Fire Station Location Analysis

for the

City of Mount Vernon Fire Department

Prepared by

The Ohio Fire Chiefs' Association

Consulting Services

PREMIER • PROFESSIONAL • PROACTIVE

September 2020

Executive Summary

The Ohio Fire Chiefs' Association (OFCA) was contracted to conduct a fire station location analysis for the city of Mount Vernon. The analysis included a community risk assessment and review of the Mount Vernon Fire Department's service delivery and demands for service. A cursory fire station facility examination was also performed as part of the project.

Mount Vernon is located 40 miles northeast of the Columbus metropolitan area and serves as the county seat of Knox County. The city has an area of 9.60 square miles and an estimated population of 16, 769. The city includes a mix of residential, commercial, and industrial development, and is home to Mount Vernon Nazarene University.

The Mount Vernon Fire Department is a full-time, career agency with 42 uniform personnel. Each of the three shifts has a captain, lieutenant, and 11 firefighters. Minimum daily staffing is nine personnel. The department operates out of one fire station on West Gambier Street and provides fire suppression response, emergency medical services (EMS), and a wide array of fire prevention and public education services to the community. In addition to serving the city, the department provides fire and EMS response to surrounding townships through contractual agreements. These include Clinton Township, Liberty Township, Pleasant Township, and approximately 35% of Morris Township. Over the past 10 years, the department experienced an 86% increase in calls for service. In 2019, the department responded to 5,275 incidents; 81% were EMS related.

A community risk assessment was conducted on each "target" hazard in the city and township response area. The assessment consisted of evaluating each property on various elements of fire risk and the potential impact on the community. There were 46 properties in the city identified as a significant risk for the fire department and the community.

The fire department's response performance for 2018 and 2019 was analyzed as part of the study. The analysis revealed that a performance gap exists in the city for fire and EMS travel times, while the total response time was slightly less than the response time criteria established by the National Fire Protection Association (NFPA). However, the time the call was received in the dispatch center was the same as the dispatch time for 84% of the fire responses and 88% of the EMS responses analyzed. The call handling time was questionable to its accuracy, which could possibly explain why the total response times were just under the target times while the travel times indicated performance gaps.

Travel time maps utilizing GIS mapping and the ARCGIS9 Fire Analysis Tool Software were developed. Using the existing fire station on West Gambier Street, a second station located near the intersection of Coshocton Avenue and Vernonview Drive was the best location to improve travel times and ultimately overall response performance in the community.

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Acknowledgements

The Ohio Fire Chiefs' Association recognizes Fire Chief Chad Christopher and members of the Mount Vernon Fire Department for their cooperation and effort during this project. They were prompt, courteous and professional in providing the background information and data necessary to conduct this analysis. Fire department members serve with pride and are committed to delivering quality service to the community. The Ohio Fire Chiefs' Association also recognizes Safety-Service Director Richard Dzik for his commitment to the project and providing information about the community, city operations, and future service delivery.

Introduction

At the request of the city of Mount Vernon, the Ohio Fire Chiefs' Association (OFCA) was contracted to perform a fire station location analysis to determine optimum locations for future fire station facility construction. Community growth, especially in the eastern portion of the city has raised concern of existing and future response times and deployment of fire department resources. This analysis included a risk assessment of the community as well as a review of the service delivery and response performance of the Mount Vernon Fire Department (MVFD). The project was limited to these specific areas of study.

The OFCA assessment team held a video conference with Chief Christopher and department officers on May 27, 2020 to review the response data requested and to provide training to conduct the community risk assessment. A site visit followed on June 24, 2020. During the site visit, the current station facility and equipment were inspected. Department response data and operational procedures were reviewed including existing township coverage areas. The assessment team was informed of current discussions with neighboring governmental entities concerning future contractual coverage areas. The assessment team viewed the downtown area and other significant risk properties. Potential growth areas identified by the city were also viewed.

Overview

Mount Vernon has an area of 9.60 square miles and serves as the county seat of Knox County. It is located 40 miles northeast of the Columbus metropolitan area. The city includes a mix of residential and commercial development, as well as some manufacturing facilities. There is an industrial park in the southern area of the city along South Main Street (State Route 661). Companies such as Ariel Corporation, Jeld-Wen, International Paper, Knox Community Hospital and the Mount Vernon Nazarene University are some of the city's largest employers.

Mount Vernon is known for its tree-lined streets and historic, quiet neighborhoods. The downtown area features small boutiques and shops, as well as the historic Woodward Opera House, an authentic 19th century theatre. The community offers several outdoor recreational opportunities. Ariel Foundation Park is a 252-acre property with trails and two ponds. Other neighborhood parks are located throughout the city as well as Heart of Ohio Trail and the Kokosing Gap Trail, a 14-mile paved recreational trail between Mount Vernon and Danville. Mount Vernon received the Best Hometown Award from *Ohio Magazine* for 2017-2018.

The city is bordered by Clinton Township to the west and southwest, Morris Township to the north, Monroe Township to the northeast and east, and Pleasant Township to the east and southeast. A small area of Miller Township borders the city on the south. The city limits have a jigsaw appearance in some areas due to annexation, which has resulted in several "doughnut

holes", which are areas of the city that surround non-annexed township land. Main roadways include West High Street and Coshocton Avenue (US Route 36), North Sandusky Street (State Route 13), Main Street, and East Gambier Street (State Route 229).

The Kokosing River meanders through the city east to west then turns north and runs along the west side of the city. The river serves as a dividing point between the north and south areas of the city. The Ohio Central Railroad operates a rail line from Newark north to Mount Vernon. The rail line provides car service to International Paper and the Central Ohio Farmers Co-Op grain facility. Farmers Co-Op averages one train weekly prior to and during harvest season. Figure 1 is a map of Mount Vernon.

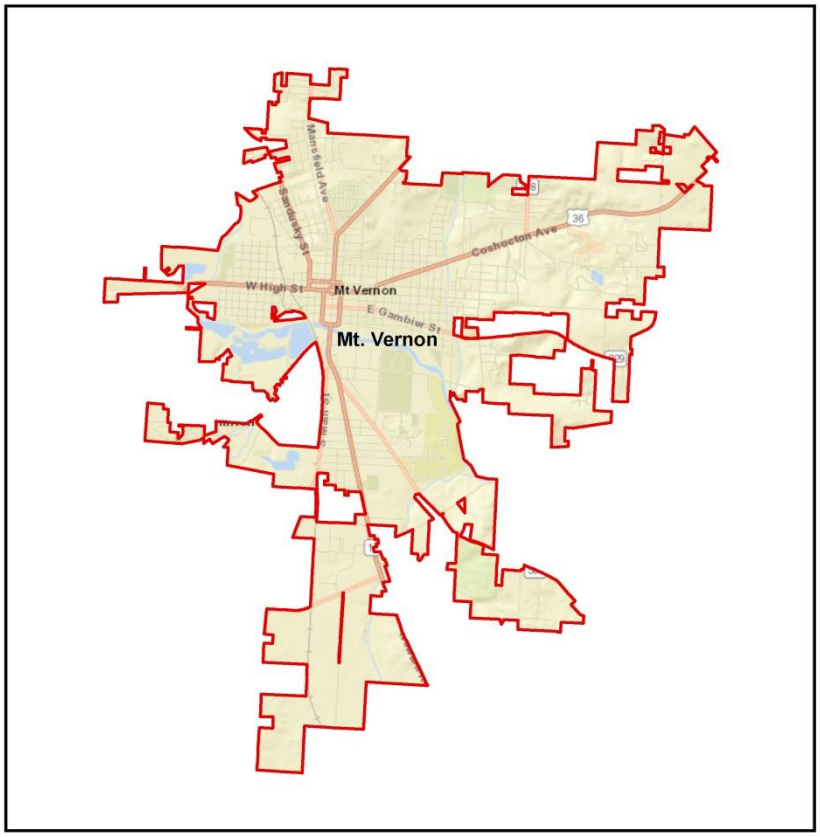

Figure 1

Governance

The city of Mount Vernon is a mayor-council form of government as outlined in the city's ordinances subject to the provisions of the Ohio Constitution. There are eight elected council members and an elected mayor. The law director and auditor are also elected positions. The mayor appoints a safety-service director, who assists in directing the various functions and operations of the city. There are 14 city departments and several boards and commissions.

Demographics

The city has a population estimated at 16,769. The population is 97.7% white, 1.7% African-American, and 1.2% Asian; other ethnicities makeup the other .6% of the population. Nineteen percent of the population is over 65 years of age and the median income is $41,098. There are 7,546 housing units in the city.[1]

Growth

The city experienced 8% population growth from 2000 to 2010. Since 2010, the population has increased 4%. The city has positioned itself to accommodate growth in designated areas. There are 90 acres planned for mixed-use (residential and business) development along Upper Gilchrist Road at the city's eastern corporation limit. A growth area has also been identified in the southeast area of the city along Harcourt Road.

The city has two tax increment financing (TIF) districts. One is located along Coshocton Avenue east of Sychar Road and generates approximately $1 million annually. A second TIF district has been established along Sandusky Street from the downtown area north to the city limits. Utilities have been extended into the township in this area. A city strategic plan is currently in development.

Mission and Vision

All organizations should have a mission statement. A carefully crafted mission statement describes an organization's purpose, function and services provided. This lays the foundation for the organization's direction and service goals. A mission statement often informs the vision statement, which describes where the organization aspires to be in the future. MVFD has a clearly developed mission and vision, along with defined core values that identify the organization's culture and belief system.

Mission

The Mount Vernon Fire Department is dedicated to protecting and serving our community with a commitment to professionalism and performance excellence.

Vision

Provide the best service to every customer.

[1] U.S. Census Estimate 2018-2019

Core Values

Team: ***A group of individuals striving to reach a common goal.***

Service: ***We protect and serve our entire community with a commitment to performance excellence.***

Professionalism: ***We take pride in our work; communicate effectively, project a positive image, and deliver service at the highest standards every time, in every situation.***

Integrity: ***We act ethically, honestly, and lead by example by having our actions reflect our word.***

Compassion: ***Demonstrate kindness and empathy.***

Leadership: ***Provide guidance and support throughout community and department.***

The department also has developed an internal strategic plan for 2020 through 2024.

Department History

MVFD began service to the community in 1849 as a volunteer organization with three hose companies. In 1891, the first paid firefighters were appointed to the department by city council. In 1914, two of the three hose companies were closed and the department responded out of the hose company building on North Gay Street. The department moved into a larger building on the northeast corner of the public square in 1918.

In 1965, the fire department moved into a former boathouse at 207 West Ohio Avenue, which was converted into a fire station. To meet the concerns of increased rail traffic, a second station was constructed in 1967 on Ames Street.

A major change in department operations occurred in the early 1980s when the department began providing emergency medical services (EMS). Prior to this time, EMS was delivered by the Life Support Team operating from the local hospital. The city built the current main station on West Gambier Street in 2000. In 2014, Station 2 on Ames Street was closed to consolidate resources and equipment in the newer and larger main station. MVFD has continued to expand and evolve to meet the needs of the community. Currently, the department serves the community with 42 full-time uniformed personnel.

Service Area

MVFD provides fire suppression response and EMS to all areas within the city corporation limits. The department also provides services to surrounding townships and special properties through contractual agreements. Fire suppression response and EMS are provided to all of Clinton Township, Liberty Township, and Pleasant Township, and approximately 35 % of Morris Township.

Pleasant Township has an area of 18 square miles and a population estimated at 1,653. Liberty Township has an area of 26 square miles and a population estimated at 1,765. Clinton Township has an area of just under 15 square miles and a population estimated at 1,767. The area serviced in Morris Township is approximately 7 square miles with a population estimated at 1,000. Fire suppression response and EMS service is also provided to the Mount Vernon Developmental Center, located north of the city in Morris Township and the Knox County Airport, located south of the city in Miller Township.

The contractual service area is mostly rural in nature with primarily light-density residential development and large areas of open spaces and farmland. There also are some light commercial and industrial properties. Figure 2 is a map of the city and surrounding service area.

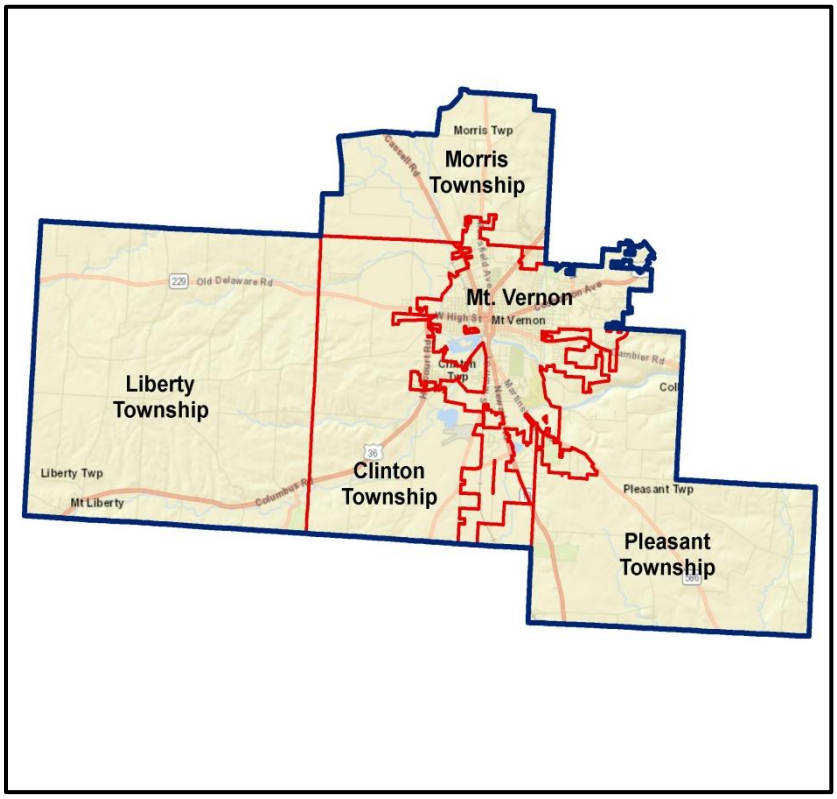

Figure 2

Service Demands

As stated previously, MVFD provides fire suppression response and EMS. The fire suppression response include responses to incidents that are non-fire such as carbon monoxide detector activation, a person stuck in a stalled elevator, gas or fuel leaks, or a rescue situation. The EMS is an advanced life support level (ALS) and transport model. ALS level is commonly referred to as paramedic level service. The department also provides a variety of community outreach and risk reduction services such as fire prevention, fire safety education and fire investigation.

MVFD has experienced a significant increase in calls for service over the past 10 years. In 2010, the department responded to 2,841 calls for service. By 2019, this number had increased to 5,275, which is an 86% increase. Note that a call for service is actually an incident count. If multiple companies respond to a fire, it counts as one incident or call for service. It should also be noted that service to Liberty Township began in 2017. The department's calls for service over the past 10 years are displayed graphically in Figure 3.

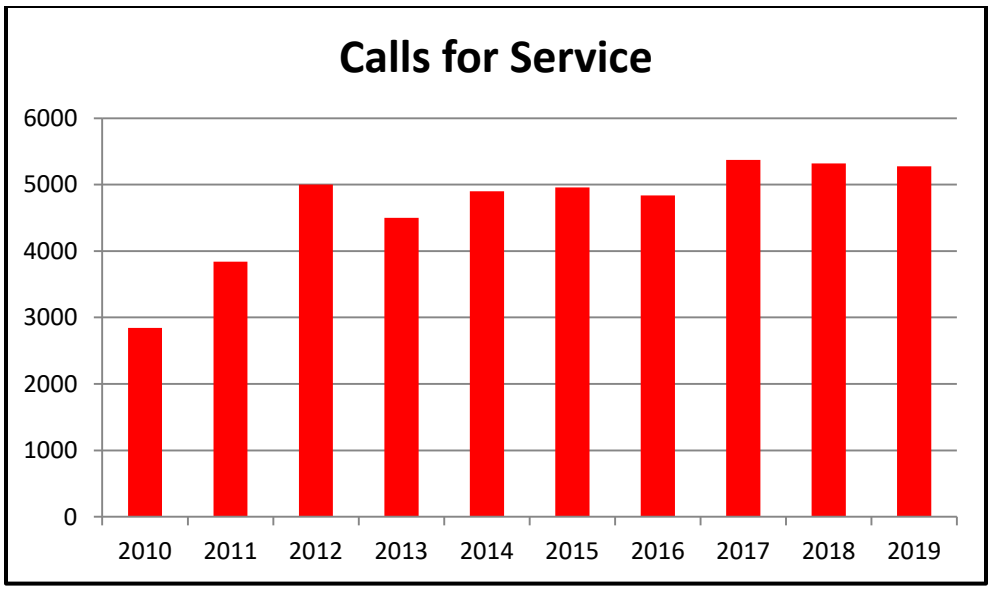

Figure 3

EMS responses increased 75% during this 10-year period. However, fire responses increased 149% over the same 10-year period. In addition to building and auto fires, this number includes fire alarms, rescues, carbon monoxide calls, service calls, and other non-EMS responses. EMS responses include motor vehicle accidents. Figure 4 shows a comparison of all fire and EMS responses over the past 10 years.

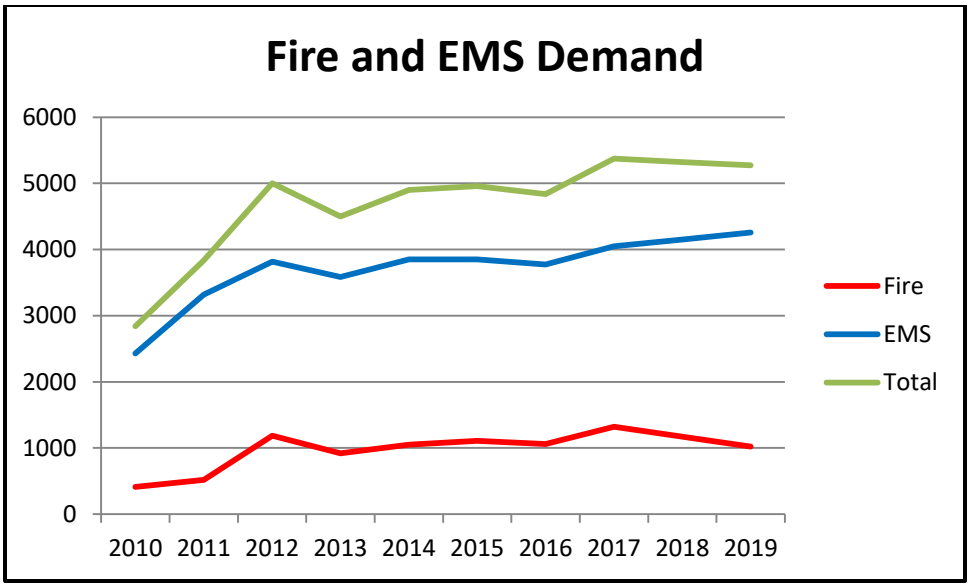

Figure 4

The contracted service areas add to the service demand on the department. The following tables in Figure 5 and 6 provide a breakdown of responses to the township and special property contract areas over the past five years. In the tables, MVDC refers to the Mount Vernon Developmental Center and MA is mutual-aid responses.

EMS Response

	Clinton	Morris	Pleasant	Liberty	MVDC	Airport	MA	City	Total
2015	345	125	99	NA	11	0	50	3,222	3,851
2016	352	137	81	NA	11	0	49	3,144	3,774
2017	419	132	102	77	10	0	43	3,267	4,050
2018	414	205	103	110	23	2	36	3,258	4,151
2019	320	168	87	111	29	0	23	3,517	4,255

Figure 5

Fire Response

	Clinton	Morris	Pleasant	Liberty	MVDC	Airport	MA	City	Total
2015	145	29	41	NA	4	3	15	871	1,108
2016	114	45	38	NA	9	0	46	810	1,062
2017	142	55	52	57	12	5	29	960	1,322
2018	134	41	41	46	15	1	55	837	1,170
2019	103	45	38	56	6	0	43	729	1,020

Figure 6

Of the total calls for service in 2019, 81% were in the city and 18% in the contracted areas. This is displayed graphically in Figure 7.

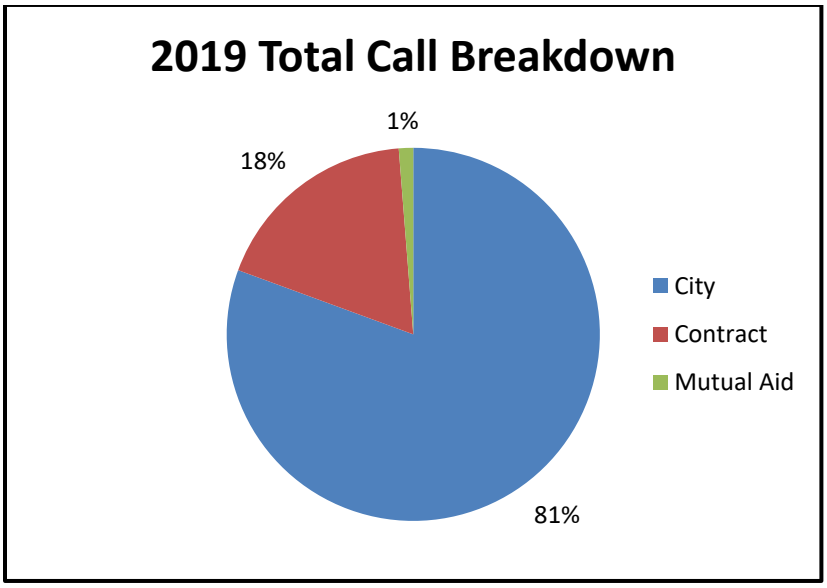

Figure 7

The recorded fire loss has fluctuated over the past five years. Fire loss is difficult to predict and one large-loss event can skew any statistical analysis. The fire loss was $423,495 in 2015 and $661,400 in 2018. In 2019, the recorded fire loss was $464,520. Residential occupancies account for most of the recorded fire loss (76%).

The department experienced three civilian fire fatalities over the past five years; one in 2017 and two in 2019. During the same period, there were six civilians injured as a result from exposure to fire by-products such as smoke or heat, or injuries received while attempting to escape from a fire.

Technical rescue is a term used to describe special response situations including confined space rescue, high-angle rope rescue, trench rescue, fast-water rescue, static-water and ice rescue, and hazardous materials response. Technical rescue incidents are referred to as high-risk, low-frequency events, which are dangerous to mitigate and involve a special set of skills, procedures and equipment for each particular rescue situation. It is often very costly to implement and maintain proficiency in each technical response capability. While a formal technical rescue assessment of the city was not performed, the department's response capability in each technical rescue response area was reviewed.

Fast-Water Rescue – these incidents involve the rescue of a victim(s) from fast moving water such as a river or other large stream. Of special concern are low-head dams, which can create dangerous currents, especially when river water levels are elevated or during flood stage. The

Kokosing River and other creeks run through the city but there are no low-head dams within the response area. The department has some rescue equipment for this type of response and two personnel are trained to the technician level.

Static-Water and Ice Rescue – these incidents involve the rescue of a victim(s) from a non-moving body of water such as ponds, quarries or lakes. During winter, these types of incidents could involve surface ice. Each rescue involves a specific set of equipment and operating procedures. There are two dive teams in Knox County that can provide assistance if an incident occurs within MVFD's service area.

Confined Space Rescue – includes incidents in which a victim(s) are trapped within an area that qualifies as a confined space. A confined space may be found in agricultural, industrial and other settings as defined by the Occupational Safety and Health Administration (OSHA). The department does not have any equipment or training for this type of response.

Rope Rescue – includes incidents that are above grade (elevated) or below grade and require the use of rope rescue systems to reach and rescue victims. A rope rescue incident could be part of a confined space incident due to the location of the victim. The department does not have any equipment or training for this type of response.

Trench Rescue – these incidents are also referred to as trench "cave-in" incidents and involve an excavation trench or underground cave-in that traps a victim. The department does not have any equipment or training for this type of response.

Hazardous Materials – All MVFD personnel are trained in hazardous materials response at the operations level. Operations level-trained personnel have the training and equipment to identify hazardous material presence through various recognition factors such as placards and labels, container shapes and sizes, and hazardous materials sites in the response area. They also have the ability and equipment to undertake defensive type of actions and low-risk offensive operations such as placement of booms and absorbent pads, plugging, patching, diking, and other containment actions that help control or mitigate the incident. More advanced offensive operations that require the use of level "A" (completely encapsulated protective equipment) or acid splash suits require a technician level response. The department has some containment and spill equipment along with an operating procedure for a hazardous material response.

Insurance Services Office

The Insurance Services Office, Inc. (ISO) is the leading supplier of statistical, underwriting and actuarial information for the property and casualty insurance industry. ISO conducts field evaluations in an effort to rate communities and their relative ability to provide fire protection

and mitigate fire risk. This evaluation allows ISO to determine and publish the Public Protection Classification (PPC). The published classification is based on a scale of 1 through 10, with 1 being the highest rating and 10 indicating that the community's fire suppression program does not meet ISO's minimum criteria.

Mount Vernon currently has a PPC rating of 04/4Y, which was published in June of 2017. The lower score indicates a more favorable rating, which translates into lower insurance premiums for the business owner and homeowner. This lower classification makes the community more attractive from an insurance risk perspective.

How the PPC for each community affects business and homeowners can be somewhat complicated because each insurance underwriter is free to utilize the information as they deem appropriate. Most underwriters in Ohio utilize what is called in the industry, the "suburban rule." In this case, the split rating identified for MVFD is a 04/4Y. What this means is that most businesses and residents in the city who are located within 1,000 feet (ft.) of a fire hydrant and not over five road miles from the fire station receive a rating of 4. Those businesses and residents who are located more than 1,000 ft. from a fire hydrant but not over five road miles from the fire station receive a rating of 4Y. The reason that the latter rating is generally not more favorable is due to the lack of a dependable water supply in the areas previously identified. When the ISO field evaluation is conducted on communities, the overall water system carries a weight of 40% of the total evaluation. Most underwriters consider properties located over five miles from a recognized fire station to receive a 10 PPC, and would be subject to higher premium rates for coverage.

The PPC program evaluates communities according to a uniform set of criteria defined in the *Fire Suppression Rating Schedule*. Using the rating schedule, ISO evaluates the fire suppression capabilities of each community in three major areas:

- Emergency Communications. This review accounts for 10% of the total classification. This section reviews the facilities provided for the general public to report fires, the number of operator(s) on duty at the communication center to dispatch fire department companies to fires, and the computer-aided dispatch (CAD) system with geographic information system (GIS) integration. Mount Vernon received 5.70 points credit out of a total maximum credit of 10.

- Fire Department. This review accounts for 50% of the total classification and focuses upon engine and ladder-service companies, distribution of fire stations and fire companies, equipment carried on apparatus, pumping capacity, training, and available firefighters. Mount Vernon received 25.53 points credit out of a total maximum credit of 50.00. This included 4.40 points credit out of a possible 10 points for deployment, 5.55 points credit out of a possible 15 points for on-duty company personnel, and 3.80 points credit out of a possible 9 points for training.

- Water Supply System. This review accounts for 40% of the total classification. This component examines the water supply a community uses for fire suppression including water main size, distribution and storage system. Also reviewed are hydrant size, type, and installation as well as the inspection frequency, maintenance, and condition of fire hydrants. Mount Vernon received 30.97 points credit out of a total maximum credit of 40.00.

An additional factor now evaluated is the Community Risk Reduction section in which fire prevention, fire safety education and fire investigations are evaluated. The inclusion of this in the evaluation process provides recognition for those communities that employ effective fire prevention practices and allows for extra points in the grading process. Mount Vernon benefited directly from this inclusion earning 4.85 additional evaluation points that moved the city's rating from what would had been a 5 to a 4.

The notification letter and summary report from ISO advised the city's PPC should serve as part of any planning document for future city development and fire safety protection improvement considerations as it relates to city residents.

Staffing

MVFD is a full-time career department with an authorized strength of 42 uniform personnel. The current department roster includes the fire chief, three captains, three lieutenants, a fire prevention officer and 33 firefighters. In addition to the fire chief, staff positions include an EMS coordinator/training lieutenant, and fire prevention officer. These three positions work a standard 40-hour workweek. There also is an executive assistant.

Shift personnel work a standard three-platoon system with what is referred to as a 48-hour workweek. With this type of schedule, personnel on each of the three shifts work 24 hours on duty followed by 48 hours off duty. Personnel receive one extra 24-hour shift off during a 21-day work cycle, which is called a Kelly Day.

There are 13 personnel assigned to each of three shifts. Each shift has a captain, lieutenant and 11 firefighters. The minimum daily staffing is nine. If a short-shift occurs due to an injury or illness, the vacancy is filled with off-duty personnel who receive overtime pay. In 2019, the department was at minimum staffing 65% of the time. An organizational chart of the department is depicted in Figure 8.

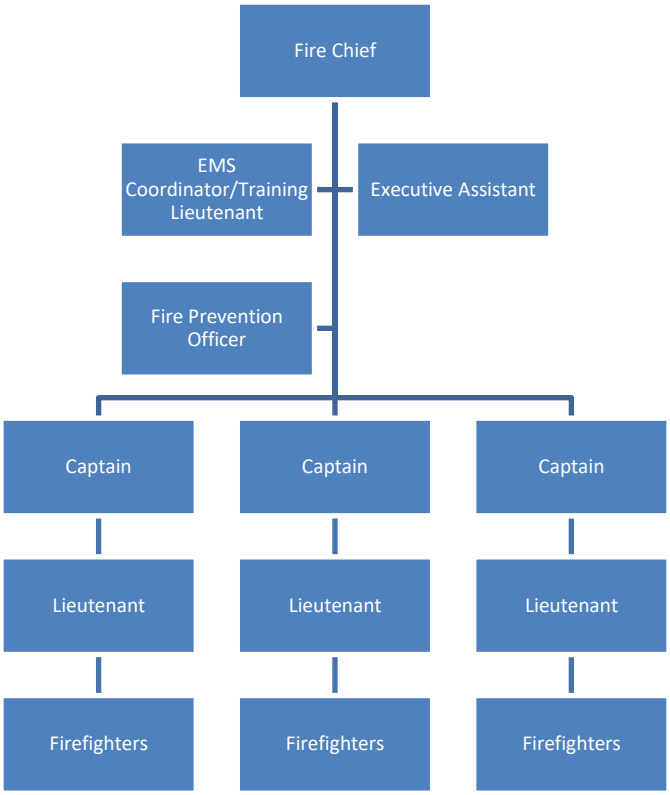

Figure 8

Funding

The city of Mount Vernon has a 2% income tax. The base 1% income tax helps fund the city's general fund, which funds basic services and overall support of city operations. There also is an additional 1% income tax for public safety. This revenue is shared between police and fire department operations. This public safety tax was previously at .5% and was increased to a total 1% in 2018 by the voters. The public safety tax supports the fire department operating budget. The department also bills for EMS calls that result in the transportation of a patient to the hospital. Revenue generated has averaged $850,000 annually over the past three years. The department's operating budget for 2020 is $5 million, excluding any capital purchases.

As noted previously, the fire department provides services to surrounding townships and special properties through contractual agreements. The annual fee collected from these contracts is estimated between $800,000 and $825,000 in 2020. The contracts with the townships are based on millage of varying amounts, so the revenue collected will depend on the tax evaluation and the amount of revenue actually collected by the county. The exception is the contract for service for the Mount Vernon Developmental Center. This contract is a fixed amount and the contract to service the Knox County Airport is a nominal one dollar per year agreement. Revenue from the contracts is deposited into the city's general fund. The estimated annual contract fees for 2020 from each contract are as follows:

- Clinton Township $310,000
- Morris Township $133,298
- Liberty Township $217,888
- Pleasant Township $122,958
- Mount Vernon Developmental Center $ 16,578

Risk Assessment

For a community to appropriately provide for and understand the need for emergency services, a coordinated and comprehensive assessment must be performed. The risk assessment involved performing a coordinated survey of every "target hazard" property in the response area. Target hazards are locally identified occupancies or properties that pose specific risks to occupants, fire service responders, or the community. This includes any large manufacturing or commercial property that typically requires a larger number of resources than is normally deployed for residential and other common types of occupancies. Target hazards also would include buildings of public assembly, schools, hospitals, nursing homes, and apartment buildings of 12 units or more.

The community risk assessment (CRA) tool was used to perform a coordinated survey of every identified target hazard. Each property was assessed for the risk posed for each of the following elements:

- Life hazard
- Community impact
- Hazard index
- Water supply
- Building usage
- Building construction
- Number of stories
- Square footage

Each of the areas described received a rating score from 1 to 3 with 1 equating to low risk or impact and 3 representing high risk or high impact. Each address was provided with a final rating from 0-9 for the lowest risk properties to 21-24 for the highest risk (based on the eight rated categories). The following levels of identified risk were classified:

Risk	CRA Score
Maximum	21-24
Significant	16-20
Moderate	10-15
Low	0-9

The risk assessment covered 188 target hazards in the city and township service area. Of the total properties analyzed, 46 city properties rated a significant risk; there were no maximum risk properties. Each property identified as a significant risk was plotted on a map displayed in Figure 9, which allows for visualization of where the "at risk" properties are located within the city.

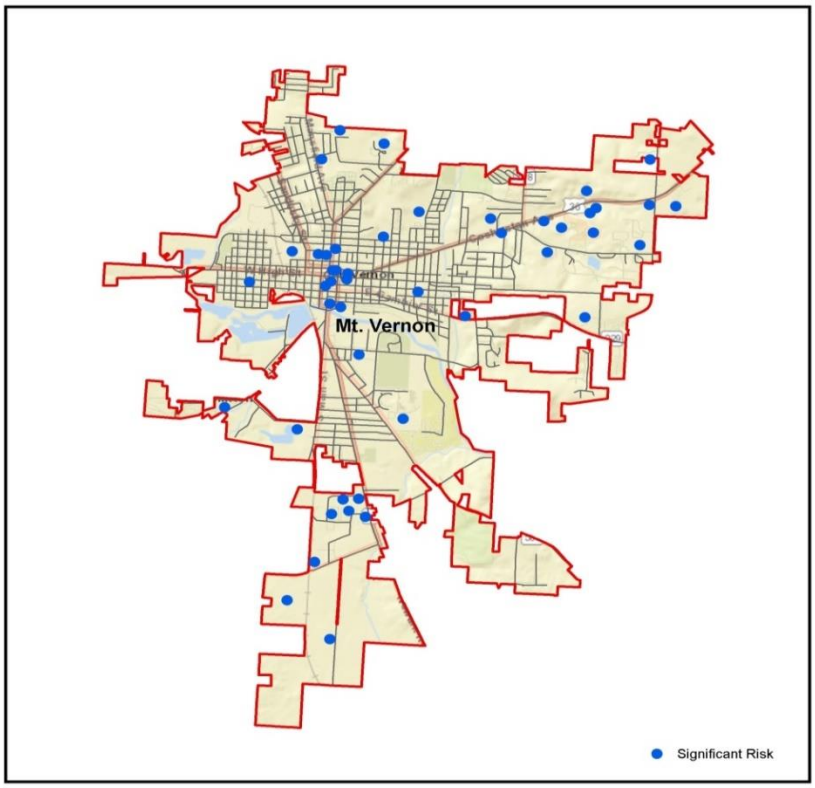

Figure 9

In Mount Vernon, the department faces typical occupancies normally found in a community of this size. However, the city has a large downtown area that contains numerous multi-story buildings, mixed-use occupancies and small commercial occupancies. Many of these properties individually would pose a moderate risk. However, with the age of the buildings and features of what is classified as "ordinary construction" methods, any fire gaining headway in one these buildings could endanger numerous adjacent structures.

There are eight nursing home and assisted living facilities in the city:

- The Ohio Eastern Star Home is a multi-building complex located at 1451 Gambier Road. It has an 86-bed skilled nursing facility, assisted living, and rehabilitation unit.
- The Country Court Skilled Nursing Center is a 92-bed skilled nursing facility located at 1076 Coshocton Avenue.
- The Mount Vernon Health and Rehab Center is located at 1135 East Gambier Street. It

has a 44-bed skilled nursing facility and rehabilitation unit in two buildings.

- The Country Club Rehabilitation Campus is located at 1350 Yauger Road. It has a 76-bed skilled nursing facility, assisted living facility, and rehabilitation and continuing care unit.
- Brookdale Mount Vernon is a 95-unit assisted living facility located at 1615 Yauger Road. It also has a memory care unit.
- Whispering Hills Care Center is a 44-bed skilled nursing and rehabilitation center located at 416 Wooster Road.
- The Living Center is a 41-bed assisted living center located at 201 North Main Street.

All of the facilities have automatic fire protection sprinkler and monitored alarm systems. There is an 81-bed nursing facility currently under construction. EMS demand is also higher in nursing, assisted living, rehabilitation, and retirement facilities.

There are 17 apartment buildings in the city. Many have multiple buildings and their configuration pose accessibility challenges for responding fire apparatus. While many have smoke detectors, none is equipped with automatic fire protection sprinkler or standpipe systems.

4-unit apartment in multi-building complex

Larger 3-story apartment building

The Mount Vernon Nazarene University is located in the southeastern part of the city along Martinsburg Road. This 346-acre campus features 15 classroom and residence buildings that serve an average enrollment of 1,600. The residence buildings have smoke detection and manual alarm systems, but no automatic fire protection sprinkler or standpipe systems.

Mount Vernon Nazarene University Campus Entrance

The Mount Vernon City School District has six school facilities in Mount Vernon: East Elementary, Pleasant Street Elementary, Wiggin Street Elementary, Dan Emmet Elementary, and the Mount Vernon Middle and High Schools. Mount Vernon St. Vincent de Paul School, a parochial K-8 school is also located in the city, along with the Knox County Career Center. Columbia Elementary School and Twin Oak Elementary School are part of the Mount Vernon City School system but their buildings are located in the MVFD's township service area. The Seventh Day Adventist School is also located in the township service area. Although identified as significant risk properties, schools always pose a special challenge due to their size and number of occupants. There are 14 churches of various size located in the city and 21 churches in the township service area.

Non-fire Risk Assessment Process

This section normally contains an analysis of the various non-fire related risks considered within the city. This would include non-fire risks such as flood, tornado, earthquake, drought, etc. Due to the limited scope of the project, this area was not included in the risk analysis.

Fire Station Facility

MVFD operates out of one station located at 200 West Gambier Street. This location appears to offer adequate access to main thoroughfares and is convenient for city residents. The station is in good condition and appears well maintained. The station has an automatic fire protection sprinkler system and has carbon monoxide detectors on all floors.

The fire station was constructed in 2000 and has 18,900 square (sq.) ft. of space. The first floor has 13,800 sq. ft. and the second floor has 5,100 sq. ft. The station has a unique design that features three drive-through apparatus bays on each side of the administrative offices. Living quarters are located on the second floor above the administrative offices in the center of the station. This area has a kitchen with commercial-grade appliances and hood fire-suppression system. The second floor also has individual dormitory rooms, as well as unisex restrooms and locker rooms. Slides are used in lieu of fire poles for personnel to travel from the second floor to the apparatus bays for an emergency response. There appears to be adequate office space for the department administration and living quarters for on-duty personnel. The department's training room can accommodate one shift or the entire department, and has appropriate audio-visual equipment. A decontamination area is located off the apparatus floor with a makeshift shower area.

The facility has a permanently installed 3-phase 180 kW diesel-fueled emergency generator located inside the front of the station in a specially constructed room. The generator's exhaust is vented to the exterior of the building. It is equipped with an automatic transfer switch that enables the generator to start and transfer building circuits to the generator anytime normal

power is lost. The generator can power the entire building.

Apparatus diesel exhaust is removed from the apparatus bay by exhaust fans located in each corner of the apparatus floors, which are activated when sensors detect carbon monoxide. The exhaust system intakes are floor level and above the apparatus. Diesel exhaust can also be removed by a manually operated ceiling exhaust fan. The apparatus bay areas are heated by ceiling-mounted radiant heating systems. A turnout gear washer and an extractor are located in a separate area off the apparatus floor. Future plans are to isolate the turnout gear storage area from the apparatus floor to prevent exposure to vapors and exhaust fumes.

The two front ramp areas are 85 ft. in length and allow apparatus to sit on the ramp without obstructing traffic. There is a clear line of sight in both directions, giving apparatus operators ample time to observe approaching vehicles while enabling the motoring public to observe emergency vehicles exiting the station.

Front of Station 1 – east side

Front of Station 1 – west side

Apparatus and Equipment

The department operates three engines, one aerial ladder platform, three medic (ambulance) units, a grass truck, two command and three staff vehicles. Overall, the impression of the department's fleet and equipment is that it is well maintained and of the appropriate size and design for the intended purpose. The maintenance records and equipment inventory were reviewed by the assessment team during the site visit. The following is a summary description of each apparatus and condition.

Engine 491 is a 2011 Sutphen pumper with a 1,500 gallons-per-minute (GPM) pump and carries 1,000 gallons of water. This unit is equipped with the necessary hose and equipment as required by NFPA 1901 *Standard on Automotive Fire Apparatus*. This unit carries a portable hydraulic rescue tool and other associated equipment used for auto extrication and other rescue situations. The unit also has advanced life support EMS equipment and supplies including an automated external defibrillator (AED). It has 32,319 miles and is in good condition.

Engine 492 is a 2006 Sutphen pumper with a 1,500 GPM pump and carries 1,000 gallons of water. This vehicle is equipped with the necessary hose and equipment as required by NFPA 1901. The unit carries basic EMS equipment including an AED. It has 70,680 miles and is in good condition.

Engine 493 is a 2000 Pierce 1,500 GPM pumper and carries 1,000 gallons of water. The vehicle is equipped with the necessary hose and equipment as required by NFPA 1901. The unit carries basic EMS equipment including an AED as well as a hydraulic rescue tool. This is a reserve engine and is in good condition. It does not have a working odometer but has 4,567 engine hours.

Ladder 491 is a 2018 Rosenbauer 75 ft. aerial platform with a 2,000 GPM pump and carries 300 gallons of water. This unit carries the necessary hose, ground ladders and equipment required by NFPA 1901. It also features a 4,500 psi breathing air system that supplies the platform and dual master stream nozzles mounted on the platform. The vehicle has 4,111 miles and is in excellent condition.

The department operates three Type I EMS units all on Ford 450 chassis. EMS units are designated as first out, second out and third out. Each month the units are rotated to a different designation to equalize mileage. The EMS units also rotate identifying numbers (491, 492, 493) when their designation is changed. Each unit is designated as F15, F16, and F19 based on their purchase year (i.e., F19 was purchased in 2019) for inventory purposes.

Each unit is equipped to deliver ALS level care and transport service, including a cardiac monitor/defibrillator and a patient power-load system. The ALS support equipment and supplies are meticulously stored in the same location and cabinets to help with familiarity when the units are rotated. F15 is a 2015 Wheeled Coach with 67,078 miles and is in good condition. F16 is a 2016 Wheeled Coach with 53,435 miles and is in good condition. F19 is a 2019 McCoy-Miller with 6,136 miles and is in very good condition.

Grass 491 is a 2009 Dodge pick-up truck with a skid-load pump and 200-gallon water tank. It carries brush firefighting equipment. It is configured for a snowplow attachment and is also used to pull utility trailers. It has 22,076 miles and is in good condition.

Chief 491 is a 2010 Ford Explorer sport-utility vehicle (SUV) utilized as the chief's vehicle and command vehicle. It carries basic equipment and supplies for incident management and support, including an accountability board. It has 43,386 miles and is in excellent condition.

Captain 491 is a 2019 Chevrolet Tahoe SUV utilized by the shift commander as a command vehicle. It carries basic life support (BLS) EMS equipment, AED and hazardous materials testing and monitoring equipment. It also carries basic equipment and supplies for incident management and support. It has 3,000 miles and is in excellent condition.

The department also has three staff vehicles. Those include cars for the fire prevention officer, EMS car, and a car used for personnel attending out of town training classes. The department also has a John Deere 4-seat "Gator" utility vehicle. It carries a variety of equipment and used for responses in the park system and other off-road situations.

Response Considerations

In fire suppression as well as EMS, there are a number of recognized safety and response standards and guidelines that are considered when analyzing fire protection services. NFPA 1500 *Standard on Fire Department Occupational Safety and Health* is the safety standard for the fire service and deals with all aspects of fire department operational safety. Major components of the standard include personnel, apparatus, equipment, and incident management. The topics have general performance objectives, but the specific topic is generally more formally addressed in its own specific standard. Appendix B in NFPA 1500 contains a checklist that can be useful for departments to evaluate their overall safety and health program. While NFPA 1500 is non-binding, the Ohio Administrative Code (OAC) specifically addresses many similar aspects of firefighting and firefighting equipment.

OSHA in recent years established a national standard for fire ground staffing. Although the directive is very detailed, it essentially states that before two properly trained and equipped firefighters can enter a structural fire there must be at least two or more properly trained and equipped firefighters ready to replace, rescue or assist the initial entry firefighters (29 CFR 1910.134 [g][4]). This standard is often referred to as the "2-in, 2-out" rule. This rule also is listed in §4123:1-2 OAC, which applies to firefighting operations in Ohio.

NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments*, states that fire suppression companies should be staffed with four personnel, with one of them being a supervisor. This staffing standard is based on fireground evolution studies and task analyses for a response to a 2,000 sq. ft. two-story single-family dwelling fire, commonly found in communities across America. NFPA 1710 is non-binding, but the staffing recommendation is

considered an ideal or optimal staffing goal for communities. However, few communities across Ohio are able to achieve this staffing goal due to financial limitations.

NFPA 1561 *Standard on Emergency Service Incident Management System* also has some relevance. It states that an effective span of control shall be determined by the ability of each supervisory position to monitor the activities of assigned subordinates. Span of control is a term to describe the number of workers that a supervisor can effectively manage. The range of span of control is considered to be three to seven, with an optimum of five. However, span of control is determined by the degree of complexity or danger of the task or activity. For example, a serious auto accident involving a difficult extrication procedure may require a span of control of three, while an officer may be able to effectively manage 10 water tenders (tankers) operating in a water shuttle at a rural fire.

Another critical factor in meeting service expectations is assuring that response crews are capable of performing the required tasks on arrival. The dispatching of a specific response with a minimum crew assignment is a concept that is widely supported by fire service literature and industry best practices. The NFPA's *Fire Protection Handbook* provides recommendations for a minimum response to various structures. Figure 10 depicts those recommendations.

High-hazard occupancies Schools, hospitals, nursing homes, explosives plants, refineries, high-rise buildings, and other high life hazard or large fire potential occupancies.	At least 4 pumpers, 2 ladder trucks (or combination apparatus with equivalent capabilities), 2 chief officers, and other specialized apparatus as may be needed to cope with the combustible involved, not fewer than 24 fire fighters and 2 chief officers. One or more safety officers and a rapid intervention team(s) are also necessary.
Medium-hazard occupancies Apartments, offices, mercantile and industrial occupancies not normally requiring extensive rescue or fire-fighting forces.	At least 3 pumpers, 1 ladder truck (or combination apparatus with equivalent capabilities), 1 chief officer, and other specialized apparatus as may be needed or available; not fewer than 15 fire fighters and 1 chief officer, plus a safety officer and a rapid intervention team.
Low-hazard occupancies One-, two-, or three-family dwellings and scattered small businesses and industrial occupancies.	At least 2 pumpers, 1 ladder truck (or combination apparatus with equivalent capabilities), 1 chief officer, and other specialized apparatus as may be needed or available; not fewer than 14 fire fighters and 1 chief officer, plus a safety officer and a rapid intervention team.
Rural operations Scattered dwellings, small businesses, and farm buildings.	At least 1 pumper with a large water tank (500 gal or more), one mobile water supply apparatus (1,000 gal or larger), and such other specialized apparatus as may be necessary to perform effective initial fire-fighting operations; at least 12 fire fighters and 1 chief officer, plus a safety officer and a rapid intervention team.
Additional alarms	At least the equivalent of that required for rural operations for second alarms. This may involve the immediate use of mutual-aid companies until local forces can be supplemented with additional off-duty personnel.

Figure 10

MVFD has developed response guidelines, which identifies the apparatus response for basic run types. The response guidelines outlined in the department's operating procedures are listed below.

Motor Vehicle Accident

- Medic
- Engine with rescue equipment

Fire Alarms

Fire alarms are classified as either a fire alarm or smoke alarm activation, or the report of a fire

or working fire. The response is further classified as either a residential or a commercial fire alarm.

Fire or Smoke Alarm

Residential

- Command vehicle
- 2 Engines or 1 Engine and 1 Ladder

Commercial

- Command vehicle
- 2 Engines or 1 Engine and 1 Ladder

Report of a fire or working fire

Residential

- 5 Engines or 4 Engines and 1 Ladder (3 Engines will be from mutual-aid departments); response to be determined by officer-in-charge
- 2 Medics (1 Medic will be from mutual-aid department)
- Tanker from mutual-aid department will respond to areas without hydrants
- Command Vehicle

Commercial

- 5 Engines or 4 Engines and 1 Ladder (3 Engines will be from mutual-aid departments); response to be determined by officer-in-charge
- 2 Medics (1 Medic will be from mutual-aid department)
- Command Vehicle
- Tanker from mutual-aid department will respond to areas without hydrant

The number of personnel responding in a specific apparatus may vary depending on the number of personnel on duty. There are 13 personnel assigned to each shift with a nine-person minimum. Personnel may also be unavailable to respond if they are committed to an emergency incident. For example, with nine personnel on duty, two personnel could be on an EMS call and transporting a patient to the hospital. If a fire call were received, there would only be seven personnel available to respond. In these incidences, the shift commander will determine which units would respond to the call.

The department has established response sectors for mutual aid. This is referred to as a mutual-aid box alarm system (MABAS). These predetermined responses are based on geographic location and allows assistance to be received more quickly. The city has four response zones, which extend into the adjacent township service areas. However, Liberty Township has two response zones, north and south of New Delaware Road. MVFD is part of the Knox County mutual-aid agreement.

Using the MABAS framework, the department has established automatic mutual-aid response (AMR) procedures for structure fire responses in the city and township area. This was previously identified with the response guidelines on pages 22-23. As noted, township responses include a tanker from a mutual-aid department to provide additional water in non-hydranted areas. Getting additional equipment and personnel on the incident scene more quickly helps the department achieve operational benchmarks in a more timely and effective manner, and results in a more positive outcome for the citizens.

The department has a very detailed operating procedure that identifies specific tasks and tools for each riding position on the apparatus. These are commonly referred to as riding assignments.

Response Performance

Response goals are a local decision and are based on a variety of factors. Some of those factors include demographics and size of the response area, risk, demand volume, and public expectation. In reviewing the department's current policy and procedures, there has been no formal policy adopted that identifies response performance goals or targets for the community. Since there is no local response performance goal established, the assessment team reviewed other nationally developed criteria. A number of efforts have been made to develop a consensus standard for response time, unit staffing and deployment of resources. While there is no single consensus standard, several provide guidance.

ISO provides some guidelines, but those are singularly focused on travel distance. Two national publications address response performance. NFPA 1710 (described briefly on page 20) addresses functions and objectives of fire department emergency service delivery, response capabilities, and resources.

Based on NFPA 1710 criteria, MVFD should meet the following response time objective: for 90% of all fire incidents, the first-due unit shall arrive within 7 minutes, 06 seconds total response time. This response objective includes 106 seconds (1:46) for call processing, 80 seconds (1:20) for turnout, and 240 seconds (4:00) for travel time. This response objective begins when the 9-1-1 call is received at the communications center.

The second published criteria are found in the *Standards of Cover*, published by the Commission on Fire Accreditation International (CFAI), which is part of the Center for Public Safety Excellence. CFAI criterion refers to the NFPA 1710 standard for communities that have personnel on-station, regardless if the personnel are full-time or part-time, or the community is suburban or urban in nature. It is important to note however, that communities should establish their own response objectives that meet the expectations of its citizens within the context of available resources.

The published response criteria are based on national fire behavior research and data collected on past EMS response in relationship to patient outcomes. This research and other information are described in Appendix B.

Total Response Time Measurement

The concept of a response time continuum (sometimes referred to as cascade of events) has evolved from the standards established by NFPA and CFAI. The department compiles response data but a total response time continuum and its effect on the services MVFD provides had not been previously evaluated or analyzed. Each component of the total fire response-time continuum was reviewed.

Call Processing Time

Call processing time is a component of the communication system. MVFD is dispatched by the Knox County 9-1-1 Communications Center, which is operated by and under the direct supervision of the Knox County Commissioners. The communications center provides dispatching services for four law enforcement and 10 fire department agencies. The communications center utilizes a Zuercher Technologies™ CAD software system. A CAD system provides displays and tools that enable the dispatcher to handle calls for service as efficiently as possible.

Determining an acceptable amount of time to process an emergency call can be difficult because communication center systems vary from jurisdiction to jurisdiction. NFPA 1221 *Standard on Emergency Services Communications Systems* establishes various benchmarks for call handling depending on the system, type of call and level of caller assistance provided. For example, Knox County 9-1-1 dispatchers are trained in Emergency Medical Dispatch (EMD), which is an enhanced service to the public. EMD is where a properly trained dispatcher can provide medical assistance instructions to a 9-1-1 caller who is requesting emergency help. Examples would be bleeding control, emergency breathing and cardiopulmonary resuscitation (CPR) instructions. With this enhanced level of service, EMS call processing and dispatching shall be completed within 120 seconds (2:00 minutes) 99% of the time. For fire calls, emergency call processing and dispatching shall be completed within 106 seconds (1:46) for at least 95% of the alarms. This call processing criteria is adopted by CFAI and included in the criteria listed in NFPA 1710. The total call handling time is measured from the time the 9-1-1 call is received to the time the emergency response agency is “toned out” for the call.

Turnout Time

Turnout time is measured from the time personnel are “toned out” or notified for an emergency response to the time the first unit is en route to the call. Turnout time is a measurement used for personnel who are “in-station”. The turnout time benchmark is 60 seconds (1:00) for EMS calls and 80 seconds (1:20) for fire responses.

Travel time

Travel time is the time it takes for dispatched response units to arrive on scene at the emergency. Travel time is generally considered to encompass the distance and time traveled from the fire station housing the apparatus until it arrives on scene at the location of the emergency. However, several factors can affect travel time. Winter weather conditions as well as localized flooding can affect travel time during certain times of the year. Traffic patterns on heavily traveled roadways, especially during peak travel hours can affect the emergency response. Another problem that can increase travel time and ultimately responder response time is receiving multiple calls for services. When simultaneous emergencies occur and adequate resources are not available to respond, a condition occurs that is referred to as a "stacking effect." A component to the stacking effect is that at times units may need to respond from mutual aid departments in an effort to provide the quickest and most reliable response to the incident. . Clearly, this would lengthen the travel time of the response unit because of the unavailability of the MVFD units. The travel time benchmark is 240 seconds (4:00).

Total Response Time

Total response time (sometimes referred to as total reflex time) is that time which totally encompasses the response event, from the time the call for service is initially received through the time dispatched units arrive on location. If the call handling time previously identified is taken into consideration, the total reflex time for fire emergencies should be 7 minutes, 06 seconds for 90% of the incidents.

EMS Response Time

Time requirements for EMS calls are comparable to fire incidents and are based on research conducted on pre-hospital delivery of medical care and patient outcome and survivability. The purpose of a quick response, especially in the most critical situation (cardiac arrest) is that the brain, deprived of oxygen and circulation, begins to die within four to six minutes. Interventions include early CPR and electrical defibrillation.

For medical emergencies, a prompt response is needed to relieve suffering and save lives, but few calls for service are true life or death emergencies. Again, a reasonable service goal is to be on scene soon enough to: 1) assess patients and prioritize to prevent death and disability; 2) intervene successfully in life-threatening emergencies; and 3) stabilize patients to prevent additional suffering. The travel time benchmark is 4 minutes and the total response time is 7 minutes, 0 seconds for 90% of the incidents.

Data Analysis

Data generated during the reporting period of January 1, 2018 through December 31, 2019 was analyzed to determine actual response performance. The data set included fire responses and

EMS responses coded as an emergency response. Responses that were coded as non-emergency responses (no lights and sirens) were not included in the analysis. False alarm responses where the responding units were cancelled before arrival were also excluded from the data set.
It is common for many organizations to use average response times in determining response performance. However, the use of averages and median measurements does not provide a true indication of performance. One or two "outliers" may adversely affect the response analysis, leading management and citizens to an inaccurate and at times, unfair service expectation. It is understood that no agency can meet a stated performance 100% of the time. Many factors can influence an agency's response including multiple calls, apparatus deployment, training assignments, traffic patterns, weather, human performance and travel distance. Therefore, the NFPA and CFAI have recognized the use of percentiles as the most accurate method to analyze and evaluate response performance.

The tables in Figure 11 and 12 show the department's response performance for all fire and EMS responses in the city in 2018 and 2019. The percentage column identifies the frequency the department met the target-time benchmark. The 90th percentile column identifies the department's actual segment or response time for 90% of the responses. For fire responses, the target-time benchmark is 95% for call handling and 90% for turnout time, travel time, and overall response time. Meeting the benchmark for at least 70% of the responses is often considered the baseline or threshold measurement.

City Fire Responses

ELEMENT	TARGET	PERCENTAGE	90th PERCENTILE
Call processing time	1:46	90%	2:00*
Turnout time	1:20	74%	2:12
Travel time	4:00	66%	6:07
Total response time	7:06	84%	8:00

*95th percentile

Figure 11

For EMS responses, the target-time benchmark is 99% for call handling and 90% for turnout time, travel time, and overall response time. Meeting the target-time benchmark for at least 70% of the responses is often considered the baseline or threshold measurement.

City EMS Responses

ELEMENT	TARGET	PERCENTAGE	90th PERCENTILE
Call processing time	2:00	98%	3:00*
Turnout time	1:00	76%	1:54
Travel time	4:00	56%	5:56
Total response time	7:00	88%	7:24

*99th percentile

Figure 12

The travel times for city fire responses are just below the 70% threshold and significantly below the 90% target. While the travel time was expected, the total response time was somewhat surprising. However, a closer examination showed the call-received time was the same as the dispatch time for 84% of the fire responses analyzed. This brings into question the accuracy of some of the response data provided. The department is meeting the turnout time of 1:20 74% of the time.

The travel and total response times for EMS responses show a similar result. The target travel time of 4:00 for city EMS responses was met 56% of the time, which indicates a performance gap. However, the total response target of 7:00 was met 88% of the time, which is just shy of the 90% target. The call-received time was the same as the dispatch time for 88% of the EMS responses analyzed.

The department has divided the city into three response districts for record keeping and management purposes:

District 1 – is an area that includes a majority of the city north of the Kokosing River. Starting at an area east of the city limits, the southern border of the district runs north of Lower Gambier Road west to a point close to Mount Vernon Avenue, then follows along the river east to Foundation Park; from this point it runs in a southwesterly direction just to the north of Terrence Drive and Pittsburg Avenue. The district includes all of the city area north of this boundary line. The northeastern border of District 1 runs east from County Road 10 along New Gambier Road to Edgewood Road, then north two blocks, then east along East Chestnut Street to Ringold Street. From this point, the boundary turns north along Sychar Road to Wooster Road, then northeast to an area just north of Mount Vernon Academy. From this point, the border turns east along an imaginary line that runs just north of the Mount Vernon Developmental Center. For the past two years (2018 and 2019), 51% of the city calls for service have occurred in District 1.

District 2 – encompasses all of the area of the city that lies south of the southern border of District 1. For the past two years, 16% of the city calls for service have occurred in District 2.

District 3 – encompasses all of the northeastern portions of the city that are north and east of the District 1 borders previously described. For the past two years, 33% of the city calls for service have occurred in District 3.

For data management purposes, District 1 includes some of Clinton Township, a small portion of Pleasant Township, and all of Liberty Township and Morris Township. District 2 includes some of Clinton Township and most of Pleasant Township.

The tables in Figure 13 and 14 display the response performance for travel times and total response times for city fire and EMS incidents in each of the response districts.

Fire Responses

Element	District	Target	Percentage
Travel Time	1	4:00	75%
Response Time	1	7:06	88%
Travel Time	2	4:00	71%
Response Time	2	7:06	84%
Travel Time	3	4:00	41%
Response Time	3	7:06	76%

Figure 13

EMS Responses

Element	District	Target	Percentage
Travel Time	1	4:00	74%
Response Time	1	7:00	93%
Travel Time	2	4:00	66%
Response Time	2	7:00	89%
Travel Time	3	4:00	27%
Response Time	3	7:00	80%

Figure 14

As can be seen, a significant performance gap exists for travel times in District 3. This area of the city is farthest from the current fire station that includes considerable commercial development. The primary thoroughfare through this area is Coshocton Avenue (US 36), which is a high-volume roadway.

Part of the analysis was to identify high-volume call locations. This provides information to identify potential EMS system abuse or help determine the need for any strategies to assist

citizens who may need additional assistance meeting daily needs. A review of the 2019 EMS run data identified 65 locations that experienced six to 10 calls for service. There were 17 locations that experienced 11 to 20 calls for service and 17 locations that experienced 21-50 calls for service. There were five locations that experienced 51 to 100 calls for service:

- 10 McGibney Road (Hawthorne Apartments)
- 1350 Yauger Road (Country Club Retirement Campus)
- 1365 Yauger Road (Country Club Retirement Campus)
- 1380 Yauger Road (Country Club Retirement Campus)
- 1575 Yauger Road (Arbors of Mount Vernon – apartments)

Two locations had over 100 calls for service. The KCH Urgent Care facility located at 1490 Coshocton Avenue had 128 calls for service and Brookdale Assisted Living at 1615 Yauger Road had 105 calls for service.

Station Location Analysis

Determining the location to build a fire station involves evaluating several factors including: travel times, roadway accessibility, first due-area impact, neighborhood type, and land availability. The factors examined for this study were limited to travel times and first due-area impact, particularly as it relates to the identified risk in the community. It is understood that in the scenarios presented, land may not be available at the exact location identified. The best option for the city would be the closest site to the identified location that has sufficient land area, topography, drainage, etc., and is within fair market values.

The analysis was completed on the assumption that the department would continue to operate from the existing station. Utilizing GIS technology and the ArcGIS9 Fire Analysis Tool Software™, the assessment team was able to determine the most advantageous location for a second fire station in the community. Planning maps were developed to show visually the emergency travel times within the city as well as the contracted township service areas. Travel times are used to provide quantifiable and reliable data for analysis and discussion. Travel time is a constant that can be measured accurately and is dependent on the location and deployment of resources. The use of travel time provides the foundation from which to determine how fire station location can influence the department's total response performance. The following maps will show city travel times from the current fire station and potential fire station locations in 4-, 5-, and 6-minute intervals. These time intervals were used based on current NFPA response performance criteria and fire growth dynamics and EMS patient outcomes. Township travel-time maps will use 6-, 8-, and 10-minute travel time intervals.

The map in Figure 15 shows the 4-, 5-, and 6-minute travel times throughout the city from the current fire station located at 200 West Gambier Street. The northeast, southeast and southern

areas of the city has significant areas with 5- and 6-minute travel times, including some areas beyond 6 minutes. The travel times were not surprising due to the large area covered and some of the city's road structure.

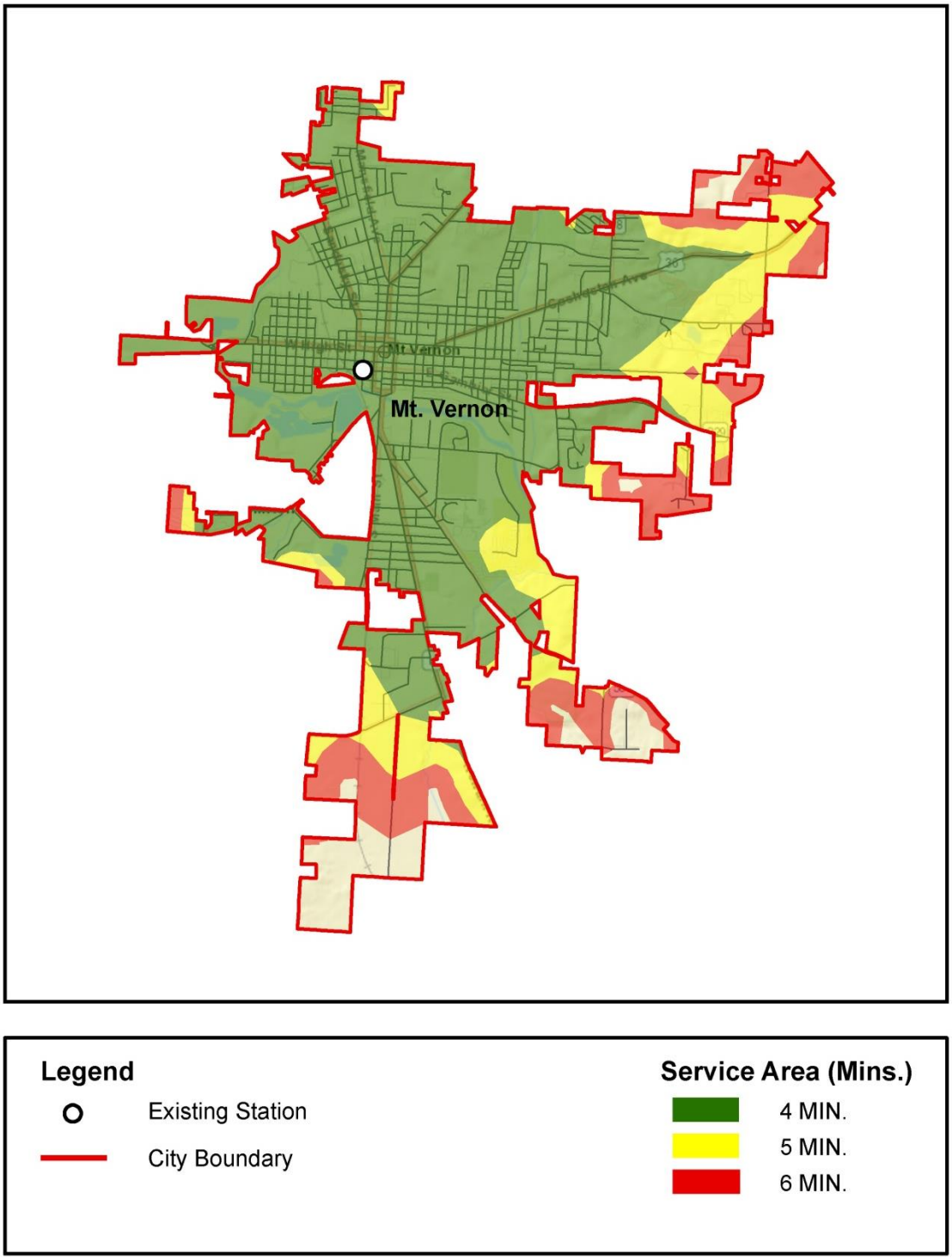

Figure 15

Several locations were analyzed to determine the best location to construct a second fire station and improve the department's response performance. At the request of the city, a city-owned parcel located on Sychar Road was analyzed as a possible location for a second station. The map in Figure 16 shows a two-station configuration with the existing station and a proposed station located adjacent to 69 Sychar Road, just south of Sycamore Street. This improves the 4-minute travel time area in the eastern portions of the city, primarily along Coshocton Avenue. The far northeastern, eastern, and southeastern areas of the city have 5- and 6-minute travel times.

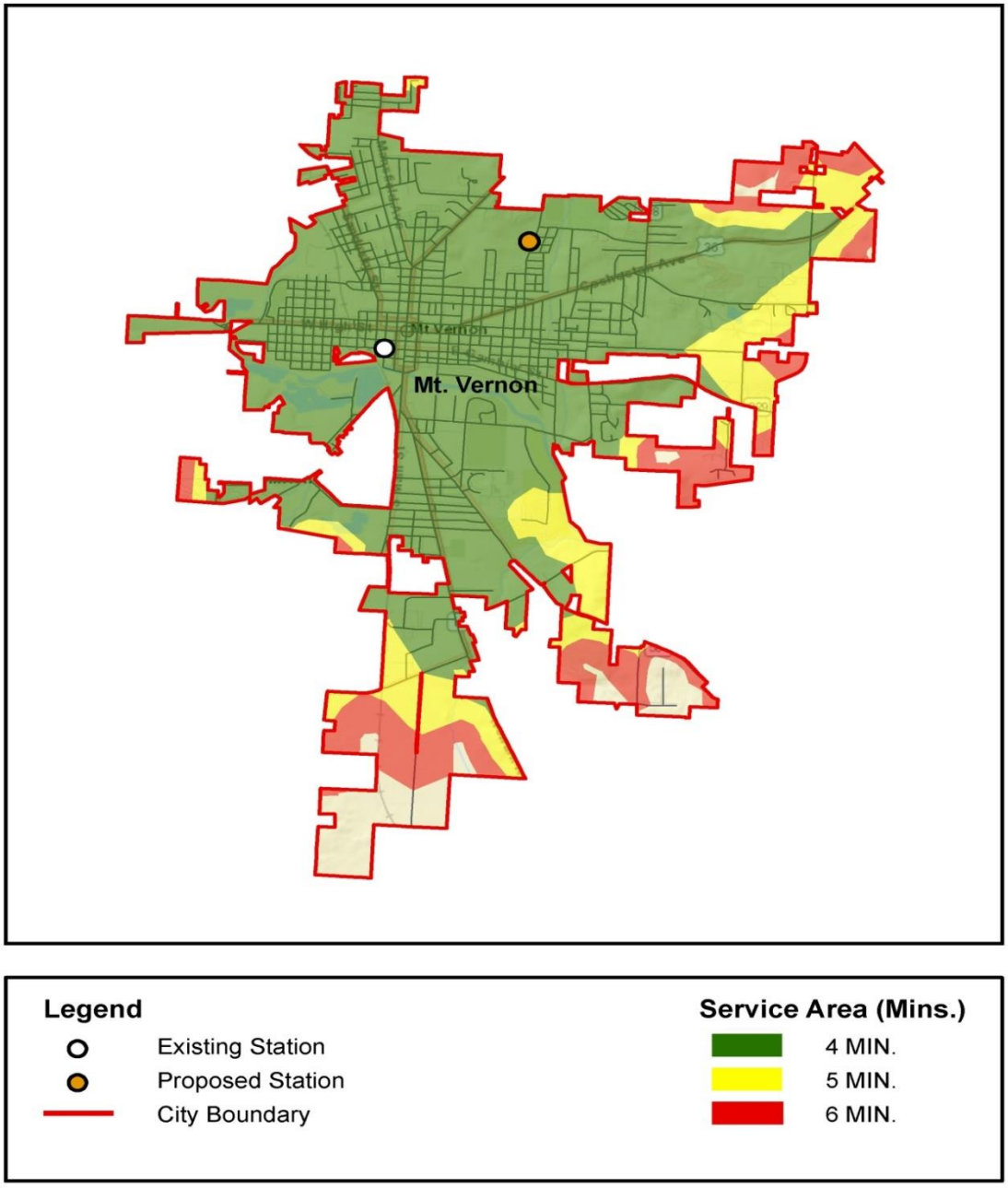

Figure 16

The map in Figure 17 shows a two-station configuration with a proposed station located at the intersection of Coshocton Avenue and Vernonview Drive. This location provides the most improvement with first-due travel times throughout the city. All of the northeastern areas of the city are within a 4-minute travel time and almost all of the eastern areas of the city are within 4- and 5-minute travel times. In addition, 32 of the significant risk properties identified are within a 4-minute travel time from this location. The travel times on the southeastern and southern areas of the city remain unchanged, primarily due to the north-south road structure and distance. Due to the shape and configuration of the city land area, a third fire station would be needed to achieve 4 to 6-minute travel times citywide.

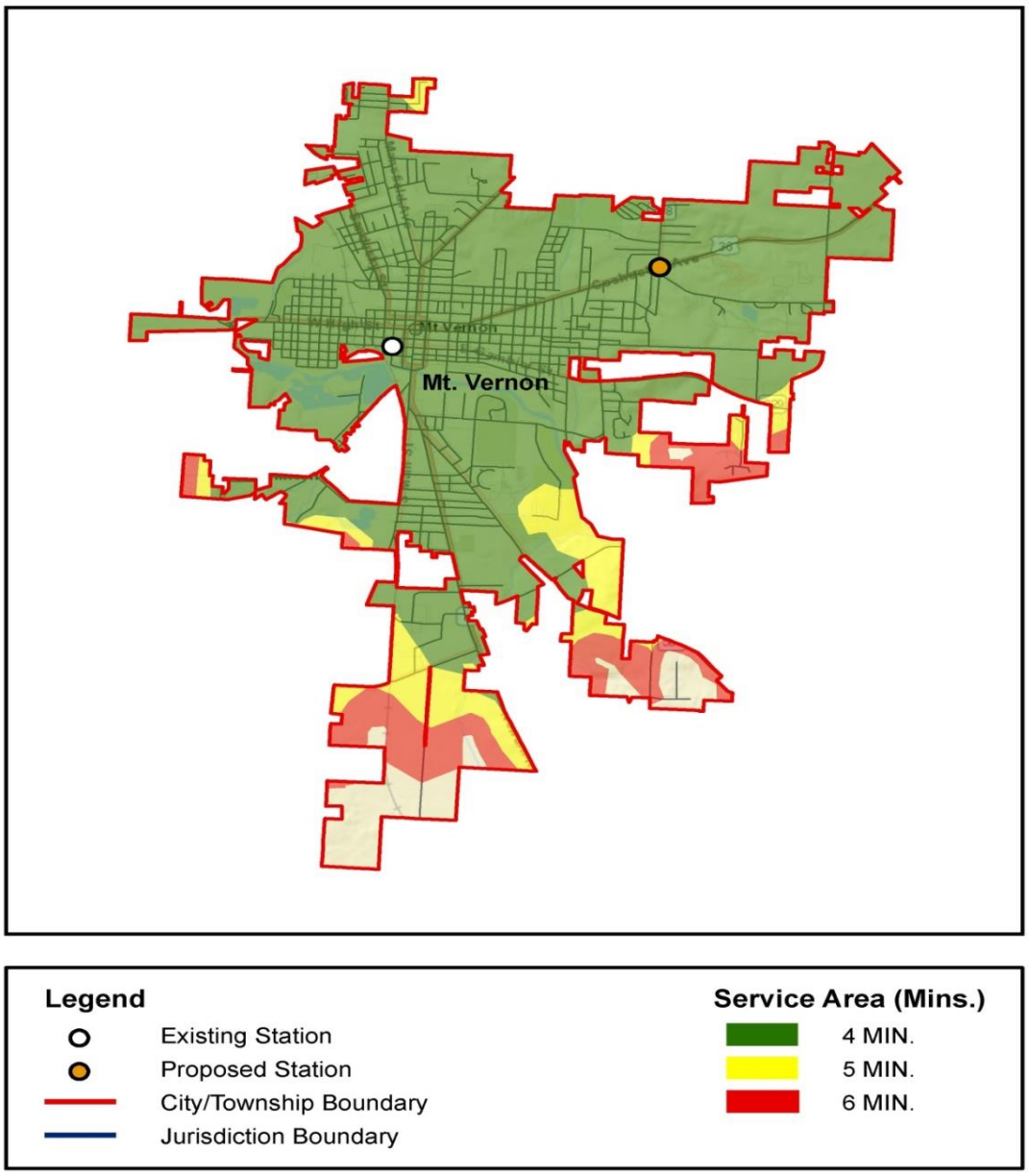

Figure 17

For future planning, a three-station configuration was analyzed to maximize first-due travel times within all parts of the city, particularly the southern and southeastern areas of the city. The map in Figure 18 shows a proposed second station at the intersection of Coshocton Avenue and Vernonview Drive, and a third station located at the intersection of Glen Road and Newark Road. This configuration provides 4-minute travel times to almost the entire southern end of the city with some 5- and 6-minue travel times, and significantly improves the travel times to the southeastern areas of the city. The layout of surface streets significantly affects the travel times in these areas of the city.

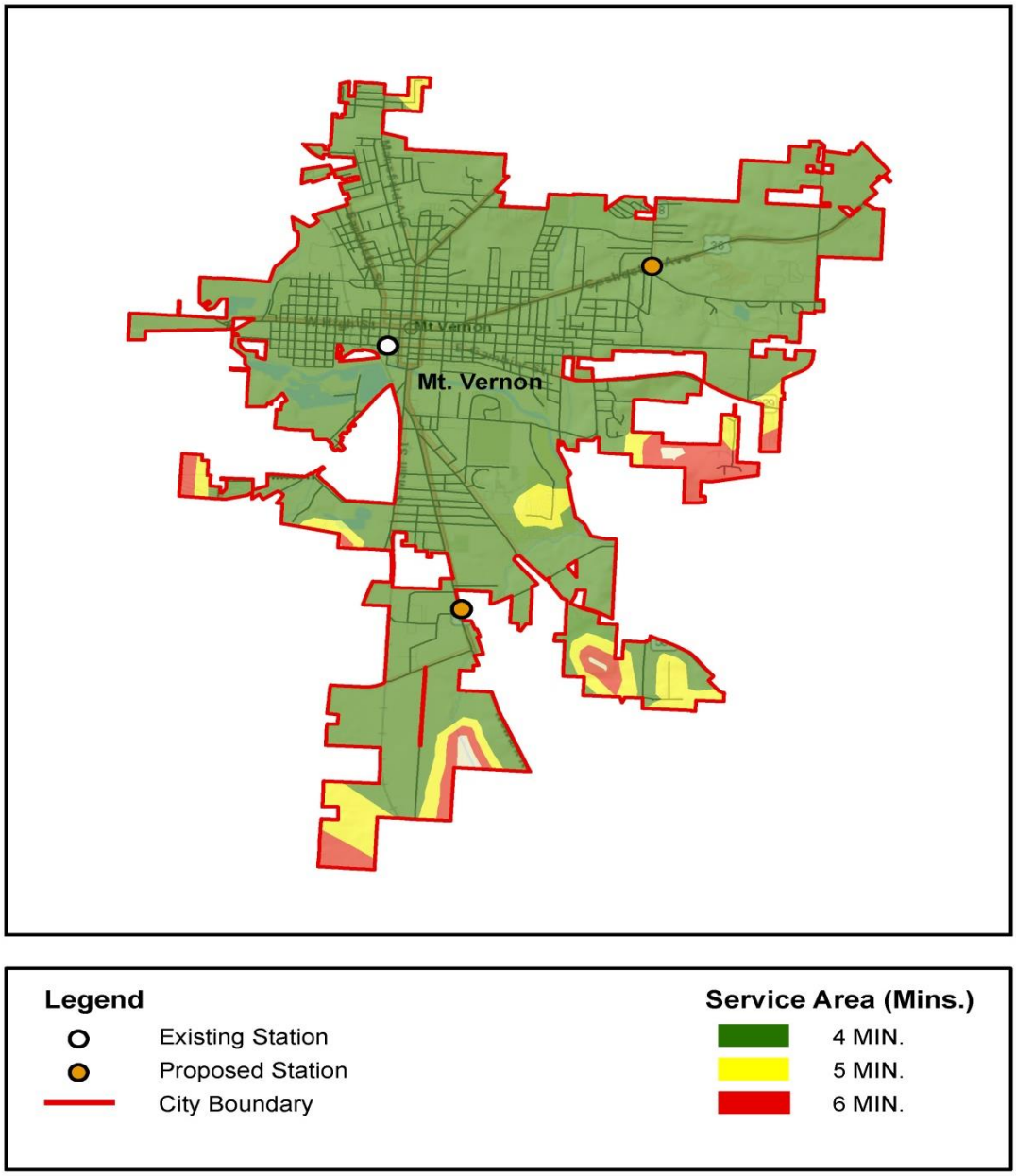

Figure 18

The assessment team also analyzed the impact of a second fire station on the department's response performance in the contracted township areas and potential expansion of the contracted service area. The map in Figure 19 shows 6-, 8- and 10-minute travel times from the existing fire station for the contracted service area including Liberty, Clinton, Pleasant and Morris Townships.

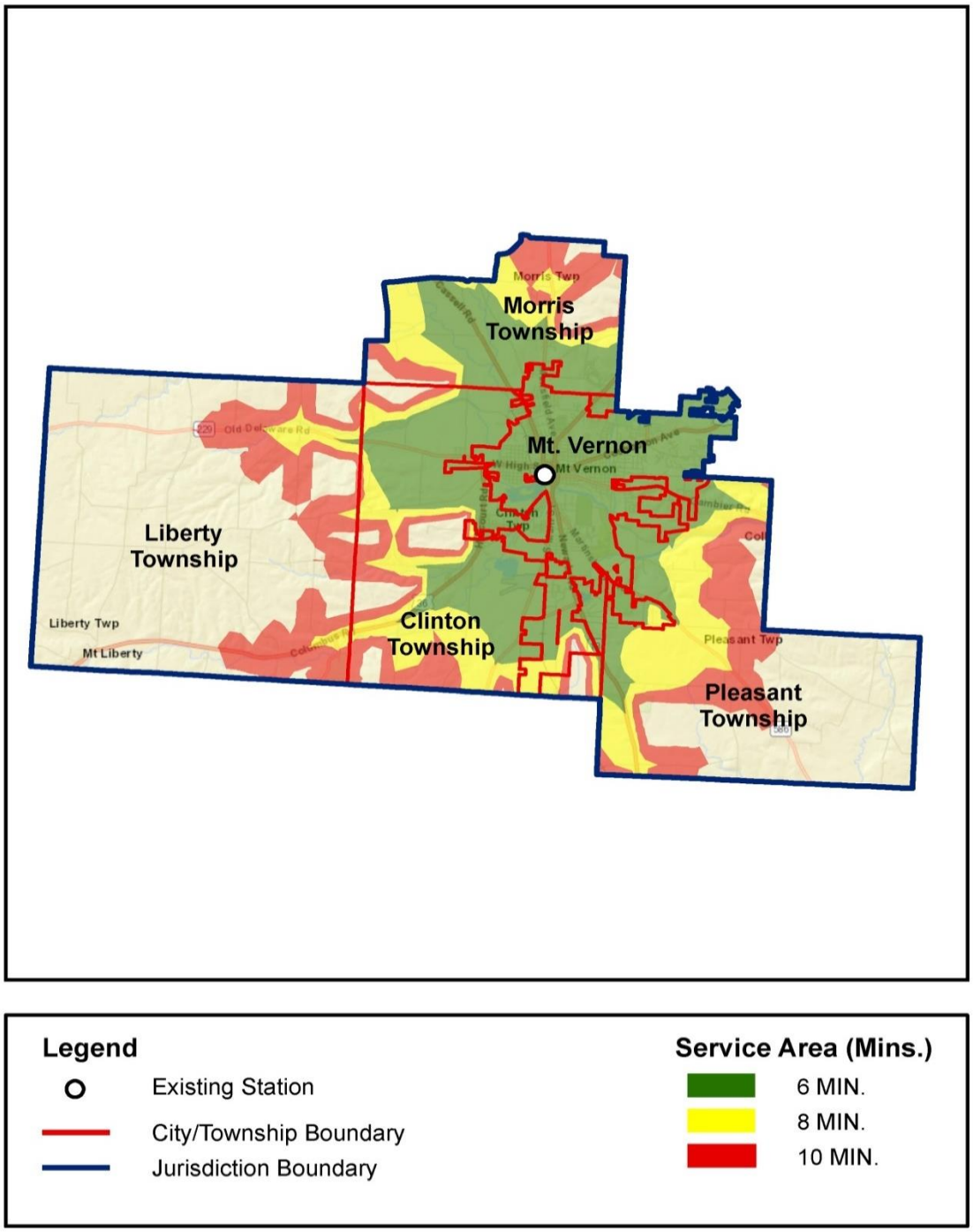

Figure 19

Clearly, the travel times to most of Liberty Township and approximately 50% of Pleasant Townships are lengthy and beyond 10-minutes due to the large rural area covered. However, much of Morris and Clinton Townships are within 10-minute travel times. These two townships are smaller and adjacent to the city borders. The map in Figure 20 shows the travel times to the township service area with a second fire station at Coshocton Avenue and Vernonview Drive.

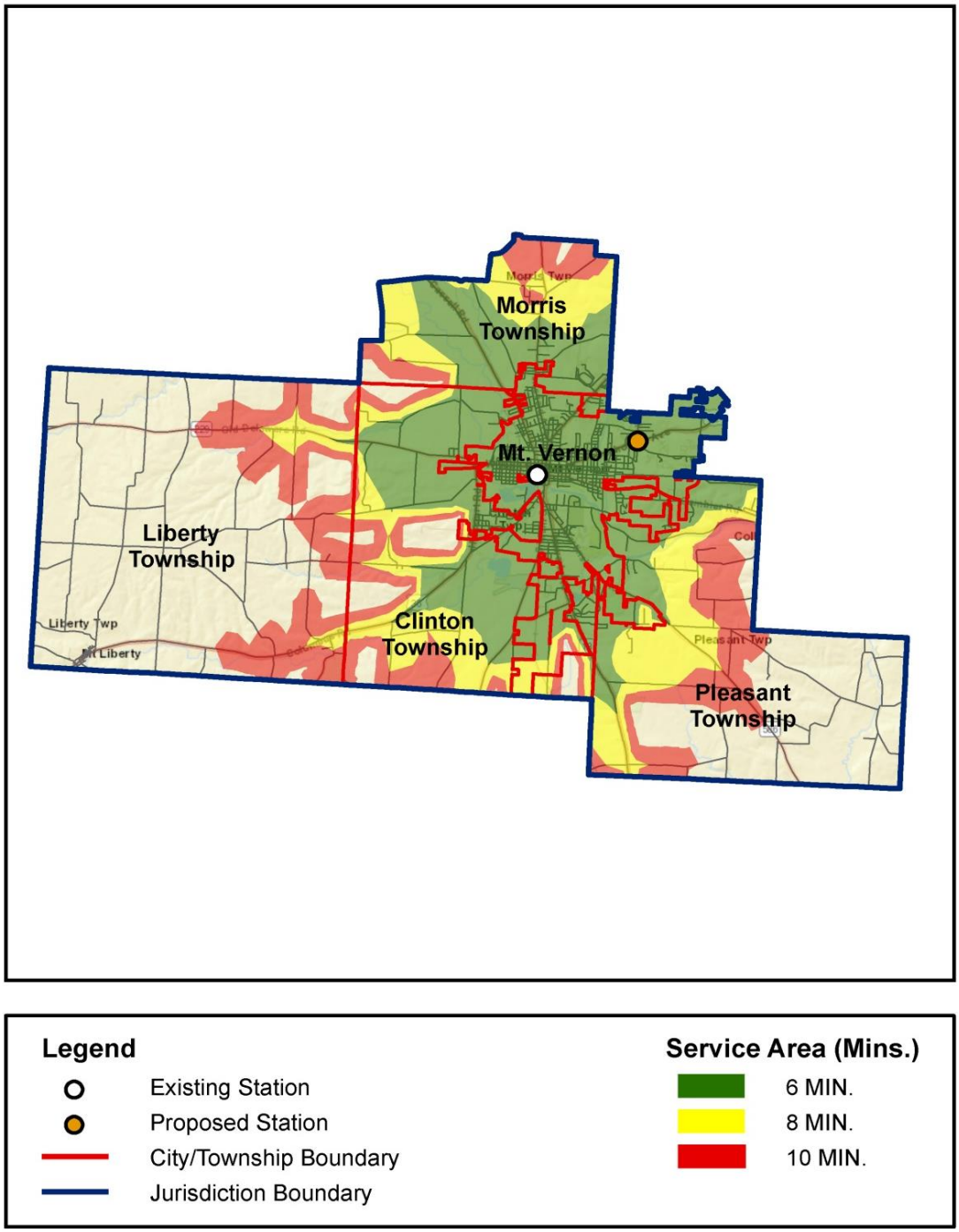

Figure 20

The second station provides noted improvement to Morris Township and slight improvement to the northern area of Pleasant Township. The travel times to Clinton and Liberty Townships are not affected by the second station.

The city and MVFD have been in discussions with College and Monroe Townships concerning the feasibility and cost of providing fire suppression response and EMS service to those areas. Travel time maps are developed for those areas. The map in Figure 21 shows the travel times to the existing service area and College Township with a two-station configuration.

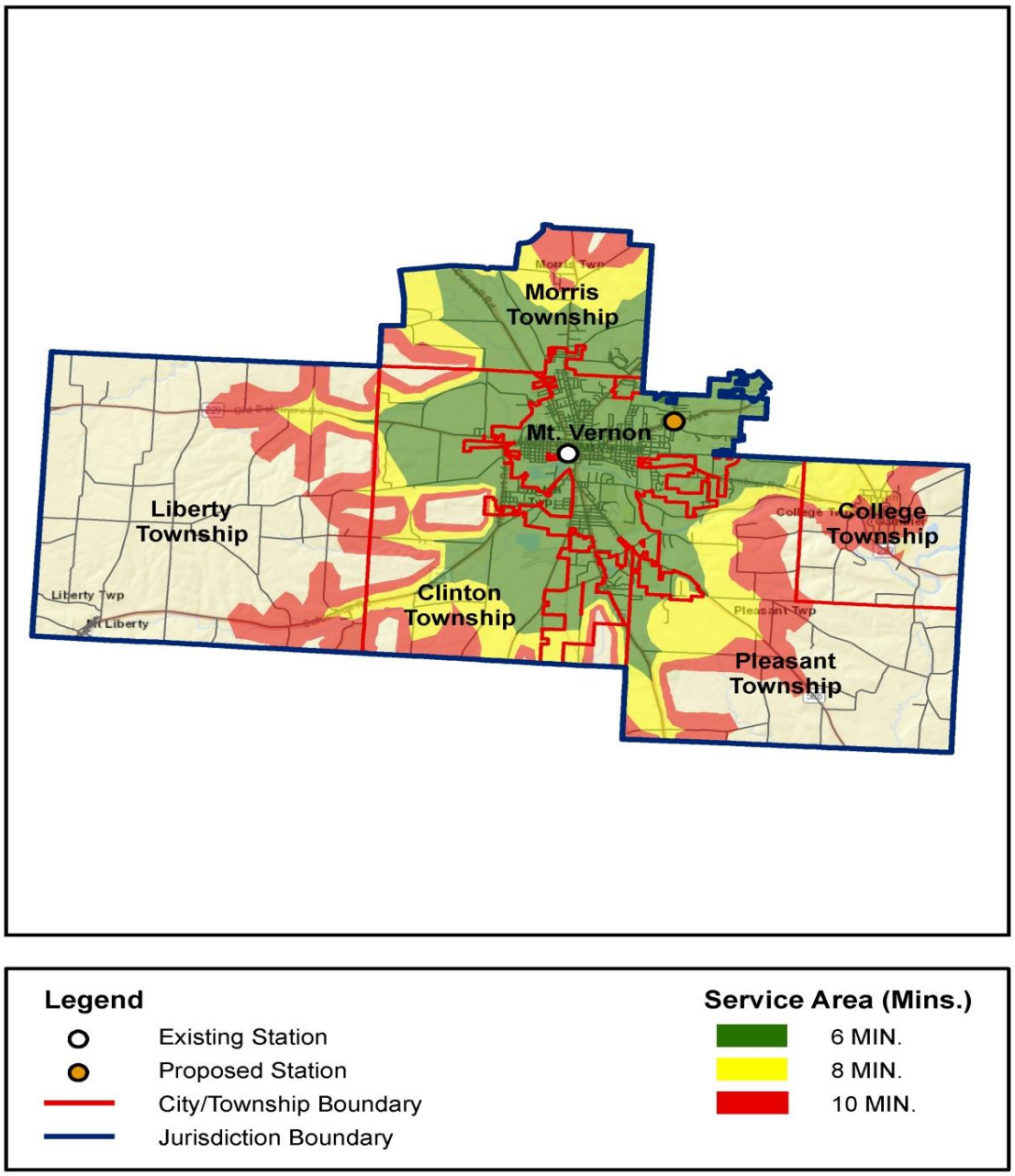

Figure 21

Approximately 35% of the township is within a 10-minute travel time or less including the village of Gambier. The remainder of the township is beyond a 10-minute travel time. The map in Figure 22 shows the travel times to the existing service area, and College and Monroe Townships with a two-station configuration.

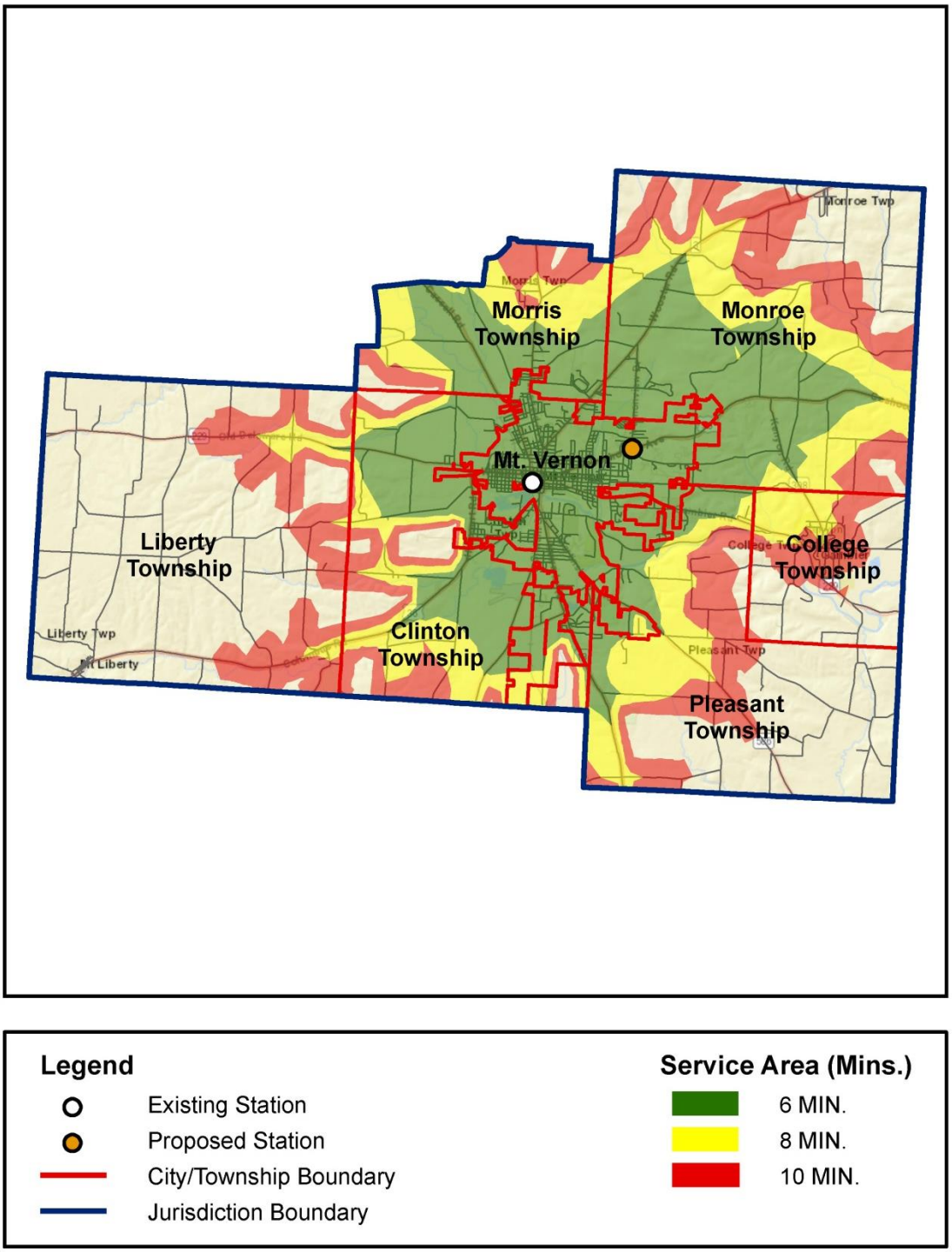

Figure 22

Approximately 75% of the Monroe Township is within 10-minute travel time, with a significant portion within 6 minutes.

Summary

The fire station location analysis identified the optimal location to construct a second fire station. Located at the intersection of Coshocton Avenue and Vernonview Drive, this site provides quick access to an east-west thoroughfare (Coshocton Avenue) and significantly improves travel times to the northeastern, eastern, and some of the southeastern areas of the city. The eastern area appears to be the current growth area, and this site would allow the department to serve future growth areas to the northeast and east, should annexation and development occur.

This site also provides good access to the downtown area and areas south for apparatus and personnel assigned to a second station to respond within a 4- and 5-minute travel time. This is important for a second-due engine responding to a fire in the downtown area or for an ambulance responding from a second station when all of the crews from the main station are committed on calls.

The assessment team also recommends the following actions to assist the fire department in future planning of service delivery to the community.

> **Recommendation #1: *Develop organizational performance goals.*** The fire department is strongly encouraged to work collaboratively with the city administration in developing and adopting organizational performance goals. An example of an organizational performance goal is *the first-due fire department unit will arrive within 7 minutes, 30 seconds total response time for 80% of all incidents.* This performance goal then provides the foundation, along with other factors, from which to determine the appropriate level of resources to meet the goal(s). This also provides a method from which to analyze response and other related data, and report to the citizens on the agency's performance in a clear and understandable manner.
>
> **Recommendation #2: *The department should take steps to strengthen their data tracking and management system*.** Currently, the department has three response districts (District 1, District 2, and District 3) used for tracking calls and determining apparatus assignments. Using this system for determining apparatus assignments works well, but developing more response sectors would aid data analysis and management. For example, the city could have eight to 12 response sectors. This would allow the department to track service demands and response performance more accurately in smaller areas as well as use the sectors to determine mutual-aid needs.

This data will also prove valuable in the future when a fire station needs to be replaced or added. In addition, each of the townships could have four response sectors to aid data analysis and management. With the current technological features of the CAD system and internal database systems, developing additional response sectors can be easily managed.

The purpose of this fire station location analysis was to identify the best location for the city to locate a second fire station. First-due travel times and the risk assessment were both key points in the analysis process. Due to the cost of constructing a fire station and anticipated 40-50 year service life, placing the fire station in the most optimal location is a practical, business approach to the issue.

The MVFD is to be commended for their efforts in providing quality service to the community. Their pride in the department and community, and dedication to quality service delivery was evident to the assessment team throughout this project. The OFCA hopes this analysis will help the department continue that effort.

Appendix A

In the state of Ohio, the Ohio Division of EMS is responsible for all the laws governing EMS. These laws are listed in §4765 of the Ohio Revised Code (ORC) [http://codes.ohio.gov/orc/4765]. Each level of certification is based on the National EMS Scope of Practice, which has been incorporated into the ORC. This outlines exactly what procedures can be performed by each certification level. A basic EMT requires a minimum of 150 hours of initial training and at least 40 hours of continuing education every three years. An advanced EMT requires an additional 200 hours of training above that of an EMT-Basic and at least 60 hours of continuing education every three years. Advanced EMTs are able to perform many advanced life support (ALS) procedures and administer certain medications to patients. To advance to the paramedic level, a person must possess EMT certification and is required to attend nearly 900 additional hours of clinical and didactic training, which allows them to perform even more life-saving procedures and administer additional medications. Examples of these procedures would be performing cardio-version, heart pacing, heart defibrillation (shocks to the heart) and advanced invasive procedures such as chest decompression and needle cricothyroidotomy. The paramedic must obtain 86 hours of continuing education every three years, which includes maintaining advanced cardiac life support certification offered through the American Heart Association.

In firefighting, training and certification has three distinct levels. Volunteer firefighting is the basic level and is limited by law to 36 hours of initial training. It is the minimum level required to perform the duties of a volunteer firefighter. This level of training is also the minimum required by law to serve as a part-time firefighter unless additional training is required by the local fire agency.

The next level of firefighter training is Firefighter I (FF I). This level requires an additional 104 hours of training beyond the volunteer course level. This level of training also requires the demonstration of competency in several specific areas such as proper use of SCBA. The highest level of training is Firefighter II (FF II). This includes 240 - 260 hours of training in a variety of subject matter and the ability to demonstrate competency in several required areas. Full-time firefighters in Ohio are required by law to achieve certification at this level to work in their position. All certification levels require personnel to obtain 54 hours of continuing education every three years for certification renewal.

Appendix B

The Science of Fire and the Need for Rapid Response to Affect Positive Change

Because there is such a wide variation in the fire dynamics of each particular fire, it is imperative to find a common reference point, something that is common to all fires regardless of the risk-level of the structure, the material involved or length of time the fire has burned. Such a reference point exists. Regardless of the speed of growth or length of burn time, all fires go through the same stages of growth. One stage in particular emerges as a very significant one because it marks a critical change in conditions; it is called *flashover*.

The flashover stage of a fire event marks a major turning point in fire conditions that increases the challenge to a fire department's resources. How and why this occurs is explained in the following descriptions of each stage of fire growth in a structural fire.

Incipient stage

The smoldering stage is the first stage of any fire. When heat is applied to a combustible material, the heat *oxidizes* the material's surface into combustible gases. The oxidation process is exothermic, meaning that the oxidation process itself produces heat. The heat from the oxidation raises the temperature of other materials, which increases the rate of oxidation and begins a chemical chain reaction of heat-release and burning.

A fire progresses from the smoldering phase immediately or slowly depending upon the fuel, nearby combustibles, and the surrounding air. For example, a bundle or stack of newspapers will smolder only a few seconds before progressing to the next stage, but a couch with a burning cigarette may continue smoldering for an hour or more.

Growth stage

When the temperature gets high enough visible flames can be seen. This stage is called the growth stage or open burning. The visible burning at this stage is still limited to the immediate area of origin. The combustion process continues to release more heat, which heats nearby objects to their ignition temperature and they begin burning.

Flashover/fully developed stage

Not all of the combustible gases are consumed in the growth stage. They rise and form a superheated gas layer on the ceiling that can quickly reach 1,500° Fahrenheit (F). As the volume of this gas layer increases, it begins to bank down to the floor, heating all combustibles regardless of their proximity to the burning object. The gas layer is mostly carbon monoxide so the absence of oxygen prevents the heated objects from bursting into flame.

Oxygen is introduced into the space in two ways. There is often enough available oxygen near floor level to start the open burning process when the gas layer reaches that level. Or, the high heat breaks a window and the incoming oxygen allows the burning to begin. It should be noted that the room becomes untenable long before flashover. Even though open flaming may not be present until everything reaches 500°F and oxygen is introduced, the room becomes untenable for human survival at 212°F.

When flashover occurs, everything in the room ignites into open flame at once. This instantaneous eruption into flame generates a tremendous amount of heat, smoke, and pressure with enough force to push beyond the room of origin through doors and windows. The combustion process then speeds up because it has an even greater amount of heat to move to unburned objects.

Flashover is a critical stage of fire growth for two reasons. First, no living thing in the room of origin will survive, so the chance of saving lives drops dramatically. Second, flashover creates a quantum jump in the rate of combustion and a significantly greater amount of water is needed to reduce the burning material below its ignition temperature. A fire that has reached flashover means that it is too late to save anyone in the room of origin, and a significant increase in staffing is required to handle the larger hose streams necessary to extinguish the fire. A post-flashover fire burns hotter and moves faster, compounding the search and rescue problems in the remainder of the structure at the same time that more firefighters are needed for fire attack. See the chart in Figure 23.

PRE-FLASHOVER	POST-FLASHOVER
Fire limited to room or area of origin Requires small attack lines	Fire spreads beyond room or origin Requires more or larger attack lines
Search and rescue efforts easier	Compounds search and rescue efforts
Requires fewer resources and can be handled by initial effective response force	Requires additional resources (companies)

Figure 23

It has long been known that the real killer in a structural fire is smoke, not the flame or heat. Smoke contains many toxic gases released as byproducts of the combustion process. Carbon monoxide is one of these gases and the most prevalent. Test fires in residential structures have demonstrated the production of carbon monoxide in measurable amounts after 3½ minutes from the ignition of the fire.

The primary objective of fire operations is to provide enough firefighters and equipment in a strategic location so that an effective response force can respond to and reach fire scenes to mitigate the problem before flashover occurs. The “time-temperature curve” standard is based

on data from NFPA and ISO that establishes that a typical point source of ignition in a residential house will flashover at some time between 5 and 30 minutes after ignition, turning a typical *room and contents* fire into a structural fire of some magnitude. The time-temperature curve illustrated in Figure 24 comes from research efforts of NFPA of smoke alarms and other detection equipment (2004).

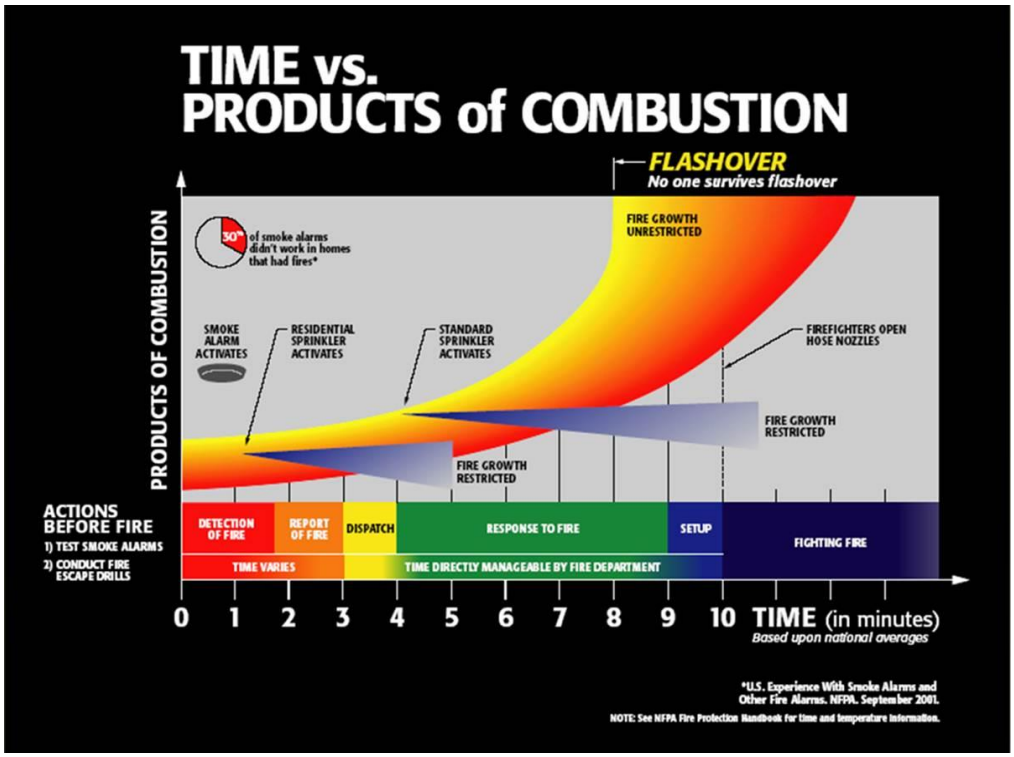

Figure 24

Time requirements for EMS calls are comparable to fire incidents. The purpose of a quick response, especially in the most critical situation (cardiac arrest), is that the brain, deprived of oxygen and circulation begins to die within four to six minutes. Brain damage is normally irreversible after 10 minutes. Interventions include early CPR and electrical defibrillation. Previous studies show the time to deliver a shock (called defibrillation) to the patient in cardiac arrest to be three to six minutes. Current guidelines from the American Heart Association plus additional guidelines from the American College of Emergency Physicians and the National Highway Traffic Safety Administration suggests a response time interval of not more than five minutes from alarm notification to scene arrival for responders capable of performing CPR and utilizing an AED.

An AED is a portable device that the first responder or trained civilian can use on a patient who is pulseless and not breathing. When the device is connected to the patient, it analyzes the patient's heart rhythm and automatically delivers electric shocks to the patient if needed. Furthermore, guidelines provide for no more than a 10-minute response interval for providers

capable of performing ALS level interventions, if that level of service is available. The importance of time of intervention in a cardiac arrest event is illustrated in the graph in Figure 25, which comes from the National Center for Early Defibrillation based on data from the American Heart Association (2020).

Figure 25

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