

May 2018

Executive Summary Report

Frederick County Life at the Top
VIRGINIA

Frederick County Fire and Rescue, Virginia

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CONSULTANT REPORT

Frederick County, Virginia

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EXECUTIVE SUMMARY

Frederick County contracted with Fitch & Associates to objectively evaluate the fire rescue department's operations, deployment, and staffing. The Frederick County Fire Rescue Department is largely motivated to evaluate the current response model and the desire to develop a long range, risk-based, data driven staffing and deployment plan based upon the specific and unique profile of Frederick County.

Comprehensive data based quantitative and geospatial analyses were utilized to objectively evaluate the historical county demand for services by type and severity. Occupancy level data were obtained from the Insurance Services Office (ISO) and Frederick County's databases and was utilized to assess occupancy level risk within the community. Ultimately, occupancies were categorized as low, moderate, and high risks and geocoded to the respective existing station service area boundaries to establish an efficient and objective risk-based strategy for resource allocation.

Additionally, the Fitch team made several visits to the organization through which it engaged internal and external stakeholders. A series of structured interviews were conducted on several occasions with members representing all levels and functions within the organization.

This comprehensive report consists of an executive summary report, a standards of response coverage and community risk assessment report, a comprehensive data report, and a detailed GIS report. The Department leadership staff has reviewed and approved the data and GIS reports as part of an iterative process. Overall, the firm's strategy is to provide administration and the elected policy group with sufficient objective data from which to establish policy. Therefore, all alternatives and recommendations are grounded in the data analysis and best practices insulating the process from potential biases.

In total 34 recommendations were provided for the department's consideration. The following executive summary will provide a brief overview of the substantive recommendations and observations.

Community Demands for Service

Commensurate with most communities that provide integrated fire and emergency medical services (EMS), requests for EMS are the vast majority of community driven incident activity. EMS accounts for 79.3% and fire accounts for less than 13.5% of the incidents. The Frederick County answered nearly 10,250 unique requests for service in 2016.

Historical Performance

The Frederick County Fire Rescue Department currently operates from 11 fixed facility fire stations and has a travel time of 10.3 minutes overall. EMS related incidents have a 10.1-minute travel time or

less and fire related incidents have an 11.7-minute travel time or less for 90 percent of the incidents. In other words, 9 out of 10 times, the department will provide this level of service or better.

The Commission on Fire Accreditation International affords accredited agencies a travel time of 13-minutes at the 90th percentile in rural communities with populations of less than 1,000 per square mile.¹ Therefore, the response performance by Frederick County is meeting and exceeding accreditation allowances.

Establishing Desired Performance and Future Fire Station Alternatives

The fire department's current performance is defined as a travel time of 10.3 minutes or less to 90% of the incidents.

The evidenced-based research in emergency medical services and fire behavior suggests that if the agency cannot respond to the most critical of incidents within 5-minutes or less from onset, the outcome is not strictly correlated to the response time. Therefore, the county has considerable latitude in establishing the desired service.

This study provides several alternatives for consideration primarily in 8 and 10-minute travel times, respectively. Results suggest that for the county to improve travel time from the current performance of 10-minutes to 8-minutes, it would require the relocation of the majority of the 11 fire stations. The current station configuration can respond to approximately 80% of the incidents within 8-minutes travel time. In other words, the long-term strategy of rebuilding stations in optimized locations, as they need replaced can improve performance by 2-minutes and 10% over the existing configuration. The recurring costs for personnel, apparatus, and equipment would not be impacted by the station locations.

The mapping for an optimized 8-minute urban/suburban and 13-minute rural travel time is provided below in Figure 1.

Recommendation:

If the desired service level is to improve to an 8-minute travel time, it is recommended that the County consider a long-term strategy to relocate fire stations when they are due for a major refurbishment or replacement. Once fully implemented the county would have the same number of fire stations as today (11).

Similarly, an optimized station location plan at the current performance of 10-minutes urban/suburban and 13-minutes rural would need a total of 7-stations to continue to provide services in 10-minutes in the urban/suburban areas at greater than 90% and a total of 97% in the rural areas within 13-minutes. Therefore, a long-term strategy could be adopted to relocate stations, as they need to be replaced in optimized locations and reduce the capital and offset personnel requirements once fully implemented.

¹ CFAI. (2016). Fire & emergency service self-assessment manual, (9th ed.). Chantilly, Virginia: Author.

While the cost of new stations vary considerably by the clients' desires and limitations in site footprints, it is reasonable to utilize \$4,000,000 as a planning placeholder for capital costs. If the assumption holds, then this option would have a long-term net capital reduction of approximately \$16,000,000 in today's dollars.

A mapping illustration of the optimized station locations for a 10-minute urban/suburban travel time and a 13-minute rural travel time is provided below in Figure 2.

Recommendation:

If the desired service level is to maintain the current 10-minute travel time, it is recommended that the County adopt a long-term strategy to relocate fire stations when they are due for a major refurbishment or replacement. Once fully implemented the county would have reduced capital liabilities by four stations and offset personnel requirement by redistributing existing personnel as desired. This is estimated as a long-term capital savings of approximately \$16,000,000 dollars while maintaining current performance.

Figure 1: Optimized Station Deployment Plan - 8-Minute Urban/Suburban and 13-Minute Rural Travel Time

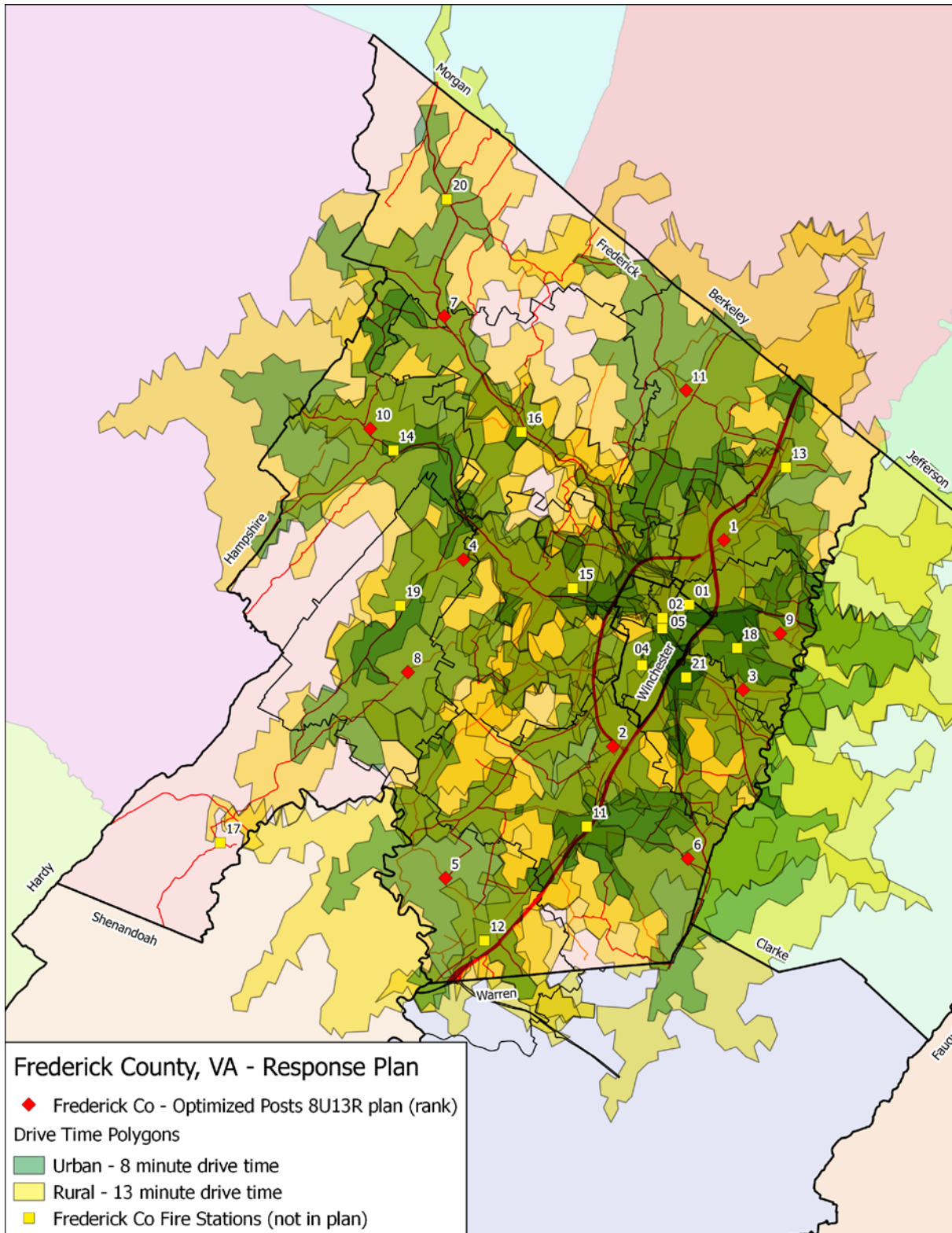
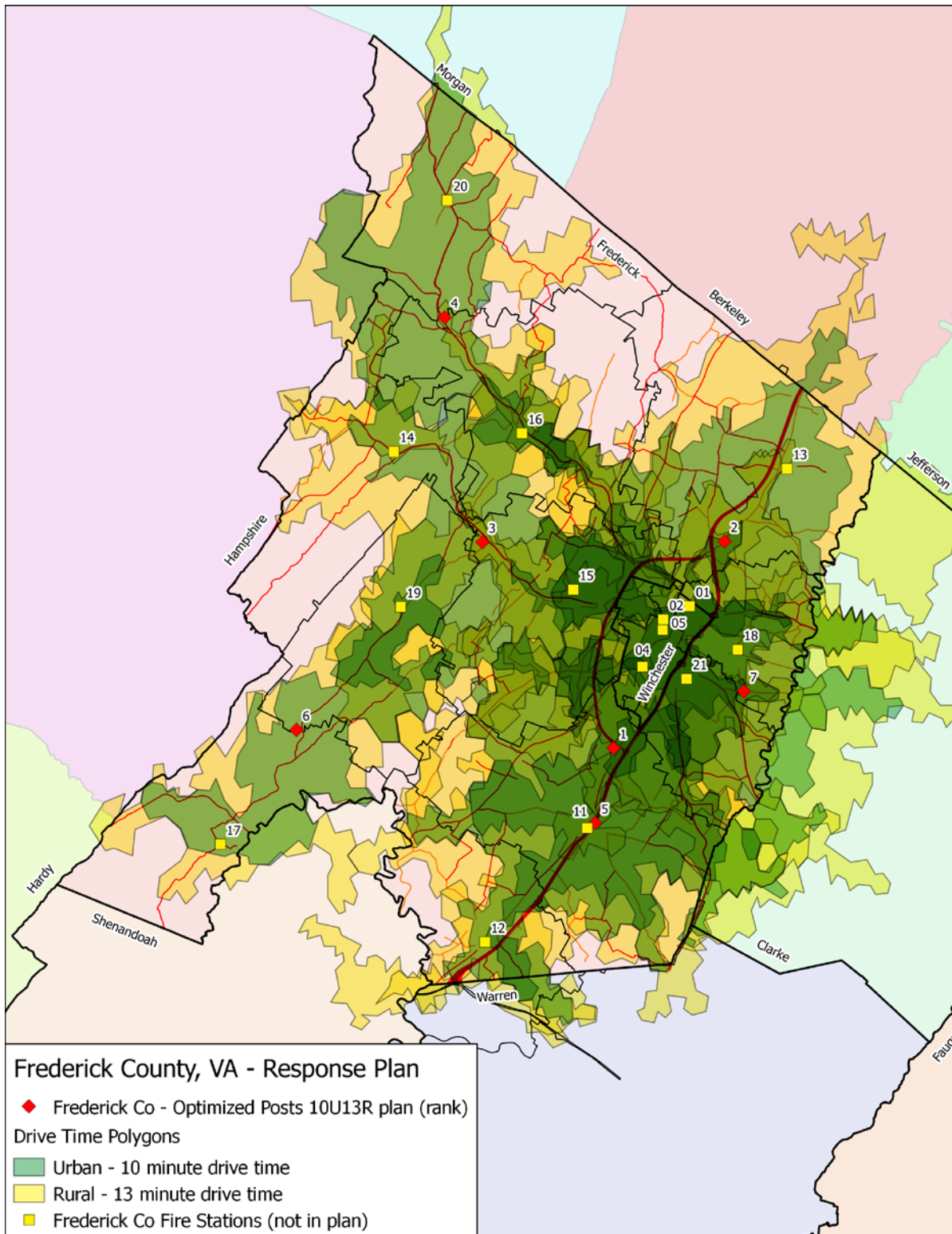


Figure 2: Optimized Station Deployment Plan - 10-Minute Urban/Suburban and 13-Minute Rural Travel Time



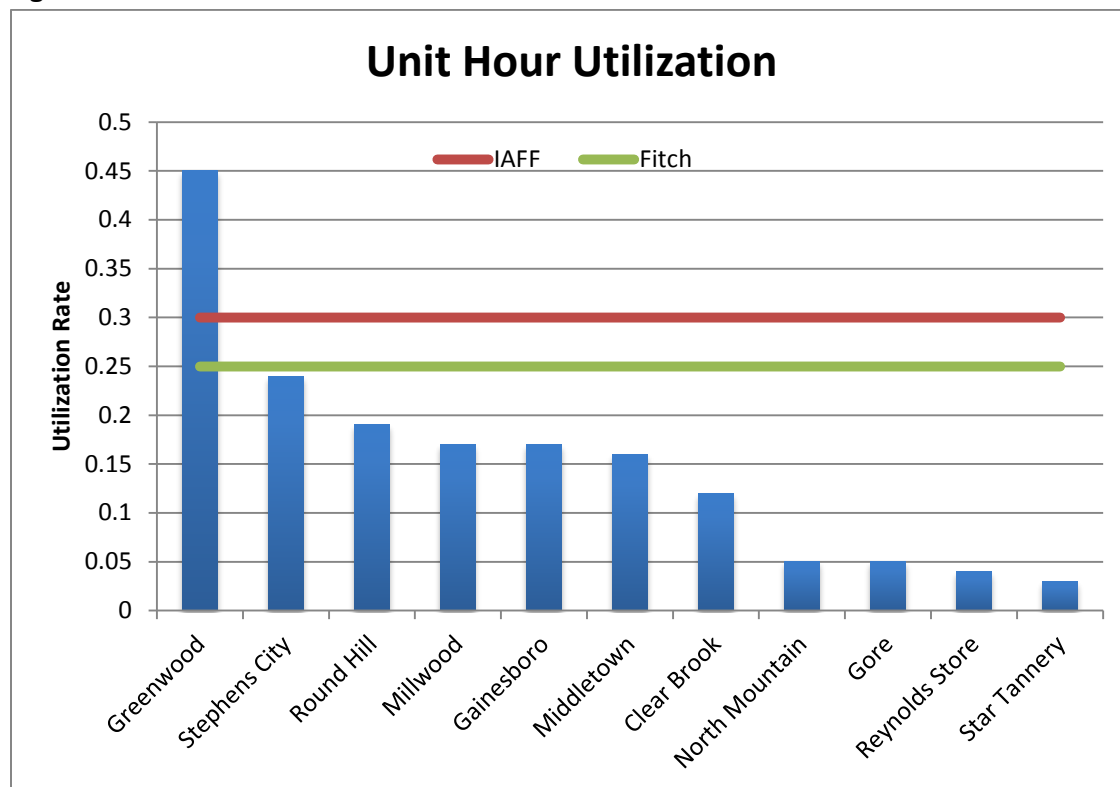
Workload Capacity – Reinvesting or Reallocating Resources

The department is currently operating within the boundaries of nationally recommended best practices with respect to workload. Overall, the department is performing at approximately 0.15, or 15%.

We grouped cross-staffed units together and conducted Unit Hour Utilization (UHU) analyses at the station level. Greenwood Station has the highest workload at 0.45, followed by Stephens City station at 0.24, Round Hill Community at 0.19. North Mountain, Gore, Reynolds Store, and Star Tannery stations all had UHU less than or equal to 5%.

FITCH's position is that workloads greater than 0.25 are not optimal on a 24-hour shift and should not exceed 0.30. The addition of a dedicated Medic unit at the Greenwood station would re-distribute the workload across the singular crew that cross-staffs each of the units. An additional Medic resource should be considered for the Stephens City station in the near future as the workload is nearly at our recommended threshold to begin planning for a new resource. Finally, these changes should have a moderating effect on some of the other stations, reducing the UHU for multiple units responding from surrounding stations. The UHU analysis is provided below.

Figure 3: Station Level Unit Hour Utilization

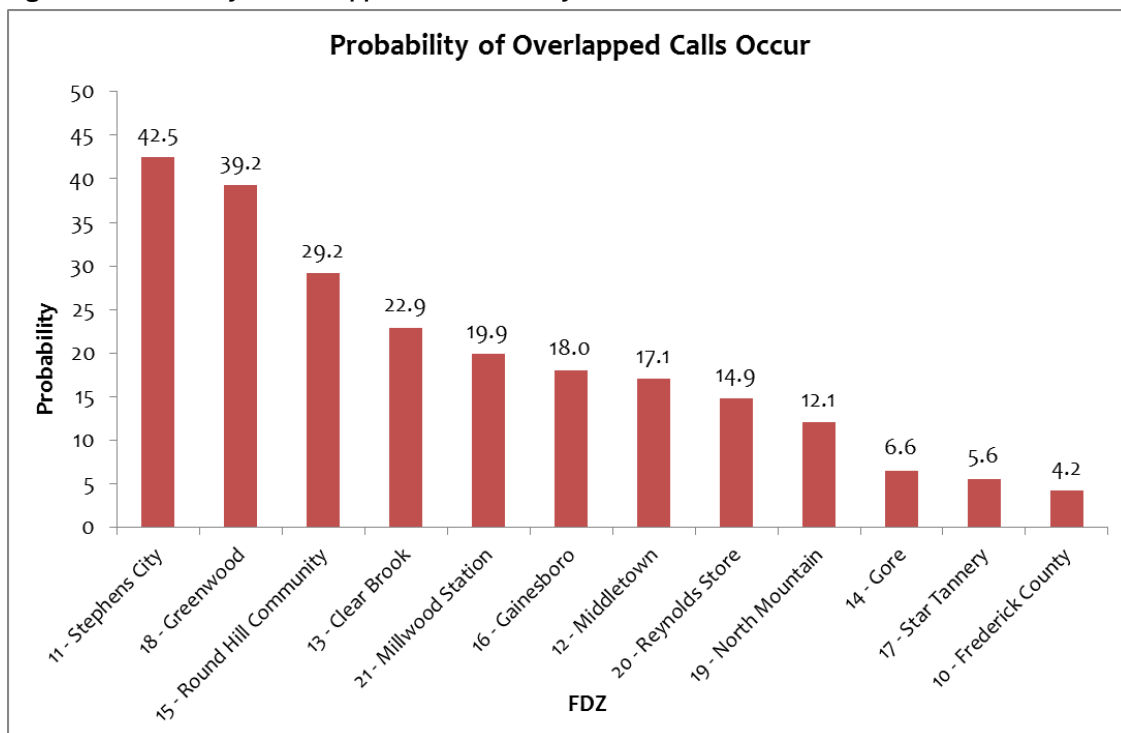


In addition, a second measure for overlapping or simultaneous events is utilized to identify areas that are challenged to respond to incidents in their own first due service area because of multiple calls

occurring at once. Overlapped calls are defined as the rate at which another call was received for the same first due station service area while there were one or more ongoing calls in the same first due station service area. For example, if there is one call in station Stephens City’s zone, before the call was cleared another request in Stephens City’s zone occurred and those two calls would be captured as overlapped calls. Some studies also refer as simultaneous calls. Understanding the probability of overlapped or simultaneous calls occurs will help to determine the number of units to staff for each station. In general, the larger the call volume a first due station has, it is more likely to have overlapped or simultaneous calls. The distribution of the demand throughout the day will impact the chance of having overlapped or simultaneous calls. The duration of a call will also have major influences, since the longer time it takes to clear a request, the more likely to have an overlapped request.

Station Stephens City had the highest probability of having overlapped calls at 42.5% since it has the highest demand at 2,216 requests in 2016, and the average duration was 65.3 minutes. Station Greenwood had the second highest probability of overlapped calls at 39.2%. Greenwood station has the second highest demand at 1,990 requests in 2016 and the average duration was 65.9 minutes.

Figure 4: Probability of Overlapped Calls Occur by Station Service Area



Therefore, the combination of both the workload indicator UHU and the probability of overlapping or simultaneous events influence the following recommendations.

Recommendation:
It is recommended that a dedicated Medic unit be added at the Greenwood station, and an additional Medic

resource should be considered for the Stephens City station in the near future.

Recommendation:

It is recommended that the workload, reliability, and call concurrency is evaluated in all stations, but specifically in Greenwood, Stephens City, Round Hill Community, Millwood, Gainesboro, and Middletown due to their relatively higher workloads.

Community Risk Assessment

In addition to the historical demands for services, a prospective review of occupancies within the jurisdiction was completed. In total, 924 occupancies were evaluated based on variables for needed fire flow, the number of stories, the square footage, construction class, and the building combustion class. In addition, the presence of passive mitigation strategies such as fire sprinkler systems were included to moderate risk ratings where appropriate.

Figure 5: Occupancy Level Risk Matrix

Risk Class	Fire Flow		Number of Stories		Square Footage		Construction Class		Building Combustion Class		Full Credit Sprinkler System (Yes/No)	Total Risk Score
	Value	Scale	Value	Scale	Value	Scale	Value	Scale	Value	Scale	Value	Scale
High	3	≥ 1500 gpm	5	≥ 4	5	≥100k Sq. Ft.	5	Combustible or Frame	5	Quick Free and Rapid Burning	-10/0	≥ 17
Moderate	2	> 499 and < 1500 gpm	3	> 1 and < 4	3	> 10k < 100k Sq. Ft.	3	Joisted Masonry	3	Combustible	-10/0	>5 and <17
Low	1	≤ 499 gpm	1	1	1	< 10k Sq. Ft.	1	Non-Combustible Masonry Non-Combustible Fire Resistive	1	Slow Non/Limited Combustible	-10/0	≤ 5

Occupancies, or commercial buildings were rated as high, moderate, or low risks and geocoded to each fire station first due service area utilizing the following occupancy level risk matrix. Next a concentration risk matrix was utilized to help identify which station service areas were of high, moderate, or low risk utilizing the following risk matrix.

Figure 6: Summary of Station Fire Demand Zone Risk Concentration Matrix

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

This analysis provides direction for the allocation and concentration of resources based on each station’s relative risk rating. The analysis suggests that both the Station 11 – Stephens City and Station 18 – Greenwood are high-risk station areas and the Station 13 – Clear Brook, Station 15 – Round Hill, and Station 21 – Millwood Station are of a moderate risk. All other stations were classified as low risk. The results are provided below.

Table 1: Summary of Station Service Area Risk Concentration Ratings

Station Service Area	Demand	Risk	Call Concurrency	Sum Score	Total Risk Score	Risk Rating
11	5	5	10	2,812.5	53.03	High
12	2	1	6	92	9.59	Low
13	3	3	8	616.5	24.83	Moderate
14	1	1	3	9.5	3.08	Low
15	4	2	10	1032	32.12	Moderate
16	1	1	7	49.5	7.04	Low
17	1	1	2	4.5	2.12	Low
18	5	3	10	1,812.5	42.57	High
19	1	1	5	25.5	5.05	Low
20	1	1	5	25.5	5.05	Low
21	3	3	7	481.5	21.94	Moderate

Risk-based Approach to the Allocation of Resources

Following a risk-based approach to managing risk in the County, two fire station service areas were categorized as high-risk station service areas and three station service areas were categorized as moderate. All other stations service areas were categorized as low-risk stations. Within a risk-based approach, the system is designed to have a higher concentration of resources at stations of higher risk versus lower risk.

In all developed alternatives below, it is assumed that the Battalion Chief will continue as currently deployed and that would bring the current minimum staffing to 27. In addition, in all models it is intended that every station would cross-staff an ambulance, preferably at the Advanced Life Support (ALS) level.

Alternative 1 – Risk-based Engine and Station Staffing at 8-Minutes Urban/Suburban

Alternative 1 contemplates a risk-based deployment strategy that utilizes all 11-current fire stations and seeks to achieve an 8-minute travel time for urban/suburban areas and a 13-minute travel time for rural incidents. As previously discussed, it is understood that the 8-minute travel time may only achieve approximately 80% of the incidents within the urban/suburban timeframe. The goal would be to achieve 90% of the incidents. However, it should not be discounted that the vast majority of the incidents would be responded to within 8-minutes or less.

This alternative would increase engine staffing from 2 to 3 personnel for 24/7 coverage for all moderate and high-risk station zones (11, 13, 15, 18, and 21). All other stations would continue to be staffed with 2 personnel on the primary fire apparatus. This is to accomplish the baseline services for fire suppression and first responder EMS incidents.

Staffed ambulances would be provided at stations 11, 12, 13, 15, 16, 18, and 21. A second ambulance would be assigned to stations 11 and 18, both high-risk stations. Stations 14, 17, 19, and 20 would continue to be staffed with 2 personnel and cross-staff an ambulance consistent with current practice. This alternative would have all ALS ambulances and would eliminate the cross-staffed ALS chase vehicles.

Station 16 is allocated an ALS ambulance and the associated 2-person staffing due to an analysis the evaluated the balance between call concurrency and call volume. For this report, it is recommended that any station service areas that have greater than or equal to 1,800 (<5 calls per day) and greater than or equal to 15% call concurrency that each unit is staffed rather than continuing to cross-staff resources.

Therefore, all additional engine staffing was allocated due to the risk ratings of moderate or high. The recommendations for staffed ambulance placement is allocated based the geographic requirements to achieve the greatest contribution to response time performance. Station 16 is the

only exception. This alternative would have all ALS ambulances and would eliminate the cross-staffed ALS chase vehicles.

Table 2: Summary of Career Staffed Resource Allocation for Alternative 1 – 8/13 All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	1 st Staffed Ambulance	2 nd Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Risk Rating
11	Engine	ALS	ALS	4	7	High
12	Engine	ALS		2	4	Low
13	Engine	ALS		2	5	Moderate
14	Engine			2	2	Low
15	Engine	ALS		2	5	Moderate
16	Engine	ALS		2	4	Low
17	Engine			2	2	Low
18	Engine	ALS	ALS	4	7	High
19	Engine			2	2	Low
20	Engine			2	2	Low
21	Engine	ALS		2	5	Moderate
Total	11	7	2	26 ²	45	

Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Alternative 2 – Risk-based Engine and Station Staffing at 10-Minutes Urban/Suburban

Alternative 2 contemplates a risk-based deployment strategy that utilizes all 11-current fire stations and seeks to achieve a 10-minute travel time for urban/suburban areas and a 13-minute travel time for rural incidents. As previously discussed, it is understood that the 10-minute travel time will accomplish a minimum of 90% of the incidents within the urban/suburban timeframe. However, it should not be discounted that the vast majority of the incidents would be responded to within 8-minutes or less (80%) if all 11 stations continue to be utilized.

This alternative would increase engine staffing from 2 to 3 personnel for 24/7 coverage for all moderate and high-risk station zones (11, 13, 15, 18, and 21). All other stations would continue to be staffed with 2 personnel on the primary fire apparatus. This is to accomplish the baseline services for fire suppression and first responder EMS incidents.

Staffed ambulances would be provided at stations 11, 12, 13, 15, 16, 18, and 21. A second ambulance would be assigned to stations 11 and 21, both high-risk stations. Stations 14, 17, 19, and 20 would

² It is understood that all current minimal staffing is 27 with the inclusion of a shift Battalion Chief. In all scenarios, the Battalion Chief is assumed to remain as currently deployed.

continue to be staffed with 2 personnel and cross-staff an ambulance consistent with current practice.

Station 16 is allocated an ALS ambulance and the associated 2-person staffing due to an analysis the evaluated the balance between call concurrency and call volume. For this report, it is recommended that any station service areas that have greater than or equal to 1,800 (<5 calls per day) and greater than or equal to 15% call concurrency that each unit is staffed rather than continuing to cross-staff resources.

Therefore, all additional engine staffing was allocated due to the risk ratings of moderate or high. The recommendations for staffed ambulance placement is allocated based the geographic requirements to achieve the greatest contribution to response time performance. Station 16 is the only exception. This alternative would have all ALS ambulances and would eliminate the cross-staffed ALS chase vehicles.

Table 3: Summary of Career Staffed Resource Allocation for Alternative 2 – 10/13 All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	1 st Staffed Ambulance	2 nd Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Risk Rating
11	Engine	ALS	ALS	4	7	High
12	Engine	ALS		2	4	Low
13	Engine	ALS		2	5	Moderate
14	Engine			2	2	Low
15	Engine	ALS		2	5	Moderate
16	Engine	ALS		2	4	Low
17	Engine			2	2	Low
18	Engine	ALS		4	5	Moderate
19	Engine			2	2	Low
20	Engine			2	2	Low
21	Engine	ALS	ALS	2	7	High
Total	11	7	2	26	45	

Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Alternative 3 – Partially Autonomous EMS Layer with Risk-based Engine Staffing

Alternative 3 is an incremental variation of the Alternative 2. Analyses have demonstrated that stations 12 and 16 are not required to meet 90% of the incidents within 10-minute urban/suburban travel times for EMS. In other words, all 11-stations would be included for fire, non-EMS, and first responder EMS incidents. Only 9-stations would be resourced with staffed ambulances and stations

12 and 16 would continue current practices. All moderate and high-risk stations are recommended to have 3-person engine staffing.

Table 4: Summary of Career Staffed Resource Allocation for Alternative 3 – 10/13 All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	1 st Staffed Ambulance	2 nd Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Risk Rating
11	Engine	ALS	ALS	4	7	High
12	Engine			2	2	Low
13	Engine	ALS		2	5	Moderate
14	Engine	ALS		2	4	Low
15	Engine	ALS		2	5	Moderate
16	Engine			2	2	Low
17	Engine	ALS		2	4	Low
18	Engine	ALS		4	5	Moderate
19	Engine	ALS		2	4	Low
20	Engine	ALS		2	4	Low
21	Engine	ALS	ALS	2	7	High
Total	11	9	2	26	49	

Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Alternative 4 – Partially Autonomous EMS Layer and 2-Person Engine Staffing

Alternative 4 is an incremental variation of either Alternatives 1 or 2. The only difference in baseline deployment between Alternative 1 and 2, are the changes from Station 18 to 21. Analyses have demonstrated that stations 12 and 16 are not required to meet 90% of the incidents within 10-minute urban/suburban travel times for EMS. In other words, all 11-stations would be included for fire, non-EMS, and first responder EMS incidents. Only 9-stations would be resourced with staffed ambulances and all fire suppression apparatus would continue with 2-person staffing.

Table 5: Summary of Career Staffed Resource Allocation for Alternative 4 – 10/13 All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	1 st Staffed Ambulance	2 nd Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Risk Rating
11	Engine	ALS	ALS	4	6	High
12	Engine			2	2	Low
13	Engine	ALS		2	4	Moderate
14	Engine	ALS		2	4	Low
15	Engine	ALS		2	4	Moderate
16	Engine			2	2	Low
17	Engine	ALS		2	4	Low
18	Engine	ALS		4	4	Moderate
19	Engine	ALS		2	4	Low
20	Engine	ALS		2	4	Low
21	Engine	ALS	ALS	2	6	High
Total	11	9	2	26	44	

Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Alternative 5 – Partially Autonomous EMS at 12 Minutes and 2-Person Engine Staffing

Alternative 5 is an incremental variation of either Alternatives 1 or 2. The only difference in baseline deployment between Alternative 1 and 2, are the changes from Station 18 to 21. In this scenario, all 11-stations would be included for fire, non-EMS, and first responder EMS incidents and would continue to perform at 10-minutes urban/suburban and 13-minutes rural coverage. However, an additional ALS ambulance layer would be provided at a 12-minute travel time. Only 5-stations would be resourced with staffed ambulances and all fire suppression apparatus would continue with 2-person staffing.

Table 6: Summary of Career Staffed Resource Allocation for Alternative 5 – 12 Minutes All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	1 st Staffed Ambulance	2 nd Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Risk Rating
11	Engine	ALS	ALS	4	6	High
12	Engine			2	2	Low
13	Engine	ALS		2	4	Moderate
14	Engine			2	2	Low
15	Engine			2	2	Moderate
16	Engine	ALS		2	4	Low
17	Engine			2	2	Low
18	Engine			4	2	Moderate
19	Engine	ALS		2	4	Low
20	Engine			2	2	Low
21	Engine	ALS	ALS	2	6	High
Total	11	5	2	26	36	

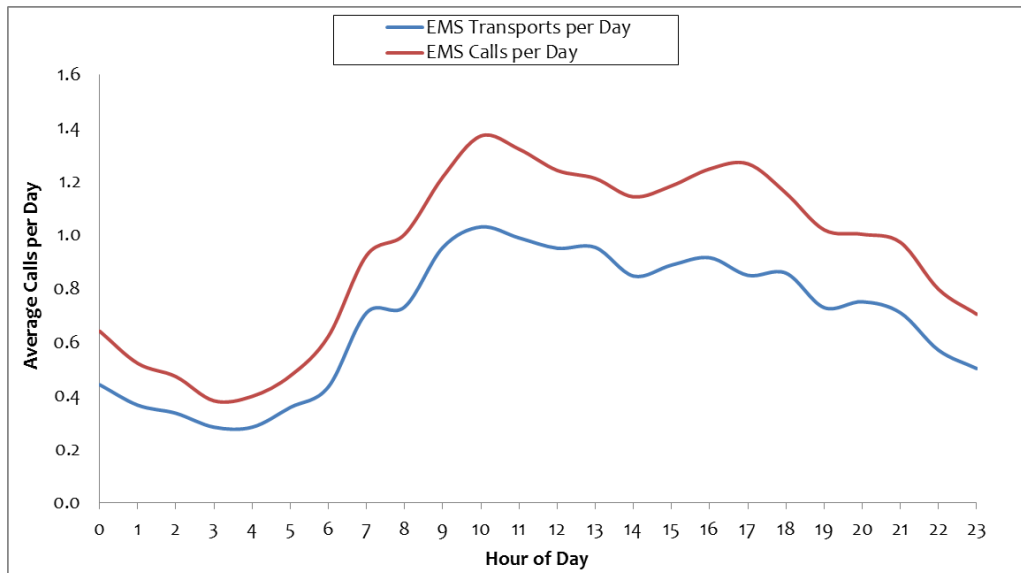
Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Alternative 6 – Peak Load Ambulance Program and 2-Person Engine Staffing

Alternative 6 is an incremental variation of either Alternatives 1 or 2. The only difference in baseline deployment between Alternative 1 and 2, is the changes from Station 18 to 21. In this scenario, all 11-stations would be included for fire, non-EMS, and first responder EMS incidents and would continue to perform at 10-minutes urban/suburban and 13-minutes rural coverage. However, any additional staffed ambulances are provided as peak-load units that work 12-hours per day. In total, 7 peak-load ambulances could be deployed plus 2 additional 24/7 ambulances. All stations would continue current practices of cross-staffing ambulances.

The middle of the day, between 8:00 am and 8:00 pm, experiences the vast majority of incident call volume and workload. In addition, the overwhelming volume is for EMS related incidents as opposed to fire suppression incidents with a relatively high transport rate. Much of the non-peak overnight period has less than one call every two hours on average. Please see the figure below.

Figure 7: Average EMS Calls and EMS Transports per Day by Hour of Day



Therefore, considering Alternative 6 would include the strategy of hiring 12-hour employees to meet demands above and beyond the base level services. This is the most efficient manner to address increases in demand for the future once base level services have been established for the 24-hour period.

Table 7: Summary of Career Staffed Resource Allocation for Alternative 6 – 10/13 All 11 Fire Stations

Station Service Area	Engine Quint Pump/Tender	Peak Load Ambulance	24/7 Staffed Ambulance	Current Minimum 24/7 Staffing	Total Recommended 24/7 Min. Career Staffing	Total Peak-Load Staffing (12-hour)	Risk Rating
11	Engine	ALS	ALS	4	4	2	High
12	Engine	ALS		2	2	2	Low
13	Engine	ALS		2	2	2	Moderate
14	Engine			2	2	0	Low
15	Engine	ALS		2	2	2	Moderate
16	Engine	ALS		2	2	2	Low
17	Engine			2	2	0	Low
18	Engine	ALS		4	2	2	Moderate
19	Engine			2	2	0	Low
20	Engine			2	2	0	Low
21	Engine	ALS	ALS ³	2	4	2	High
Total	11	7	2	26	26	14	

Note: Apparatus are restricted to the recommended primary staffed units. This summary does not address additional apparatus staffed by volunteers.

Fiscal Comparison of Alternative Staffing and Deployment Models

A comparison of the general costs for each of the developed alternatives are provided in the table below. A baseline estimate for a minimum staffing of 26 personnel per day utilized the average salary range of \$54,118.12 as provided by the department. It is understood that a Battalion Chief (BC) is assigned to each shift bringing the actual minimum staffing to 27 each day. However, to compare alternatives for the personnel assigned to primary response apparatus, the base minimum staffing utilized was 26. As stated previously, in all scenarios it is assumed that the BC will continue as currently deployed. In addition, the department’s current staffing multiplier (3.82) was utilized for these comparison purposes. Under the current staffing strategy, FCFRD requires 3.82 personnel for each person deployed 24/7. Finally, it is also understood that these estimates are personnel costs only utilizing the average salary as provided by FCFRD and may not be representative of the total compensation. This is for comparison purposes to illustrate the relative fiscal impact of each alternative.

³ The resource allocation and definition of high-risk station shifts between Stations 18 and 21 depending on whether an 8 or 10-minute travel time is adopted.

Table 8: Comparison Table of Alternatives Utilizing Average Salary for Personnel Costs Only

Alternative	Current Minimum Staffing (w/o BC)	Proposed Minimum Staffing (w/o BC)	Delta from Current FTE of 100 (w/o BC)	Delta from Current Staffing Utilizing Average Salary
Alternative 1	26	45	73	\$3,927,893.15
Alternative 2	26	45	73	\$3,927,893.15
Alternative 3	26	49	89	\$4,754,818.02
Alternative 4	26	44	69	\$3,721,161.93
Alternative 5	26	36	39	\$2,067,312.18
Alternative 6	26	14 ⁴	35	\$1,894,134.20

Recommendation: #

The County is encouraged to consider one of the alternatives to meet or exceed desired service levels.

Staffing, Scheduling, and Overtime

Staffing and Schedules

The fire department currently operates on a “modified Detroit” schedule that equates to an average workweek of 56 hours per week regardless of the pay cycle for each of three shifts. Analyses were completed to determine if there were any fiscal advantages to changing the schedule.

Departments around the country utilize a variety of schedules that typically result in a 42, 48, or 56-hour workweek. Schedules for 42, 48, and 56-hour workweeks were evaluated to determine the relative fiscal impact of the various schedules. In all scenarios the minimum staffing was maintained on all units and no deployment changes were necessary or contemplated. Finally, an evaluation was completed to determine the impact of establishing a Kelly Day or Relief Day to reduce overtime hours; 52-hour workweek or less. This analysis utilizes the average leave histories of the employees provided by FCFRD.

When referring to the table below, the staffing multiplier is the number of personnel needed to fill one position or seat on an apparatus 24 hours a day and 7 days a week given the average work week and annual hours. For example, for the 42-hour workweek in the first row, it would require 4.67 employees to continuously staff one position 24/7. This table assumes a minimum daily staffing of 27 personnel 24/7.

⁴ Peak Load Schedule only requires 2.5 personnel to fulfill the schedule as opposed to FCFRD current practice of 3.85.

Table 9: Comparison of Various Work Schedules and Staffing Demands

Work Week (hrs.)	Annual Hours	Staffing Multiplier	Needed Employees	Additional Employees to Cover Vacation Slots	Delta from Current of 103	Delta in Personnel Costs Utilizing Average Salary
42 (Kelly Days)	2,184	4.67	126	21	44 Additional	\$2,381,197.28
48 (Kelly Days)	2,496	4.0	108	15	20 Additional	\$1,082,362.40
52 (Kelly Day)	2,704	3.65	99	13	9 Additional	\$487,063.08
56	2,912	3.36	91	12	0	\$0

The department’s current staffing multiplier is 3.82 (103 shift FTE / 27 minimum staffing). Therefore, the department has elected to staff for the available vacation slots above and beyond the staffing multiplier. For example, 103 shift FTE / 3 shifts = approximately 34 personnel per shift. This would equate to a total of 7 personnel that could be off on any shift (34 personnel per shift – 27 minimum staffing = 7) prior to hiring back on overtime. However, as the department adds relief personnel, those employees need to have access to time off as well. Therefore, the number of time off slots needs to be increased to 3.6 from 3.2. Again, doubling the available slots employees can take off would be approximately 7 slots, which is in line with the department’s current practices.

Results from this analysis suggest that within the current minimum staffing of 27 personnel and the average leave history of the employees; the optimized staffing could be 91 (27 x 3.36). Utilizing this approach already accounts for 3.6 vacation slots per day within the relief formula. Therefore, following the department’s current practice, an additional 12 employees would need to be hired (3.6 x 3.36 = 12.1) to cover the available time off slots.

The number of available “slots” that personnel can take off each day on scheduled leave is approximately 6. There are times where this may be exceeded with Fire Chief’s approval. Utilizing the total hours of 27,923 hours that include vacation, sick leave, and other miscellaneous leave accounts, it would require a minimum of 3.2 available slots for all employees to utilize their average leave. This figure was calculated when the department had 91 personnel on shift. Now that there are 103 personnel, the number of required slots is 3.6. However, it is understood that not all days are as desirable as others, therefore a factor of approximately 2, or a total of 7 slots off for vacation is a reasonable solution to account for desirable days, partial vacation days, etc. It is recommended that the department continue to utilize the 7 available slots per day, but do not allow greater than 7 personnel off per shift on scheduled leave.

The current schedule that the fire department utilizes is the most efficient schedule to provide coverage 24 hours per day 7 days a week.

Recommendation:
It is recommended that Frederick County and FCFRD continue with the current work schedule for the foreseeable future.

Recommendation:

It is recommended that FCFRD continue to use no more than 7 “slots” per day for scheduled leave.

Overtime

There is a direct relationship between the available staffing and overtime liabilities. Understanding the average workweek and minimum staffing, there may be some additional capacity to reallocate resources as the system continues to grow to meet community demands. However, there are three general factors that contribute to overtime usage that deserves consideration. First, Virginia affords payment for premium overtime (1.5 X base rate) for all scheduled hours. Since the average workweek is 56 hours, there is inherent Fair Labor Standards Act (FLSA) overtime that occurs each pay period that has nothing to do with leave usage of the personnel. Virginia requires payment of all overtime at the premium regardless of the “sweat hours” (hours actually worked as opposed to hours on some type of leave) that are afforded in the federal FLSA standard. In other words, even if the employee took several days’ vacation, reducing the “sweat hours” or actual time at work, the scheduled work hours would continue to be compensated at full rate and at a premium rate for hours past 212 hours in the 28-day work cycle (7 days/week x 4 weeks). At 56 hours a workweek, the average month would be approximately 224 hours (56-hour week x 4 weeks). Therefore, there would be approximately 12 hours of overtime each month for each employee due to the current schedule plus an additional 8 hours of off duty training per month for a total of 20 hours of overtime. These hours are inherent in the prescribed schedule prior to any operational overtime to cover PTO, unscheduled leave, etc.

Second, as previously described, the department has 8-hours of training scheduled each month that will always be paid at the premium rate because it is above the 56 hour work week. Third, anytime the department allows greater than 7 personnel off per shift, such as scheduled leave, or additional positions are vacated due to unscheduled leave, the department must hire back personnel to ensure minimum staffing of 27 is obtained. The unscheduled leave experience may have the greatest unpredicted impact on overtime based on the limited ability for administrative control.

Finally, since all scheduled hours above 212 in 28 days are essentially overtime, it may be in the best interest of the County to hire FTE’s rather than carry the extra burden of overtime. For example, since all overtime is at the premium 1.5 rate, it may be better to hire an FTE at the 1.0 rate. Virginia has eliminated the benefit of the FLSA “sweat hours” requirement to pay premium pay, by requiring all scheduled hours to be compensated irrespective of if they utilized vacation for example. Therefore, the traditional method of determining the break over of straight time employment versus overtime at a premium is negated.

Recommendation:

Since the relationship is a 1 to 1 ratio, it is recommended that Frederick County continue to hire personnel to offset the need for shift back-fill and provides for additional surge capacity in the system for extreme events. Adding additional personnel seems to be a more efficient use of limited fiscal resources.

Measuring Total Response Time and Dispatch Center Performance

The Department has not established goals for system performance prior to the completion of this SOC. The aggregate performance is more representative of the system performance. The individual station demand zones performance provides understanding of the compartmentalized performance. While it is up to the department to establish policy related to meeting or exceeding community expectations, there are opportunities to better align goals and baseline objectives.

However, it is important to clarify nuances in the data collection process for the CAD system. A distinct “dispatch time”, defined from when a citizen calls 911 until the emergency crews and apparatus are dispatched, is not clearly identifiable in the data set. Turnout time, defined as the time between when the units/crews are notified until they are enroute to the incident, is not identifiable either. Therefore, the data reports an aggregated value of both dispatch and turnout time at 7.3 minutes at the 90th percentile.

Based-on national experience, it is more likely that the elongated time (7.3 minutes) is associated with the turnout time that may be most influenced by times when volunteers have to drive to the station before responding. However, several suggestions are provided to improve data collection and performance management.

While it is understandable that the travel time is over 10-minutes for Frederick County Fire and Rescue, it is also recognized that the total citizen experience is over 16 minutes from the time 911 is called until the first unit’s arrival at the 90th percentile. This is known as the total response time.

The department could impact the total response time in most instances with the improvement of crew turnout time and/or improved dispatch time that is more closely aligned with best practices such as NFPA 1710 or NFPA 1221. Irrespective of the national recommendations and standards, it is suggested that best practice is 2 minutes or less at the 90th percentile for call processing or dispatch time.

Recommendation:
It is recommended that FCFRD begin dispatching at the unit level rather than at the station level. In this manner, performance between career or staffed models and volunteer or unstaffed models could be evaluated within the context of the service delivery model. This would also provide a definitive data point to measure dispatch or call processing time.

Recommendation:
Once the dispatch center is able to dispatch at the unit level and separate out dispatch time from turnout time. The department is encouraged to monitor turnout time to ensure the performance is best practice at 60 seconds for an EMS incident and up to 90 seconds for a fire related incident. Turnout time performance is typically within personnel and management control. Improvement of turnout times is generally a no-cost option.

NON-DEPLOYMENT OBSERVATIONS AND CONSIDERATIONS

Division and Support Staff Needs

Admin/EMS Billing – As the organization grows additional demands are placed on the administrative staff. Additional line personnel equate to an exponential increase in the provision of routine administrative services, which in turn can negatively impact the effective output of staff. Keeping pace with the number of administrative personnel is paramount to ensure that all aspects of organizational activities can be accomplished effectively and efficiently. Consistent with this theme is the need to provide an identifiable means of horizontal and vertical communications, clearly defined job descriptions, work space and equipment compatible with required functions, succession planning, and opportunities for personal and professional growth. Deliberate and contemplative consideration should be given when determining the need for additional administrative staff, appropriate assignments, and the potential of replacing administrative FTE vacancies with line and staff fire officers.

Recommendation:

It is understood that FCFRD has recently filled this position. Therefore, It is recommended that FCFRD continue efforts to ensure long-term sustainability of the new position.

Training Division - The personnel assigned to the FCFRD Training Division continue to perform at a high level under continually increasing demands. As the community continues to develop, and the risks and exposures become more diverse, training of personnel becomes even more imperative. Delivery of requisite training programs is directly proportionate to the personnel available to conduct the training. Currently the limited staff is providing all programs including recruit school, in-service, specialty on-demand programs, and officer development. Potential increases to training efficiencies could be realized through the development of a dedicated training facility, compiling a cadre of certified instructors, and the expanded use of Target Solutions, or similar software, by the Training Division and company officers. Current delivery methodology lends itself to increasing amounts of overtime hours, flex scheduling, and potential “burn out” of training staff. As the organization continues to grow it does not appear that the current number of training staff, and subsequent delivery systems, are sustainable over time. In addition, it would be extremely beneficial for the organization to develop a division succession plan to account for staff changes and retirements.

Recommendation:

It is recommended that the possibility of developing on shift training officers be explored to augment the training division and relieve excessive hours from current staff.

Life Safety/Fire Marshal - This division is impacted by county growth and development on a daily basis due to the plan review and inspection functions being performed. In addition, personnel in this division also supplement and support emergency functions as needed or directed by the organizational hierarchy. The divergence from their identified primary responsibilities has the potential to negatively impact service delivery and customer satisfaction. Timeliness is paramount

when assisting customers who need approvals, certifications, or authorizations to move forward with various business endeavors. Currently division functions are being provided by a combination of full time and part time personnel. As the built inventory increases it will become necessary to evaluate the historic work metrics of both full and part time staff. Demands for the services of the Life Safety division will continue to increase and may create the need to transition part time positions to full time positions.

The department can determine the appropriate fire inspection staffing levels by evaluating the general demand for services, the frequency of service, and the average duration of each activity. As an example, if the department has 1,000 inspectable properties, that need to be inspected once each year, and the average time to complete an inspection is 1 hour; then with an estimated employee capacity to accomplish 6 full inspections (plus travel and lunch) would require 1 employee to complete (less average vacation, sick leave, etc.). This is calculated as $1,000 \text{ inspections} \times 1 \text{ hour per inspection} = 1,000 \text{ needed hours}$. Next, $6 \text{ inspections per day} \times 52 \text{ weeks} \times 30 \text{ hours per week} = 9,360 \text{ hours}$. This can be replicated for other activities such as plans review, public education, etc.

As fire prevention is the first line of defense in protecting the community from fire it is incumbent on the organization to constantly reassess the effectiveness of these efforts to insure an appropriate return on the investment being made. The Fire Marshal's office has a dedicated, qualified staff committed to their mission. Progress and effectiveness can be eroded should support be lacking, or activities perceived to be a low priority. Horizontal and vertical communication pathways should be well defined and contain feedback and follow up provisions.

Recommendation:

It is recommended that the FCFRD consider requesting an official opinion from the U.S Dept. of Labor, Wage and Hour Division, regarding the specific local conditions regarding On-Call status. While there are general guidelines relative to compensation for these hours, there are more specific benchmarks that are unique to each agency's use of on-call hours. Said opinion would be useful in developing an organizational policy that could clearly and definitively explain the counties position

Operations - Emergency response personnel continue to meet their challenge with limited resources. FCFRD is fortunate to have dedicated individuals committed to the mission and who constantly adapt to the changing environment. Limited staffing, as identified by FCFR staff officers, directly impacts the time necessary to assemble an effective fire force. Due to the uncertainties of volunteer response the limited staffing also impacts the commitment of multiple fire stations, which further exacerbates the issue of coverage of simultaneous calls for assistance. Under the current model the continued increase of EMS related incidents further erodes the availability of full time staff for fire and other emergency activities. Given the inherent risks associated with emergency response, personnel safety is of the utmost importance. Essential to this task is the standardization of policies.

Recommendation:

It is recommended that a clearly defined chain of command policy be created, and directives for consistency in volunteer staffing/response. Continued analysis of projected community growth is necessary to determine short and long-term needs for appropriate staffing locations

Organizational Structure and Management

The current FCFRD organizational chart shows three distinct divisions: Operations, Life Safety, and Training. While “Administration” can loosely be identified on the org chart as those positions above the Division level, EMS Operations and Volunteer related activities do not appear in the organizational chart. While neither of the absent functional areas appears to rise to the Division level, they are nevertheless significant contributors to organizational success. It is not uncommon for certain functional tasks to be comingled within existing Divisions for ease of administration, as indicated by “Resource Manager” (Logistics), under the Operations Division as much of the logistics function is impacted by operational concerns or issues. In similar fashion, volunteer related functions seem to be aligned with Administration due, in large part, to the need to have access to the Fire Chief. Both the Chief’s Working Group and the Fire & Rescue Association interact with the Fire Chief, however they have no official place on the FCFRD organizational chart.

Managing across divisional boundaries requires a concentrated effort to be successful. Horizontal communication is paramount and should include the Chief’s Working Group and the Fire & Rescue Association. Administrative communications should be formalized and utilize a defined distribution pathway. The development of specific distribution lists can be helpful to insure the right people get the right messages. Each functional division should develop a vertical pathway to streamline the dissemination of information. Information intended for department wide distribution should not rely on word of mouth communication and should be accomplished through a process defined by organizational policy.

Divisional leadership should be charged with developing recommendations that can be used to incentivize personnel to pursue opportunities within the division. This would include opportunities for divisional advancement based on competencies, experience, and education. Often the best-qualified candidates in a division can be eliminated from consideration for advancement based on prerequisite requirements not available by serving in the division. Continuity of service delivery may be impacted due to divisional leaders having to learn from the ground up regarding their new responsibilities.

Effective control of emergency incidents relies heavily on span of control and a clear chain of command. Standardized operating policies are necessary to allow personnel from various districts to be effective throughout the system regardless of location. Adequate supervision of response personnel, paid and volunteer, is essential for safe operations. The magnitude of the event is not the sole determinant of the need for supervision. Each station would be well served to have an Officer on duty at all times. This provides for the necessary accountability, adheres to chain of command, and clearly identifies the decision-making authority. Station Officers take command of incidents until relieved by a higher-ranking officer or as defined by organizational policy. Ultimately, each incident

should have one Incident Commander. The delineation of this concept should be defined by organizational policy, with input from the various stakeholders, and be implemented across all districts within FCFRD.

With approximately 80% of all emergency activity being EMS related, and a substantial portion of the paid staff involved in these incidents, there seems to be a limited of identity of this function in the current organizational chart. Given the complexities of prehospital emergency care, and the transportation of the sick and injured, the need for specialized training, incident supervision, compliance, equipment standardization, protocols, and medical direction may require a dedicated EMS officer.

The continued success of FCFRD, and the effective planning for future growth in human resources, fixed stations, apparatus acquisition and deployment, operating efficiencies, and the dynamic changes required by an evolving community, is best served by the appointment of a single Fire Chief who has the ultimate authority and is directly responsible for all activities and decisions of the FCFRD. From a historical perspective this has been an outcome for many fire organizations across the country. It is an evolutionary process necessitated by the ever changing, time sensitive, internal and external influences faced by fire departments everywhere, every day. This transition should be a collaborative effort of all the stakeholders and does not signal the demise of the individual company's leadership. The opportunity exists to synthesize volunteer leadership groups into a single advisory committee for providing input to the organizations decision-making process.

The combination of a single Fire Chief, and an engaged advisory committee, will provide advantage to the oversight of funding and the distribution of assets, thus maximizing the return on investment of taxpayer dollars. It would also allow for a general standardization of service levels across the entire county

Recommendation:

It is recommended that FCFRD develop a policy that clearly defines the internal communication process, both horizontally and vertically.

Recommendation:

It is recommended the FCFRD take the necessary action to provide an officer at each station on each shift.

Recommendation:

It is recommended that promotional policies be revised to permit internal divisional promotion without the encumbrance of rank requirements not achievable within the division.

Recommendation:

It is recommended that FCFRD develops, adopts, and publishes a policy that defines emergency operation guidelines that will be implemented on a countywide basis for career and volunteer personnel.

Recommendation:

It is recommended that Frederick County revisit the hierarchal makeup of the county fire service to create a single fire chief supported by an advisory committee to be defined by the county.

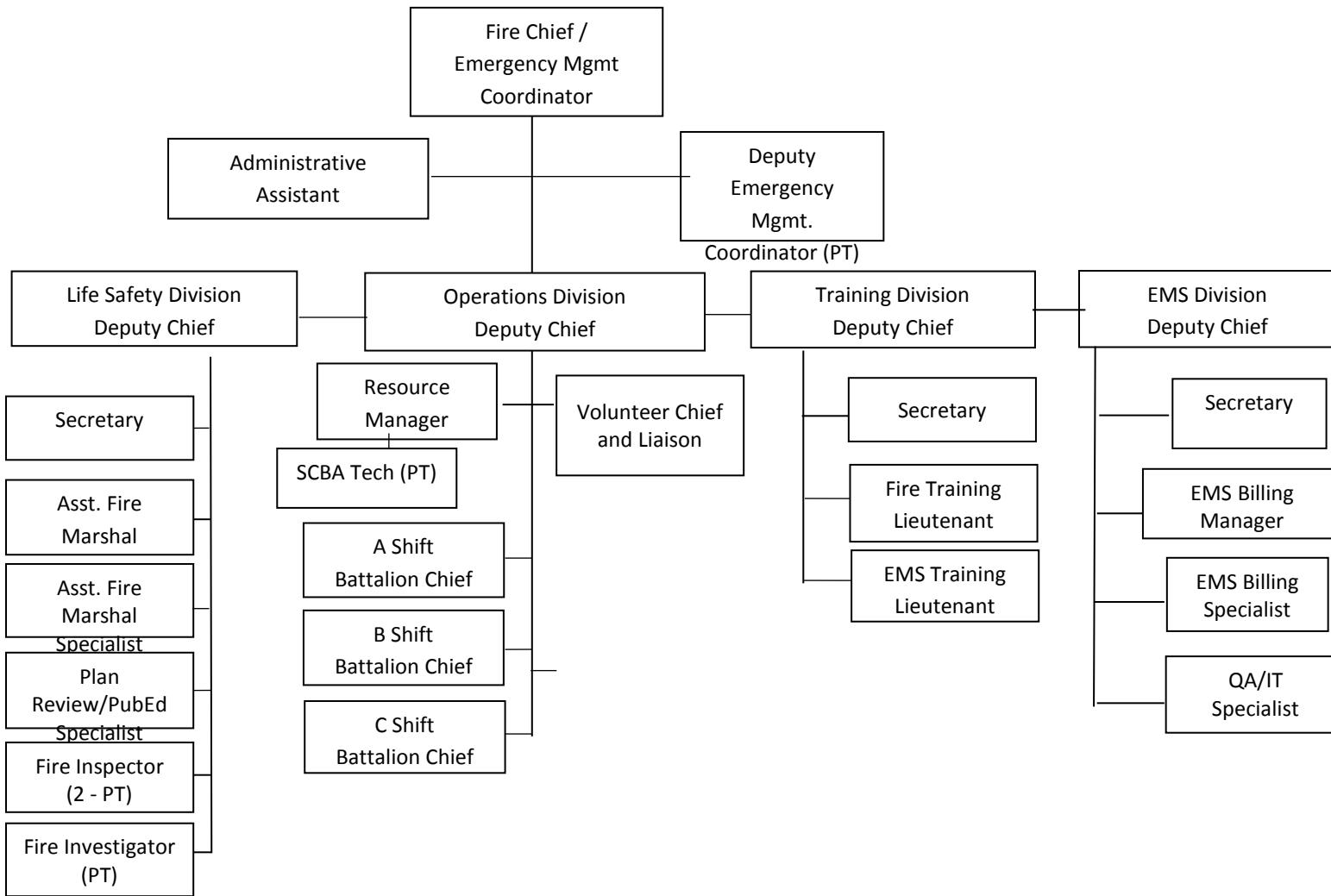
Recommendation:

It is recommended that FCFR appoint a senior officer as the Medical Officer or EMS Officer to oversee the multiple issues regarding the delivery of pre-hospital emergency medical services.

Recommendation:

It is recommended that FCFRD revise the existing Organizational Chart to include the functional areas of EMS and Volunteers.

PROPOSED FREDERICK COUNTY FIRE AND RESCUE ORGANIZATIONAL CHART



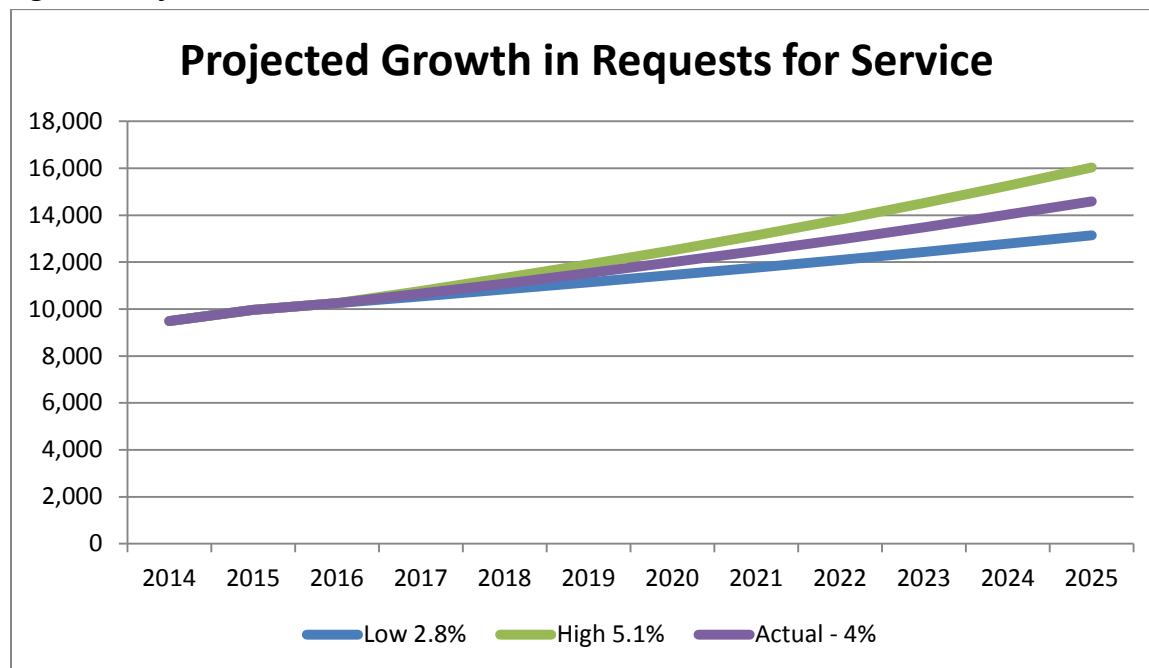
Future Vision, Goals, and Objectives for Future Growth

Evaluation of Projected Future Growth

Two measures were utilized to help describe the potential growth in Frederick County that may impact future demands for service. First, is the year over year projection of increasing call volume, or requests for service.

The annualized growth was approximately 4% between 2014 and 2016. The following straight-line projection in the figure below should be used with caution due to the variability across years. Therefore, data must be reviewed annually to ensure timely updates to projections with the goal of utilizing at least 5-years of continuous data.

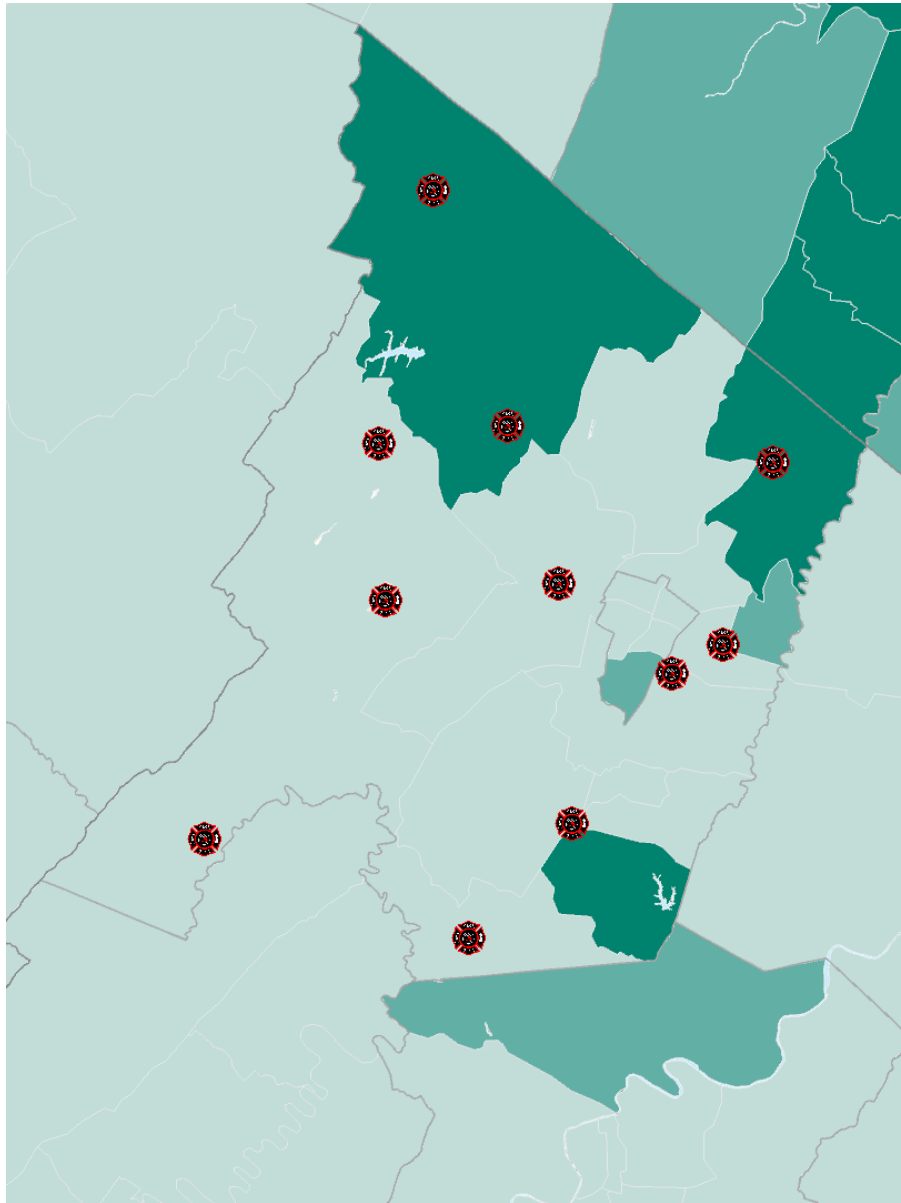
Figure 8: Projected Service Demand Growth of 4.02%



Assuming that future demands may not reasonably distributed across the various station service areas 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.

Second, is a source from the US Census and ESRI that estimates population growth by census block. As a growing community, the population change is increasing at a moderate rate. The greatest growth areas are to the northwest, northeast, and southeast portions of the county. There are no reductions in population projected.

Figure 9: Annual Population Change 2016-2021



2016-2021 USA Population Growth

Tract

- 1.9 - 54.1 %
- 1.25% to 1.9%
- 0% to 1.25%
- 1.25% to 0%
- 1.9% to -1.25%
- 2.3 to -1.9%

Developing a System of Standards to Guide Performance Management

The Frederick County Fire and Rescue system utilizes a variety of staffing and performance levels to bring the “system” together to respond to requests for service. There is evidence that the current FCFR leadership has lead with inclusion and transparency and the collective system is collegial while working together to provide services. However, performance and capabilities vary across the county due to the segmented approach to service delivery. Specifically, the performance varies anytime the first due (career) staff are unavailable or require a multi-unit response within the first due territory as the volunteer performance may vary by time of day and organizational requirements. It is both reasonable and a best practice to recognize that differentiate deployment plans may exist between rural areas and urban or suburban areas.

Therefore, a system of measures and thresholds that serve as triggers are offered to assist the Department and system in maintaining a commensurate manner in or to respond and mitigate like risks. In addition, these measures should establish baseline service levels to be provided irrespective of service or employment status. In other words, baseline service objectives should be established to provide a highly credible and reliable service to the citizens of Frederick County that utilizes performance as the measure rather than whether the personnel are career or volunteer.

The following table summarizes initial recommendations to the County. However, FCFR should review and modify as necessary to best meet their needs. When referring to the table below, it is intended to be read as the desired performance is either less than or greater than what is stated. When the reciprocal is true on any of the individual measures, it would be important for FCFR to review other like measures to determine if action must be taken. Two examples are provided to compare and contrast. First, if the “unit hour utilization” is exceeding the threshold of 0.25 on a 24-hour staffed unit then action must be taken based on only the individual factor. However, the immediacy of the change may have some flexibility if other performance measures such as response time and concurrency are within limits. Similarly, if the “reliability begins to fall below the threshold, but the response time and workload is still acceptable, then a longer reaction time may be acceptable.

Figure 10: Summary of Recommended Baseline Service Objectives

Type of Measure	Performance Metric	Career	Volunteer ⁵	Review Period
Station/Unit Performance	Dispatch	≤2 Min at 90%	≤2 Min at 90%	Quarterly
	Turnout Time	≤1.5 Min at 90%	≤6 Min at 90%	Quarterly
	Travel Time	≤6 Min at 90%	≤15 Min at 90%	Quarterly
	Minimum Engine Staffing	≥2 Firefighters	≥2 Firefighters	Daily
	Minimum Ambulance Staffing	≥1 FF/PM ≥1 FF/EMT	≥1 PM and ≥1 EMT *If cross staffed must be FF Certified	Daily
	Percentage of Calls with “no response”	≤1%	≤9.9%	Quarterly
System Design and Performance	Station Service Area Risk Rating Changing	Increases in Risk to Moderate or High	Increases in Risk to Moderate or High	Annually
	Reliability	≥90%	≥90%	Quarterly
	Call Concurrency	≤15%	≤15%	Quarterly
	Call Volume	3,000 – Initial 500 – Ongoing	1,800 – Initial 300 - Ongoing	Annually
	Unit Hour Utilization	≤0.25 on 24-hour units ≤0.50 on 12-hour units	≤0.25 on 24-hour units ≤0.50 on 12-hour units	Quarterly
	Cross-Staffing	<1,800 annual calls and <15% Call Concurrency	<1,800 annual calls and <15% Call Concurrency	Annually

⁵ If Rural Stations are staffed 24-7 career personnel the Turnout Time should be equal to the career performance.



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