Specific members of the committee included:

- Dr. Mathew Jackson - System Medical Director
- Assistant Chief Anthony Ardis – Peoria Fire Department
- Battalion Chief Roland Tenley – Peoria Fire Department
- Greg Chance - AMT Vice-President of Development
- Tom Geraci - AMT Vice-President of Operations
- David Tuttle – 911 Director

Medical Response System Revisions

Research has demonstrated that the overwhelming majority of requests for EMS services are not time sensitive between five minutes and 11 minutes for emergency and 13 minutes for non-emergency responses. 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.

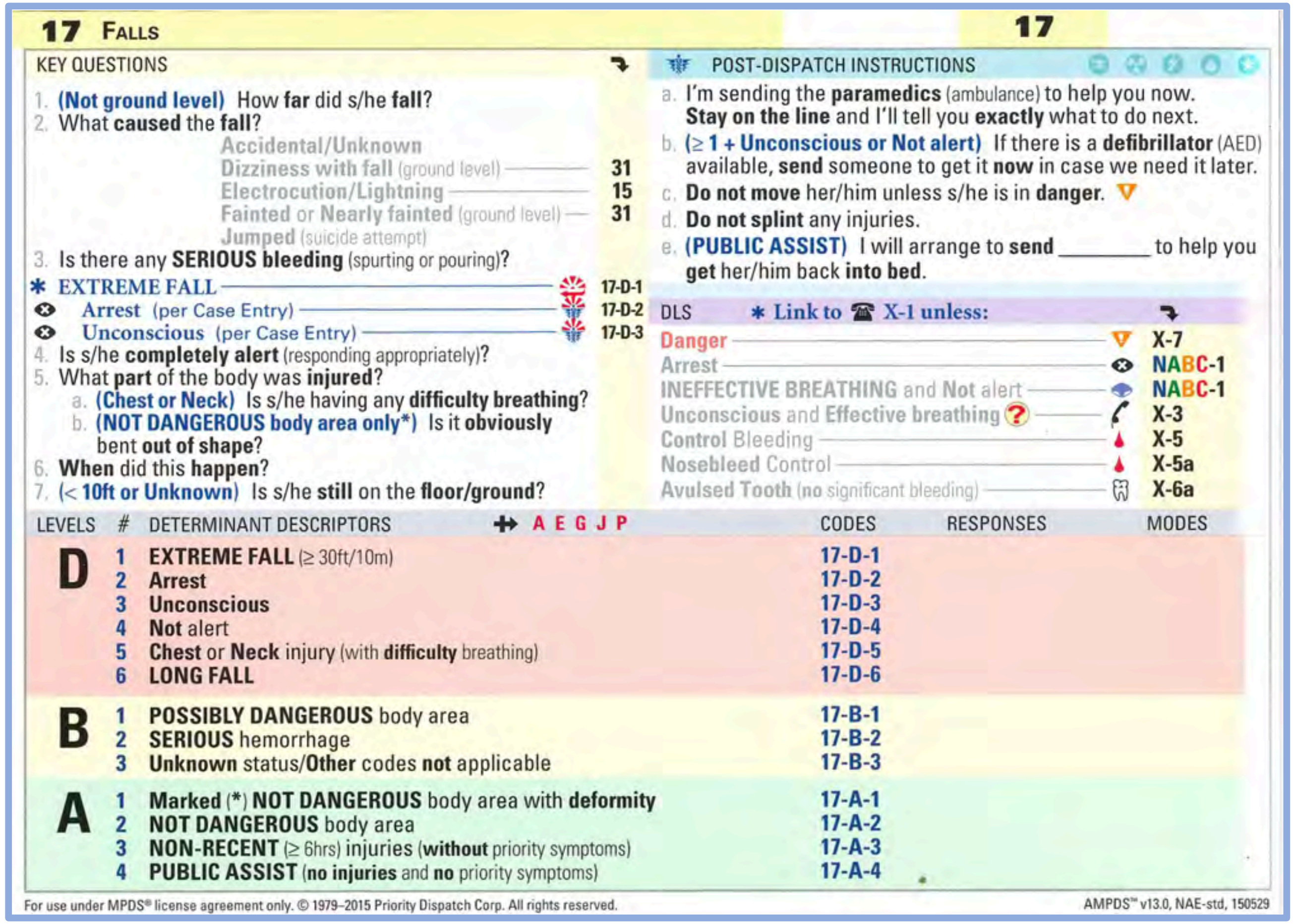
- *Blackwell, T.H., & Kaufman, J.S. (April 2002). Response time effectiveness: Comparison of response time and survival in an urban emergency medical services system. Academic Emergency Medicine, 9(4): 289-295.*
- *Blackwell, T.H., et al. (Oct-Dec 2009). Lack of association between prehospital response times and patient outcomes. Prehospital Emergency Care, 13(4): 444-450.*

ALS vs. BLS

- Scientific literature has produced different results when comparing ALS vs. BLS care
  - Generally, ALS has been shown to be of greater value in non-traumatic cardiac arrest
  - Trauma victims receive greater benefit from rapid transport – rather than delay to provide advanced care in the field

Medical Response System Revisions

- System does not currently reflect the current complexity of EMS – a more granular assessment & response system is needed
  - 9-1-1 already employs MPDS system – though not fully utilized
  - Revisions move from existing 121 dispatch codes to a system built off 1,326 determinant codes with 14 response options



17 FALLS 17

KEY QUESTIONS

1. (Not ground level) How far did s/he fall?
2. What caused the fall?
   - Accidental/Unknown
   - Dizziness with fall (ground level) — 31
   - Electrocution/Lightning — 15
   - Fainted or Nearly fainted (ground level) — 31
   - Jumped (suicide attempt)
3. Is there any SERIOUS bleeding (spurting or pouring)?

* EXTREME FALL — 17-D-1
Arrest (per Case Entry) — 17-D-2
Unconscious (per Case Entry) — 17-D-3

4. Is s/he completely alert (responding appropriately)?
5. What part of the body was injured?
   a. (Chest or Neck) Is s/he having any difficulty breathing?
   b. (NOT DANGEROUS body area only*) Is it obviously bent out of shape?
6. When did this happen?
7. (< 10ft or Unknown) Is s/he still on the floor/ground?

POST-DISPATCH INSTRUCTIONS

a. I'm sending the paramedics (ambulance) to help you now. Stay on the line and I'll tell you exactly what to do next.
b. (≥ 1 + Unconscious or Not alert) If there is a defibrillator (AED) available, send someone to get it now in case we need it later.
c. Do not move her/him unless s/he is in danger.
d. Do not splint any injuries.
e. (PUBLIC ASSIST) I will arrange to send ________ to help you get her/him back into bed.

DLS * Link to X-1 unless:

Danger	X-7
Arrest	NABC-1
INEFFECTIVE BREATHING and Not alert	NABC-1
Unconscious and Effective breathing	X-3
Control Bleeding	X-5
Nosebleed Control	X-5a
Avulsed Tooth (no significant bleeding)	X-6a

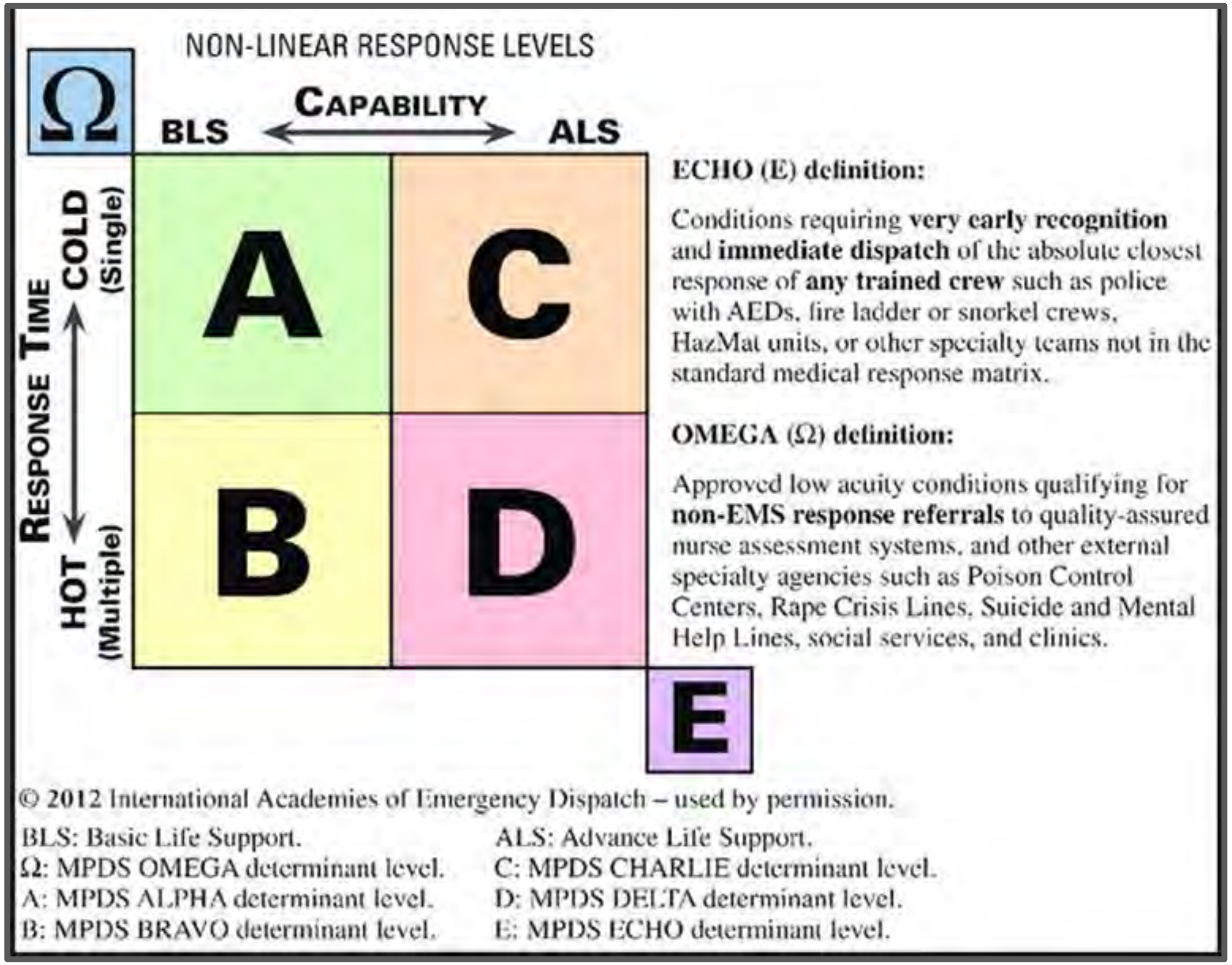
LEVELS	#	DETERMINANT DESCRIPTORS	CODES	RESPONSES	MODES
D	1	EXTREME FALL (≥ 30ft/10m)	17-D-1		
	2	Arrest	17-D-2		
	3	Unconscious	17-D-3		
	4	Not alert	17-D-4		
	5	Chest or Neck injury (with difficulty breathing)	17-D-5		
	6	LONG FALL	17-D-6		
B	1	POSSIBLY DANGEROUS body area	17-B-1		
	2	SERIOUS hemorrhage	17-B-2		
	3	Unknown status/Other codes not applicable	17-B-3		
A	1	Marked (*) NOT DANGEROUS body area with deformity	17-A-1		
	2	NOT DANGEROUS body area	17-A-2		
	3	NON-RECENT (≥ 6hrs) injuries (without priority symptoms)	17-A-3		
	4	PUBLIC ASSIST (no injuries and no priority symptoms)	17-A-4		

AMPDS™ v13.0, NAE-std, 150529

Medical Priority Dispatch System

- Classifies EMS calls into 1 of 37 different complaints
- Then classifies the complaint into 1 of 6 determinants based on severity
  - Ω and A through E, with E being the most life-threatening
- Finally, further classifies the call into sub-determinates which provide more specific information
- In total, 1,326 MPDS codes were reviewed and assigned into 1 of 14 response protocols

Medical Priority Dispatch System



Complain Severity	CY2017	CY2017 %	Proposed	Proposed %	Difference	Difference %
Omega	141	0.86%	0	0.00%	(141)	-100.00%
Alpha	2,780	16.93%	454	3.25%	(2,326)	-83.67%
Bravo	4,173	25.41%	4711	33.73%	538	12.89%
Charlie	5,413	32.96%	4884	34.97%	(529)	-9.77%
Delta	3,640	22.16%	3640	26.06%	-	0.00%
Echo	278	1.69%	278	1.99%	-	0.00%
Total	**16,425**	**100%**	**13,967**	**85.04%**	**(2,458)**	**-14.96%**

Net Impact of Updated EMS Response Policy on Fire

- Lower severity calls are reduced
- Fire Department has increased availability for high-priority incidents

Medical Priority Dispatch System

- Right Resource to the Right Call
  - Fire Department will eliminate low acuity calls – which will be handled by AMT alone.
  - Fire Department will focus on higher-priority incidents where quicker response times are shown to be more important
  - System reflects greater effectiveness and efficiency with the following impacts:
    - Fire Department has greater availability and quicker response times
    - Introduce more efficient BLS transport units to handle low acuity calls
    - Transport component performance target is adjusted from 8:59 to 10:59

Next Steps – 911 Dispatch Center

Analyze	Analyze full workload & demands
Specify	Specify staffing requirements
Identify	Identify process changes required to implement Revised Medical Response System protocols
Support	Support implementation

FITCH

& ASSOCIATES

?

SECTION 3: DATA ANALYSIS

FITCH & ASSOCIATES

METHODOLOGY

The Consultants were provided five years of data output for the City of Peoria Fire Department (PFD) and Advanced Medical Transport of Central Illinois (AMT). The data was provided by both the City of Peoria's Emergency Communications Center (Peoria 911) and AMT's Computer Aided Dispatch (CAD) systems, spanning 2013 through 2017. The primary analyses of this report are based on the City's 12-month fiscal year, from January 1 through December 31, 2017 (CY2017). Baseline incident counts and workloads for all five years are presented in the last section of this report.

In this report we use three measures of operations—counts of incidents, counts of vehicle responses, and time-on-task for these vehicle responses.

- An "incident" is a record in the CAD that was created as a result of an in-coming request for service. One, or more, vehicles in the Peoria fleet may be tasked with providing the required service.
- The assignment of these vehicles is a "response".
- The interval of time that these vehicles require to execute the task is "time-on-task".

Incidents were categorized as EMS, Fire, Rescue, or non-Fire, non-Medical. The term "cancellation" may refer to either an incident or a vehicle response. An incident was considered cancelled when the CAD showed the existence of an incident record and no vehicles arrived OnScene. A vehicle response was considered cancelled when a vehicle received an assignment and did not arrive OnScene.

The reader of this report needs to be aware that some analyses involve incidents with vehicles assigned while other analyses involve incidents with vehicles arrived OnScene. The counts of incidents in these two cases will be different. In addition some figures may not reconcile with others, as a number of CAD records had missing data elements. Where applicable, these differences are explained in further detail when the differences are significant.

In the text of this report, "time" will refer exclusively to a clock time, while "interval" will refer to the duration of a time interval. Hence, reference will be made to dispatch intervals, turnout intervals, travel intervals, and total response intervals.

The goal underlying the calculation of the performance intervals for dispatch turnout, travel, and response, is to judge the department's conduct of these operational functions against industry standards and community expectations.

In the real world, extraordinary events intervene and could distort these time intervals and often appear as long duration outliers.

3X Median Filter

In order to obtain a better representation of normal operations, the consultants chose to use a "3X Median" filter to exclude long duration outliers from the analyses of this report. All of the instances that would go into calculation of time intervals are collected, sorted into ascending order, and the duration of the median instance picked out. Instances in the original list that have durations greater than three times the median duration are designated "long duration outliers" and are excluded from analyses. Thus, the criterion for exclusion of long duration outliers from a dataset is dynamically derived from the original dataset itself. In the consultant's experience, the 3X Median filter, applied to data from urban systems, excludes 1-3% of the instances as long duration outliers.

Average and Standard Deviation

Averages and standard deviations are calculated using routine mathematical packages, except the calculation were applied to datasets that had long duration outliers excluded using the 3X Median filter.

Ranked 90th Percentiles

Most of the 90th percentiles in this report were obtained using a "ranking" procedure, the ranked 90th. A dataset, filtered of long duration outliers, was first sorted into ascending order. Instances are then counted off until 90% of instances was reached. Instances between 90% and 91% were collected and averaged. The result was reported as the 90th percentile. This procedure was applied to datasets with 30 or more instances.

Predicted 90th Percentiles

When a dataset has fewer than 30 instances, the ranked 90th begins to become unreliable. Each single instance is worth three percentile points all by itself. The last instance in the list gets a magnified and unwarranted influence on the outcome. In these cases, a procedure is used to *predict* a 90th percentile that would apply to the dataset, assuming that it had a statistically normal distribution.

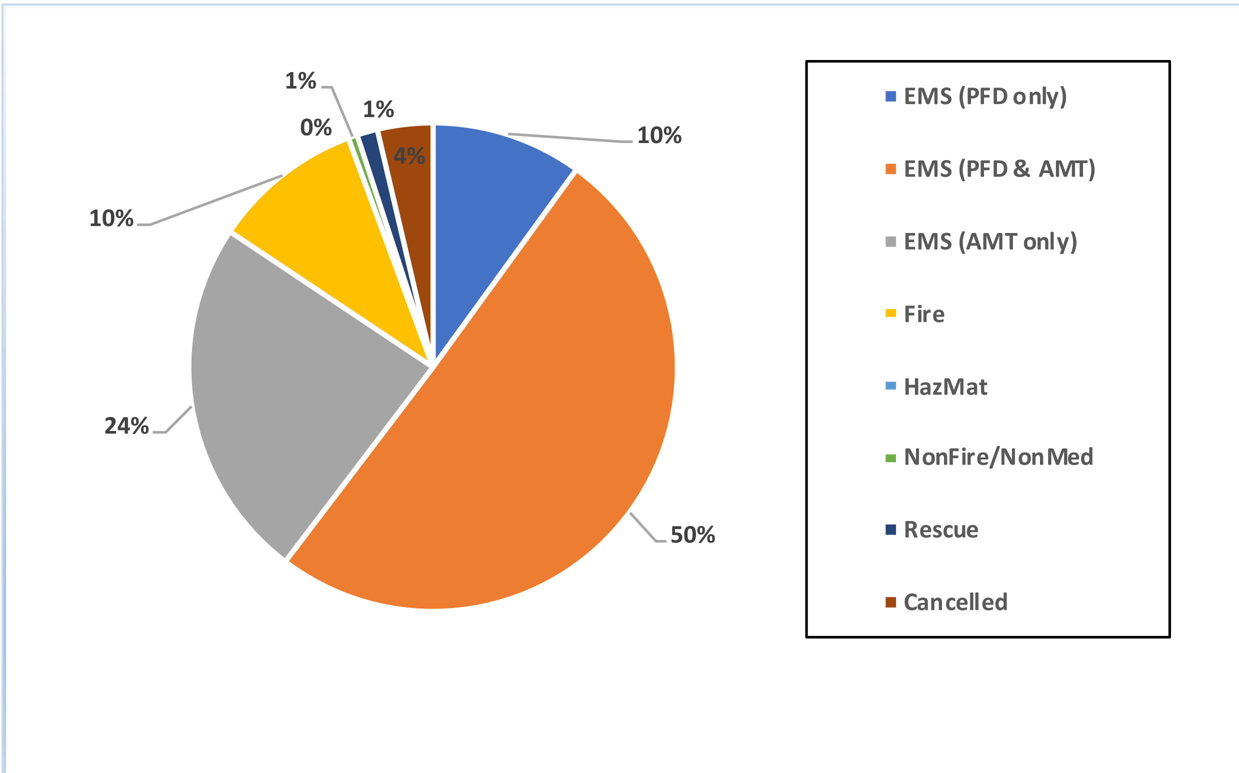
When fewer than 30 instances are available, the dataset was filtered for long duration outliers, and an average and standard deviation specific for the 90th percentile were multiplied to provide a "predicted" 90th percentile. In this manner, small sets of data are handled consistently. The last instance in the list no longer has a magnified and unwarranted influence.

When starting from small samples of real-world data, even these methodologies for developing statistics at the 90th percentile often lead to unreliable results. These types of problems arose in developing statistics of Effective Response Forces (ERF) for several of the First Due Zones, as noted in the text.

COMMUNITY RESPONSE HISTORY

The figure below indicates the incident categories for the Peoria Fire Department and includes AMT's responses to emergency medical incidents. The figure represents the 12-month reporting period from January 1, 2017 through December 31, 2017, hereinafter referred to as CY2017. As expected, EMS incidents represented the largest portion of all incident types. Based on the consultant's experience with similar systems, cancelled incidents appear under-represented.

Figure 31: Percentage of Total Incidents Dispatched by Incident Category



The next figure provides counts of incidents in the categories of EMS, Fire, Rescue, non-Fire/non-Medical and HazMat. The descriptors assigned by the Peoria Fire Department to these incidents were used as much as possible. However, PFD is not rigorously consistent in the use of these descriptors. Some, mostly minor, inconsistencies in incident counts do appear.

Figure 32: Number of Incidents Dispatched by Category

Incident Category	Number of Incidents	Average Incidents per Day	Incident Percentage
Falls	2,740	7.51	10.09%
Breathing Problem	2,556	7.00	9.41%
Sick Person (Specific Diagnosis)	1,850	5.07	6.81%
Traffic / Transportation Incidents	1,508	4.13	5.55%
Chest Pain / Chest Discomfort	1,142	3.13	4.21%
Unconscious / Fainting (Near)	1,105	3.03	4.07%
Convulsions / Seizures	981	2.69	3.61%
Unknown Problem (Person Down)	942	2.58	3.47%
Overdose / Poisoning	579	1.59	2.13%
Stroke (CVA) / Transient Ischemic Attack (TIA)	416	1.14	1.53%
Hemorrhage / Lacerations	364	1.00	1.34%
Assault / Sexual Assault / Stun Gun	327	0.90	1.20%
Diabetic Problem	323	0.88	1.19%
Traumatic Injuries (Specific)	319	0.87	1.17%
Pregancy / Childbirth / Miscarriage	261	0.72	0.96%
Abdominal Pain / Problems	247	0.68	0.91%
Heart Problem / AICD	167	0.46	0.62%
Stab / Gunshot / Penetrating Trauma	151	0.41	0.56%
Psychiatric / Abnormal Behavior / Suicide Attempt	143	0.39	0.53%
Allergies / Envenomations (stings, Bites)	79	0.22	0.29%
Choking	76	0.21	0.28%
Cardiac or Respiratory Arrest / Death	56	0.15	0.21%
Headache	50	0.14	0.18%
Back Pain (NonTraumatic or Non-Recent Trauma	47	0.13	0.17%
EMS call, excluding vehicle accident with injury	42	0.12	0.15%
Eye Problem / Injuries	21	0.06	0.08%
Animal Bites / Attacks	15	0.04	0.06%
MPDS Descriptor Absent	14	0.04	0.05%
Carbon monoxide / Inhalation / Hazmat / CBRN	12	0.03	0.04%
Burns / Explosion	7	0.02	0.03%
Heat / Cold Exposure	7	0.02	0.03%
Drowning / Near Drowning / Diving / SCUBA Accident	5	0.01	0.02%
Electrocution / Lightning	3	0.01	0.01%
Inaccessible Incident / Other Entrapments (Non-Traffic)	1	0.00	0.00%
AMT Priority 1	3,014	8.26	11.10%
AMT Priority 2	4,082	11.18	15.03%
EMS Total	**23,652**	**64.80**	**87.10%**
Reported Structure Fire	1,473	4.04	5.42%
One Engine Response	828	2.27	3.05%
Fire Alarm	242	0.66	0.89%
Brush or Rubbish Fire	135	0.37	0.50%
Vehicle Fire	94	0.26	0.35%
Smoke Alarm	84	0.23	0.31%
One Truck Company Response	60	0.16	0.22%

Incident Category	Number of Incidents	Average Incidents per Day	Incident Percentage
Fire Total	**2,916**	**7.99**	**10.74%**
Waterflow Alarm	145	0.40	0.53%
Carbon Monoxide Alarm Code 2	140	0.38	0.52%
Building Rescue	35	0.10	0.13%
Elevator Rescue No Injury	23	0.06	0.08%
Gas Leak Inside	27	0.05	0.07%
River Rescue	9	0.02	0.03%
Bridge Jumper	3	0.02	0.03%
Building Collapse	2	0.01	0.01%
Rescue Total	**384**	**1.05**	**1.41%**
NonFire/NonMedical	**198**	**0.54**	**0.73%**
HazMat	**4**	**0.01**	**0.01%**
Total Incidents (with PFD Codes)	**27,154**	**74.39**	**100.00%**

In the Peoria CAD, EMS incidents appear under 115 discrete incident codes. The 115 codes were manually consolidated into 31 EMS categories in order to better convey a sense of the actual activities occurring in the system. An additional 20 incidents, identified in the CAD as EMS incidents, were excluded from from the tabulation of EMS incidents because the PFD codes could not be associated with descrete MPDS descriptors.

The number of individual vehicle responses is provided below. A more comprehensive picture of the resources required to meet the requests for service is given by the annual Time-on-task.

Figure 33: Number of Incidents, Number of Responses, and Total Busy Time by Category

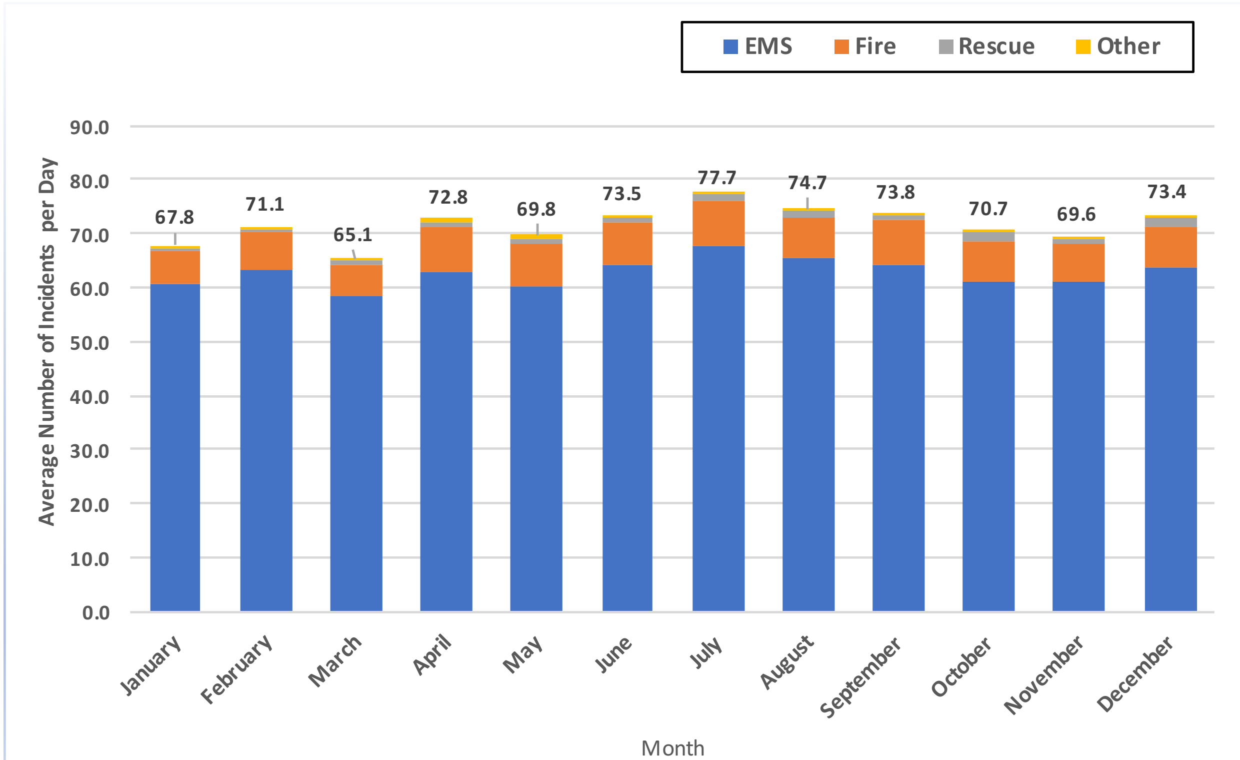
Category	Number of Incidents	AMT Vehicles Assigned	PFD Vehicles Assigned	ToT (hrs) / Year	ToT (min) / Veh	% ToT PFD & AMT	% ToT PFD only
EMS	23,652			7,835.5			
EMS AMT vehicles		22,186		12,887.3	37.76	62.30	
EMS PFD vehicles			19,805	4,948.2	17.51	23.92	63.44%
Fire	2,916		11,694	2,521.0	24.72	12.19	32.32%
Rescue	384		1,332	265.3	20.43	1.28	3.40%
NonFire/NonMed	198		279	56.0	16.88	0.27	0.72%
Hazmat	4	8	14	9.0	67.50	0.04	0.12
Totals	27,154	22,194	33,124				

The higher Time-on-task for AMT vehicles on EMS incidents is a consequence of the transports conducted by AMT. The functions of transporting the patient to the hospital and conducting drop off of the patient consumes time that is not required of PFD vehicles on EMS incidents.

The following temporal analyses were conducted to show the patterns in community demands. These analyses are based on the all incidents with PFD vehicles arrived OnScene. The frequency of incidents was examined by month of year, day of week, and hour of day.

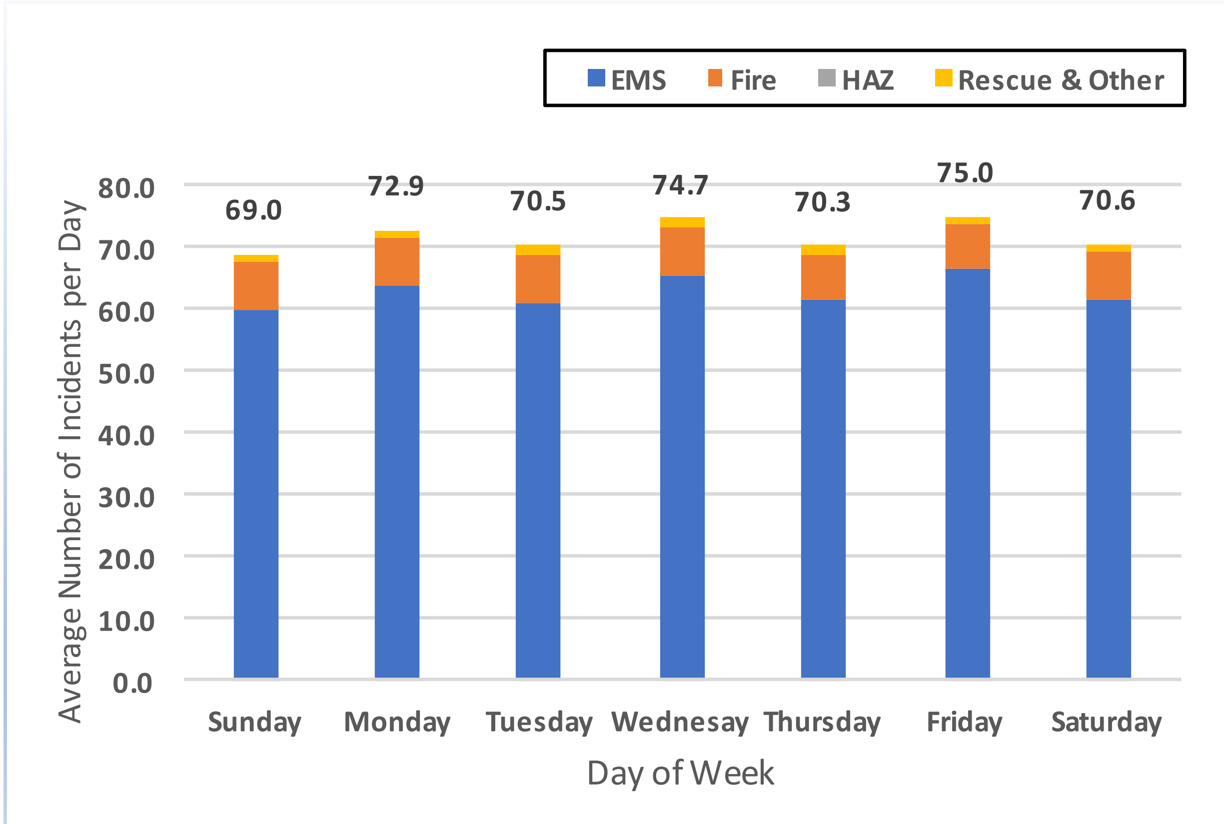
The figure below presents the variation of incident demands by month of year and shows a relatively minimal variation from month to month. Because of the very small number of incidents, Hazmat and non-Fire/non-Medical were grouped into an "Other" category for presentation purposes.

Figure 34: Overall: Average Incidents per Day by Month



The next figure reflects the average number of incidents by day of week. There appears to be minimal variation from day to day, however, the highest average number of incidents occur on Fridays.

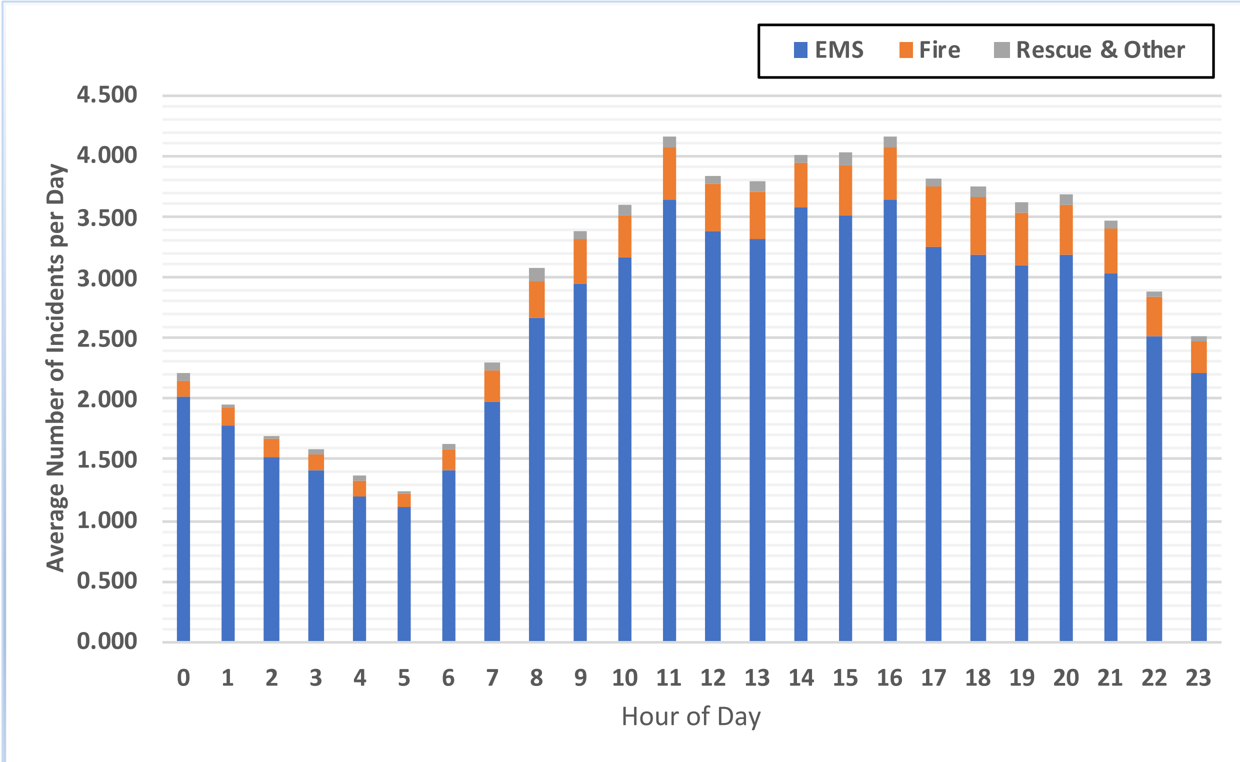
Figure 35: Overall: Average Incidents per Day by Day of Week



The average number of incidents by hour of day are presented in the figure that follows.

The hourly incident count tapers off after midnight and reaches a minimum at 0500 hours. The hourly incident count builds up through the morning and reaches a broad, but irregular, plateau from 1000 hours through 2100 hours.

Figure 36: Overall: Average Incidents per Hour by Hour of Day



Temporal distributions of incidents related to hour of day were created for each of PFD's 12 fire stations and are displayed in the figures that follow. These reflect station-specific demands for service.

Figure 37: Average Incidents per Hour by Hour of Day for Station 1

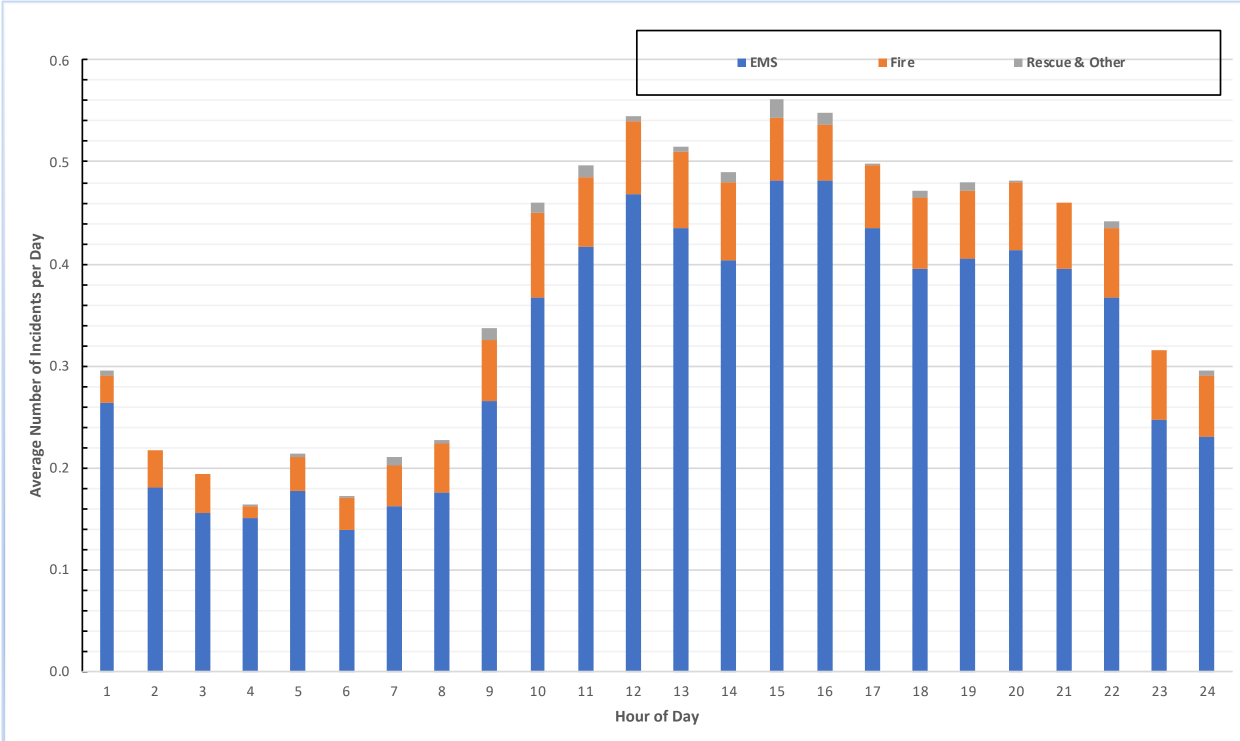


Figure 38: Average Incidents per Hour by Hour of Day for Station 8

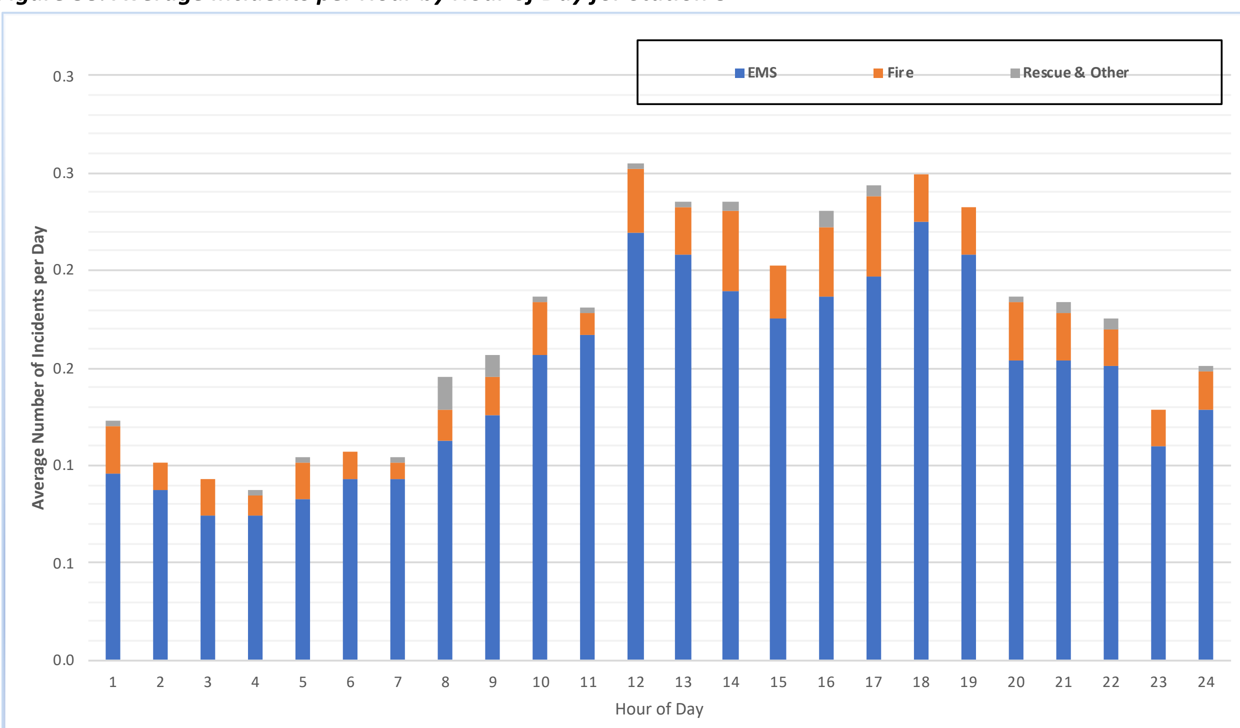


Figure 39: Average Incidents per Hour by Hour of Day for Station 3

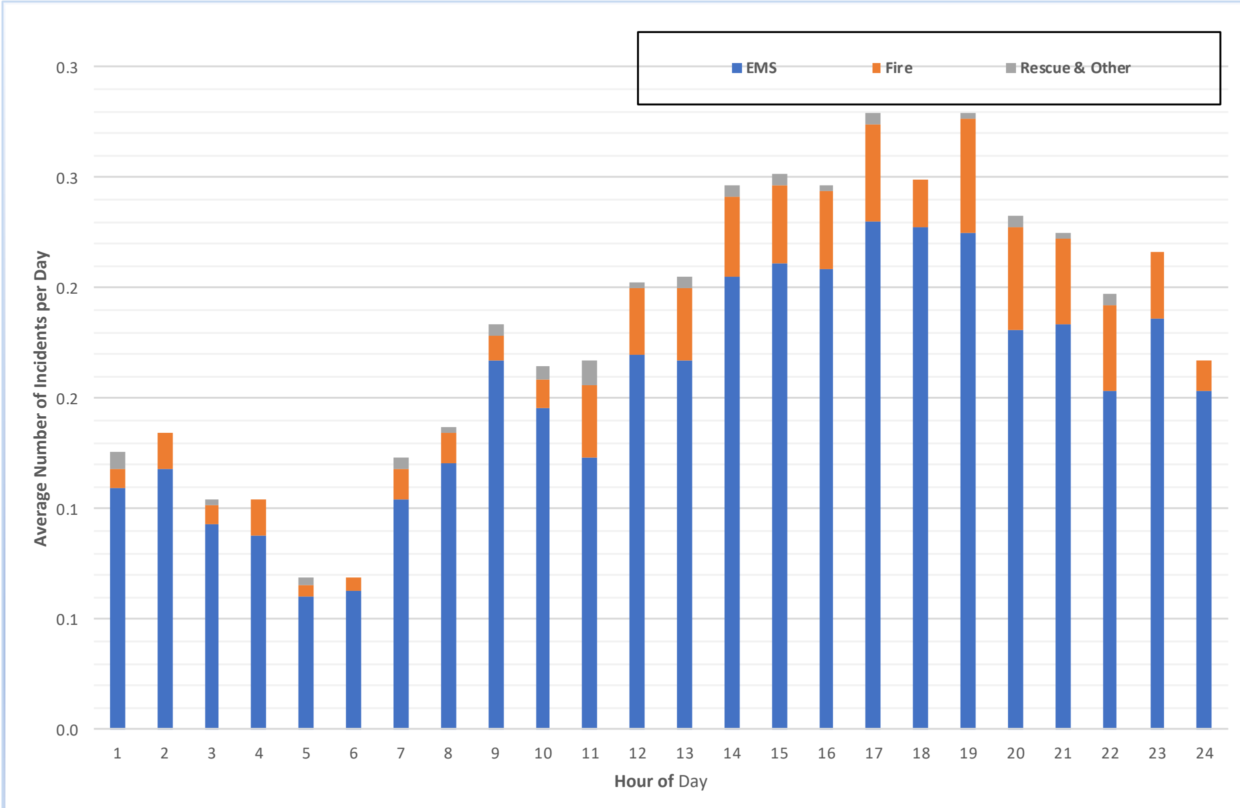


Figure 40: Average Incidents per Hour by Hour of Day for Station 4

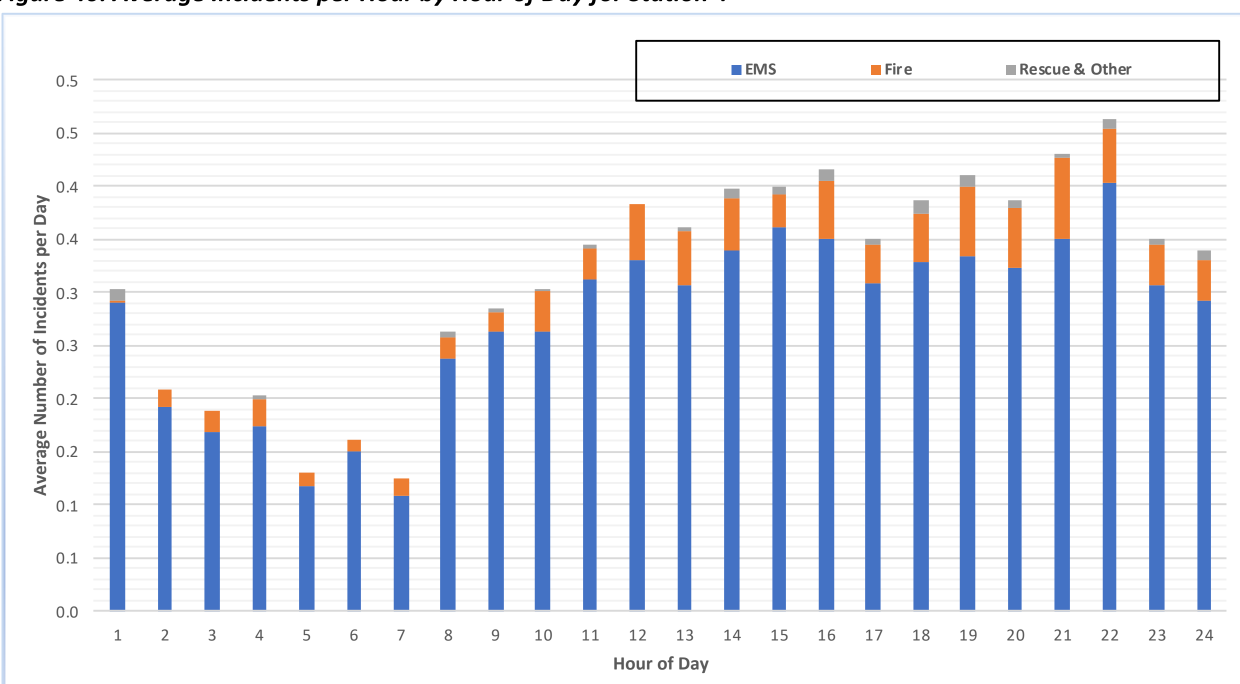


Figure 41: Average Incidents per Hour by Hour of Day for Station 10

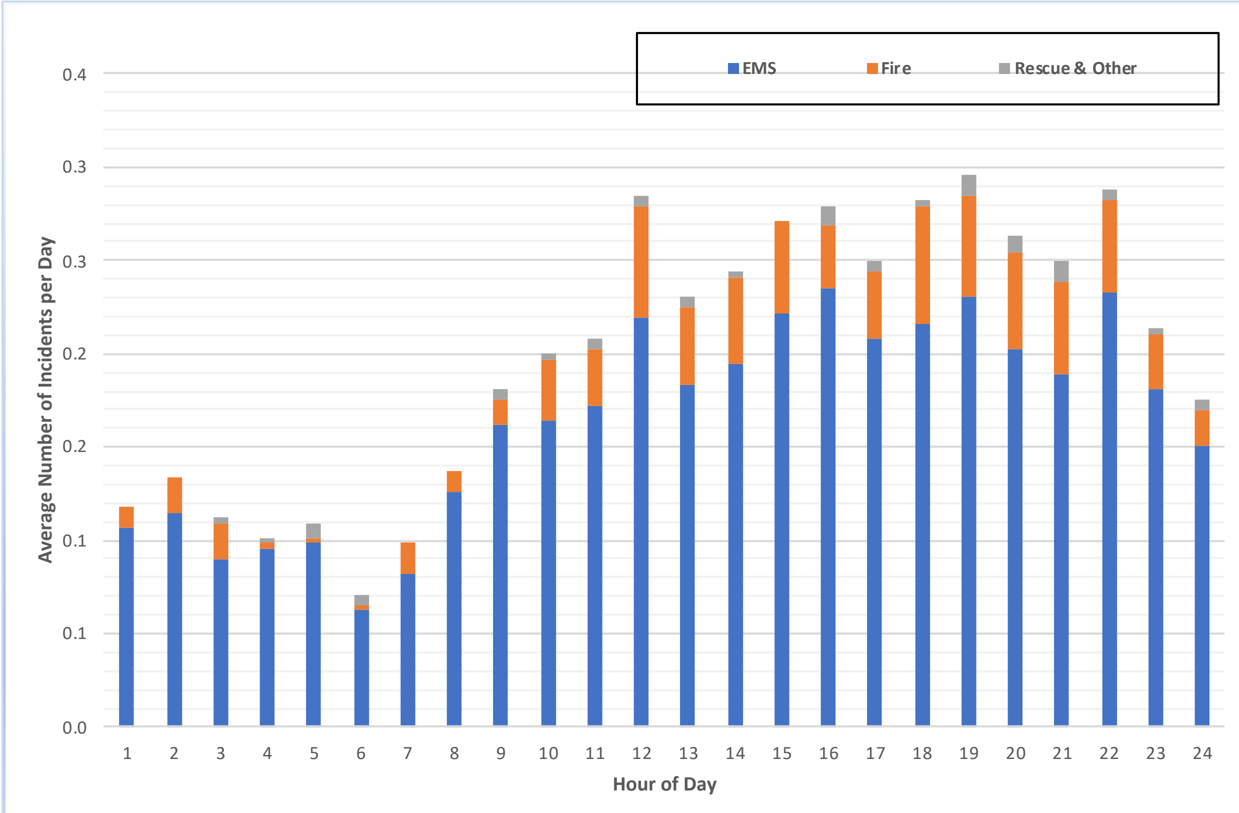


Figure 42: Average Incidents per Hour by Hour of Day for Station 11

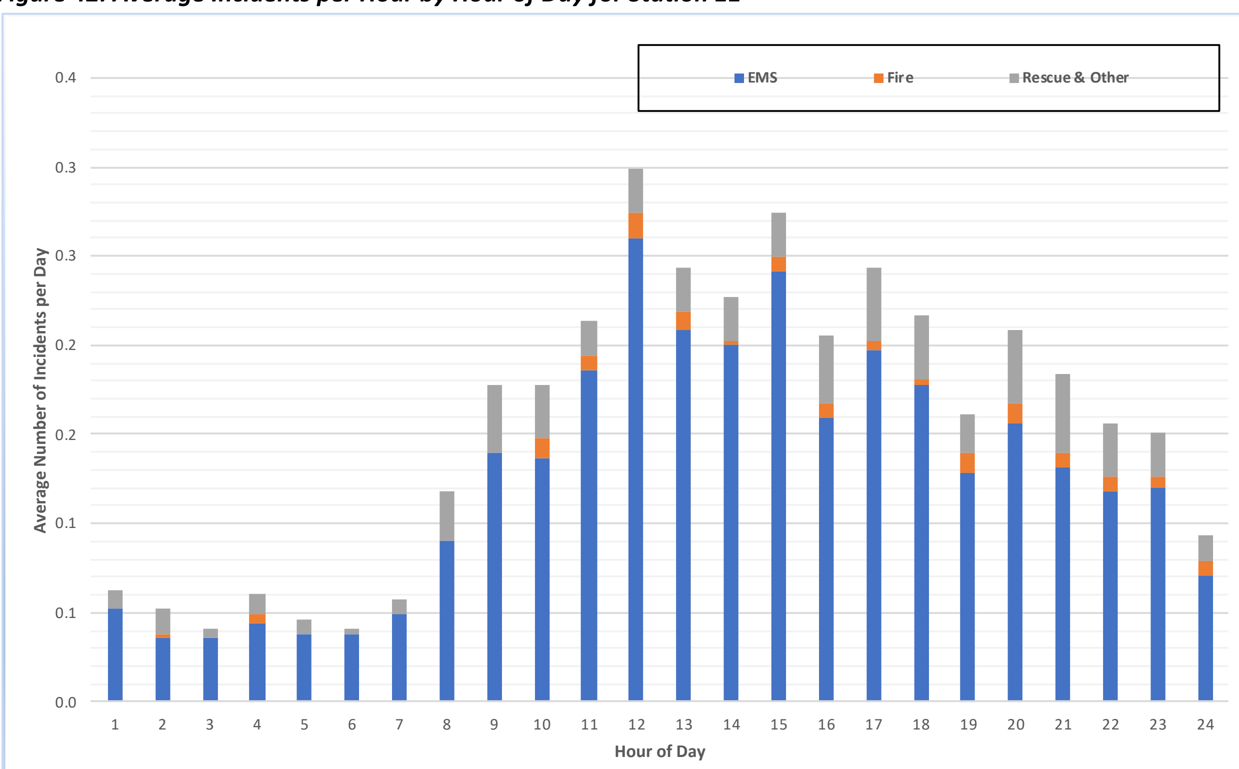


Figure 43: Average Incidents per Hour by Hour of Day for Station 12

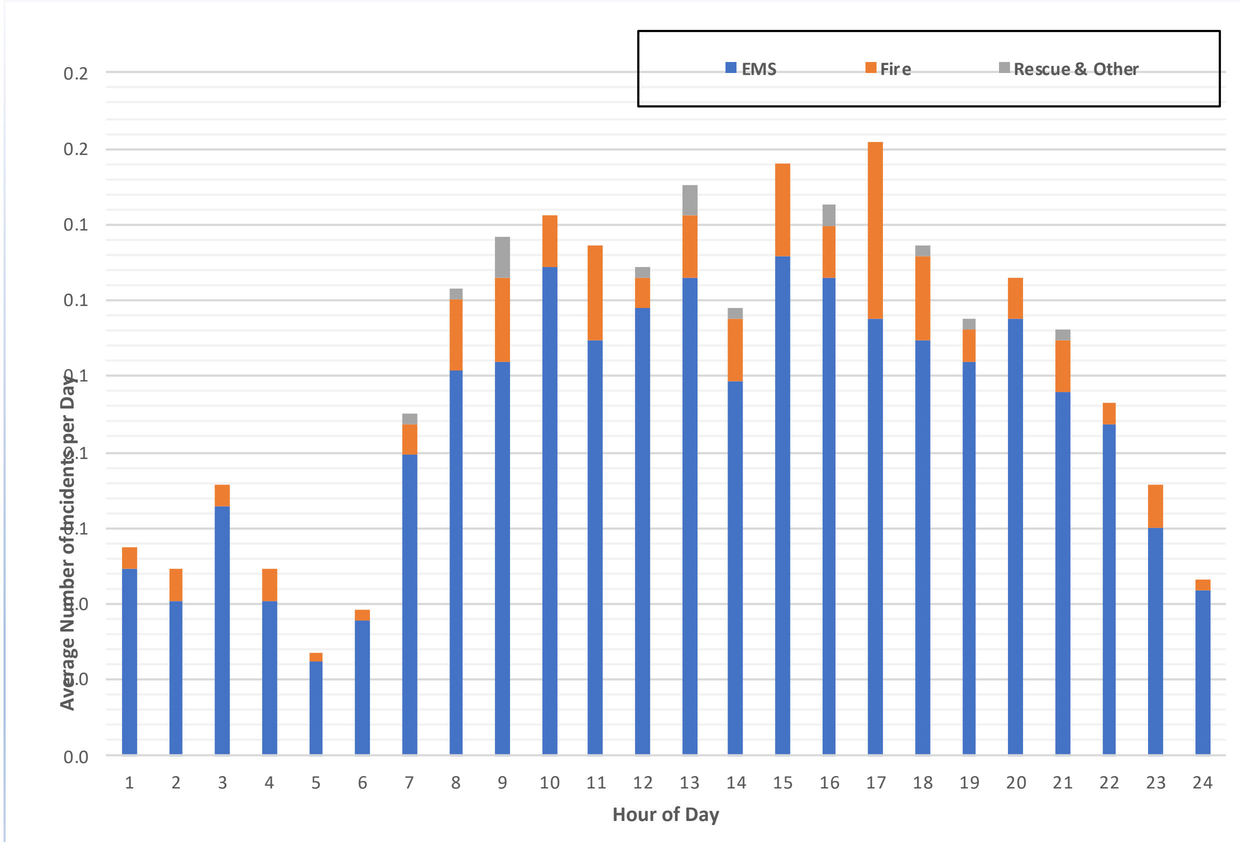


Figure 44: Average Incidents per Hour by Hour of Day for Station 13

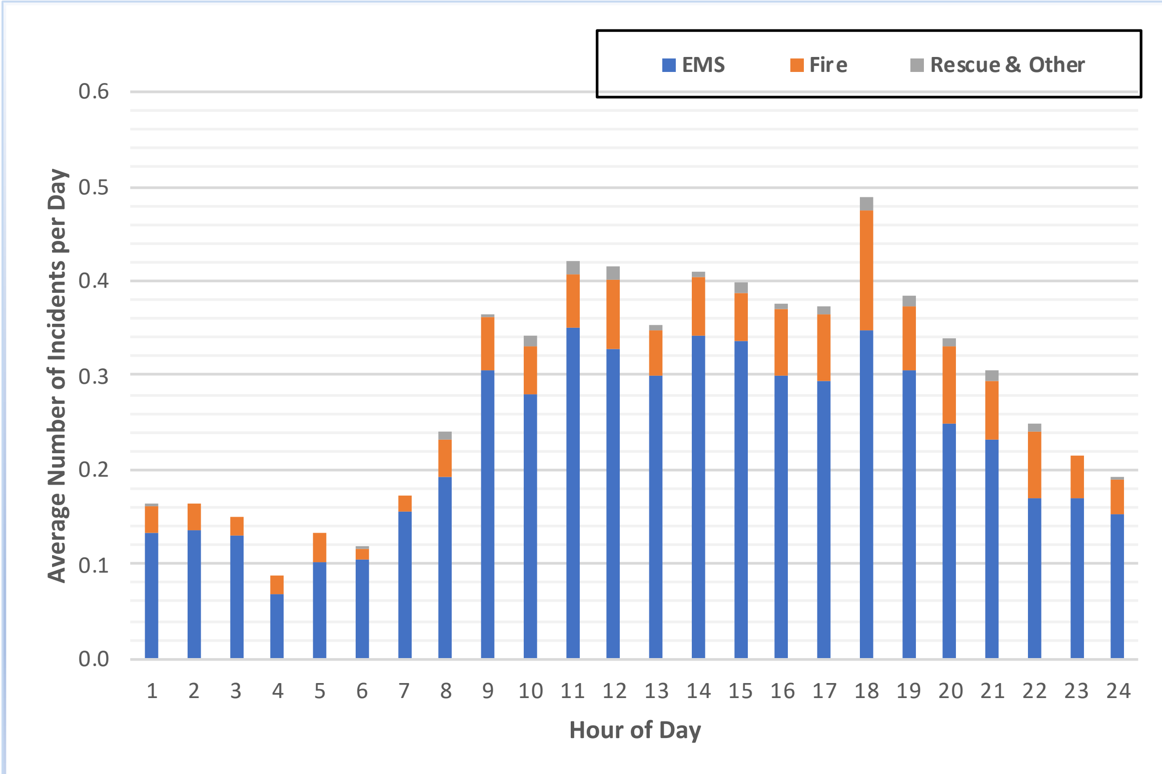


Figure 45: Average Incidents per Hour by Hour of Day for Station 15

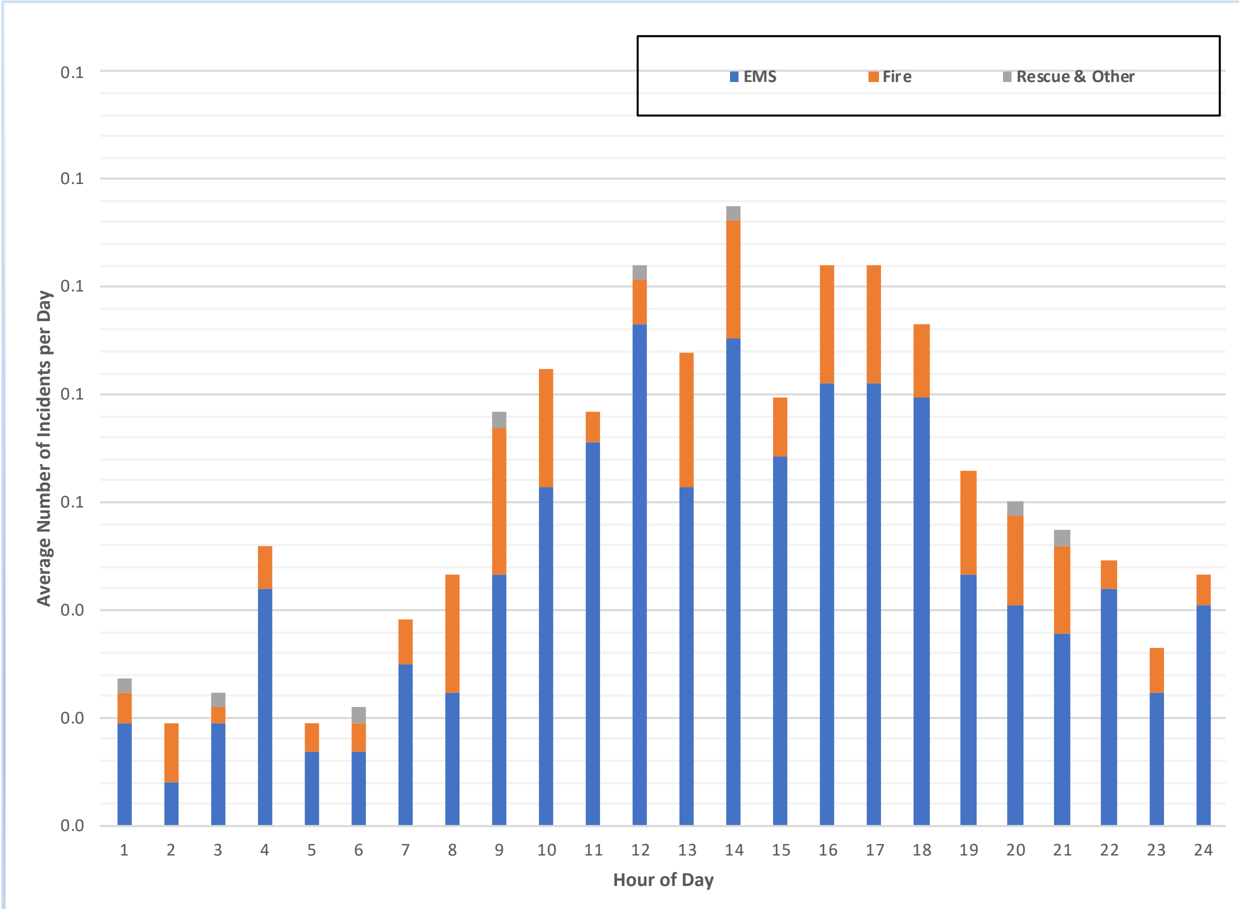


Figure 46: Average Incidents per Hour by Hour of Day for Station 16

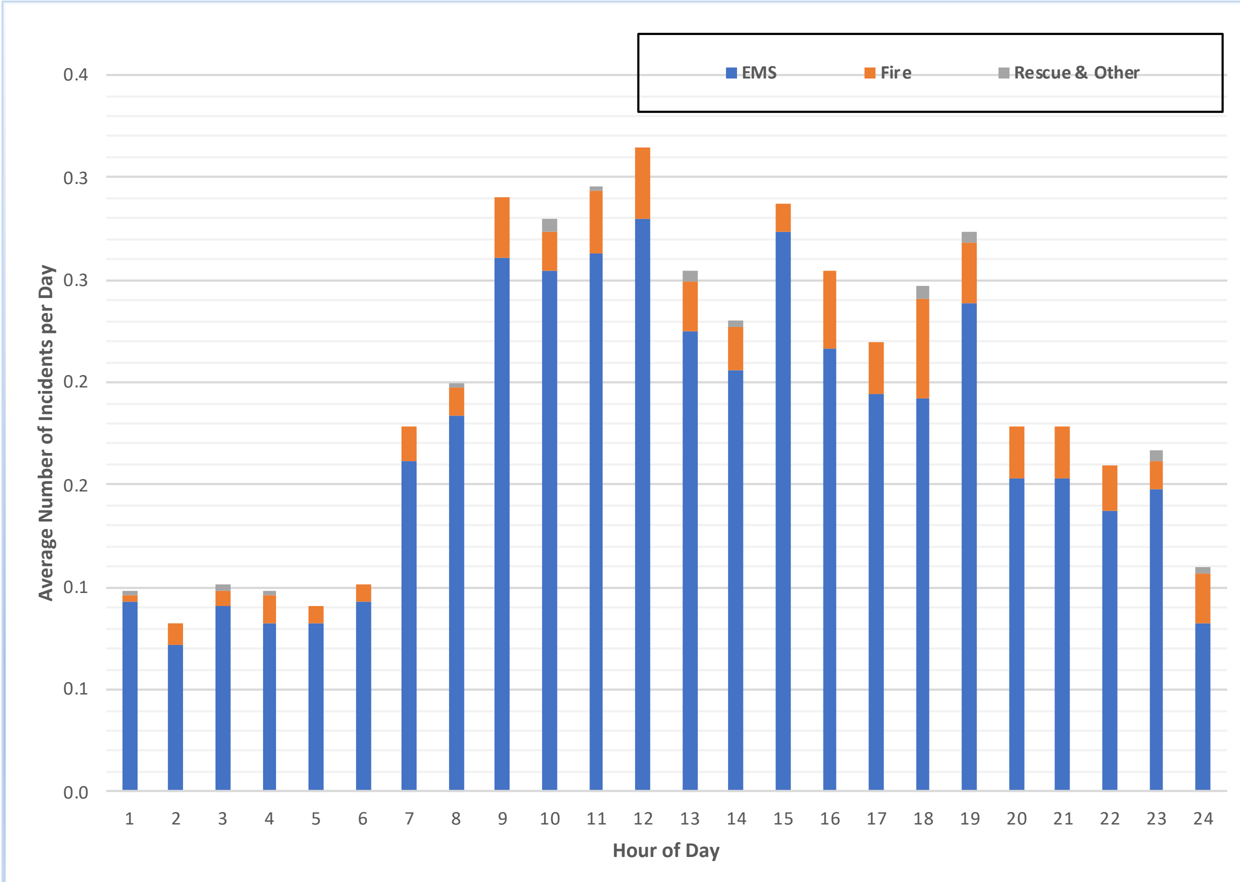


Figure 47: Average Incidents per Hour by Hour of Day for Station 19

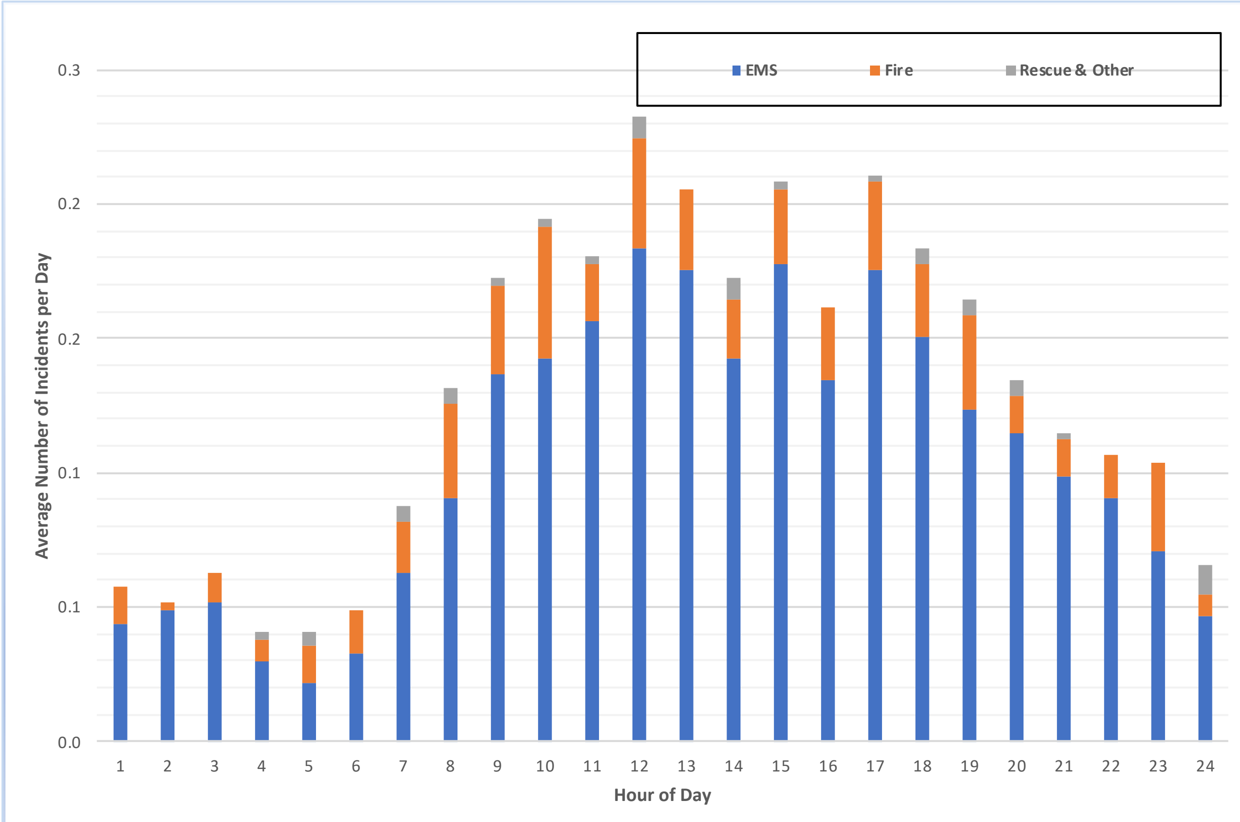
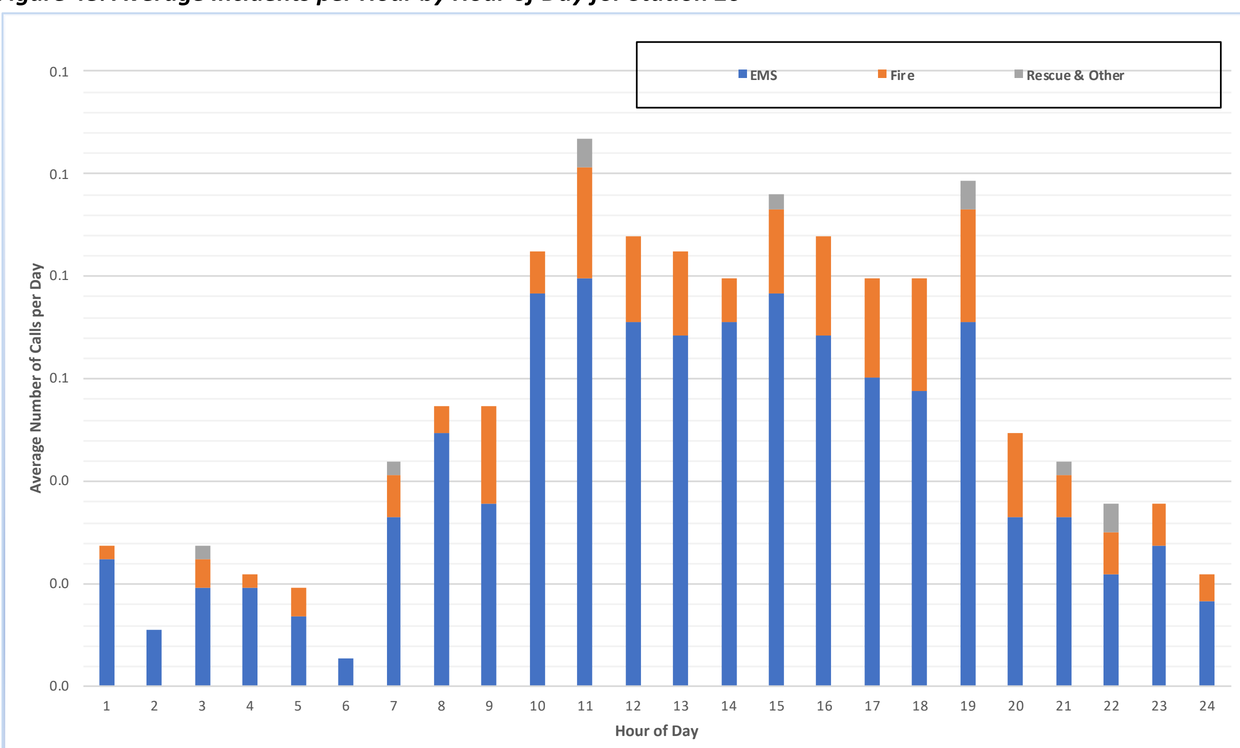


Figure 48: Average Incidents per Hour by Hour of Day for Station 20



In the figure below, annual vehicle response is a count of vehicles assigned. Annual Time-on-task in this figure, is a summation of the intervals between vehicle assigned and vehicle cleared. Vehicles cancelled enroute, without arrival OnScene, are captured in these accountings. Annual time-on-task at the station level is relevant to deployment decisions.

Figure 49: Overall Workload by Station

Station	Annual Vehicle Responses	Annual Time on Task (hr:min:sec)	Average Time on Task per Response (hr:min:sec)
1	7,652	1800:38:52	00:14:07
4	3,679	908:21:58	00:14:49
3	3,698	831:51:15	00:13:30
16	3,416	840:11:20	00:14:45
13	2,880	756:16:01	00:15:45
10	2,376	584:38:15	00:14:46
8	2,032	510:55:40	00:15:05
11	2,151	504:38:52	00:14:04
19	1,386	384:11:55	00:16:38
12	1,166	360:16:46	00:18:32
15	869	253:34:19	00:17:30
20	820	236:48:46	00:17:20
Fleet Statistics	**32,125**	**7972:23:59**	**00:14:54**

Stations that house multiple response units will typically respond to more incidents and accrue more annual Time-on-task than do stations that house only one unit. The data for each PFD response unit is provided below, organized by station. The Unit Hour Utilization, UHU, is the ratio of the unit's annual Time-on-task divided by 8,760 hours, the number of hours in one year.

Annual Time-on-task at the unit level is relevant to measure the utilizations of physical apparatus, and helps inform apparatus procurement or maintenance decisions.

Figure 50: Overall Workload by Unit

Sta.	Unit	Unit Type	Annual Responses	Annual Time on Task	Time on Task / Response	Unit Hour Utilization
1	E1	ENGINE	2,289	506:21:46	00:13:16	0.058
	T1	TRUCK	1,033	264:49:33	00:15:23	0.030
	R1	RESCUE	3,144	719:16:53	00:13:44	0.082
	B1	BATT	1,162	293:16:11	00:15:09	0.033
	MR1	MARINE	19	13:14:26	00:41:49	0.002
	HM1	HAZMAT	5	03:40:03	00:44:01	0.000
	Station 1 Total		**7,652**	**1800:38:52**	**00:14:07**	
3	E3	ENGINE	2,544	594:29:51	00:14:01	0.068
	T3	TRUCK	1,154	237:21:24	00:12:20	0.027
	Station 3 Total		**3,698**	**831:51:15**	**00:13:30**	
4	E4	ENGINE	2,843	682:00:04	00:14:24	0.078
	T4	TRUCK	836	226:21:54	00:16:15	0.026
	Station 4 Total		**3,679**	**908:21:58**	**00:14:49**	
8	E2	ENGINE	2,032	510:55:40	00:15:05	0.058
	Station 8 Total		**2,032**	**510:55:40**	**00:15:05**	
10	E10	ENGINE	2,376	584:38:15	00:14:46	0.067
	Station 10 Total		**2,376**	**584:38:15**	**00:14:46**	
11	R2	RESCUE	2,151	504:38:52	00:14:04	0.058
	Station 11 Total		**2,151**	**504:38:52**	**00:14:04**	
12	E12	ENGINE	1,166	360:16:46	00:18:32	0.041
	Station 12 Total		**1,166**	**360:16:46**	**00:18:32**	
13	E13	ENGINE	2,880	756:16:01	00:15:45	0.086
	Station 13 Total		**2,880**	**756:16:01**	**00:15:45**	
15	E15	ENGINE	869	253:34:19	0:17:30	0.029
	Station 15 Total		**869**	**253:34:19**	**00:17:30**	
16	E16	ENGINE	2,211	548:04:50	00:14:52	0.063
	T14	TRUCK	1,205	292:06:30	00:14:32	0.033
	Station 16 Total		**3,416**	**840:11:20**	**00:14:45**	
19	E19	ENGINE	1,386	384:11:55	00:16:38	0.044
	Station 19 Total		**1,386**	**384:11:55**	**00:16:38**	
20	E20	ENGINE	820	236:48:46	00:17:20	0.027
	Station 20 Total		**820**	**236:48:46**	**00:17:20**	
	Totals		**32,125**	**7972:23:59**	**00:14:53**	

The last analysis of this section follows. Data is specifically for vehicles first arrived OnScene for the various incident categories. Four time intervals are included that describe the conduct of the incident. Response time is calculated as the interval from when an incident was received until a unit first arrived OnScene.

For a single unit and a single incident, response time is equal to the sum of dispatch, turnout, and travel intervals. Rigorous additivity does not hold when dealing with average values for these intervals because the list of instances that went into calculating each average value are not all exactly the same. These differences show up in the sample counts.

Figure 51: Average Dispatch, Turnout, Travel, and Response Intervals in Minutes:Seconds of First Arriving Units by Incident Category

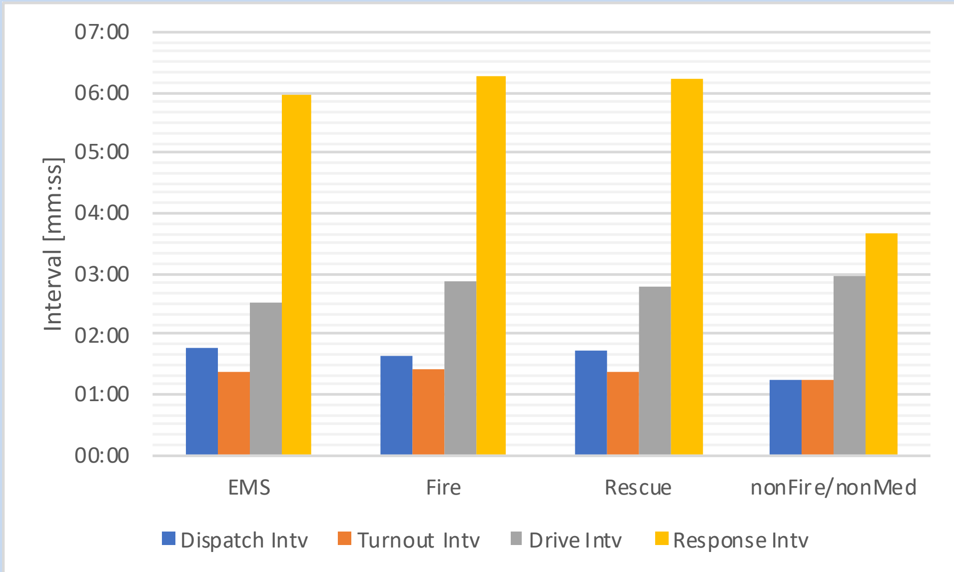
Incident Category	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	Average	Sample	Average	Sample	Average	Sample	Average
EMS	11,646	01:46	11,877	01:24	11,794	02:31	12,185	05:58
Fire	2,446	01:38	2,539	01:26	2,501	02:54	2,602	06:17
Rescue	330	01:44	347	01:24	347	02:48	350	06:13
nFnM	136	01:15	82	01:16	81	02:59	146	03:39
HazMat	1	03:52	1	00:49	1	00:29	1	14:19
All	14,559	01:45	14,846	01:24	14,724	02:35	15,284	06:00

The sample counts vary from interval to interval in the figure above because all of the timestamps needed to describe all of the status changes for each first arriving unit were not recorded into the CAD. Omissions occurred.

Average durations for Dispatch, Turnout, and Drive intervals are graphically depicted below. These data are for units first arrived OnScene.

Typically, performance varies across incident categories due to a variety of reasons. For example, the turnout interval may be longer for fire related incidents 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 response times due to their size and lack of maneuverability. This said, the turnout interval actually experienced for the Peoria FD is longer on EMS incidents than on FIRE incidents.

Figure 52: Average Dispatch, Turnout, Travel Time, and Response Intervals of First Arriving Units by Category



The following figures present durations for Dispatch, Turnout, and Drive intervals, but at the 90th percentile. This metric is another way to characterize the distribution of response intervals that are encountered even under normal operations. For example, if a response interval is reported as 06:00 at the 90th percentile, first responders will arrive OnScene in 6 minutes, zero seconds or less, nine incidents out of ten.

Many industry standards for response intervals are couched in terms of 90th percentiles. Calculation of 90th percentiles in this report facilitates direct comparison with these standards.

For a single unit and a single incident, response time is equal to the sum of dispatch, turnout, and travel intervals. Rigorous additivity does not hold for sums of averages values for these intervals because the instances that went into calculating the value of each statistic are not all exactly the same. These differences show up in the sample counts.

Figure 53: 90th Percentile Dispatch, Turnout, Travel, and Response Intervals of First Arriving Units by Incident Category

0	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]
EMS	11,646	03:01	11,877	02:05	11,794	04:22	12,185	08:43
Fire	2,446	02:57	2,539	02:08	2,501	05:06	2,602	09:46
Rescue	330	03:05	347	02:05	347	04:44	350	08:54
Other	136	02:47	82	01:56	81	05:00	146	08:33
HazMat	1		1		1		1	
All	14,559	03:02	14,846	02:06	14,724	04:32	15,284	08:53

Data indicate that both the average and 90th percentile travel times and total response times for fire incidents were slightly longer than for EMS incidents. As expected, significant variability is introduced in responses for hazmat and rescue Incidents due to their small sample sizes.

For a single unit and a single incident, response time is equal to the sum of dispatch, turnout, and travel intervals. Rigorous additivity does not hold for sums of 90^{th} percentile values for these intervals because the instances that went into calculating the value of each statistic are not all exactly the same. These differences show up in the sample counts.

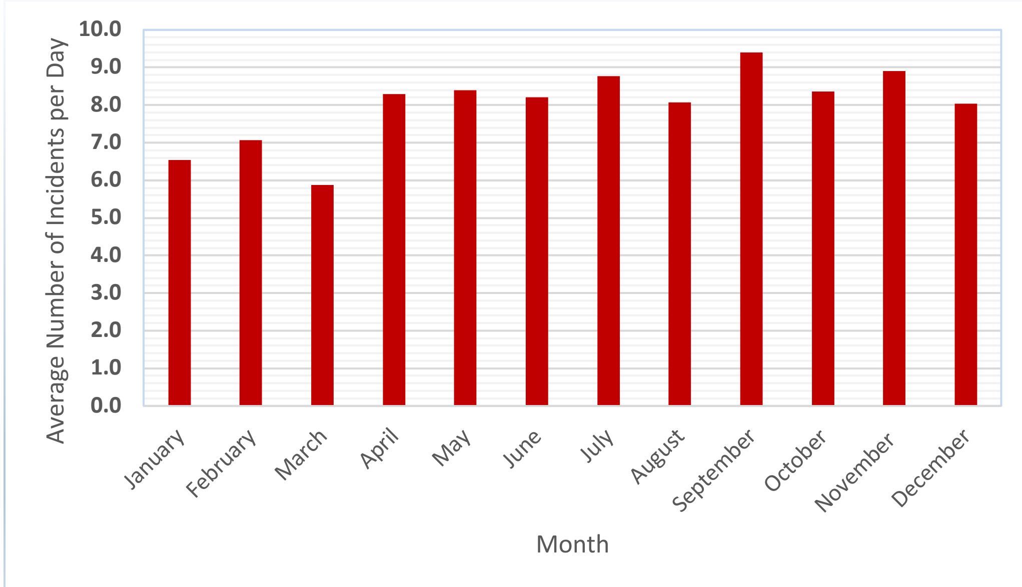
Fire Services

Temporal analyses were conducted to evaluate patterns in community demands for fire related services. These analyses examined the frequency of requests for service in CY2017 by month, day of week, and hour of day. The number of incidents and average number of incidents per day and by month are indicated below, which is followed by a graphic representation of the same data.

Figure 54: Total Fire Related Incidents and Average Incidents per Day by Month

Month	Number of Incidents	Average Incidents per Day	Call Percentage
January	203	6.55	6.96%
February	198	7.07	6.79%
March	182	5.87	6.24%
April	249	8.30	8.54%
May	260	8.39	8.91%
June	246	8.20	8.43%
July	272	8.77	9.32%
August	250	8.06	8.57%
September	282	9.40	9.67%
October	259	8.35	8.88%
November	267	8.90	9.15%
December	249	8.03	8.54%
Total	2,917	**7.99**	**100.00%**

Figure 55: Average Fire Related Incidents per Day by Month



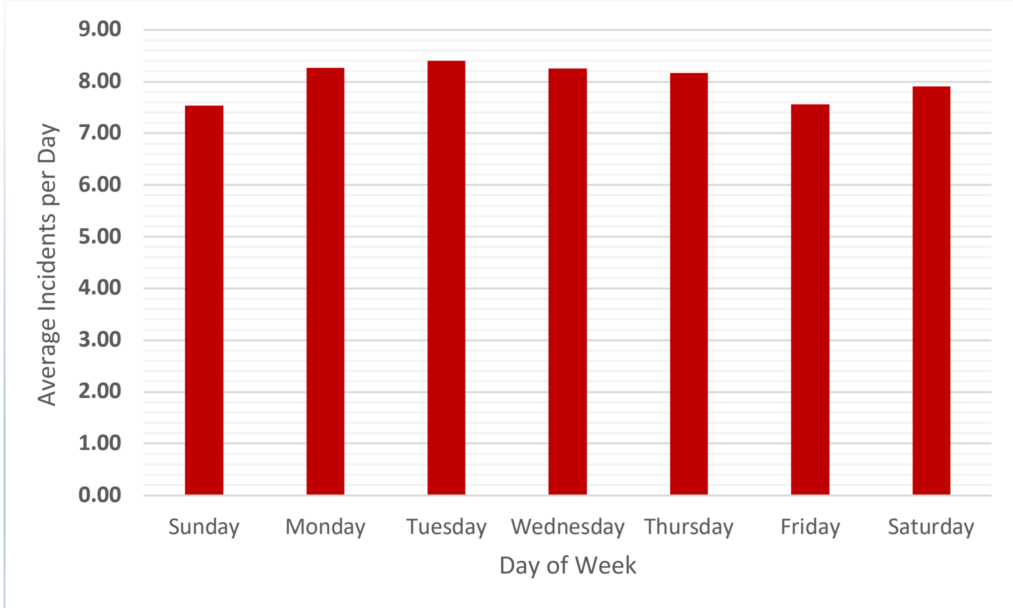
The highest average number of fire incidents occurred in the three months of May, July, and September. Similar analyses were conducted for fire related incidents by day of week and are reflected in the tabular and graphic figures that follow.

Figure 56: Total Fire Related Incidents and Average Incidents per Day by Day of Week

Day of Week	Incidents Per Day	Average Incidents per Day	Daily Percentage of Total
Sunday	392	7.54	13.44%
Monday	430	8.27	14.74%
Tuesday	437	8.40	14.98%
Wednesday	429	8.25	14.71%
Thursday	425	8.17	14.57%
Friday	393	7.56	13.47%
Saturday	411	7.90	14.09%
Total	**2,917**	7.99	**100.0%**

The data revealed that there is only slight variability in the number of fire incidents services by day of week.

Figure 57: Average Fire Related Incidents per Day by Day of Week

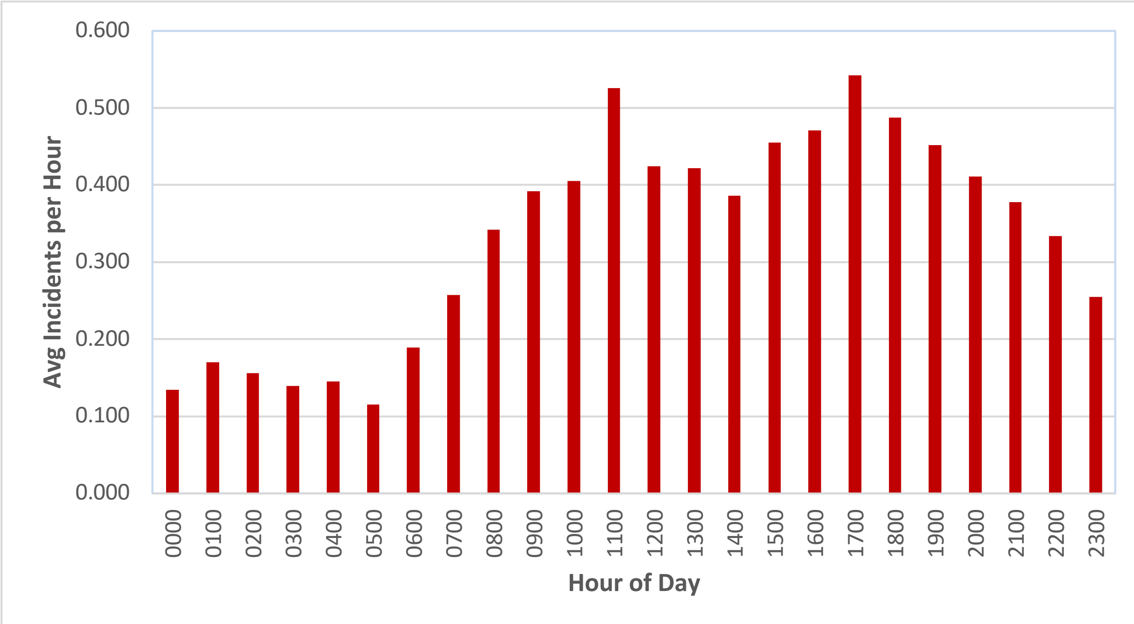


Fire related Incidents were also evaluated by hour of the day and are reported.

Figure 58: Total Fire Related Incidents and Average Incidents per Hour by Hour of Day

Hour of Day	Number of Incidents	Average Incidents per Hour	Fire Incidents Percentage
0	49	0.13424658	1.80%
1	62	0.16986301	2.28%
2	57	0.15616438	2.09%
3	51	0.13972603	1.87%
4	53	0.14520548	1.95%
5	42	0.11506849	1.54%
6	69	0.1890411	2.54%
7	94	0.25753425	3.45%
8	125	0.34246575	4.59%
9	143	0.39178082	5.26%
10	148	0.40547945	5.44%
11	192	0.5260274	7.06%
12	155	0.42465753	5.70%
13	154	0.42191781	5.66%
14	141	0.38630137	5.18%
15	166	0.45479452	6.10%
16	172	0.47123288	6.32%
17	198	0.54246575	7.28%
18	178	0.48767123	6.54%
19	165	0.45205479	6.06%
20	150	0.4109589	5.51%
21	138	0.37808219	5.07%
22	122	0.33424658	4.48%
23	93	0.25479452	3.42%
Total	**2,917**	**7.99**	**100.0%**

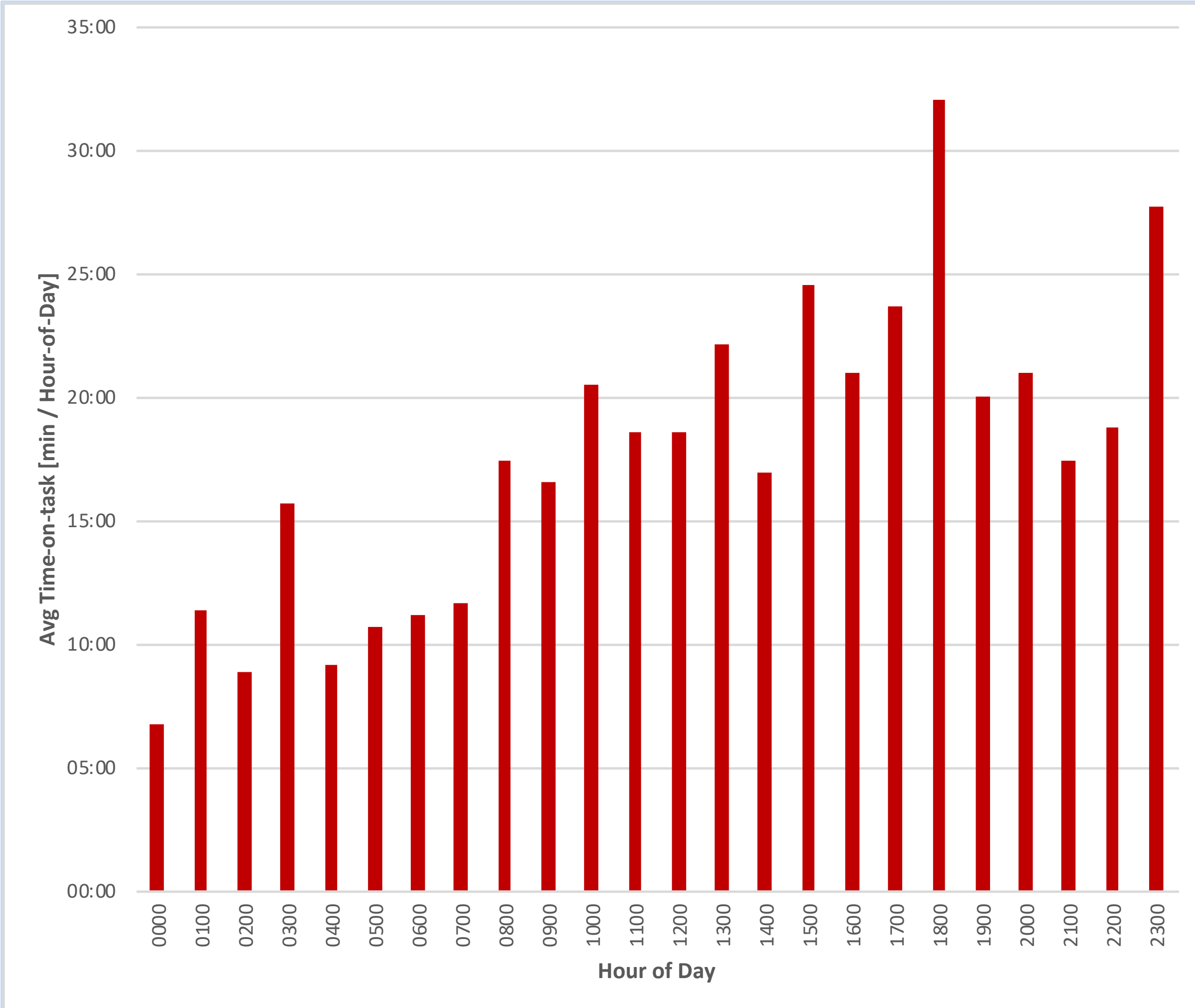
Figure 59: Average Fire Related Incidents per Hour by Hour of Day



Variability exists in the time of day that requests for fire related services were received. PFD's hourly pattern of fire service requests is similar to that experienced by other urban fire agencies.

The average time-on-task was evaluated to assess the demand for resources through the lens of time commitment per hour because many fire related incidents require multi-unit responses on long duration incidents. Thus, a count of incidents under-represents the resources the department must commit to these incidents. Time-on-task by hour of day is presented.

Figure 60: Average Time-on-Task per Hour by Hour of Day for Fire Related Incidents



The average time-on-task per unit at 0300 hours and at 2300 hours are due to several major structure fires, with multiple vehicles arrived OnScene, that occurred at these particular hours of day.

Fire related incidents are an aggregated category of the various final incident types available in the CAD databases. The following figure provides details of these fire related incidents by the nature of the incident found in CAD. Reported Structure Fire was the most frequently occurring fire related incident. This distribution of fire related incidents is quite different than found in similar agencies, and it does not align well with the incident type found upon arrival of the fire department as reflected within the agency's fire reports. Based on fire reports filed with the Office of the Illinois State Fire Marshal over a five-year period (2012 thru 2016), the department averaged 298 structure fires per year compared to the 1,473 noted below. Based on the department's fire reports, there were 1,499 fire alarm incidents during 2017 compared to 242 identified in CAD records. This reversal in counts of reported structure fires versus fire alarms are at a magnitude of approximately 5:1, and reflects challenges within the 911 Center to properly categorize incident types.

Figure 61: Total Fire Related Incidents by Incident Descriptor Logged into the CAD

Incident Descriptor	Number of Incidents	Average Incidents per Day	Percentage of Total Fire Incidents
Reported Structure Fire	1,473	4.04	50.51%
One Engine Response	828	2.27	28.40%
Fire Alarm	242	0.66	8.30%
Brush or Rubbish Fire	135	0.37	4.63%
Vehicle Fire	94	0.26	3.22%
Smoke Alarm	84	0.23	2.88%
One Truck Company Response	60	0.16	2.06%
Total	2,916	7.99	100.00%

The following provides time-on-task for units in each station. The unit hour utilization for each unit is also reported.

Figure 62: Workload by Unit for Fire Related Incidents

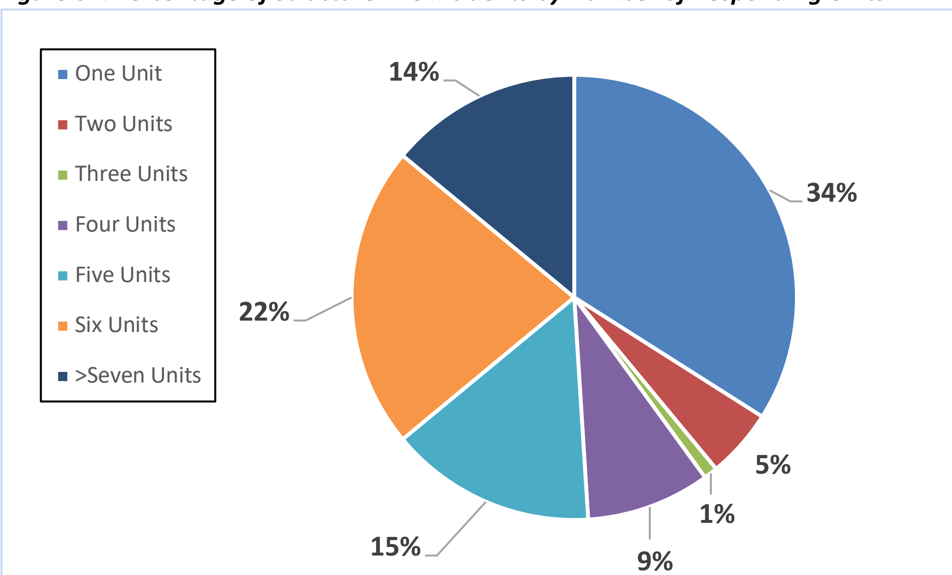
Station	Unit	Unit Type	Annual Number Arrivals on Scene	Annual Time on Task	Time on Task per Response	Unit Hour Utilization
1	E1	ENGINE	998	206:12:06	00:12:24	0.024
	T1	TRUCK	687	178:54:08	00:15:37	0.020
	R1	RESCUE	875	179:47:09	00:12:20	0.021
	B1	BATT	1,008	249:25:58	00:14:51	0.028
	MR1	MARINE	2	00:32:33	00:16:17	0.000
	HM1	HAZMAT	-	00:00:00	00:00:00	0.000
	Station 1 Total		**3,570**	**814:51:54**	**00:13:42**	
3	E3	ENGINE	1,040	221:22:57	00:12:46	0.025
	T3	TRUCK	688	132:30:11	00:11:33	0.015
	Station 3 Total		**1,728**	**353:53:08**	**00:12:17**	
4	E4	ENGINE	498	120:03:46	00:14:28	0.014
	T4	TRUCK	302	100:00:50	00:19:52	0.011
	Station 4 Total		**800**	**220:04:36**	**00:16:30**	
8	E2	ENGINE	720	153:17:51	00:12:46	0.017
	Station 8 Total		**720**	**153:17:51**	**00:12:46**	
10	E10	ENGINE	748	145:48:11	00:11:42	0.017
	Station 10 Total		**748**	**145:48:11**	**00:11:42**	
11	R2	RESCUE	580	85:51:08	00:08:53	0.010
	Station 11 Total		**580**	**85:51:08**	**00:08:53**	
12	E12	ENGINE	313	70:10:00	00:13:27	0.008
	Station 12 Total		**313**	**70:10:00**	**00:13:27**	
13	E13	ENGINE	701	166:06:10	00:14:13	0.019
	Station 13 Total		**701**	**166:06:10**	**00:14:13**	
15	E15	ENGINE	401	90:51:05	00:13:36	0.010
	Station 15 Total		**401**	**90:51:05**	**00:13:36**	
16	E16	ENGINE	646	131:20:51	00:12:11	0.015
	T14	TRUCK	595	123:45:20	00:12:28	0.014
	Station 16 Total		**1,241**	**255:06:11**	**00:12:20**	
19	E19	ENGINE	460	93:27:23	00:12:11	0.011
	Station 19 Total		**460**	**93:27:23**	**00:12:11**	
20	E20	ENGINE	356	71:37:22	00:12:04	0.008
	Station 20 Total		**356**	**71:37:22**	**00:12:04**	
	Total All		**11,618**	**2310:18:20**	**00:13:17**	

The following reflects the number of responding PFD units by fire related call type and the figure after indicates the percentage of structure fire calls by number of responding units. Of all fire type incidents, 56% were handled with a single responding fire unit.

Figure 63: Number of Responding Units by Fire Incident Type

Call Category	Number of Responding PFD Units							Total
	1	2	3	4	5	6	7 or more	
Brush or Rubbish Fire	117	14	4	1	0	0	0	136
Fire Alarm	9	1	0	42	54	82	54	242
One Engine Response	713	90	15	2	1	6	1	828
One Truck Compnay Response	45	14	0	1	0	0	0	60
Reported Structure Fire	48	3	2	203	354	525	338	1,473
Smoke Alarm	2	1	1	8	26	29	17	84
Vehicle Fire	59	24	6	1	2	1	1	94
Total	**993**	**147**	**28**	**258**	**437**	**643**	**411**	**2,917**
Percentage	**34%**	**5%**	**1%**	**9%**	**15%**	**22%**	**14%**	**100%**

Figure 64: Percentage of Structure Fire Incidents by Number of Responding Units



Emergency Medical Services

The following tabulations include EMS incidents on which at least one PFD unit was assigned to the response. These incidents often included an AMT unit as part of the response. There are additional emergency medical incidents in which only an AMT unit was assigned to the response. Responses involving AMT only are not included in these tabulations.

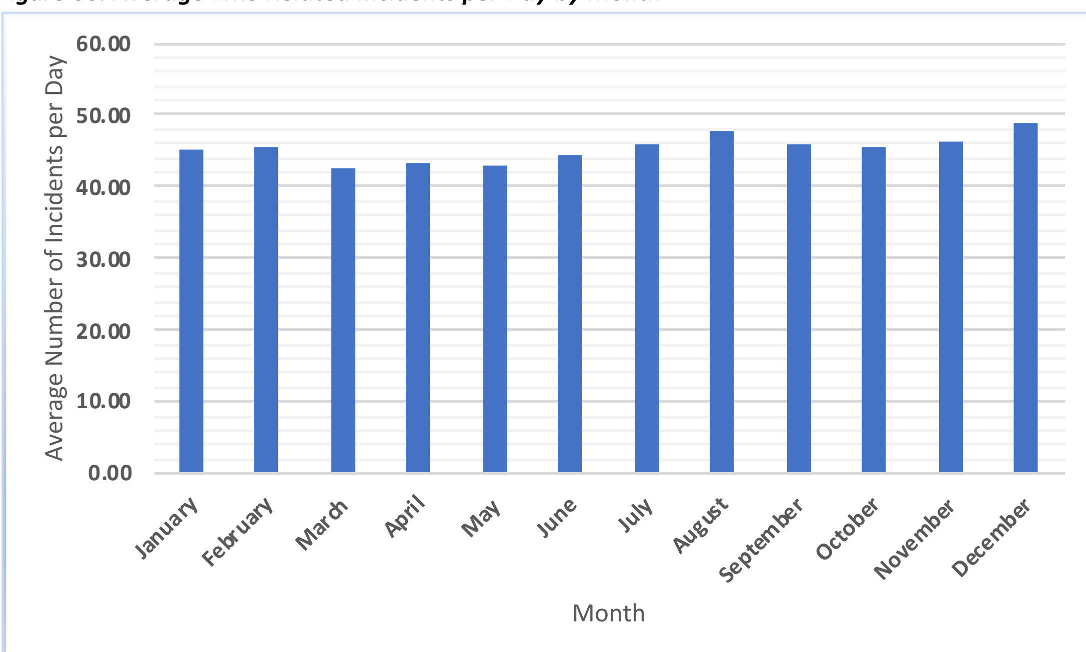
A full discussion of AMT's responses is provided in a later section of this report.

Temporal analyses were conducted to evaluate patterns in community demands for EMS related services. These analyses examined the frequency of requests for service in CY2017 by month of year, day of week, and hour of day. The overall analyses are presented in the next three figures.

Figure 65: Total EMS Related Incidents and Average Incidents per Day by Month of Year

Month	Number of Incidents	Average Incidents per Day	Monthly Incident Percentage
January	1,405	45.32	8.49%
February	1,279	45.68	7.73%
March	1,324	42.71	8.00%
April	1,294	43.13	7.82%
May	1,330	42.90	8.03%
June	1,334	44.47	8.06%
July	1,418	45.74	8.56%
August	1,484	47.87	8.96%
September	1,376	45.87	8.31%
October	1,415	45.65	8.55%
November	1,383	46.10	8.35%
December	1,514	48.84	9.14%
Total	**16,556**	**45.36**	**100.00%**

Figure 66: Average EMS Related Incidents per Day by Month



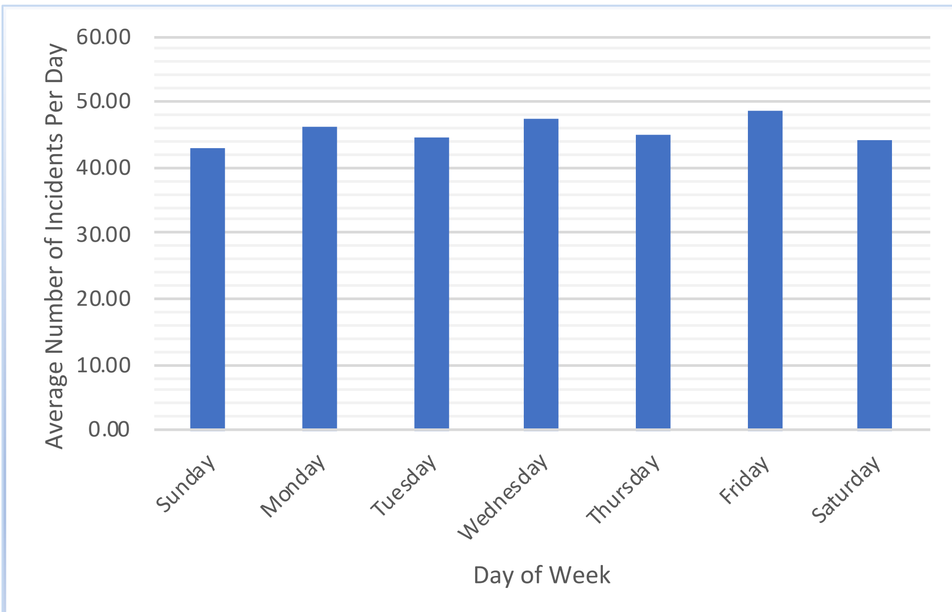
Results found that there was some, but not dramatic, variability by month.

Similar analyses were conducted for EMS related Incidents by day of week. Again, the data revealed that there is modest variability in the demand for services by day of week. The two figures below indicate the average incidents per day by day of week.

Figure 67: Total EMS Related Incidents and Average Incidents per Day by Day of Week

Day of Week	Number of Incidents	Average Incidents per Day	Call Percentage
Sunday	2,228	42.85	13.46%
Monday	2,405	46.25	14.53%
Tuesday	2,308	44.38	13.94%
Wednesday	2,458	47.27	14.85%
Thursday	2,341	45.02	14.14%
Friday	2,521	48.48	15.23%
Saturday	2,295	44.13	13.86%
Total	**16,556**	**45.36**	**100.00%**

Figure 68: Average EMS Related Incidents per Day by Day of Week

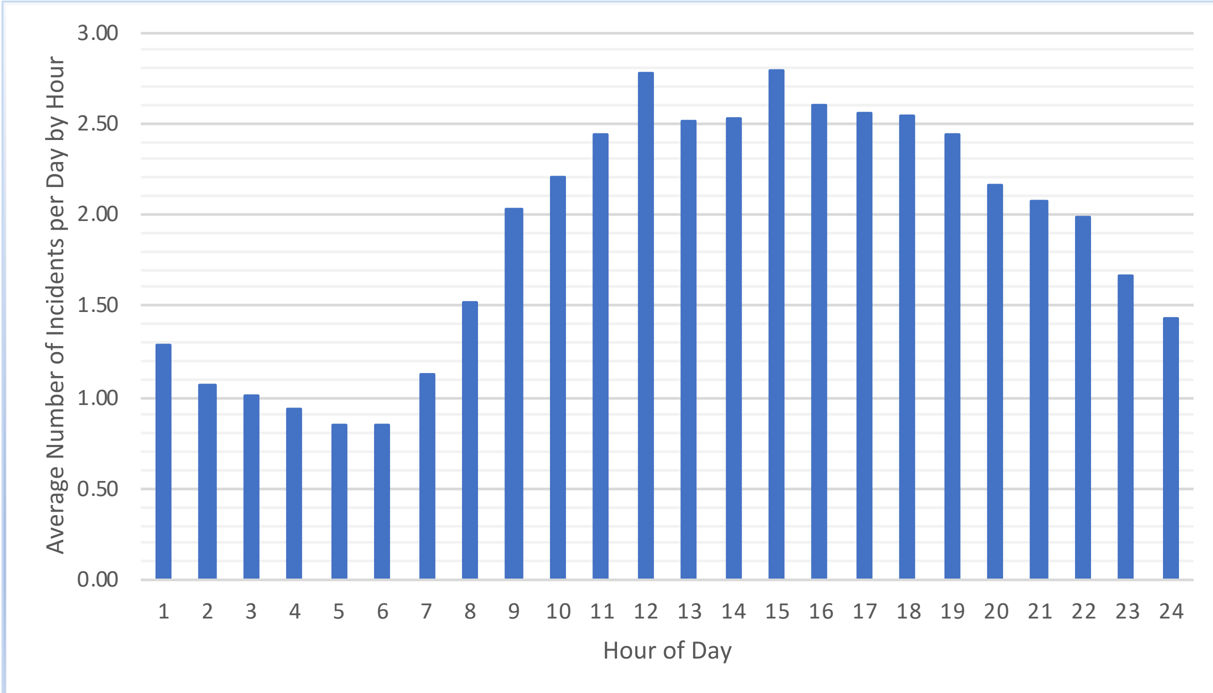


EMS related Incidents were also evaluated by hour of the day. Variability in the hourly requests for emergency medical services by hour-of-day is typical of EMS systems.

Figure 69: Total EMS Related Incidents and Average Incidents per Hour by Hour of Day

Hour of Day	Number of Incidents	Average Incidents per Hour	Call Percentage
0	470	1.29	2.84%
1	388	1.06	2.34%
2	366	1.00	2.21%
3	339	0.93	2.05%
4	309	0.85	1.87%
5	308	0.84	1.86%
6	412	1.13	2.49%
7	555	1.52	3.35%
8	742	2.03	4.48%
9	804	2.20	4.86%
10	892	2.44	5.39%
11	1,013	2.78	6.12%
12	919	2.52	5.55%
13	922	2.53	5.57%
14	1,019	2.79	6.15%
15	948	2.60	5.73%
16	933	2.56	5.64%
17	926	2.54	5.59%
18	890	2.44	5.38%
19	787	2.16	4.75%
20	757	2.07	4.57%
21	725	1.99	4.38%
22	607	1.66	3.67%
23	525	1.44	3.17%
Total	**16,556**	**45.36**	100.00%

Figure 70: Average EMS Related Incidents per Hour by Hour of Day



EMS related incidents are an aggregated category of the various final incident types available in the CAD databases. The following figure provides details for a subset of these EMS related incidents by nature of the incident.

Peoria 911 Dispatch assigns a four to seven digit code to incidents. For emergency medical incidents, these codes can be associated with a corresponding MPDS descriptor. It is these MPDS descriptors that are reported in the following figure.

Figure 71: Total EMS Related Incidents by Nature of Incident

Nature of Incident	Number of Incidents	Percentage of Total EMS Demands
Falls	2,740	16.55%
Breathing Problem	2,556	15.44%
Sick Person (Specific Diagnosis)	1,850	11.17%
Traffic / Transportation Incidents	1,508	9.11%
Chest Pain / Chest Discomfort	1,142	6.90%
Unconscious / Fainting (Near)	1,105	6.67%
Convulsions / Seizures	981	5.93%
Unknown Problem (Person Down)	942	5.69%
Overdose / Poisoning	579	3.50%
Stroke (CVA) / Transient Ischemic Attack (TIA)	416	2.51%
Hemorrhage / Lacerations	364	2.20%
Assault / Sexual Assault / Stun Gun	327	1.98%
Diabetic Problem	323	1.95%
Traumatic Injuries (Specific)	319	1.93%
Pregancy / Childbirth / Miscarriage	261	1.58%
Abdominal Pain / Problems	247	1.49%
Heart Problem / AICD	167	1.01%
Stab / Gunshot / Penetrating Trauma	151	0.91%
Psychiatric / Abnormal Behavior / Suicide Attempt	143	0.86%
Allergies / Envenomations (stings, Bites)	79	0.48%
Choking	76	0.46%
Cardiac or Respiratory Arrest / Death	56	0.34%
Headache	50	0.30%
Back Pain (NonTraumatic or Non-Recent Trauma	47	0.28%
EMS call, excluding vehicle accident with injury	42	0.25%
Eye Problem / Injuries	21	0.13%
Animal Bites / Attacks	15	0.09%
MPDS Descriptor Absent	14	0.08%
Carbon monoxide / Inhalation / Hazmat / CBRN	12	0.07%
Burns / Explosion	7	0.04%
Heat / Cold Exposure	7	0.04%
Drowning / Near Drowning / Diving / SCUBA Accident	5	0.03%
Electrocution / Lightning	3	0.02%
Inaccessible Incident / Other Entrapments (Non-Traffic)	1	0.01%
Total	16,556	**100.00%**

Time-on-Task for EMS incidents, by units and by station, is presented in the following figure. These data show how the workload for EMS responses is distributed across the system.

Figure 72: Time-on-Task by Unit and by Station for EMS Incidents

Station	Unit	Unit Type	Annual Responses	Annual Time on Task	Time on Task per Response	Unit Hour Utilization
1	E1	ENGINE	1,239	292:19:49	00:14:09	0.033
	T1	TRUCK	281	64:03:46	00:13:40	0.007
	R1	RESCUE	2,190	526:00:39	00:14:25	0.060
	B1	BATT	74	22:38:55	00:18:22	0.003
	MR1	MARINE	2	00:25:37	00:12:49	0.000
	HM1	HAZMAT	1	01:32:09	01:32:09	0.000
	Station 1 Total		**3,787**	**907:00:2855**	**00:14:21**	
3	E3	ENGINE	1,386	353:06:17	00:15:18	0.040
	T3	TRUCK	335	79:58:35	00:14:21	0.009
	Station 3 Total		**1,721**	**433:04:52**	**00:15:06**	
4	E4	ENGINE	2,303	580:22:27	00:15:07	0.063
	T4	TRUCK	482	112:10:15	00:13:59	0.013
	Station 4 Total		**2,785**	**692:22:42**	**00:14:55**	
8	E2	ENGINE	1,267	346:11:06	00:16:26	0.039
	Station 8 Total		**1,267**	**346:11:06**	**00:16:24**	
10	E10	ENGINE	1,434	404:36:10	00:16:56	0.046
	Station 10 Total		**1,434**	**404:36:10**	**00:16:56**	
11	R2	RESCUE	1,306	359:06:24	00:16:30	0.040
	Station 11 Total		**1,306**	**359:06:24**	**00:16:30**	
12	E12	ENGINE	823	280:23:37	00:20:27	0.032
	Station 12 Total		**823**	**280:23:37**	**00:20:27**	
13	E13	ENGINE	1,977	543:28:21	00:16:30	0.062
	Station 13 Total		**1,977**	**543:28:21y**	**00:16:30**	
15	E15	ENGINE	438	157:54:21	00:21:38	0.018
	Station 15 Total		**438**	**157:54:21**	**00:21:38**	
16	E16	ENGINE	1,447	395:35:43	00:16:24	0.045
	T14	TRUCK	515	150:03:56	00:17:28	0.017
	Station 16 Total		**1962**	**545:39:39**	**00:16:41**	
19	E19	ENGINE	865	277:03:56	00:19:12	0.032
	Station 19 Total		**865**	**277:03:56**	**00:19:12**	
20	E20	ENGINE	442	159:24:29	00:21:38	0.018
	Station 20 Total		**442**	**159:24:29**	**00:21:38**	
	Total All		**18,807**	**5106:26:22**	**00:16:17**	

Time-on-Task for PFD units responding to EMS incidents ranges from a low of 64 hours per year for Truck T1, to a high of 555 hours per year for Engine E4.

Figure 73: Number of Responding PFD Units by EMS Related Incident Type

Incident Category	Number of Responding PFD Units							Total
	1	2	3	4	5	6	7 or more	
Falls	2,415	293	24	8	0	0	0	2740
Breathing Problem	2,356	178	13	5	0	2	2	2556
Sick Person (Specific Diagnosis)	1,695	143	10	1	0	1	0	1850
Traffic / Transportation Incidents	1,011	371	76	32	10	4	4	1508
Chest Pain / Chest Discomfort	1,073	57	10	2	0	0	0	1142
Unconscious / Fainting (Near)	997	90	15	3	0	0	0	1105
Convulsions / Seizures	916	59	2	3	1	0	0	981
Unknown Problem (Person Down)	851	77	11	2	0	1	0	942
Overdose / Poisoning	505	57	14	2	1	0	0	579
Stroke (CVA) / Transient Ischemic Attack (TIA)	387	29	0	0	0	0	0	416
Hemorrhage / Lacerations	337	26	1	0	0	0	0	364
Assault / Sexual Assault / Stun Gun	305	19	2	1	0	0	0	327
Diabetic Problem	301	18	2	1	0	0	1	323
Traumatic Injuries (Specific)	292	23	2	0	1	1	0	319
Pregancy / Childbirth / Miscarriage	245	15	0	1	0	0	0	261
Abdominal Pain / Problems	237	8	2	0	0	0	0	247
Heart Problem / AICD	153	13	0	1	0	0	0	167
Stab / Gunshot / Penetrating Trauma	124	19	2	5	1	0	0	151
Psychiatric / Abnormal Behavior / Suicide Attempt	136	6	1	0	0	0	0	143
Allergies / Envenomations (stings, Bites)	74	5	0	0	0	0	0	79
Choking	72	3	0	1	0	0	0	76
Cardiac or Respiratory Arrest / Death	41	14	1	0	0	0	0	56
Headache	50	0	0	0	0	0	0	50
Back Pain (NonTraumatic or Non-Recent Trauma	46	1	0	0	0	0	0	47
EMS call, excluding vehicle accident with injury	40	2	0	0	0	0	0	42
Eye Problem / Injuries	21	0	0	0	0	0	0	21
Animal Bites / Attacks	13	2	0	0	0	0	0	15
MPDS Descriptor Absent	14	0	0	0	0	0	0	14
Carbon monoxide / Inhalation / Hazmat / CBRN	5	4	2	0	0	0	1	12
Burns / Explosion	4	3	0	0	0	0	0	7
Heat / Cold Exposure	7	0	0	0	0	0	0	7
Drowning / Near Drowning / Diving / SCUBA Accident	4	1	0	0	0	0	0	5
Electrocution / Lightning	2	1	0	0	0	0	0	3
Inaccessible Incident / Other Entrapments (Non-Traffic)	0	0	1	0	0	0	0	1
Total	14,729	1,537	191	68	14	9	8	16,556
Percentage	88.96%	9.28%	1.15%	0.41%	0.08%	0.05%	0.05%	100.00%

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 portion of the analysis will focus efforts on the cascade of events that lead to timely goals for performance, intervals should be viewed in terms of the total response interval, which includes the dispatch processing interval, turnout interval, and travel interval.

Cascade of Events

The total time-on-task for an incident is the result of the cascade of time intervals that comprise progression of the event starting from a state of normalcy and continuing until normalcy is returned. The cascade begins with initiation of the event in the field. The next step in the cascade is the interval of time required for the event to be detected and a decision reached to seek emergency assistance. Obviously, prompt recognition is essential to achieving prompt mitigation with the best outcomes. To this point, these events are not in the control of the emergency response system.

It is only after a request for assistance has been executed that emergency services can begin their response. The first quantifiable "hard" data point to measure system performance is receipt of this request for assistance. The cascade of time intervals that comprise further progression of the event include the dispatch processing interval, turnout interval, and travel interval.

Detection/Notification
Detection is the time interval from when an event occur until someone recognizes the emergency event. Notification occurs after a decision has been reached to seek emergency assistance.

Dispatch Processing Interval
Dispatch processing is the interval of time from when notification reaches the emergency system until units are assigned to respond to the request for assistance. Notification is typically accomplished by calling the 911 Primary Safety Answering Point (PSAP).

Turnout Interval
The turnout interval is from when a unit is notified that it has been assigned to a response until the crew loads to their apparatus and the apparatus first goes enroute to the incident location.

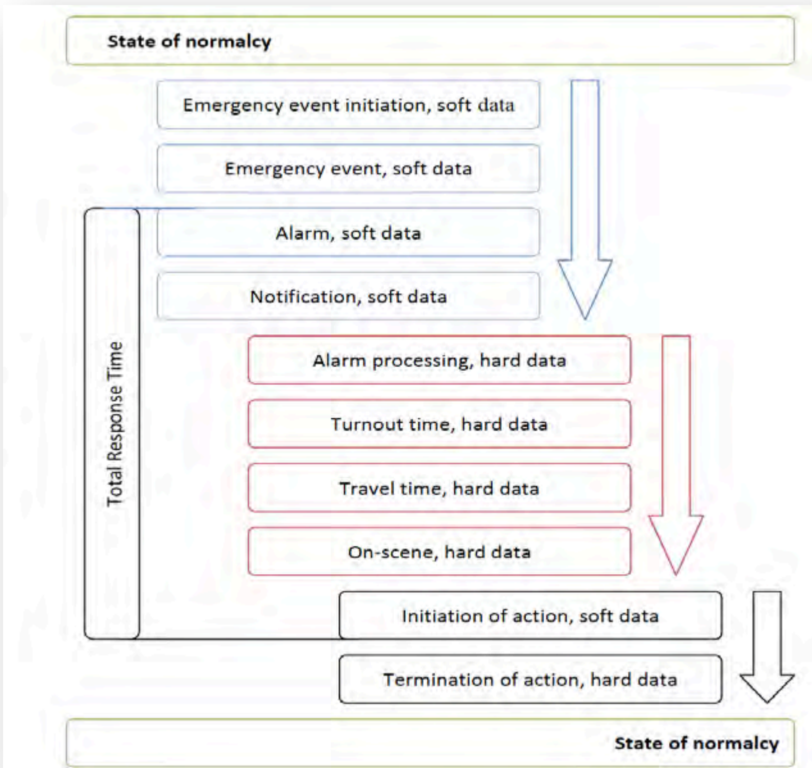
Travel Interval
The travel interval is from when a unit first goes enroute until it arrives at the scene of the incident.

Response Interval
The response interval is the interval of time form when the request for assistance "rang-in" at the PSAP until the responding unit arrived at scene.

Time-on-Task
Time-on-Task is a metric applied to field responses. It is the interval of time from when a unit is assigned to a response until the unit completes the response.

A graphic example of the cascade of events and the elements of performance is provided in the fgure below.[4]

Figure 74: Cascade of Event



Comparison of Workloads by Demand Zone

Workload is assessed at the station demand zone level and at the individual unit level. This permits an assessment of how effectively the geographic deployment of system resources matches the geographic distribution of demands on the system.

Information below presents the counts of vehicles arrived OnScene and the percent of department Time-on-task for PFD first due zones. Data is presented from the highest to lowest Time-on-Task by First Due Zone.

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

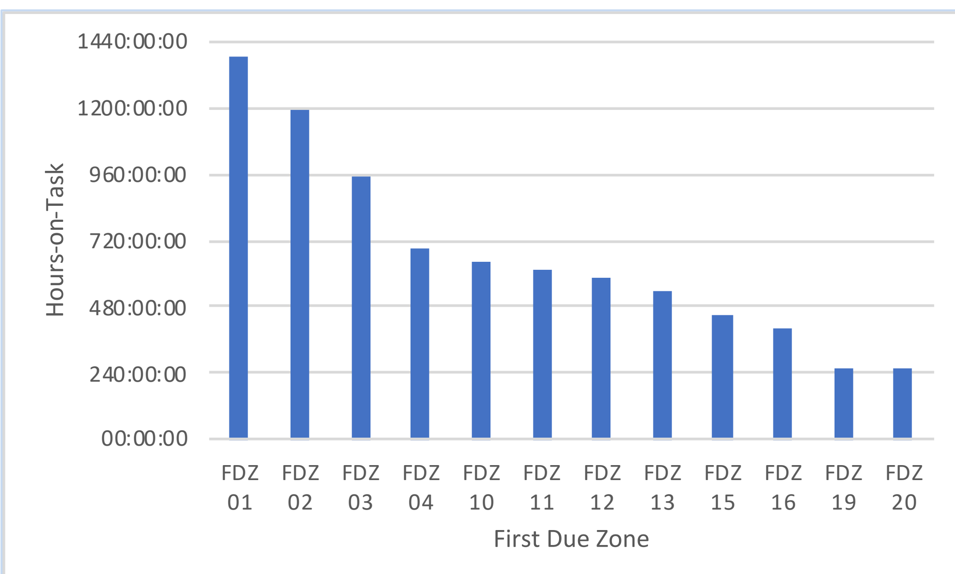
Figure 75: Annual Time-on-Task by First Due Zone

First Due Zone	Vehicles Assigned	Percent of Vehicles Arrived	FDZ Time on Task hr:mm:ss	Percent of Department Time on Task
FDZ 01	6,328	19.73%	1385:14:09	17.40%
FDZ 04	4,319	13.47%	1191:17:02	14.96%
FDZ 13	4,104	12.80%	955:32:56	12.00%
FDZ 10	2,675	8.34%	691:34:35	8.69%
FDZ 16	2,456	7.66%	640:34:58	8.05%
FDZ 03	2,540	7.92%	610:47:19	7.67%
FDZ 02	2,449	7.64%	583:13:09	7.33%
FDZ 11	2,315	7.22%	538:24:43	6.76%
FDZ 19	1,812	5.65%	448:42:33	5.64%
FDZ 12	1,403	4.38%	403:50:02	5.07%
FDZ 15	881	2.75%	258:16:20	3.24%
FDZ 20	783	2.44%	254:05:20	3.19%
Total PFD	32,065		7961:33:06	**100%**

The total of PFD vehicles assigned does not reconcile with the totals presented earlier. That a PFD vehicle assignment occurred is captured elsewhere. More than 1,000 vehicle assignment records from the CAD fail to identify the vehicle that was assigned. Consequently, the incident cannot be ascribed to a FDZ, and the vehicle assigned.

First Due Zones 1, 4, and 13 report the largest percentage of Time-on-task for all vehicles arrived OnScene. Figure 76 below shows the distribution of Time-on-task by First Due Zones.

Figure 76: Annual Time-on-Task by First Due Zone



Finally, counts of vehicles assigned by First Due Zone were tallied. These data are presented in Figure 77.

Figure 77: Vehicles Assigned by First Due Zone and Incident Category

First Due Zone	EMS	Fire	Rescue	nonFire / nonMed	HazMat	Total
FDZ 01	3,434	2,744	114	30	6	6,328
FDZ 02	1,385	977	69	18	-	2,449
FDZ 03	1,553	909	60	16	2	2,540
FDZ 04	2,828	1,386	89	14	2	4,319
FDZ 10	1,626	978	60	11	-	2,675
FDZ 11	1,311	170	697	137	-	2,315
FDZ 12	854	512	26	11	-	1,403
FDZ 13	2,256	1,734	92	22	-	4,104
FDZ 15	468	387	25	1	-	881
FDZ 16	1,685	732	34	5	-	2,456
FDZ 19	992	762	50	8	-	1,812
FDZ 20	20	404	363	2	-	789
Total	**18,412**	**11,695**	**1,679**	**275**	**10**	**32,071**

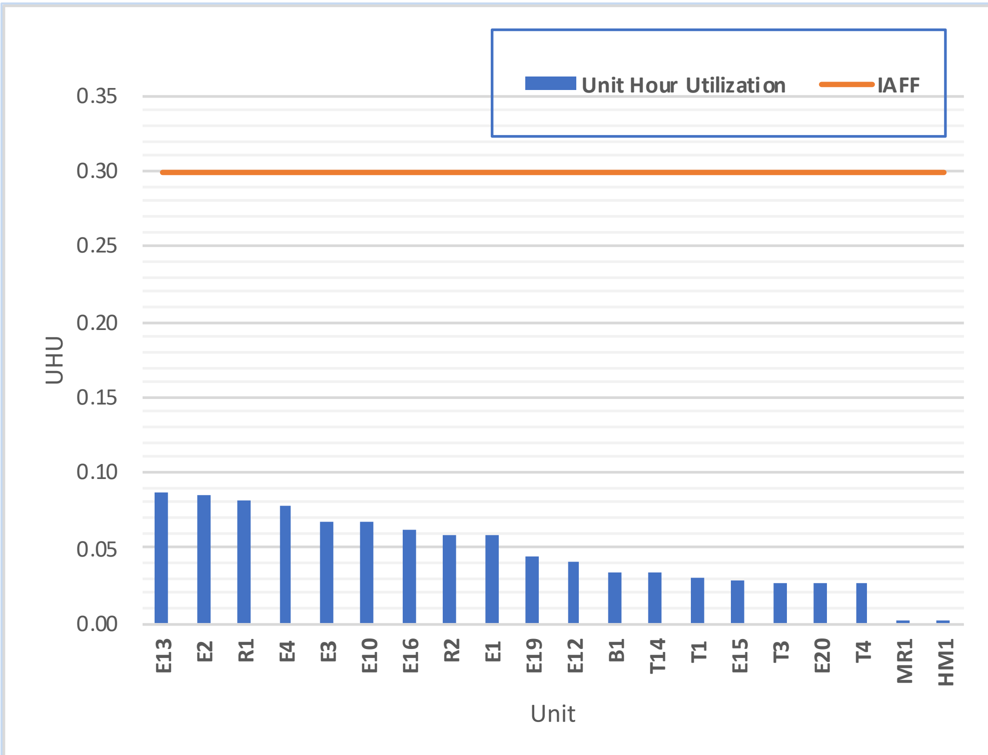
In order to evaluate a system's ability to deliver quality emergency services, it is necessary to consider the impact that workload has on personnel, particularly personnel on 24-hour shifts. An evaluation of workload begins with a unit's annual Time-on-task, that is, the sum of hours logged into the CAD between the unit's assigned and cleared timestamps. Evaluation then proceeds to Unit Hour Utilization, UHU, which is the metric most commonly used to quantify crew workloads. The UHU is the ratio of a unit's annual Time-on-task divided by 8,760 hours per year.

Historically, the International Association of Fire Fighters (IAFF) has recommended that 24-hour units utilize 0.30, or 30% workload as an upper threshold.[5] In other words, this recommendation would have personnel spend no more than eight hours per day directly working 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 eight hours, of their workday responding to incidents. 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.[6] Similarly, in a standards of

[5] International Association of Firefighters. (1995). Emergency *Medical Services: A Guidebook for Fire-Based Systems.* Washington, DC: Author. (p. 11)
[6] Illinois Fire Chiefs Association. (2012). An *Assessment of Deployment and Station Location: Rolling Meadows Fire Department.* Rolling Meadows, Illinois: Author. (pp. 54-55)

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.[7] Below is a graphic representation of the PFD units and the respective unit hour utilization for CY2017.

Figure 78: Unit Hour Utilization by Unit



All PFD units had a UHU of less than 0.10. None of the PFD units approach the IAFF's recommended maximum unit hour utilizations of 0.30.

[7] Castle Rock Fire and Rescue Department. (2011). Community *Risk Analysis and Standards of Cover*. Castle Rock, Colorado: Author. (p. 58)

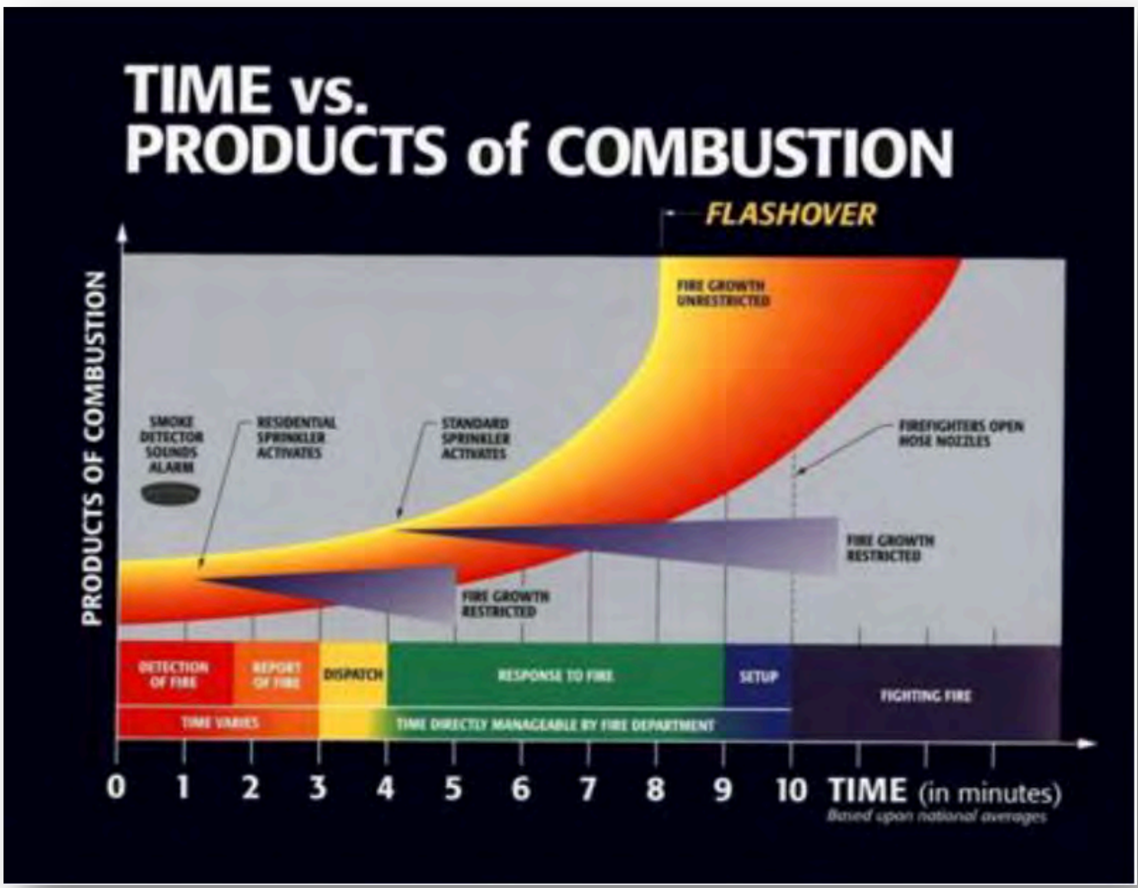
RESPONSE TIME CONTINUUM

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 below.[8]

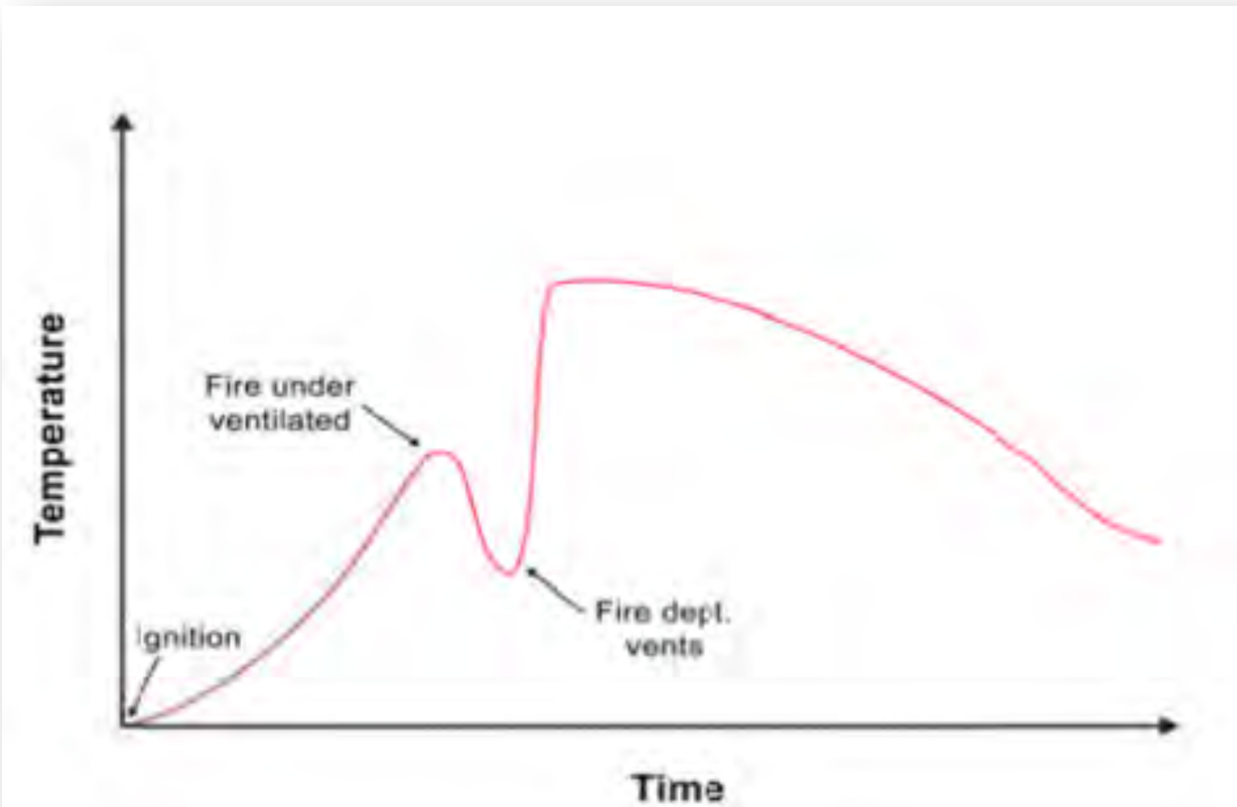
Figure 79: Example of Traditional Time Temperature Curve



[8] 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 flashover occurs within four minutes in the modern fire environment for compartment fires such as structure fires. 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 below.[9]

Figure 80: 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

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

sensitive between five minutes and 11 minutes for emergency responses and 13 minutes for non-emergency responses.[10] 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.[11]

Out of hospital sudden cardiac arrest is the most identifiable and measured incident type for EMS. The American Heart Association (AHA) has determined that brain damage will begin to occur between four and six minutes and become irreversible after 10 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. 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. The figure is representative of a sudden cardiac arrest that is presenting in a shockable heart rhythm such as Ventricular Fibrillation or Ventricular Tachycardia.[12]

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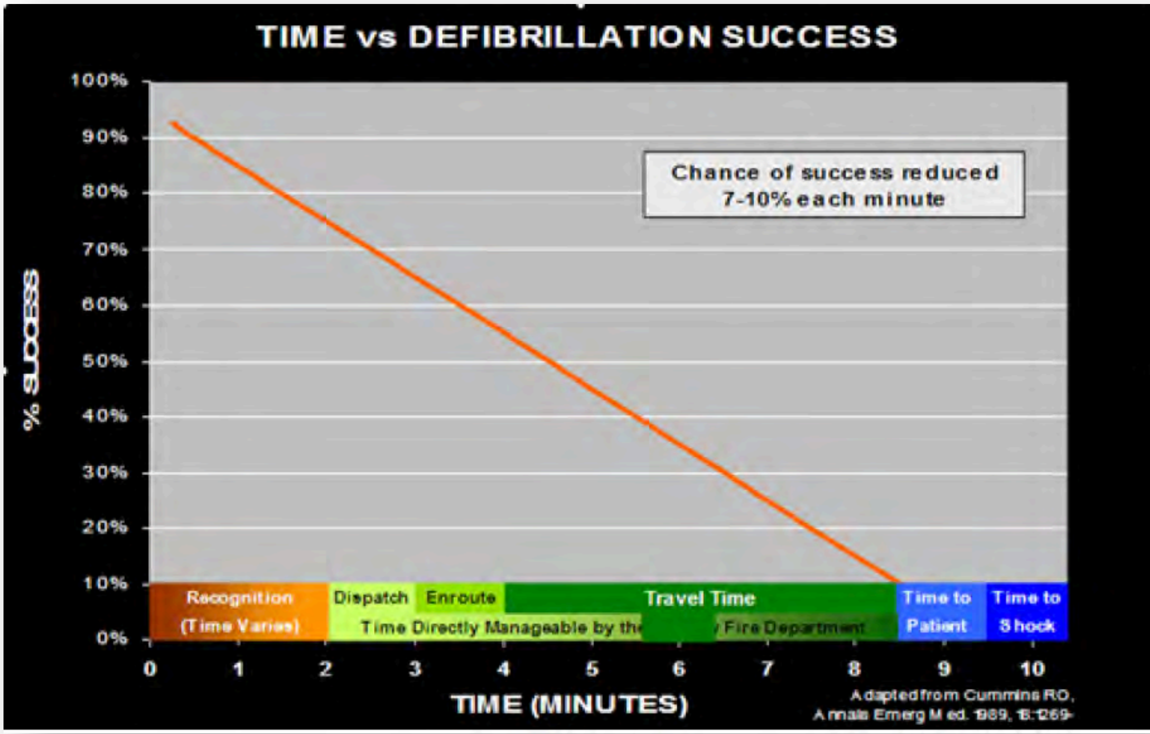
[10] Blackwell, T.H., & Kaufman, J.S. (April 2002). Response time effectiveness: Comparison of response time and survival in an urban emergency medical services system. *Academic Emergency Medicine,* 9(4): 289-295.
[11] Blackwell, T.H., et al. (Oct-Dec 2009). Lack of association between prehospital response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

Figure 81: Cascade of Events for Sudden Cardiac Arrest with Shockable Rhythm



DESCRIPTION OF FIRST ARRIVING UNIT PERFORMANCE

Analyses of the response characteristics of the first arriving units were conducted. This analysis focused on lights and sirens responses. Below indicates PFD performance at both the average and 90th percentile for dispatch, turnout, and travel, total response intervals.

Figure 82: Incident Response Intervals for Vehicles First Arrived OnScene

Measure	Average [mm:ss]	90th Percentile [mm:ss]
Dispatch Interval	01:45	03:02
Turnout Interval	01:24	02:06
Travel Interval	02:35	04:32
Response Interval	06:00	08:53

The travel times for all first arriving unit responses were calculated irrespective of their assigned First Due Zone. In other words, this analysis describes the first arriving unit to the scene. The next two figures depict performance for turnout and travel intervals and include the percentage of incidents at the various response increments.

Figure 83: Distribution of Turnout Interval of First Arriving Unit and Percent of Incidents

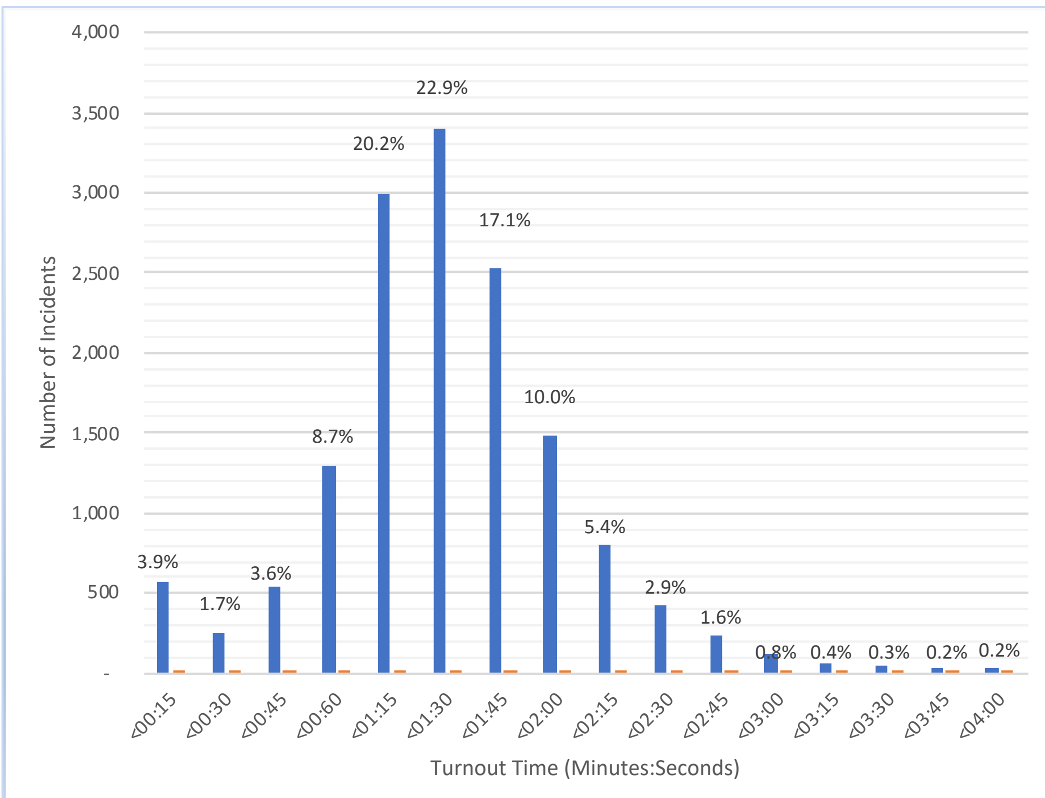
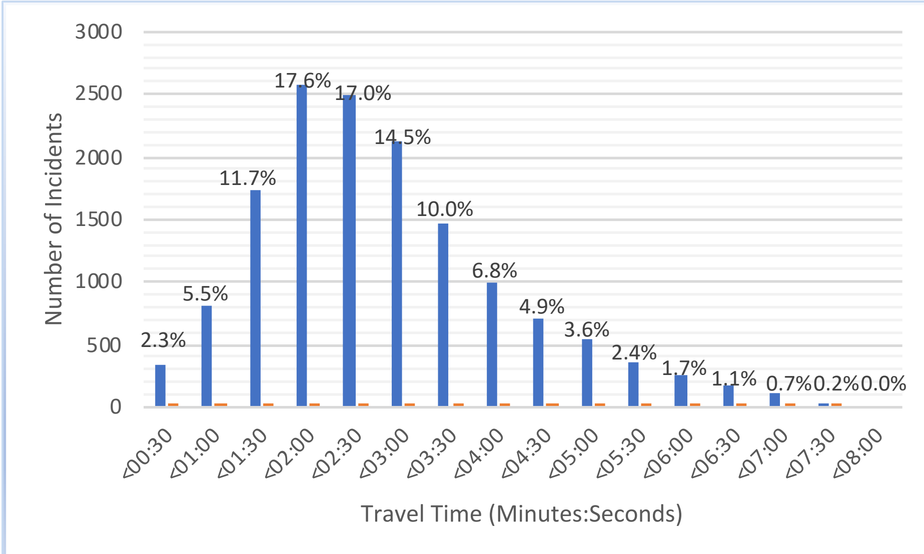
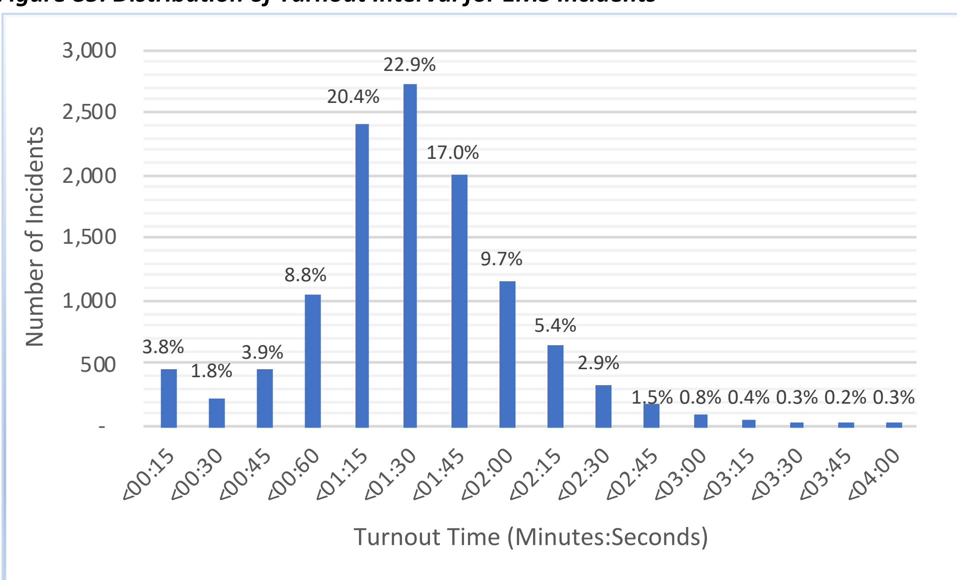


Figure 84: Distribution of Travel Interval of First Arriving Unit



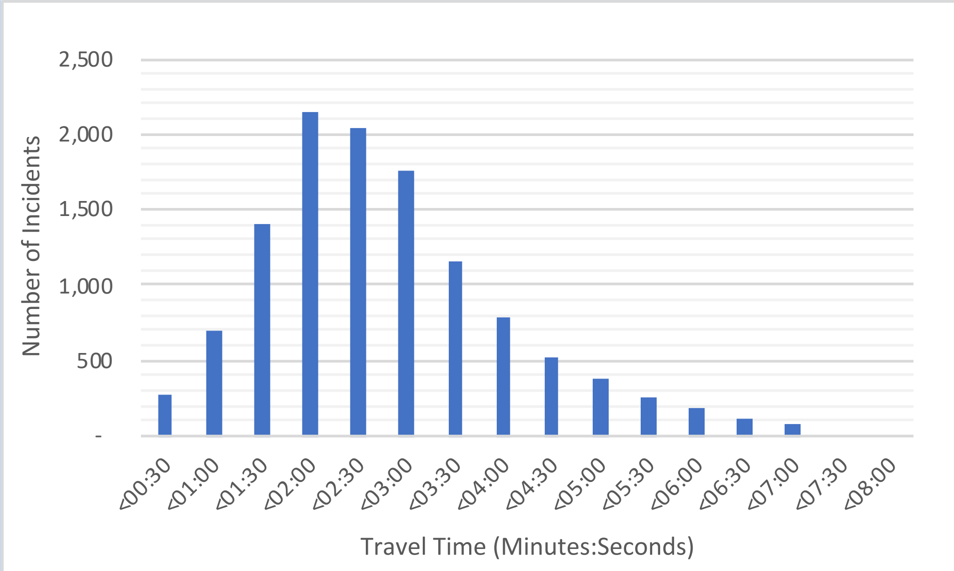
National recommendations provide differentiation between EMS and Fire/Special Operations incidents. For example, the best practice for an EMS incident is a turnout interval of 60 seconds or less 90% of the incidents. Due to the necessity to don personal protective equipment prior to responding to fire-related incidents, best practices provide either 80 seconds (National Fire Protection Association/NFPA) or 90 seconds (Commission on Fire Accreditation International/CFAI) or less at the 90th percentile for turnout intervals associated with fire Incidents. Turnout intervals and travel intervals are also reported for EMS and Fire incidents in the two figures that follow.

Figure 85: Distribution of Turnout Interval for EMS Incidents



PFD turnout interval is 02:15 [mm:ss] or less for 94% of EMS incidents.

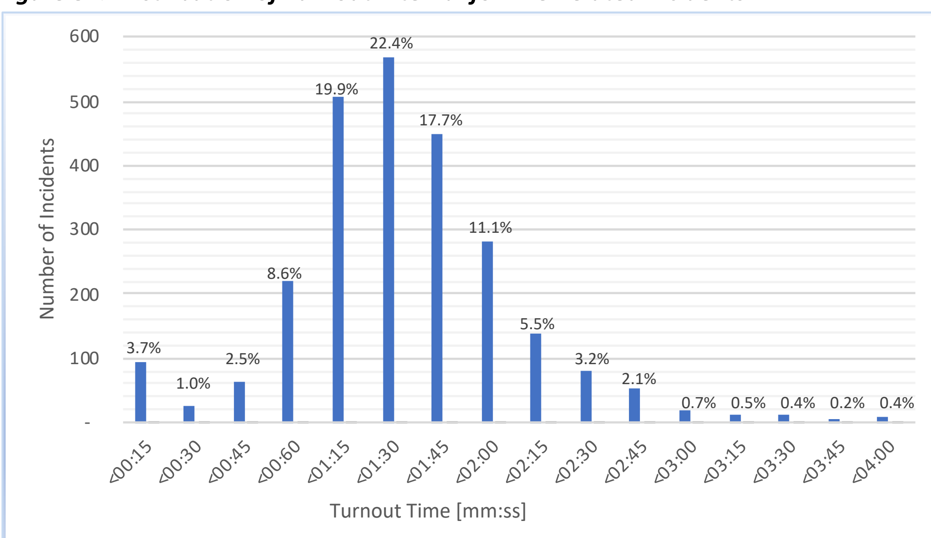
Figure 86: Distribution of Travel Interval for EMS Incidents



PFD travel interval is less than 04:30 mm:ss for 92% of EMS incidents.

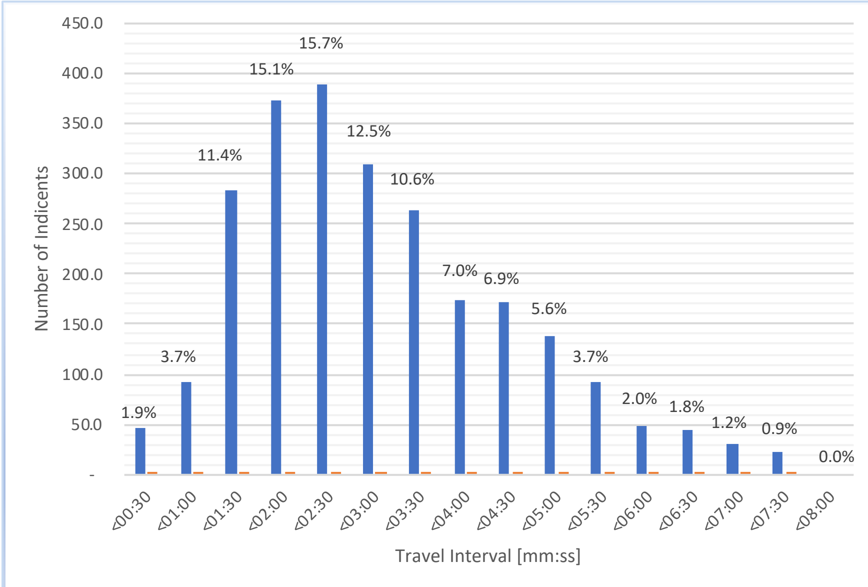
The next two figures indicate turnout and travel time for fire related incidents.

Figure 87: Distribution of Turnout Interval for Fire Related Incidents



PFD turnout interval is less than 02:15 mm:ss for 93% of fire incidents.

Figure 88: Distribution of Travel Interval for Fire Related Incidents



PFD travel interval is less than 05:00 mm:ss for 90% of fire incidents.

Response Interval for First Arriving Unit by First Due Zone

The next two analyses were conducted to measure the response intervals for vehicles first arrive OnScene by First Due Zone. Below presents average dispatch intervals, turnout intervals, travel intervals, and total response intervals.

Figure 89: Average Response Intervals for First Arriving Units by First Due Zone

First Due Zone	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	average	Sample	average	Sample	average	Sample	average
FDZ 01	2,737	01:49	2,753	01:23	2,739	01:53	2,848	05:15
FDZ 02	1,217	01:43	1,239	01:31	1,233	02:13	1,272	05:38
FDZ 03	1,154	01:47	1,166	01:19	1,166	02:23	1,217	05:46
FDZ 04	1,931	01:44	1,972	01:25	1,963	02:21	2,044	05:47
FDZ10	1,385	01:44	1,425	01:21	1,428	02:50	1,452	06:09
FDZ 11	974	01:42	984	01:20	985	02:39	1,021	05:52
FDZ 12	718	01:47	727	01:30	730	03:26	753	07:07
FDZ 13	1,632	01:37	1,682	01:18	1,657	02:44	1,738	05:58
FDZ 15	443	01:49	448	01:35	441	03:05	456	06:45
FDZ 16	1,142	01:43	1,167	01:24	1,170	02:55	1,201	06:17
FDZ 19	838	01:49	865	01:27	864	04:08	878	07:39
FDZ 20	385	01:48	398	01:35	397	03:40	400	07:25

Figure 90 presents dispatch intervals, turnout intervals, travel intervals, and total response intervals at the 90th percentile.

Figure 90: 90th- Percentile Response Intervals for First Arriving Units by First Due Zone

First Due Zone	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile
FDZ 01	2,737	03:11	2,753	02:09	2,739	03:05	2,848	07:33
FDZ 02	1,217	02:55	1,239	02:13	1,233	03:23	1,272	07:45
FDZ 03	1,154	03:04	1,166	01:54	1,166	03:49	1,217	08:19
FDZ 04	1,931	03:00	1,972	02:07	1,963	03:46	2,044	08:18
FDZ10	1,385	02:58	1,425	01:57	1,428	04:22	1,452	08:37
FDZ 11	974	02:57	984	01:57	985	04:14	1,021	08:37
FDZ 12	718	03:06	727	02:11	730	05:58	753	10:26
FDZ 13	1,632	02:46	1,682	01:57	1,657	04:54	1,738	09:09
FDZ 15	443	03:08	448	02:17	441	05:08	456	09:52
FDZ 16	1,142	02:54	1,167	02:03	1,170	04:48	1,201	09:00
FDZ 19	838	03:05	865	02:08	864	06:25	878	10:45
FDZ 20	385	02:51	398	02:20	397	05:48	400	10:20

First arriving units responding to incidents in the first due zone FDZ 01 had the shortest 90th percentile total response intervals (07:33 mm:ss). First arriving units responding to incidents in the FDZ 19 had the longest 90th percentile total response intervals (10:45 mm:ss).

Figure 91: Average Performance Intervals for Units First Arrived by First Due Station

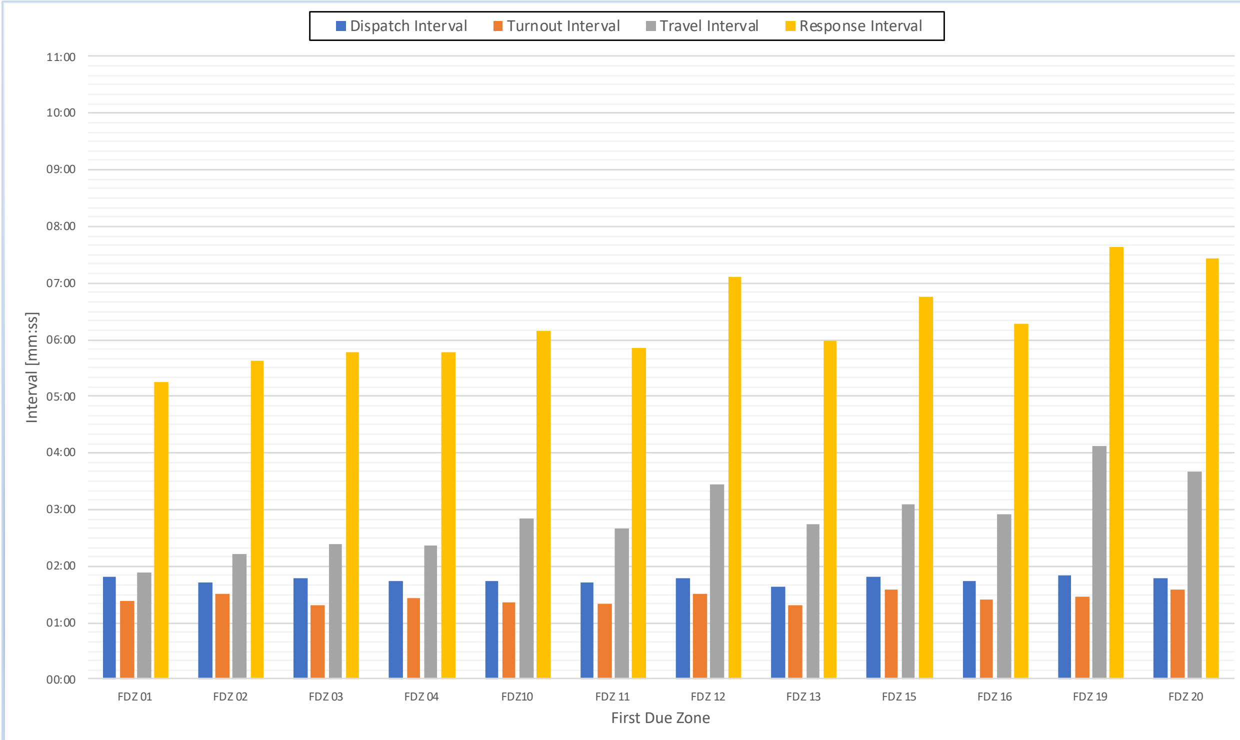
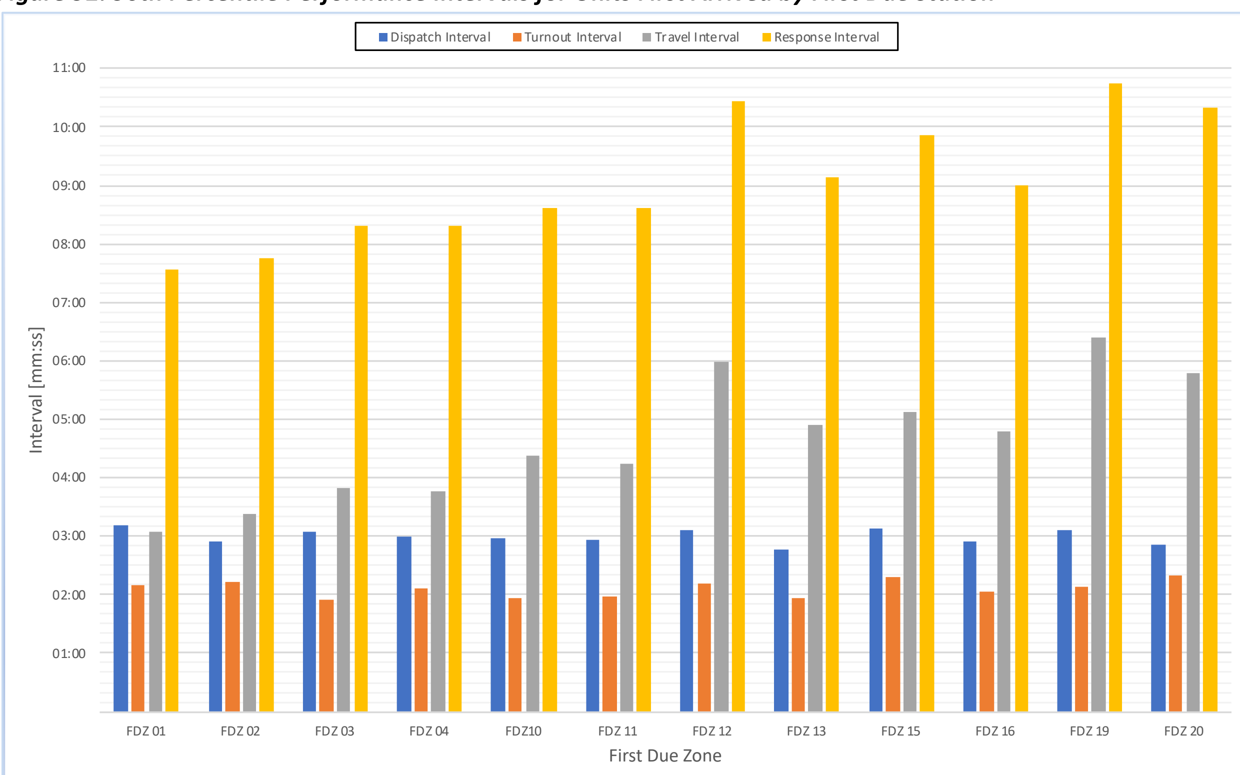


Figure 92: 90th Percentile Performance Intervals for Units First Arrived by First Due Station



Effective Response Force Capabilities for Structure Fires

Assembly of an Effective Response Force (ERF) in a timely manner with the appropriate personnel, apparatus and equipment is required for a successful response to a significant structural fire event. Several factors affect the capabilities to assemble an ERF such as the number of fire stations, the locations of these stations, the number of units, number of personnel on each unit, and the location of the fire. Of these factors, the primary parameters that affect assembly of an Effective Response Force are the geographic distribution of where units are quartered relative to the geographic distribution of where the structural fires occur. The travel interval for vehicles arrived OnScene is used as the parameter to judge how these two geographic distributions interact in a given system.

The average travel intervals for units 1st arrived through 4th arrived OnScene by First Due Zone, is presented in Figure 93.

Figure 93: Average Travel Intervals for ERF on Structure Fire Incidents by First Due Zone

First Due Zone	Order of Arrival			
	1	2	3	4
FDZ 01	01:37	01:52	02:10	02:41
FDZ 02	02:16	02:59	03:26	03:35
FDZ 03	02:28	02:46	03:21	03:56
FDZ 04	02:24	02:48	04:25	06:45
FDZ 10	02:38	03:26	03:45	04:01
FDZ 11	01:44	02:38	03:22	04:13
FDZ 12	03:31	04:29	05:08	04:02
FDZ 13	02:54	04:47	05:11	05:46
FDZ 15	03:01	04:49	05:53	07:42
FDZ 16	02:47	03:30	04:54	05:58
FDZ 19	04:38	06:14	06:55	06:45
FDZ 20	03:47	05:25	07:05	09:03

The 90th percentile travel intervals for units 1st arrived through 4th arrived OnScene by First Due Zone, are presented in the figure below.

Figure 94: 90th Percentile Travel Intervals for ERF on Structure Fire Incidents by First Due Zone

First Due Station	Order of Arrival			
	1	2	3	4
FDZ 01	02:30	02:48	03:13	03:53
FDZ 02	03:01	04:17	04:44	04:32
FDZ 03	03:35	04:07	04:34	05:02
FDZ 04	03:31	04:13	05:43	06:24
FDZ 10	03:39	04:49	05:05	05:33
FDZ 11	00:41	01:48	01:51	02:04
FDZ 12	05:21	03:00	03:00	01:15
FDZ 13	05:12	07:02	07:43	07:50
FDZ 15	04:39	01:26	01:47	02:00
FDZ 16	04:09	04:51	06:30	07:19
FDZ 19	06:58	01:45	01:41	02:02
FDZ 20	06:17	02:55	02:06	01:53

In the figure above, travel intervals presented in cells without shading were calculated using the ranked 90th methodology. Travel intervals presented in cells shaded grey were calculated using the predicted 90th methodology as there were less than 30 instances available for extraction of the parameter. The number of instances available for each calculation are presented Figure 95. Many of the grey shaded datasets contained enough unusual instances that the dataset did not provide a reliable statistic at the 90th percentile.

Figure 95: Sample Sizes for ERF on Structure Fire Incidents by First Due Zone

First Due Station	Order of Arrival			
	1	2	3	4
FDZ 01	261	224	198	168
FDZ 02	115	86	61	47
FDZ 03	105	76	55	36
FDZ 04	145	123	79	58
FDZ 10	122	83	73	55
FDZ 11	4	4	3	3
FDZ 12	63	19	16	11
FDZ 13	219	98	54	37
FDZ 15	59	23	21	11
FDZ 16	109	81	46	31
FDZ 19	124	26	11	5
FDZ 20	52	23	15	10

Figure 96: 90th Percentile ERF Travel Interval for Structure Fires Overall PFD

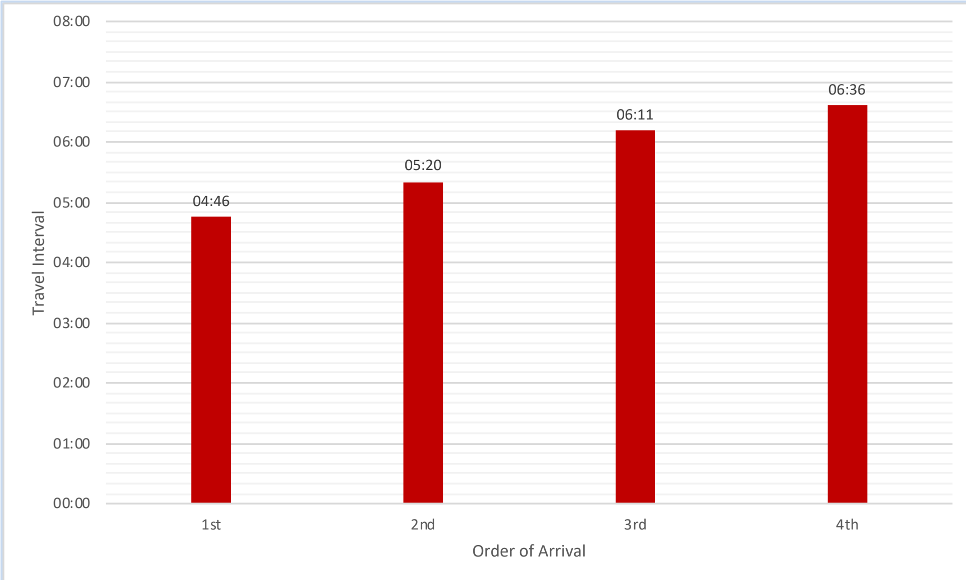


Figure 97: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 1

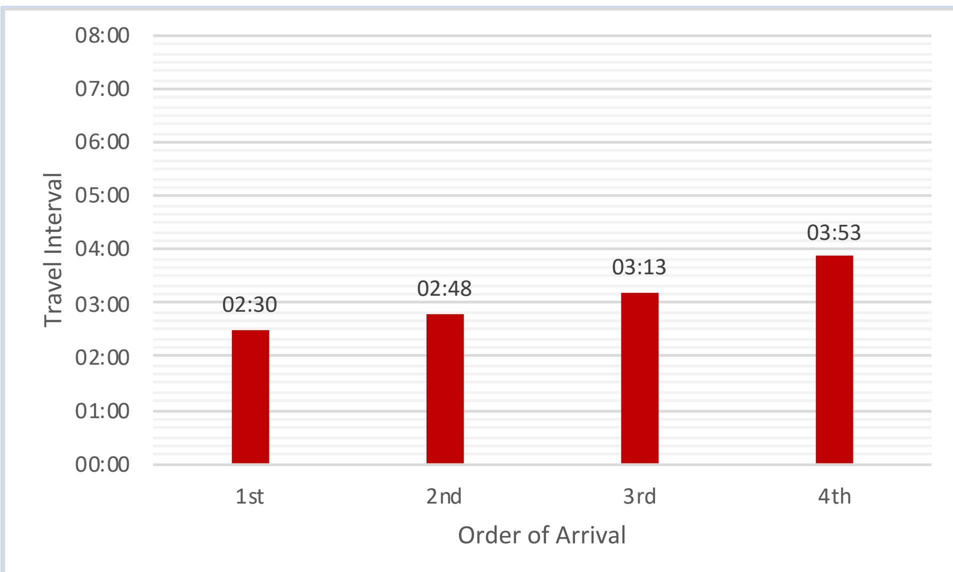


Figure 98: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 2

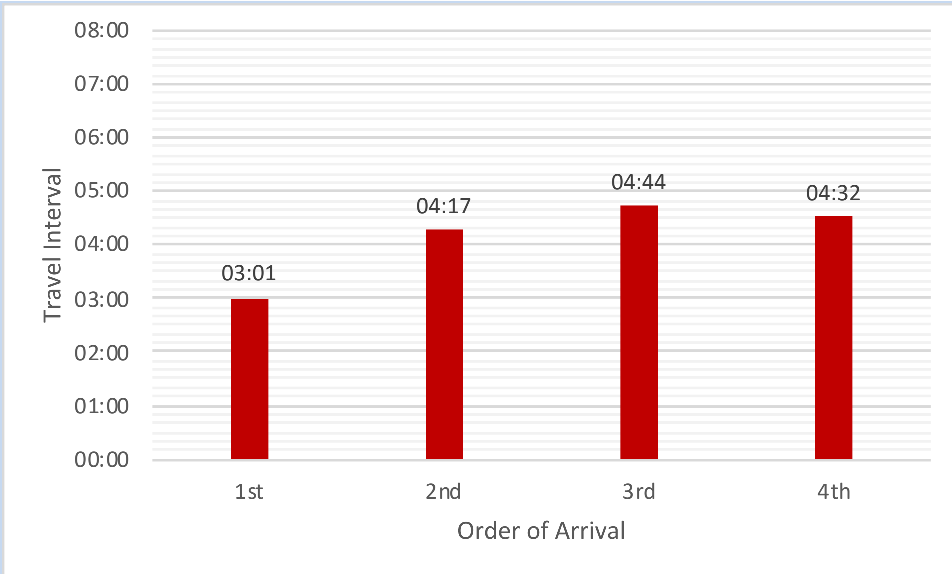


Figure 99: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 3

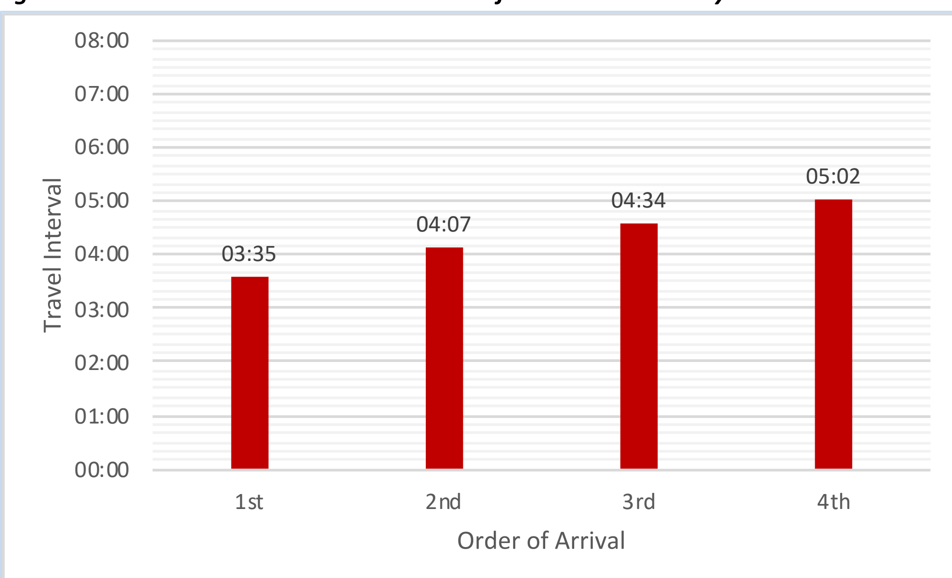


Figure 100: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 4

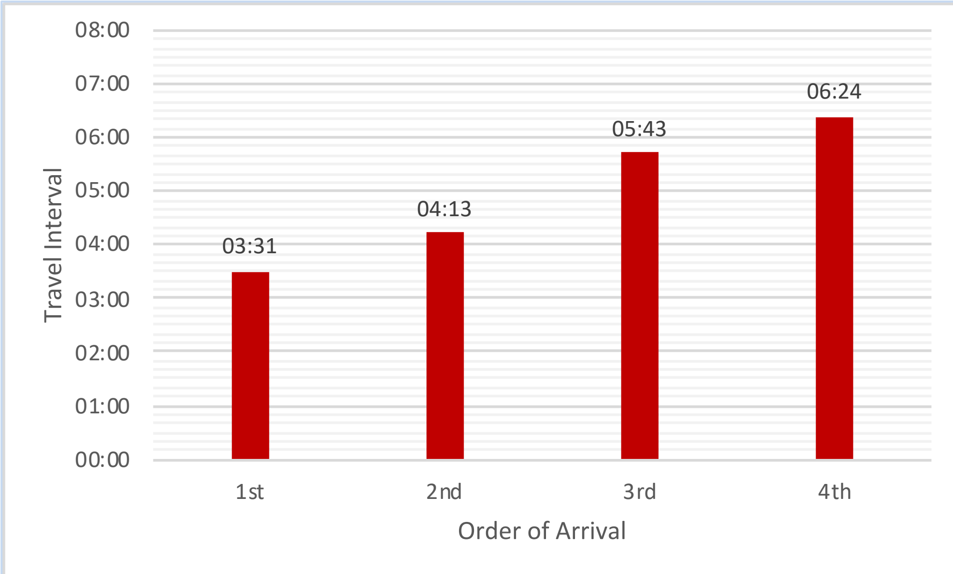


Figure 101: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 10

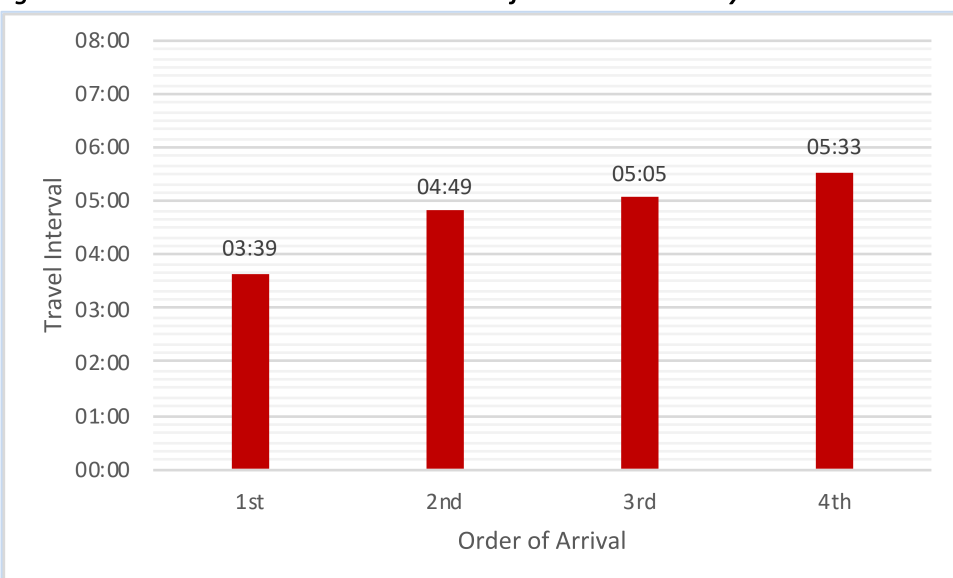
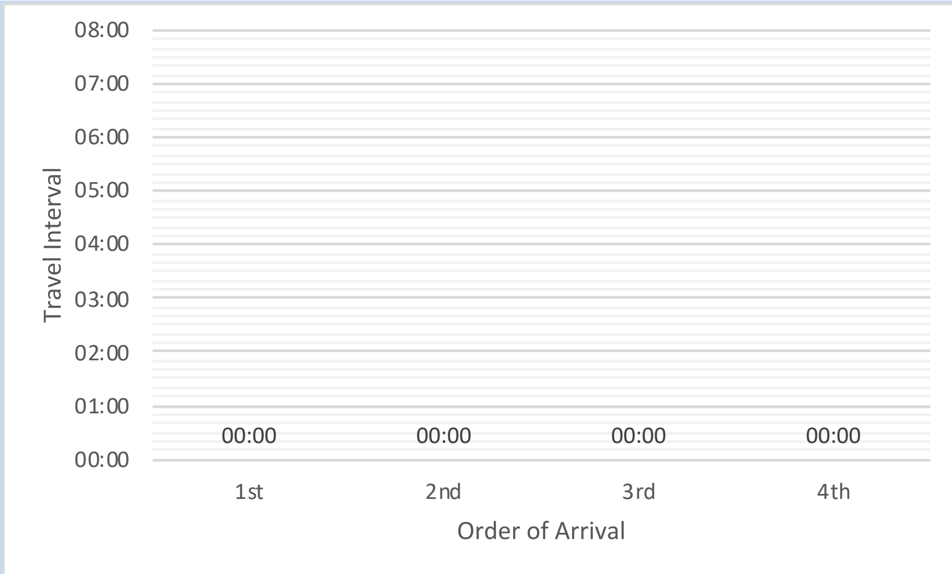
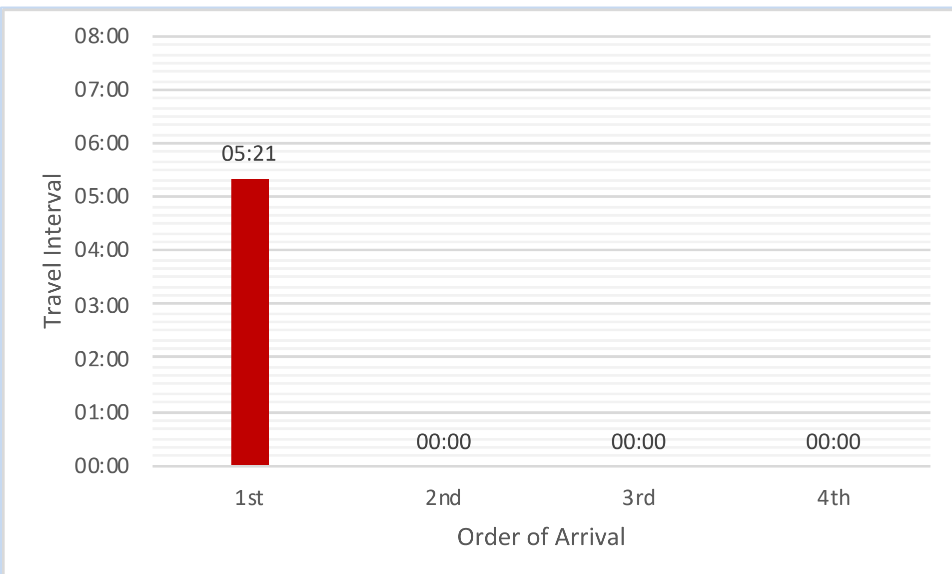


Figure 102: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 11



There are too few instances of vehicle responses to structure fire incidents in First Due Zone 11 to permit calculation of reliable statistics at the 90th percentile for vehicles 1st, 2nd, 3rd, and 4th arrived OnScene.

Figure 103: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 12



There are too few instances of vehicle responses to structure fire incidents in First Due Zone 12 to permit calculation of reliable statistics at the 90th percentile for vehicles 2nd, 3rd, and 4th arrived OnScene.

Figure 104: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 13

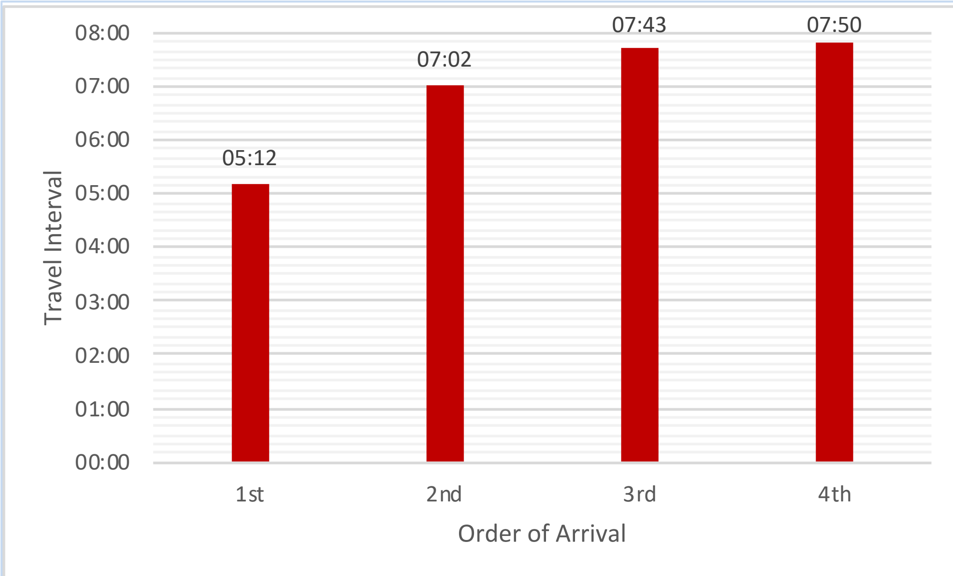
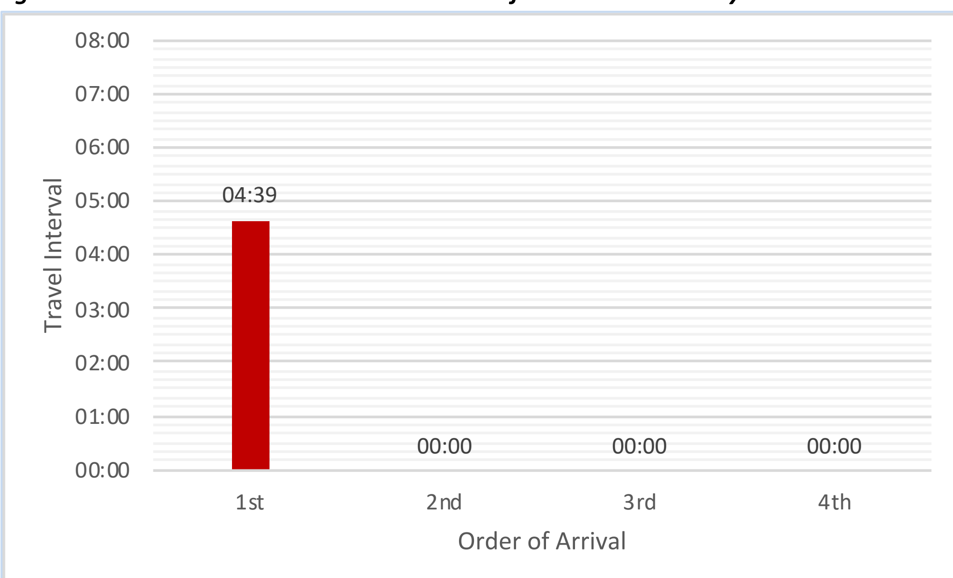


Figure 105: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 15



There are too few instances of vehicle responses to structure fire incidents in First Due Zone 15 to permit calculation of reliable statistics at the 90th percentile for vehicles 2nd, 3rd, and 4th arrived OnScene.

Figure 106: 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 16

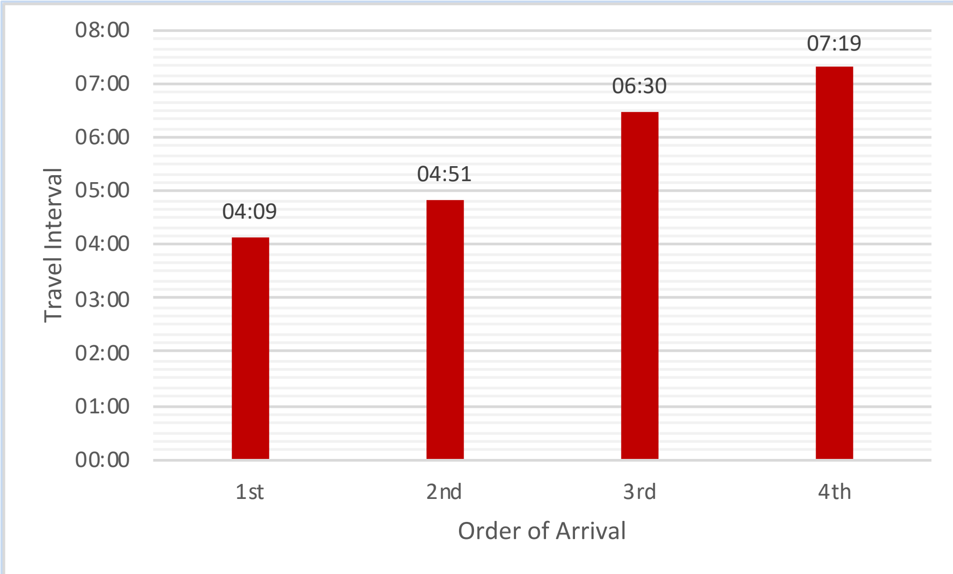
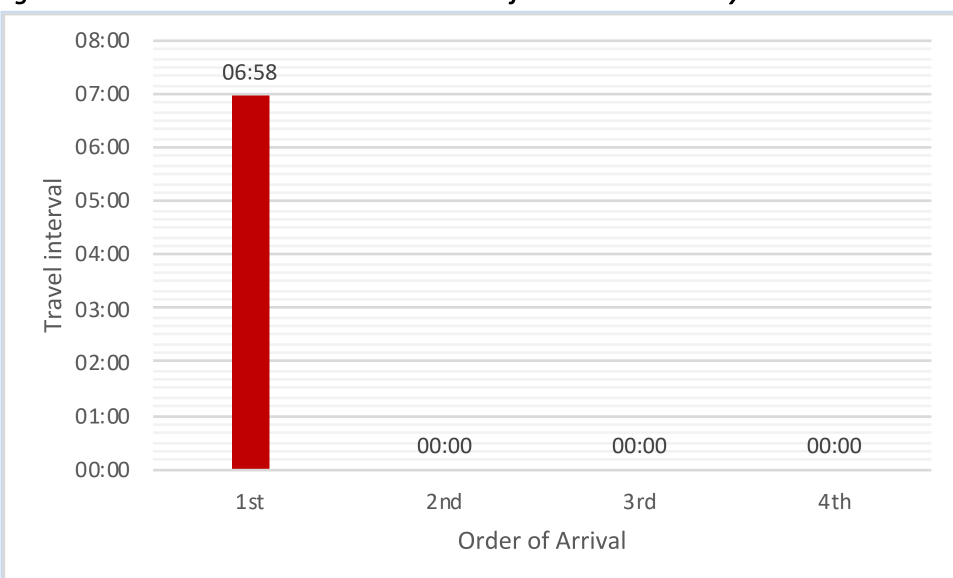
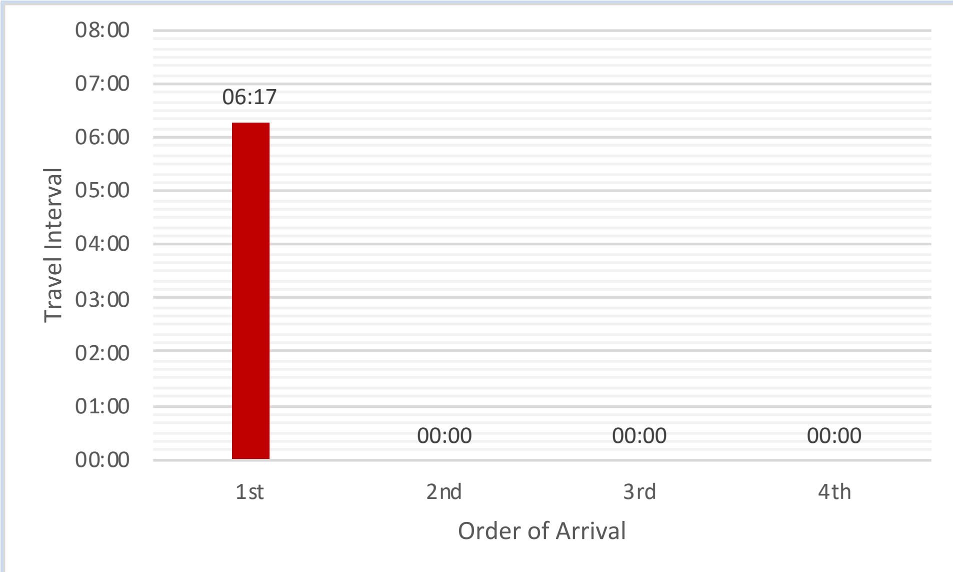


Figure 107. 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 19



There are too few instances of vehicle responses to structure fire incidents in First Due Zone 19 to permit calculation of reliable statistics at the 90th percentile for vehicles 2nd, 3rd, and 4th arrived OnScene.

Figure 108. 90th Percentile ERF Travel Interval for Structure Fires by First Due Zone 20



There are too few instances of vehicle responses to structure fire incidents in First Due Zone 20 to permit calculation of reliable statistics at the 90th percentile for vehicles 2nd, 3rd, and 4th arrived OnScene.

System Performance by Available Vehicles

During normal operations, varying numbers of the department's units are committed to responses, Vehicles Already On Task. During normal operations incoming requests for service continue to arrive.

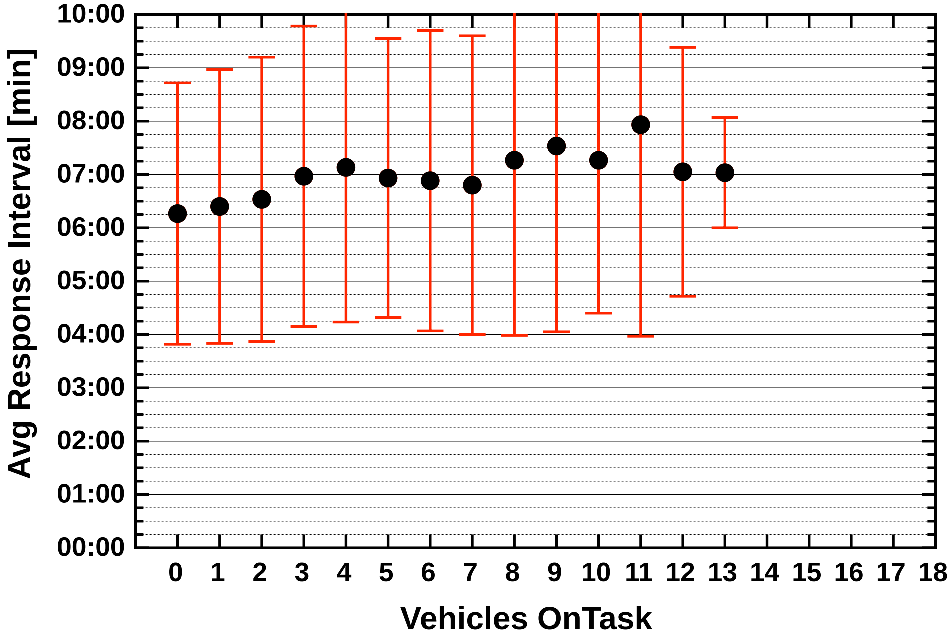
The analyses of this section examine how the number of vehicles already On Task affects the performance of the system in servicing these next incoming requests. The appropriate metric for measuring the performance of the system is the total response interval experienced by these next incoming requests, that is the time interval from ring-in until arrived OnScene. Such an analysis is presented below for the Peoria system for CY2017. The data included incoming requests for service in all incident categories.

Figure 109: Average Response Intervals for Incoming Incidents by Vehicles Already On Task

Number of Vehicles Already on Task	Incoming Incidents	Average Response Interval (Min:Sec)	Average Response Interval (Seconds)	Response Time Standard Deviation (Min:Sec)	Response Time Standard Deviation (Seconds)
0	8,272	06:16	376	02:27	147
1	6,241	06:24	384	02:34	154
2	3,310	06:32	392	02:40	160
3	1,760	06:58	418	02:49	169
4	1,182	07:08	428	02:54	174
5	897	06:56	416	02:37	157
6	616	06:53	413	02:49	169
7	378	06:48	408	02:48	168
8	202	07:16	436	03:17	197
9	113	07:32	452	03:29	209
10	62	07:16	436	02:52	172
11	20	07:56	476	03:58	238
12	16	07:03	423	02:20	140
13	4	07:02	422	01:02	62
14	-	00:00	0	00:00	0
15	-	00:00	0	00:00	0
16	-	00:00	0	00:00	0
17	-	00:00	0	00:00	0

As can be seen above, the distribution of average response intervals experienced by the "next incoming requests" show little systematic dependence on the number of vehicles already OnTask. The whiskers above and below the dots present the standard deviation around the average response interval.

Figure 110: Average Response Intervals for Incoming Incidents by Vehicles Already On Task

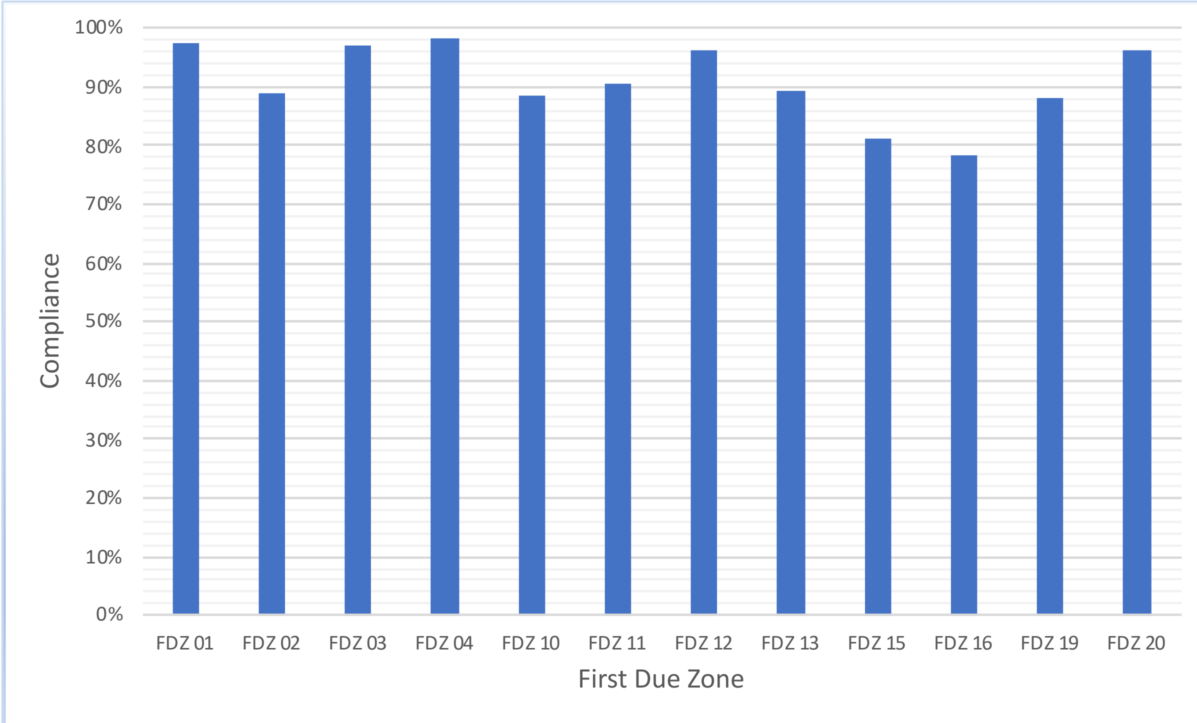


Reliability Factors

Percentage of First Due Compliance

The reliability of the Peoria system depends on how the metric for judging this coincident is First Due Compliance: how often is a vehicle quartered in a zone included in the response to an incident in the zone? The results of this analysis are presented below.

Figure 111: Percentage of First Due Compliance by Station Demand Zone



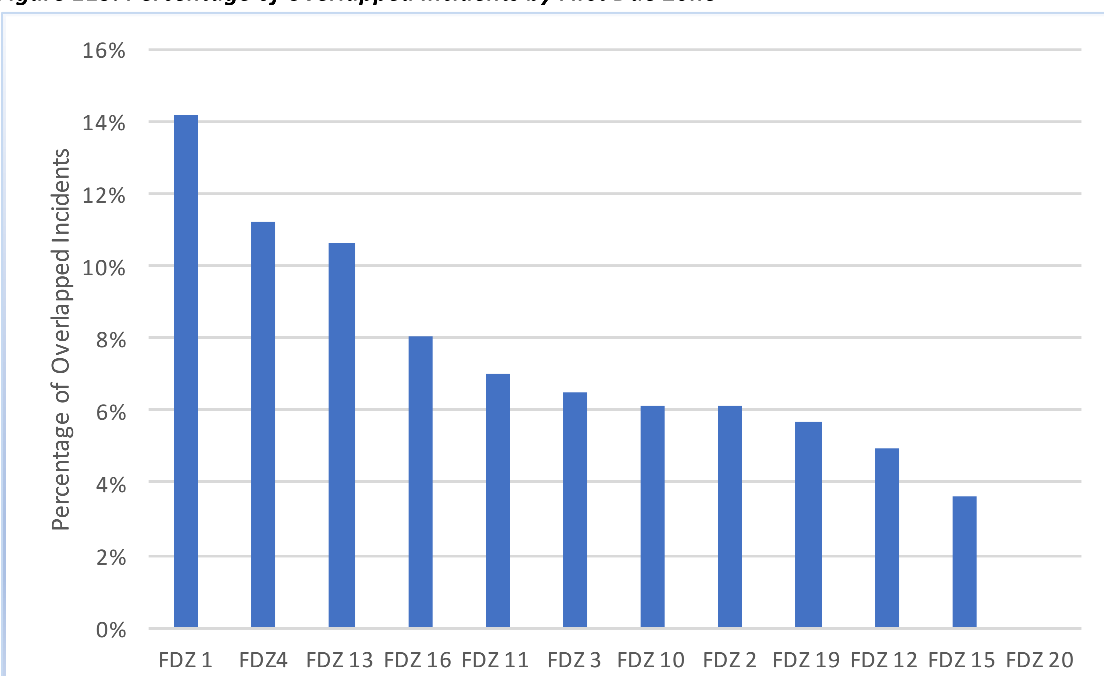
Analyses of Simultaneous Incidents by First Due Zones

Overlapped or simultaneous incidents are defined as a second call being received for a first due zone while one or more incidents are already ongoing for the same first due zone. In general, the larger the call volume for a first due station, the greater the likelihood of overlapped incidents occurring. 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. The results of these analyses are presented for all incident categories.

Figure 112: Overlapped Incidents by First Due Zone

First Due Zone	Total Incidents	Overlapped Incidents	Percentage Overlapped Incidents
FDZ 01	3,120	442	14.2%
FDZ 02	1,440	88	6.1%
FDZ 03	1,499	97	6.5%
FDZ 04	2,643	296	11.2%
FDZ 10	1,627	100	6.1%
FDZ 11	1,311	92	7.0%
FDZ 12	852	42	4.9%
FDZ 13	2,418	257	10.6%
FDZ 15	521	19	3.6%
FDZ 16	1,651	133	8.1%
FDZ 19	1,103	63	5.7%
FDZ 20	474	14	3.0%

Figure 113: Percentage of Overlapped Incidents by First Due Zone



First Due Zone 20 experienced no overlapped incidents.

Figure 114: Overlapped EMS Incidents by First Due Zone

First Due Zone	Total EMS Incidents	Overlapped EMS Incidents	% Overlapped EMS Incidents
FDZ 01	2,616	376	14.4%
FDZ 02	1,217	73	6.0%
FDZ 03	1,261	82	6.5%
FDZ 04	2,297	257	11.2%
FDZ 10	1,332	86	6.5%
FDZ 11	1,064	74	7.0%
FDZ 12	731	37	5.1%
FDZ 13	1,929	213	11.0%
FDZ 15	402	14	3.5%
FDZ 16	1,455	115	7.9%
FDZ 19	878	58	6.6%
FDZ 20	368	10	2.7%

Figure 115: Percentage of Overlapped EMS Incidents by First Due Zone

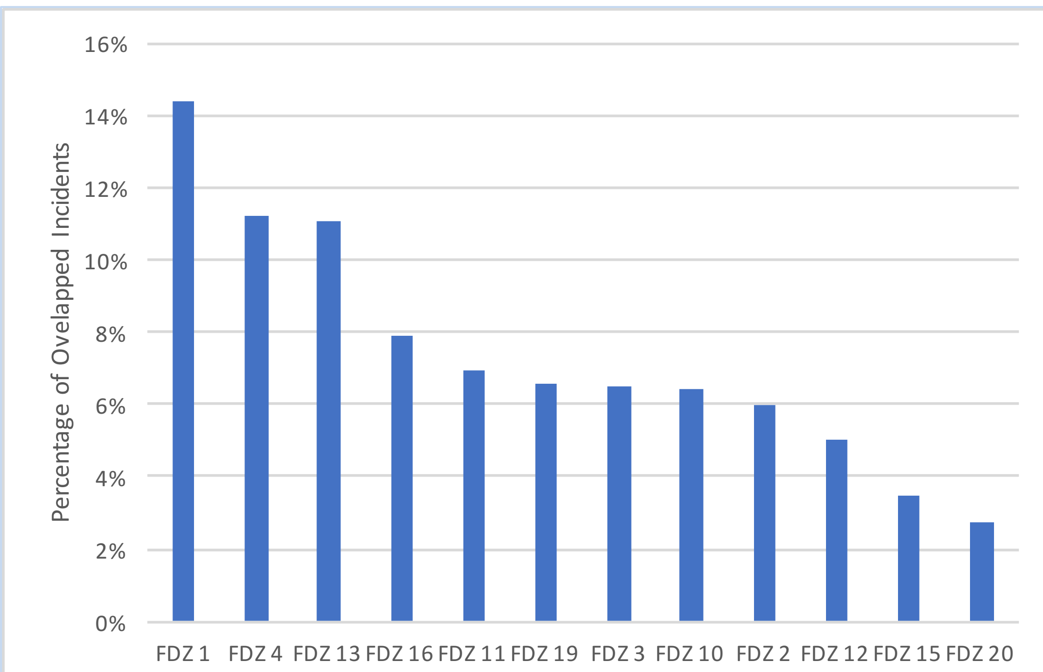
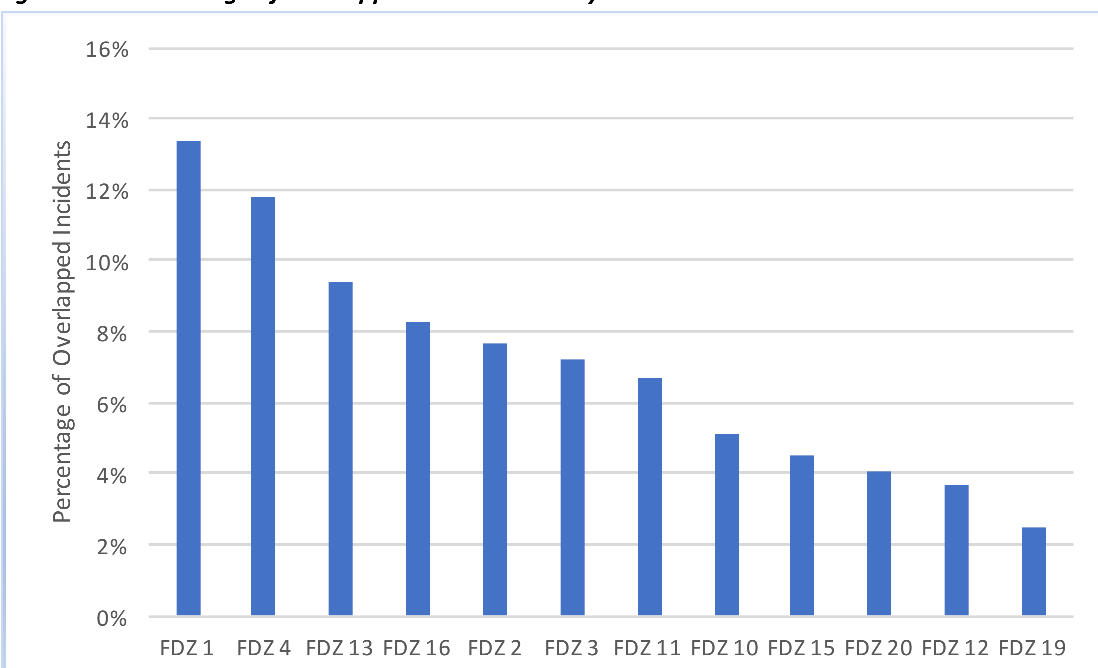


Figure 116: Overlapped Fire Incidents by First Due Zone

First Due Zone	Total Fire Incidents	Overlapped Fire Incidents	% Overlapped Fire Incidents
FDZ 01	462	62	13.42%
FDZ 02	195	15	7.69%
FDZ 03	208	15	7.21%
FDZ 04	306	36	11.76%
FDZ 10	257	13	5.06%
FDZ 11	45	3	6.67%
FDZ 12	109	4	3.67%
FDZ 13	438	41	9.36%
FDZ 15	111	5	4.50%
FDZ 16	181	15	8.29%
FDZ 19	197	5	2.54%
FDZ 20	97	4	4.12%

Figure 117: Percentage of Overlapped Fire Incidents by First Due Zone



AMT OPERATIONS

Advanced Medial Transport (AMT) is a private ambulance operator that works with the Peoria Fire Department (PFD) and provides transportation for those patients requiring hospital services. An emergency medical incident will have one of three configurations of units assigned to it: a response by PFD units only; a response by AMT units only; or a response that includes PFD and AMT units. The average performance intervals for these configurations are presented.

Figure 118: Average Performance Intervals for AMT & PFD on EMS Incidents

EMS Ops by Agency	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	average	Sample	average	Sample	average	Sample	average
AMT [only responder]	6,206	01:19	5,790	00:15	6,579	04:40	6,177	06:58
PFD [only responder]	2,945	01:45	2,748	01:24	2,515	02:59	2,655	06:31
AMT [responded w PFD]	13,752	01:32	11,877	00:18	13,760	05:01	13,524	07:29
PFD [responded w AMT]	14,079	01:52	13,914	01:24	13,261	02:38	13,641	06:17
AMT [1st Arrvd w PFD]	3,637	01:28	3,087	00:16	3,750	03:29	3,703	05:33
PFD [1st Arrvd w AMT]	9,237	01:48	9,422	01:23	9,391	02:25	9,636	05:50

The 90th percentile performance intervals for the three emergency medical response configuration are presented.

Figure 119: 90thPercentile Performance Intervals for AMT & PFD on EMS Incidents

EMS Ops by Agency	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile	Sample	90th-%tile
AMT [only responder]	6,206	01:35	5.790	00:29	6,579	08:26	6,177	12:17
PFD [only responder]	2,945	03:08	2.748	02:12	2,515	05:19	2,655	09:55
AMT [responded w PFD]	13,752	01:52	11.877	00:38	13,760	08:03	13,524	11:06
PFD [responded w AMT]	14,079	03:15	13.914	02:07	13,261	04:33	13,641	09:14
AMT [1st Arrvd w PFD]	3,637	01:41	3.087	00:33	3,750	05:40	3,703	07:50
PFD [1st Arrvd w AMT]	9,237	03:02	9.422	02:03	9,391	04:07	9,636	08:24

The data presented in Figure 120 shows the amount of effort AMT and PFD apply to meeting emergency medical requests for service. The way in which AMT and PFD effort is allocated among the three response configurations is also shown.

Figure 120: Time-on-Task for EMS Operations by Agency

EMS Ops by Agency	Time-on-Task [hh:mm:ss]
AMT [all vehicle responses]	12742:44:36
AMT [only responder]	3234:15:30
AMT [responded w PFD]	9508:29:06
PFD [all vehicle responses]	5126:41:15
PFD [only responder]	724:59:00
PFD [responded w AMT]	4401:42:15
EMS Total	17869:25:51

AMT conducts all medical transports is the Peoria system. The transport ratios experienced by AMT are presented. These data are organized by response configuration and by incident acuity.

Figure 121: AMT Transport Ratio by Response Configuration and Incident Acuity

AMT Responses	Vehicles Arrvd At Scene	Transports	Transport Ratio
AMT [only responder]	6,665	2,809	42.15%
AMT [responded w PFD]	13,801	11,500	83.33%
AMT [all responses]	20,466	14,309	69.92%
AMT Alpha	1,758	1,577	89.70%
AMT Bravo	2,839	2,093	73.72%
AMT Charlie	9,146	6,979	76.31%
AMT Delta	6,474	3,475	53.68%
AMT Echo	249	185	74.30%
AMT [all responses]	20,466	14,309	69.92%

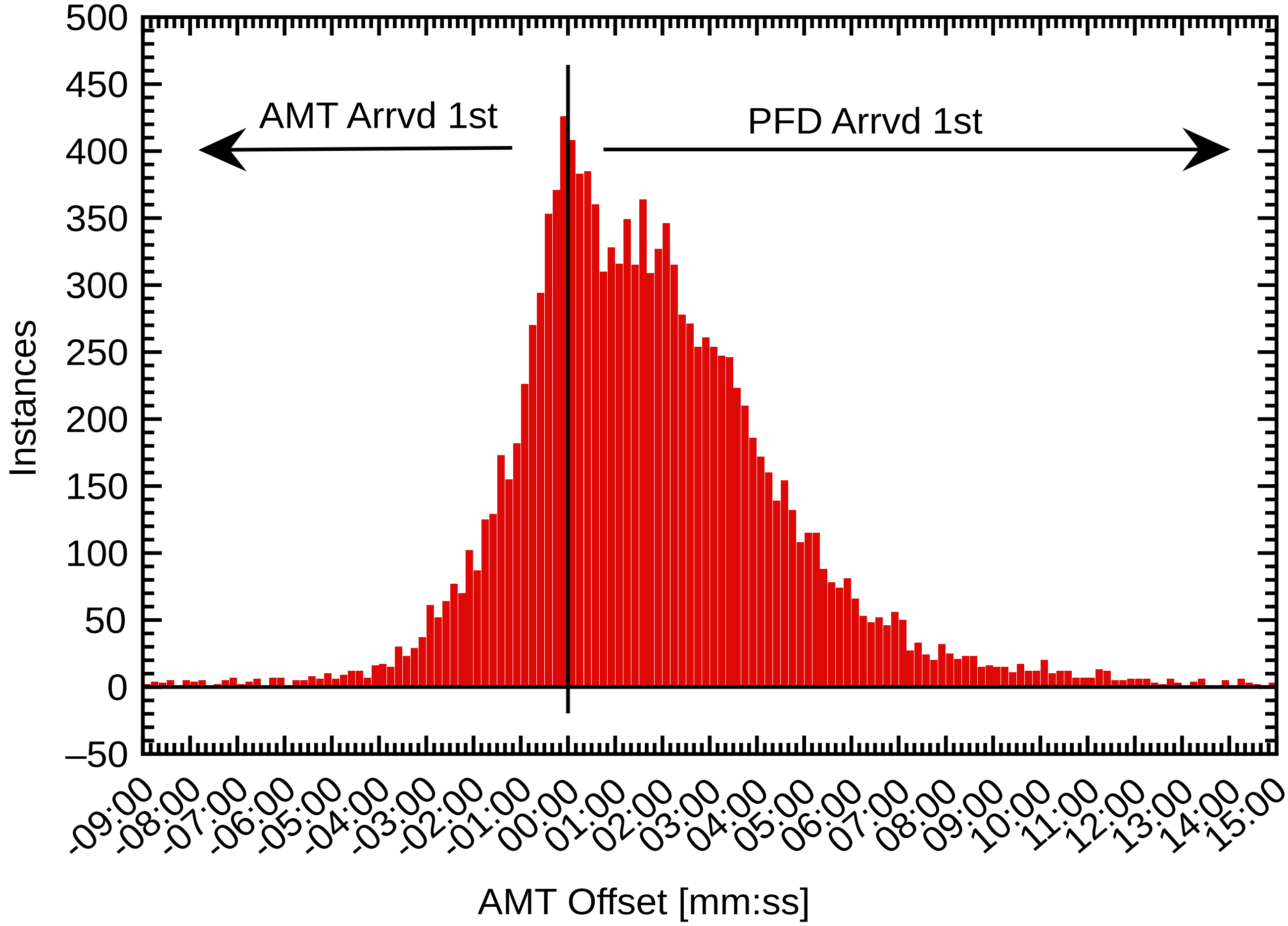
Following presents the average arrival offsets experienced in the system when both AMT and PFD vehicles were assigned to an incident. In this presentation, positive values for the offset means that the PFD vehicle was first arrived OnScene. In all years, PFD has arrived, on average, first at scene.

Figure 122: Average AMT / PFD Arrival Offsets on EMS Incidents

Year	Average AMT / PFD Arrival Offset [mm:ss]
CY2013	02:11
CY2014	02:25
CY2015	02:05
CY2016	01:46
CY2017	01:46
2018 (Jan thru Jun)	01:55

A complete frequency distribution histogram of AMT / PFD arrival offsets for CY2017 is presented. Again, positive values for the offset means that the PFD vehicle was first arrived OnScene. Approximately 13,000 data pairs are represented in this histogram.

Figure 123: Frequency Distribution of AMT/PFD Arrival Offset for CY2017



The following data show counts and percentages for AMT 1st Arrived versus PFD 1st Arrived. These numbers are the counts of instances under the distribution histogram to the left and right of the line at 00:00 [mm:ss] offset.

Figure 124: Percentage of AMT/PFD First Arrived

Arrival Order	Count	Percentage
AMT 1st Arrvd	3,598	26.96%
PFD 1st Arrvd	9,750	73.04%
Total Incidents	13,348	100.00%

The data show how many instances are captured within windows of varying width, centered at 00:00 [mm:ss] offset. The ± 2 minute window of offsets captures 52.72% of the incidents.

Figure 125: Range of Offsets for AMT/PFD First Arrived

Range of AMT Offsets [mm:ss]	Instances	Cumulative Percent Capture	Increment Percent Capture
-00:30 to +00:30	2,356	17.78%	0.00%
-01:00 to +01:00	4,145	31.29%	13.50%
-02:00 to +02:00	6,984	52.72%	21.43%
-03:00 to +03:00	9,132	68.93%	16.21%
-04:00 to +04:00	10,638	80.30%	11.37%
-05:00 to +05:00	11,556	87.23%	6.93%
-09:00 to +15:00	13,248	100.00%	12.77%

There are 13,801 EMS incidents which received a [1 PFD + 1 AMT] response. However in the following figures, there are 13,248 offsets of arrival times between the PFD unit and the AMT unit. The difference arises because some incident records are missing data, specifically arrival timestamps for either the AMT unit or the PFD unit. In these cases, no offset can be calculated.

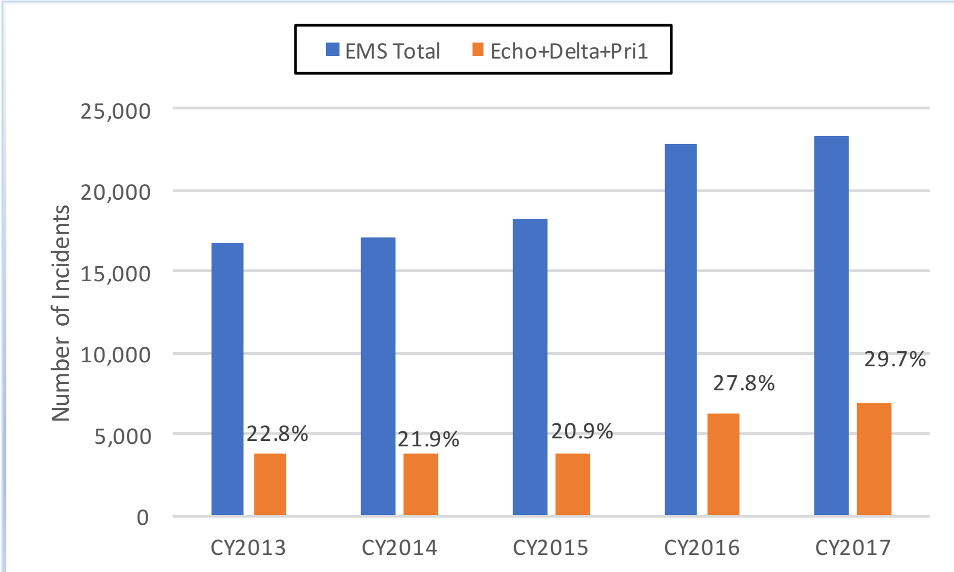
BASELINE PERFORMANCE TABLES

For the reporting periods CY2013 to CY2017, the total number of incidents increased from 20,659 (average 56.60 Incidents per day) to 26,898 (average 73.69 Incidents per day). Year-over-year (YoY) growth during this time frame ranged from 2.1% to 19.3%. The abrupt increase for CY2016 is unexplained.

Figure 126: Number of Incidents by Category and Reporting Period

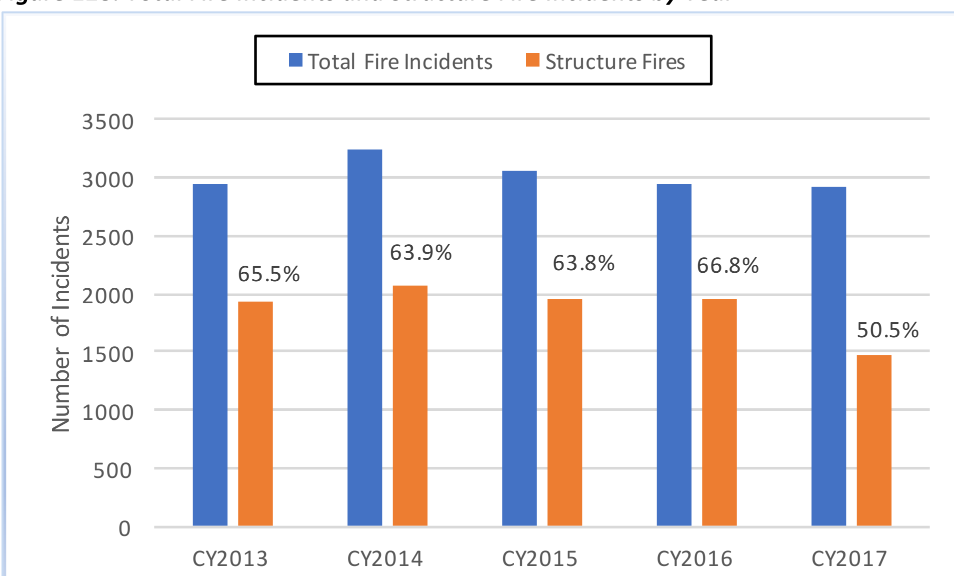
Incident Category	CY2013	CY2014	CY2015	CY2016	CY2017
PFD Alpha	2,207	2,187	2,516	2,817	2,780
PFD Bravo	3,993	3,892	3,937	3,975	4,173
PFD Charlie	4,804	5,034	5,460	5,830	5,413
PFD Delta	3,233	3,173	3,098	3,323	3,640
PFD Echo	191	230	202	208	278
PFD EMS Total	**14,428**	**14,516**	**15,213**	**16,153**	**16,284**
AMT Priority 1	406	350	526	2,797	3,022
AMT Priority 2	1,988	2,285	2,565	3,848	4,088
AMT Only Total	**2,394**	**2,635**	**3,091**	**6,645**	**7,110**
ONE ENGINE	734	849	859	717	828
ONE TRUCK COMPANY	81	104	50	68	60
STRUCTURE	1,926	2,070	1,950	1,967	1,473
VEHICLE FIRE	92	98	89	79	94
OTHER	108	120	107	113	462
FIRE Total	**2,941**	**3,241**	**3,055**	**2,944**	**2,917**
Rescue	**458**	**494**	**408**	**431**	**385**
nonFire/NonMedical	**431**	**288**	**314**	**172**	**198**
HazMat	**7**	**7**	**6**	**4**	**4**
Total Incidents (Includes AMT)	**20,659**	**21,181**	**22,087**	**26,349**	**26,898**
Average Incidents Per Day	**56.60**	**58.03**	**60.51**	**72.19**	**73.69**
Year to Year Growth		**522**	**906**	**4262**	**549**
Year to Year % Change		**2.5%**	**4.3%**	**19.3%**	**2.1%**

Figure 127: Total EMS Incidents and Life-Threatening EMS Incidents by Year



The data presented here shows two anomalies. First, there is an abrupt increase in EMS incidents in CY2016. At the same time, the proportion of life-threatening incidents also increased.

Figure 128: Total Fire Incidents and Structure Fire Incidents by Year



The percentages represent the proportion of incident records in the CAD with incident codes that have STRUCTURE FIRE as their descriptors. In the consultant's experience with similar sized urban systems, this percentage is unusually high. It may have to do with how the STRUCTURE FIRE descriptor is assigned when an incident is logged into the CAD. The number of fire related incident is stable. The number of structure fires was stable for CY2013 through CY2016. The abrupt drop in STRUCTURE FIRES in CY2017 is unexplained.

Figure 129: Number of Incidents, Responses, and Total Time on Task by Reporting Period

Reporting Period	Number of Incidents	Number of Vehicle Responses	Average Vehicle Responses per Incident	Total Time on Task	Average Time on Task per Vehicle Response	Average Incidents per Day	Average Vehicle Responses per Day
CY2013	20,432	30,689	1.50	8190:57:59	0:16:01	55.98	84.08
CY2014	20,983	31,809	1.52	8324:06:42	0:15:42	57.49	87.15
CY2015	21,810	31,370	1.44	7565:54:37	0:14:28	59.75	85.95
CY2016	25,731	32,874	1.28	8153:14:21	0:14:53	70.50	90.07
CY2017	26,157	32,147	1.23	8017:02:17	0:14:58	71.66	88.07

Over the period CY2013 through CY2017, the number of vehicle responses has increased from 30,689 to only 32,147 even though the number of incidents increased 28%. Over the same period, system Time-on-task decreased from 8,190 hours to 8,017 hours.

SECTION 4: G.I.S. MODELING

FITCH & ASSOCIATES

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 programs is provided below. Overall, the travel time is 4 minutes and 32 seconds or less for 90% of the incidents.

Figure 130: 90th Percentile Turnout and Travel Time of First Arriving Units by Program

Incident Category	Dispatch Interval		Turnout Interval		Travel Interval		Response Interval	
	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]	Sample	90th %-tile [mm:ss]
EMS	11,646	03:01	11,877	02:05	11,794	04:22	12,185	08:43
Fire	2,446	02:57	2,539	02:08	2,501	05:06	2,602	09:46
Rescue	330	03:05	347	02:05	347	04:44	350	08:54
Other	136	02:47	82	01:56	81	05:00	146	08:33
HazMat	1		1		1		1	
All	14,573	03:02	14,844	02:06	14,704	04:32	15,287	08:53

Comparison to National References

There are two notable references for travel time available to the fire service in National Fire Protection Association (NFPA) 1710[13] and the Commission on Fire Accreditation International (CFAI)[14]. 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 population densities 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[15].

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[13] 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.
[14] CFAI. (2009). Fire & emergency service self-assessment manual, (8th ed.). Chantilly, Virginia: Author. (page 71)
[15] CFAI. (2016). Fire & emergency service self-assessment manual, (9th ed.). Chantilly, Virginia: Author.

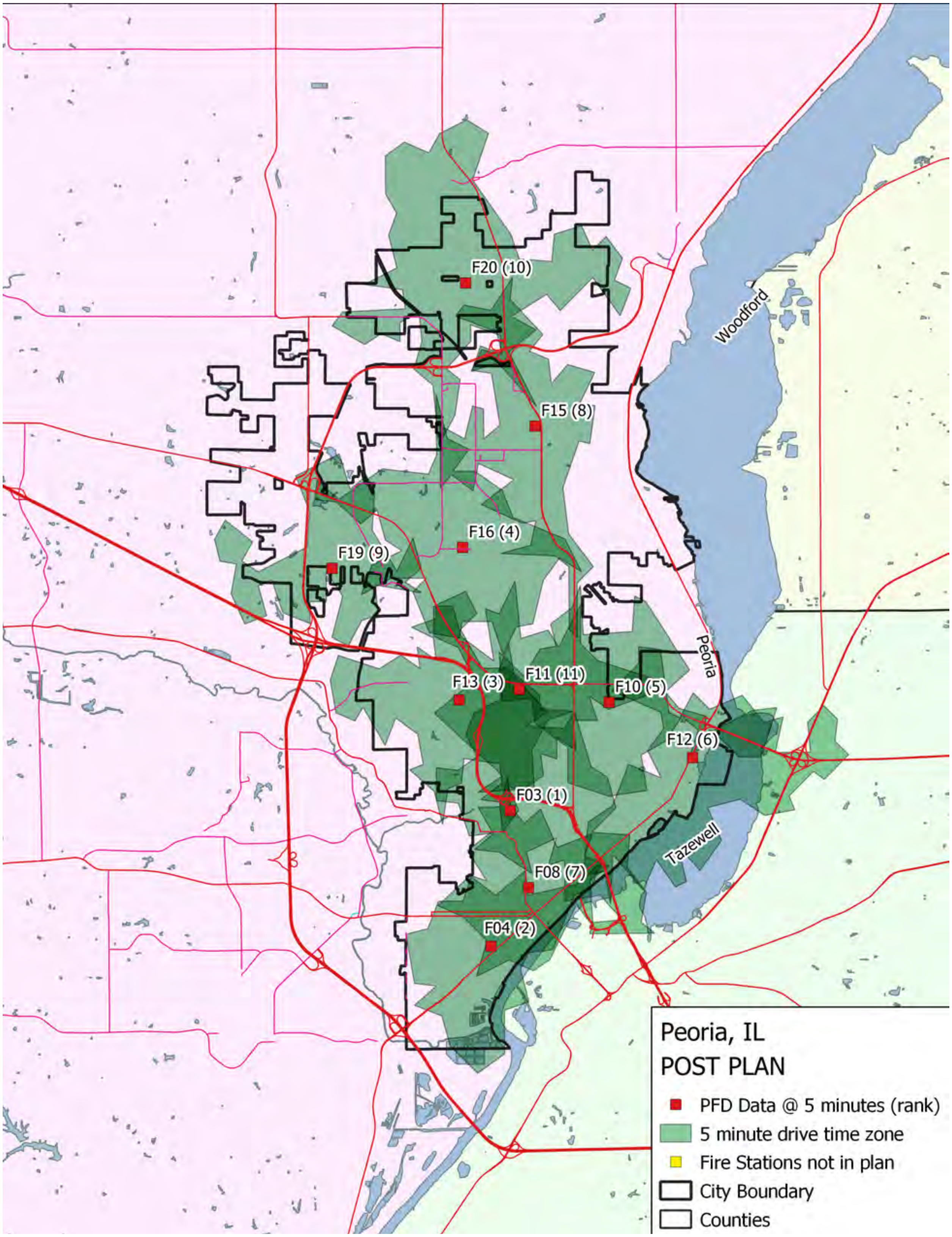
Validation of Planning Analysis

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 minute and 32 second overall department performance and a 5 minute and 6 second fire travel time capability from the existing fire stations at the 90th percentile. Utilizing average road speeds, the planning assessments estimated greater than 87% of the incidents could be responded to within 5-minutes travel time from eleven of the existing fire stations. Station 1 did not capture any additional calls in the analysis and therefore is not reflected below. Comparing the historical performance to the GIS planning analysis does suggest the agency is responding to incidents on the road network quicker than average road speeds suggesting the percentage of calls captured are slightly higher than indicated below. 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.

Figure 131: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	5,322	5,322	28.62%
2	S4	2,607	7,929	42.65%
3	S13	2,064	9,993	53.75%
4	S16	1,737	11,730	63.09%
5	S10	1,552	13,282	71.44%
6	S12	829	14,111	75.89%
7	S8	730	14,841	79.82%
8	S15	643	15,484	83.28%
9	S19	348	15,832	85.15%
10	S20	276	16,108	86.63%
11	S11	91	16,199	87.12%

Figure 132: Current Fire Station Bleed Maps for 5-Minute Travel Time



Internal Performance Objectives

The Peoria 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 minutes and 32 seconds overall and 5 minutes and 6 seconds for fire related responses. The following analyses are utilized to compare and contrast the various potential distribution models.

Current Stations Configurations-Minute Travel Time

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 Peoria Fire Department (PFD) 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.

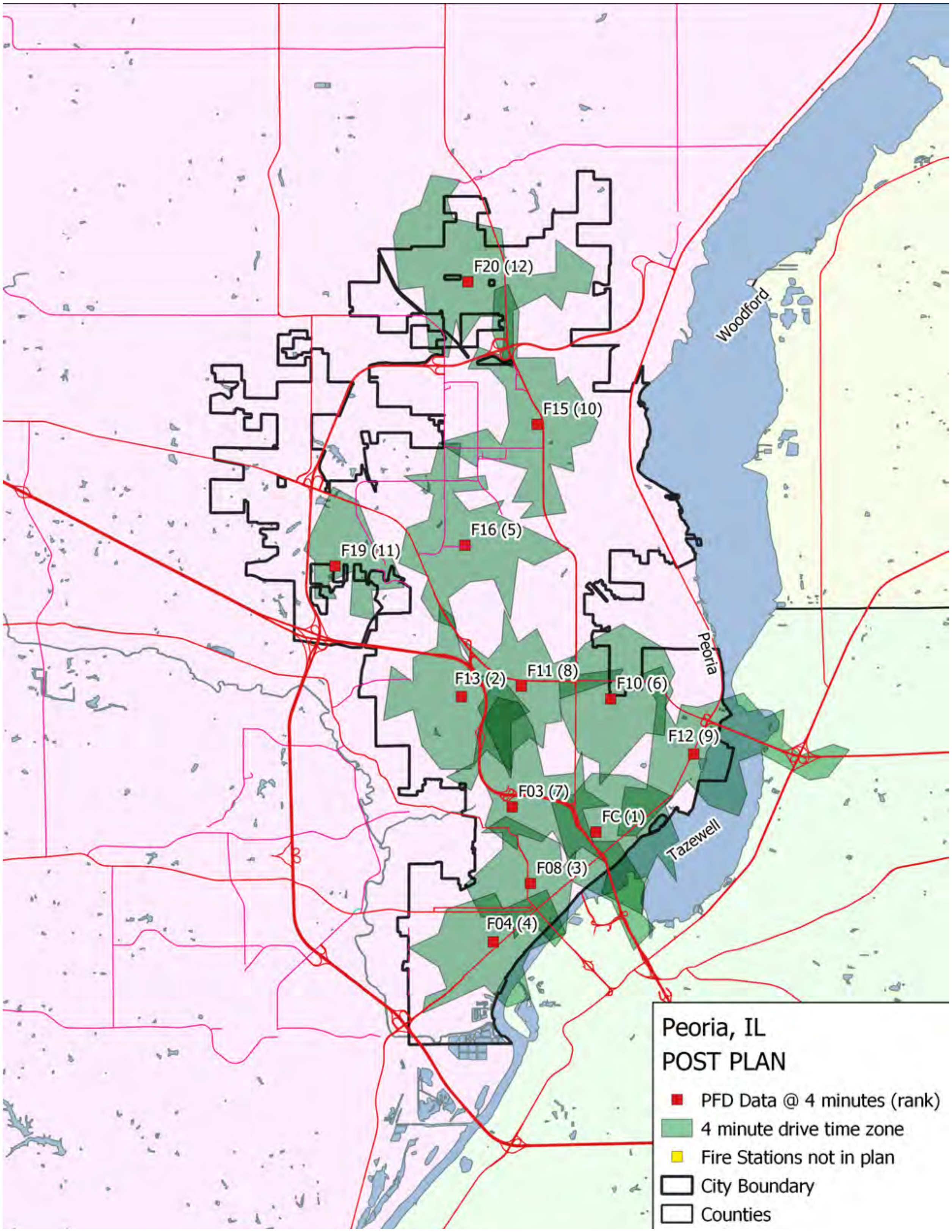
Therefore, the station that contributed the most to the overall system's performance was Station 1 in the first row and would capture 16.70% of the risks within 4 minutes. Station 13 would cover an additional 10.98% of the risk bringing the cumulative total to 27.68% between Stations 1 and 13. In total, with all 12 fixed fire stations, 73.48% of the incidents could be responded to within 4 minutes travel time.

In other words, within the current configuration of stations, the department could not achieve a 4-minute travel time, as recommended by NFPA 1710 without additional stations and resources. Results are provided in tabular format and drive time mapping format below.

Figure 133: Marginal Fire Station Contribution for 4-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	FC1	3,105	3,105	16.70%
2	S13	2,042	5,147	27.68%
3	S8	1,946	7,093	38.15%
4	S4	1,539	8,632	46.43%
5	S16	1,111	9,743	52.40%
6	S10	1,041	10,784	58.00%
7	S3	923	11,707	62.96%
8	S11	634	12,341	66.37%
9	S12	430	12,771	68.69%
10	S15	411	13,182	70.90%
11	S19	274	13,456	72.37%
12	S20	206	13,662	73.48%

Figure 134: Current Fire Station Bleed Maps for 4-Minute Travel Time



5-Minute Travel Time

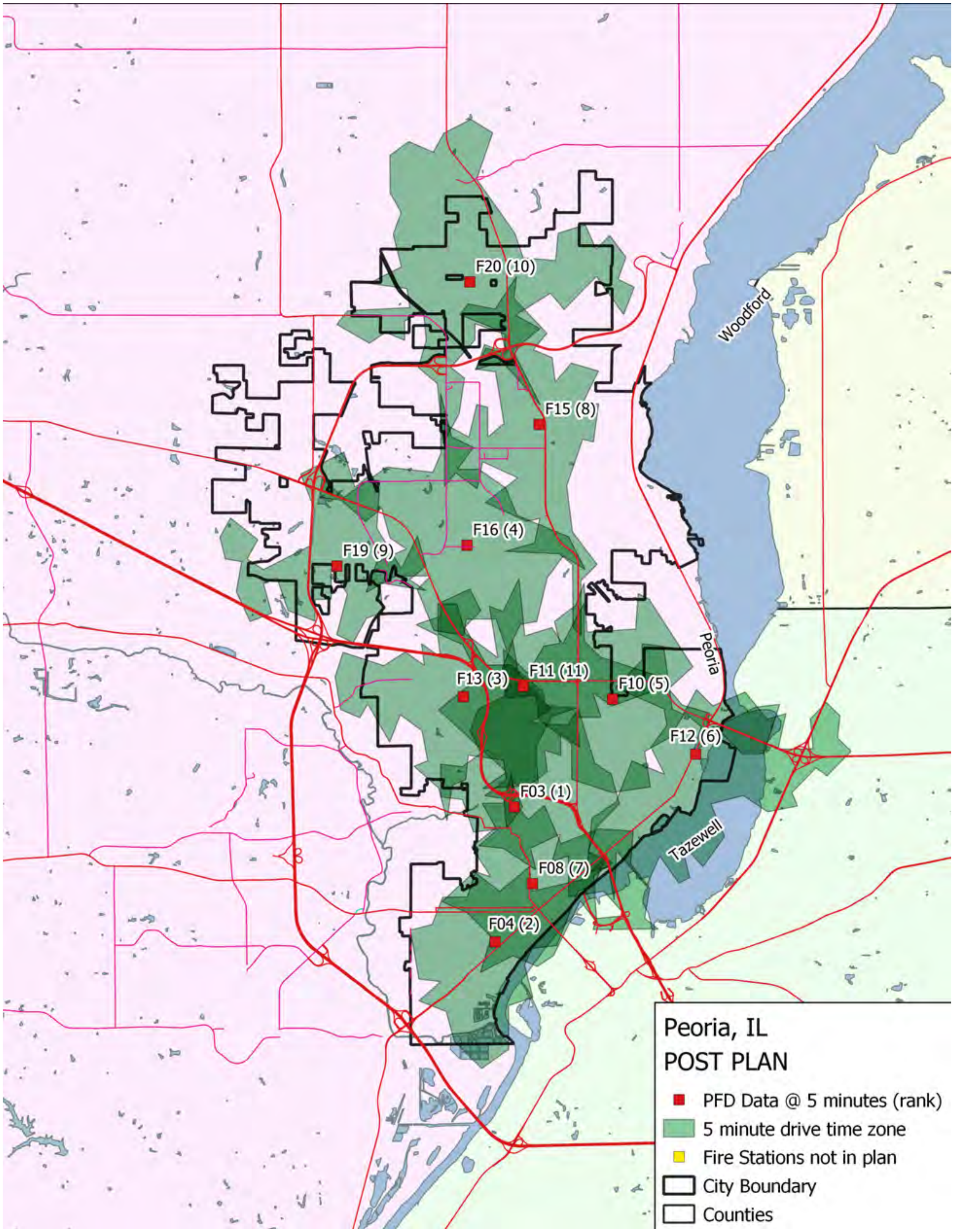
The analysis demonstrates that the current station configuration could capture greater than 87% of the incidents within 5 minutes utilizing the department's current station configuration. As indicated in above, the same performance could be achieved strictly from a geographic perspective with eleven stations without consideration for occupancy risk or call concurrency.

Figure 135: Marginal Fire Station Contribution for 5-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	5,322	5,322	28.62%
2	S4	2,607	7,929	42.65%
3	S13	2,064	9,993	53.75%
4	S16	1,737	11,730	63.09%
5	S10	1,552	13,282	71.44%
6	S12	829	14,111	75.89%
7	S8	730	14,841	79.82%
8	S15	643	15,484	83.28%
9	S19	348	15,832	85.15%
10	S20	276	16,108	86.63%
11	S11	91	16,199	87.12%

When referring to the mapping output below, the areas of the city that are not shaded with green, represent a maximum of 13% 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 136: Current Fire Station Bleed Maps with a 5-Minute Travel Time



6-Minute Travel Time

The analysis demonstrates that the current station configuration could capture nearly 92% of the incidents within 6 minutes with the utilization of 6 fire stations. Station 12 improves coverage by an additional 1.38%. Collectively, the remaining PFD fire stations improve coverage by approximately 3.29%.

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

- Operate out of 6 stations until the call volume across the jurisdiction increases
- Continue to operate out of all 12 stations to cover the geographic area irrespective of the current community demands
- Continue to operate out of all 12 stations, but utilize other stations and resources during peak demand times only

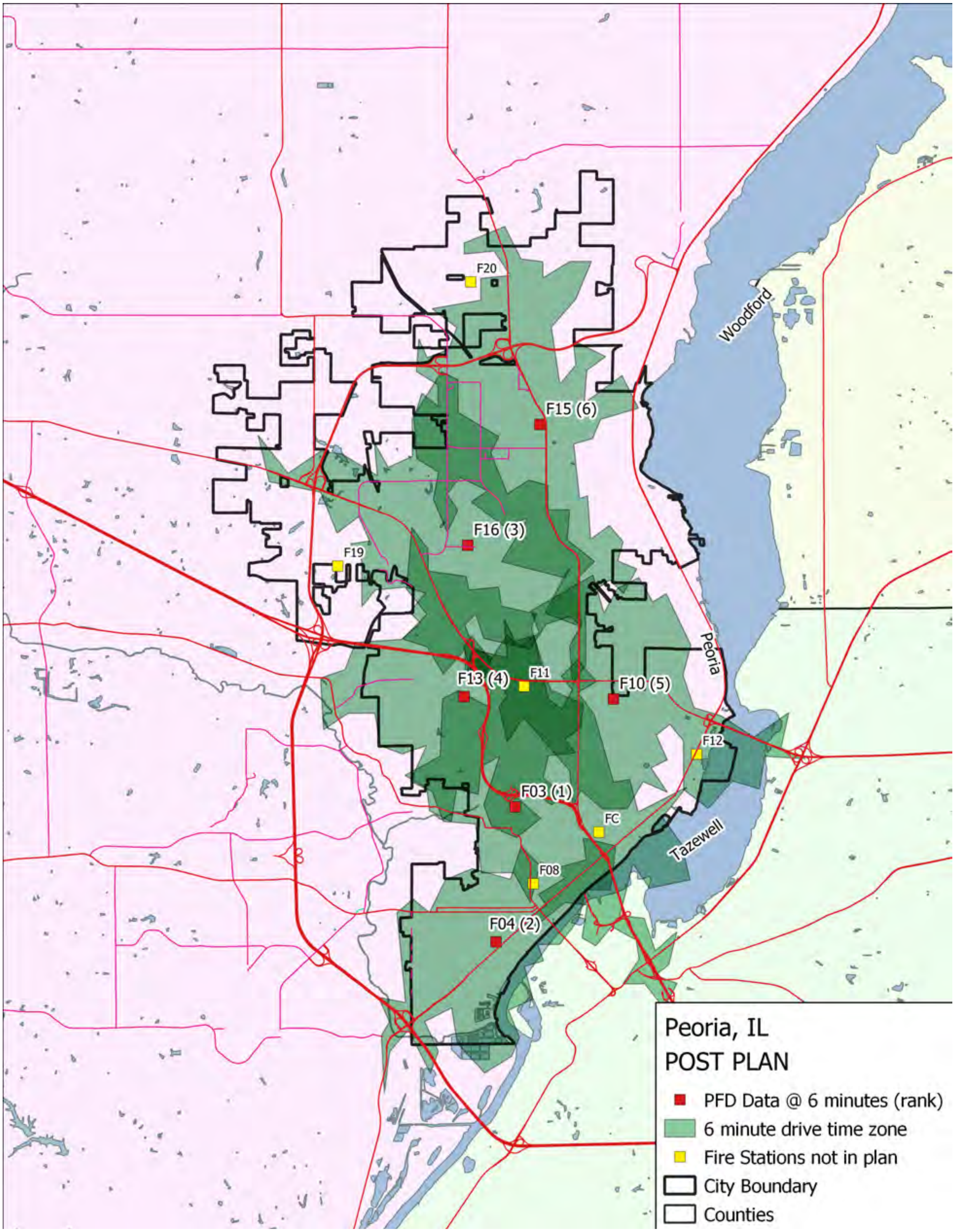
This list above is not intended to be all-inclusive.

Figure 137: Marginal Fire Station Contribution for 6-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	7,160	7,160	38.51%
2	S4	3,074	10,234	55.04%
3	S16	2,964	13,198	70.98%
4	S13	1,664	14,862	79.93%
5	S10	1,572	16,434	88.39%
6	S15	652	17,086	91.89%
7	S12	256	17,342	93.27%
8	S19	211	17,553	94.41%
9	S20	91	17,644	94.90%
10	S8	53	17,697	95.18%

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 138: 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 greater than 92% of the incidents within 8 minutes with the utilization of 3 fire stations and over 99% with 8 stations. Collectively, the remaining four PFD fire stations improve coverage by less than half of 1%.

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

- Operate out of 3 stations and adjust response time objectives from 5 minutes and 6 seconds (fire) to 8 minutes
- Continue to operate out of all 12 stations to cover the geographic area irrespective of the current community demands
- Continue to operate out of all 12 stations, but utilize other stations and resources during peak demand times only.

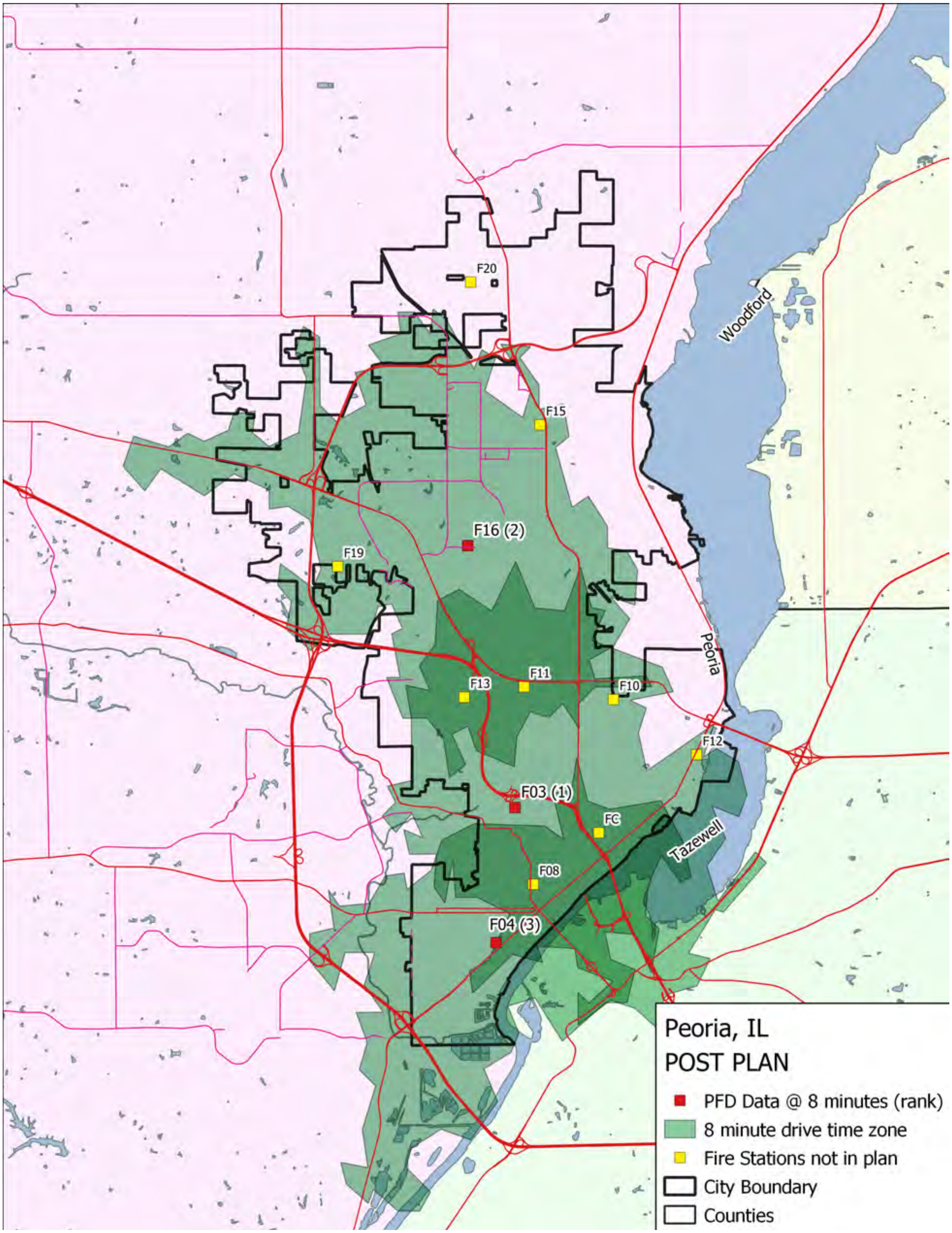
This list above is not intended to be all-inclusive.

Figure 139: Marginal Fire Station Contribution for 8-Minute Travel Time

Rank	Station Number	Station Capture	Total Capture	Percent Capture
1	S3	11,288	11,288	60.71%
2	S16	3,708	14,996	80.65%
3	S4	2,122	17,118	92.07%
4	S13	452	17,570	94.50%
5	S12	428	17,998	96.80%
6	S15	388	18,386	98.89%
7	S19	108	18,494	99.47%
8	S20	38	18,532	99.67%

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 140: 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.

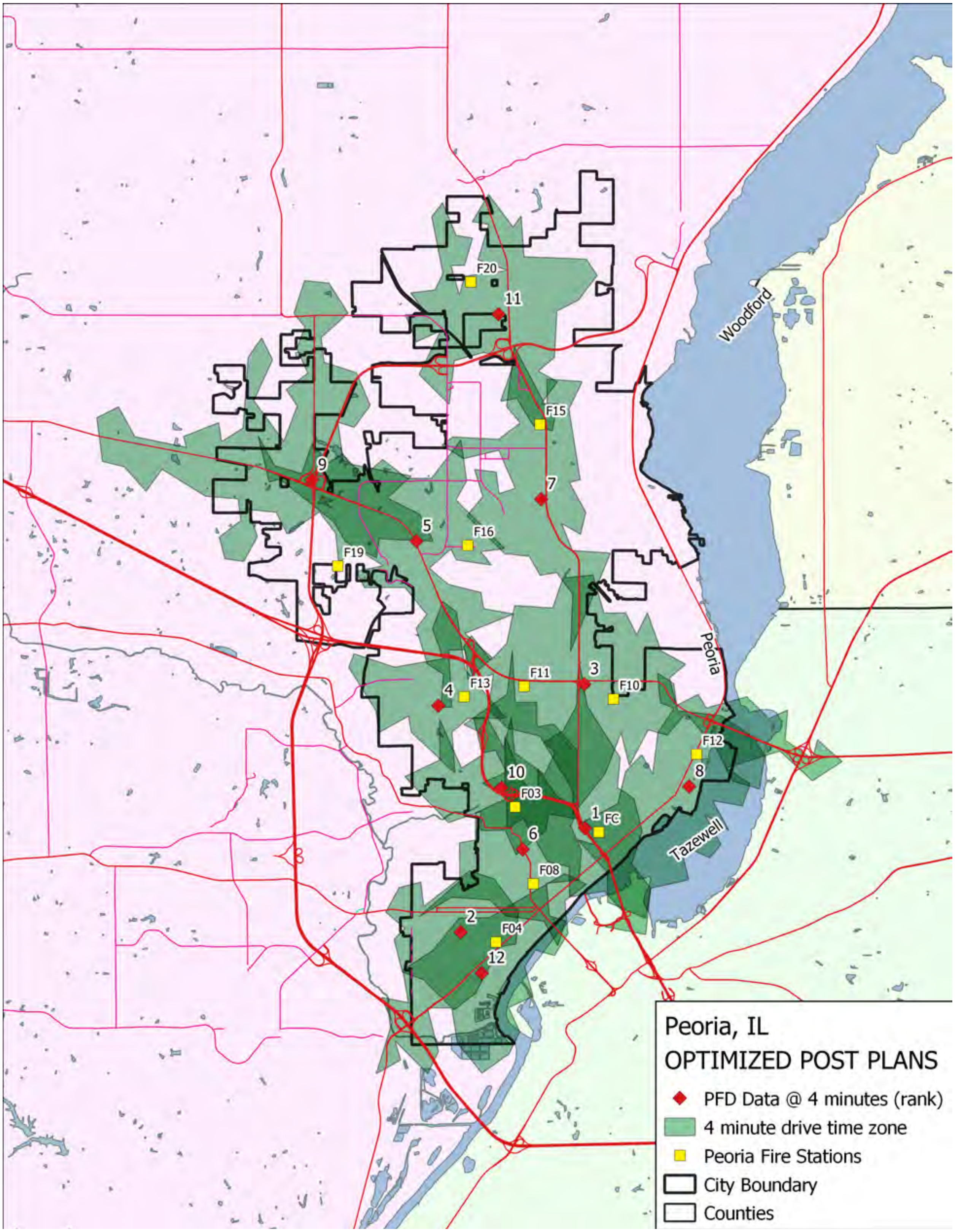
However, these analyses are beneficial for validating existing stations where applicable and identifying potential areas of future need for either new stations or station relocations.

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 12-station model can provide for greater than 90% effectiveness covering all incidents within 4-minutes or less travel time. In comparison, the current 12-station configuration achieved 4 minutes or less approximately 73% of the time, or an improvement of approximately 17%.

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

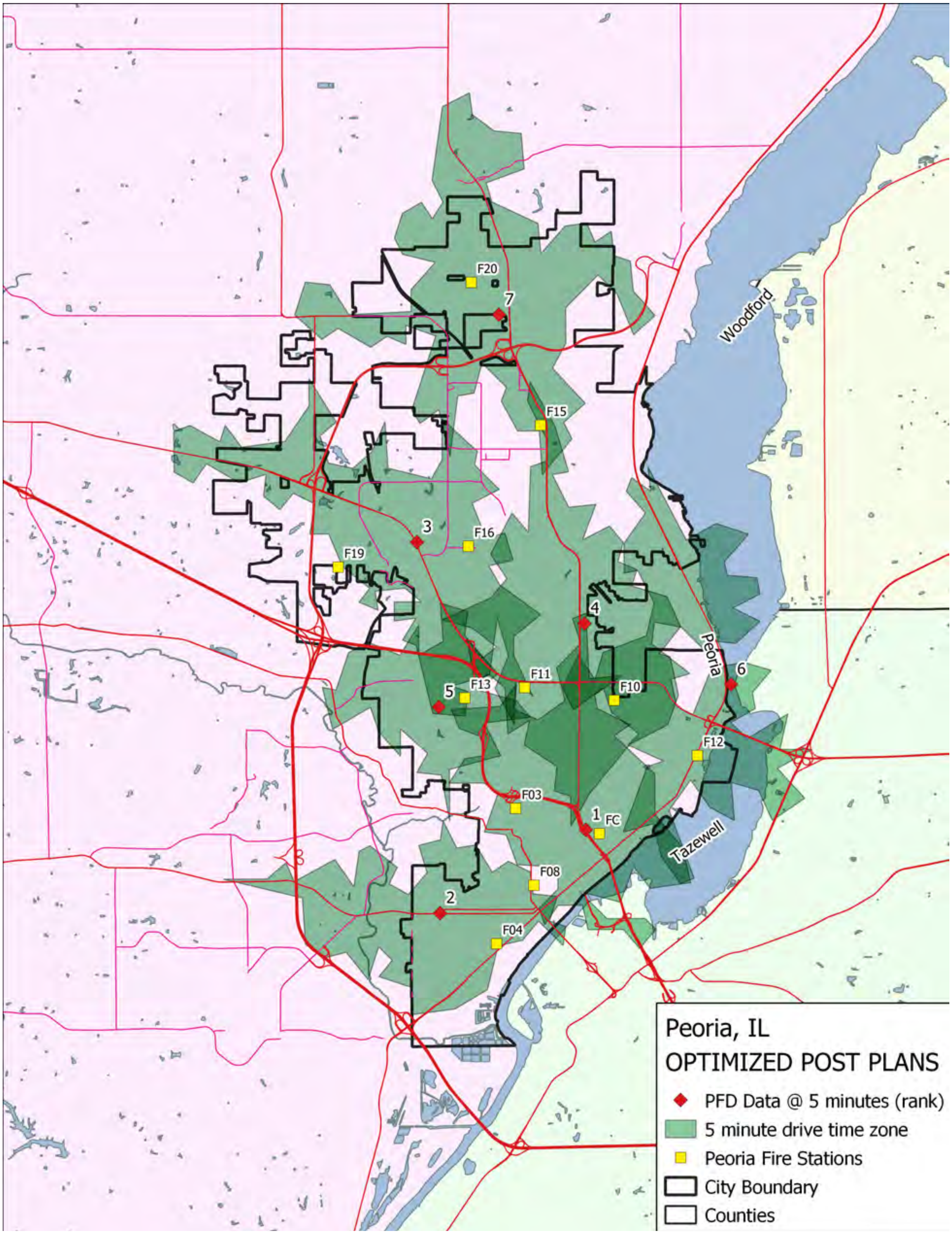
Figure 141: Optimized Station Deployment Plan - 4-Minute Travel Time



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 93% effectiveness covering all incidents within 5-minutes. This optimized configuration improves performance by approximately 5%, compared to the current 12-station configuration. A graphic illustration is presented below.

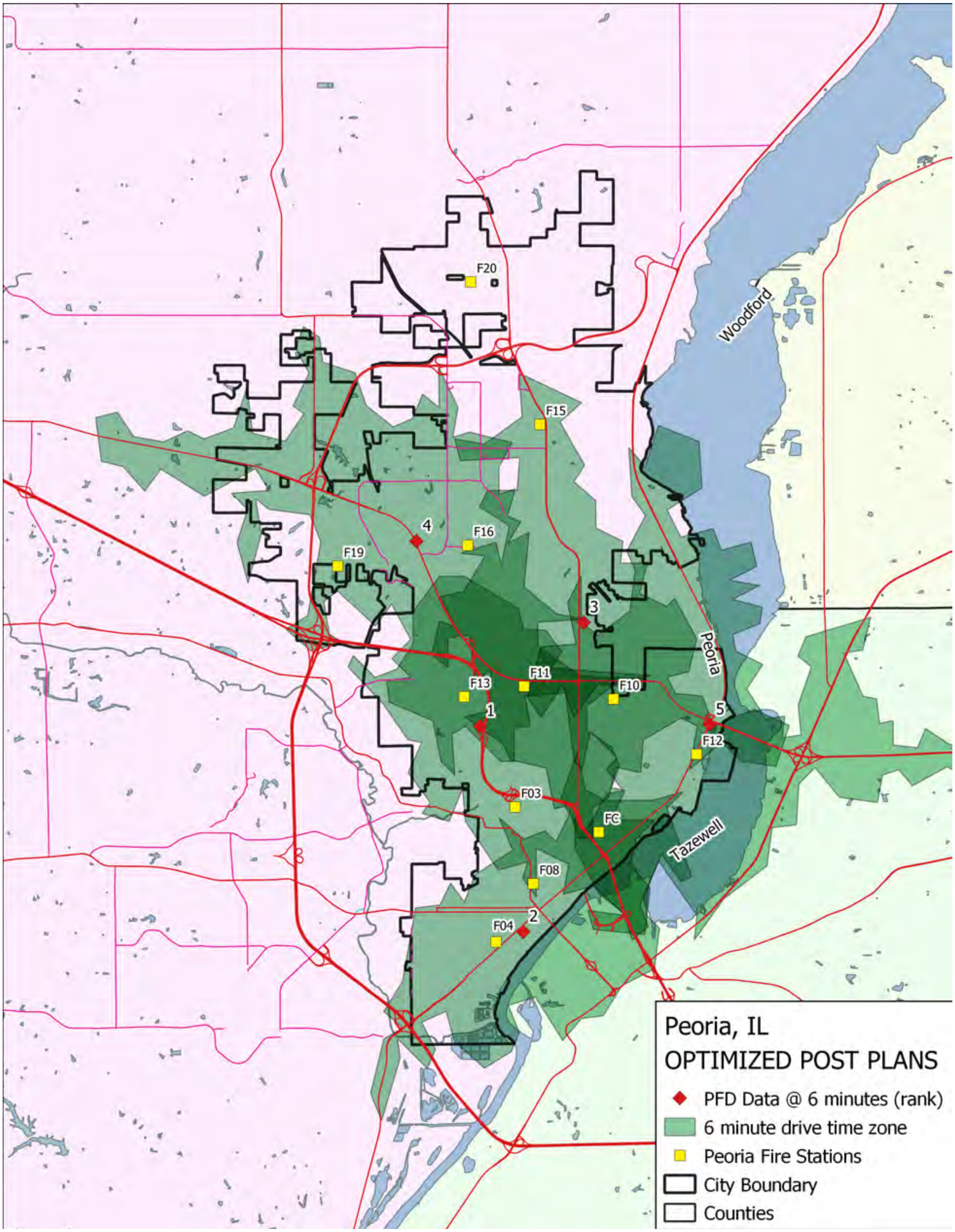
Figure 142: Optimized Station Deployment Plan – 5--Minute Travel Time



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 94% effectiveness covering all incidents within 6-minutes. This optimized configuration improves performance by approximately 3%, compared to the current 6-station configuration presented previously. A graphic illustration is presented below.

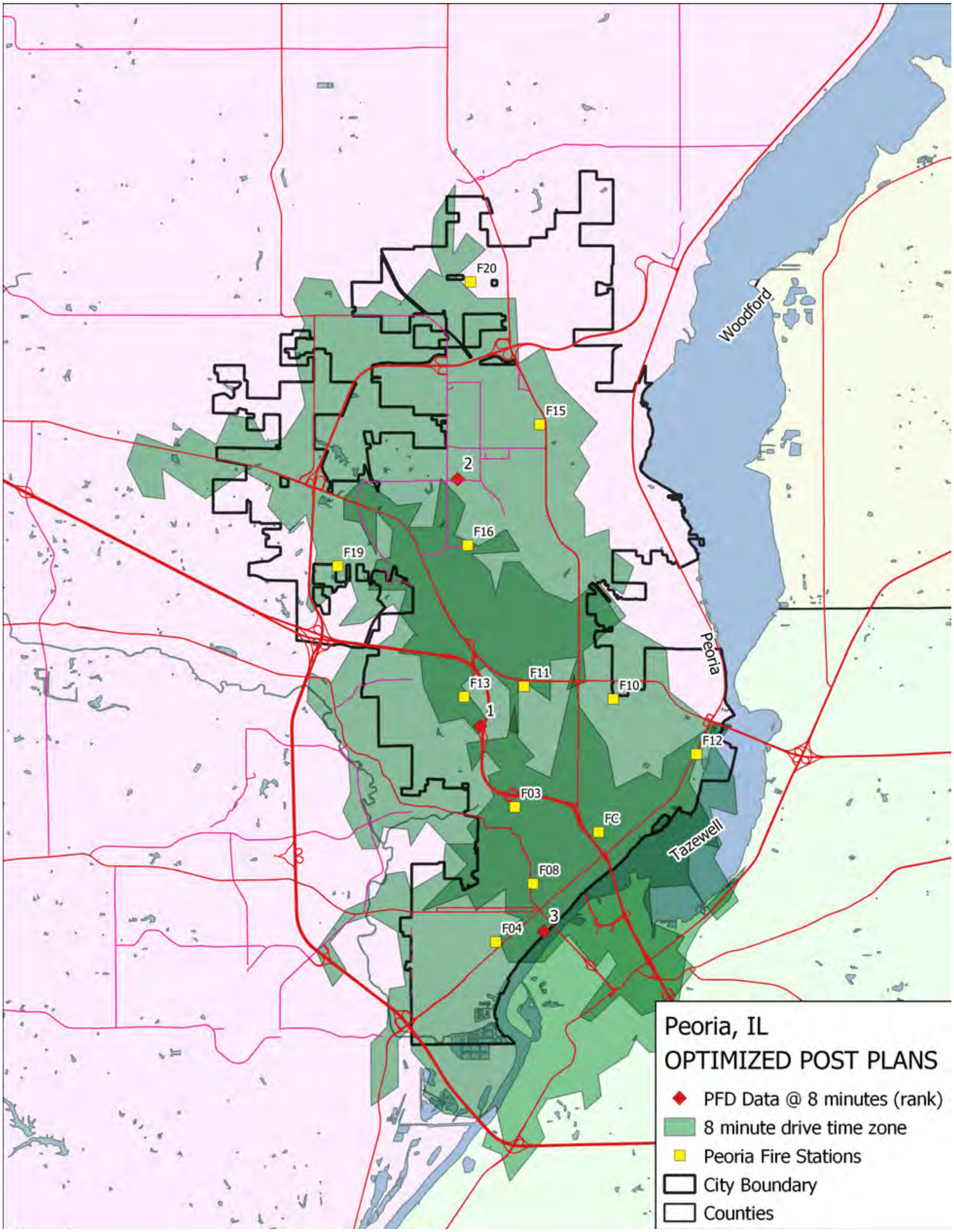
Figure 143: Optimized Station Deployment Plan – 6--Minute Travel Time



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 97% effectiveness covering all incidents within 8-minutes. This optimized configuration improves performance by approximately 5%, compared to the current station configuration. A graphic illustration is presented below.

Figure 144: 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.

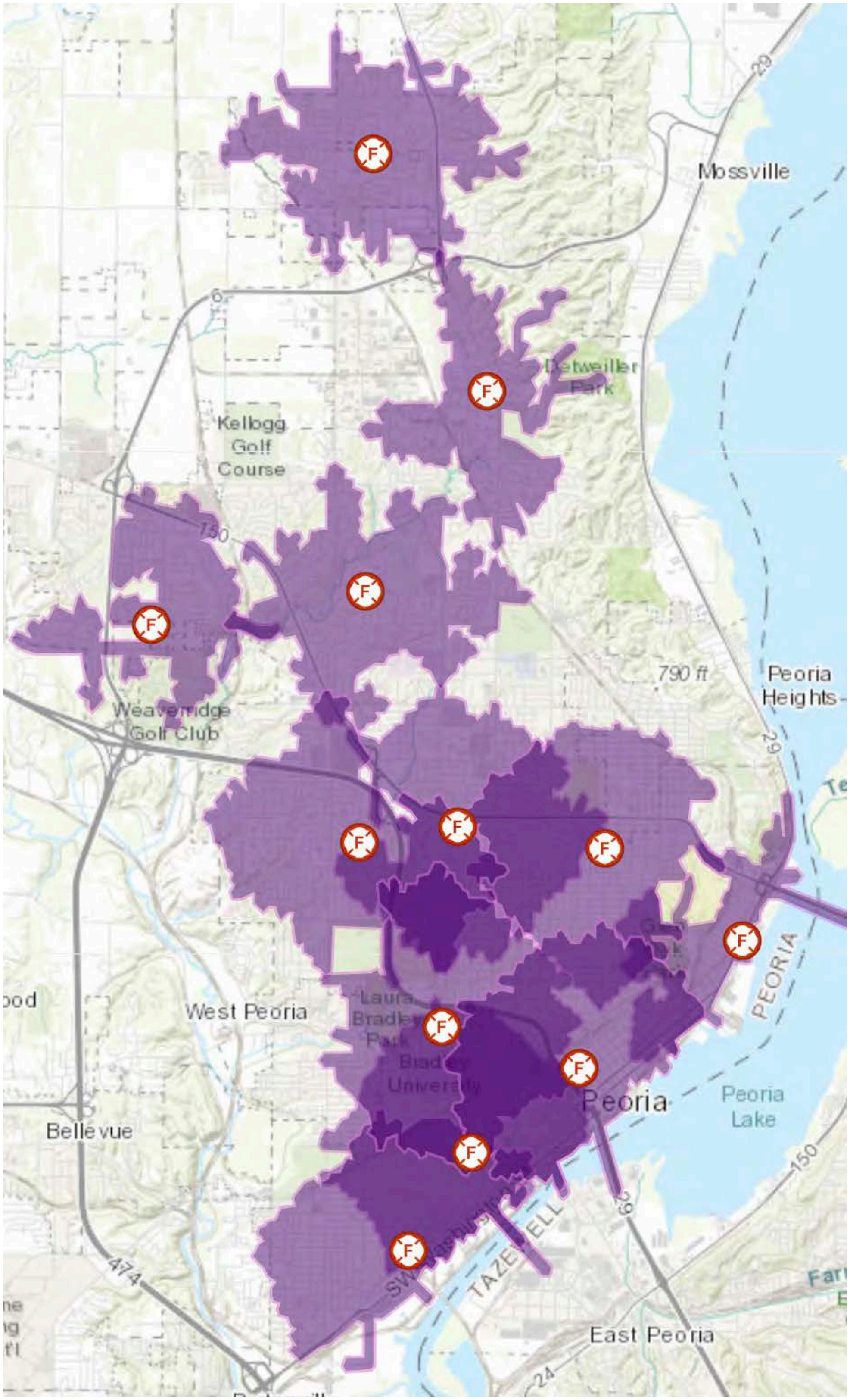
A second strategy is to provide station response coverage purely through a geographic lens without any consideration for how calls are distributed throughout the community. In addition, this analysis utilized distance without consideration to the relative impendence and/or the robustness of the road 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, 2.5-mile truck polygons, and 5-mile station locations, respectively.

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 12 stations maintain contiguous road miles within 1.5-mile drive times.

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.

Figure 145: 1.5 Mile Engine Polygons



Ladder Truck Coverage

When examining the 2.5-mile polygons for truck coverage based on the potential geographic coverage only and without consideration for the distribution of risk or the ability of current fire stations to house additional apparatus, the northern portion of the jurisdiction falls outside the 2.5-mile polygon service area. 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 also encompasses a Quint concept 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.

The department's current deployment strategy is to have a ladder truck at Stations 1, 3, 4 and 16. The mapping illustrates that the ladder truck at Station 1 does provide a great deal of duplication of service area as Stations 3 and 4. For illustration purposes only, a map was created to show ladder truck placement at stations 3, 4, 16 and 20 for an alternative geographic coverage option.

Figure 146: Current Stations 1, 3, 4 and 16 with Ladder Trucks - ISO 2.5 Mile

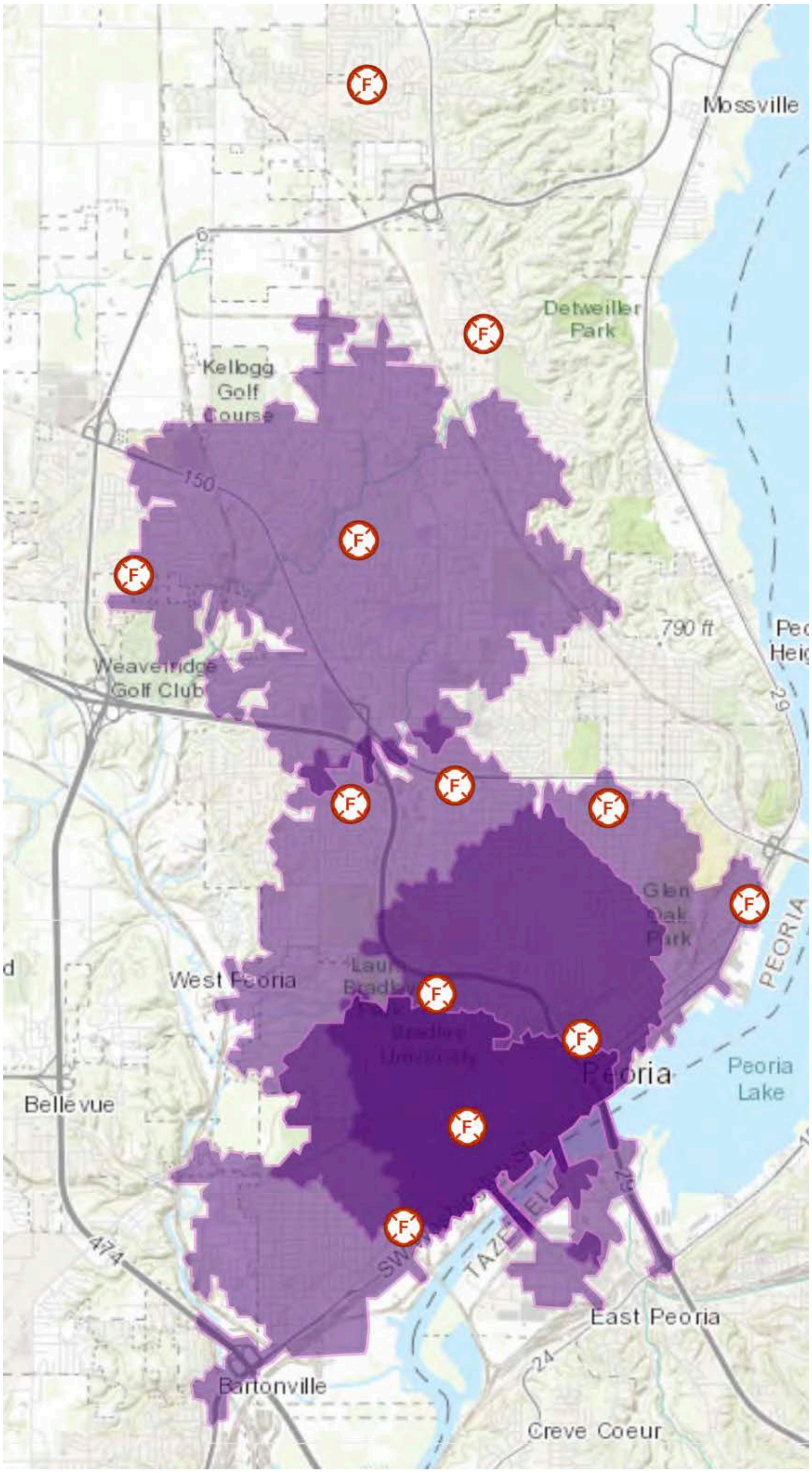
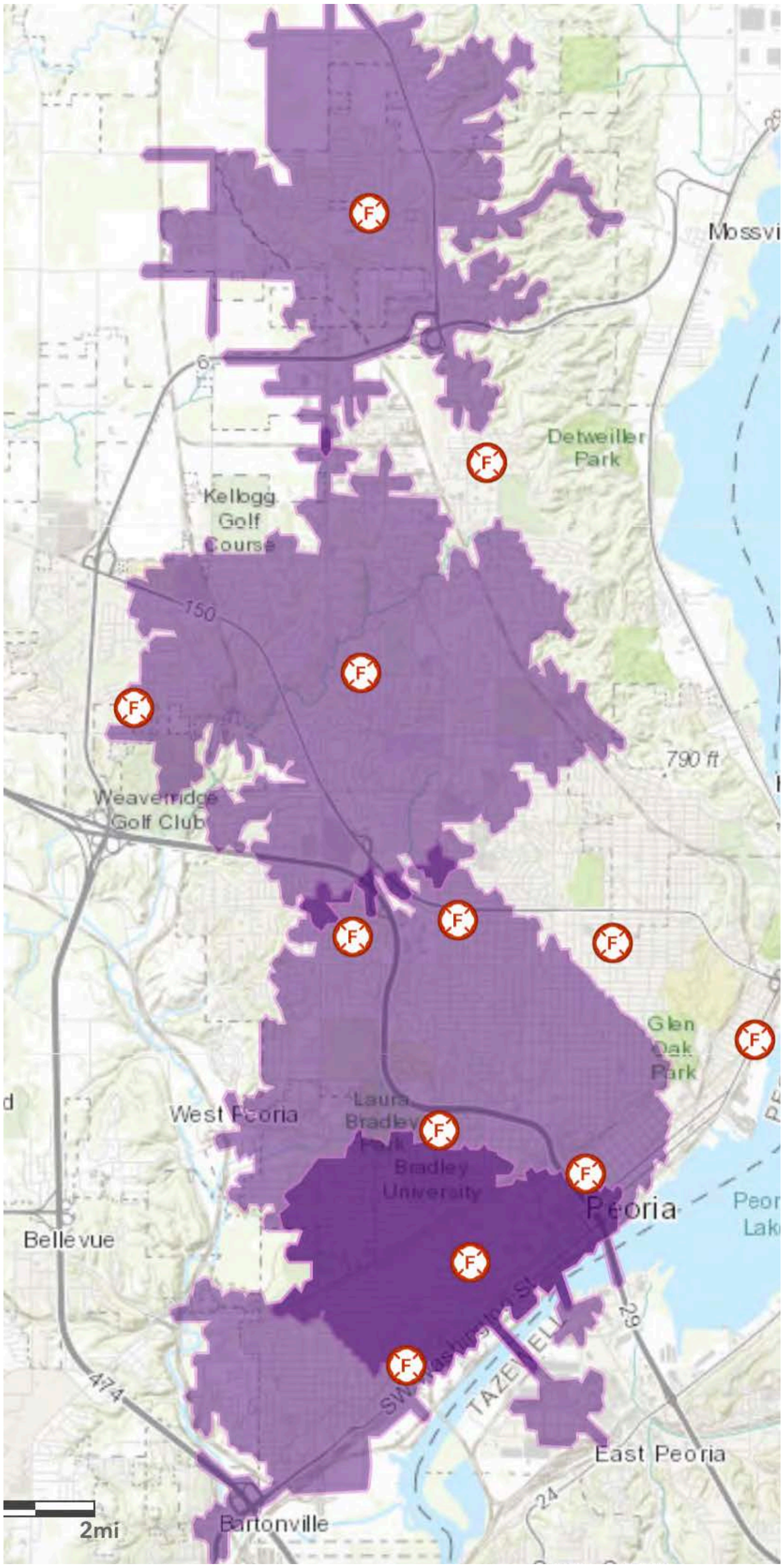
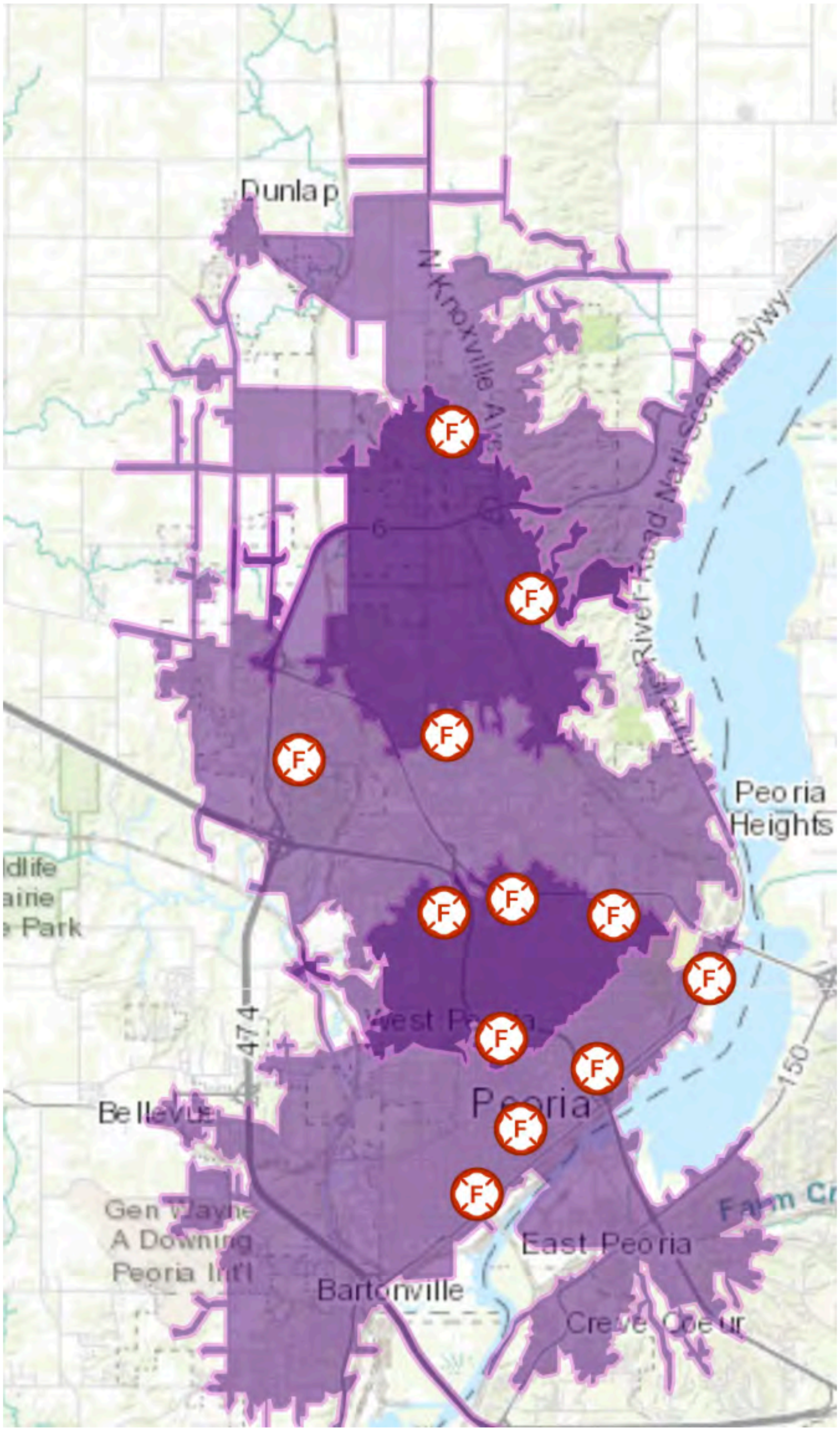


Figure 147: Current Stations 3, 4, 16 and 20 with Ladder Trucks - ISO 2.5 Mile



Finally, mapping analyses for the ISO 5-Mile configuration is provided below. The analyses suggest that there are contiguous road miles for each of the twelve stations. This illustration only utilizes the most northern, central and southern fire stations for clarity (Stations 4, 16 and 20).

Figure 13: Current Station Configuration (Stations 4, 16 and 20 only) - ISO 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. 8, 10, 12 and 14-minute travel times were created to demonstrate the relative ERF coverage throughout the jurisdiction.

In addition, 2 alternatives were evaluated as reflected below. The options were based on conversation with the Fire Department's administration and reflected the following changes from the current deployment described elsewhere:

Option 1:
Station 8 would be closed and E-2 shuttered
Station 4 rebuilt in new location and house E-4 & T-4
Station 3 would house E-3 and R-1
Station 11 would shutter R-2 and house T-3 and B-3

Option 2:
Shutter R-1 currently stationed at central house
Shutter R-2 currently stationed at St 11
Move T-4 to Station 8 to be with E-2
Move T-3 to Station 11 to replace R-2

For these purposes ERF was defined as the arrival of 5 apparatus with three-person staffing and is restricted to the city jurisdiction.

Figure 148: Comparisons of Effective Response Force Configurations

Travel Time Objective	Current ERF	Option 1 ERF	Option 2 ERF
8-Minute	31.95%	30.76%	28.62%
10-Minute	58.91%	57.99%	58.15%
12-Minute	79.99%	79.88%	79.55%
14-Minute	96.21%	96.21%	96.21%

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 14: 12-Minute ERF from All Current Stations – Current Staffing

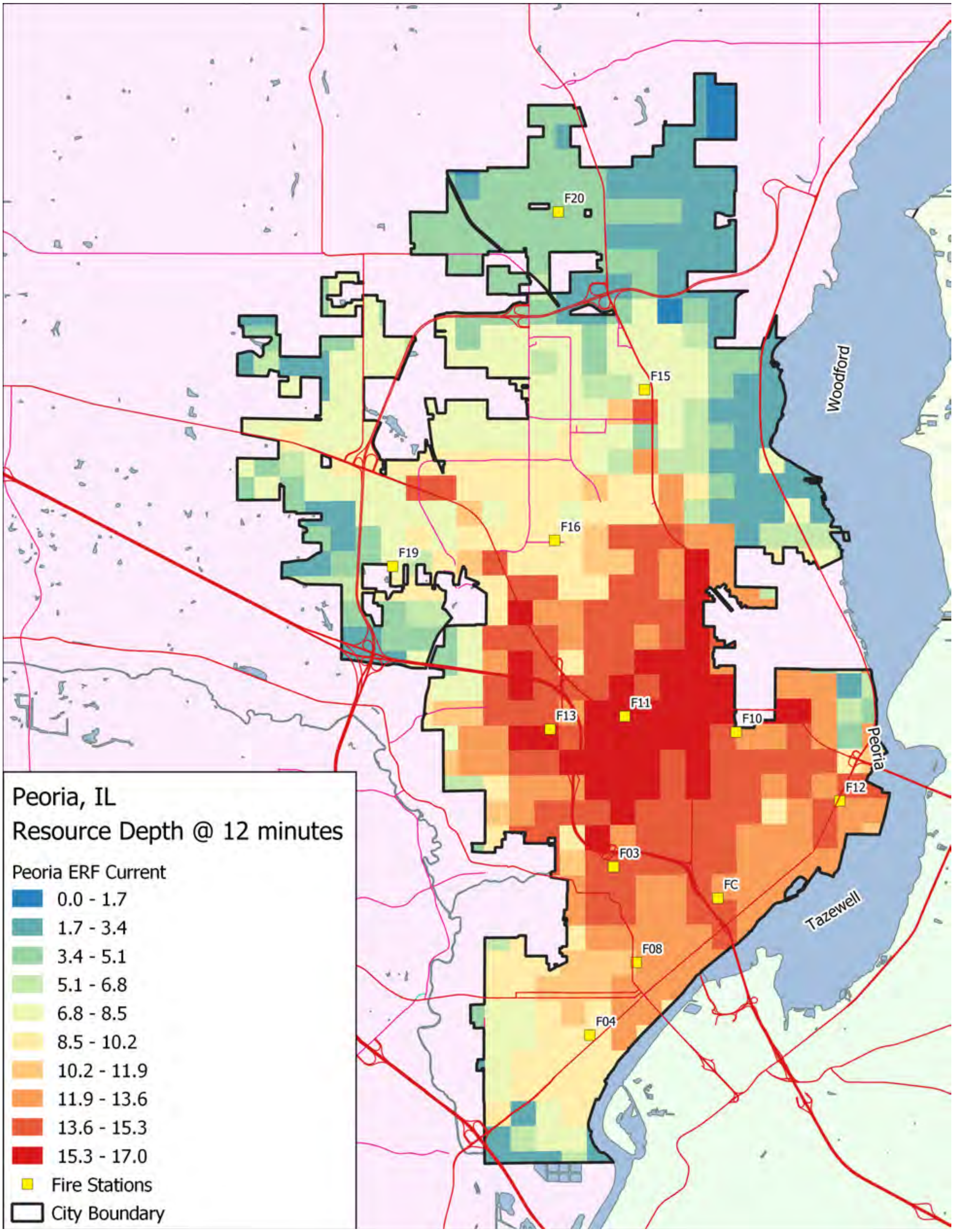


Figure 15: 14-Minute ERF from All Current Stations – Current Staffing

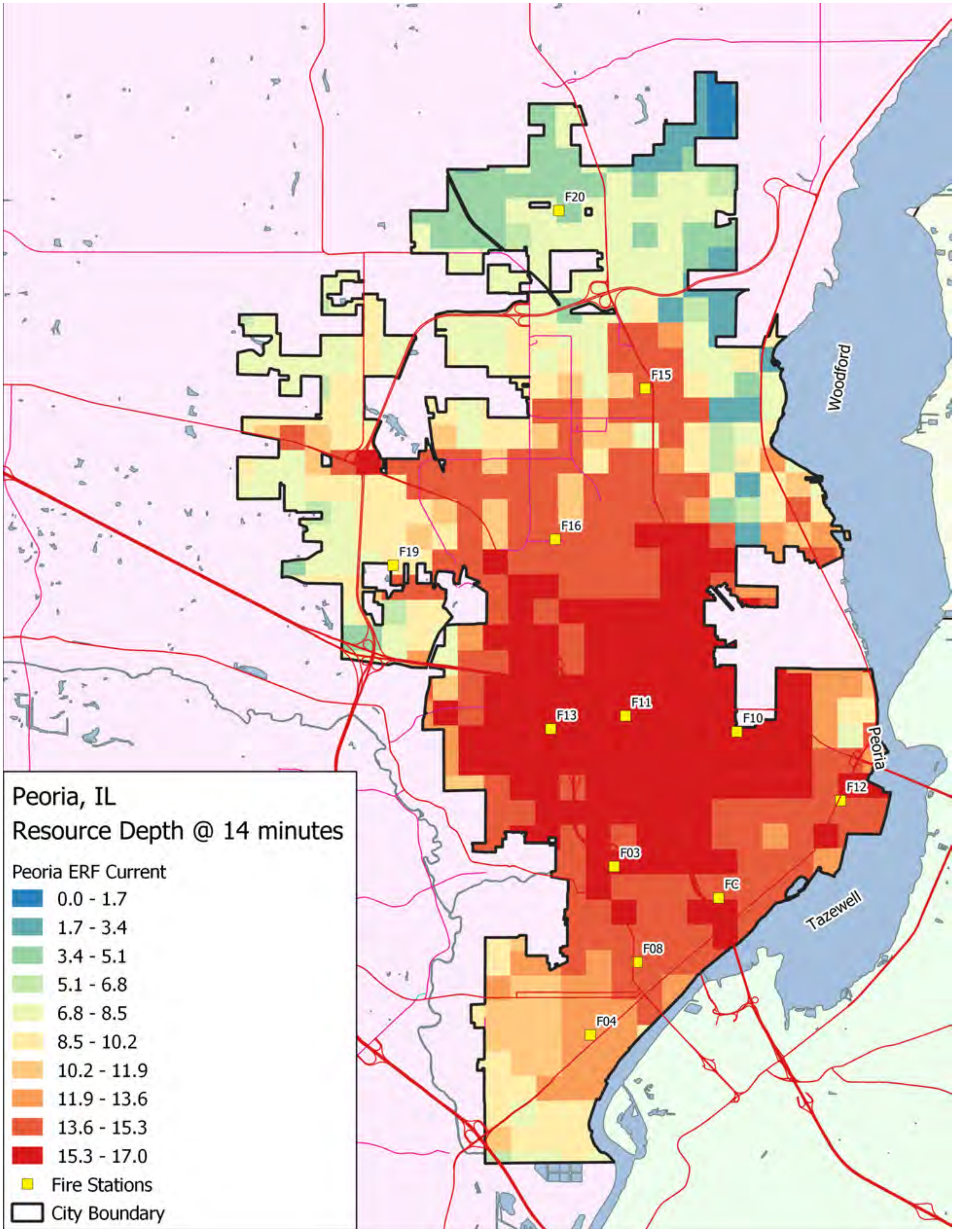


Figure 16: 12-Minute ERF from All Current Stations - Option 1

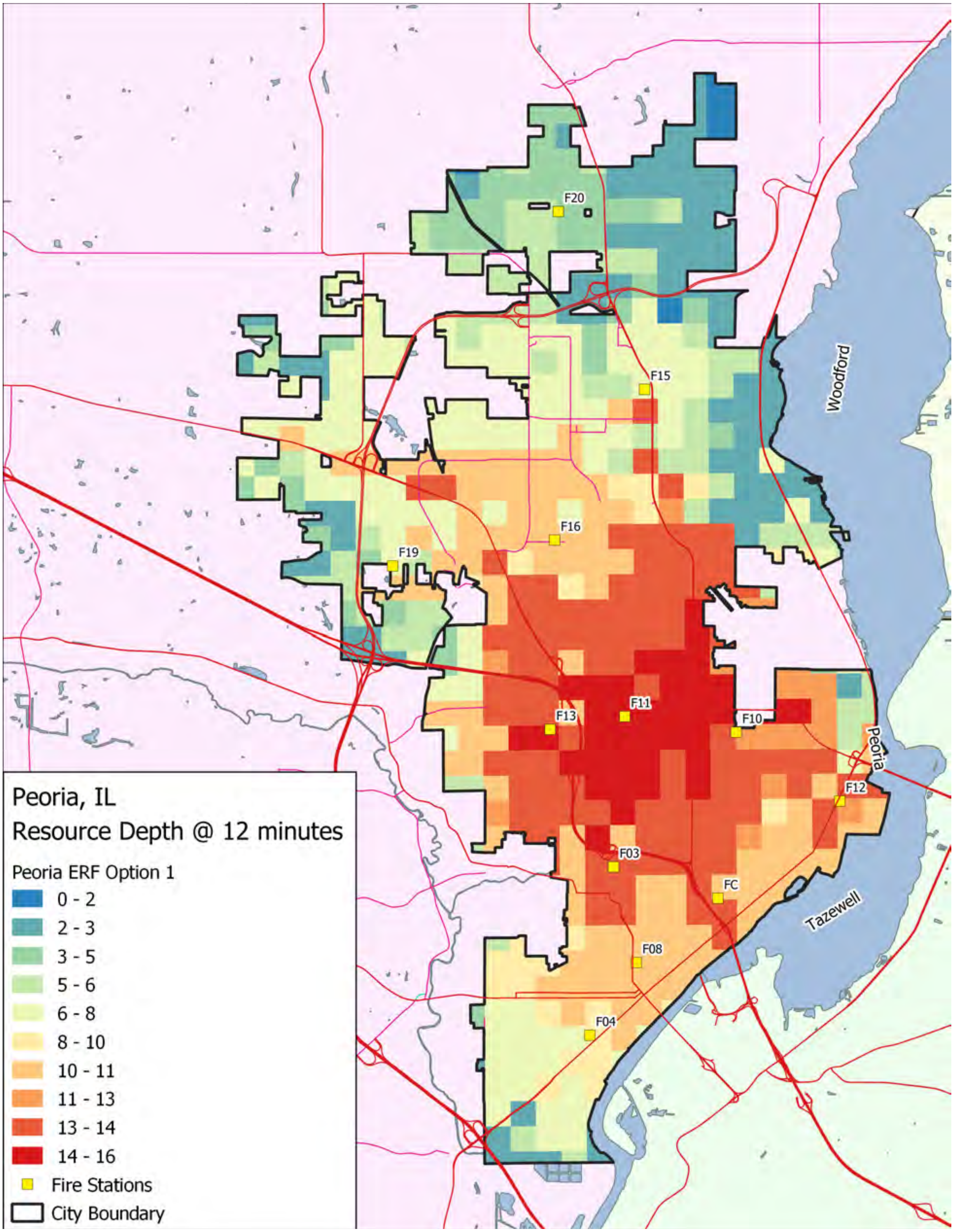


Figure 17: 14-Minute ERF from All Current Stations - Option 1

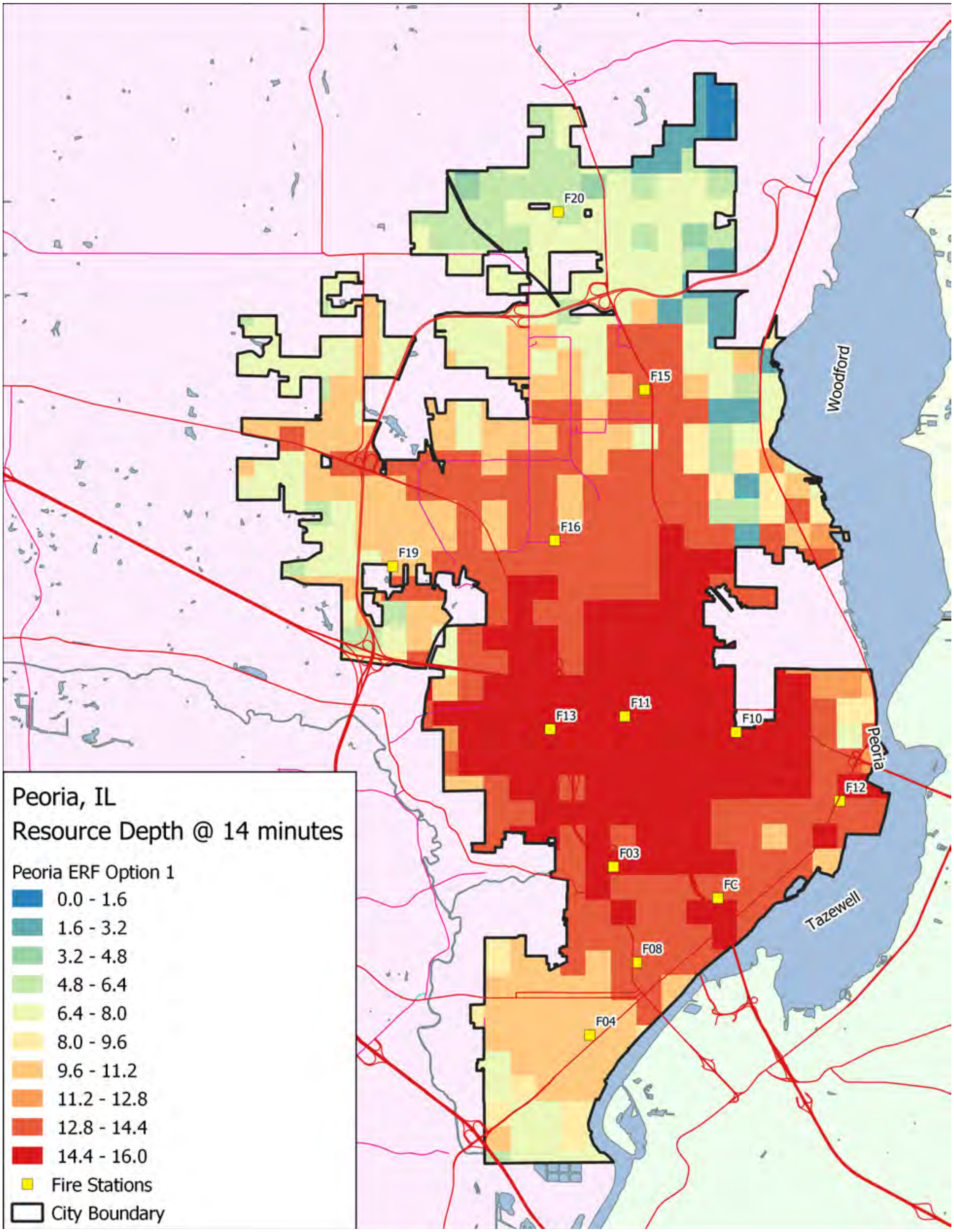


Figure 18: 12-Minute ERF from All Current Stations - Option 2

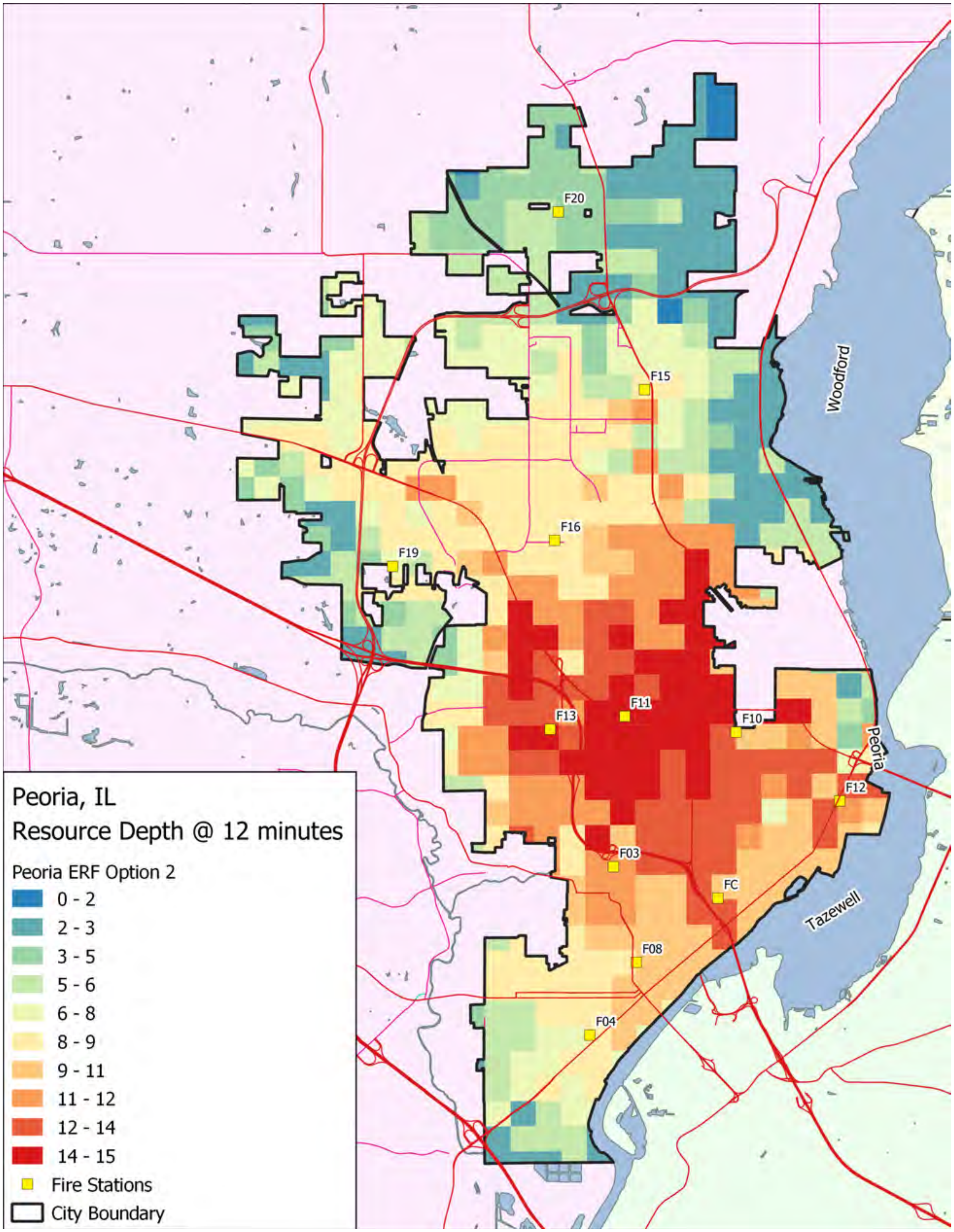
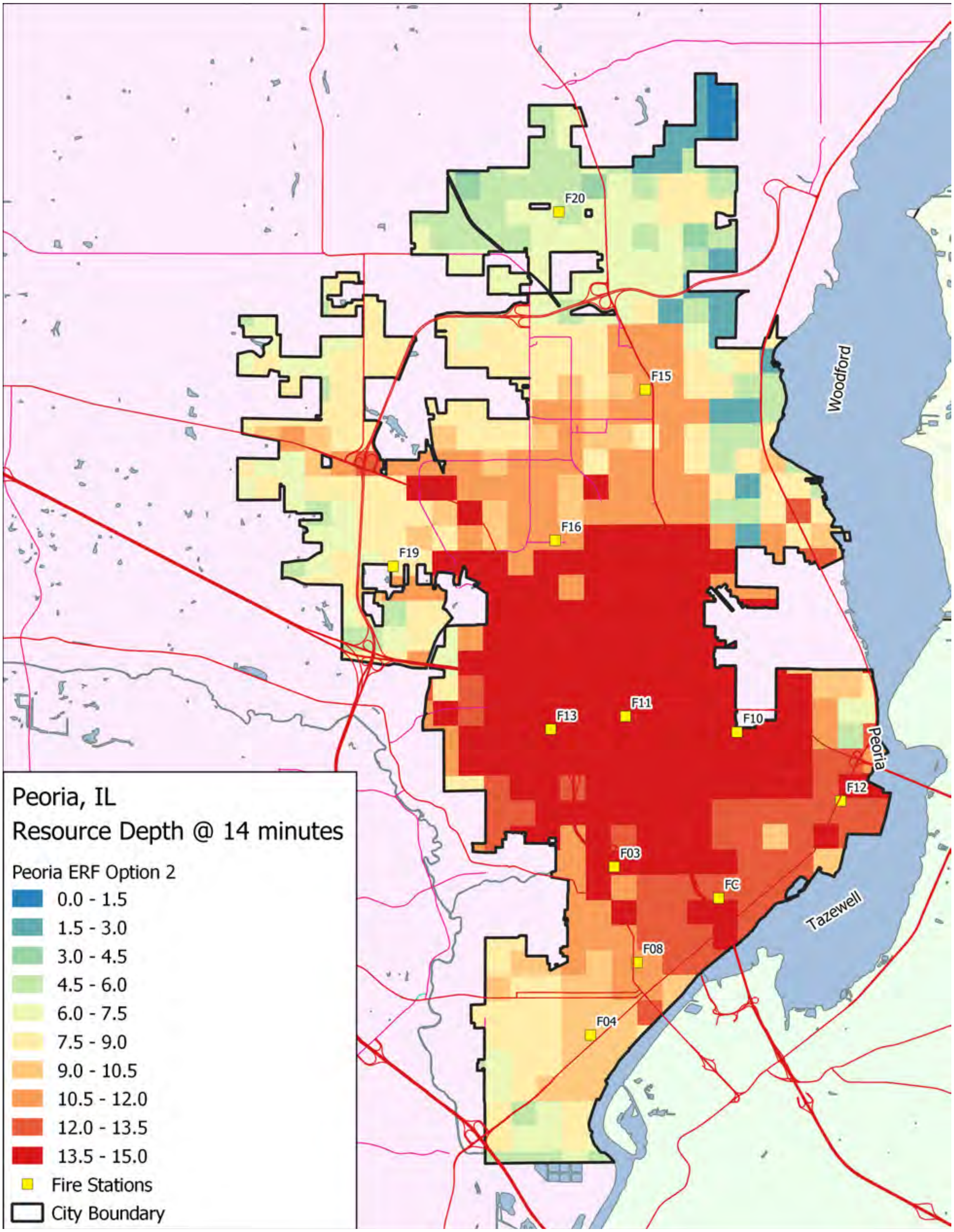


Figure 19: 14-Minute ERF from All Current Stations - Option 2



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, HAZMAT and Rescue, respectively. The Blue areas have the least demand and the dark red areas have the highest concentration of demand.

Figure 20: Heat Map for Fire Related Incidents

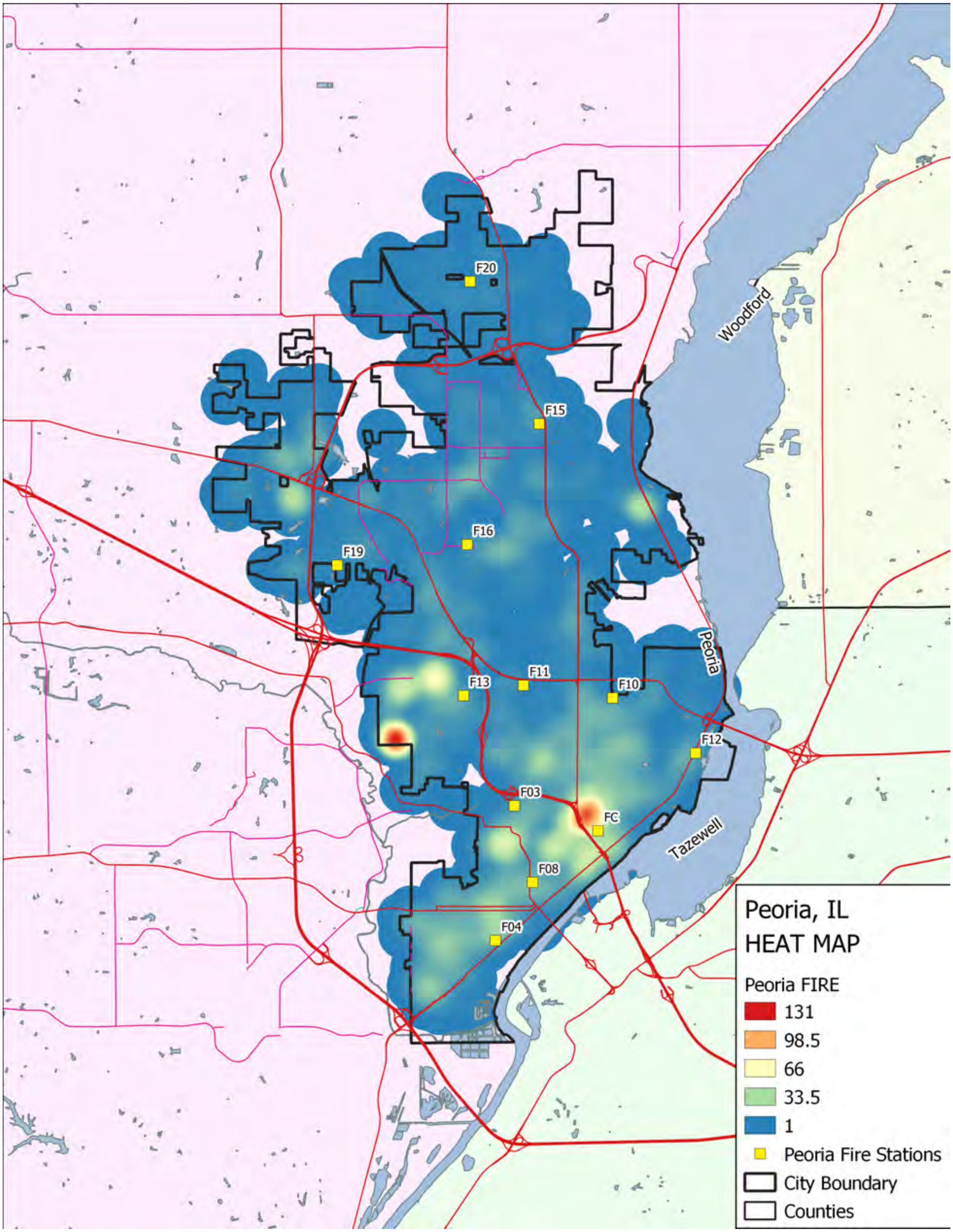


Figure 21: Heat Map for EMS Related Incidents

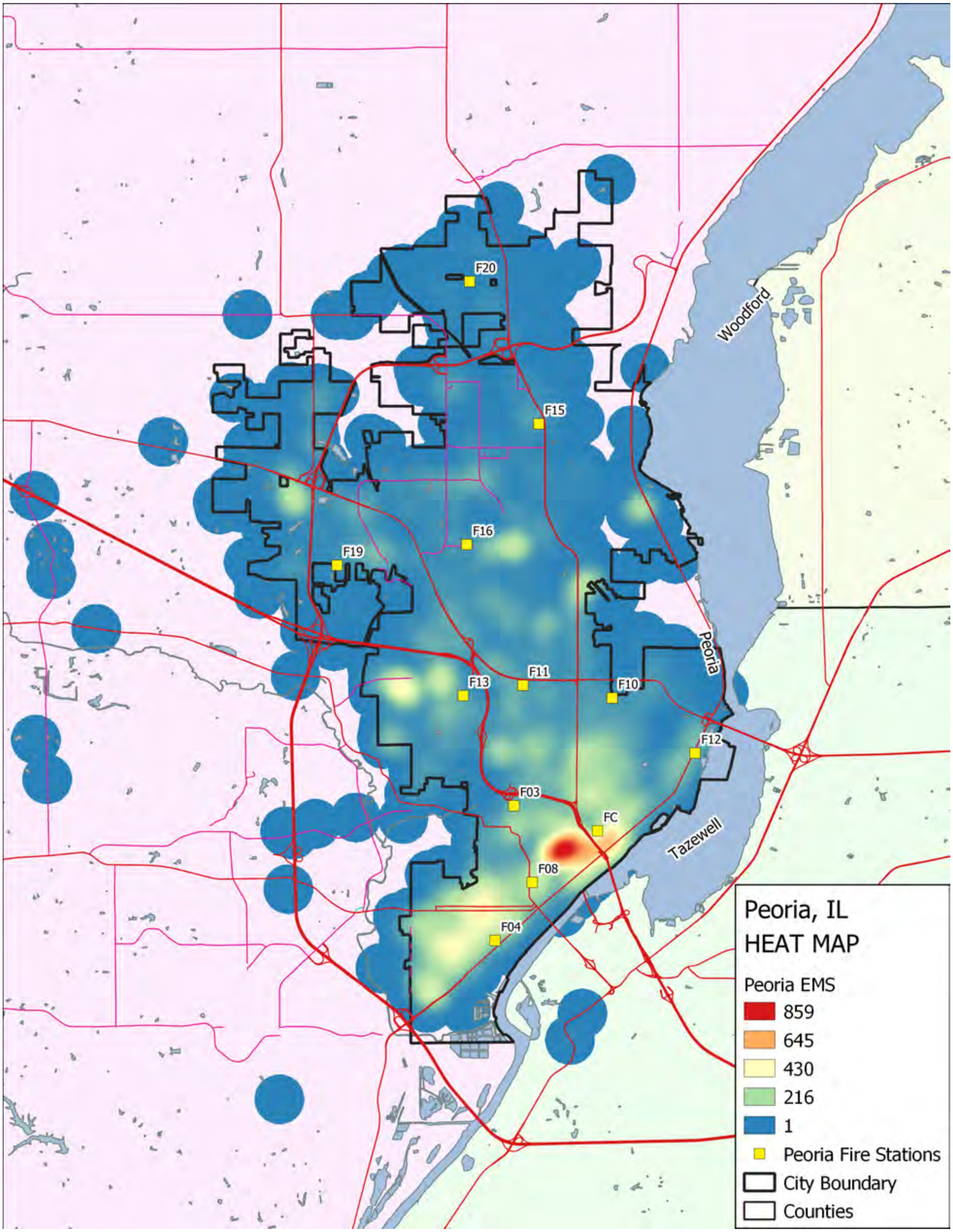


Figure 22: Heat Map for HazMat Related Incidents

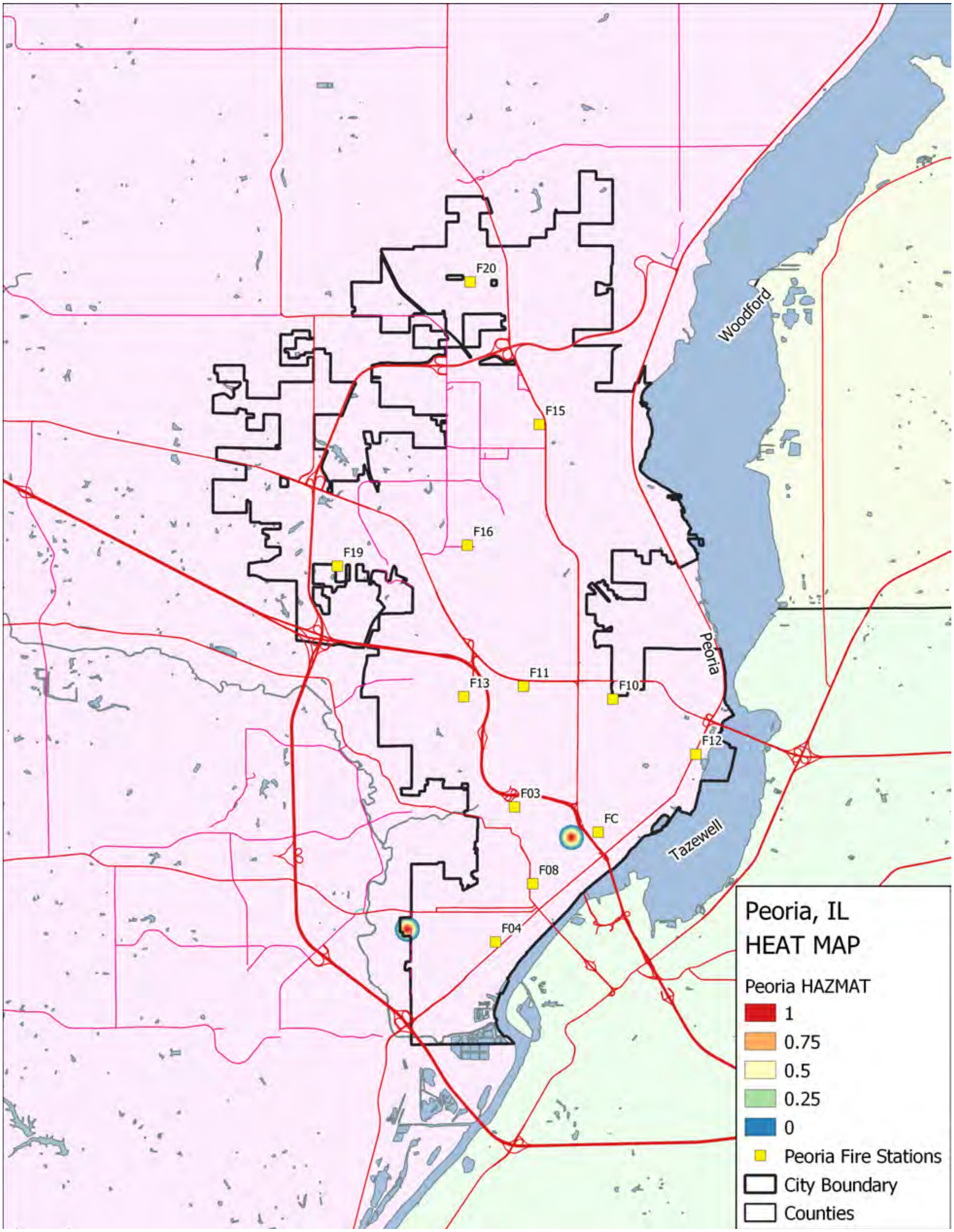
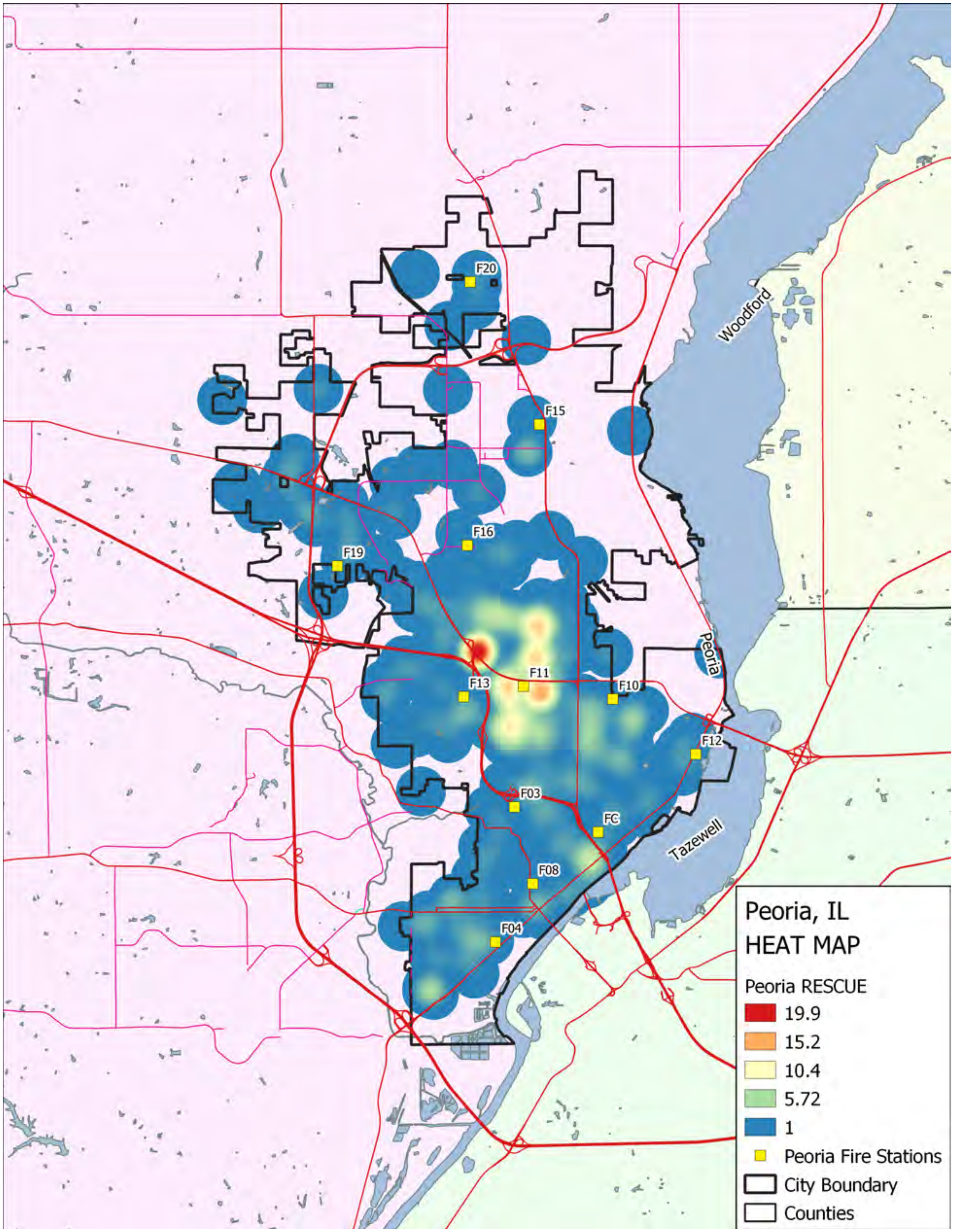
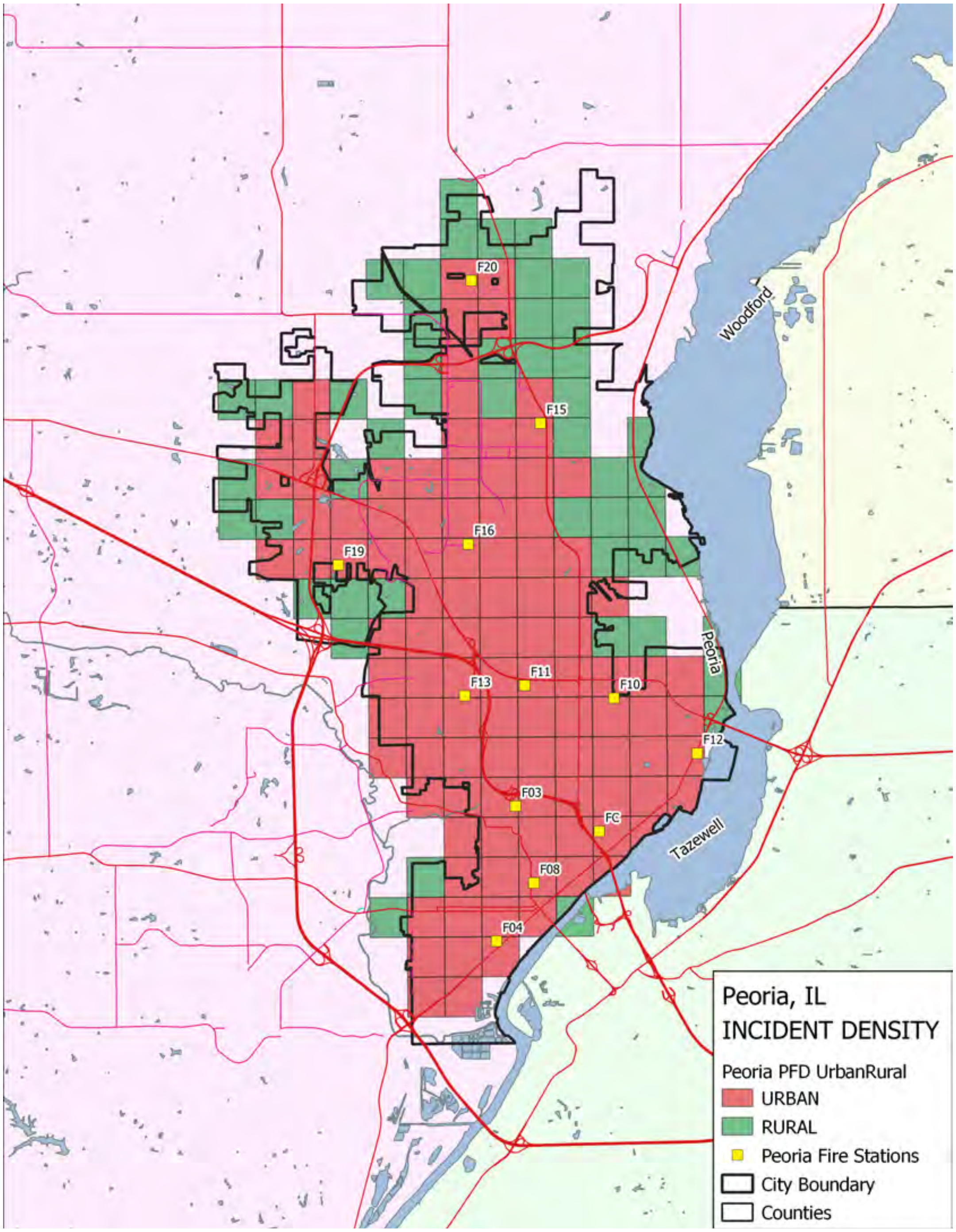


Figure 23: Heat Map for Rescue Related Incidents



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

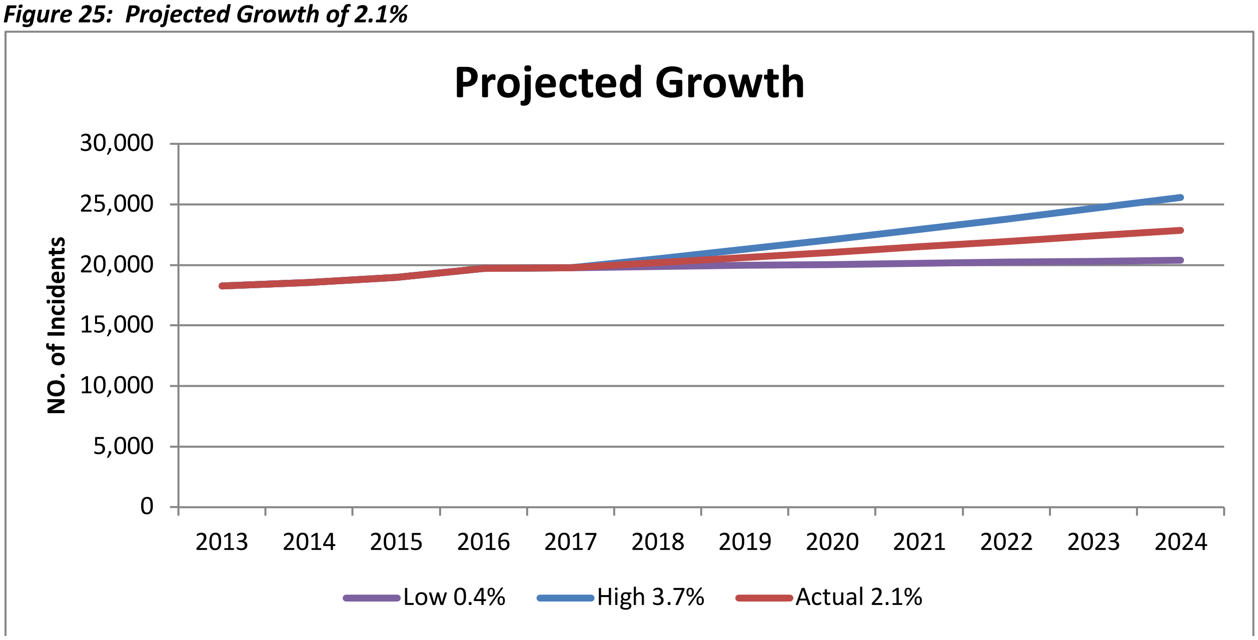
It is important to understand that the distribution models are restrictive to the geographic limitations of the jurisdiction and the historical demand for services. Therefore, the number of stations is descriptive of the number of fixed facilities required from which to deploy resources. These analyses 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 3.73% increase in incidents between 2015 and 2016 as well as a 0.43% change between 2016 and 2017.

Figure 25: Projected Growth of 2.1%

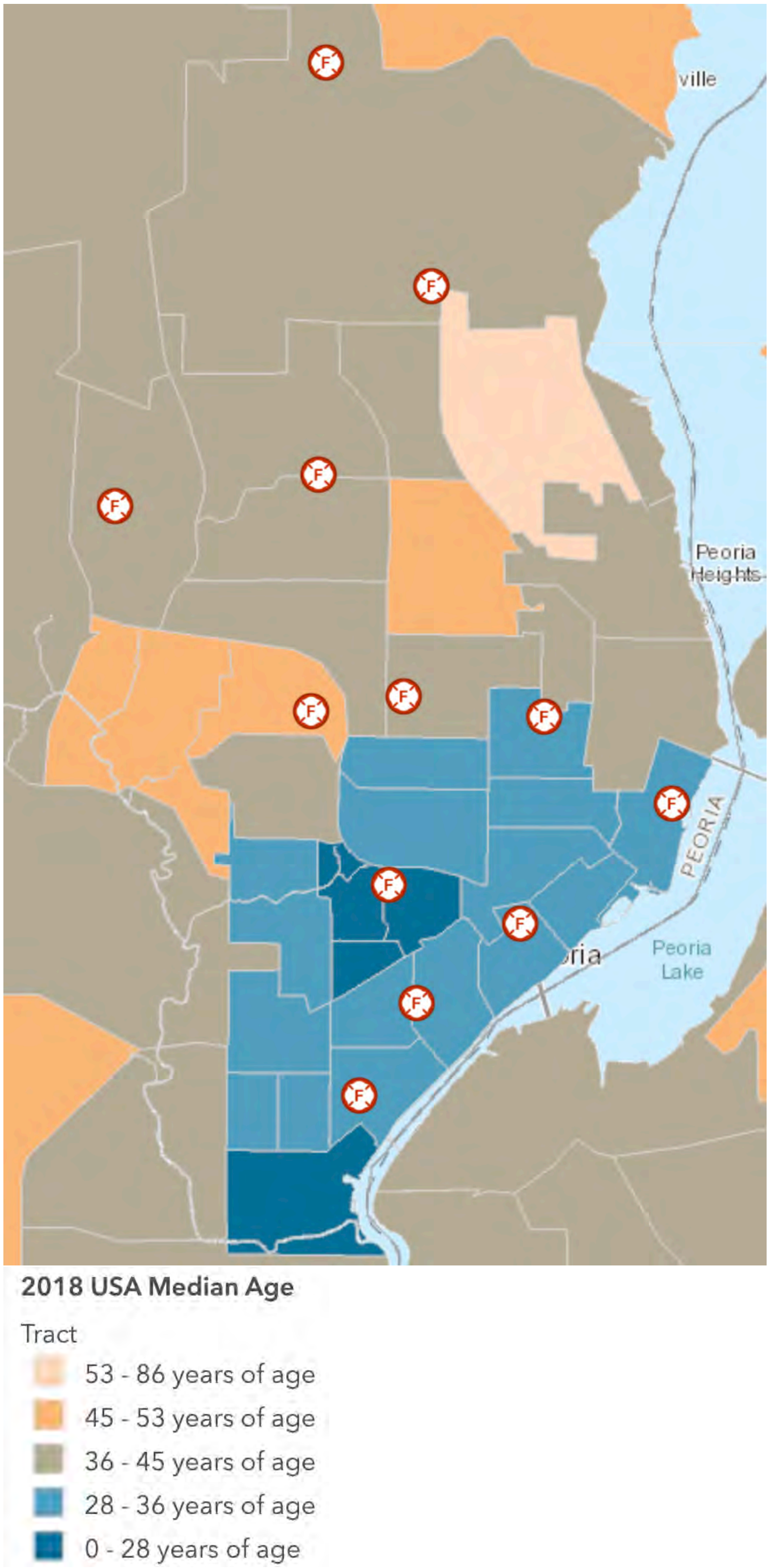


Assuming that future demands may not be reasonably distributed across the various stations in the system, the system will require a redistribution of workload and ultimately reinvestment in resources to meet the growing demand. While the system should be evaluated continuously for performance and desired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

Population Characteristics

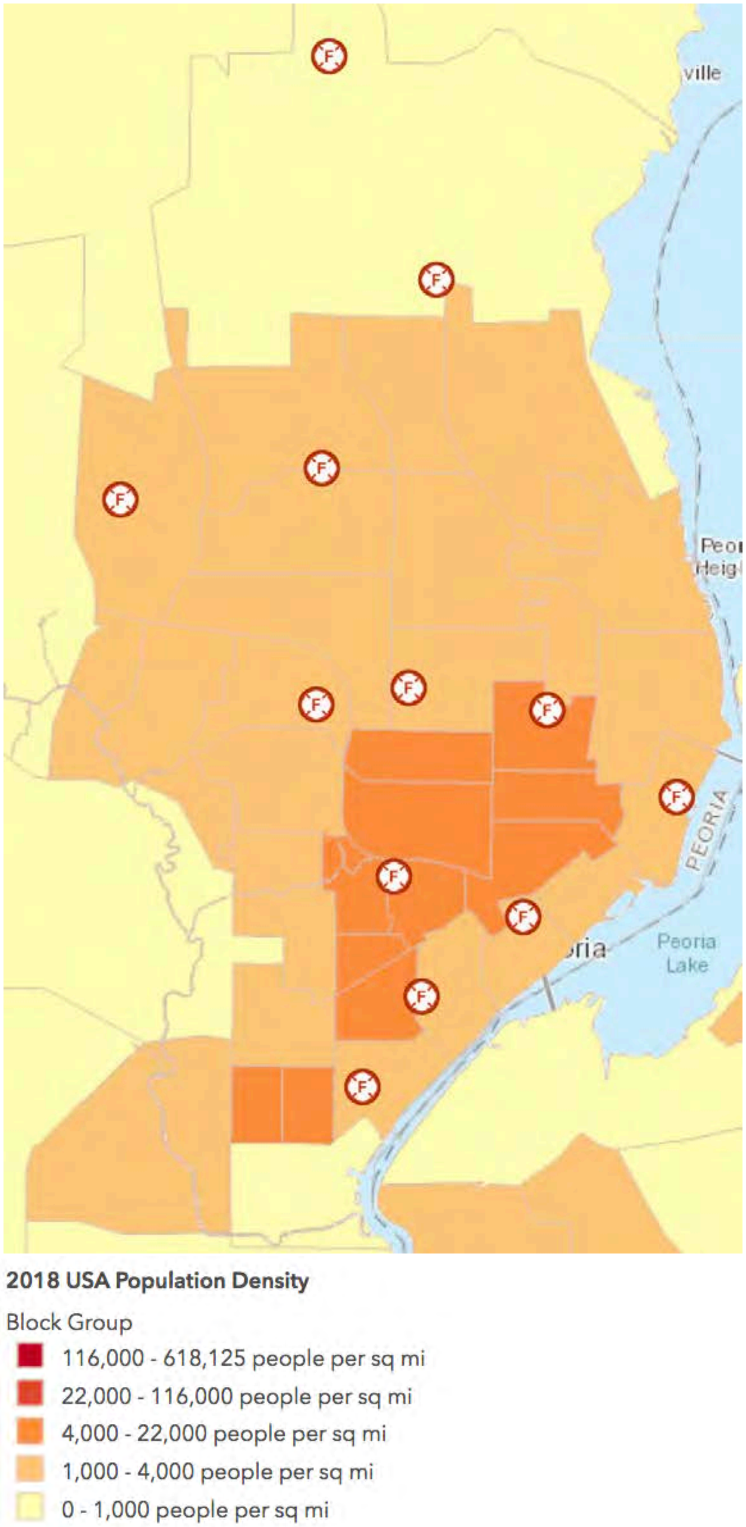
Generally, older populations and very young populations are considered to be most vulnerable to the frequency and incidents of fire. In addition, older populations historically utilize EMS services with greater frequency. It is important to understand, what field crews often recognize intuitively, is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

Figure 26: Median Age - 2018



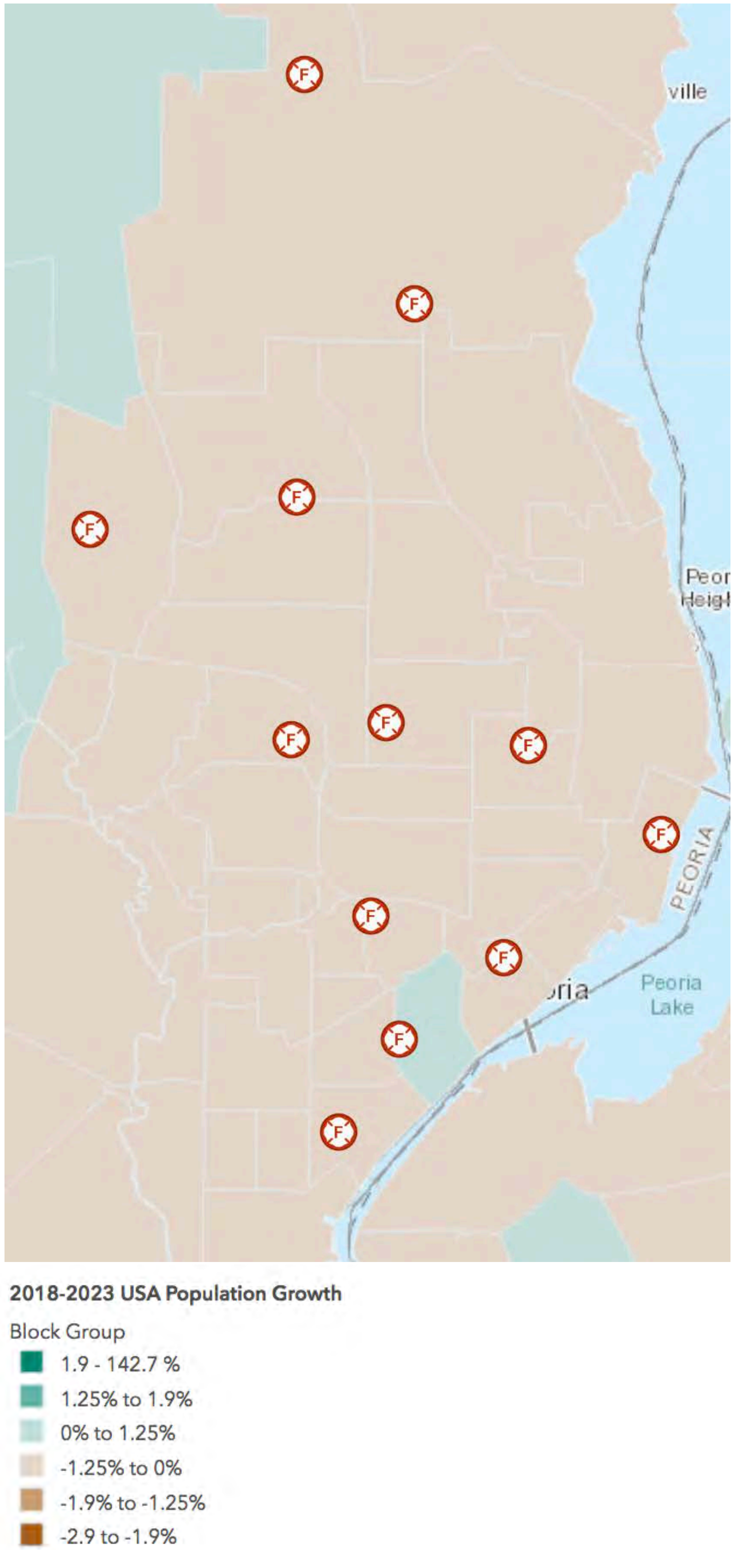
For the majority of the jurisdiction, the population density is urban or suburban.

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 census blocks reflected portions of the jurisdiction that were both above and below the national median household income. The national median household income is reported at $58,100.

Figure 29: Median Household Income -2018