ATTACHMENTS

CITY OF SHEBOYGAN

COMMITTEE OF THE WHOLE MINUTES

JULY 25, 2016

Chair Joe Heidemann called the meeting to order at 6:00 p.m. The Pledge of Allegiance followed.

ALDERPERSONS PRESENT: Chair Joe Heidemann, Alderpersons: John Belanger, Bryan Bitters, Jim Bohren, Mary Lynne Donohue, Job Hou-Seye, Scott Lewandoske, Andrew Schneider, Bill Thiel, Rosemarie Trester and Todd Wolf

ALDERPERSONS EXCUSED: Mike Damrow and Roman Draughon

ALDERPERSONS ABSENT: Mark Hermann, Susan Lessard and Tammy Rabe

STAFF/OFFICIALS PRESENT: Mayor Mike Vandersteen, City Administrator Darrell Hofland, Department of Public Works Director David Biebel, Finance Director Nancy Buss, Information Technology Director Dave Augustin, Director of Planning and Development Chad Pelishek and Fire Chief Mike Romas

MINUTES

Motion by Alderperson Wolf, seconded by Alderperson Bitters to approve the minutes of June 13, 2016. Motion Carried.

ITEMS FOR DISCUSSION AND POSSIBLE RECOMMENDATION TO THE COMMON COUNCIL

2.1 Res. No. 11-16-17. By Alderperson Belanger. A Resolution extending the special charge for residential garbage and refuse disposal services provided by the City.

City Administrator Darrell Hofland provided an overview of the special charge for residential garbage and refuse services that Alderperson Belanger is requesting the Committee of the Whole to consider extending, effective for January, 2017.

The original garbage user fee was approved by City Council in 2012 for $7.16 per month and was reduced in subsequent years to $5.00 per month.

The last action taken by the City Council on this matter was Resolution 67-14-15 in which the Council required a review of the special charge every two years with the first review to occur prior to the start of 2017.

The garbage user fee, at $5.00 per month per household, generates $1,200,000 per year. This money is deposited into the General Fund but linked to the annual street improvement program.

Director of Public Works David Biebel provided a PowerPoint presentation on 2017 Transportation Infrastructure Management. The report indicated the percentage of city streets receiving a failed "Paser" rating increased from 4.618 percent in 2007 to 6.560 percent in 2013 and up to 14.084 percent in 2015. That is a 205 percent increase between 2007 and 2015. Project type cost vary from $5.50 per foot for crack filling to $225 per foot for concrete road reconstruction. The total amount needed for repairing streets, bridges and equipment is $62,058,229. The report assumes the funding sources to include:

- $11,200,000 - Wheel tax
- $16,800,000 - Garbage user fee
- $ 6,250,000 - Special assessments
- $ 2,800,000 - County Sales Tax

- $25,200,000 - Debt issuance
- $62,250,000 Total

Discussion followed Director of Public Works David Biebel's presentation. All agreed that streets are in need of maintenance and repair, however some felt that other funding mechanisms should be explored. With the County sales tax and wheel tax recently added to city tax payers it was felt by several that their constituents shouldn't be subjected to continue to pay the garbage fee when it was scheduled to end this year.

Motion by Alderperson Belanger, seconded by Alderperson Lewandoske to amend the resolution from $5.00 to $2.50 per month for five years.

Alderperson Hou-Seye stated there wasn't a motion on the floor for the original resolution.

Motion by Alderperson Belanger, seconded by Alderperson Bitters introducing Resolution No. 11-16-17 by Alderperson Belanger extending the special charge for residential garbage and refuse disposal services provided by the City. Alderperson Belanger then asked to attach his amendment that was previously stated.

Motion by Alderperson Belanger, seconded by Alderperson Bitters to amend the resolution from $5.00 to $2.50 per month for five years.

Motion by Alderperson Bohren, seconded by Alderperson Lewandoske making a friendly amendment to reduce from five years to three years. Motion carried. (7 Ayes - Alderpersons Bohren, Heidemann, Hou-Seye, Lewandoske, Schneider, Thiel, Trester) (4 Nays - Alderpersons Belanger, Bitters, Donohue and Wolf)

Chairman Heidemann stated that there is a motion on the floor to amend the original resolution to $2.50 per month for three years and vote was taken. Motion carried. (6 Ayes - Alderpersons Belanger, Bitters, Bohren, Hou-Seye, Lewandoske, and Schneider) (5 Nays - Alderpersons Donohue, Heidemann, Thiel, Trester, Wolf)

NEXT MEETING DATE: TBD

ADJOURN.
Motion by Alderperson Belanger, seconded by Alderperson Wolf to adjourn at 7:11 p.m. Motion carried.

CITY OF SHEBOYGAN

REQUEST FOR COMMITTEE OF THE WHOLE CONSIDERATION

ITEM DESCRIPTION: Charter Ordinance increasing number of alderpersons in the City to 16

REPORT PREPARED BY: Charles C. Adams, City Attorney

REPORT DATE: August 17, 2016 **MEETING DATE:** August 22, 2016

FISCAL SUMMARY:		**STATUTORY REFERENCE:**	
Budget Line Item:	N/A	Wisconsin Statutes:	§62.09(1)(b)(& §66.0101, Wis. Stats.
Budget Summary:	N/A		
Budgeted Expenditure:	N/A		
Budgeted Revenue:	N/A	Municipal Code:	§2-224(c), Sheboygan Municipal Code

BACKGROUND/ANALYSIS:
In 2015, the Common Council approved Charter Ordinance No. 1-15-16, decreasing the size of the council from 16 to 10. The ordinance did not go into effect for 60 days in order to give the public the opportunity to consider and object to the ordinance. Had a verified petition opposing the ordinance been presented to the council with sufficient signatures, the ordinance would have gone to referendum. The public did not object and there were no petitions presented. As a result, the eight aldermanic positions up for election in 2017 are for one-year terms.

The current Charter Ordinance purports to repeal the ordinance and go back to a 16-member council. The primary author indicates that the purpose is to send the original charter ordinance to referendum, despite the lack of interest in doing so from the public.

STAFF COMMENTS:
First, the significant work of the ad hoc committee on restructuring should be recognized and considered. There have been questions about whether a 10-member council could work. I have attached a document that has come out of that committee that you may wish to review in light of those questions.

Even more importantly, however, is the fact that there is a major time problem with this ordinance. As noted above, Charter Ordinances do not go into effect immediately. Rather, there is a 60-day period after publication during which the public has an opportunity to object to the change.

If this charter ordinance is approved at the next council meeting (and it must be approved by a supermajority in order to pass), it would not go into effect until November. By that time, it is possible that one or more candidates will have taken out papers to run for alderman on a one-year term, per the current Charter Ordinance.

Worse yet, if an objection is properly filed via a petition, the clerk would have to verify the petition, a process that takes about 30 days. Then, the matter would be put on the spring ballot, meaning candidates would be running for one-year terms, but a charter ordinance making them two-year terms would be up for a vote. This conflict cannot stand: an alderperson cannot run for a seat that may or may not be a 1-year term. Thus, should any objection be raised via petition (or even should an aldermanic candidate up for election in 2017 take out papers prior to the 60-day period), the council would have no legal option but to withdraw the charter ordinance. This is not proper practice.

Therefore, it is my legal opinion that this charter ordinance is untimely and should not be passed.

ACTION REQUESTED:
Motion to recommend the Common Council not approve Charter Ordinance No. 1-16-17.

ATTACHMENTS:

I. Subs of Charter Ordinance No. 1-15-16
II. Charter Ordinance No. 1-16-17
III. Modifications to Committee Structure

VII

5.9

R. C. No. 131 - 16 - 17. By LAW AND LICENSING. August 15, 2016.

Your Committee to whom was referred Charter Ord. No. 1-16-17 by Alderpersons Lewandoske, Hermann and Rabe (being subject to the home rule provisions of sec. 66.0101 of the Wisconsin Statutes) to maintain the number of alderpersons in the City of Sheboygan at 16; recommends that the documents be referred to the Committee of the Whole.

refer to C.O.W.

Susan J Leonard — Tammy Lake

Scott Lewandoske

Mark Hermann

Committee

I HEREBY CERTIFY that the foregoing Committee Report was duly accepted and adopted by the Common Council of the City of Sheboygan, Wisconsin, on the _____ day of _____, 20____.

Dated_____ 20____. _____, City Clerk

Approved_____ 20____. _____, Mayor

X

6.1

Charter Ord. No. 1 - 16 - 17. By Alderpersons Lewandoske, Hermann and Rabe. August 1, 2016.

AN ORDINANCE (being subject to the home rule provisions of sec. 66.0101 of the Wisconsin Statutes) to maintain the number of alderpersons in the City of Sheboygan at 16.

THE COMMON COUNCIL OF THE CITY OF SHEBOYGAN DO ORDAIN AS FOLLOWS:

Section 1. The City of Sheboygan hereby elects, pursuant to the provisions of Sec. 62.09(1)(b) of the Wisconsin Statutes and the home rule provisions of Sec. 66.0101 of the Wisconsin Statutes, to repeal the provisions of Charter Ordinance No. 1-15-16, which reduced the number of alderpersons in the City of Sheboygan from sixteen (16) to ten (10) by the 2018-2019 council year.

Section 2. Section 2-224(c) of the Sheboygan Municipal Code, relating to terms of office for alderpersons, shall be repealed and recreated to read as follows:

"Sec. 2-224. *Terms.*

. . .

(c) *Alderpersons.* The term of the office of alderperson shall be two years. The alderpersons shall be residents of the aldermanic district from which they are elected, and eight of their number, representing one alderperson from each aldermanic district, shall be elected each year."

Section 3. All ordinances or parts thereof in conflict with the provisions of this ordinance are hereby repealed to the extent of such conflict.

Laid on the table
refer to
Com. of the Whole

Section 4. This is a charter ordinance and shall take effect sixty (60) days after its passage and publication, unless within such sixty (60) days after its passage and publication a referendum petition shall be filed as provided in sec. 66.0101 of the Wisconsin Statutes, in which event this ordinance shall not take effect until it shall have been submitted to a referendum of the electors and approved by a majority of the electors voting thereon.

I HEREBY CERTIFY that the foregoing Ordinance was duly passed by the Common Council of the City of Sheboygan, Wisconsin, on the _____ day of _____, 20____.

Dated_____ 20____. _____, City Clerk

Approved_____ 20____. _____, Mayor

MODIFICATIONS TO COMMITTEE STRUCTURE

A. No Council Member Modification to:

Architectural Review Board (7 Members)

- Alderperson J
- City Plan Commissioner
- Licensed Real Estate Broker
- General Contractor Licensed by the City of Sheboygan
- Licensed Architect
- Licensed Architect
- Licensed Architect

Board of Appeals (5 Members/2 Alternates)

- Citizen
- Citizen
- Citizen
- Citizen
- Architect/Structural Engineer (Minimum – 10 Years Practical Experience)
- Alternates
    - Alternate 1
    - Alternate 2

Board of Marina, Park and Forestry Commissioners (9 Members)

- Alderperson I
- Director of Public Works
- ~~Superintendent of Parks and Forestry~~
- City Plan Commission Member
- Historic Preservation/Housing Rehabilitation Loan Commission Member
- Sheboygan County Board Representative
- Sheboygan Area School District Recreation Department
- Citizen – Boat Slip Lessee
- Citizen
- Citizen
- Non-Voting Members
    - Police Department Representative
    - ~~Director of Public Works~~
    - Superintendent of Parks and Forestry

Board of Police and Fire Commissioners (5 Members)

- Citizen
- Citizen
- Citizen
- Citizen
- Citizen

Board of Review (5 Members)

- Citizen
- Citizen
- Citizen
- Citizen
- Citizen

Board of Water Commissioners (3 Members)

- Citizen
- Citizen
- Citizen

Business Improvement District (11 Members)

- City Government Representative
- Business Owner
- Business Owner
- Business Owner
- Business Owner
- Business Owner
- Property Owner Representing Commercial Property Owner
- Property Owner Representing Commercial Property Owner
- Property Owner Representing Commercial Property Owner
- Property Owner Representing Commercial Property Owner
- Property Owner Representing Commercial Property Owner
- Ex-Officio Member
    - BID Manager

City-County Shared Service Committee (11 Members)

- Mayor
- Alderperson F – Chair of Public Protection and Safety Committee
- Alderperson D - Chair of Public Works Committee
- Alderperson A – Chair of Finance and Personnel Committee
- Business Person
- Business Person
- Business Person
- County Board Chair
- County Board Supervisor
- County Board Supervisor
- County Board Supervisor

Historic Preservation/Housing Rehabilitation Loan Committee (7 Members)

- Alderperson J
- Registered Architect
- Historian
- Licensed Real Estate Broker
- Citizen

- Citizen
- Citizen

Joint Review Board (5 Members)
- City Government Representative
- Sheboygan Area School District Representative
- Lakeshore Technical College Representative
- Sheboygan County Representative
- Public Member

Library Board (10 Members)
- Alderperson H
- Sheboygan County Supervisor
- Superintendent – Sheboygan Area School District or Designee
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Ex-Officio Member
    - Library Director

Mayor's International Committee (Up to 17 Members)
- Alderperson G
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen

Mayor's Neighborhood Leadership Cabinet (13 Members)

- Mayor
- Alderperson H
- Director of Planning and Development or Designee
- Chief of Police or Designee
- Gateway Neighborhood Association Representative
- Ellis Historical Neighborhood Representative
- North Flats Neighborhood Association Representative
- Indiana Avenue Corridor Neighborhood Association Representative
- Sheboygan Neighborhood Pride Board President or Designee
- Neighborhood Association Alternates
    - Gateway Neighborhood Association Representative Alternate
    - Ellis Historical Neighborhood Representative Alternate
    - North Flats Neighborhood Association Representative Alternate
    - Indiana Avenue Corridor Neighborhood Association Rep. Alternate

City Plan Commission

- Mayor
- Alderperson I
- City Engineer
- Citizen
- Citizen
- Citizen

Redevelopment Authority (7 Members)

- Alderperson B
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen

B. Council Member Modification to:

Finance (and Personnel) Committee

- Alderperson A
- Alderperson B
- Alderperson C
- ~~Alderperson O~~
- ~~Alderperson P~~

(Receive duties of Strategic Fiscal Planning Committee)
(Receive duties of Salaries and Grievances Committee)

Public Protection and Safety Committee

- Alderperson F
- Alderperson G
- Alderperson H
- ~~Alderperson M~~
- ~~Alderperson N~~

(Receive duties of Law and Licensing Committee)

Public Works Committee

- Alderperson D
- Alderperson E
- Alderperson C
- ~~Alderperson K~~
- ~~Alderperson L~~

(Receive duties of Building Use Committee)

Senior Activity Center Commission (9 Members)

- Alderperson I
- ~~Alderperson J~~
- Citizen – Member of Friends of Senior Activity Center
- Citizen – Member of Friends of Senior Activity Center
- Citizen – Member of Friends of Senior Activity Center
- Citizen
- Citizen
- Citizen
- Citizen
- Citizen

Sheboygan Transit Commission (9 Members)

- Mayor
- Alderperson A – ~~Chair~~ Member of Finance and Personnel Committee
- Alderperson F – ~~Chair~~ Member of Public Protection and Safety Committee
- Alderperson D – ~~Chair~~ Member of Public Works Committee
- Director of Planning and Development or proxy
- Chief of Police or proxy
- Citizen
- Citizen
- Citizen
- Ex-Officio Member
    - Director of Transit and Parking

Sustainable Sheboygan Task Force (~~18~~ 17 Members)

- Alderperson E
- ~~Alderperson I~~
- Director of Public Works or Designee
- Director of Planning and Development or Designee

- Sheboygan County Government Representative
- Sheboygan Area School District Representative
- University of Wisconsin – Sheboygan Representative
- Sheboygan County Chamber of Commerce Representative
- Utility Company Representative
- Utility Company Representative
- Environmental Group Representative
- Small Business Owner
- Large Business Owner
- Private Industry Representative – Non-City Resident
- Private Industry Representative – Non-City Resident
- Private Industry Representative – City Resident
- Private Industry Representative – City Resident
- Private Industry Representative – City Resident

Housing Authority (5 Members)

- Alderperson I
- Citizen
- Citizen
- Citizen
- Citizen
- ~~Citizen~~

C. Elimination of:

Board of Contractor's Examiners
- Duties shifted to Board of License Examiners

Board of Electrical and Heating Examiners
- Duties shifted to Board of License Examiners

Board of Housing Appeals and Fair Housing Practices
- Duties shifted to City Plan Commission (fair housing) and Board of Appeals (housing appeals)

Building Use Committee
- Duties shifted to Public Works Committee

Capital Improvements Commission
- Duties shifted to respective Committees for each Department, then Finance Committee

Civil Service Commission
- Duties shifted to an Employee Based Committee

Collective Bargaining Committee
- Duties shifted to an Employee Based Committee

Emergency Planning and Preparedness Committee
- Duties shifted to an Employee Based Committee

Group Health Insurance and Wellness Committee
- Duties shifted to an Employee Based Committee

Law and Licensing Committee
- Duties shifted to Public Protection and Safety Committee

Salaries and Grievances Committee
- shifted to Finance Committee

Strategic Fiscal Planning Committee
- Duties shifted to Finance Committee

Example of possible committee assignments:

Alderperson	Monthly Meetings	Infrequent Meetings
A	Finance/Personnel	Shared Services
	Transit	
	Common Council	COTW
B	Redevelopment Authority	
	Finance/Personnel	
	Common Council	COTW
C	Marina/Park/Forestry	
	Public Works	
	Common Council	COTW
D	Transit	Shared Services
	Public Works	
	Common Council	COTW
E	Sustainable	
	Public Works	
	Common Council	COTW
F	Transit	Shared Services
	Public Protection	
	Common Council	COTW
G	International	
	Public Protection	
	License Examiners	
	Common Council	COTW
H	Library	Neighborhood
	Public Protection	
	Common Council	COTW
I	City Plan	Housing Authority
	Senior Activity	
	Common Council	COTW
J	Finance/Personnel	Historic Preservation
	Architectural Review	
	Common Council	COTW

OFFICE OF THE CITY CLERK
Sheboygan, Wisconsin
CITY HALL

I hereby certify that this is a true copy of a document from the Common Council proceedings of the City of Sheboygan.

Susan Richards
City Clerk

Subs. of Charter Ord. No. 1 - 15 - 16. By Alderpersons Carlson and Belanger. November 16, 2015.

AN ORDINANCE (being subject to the home rule provisions of sec. 66.0101 of the Wisconsin Statutes) to reduce the number of alderpersons in the City of Sheboygan from 16 to 10 by the 2018-2019 council year.

THE COMMON COUNCIL OF THE CITY OF SHEBOYGAN DO ORDAIN AS FOLLOWS:

Section 1. The City of Sheboygan hereby elects, pursuant to the provisions of Sec. 62.09(1)(b) of the Wisconsin Statutes and the home rule provisions of Sec. 66.0101 of the Wisconsin Statutes, to reduce the number of alderpersons in the City of Sheboygan from sixteen (16) to ten (10) by the 2018-2019 council year in the following manner:

A. In the Spring election of 2017, the eight (8) aldermanic positions up for election for the 2017-2018 council year (one from each district) shall be elected for a term of one (1) year.

B. In the Spring election of 2018, the number of aldermanic positions up for election for the 2018-2019 council year shall be reduced to ten (10) (one from each district, with aldermanic districts being equivalent to county supervisory districts), with the five (5) alderpersons in the five (5) odd-numbered aldermanic districts being elected for terms of two (2) years and the five (5) alderpersons in the five (5) even-numbered aldermanic districts being elected for terms of one (1) year.

C. Thereafter, the five (5) alderpersons from the even-numbered aldermanic districts shall be elected in the even-numbered years for terms of two (2) years and the five (5) alderpersons from the odd-numbered aldermanic districts shall be elected in the odd-numbered years for terms of two (2) years.

Section 2. Section 2-224(c) of the Sheboygan Municipal Code, relating to terms of office for alderpersons, shall be repealed and recreated to read as follows:

"Sec. 2-224. *Terms.*

. . .

(c) *Alderpersons.*

(1) The term of alderperson shall be two years, with the following exceptions:

a. The eight alderpersons elected in 2017 shall serve terms of one year; and

b. The five alderpersons elected in 2018 in the even-numbered aldermanic districts shall serve terms of one year.

(2) The alderpersons shall be residents of the aldermanic district from which they are elected, and commencing in 2019 and thereafter, five of their number, representing one alderperson from each of the five even-numbered districts in even-numbered years, and one alderperson from each of the five odd-numbered districts in odd-numbered years shall be elected."

Section 3. All ordinances or parts thereof in conflict with the provisions of this ordinance are hereby repealed to the extent of such conflict.

Section 4. This is a charter ordinance and shall take effect sixty (60) days after its passage and publication, unless within such sixty (60) days after its passage and publication a referendum petition shall be filed as provided in sec. 66.0101 of the Wisconsin Statutes, in which event this ordinance shall not take effect until it shall have been submitted to a referendum of the electors and approved by a majority of the electors voting thereon.

Subs of Charter

I HEREBY CERTIFY that the foregoing Ordinance was duly passed by the Common Council of the City of Sheboygan, Wisconsin, on the 16th **day of** November, 2015.

Dated November 18, 2015. Susan Richards, City Clerk

Approved November 18, 2015. Michael Vandersteen, Mayor

Proceedings Published November 21, 2015.
Ordinances Published November 21, 2015.
Certified November 19, 2015 to - Atty.; Muni Code; Ord. Book; Mayor; Secretary of State

GEOGRAPHIC INFORMATION SYSTEM EMERGENCY SERVICES RESPONSE CAPABILITIES ANALYSIS

FINAL REPORT

International Association of Fire Fighters
1750 New York Avenue, N.W.
Washington, DC 20006

Sheboygan Fire Department

Sheboygan, Wisconsin

June 2016

Dedication

This Report is Dedicated to the Citizens of Sheboygan, WI who Deserve the Most Efficient and Effective Fire, Rescue, and Emergency Medical Services Available.

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Table of Contents

Executive Summary

The International Association of Fire Fighters (IAFF) Headquarters was engaged by the Sheboygan Fire Department, IAFF Local 483, to provide information and resources to decision makers of the City of Sheboygan regarding the impact of the reduction in staffing levels and proposed station consolidation on Fire Department capabilities. Currently, the Sheboygan Fire Department maintains five fire stations housing apparatus which are not staffed appropriately to provide for effective, efficient, and safe staffing levels required by industry standards. This document will discuss the importance of maintaining safe and effective staffing levels and the impact on service when these levels are not met.

This computer-based analytical study examines predicted travel times and geographic coverage areas for emergency response units deployed from existing and proposed fire station locations in the Sheboygan Fire Department response jurisdiction under existing and proposed scenarios. It has been proposed that a new fire station be constructed and that this station will effectively consolidate 2 of the current fire stations in Sheboygan. Each proposal features the closure of Stations 1 and 2 and the re-deployment of a majority of those resources to a new station. The City has identified three possible general locations for the new station. This study will examine the possible implications of this consolidation by analyzing response coverage from each of these locations and comparing the results to current capabilities.

Located in Sheboygan, WI, the Sheboygan Fire Department provides fire suppression, vehicle and industrial extrication, ice/water and fast water rescue, hazardous materials response, confined space and low angle rescue, EMS first response, and Advanced Life Support (ALS) and Basic Life Support (BLS) ambulance response and transport. According to the 2010 Census, the City had a population of 49,288.[1] In addition to all-hazard emergency responses, the Department performs other services for the City such as fire prevention and safety education programs, which include fire-safety inspections.

A brief risk analysis was performed on the City of Sheboygan to assess the need for emergency services. An assessment of the 2010 Census revealed that 21.4% of the population were in a vulnerable category. This category consists of persons under the age of 5 (7.5%) and persons 65 years of age and older (13.9%), but does not include the special needs population. Additionally, 14.8% of the population was living at or below the poverty level. There were 20,917 housing units, consisting of single or semi-detached houses (61.5%), multifamily housing structures containing 2 or more apartment units (36.8%), and other dwellings including mobile homes (1.7%). Of these structures, 32.6% were constructed between 1940 and 1970, and 36.2% were

[1] U.S. Census Demographic Profile of Sheboygan, WI: General Population and Housing Characteristics: 2010, <http://factfinder.census.gov/bkmk/table/1.0/en/DEC/10_DP/DPDP1/1600000US5572975> visited May 31, 2016.

built 1939 or earlier. Typically, when there are high numbers of vulnerable citizens and older buildings constructed before current fire codes were developed, there is an increased demand on emergency services. Given these numbers, the Department is likely to have a high and steady call volume now and in the future.

The Sheboygan Fire Department current staffing levels are out of compliance with industry standard performance objectives. Stations 1, 2, and 3 typically supplements on-scene total staffing with firefighter/paramedic assigned to the same station. The department is not in compliance with industry standards by splitting crews, and should appoint permanently assigned personnel. Furthermore, Stations 4 and 5, presently utilize quint apparatus. A quint, is a fire truck apparatus, that is serves the dual purpose of an engine and a ladder truck. Normally, these quint trucks take on ladder truck operations when arriving on scene. Although when these quints are first due, they may start engine responsibilities. Delays then may ensue when these roles are shifted to truck as a designated engine truck arrives on scene.

Key Findings

- Analysis of the Sheboygan Fire Department reveals that some suppression companies (including engine companies at Stations 4 and 5) typically deploy with two or three firefighters, out of compliance with industry standards.

- Sheboygan's fire suppression apparatus are staffed with as few as two personnel. Apparatus not staffed with a minimum of four firefighters are not in compliance with the company staffing objectives outlined in National Fire Protection Association (NFPA®) 1500, *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. Because units are not staffed with four, Sheboygan firefighters must rely on supplemental personnel arriving later before making entry into environments that are immediately dangerous to life and health (IDLH), such as structure fires, in order to comply with industry standards and U.S. Occupational Safety and Health Administration (OSHA) rules and regulations.

- The Sheboygan Fire Department typically supplements the engine company crews with staff assigned to the medic units by deploying an engine and ambulance together on all call types, whether it be for suppression incidents or EMS responses. If an EMS call necessitates transport to a medical facility, the engine may be deployed alone and will only have a crew of two firefighters. This practice can create significant delays to the overall emergency response system. This reduces both fire protection and EMS response capabilities within the jurisdiction.

- According to emergency call volume data provided by the Sheboygan Fire Department from 2012 through September 2015, the Department responded to 13,810 emergency incidents. The coverage of emergency incidents with current capabilities to establish "2 In/2 Out" within 4 minutes in Sheboygan is severely insufficient. There are a few areas outside of the 4-minute response capabilities with high incident densities.

- The Sheboygan Fire Department has lost several positions through attrition in recent years, including 3 in 2012. Since January 2016, there have been 3 positions that have not been filled, lowering the daily minimum staffed total from 17 to 16 personnel. The reduction in daily staffing furthers the inconsistency with industry standards.

- Each proposed station location arrangement decreases the response coverage area to which apparatus can arrive within 4 minutes of travel. Currently, firefighters can reach 72.2% of roads within 4 minutes.

- None of the proposed staffing and deployment scenarios will increase staffing on engine companies to the minimum of 4 firefighters required by industry standards. Instead, engine companies will continue to deploy with two to three firefighters on a daily basis.

- NFPA 1710 requires the first arriving company at a structure fire to be on scene within 4 minutes to 90% of incidents. The standard also requires a minimum of four personnel on all suppression apparatus. Currently, these requirements can only be met on 48.7% of roads. The lack of resources in Sheboygan significantly contributes to the fire department's inability to provide for safe and effective fireground operations.

- A fire department should be designed to adequately respond to a number of emergencies occurring simultaneously. With supplemented staffing between the engines and medic units, as firefighter/paramedic crews are deployed to EMS incidents, the amount of fire response coverage available drastically lowers. When all medic units (3 companies total) are unavailable, Sheboygan Fire Department can only respond with four personnel within 4 minutes on 19.0% of roads.

- Based on this geographic information system assessment of the areas within the Sheboygan city limits, a good measure of area roads are not currently serviced within safe and effective time frames as illustrated in this report. When fully staffed, the Sheboygan Fire Department only provides for the arrival of 15 firefighters on approximately 15.6% of roads within the Sheboygan area within 8 minutes. The arrival of 15 firefighters within 8 minutes is considered to be the standard for safe, effective, and efficient operations at a typical residential structure fire[2].

[2] NFPA defines a typical structure fire as a fire occurring in a 2,000 sf. ft. single family home with no exposures and no basement.

- Any reduction of Sheboygan Fire Department resources, especially on-duty and immediately available firefighters, will dramatically worsen performance. This increases the risk of death or injury due to fire for both citizens and firefighters of Sheboygan, as well as significantly increases the risk of considerable property loss for housing units in many areas of the city.

- In Stations 4 and 5, fire truck apparatus are quints and generally perform ladder operations. If the truck company arrives on scene first it may be directed to start engine operations. Once additional apparatus arrives on scene, the truck company will transition to ladder operations. This practice is inefficient as the truck company may have to re-position itself in order to perform ladder operations delaying life-saving fire suppression and rescue tasks.

- Station 5 houses an engine and a ladder truck, where the practice of cross-staffing apparatus is utilized. This requires personnel to move between different apparatus based on the type of emergency to which they are responding. Cross-staffing leaves front-line suppression and EMS resources potentially unstaffed and creates the possibility of personnel being out of the station, but available, with the wrong type of apparatus when an incident occurs. This requires firefighters to first return to the station, move personal protective equipment to another unit, and then respond. This can create significant delays to an emergency response. Cross-staffing reduces fire protection capabilities and creates unnecessary response delays to both fire and EMS incidents.

- Sheboygan Fire Department typically supplements the Battalion Chief (Command) position with previously scheduled firefighter personnel. By not having a permanently assigned Battalion Chief, there is a decrease in fire apparatus staffing. In addition, the Department should also increase staffing to provide the dedicated Battalion Chief with a dedicated staff aide, as required by NFPA 1710.

IAFF Recommendations

Additional staffing is required to bring the Sheboygan Fire Department closer to compliance with NFPA 1710 performance objectives and to enhance firefighter safety and effectiveness. This finding is reflected in the following recommendations:

- Increase staffing on all engine companies to at least four multi-role firefighters at all times in compliance with NFPA 1710 and NFPA 1500 staffing performance objectives.

- Increase staffing on all ladder companies to at least four multi-role firefighters at all times in compliance with NFPA 1710 and NFPA 1500 staffing performance objectives.

- The Department should provide the Battalion Chief with a command aide.

Executive Summary Conclusion

This analysis assessed the existing deployment of the Sheboygan Fire Department as well as 3 proposed plans to merge the resources of two currently existing fire stations into a combined station at a new location. Three separate locations were proposed and analyzed. Each proposal follows these details: Station 1, currently staffed with two firefighters and two firefighter/paramedics that staff an engine and an ambulance, and Station 2, currently staffed with two firefighters and two firefighter/paramedics that staff a rescue truck (engine) and an ambulance, will be closed. A new station will be staffed by four firefighters and two firefighter/paramedics and deploy one engine, the rescue, and one ambulance. One ambulance and two firefighter/paramedics will be relocated to Station 4, which is currently void of ALS resources.

Both current and proposed staffing levels place the Sheboygan Fire Department out of compliance with industry standard performance objectives. Under-staffed units will increase risk to the firefighters, citizens and visitors of Sheboygan. Additional staffing and resources will improve the ability to provide for the arrival of an effective firefighting force within 8 minutes in Sheboygan. Furthermore, additional staffing and resources will improve the ability to respond to medical or fire emergencies in the event that some Department resources are already in service, responding to other calls.

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Background

The International Association of Fire Fighters (IAFF) Headquarters was engaged by the Sheboygan Professional Fire Fighters, IAFF Local 483, to create a data-driven document for decision makers in Sheboygan to assist with informed decisions regarding emergency response.

Since 2008, when Sheboygan Fire Department was tasked with EMS ambulance services, the department has lost several positions through attrition, reducing the total number of personnel available for emergency response performance. Furthermore, there are currently 3 open positions that have not been filled, decreasing the minimum daily staffed personnel from 17 to 16. While Sheboygan Fire department staffing has declined in recent years, the responsibilities involved for effective emergency response has stayed the same, threatening safety and putting the community more at risk.

The high percentage of vulnerability within the population of Sheboygan is reflected in high volume and concentration of incident responses by the Sheboygan Fire Department. The proposed closure of Stations 1 and 2 in two highly concentrated areas of incident volume (ranked 1st and 3rd in incidents, respectively) will only increase the risk to citizens in the community. The Sheboygan Fire Department, currently and in all proposals, supplements engine company personnel with firefighter/paramedic crews. This requirement drains available personnel from front line apparatus companies, resulting in a condition that significantly impacts the overall emergency response system.

Sheboygan also employs quint apparatus in Stations 4 and 5, which serves generally as a ladder truck. In some cases, when arriving first, this quint apparatus may take on engine company duties which can cause delays later when roles change back to those of a ladder company when an engine arrives on scene. Typically, the Battalion Chief position is filled with an already scheduled firefighter, thus reducing the total personnel for fire suppression duties. Station closures and staffing reductions do not address the existing, severely insufficient response effectiveness of the Department.

The provision of fire protection is an essential service that governments must provide. The Department's current and proposed staffing protocols have apparatus staffed with less than 4 firefighters. Apparatus staffed with less than 4 firefighters will have to wait until a second apparatus arrives to initiate effective fire suppression and rescue operations following the Occupational Safety and Health Administration's (OSHA) "2 In/ 2 Out" regulation. Currently, the Fire Department is able to respond with a first-due company in 4 minutes or less on 72.2% of the roads in the City. Moreover, the department can only respond to 48.7% of city roads with a minimum of 4 firefighters within 4 minutes. Each proposal does not significantly improve, and

in some areas negatively impacts, Fire Department capabilities. This analysis will discuss the potential negative impacts of a City proposal to redeploy Fire Department personnel and resources. Furthermore, this analysis will discuss how existing staffing deficiencies can potentially be improved.

The information provided in this document is designed to help decision makers understand the depth of fire department operations and how low staffing levels negatively impact responders and citizens in the City.

Fire Suppression Operations

The business of providing emergency services has always been labor intensive, and remains so today. Although new technology has improved firefighting equipment and protective gear, and has led to advances in modern medicine, it is the firefighters who still perform the time-critical tasks necessary to contain and extinguish fires, rescue trapped occupants from a burning structure, and provide emergency medical and rescue services.

In less than 30 seconds a small flame can burn out of control and become a major fire. During fire growth, the temperature of a fire rises to above 1,000° Fahrenheit (F). It is generally accepted in the fire service that for a medium growth rate fire[3], flashover—the very rapid spreading of the fire due to super heating of room contents and other combustibles—can occur. Assuming an immediate discovery of a fire, followed by an un-delayed call to 9-1-1, and dispatch of emergency responders, flashover is likely to occur within 8 minutes of fire ignition. However, due to newer building construction materials and room contents that act as fuel, studies conducted by the Underwriters Laboratory (UL) and the National Institute of Standards and Technology (NIST), it was found that flashover can actually occur in as few as 4 to 5 minutes after ignition.

At the point of flashover, the odds of survival for unprotected individuals inside the affected area are virtually non-existent. The rapid response of an appropriate number of firefighters is therefore essential to initiating effective fire suppression and rescue operations that seek to minimize fire spread and maximize the odds of preserving both life and property. The appropriate number of personnel required for response to what is considered a low-hazard structure fire is 15. A low-hazard structure fire is a fire in a typical, 2,000 square foot, single-family residential home with no basement or exposures. [4]

[3] As defined in the *Handbook of the Society of Fire Protection Engineers*, a fast fire grows exponentially to 1.0 MW in 150 seconds. A medium fire grows exponentially to 1 MW in 300 seconds. A slow fire grows exponentially to 1 MW in 600 seconds. A 1 MW fire can be thought-of as a typical upholstered chair burning at its peak. A large sofa might be 2 to 3 MWs.

[4] NFPA 1710, 2016 ed. Pg. 1710-19 A.4.1.2.5.1

This section will explain fire growth and the importance of fire department response.

Fire Growth

The Incipient Phase

The first stage of any fire is the incipient stage. In this stage, a high heat source is applied to a combustible material. The heat source causes chemical changes to the material's surface which converts from a solid and begins to release combustible gases. If enough combustible gases are released, the material will burn freely.

This process is exothermic, which means it produces heat. The generated heat raises the temperature of surrounding materials, which in turn begin to release more combustible gases into the environment and begins a chemical chain reaction of heat release and burning. At this point, the fire may go out if the first object burns before another fire begins. Otherwise, the fire can progress to the next stage, the Free Burning Phase.

The Free Burning Phase

The second stage of fire growth is the "free" or "open burning" stage. When an object in a room starts to burn, (such as the armchair in Figure 1, following page), it burns in much the same way it would in an open area. In this phase of a fire, oxygen in the air is drawn into the flame and combustible gases rise to the ceiling and spread out laterally. Simultaneously, the burning materials continue to release more heat, which heats nearby objects and materials to their ignition temperature and they begin burning as well. Inside a room, unlike in an open area, confinement begins to influence fire development after a period of time. The combustible gases that have collected on the ceiling will eventually begin to have an adequate mixture of oxygen and combustible gases to begin burning. Thermal radiation from this hot layer will begin to heat the ceiling, upper walls, and all the objects in the lower part of the room. This will augment both the rate of burning for the original object and the rate of flame spread over its surface.

When this occurs, the structure fire reaches a critical point: either it has sufficient oxygen available to move onto the next stage or the fire does not have sufficient oxygen and progresses back to the Incipient Phase. However, since structures are not airtight, there is a low likelihood of the fire depleting all available oxygen. During this stage of fire growth, toxic chemicals released by the fire and high heat are enough to burn anyone in the immediate area and disorient and/or incapacitate others elsewhere in the structure. Without rapid response and aggressive intervention by an adequately staffed fire department, the fire will likely spread to the rest of the structure.

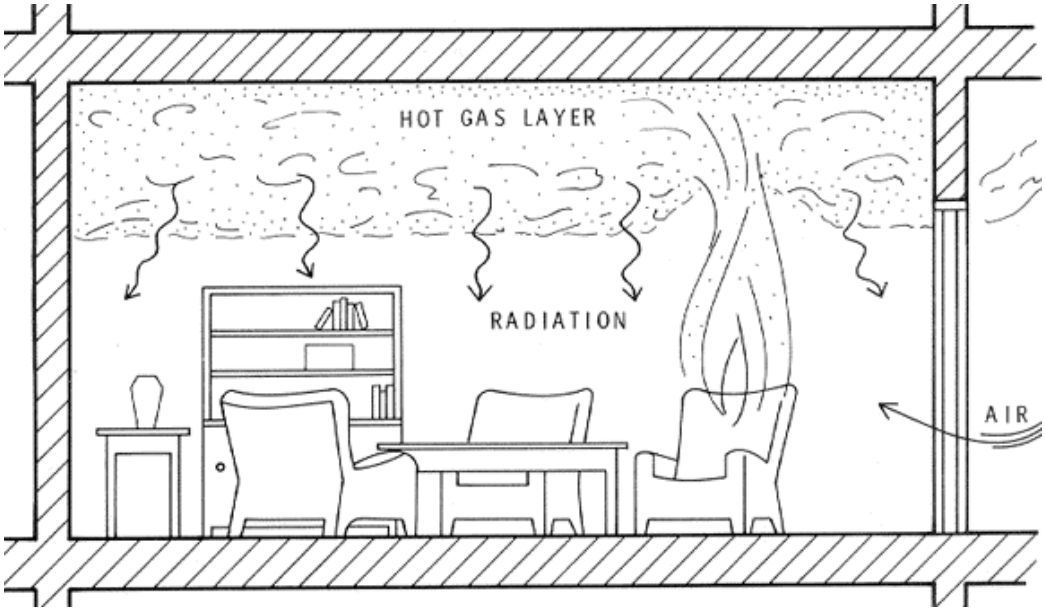


Figure 1: Fire Growth in a Compartment.[5] The above figure depicts the growth of fire in a compartment, which is an enclosed space or room in a building. In a compartment the walls, ceiling, floors, and objects absorb radiant heat produced by the fire. Unabsorbed heat is reflected back to the initial fuel source, which is depicted by the armchair above. This reflected heat continues to increase the temperature of the fuel source and therefore the rate of combustion. Hot smoke, combustible gases, and super-heated air will then rise to the ceiling and spread at first laterally across the ceiling, but later downward towards other fuel sources and the floor of the compartment. As this toxic, super-heated cloud touches cooler materials, the heat is conducted to them, thus increasing their temperature and eventually leading to pyrolysis, which is the process where a fuel source begins to release flammable vapor. This release of flammable vapor leads to further fire growth and eventually flashover. Flashover is the point at which all exposed fuel sources in a compartment ignite.

If the fire does continue to grow, the heating of the other combustibles in the room will continue to the point where they reach their ignition temperatures more or less simultaneously. If this occurs, all combustible materials in the room will spontaneously ignite. This transition from the burning of one or two objects to full room involvement is referred to as flashover.[6]

Flashover

Flashover, when it occurs, is the most significant event during a structure fire. As combustible gases are produced by the two previous stages they are not entirely consumed and are therefore available fuels. These "available fuels" rise and form a superheated gas layer at the ceiling that continues to increase, until it begins to bank down to the floor, heating all combustible objects regardless of their proximity to the burning object. In a typical structure fire, the gas layer at the ceiling can quickly reach temperatures of 1,200 degrees F. With enough existing oxygen at the floor level, flashover occurs, burning everything in the room at once. The instantaneous

[5] Image courtesy of University of California at Davis Fire Department
[6] J.R. Mehaffey, Ph.D., Flammability of Building Materials and Fire Growth, Institute for Research in Construction, 1987.

eruption into flame generates a tremendous amount of heat, smoke, and pressure. The pressure has enough force to push beyond the room of origin and through doors and windows. Usually at the time of flashover, windows in the room will break, allowing for the entry of fresh air. The introduction of fresh air serves to further fuel the growth of the fire by increasing the fire's temperature and spreading the fire beyond the room of origin.

Based on the dynamics of fire behavior in an unprotected structure fire, any decrease in emergency unit response capabilities will correlate directly with an increase in expected life, property, and economic loss.

The Importance of Adequate Staffing: Concentration

NFPA 1500 and 1710 both recommend that a minimum acceptable fire company staffing level should be four members responding on, or arriving with, each engine and ladder company responding to any type of fire.

A prime objective of fire service agencies is to maintain enough strategically located personnel and equipment so that the minimum acceptable response force can reach a reasonable number of fire scenes before flashover is likely. [7] Two of the most important elements in limiting fire spread are the quick arrival of sufficient numbers of personnel and equipment to attack and extinguish the fire as close to the point of origin as possible, as well as rescue any trapped occupants and care for the injured. Rapid and aggressive interior attack of structure fires, as close as possible to the point of origin, can reduce human and property losses. Sub-optimal staffing of arriving units may delay such an attack, thus allowing the fire to progress to more dangerous conditions for firefighters and citizens. "If the arriving units have adequate resources to handle the situation, then they will fight the fire aggressively and offensively. They will attack the problem head-on and, following department standards, will accomplish their objectives efficiently, effectively, and safely. If they do not have adequate resources to aggressively handle the situation, then they will have to fight the fire in a defensive mode of attack. This mode will continue until enough resources can be massed to then change to an aggressive, offensive attack." [8]

Staffing deficiencies on primary fire suppression apparatus also negatively affect the ability of the fire department to safely and effectively mitigate emergencies and therefore correlate directly with higher risks and increased losses. Continued fire growth beyond the time of firefighter on scene arrival is directly linked to the time it takes to initiate fire suppression operations. As indicated in Table 1(following page), responding companies staffed with four firefighters are

[7] University of California at Davis Fire Department website; site visited June 7, 2004.
< http://fire.ucdavis.edu/ucdfire/UCDFDoperations.htm >
[8] National Institute for Occupational Safety and Health, High-Rise Apartment Fire Claims the Life of One Career Fire Fighter (Captain) and Injuries Another Career Fire Fighter (Captain) – Texas, 21 October 2002

capable of initiating critical fire ground operational tasks more efficiently than those with crew sizes below industry standards.

Engine Company Duties					Ladder Company Duties			
Fireground Tasks	**Advance Attack Line**	**% Change**	**Water on Fire**	**% Change**	**Primary Search**	**% Change**	**Venting Time**	**% Change**
4 Firefighters	0:03:27		0:08:41		0:08:47		0:04:42	
3 Firefighters	0:03:56	12% Less Efficient	0:09:15	6% Less Efficient	0:09:10	4% Less Efficient	0:07:01	32% Less Efficient
2 Firefighters	0:04:53	29% Less Efficient	0:10:16	15% Less Efficient	0:12:16	28% Less Efficient	0:07:36	38% Less Efficient

Table 1: Impact of Crew Size on a Low-Hazard Residential Fire.[9] The above table compares and contrasts the efficiencies of suppression companies in the completion of critical tasks for fire control and extinguishment. The smaller the crew size, the more tasks an individual must complete as a team member, which contributes to the delay in initiating fire attack and contributes to diminished efficiency in stopping fire loss. The Department currently staffs two to three firefighters on each suppression apparatus.

First-arriving companies staffed with four firefighters are more efficient in all aspects of initial fire suppression and search and rescue operations compared to two- or three-person companies. There is a significant increase in time for all the tasks if a company arrives on scene staffed with only three firefighters compared to four firefighters. According to the NIST Report on Residential Fireground Field Experiments, four-person crews are able to complete time critical fireground tasks 5.1 minutes (nearly 25%) faster than three-person crews. The increase in time to task completion corresponds with an increase in risk to both firefighters and trapped occupants.

With four-person crews, the effectiveness of first-arriving engine company interior attack operations increases by 12% to 29% efficiency compared to three- and two-person crews respectively. The efficacy of search and rescue operations also increases by 4% to 28% with four-person crews compared to three- and two-person crews. Moreover, with a four-person company, because the first-in unit is staffed with a sufficient number of personnel to accomplish its assigned duties, the second-in company does not need to support first-in company operations and is therefore capable of performing critical second-in company duties.

[9] Averill, J.D., e al. Report on Residential Fireground Experiments. NIST Technical Note 1661. National Institute of Standards and Technology; Gaithersburg, MD, April 2010.

At the scene of a structure fire, the driver/operator of the first engine company on the scene must remain with the apparatus to operate the pump. This leaves one firefighter to assist the operator in securing a water source from a hydrant and two firefighters to deploy a hoseline and stretch it to the fire. After assisting the operator, the third firefighter should begin to assist the other two firefighters with advancing the hoseline into the building and to the location of the fire. Before initiating fire suppression, the supervising officer of the first arriving engine company is also responsible for walking around the building to assess the situation, determine the extent of the emergency, and request any additional resources necessary to mitigate the fire.

Similarly, the driver/operator of the first arriving ladder company must remain with the apparatus to safely position and operate the aerial device while the other three firefighters also perform critical fireground tasks such as ventilation and search and rescue. Due to the demands of fireground activities, a fire attack initiated by companies with only three or fewer firefighters is not capable of affecting a safe and effective fire suppression and/or rescue operation until additional personnel arrive.

Insufficient numbers of emergency response units or inadequate staffing levels on those units exposes civilians and firefighters to increased risk, further drains already limited fire department resources, and stresses the emergency response system by requiring additional apparatus to respond from further distances. Failing to assemble sufficient resources on the scene of a fire in time to stop the spread and extinguish the fire, conduct a search, and rescue any trapped occupants puts responding firefighters and occupants in a dangerous environment with exponential risk escalation such that it is difficult to catch up and mitigate the event to a positive outcome.

The Importance of Crew Size to Overall Scene Time

Studies have shown that the more personnel that arrive on engine and ladder truck companies to the scene of a fire, the less time it takes to do all aspects of fire suppression and search and rescue. As units arriving with more firefighters increases, the overall time on the scene of the emergency decreases. In other words, the more firefighters available to respond and arrive early to a structure fire, the less time it takes to extinguish the fire and perform search and rescue activities, thus reducing the risk of injury and death to both firefighters and trapped occupants and reducing the economic loss to the property.

Overall Scene Time Breakdown by Crew Size		
Scenario	**Total Time**	**Efficiency**
4-Person Close Stagger	0:15:14	
3-Person Close Stagger	0:20:30	25% Less Efficient
2-Person Close Stagger	0:22:16	29% Less Efficient
4-Person Far Stagger	0:15:48	
3-Person Far Stagger	0:21:17	26% Less Efficient
2-Person Far Stagger	0:22:52	31% Less Efficient

Table 2: The Relationship between Crew Size and Scene Time. [10] The above table displays how companies staffed with larger crew sizes will be on the scene of an emergency for a shorter time than smaller sized companies. This lag on scene could be translated to mean that emergency resources will be unavailable longer to address other emergencies that may arise.

As Table 2 shows, units that arrive with only two firefighters on an engine or ladder truck are on the scene of a fire almost 7 minutes longer than units that arrive with four firefighters on each crew. Responding units arriving with only three firefighters on an apparatus are on the scene of a fire 5 to 6 minutes longer than units that arrive with four firefighters on each apparatus. In addition to crew size, the time between the arriving crews matters to overall effectiveness and total on scene time.

In the NIST study on the low hazard residential fire, close stagger was defined as a 1-minute time difference in the arrival of each responding company. Far stagger was defined as a 2-minute time difference in the arrival of each responding company. [11] [12] The results show a consistent pattern of units arriving with four firefighters in a close stagger or far stagger will

[10] Averill, J.D., et al. Report on Residential Fireground Field Experiments. NIST Technical Note 1661. National Institute of Standards and Technology; Gaithersburg, MD, April 2010.
[11] Ibid.
[12] One minute and two minute arrival stagger times were determined from analysis of deployment data from more than 300 U.S. fire departments responding to a survey on fire department operations conducted by the International Association of Fire Chiefs and the International Association of Firefighters.

decrease the overall time at the scene of the emergency compared to units that arrive with two or three firefighters, and are more efficient in fire suppression tasks as well.

Physiological Strain on Smaller Crew Sizes

The same NIST study also examined the relationship between crew size and physiological strain. Two important conclusions were drawn from this part of the experiments.

- Average heart rates were higher for members of small crews.
- These higher heart rates were maintained for longer durations.[13]

In 2014 alone, 57% of all firefighter fatalities were related to overexertion.[14] There is strong epidemiological evidence that heavy physical exertion can trigger sudden cardiac events.[15] Smaller crews are responsible for performing a number of task that are designed to be performed by multiple people and frequently in teams of two. This means that firefighters on smaller crews are required to work harder than larger crews to accomplish multiple tasks. Additionally, as discussed earlier, firefighters on smaller crews will also be working longer than larger-sized crews. Working harder and longer in high heat and dangerous stressful environments increases the likelihood of firefighters suffering an injury, or worse dying, as a result of overexertion.

Charts 1 and 2, on the following pages, highlight the cardiovascular impact on firefighters based on crew size for the first arriving engine and truck company. The heart rates of firefighters of crew sizes ranging from 2 to 5 firefighters were measured as they participated in the NIST study. The study was able to conclude that not only do smaller crews work harder and longer than larger crews, their heart rates are also more elevated for longer periods of time. This increases the risk of firefighters suffering an injury or death from overexertion. A firefighter suffering a medical emergency on the scene of a working fire, EMS, or rescue incident negatively impacts outcomes and increases the risk to the community, the citizen requiring assistance, and the firefighter.

[13] Averill, J.D., et al. Report on Residential Fireground Field Experiments. NIST Technical Note 1661. National Institute of Standards and Technology; Gaithersburg, MD, April 2010.
[14] Fahy, R.F., LeBlanc, P.R., Molis, J.L. (June, 2015) Firefighter Fatalities in the United States-2014. NFPA.
[15] Albert, C.A., Mittleman, M.A., Chae C.U., Lee, I.M., Hennekens, C.H., Manson, J.E. (2000) Triggering Sudden Death from Cardiac Causes by Vigorous Exertion. N Engl J Med 343(19):1355-1361

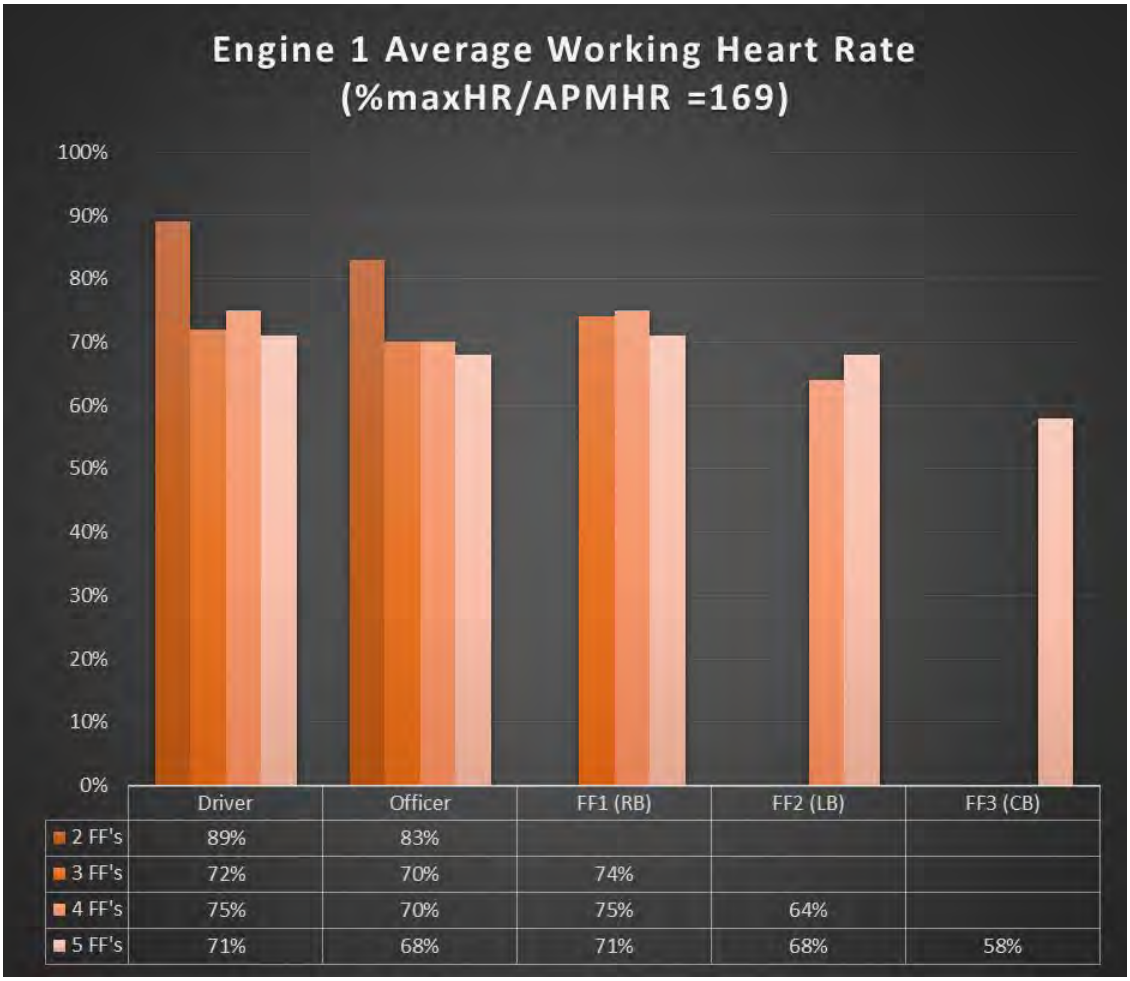
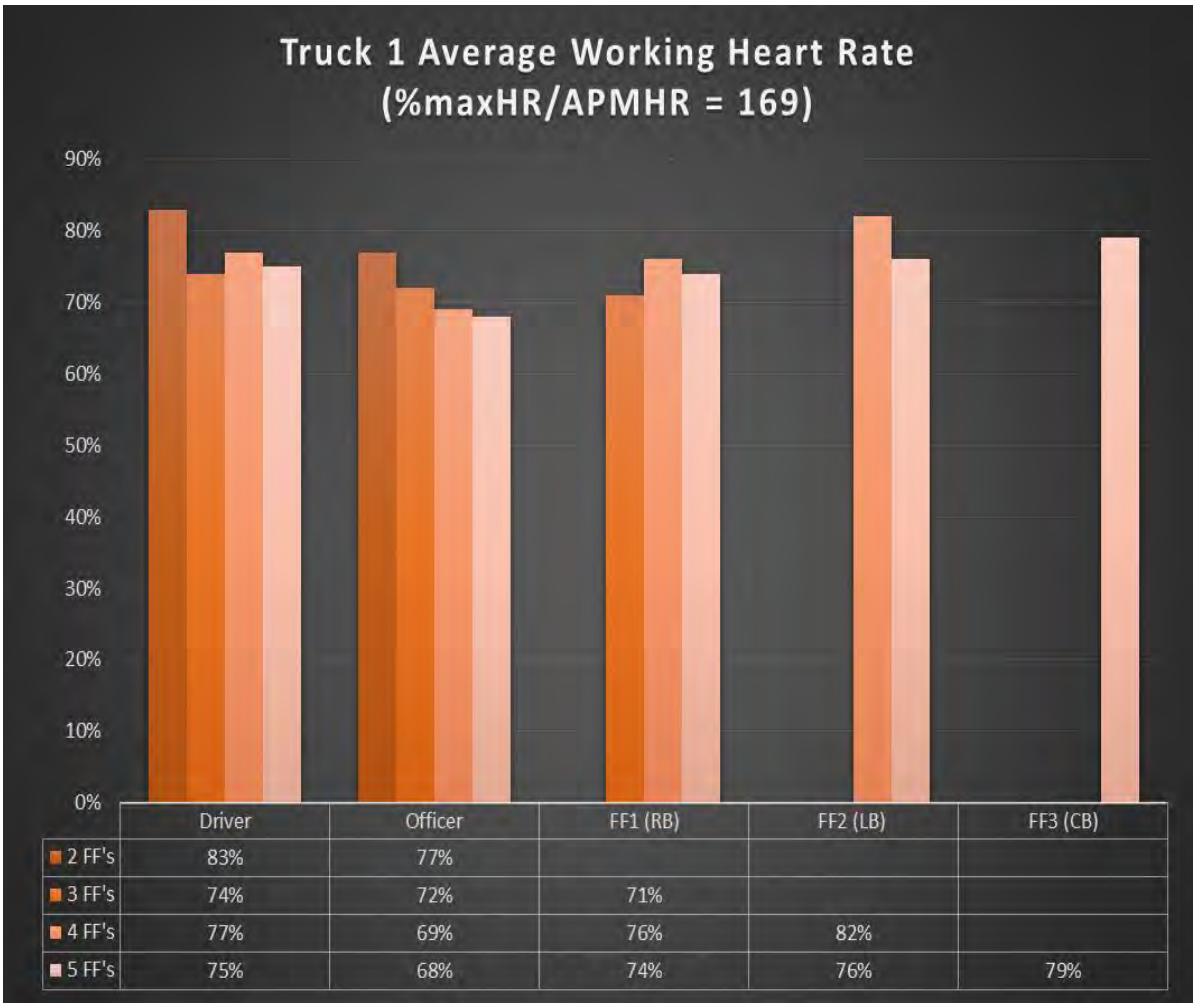


Chart 1: Average Peak Heart Rate of First Engine (E1) with Different Crew Sizes by Riding Position.[16] *In Chart 1, heart rates are expressed as a percent of maximal age-predicted maximal HR.* The average heart rates for firefighters on the first engine company were above 80% of age-predicted maximum values when only 2 firefighters were working. When staffing was at 2 firefighters, the driver of the apparatus had an average peak heart rate of nearly 90% of the age-predicted maximum. This is largely due to the number of additional tasks the driver must perform to prepare the engine to pump water to the fire and then join the officer to stretch hose to the fire. As can be seen, the larger the crew size, the lower the heart rate.[17] Decision makers could potentially reduce their liability for firefighter injury and death by ensuring staffing is compliant with the minimum recommended industry standards of four firefighters per apparatus.

[16] Riding position for Chart 1 are as follows: Driver, Officer, Firefighter 1-Right Bucket (RB) seat, Firefighter 2-Left Bucket (LB) seat, Firefighter 3- Center Bucket (CB) seat. A fire company that is staffed with 2 will consist of a Driver and an "Officer."

[17] Smith, D.L., Benedict, R. Effect of Deployment of Resources on Cardiovascular Strain of Firefighters. April, 2010. Pp 5-7



	Driver	Officer	FF1 (RB)	FF2 (LB)	FF3 (CB)
2 FF's	83%	77%			
3 FF's	74%	72%	71%		
4 FF's	77%	69%	76%	82%	
5 FF's	75%	68%	74%	76%	79%

Chart 2: Average Peak Heart Rate of First Truck (T1) with Different Crew Sizes by Riding Position.[18] *In Chart 2, heart rates are expressed as a percent of maximal age-predicted maximal HR.* The average heart rates for firefighters on the first truck company were above 80% of age-predicted maximum values when only 2 firefighters were working.[19] Decision makers could potentially reduce their liability for firefighter injury and death by ensuring staffing is compliant with the minimum recommended industry standards of four firefighters per apparatus.

[18] Riding position for Chart 2 are as follows: Driver, Officer, Firefighter 1-Right Bucket (RB) seat, Firefighter 2-Left Bucket (LB) seat, Firefighter 3- Center Bucket (CB) seat. A fire company that is staffed with 2 will consist of a Driver and an "Officer."

[19] Smith, D.L., Benedict, R. Effect of Deployment of Resources on Cardiovascular Strain of Firefighters. April, 2010. Pp 5-7

The Importance of a Rapid Response

Uncontained fire in a structure grows with every passing minute. Any delay in the initiation of fire suppression and rescue operations, such as the 5- to 7-minute delay that results from smaller sized crews of firefighters, translates directly into a proportional increase in expected property, life, and economic losses as is shown in Table 3, following page. It warrants emphasizing that if a structure has no automatic suppression or detection system, a more advanced fire may exist by the time the fire department is notified of the emergency and is able to respond. Fires of an extended duration weaken structural support members, compromising the structural integrity of a building and forcing operations to shift from an offensive to defensive mode.[20] As with inadequate staffing, this type of operation will continue until enough resources can be amassed to then change to an aggressive, offensive attack.

In the NIST study on the low-hazard residential fire, researchers also used fire modeling to mark the degree of the toxicity of the environment for a range of growth fires (slow, medium, and fast). Occupant exposures were calculated both when firefighters arrive earlier to the scene, and when arriving later. The modeling provided that the longer it takes for firefighters to rescue trapped occupants, the greater the risk posed to both the firefighters and occupants by increasing atmospheric toxicity in the structure.

[20] According to the NFPA, "it's important to realize that every 250 GPM stream applied to the building can add up to one ton per minute to the load the weakened structure is carrying."

Rate Per 1,000 Fires			
Fire Extension in Residential Structures:	Civilian Deaths	Civilian Injuries	Average Property Damage
Confined fires (identified by incident type)	0.00	10.29	$212.00
Confined to object of origin	0.65	13.53	$1,565.00
Confined to room of origin, including confined fires by incident type[21]	1.91	23.32	$2,993.00
Beyond the room, but confined to floor of origin	22.73	64.13	$7,445.00
Beyond floor of origin	24.63	60.41	$58,431.00

Table 3: The Relationship between Fire Extension and Fire Loss. [22] The above table displays the rates of civilian injuries and deaths per 1,000 fires, as well as the property damage. Following the far left column from top to bottom, each row represents a more advanced level of fire involvement in a residence. Typically, the more advanced the fire, the larger the delay in suppression. Assuming an early discovery of a fire, companies staffed with larger crew sizes help to minimize deaths, injuries, and property loss. This highlights why a 5- to 7-minute delay in suppression activities by smaller sized crews results in higher economic losses to a residence.

[21] NFIRS 5.0 has six categories of confined structure fires including cooking fires confined to the cooking vessel, confined chimney or flue fires, confined incinerator fires, confined fuel burner or boiler fires or delayed ignition, confined commercial compactor fires, and trash or rubbish fire in a structure with no flame damage to the structure or its contents. Homes include one- and two-family homes (including manufactured housing) and apartments or other multifamily housing. These statistics are national estimates based on fires reported to U.S. municipal fire departments and so exclude fires reported only to federal or state agencies. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Property damage has not been adjusted for inflation.

[22] National Fire Protection Association, NFPA 1710 (2016), Table A.5.2.2.2.1(b) Fire Extension in Home Structure Fires, 2006-2010.

OSHA's "2 In/2 Out" Regulation

The "2 In/2 Out" Regulation is part of paragraph (g)(4) of the United States Occupational Safety and Health Administration's revised respiratory protection standard, 29 CFR 1910.134. The focus of this important section is the safety of fire fighters engaged in interior structural firefighting. OSHA's requirements for the number of firefighters required to be present when conducting operations in atmospheres that are immediately dangerous to life and health (IDLH) also covers the number of persons who must be on the scene before firefighting personnel may initiate an interior attack on a structural fire.

An interior structural fire (*an advanced fire that has spread inside of the building where high temperatures, heat and dense smoke are normally occurring*) would present an IDLH atmosphere and, therefore, require the use of respirators. In those cases, at least two standby persons, in addition to the minimum of two persons inside needed to fight the fire, must be present before firefighters may enter the building.[23] [24] This requirement is mirrored in NFPA 1500, which states that "a rapid intervention team shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. Once a second team is assigned or operating in the hazardous area, the incident shall no longer be considered in the 'initial stage,' and at least one rapid intervention crew shall be required."

NFPA Standard 1710 also supports the OSHA regulation by requiring a minimum of four personnel on all suppression apparatus. Portions of the 1710 Standard recommend that "fire companies whose primary functions are to pump and deliver water and perform basic firefighting at fires, including search and rescue… shall be staffed with **a minimum of four on-duty members**,"[25] while "fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work… shall [also] be staffed with **a minimum of four on-duty members**."[26]

For either fire suppression company, NFPA 1710 states that "In jurisdictions with a high number of incidents or geographical restrictions, as identified by the AHJ,[27] these companies shall be staffed with a minimum of five on-duty members" and "In jurisdictions with tactical hazards, high-hazard occupancies, or dense urban areas, as identified by the AHJ, these companies shall be staffed with a minimum of six on-duty members."[28]

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[23] According to NFPA standards relating to fire fighter safety and health, the incident commander may make exceptions to these rules if necessary to save lives. The Standard does not prohibit fire fighters from entering a burning structure to perform rescue operations when there is a "reasonable" belief that victims may be inside.
[24] Paula O. White, letter to Thomas N. Cooper, 1 November 1995 (OSHA)
[25] NFPA 1710, § 5.2.3.1 and § 5.2.3.1.1
[26] NFPA 1710, § 5.2.3.2 and § 5.2.3.2.1
[27] Authority Having Jurisdiction.
[28] NFPA 1710, §5.2.3.1.2, § 5.2.3.1.2.1, § 5.2.3.2.2, and § 5.2.3.2.2.1.

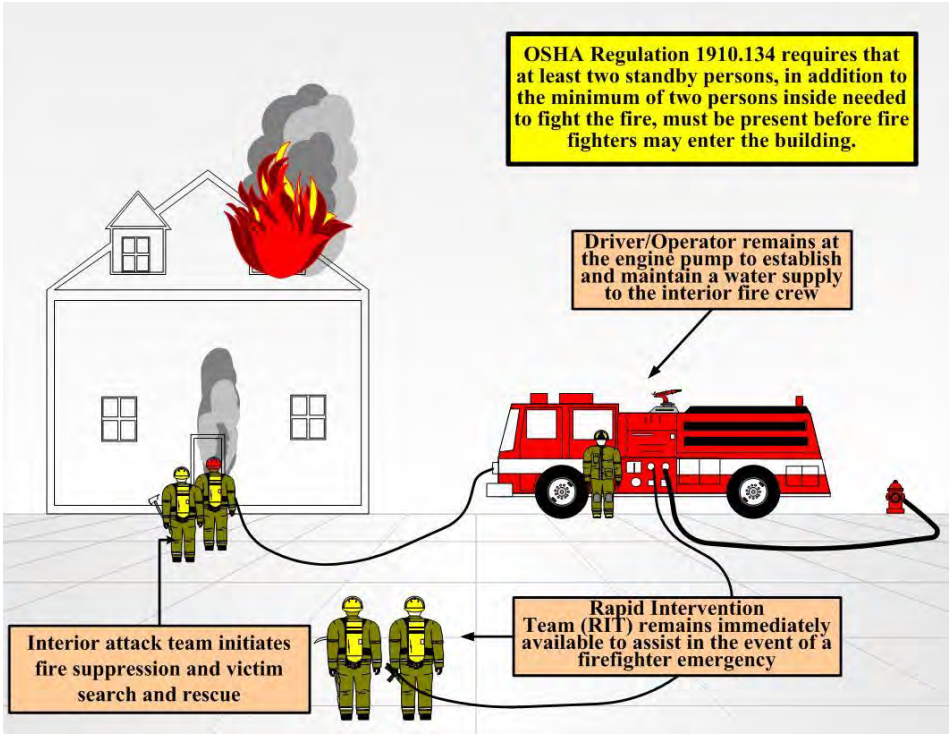

Figure 2: The OSHA "2 In/2Out" Rule. The above figure depicts the number of firefighters required to meet OSHA regulation 1910.134, which demands one firefighter outside for every firefighter inside. In this sense, the firefighters outside can support a secondary attack line and facilitate the rescue of trapped or disabled firefighters should the need arise. In this scenario, the driver/operator of the apparatus is not counted towards the total number of firefighters.

A number of incidents exist in which the failure to follow "2 In/2 Out" procedures have contributed to firefighter casualties. For example, in Bridgeport, Connecticut in July 2010, two firefighters died following a fire where NIOSH later found that although a "Mayday" was called by the firefighters, it wasn't responded to promptly as there was no Incident Safety Officer or Rapid Intervention Team (RIT) readily available on scene. In a second case, two firefighters were killed in a fire in San Francisco, California in June 2011. The initial RIT was re-assigned to firefighting duties, and the back-up RIT did not arrive on scene until after the victims were removed.

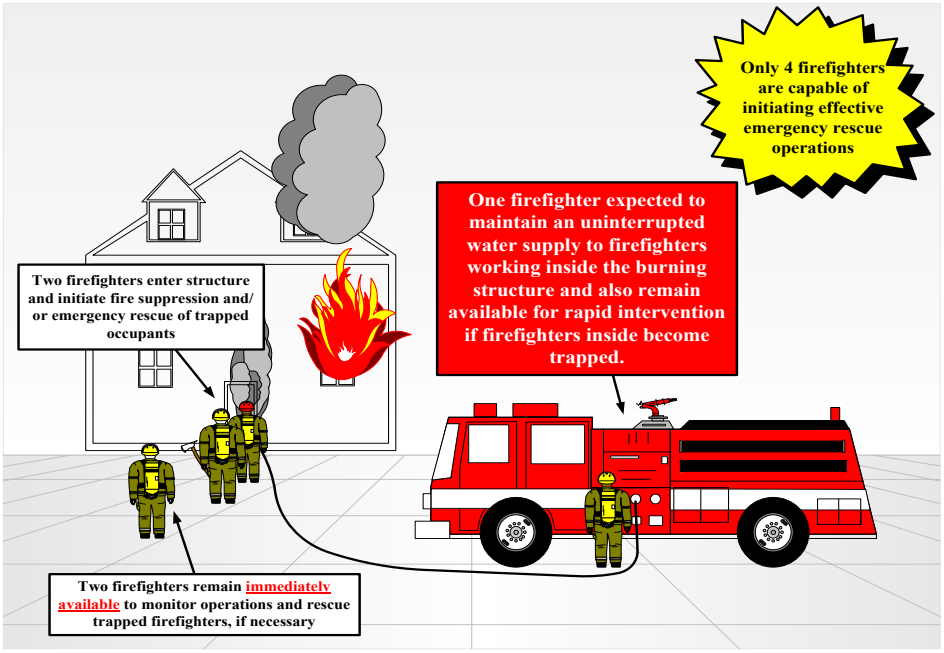

Figure 3: Emergency "2 In/2 Out" Operations. In the emergency model depicted above, the arriving fire apparatus is staffed with a crew of 4 personnel and operates under emergency conditions. In this case the driver/operator of the fire apparatus is also counted as a firefighter, which means that firefighter must be dressed in personal protective equipment (PPE) and be ready to participate in rescue if the need should arise.

When confronted with occupants trapped in a burning structure and a single fire company is on scene, only a company staffed with four firefighters is able to initiate emergency search and rescue operations in compliance with the "2 In/2 Out" Regulation. As indicated in the previous graphic, this requires the complete engagement of every firefighter from the first-in fire company, staffed with four, to participate in the effort, and means that the driver-operator of the apparatus must tend to the pump to ensure the delivery of water to the firefighters performing the initial attack and search and rescue operations and be prepared to make entry with the remaining firefighter should the crew operating inside become trapped.

Regardless, when there exists an immediate threat to life, only a company of four firefighters can initiate fire suppression and rescue operations in compliance with the "2 In/2 Out" regulation, and in a manner that minimizes the threat of personal injury. In crews with fewer than 4 firefighters, the first-in company must wait until the arrival of the second-in unit to initiate safe and effective fire suppression and rescue operations. This condition underlines the importance and desirability of fire companies to be staffed with four firefighters, and stresses the benefit of four-person companies and their ability to save lives without having to wait for the second-in company to arrive.

Initial Full Alarm Assignment

Initial Full Alarm Assignment Capability, as outlined in NFPA Standard 1710, recommends that the "fire department shall have the capability to deploy an initial full alarm assignment within a 480-second travel time to 90 percent of the incidents… [and that the] initial full alarm shall provide for the following:

Assignment	*Required Personnel*
Incident Command	1 Officer
Uninterrupted Water Supply	1 Pump Operator
Water Flow from Two Handlines	4 Firefighters (2 for each line)
Support for Handlines	2 Firefighters (1 for each line)
Victim Search and Rescue Team	2 Firefighters
Ventilation Team	2 Firefighters
Aerial Operator	1 Firefighters
Initial Rapid Intervention Crew (IRIC)	2 Firefighters
Required Minimum Personnel for Full Alarm	**14 Firefighters & 1 Scene Commander**

Table 4: NFPA 1710, §5.2.4.1.1. [29] This breakdown of the expected capabilities of a full alarm assignment, in compliance with NFPA 1710, requires a minimum contingent of 15 fire suppression personnel. NFPA 1710 also requires that supervisory chief officers shall be assisted by a staff aide which will increase on-scene staffing to 16 personnel required to arrive at the scene of a structure fire within 8 minutes of travel. Although not specifically discussed in the standard, an industry best practice is to have a second uninterrupted water supply which requires a second dedicated engine pump operator. This second, dedicated pump operator brings the total count of firefighters to 17.

[29] NFPA 1710, § 5.2.4.1

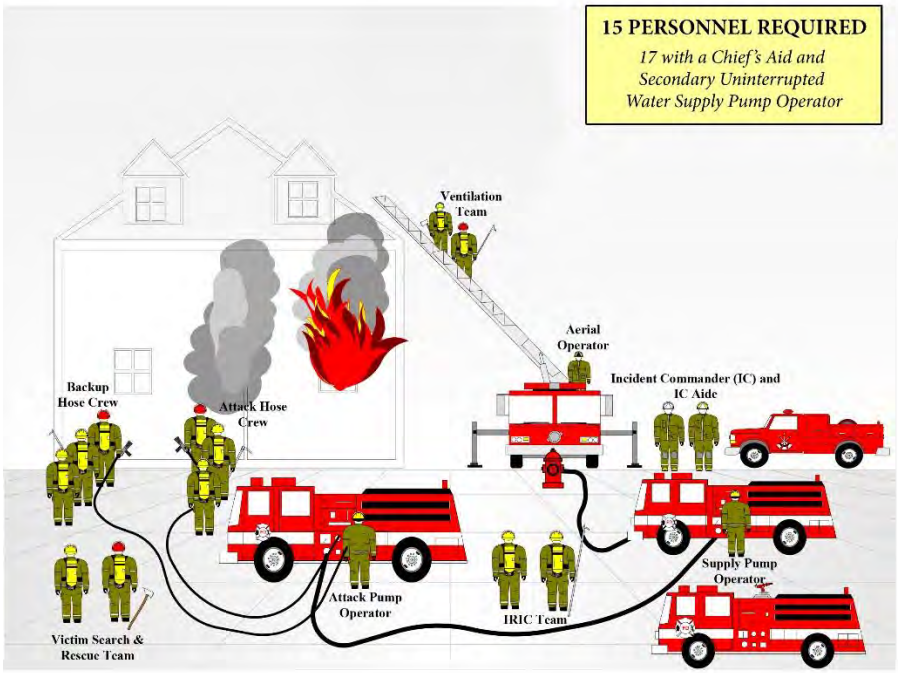

Figure 4: Initial Full Alarm Assignment Deployed Within 8 Minutes. The above figure depicts the full alarm assignment discussed in NFPA 1710, with an additional firefighter to act as an incident commander aide, and another additional firefighter to act as a pump operator for a supply apparatus.

In addition, NFPA 1710, §5.2.4.3.2 states, "The Fire Department shall have the capability for additional alarm assignments that can provide for additional command staff, members, and additional services, including the application of water to the fire; engagement in search and rescue, forcible entry, ventilation, and preservation of property; safety and accountability for personnel; and provision of support activities…" The Sheboygan Fire Department does not have the capability to respond to simultaneous requests for service that require multiple apparatus. Additionally, the Fire Department does not have sufficient resources to respond to medium- or high-hazard incidents.

The ability of adequate fire suppression forces to greatly influence the outcome of a structural fire is undeniable and predictable. Data generated by the NFPA provides empirical proof that a rapid and aggressive interior attack can substantially reduce loss of life and the loss of property associated with structural fires. Each stage of fire extension beyond the room of origin directly increases the rate of citizen fatalities, injuries, and property damage.

Fire growth is exponential, growing in a non-linear manner over time. Extending the time for crew assembly by waiting for additional crews to arrive causes on-scene risk to escalate. The higher the risks at the time firefighters engage in fire suppression, the greater the chance of poor outcomes including civilian injury or death, firefighter injury or death, and increased property loss.

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High-Rise Operations

Although this section specifically addresses fire response to high-rise buildings, it is important to note that the discussion can be extrapolated to large area buildings such as manufacturing centers, warehouses, grocery stores, schools, and other structures with a high fire load and populations.

Overview of High-Rises

High-rise buildings were once found exclusively in urban cities. However, today they are commonly found in small and mid-sized suburban communities as well. Many high-rise buildings in suburban areas are newer, shorter, and protected by automatic sprinkler systems, although this is not always a guarantee. NFPA 101, Life Safety Code, 2012 Edition and the International Code Council's International Building Code both define a high-rise structure as a building more than 75 ft. (23 m) in height, measured from the lowest level of fire department vehicle access to the bottom of the highest occupied floor. High-rises, which are described in NFPA 1710 §A.3.3.28 as high-hazard occupancies, represent an extraordinary challenge to fire departments and are some of the most challenging incidents firefighters encounter.

High-rise buildings may hold thousands of people above the reach of fire department aerial devices and the chance of rescuing victims from the exterior is greatly reduced once a fire has reached flashover. The risk to firefighters and occupants increases in proportion to the height of the building and the height of the fire above grade level.[30] This is especially true once firefighters are operating above the reach of aerial ladders on truck companies. In these situations, the only viable means of ingress or egress is the interior stairs. Therefore, a sound fire department deployment strategy, effective operational tactics, and engineered fire protection systems cannot be separated from firefighter safety. As in any structure fire, engine company and truck company operations must be coordinated.

High-rise buildings present a unique threat to the fire service. Multi-floor fires such as the Interstate Building Fire, One Meridian Plaza Fire, World Trade Center collapse, Cook County Administration Building Fire, and Deutsche Bank Building Fire each represented serious challenges to the operational capabilities of a modern fire department. According to the NFPA, between 2007 and 2011, there were an estimated 15,400 reported high-rise structure fires per year that resulted in associated losses of 46 civilian deaths, 520 civilian injuries, and $219 million in direct property damage. Office buildings, hotels, apartment buildings, and health care facilities accounted for nearly half of these high-rise fires.[31]

[30] Klaene, B. and Sanders, R. (2007). Structural Firefighting: Strategies and Tactics- High-Rise. Jones and Bartlett 2007.
[31] Hall, J.R. (2013), High-Rise Building Fires. NFPA.

Although the frequency of fires in high-rise structures is low, they pose a high consequence of loss with regards to injury, loss of life, and property damage. Even if a department does not respond to high-rise buildings at present, it may in the future as urban sprawl continues and/or jurisdictional border restrictions and population growth require taller buildings to meet residential needs.

High-Rise Firefighting Tactics

As has been stated, in a high-rise fire the risk to firefighters and occupants increases in proportion to the height of the building and the height of the fire above ground level. As the level of the fire floor gets higher, firefighters are required to carry more equipment further and must rely more on the building's standpipe system. A standpipe system is a piping system with discharge outlets at various locations usually located in stairwells on each floor in high-rise buildings that is connected to a water source with pressure supplemented by a fire pump[32] located in the building and/or a fire apparatus with pumping capabilities.

A fire in a high-rise building can threaten occupants and responding firefighters. Because of the amount of time it takes firefighters encumbered with equipment to access the involved floors, the fire may have expanded well past the area of origin. This means that firefighters can encounter a large volume of fire and darkened conditions when they arrive on the involved floors. This can be further complicated if the building is not equipped with a sprinkler system. Additionally, open-layout floor plans such as office buildings with cubicle farms can challenge both the standpipe's flow capacity and fire department resources in regards to search, rescue, and hoseline deployment. The most effective way to extinguish a high-rise fire is by mounting an offensive attack as early as possible, because in the vast majority of historic high-rise fires, the best life safety tactic is extinguishing the fire. Good high-rise firefighting tactics and firefighter/occupant safety cannot be separated. As with a residential structure fire, the first arriving suppression apparatus should be on the scene within four minutes of travel time. However, when responding to any high-hazard buildings or structures, which include high-rises, first responding fire apparatus should be staffed with five to six firefighters per NFPA 1710, upon the determination of the Authority Having Jurisdiction (AHJ).

Similar to residential structure fires, there are several critical tasks that must be accomplished. However, unlike residential firefighting in a 2,000 square foot residence, firefighters working at a high-rise fire must travel upwards of more than three stories and carry additional equipment beyond the normal requirements. Additionally, as it takes longer to assemble an effective firefighting force and to access the fire floor, firefighters are likely to encounter a large volume of fire and will therefore have an extended fire attack. Because of this, it is necessary to establish an equipment supply chain to transport equipment and resources up and down the building.

[32] Structural Firefighting Strategy and Tactics 2nd Edition. Klaene B., Sanders R. NFPA 2008

Search and Rescue

Search and rescue are critical fireground tasks that comprise a systematic approach to locating possible victims and removing those victims from known danger to a safe area. In a residential structure fire, searches are normally conducted by a crew of two firefighters, supplemented by an attack or ventilation crew. However, high-rise structures pose challenges regarding search and rescue that are not typically encountered in residential housing. For commercial high-rises and wide-area structures, large open areas and cubicle farms require additional search and rescue teams so that thorough searches can occur over a larger area than found in most residences. In addition to these larger areas, search and rescue can be further complicated because conscious victims may retreat to areas in an attempt to find shelter from heat and smoke. These areas may differ from places where they are typically seen by coworkers, making locating them difficult if they are unaccounted for.

In residential high-rises, apartments typically lack two exits and usually share a common hallway for egress. Doors left open by victims fleeing fire can allow fire and smoke to spread into the hallway and impact escape attempts. Firefighters will be slowed in their search since they will be required to force their way into numerous apartments to search for victims. For this reason, regardless of commercial or residential, it is essential for there to be multiple search and rescue teams operating per involved floor to quickly locate victims in large surface areas. It is also necessary for additional search and rescue teams to search the floors above the fire and the highest floor of the building, due to how fire and smoke spread to the rest of the building. Search and rescue teams should also be supplemented with evacuation management teams to assist injured or disabled victims down the stairwells so searching can continue. Because of the larger search area, NFPA 1710 requires a minimum of four firefighters for searching and a minimum of four firefighters for evacuation management teams.

Fire Extinguishment

Fire extinguishment is a critical factor, since the intensity and size of the fire will determine the extent to which combustion gases are heated and how high they will rise inside the building. Building suppression systems, both active and passive, can impact fire growth, occupant safety, and firefighter safety and effectiveness. Such features include active fire detection and automatic sprinkler systems that are designed to either extinguish the fire or contain it until firefighters arrive.

Once firefighters are on scene, they will complete a series of fire confinement and extinguishment tasks. Firefighters access the structure, locate the fire, locate any avenues of spread, place hoselines, and establish a water supply. Once a water supply is established, water should be placed at the seat of the fire or in the compartment containing the fire to extinguish it. Unlike residential structure fires where hoselines can be stretched from the fire apparatus into the

structure, high-rise structures require the use of standpipe systems to combat fire. This requires firefighters to carry multiple sections of hose to the affected floors and connect into the system to fight fire. Minimally, firefighters must deploy two hoselines to the involved floor and one hoseline to the floor above the fire. The third hoseline supports a number of critical tasks in the suppression effort. Principally, it is used to protect search and rescue teams, but also to stop the spread of fire as a result of conduction and convection through exposed pipes, metal framing, and ventilation systems.

Ventilation

Ventilation affects both search and rescue and fire extinguishment. Coordinated ventilation may be implemented at any time during the operation, but it should be coordinated with suppression and interior rescue activities. Ventilation is used to channel and remove heated air, smoke, fire gases, and other airborne contaminants. Applying proper ventilation at the right time and place is key to firefighter and occupant safety. Venting at the wrong time or place can draw active fire toward fresh air, which will injure or kill anyone in its path. In instances of high-rise fire suppression, adequate and appropriate ventilation is important to keep stairways free of smoke and noxious gases for victims who are evacuating.

Because of the size of high-rise buildings and high-hazard structures in general, a larger number of firefighters is required for a ventilation team than would be for a residential structure. NFPA 1710 recommends a minimum of four firefighters to be assigned to ventilation.

Support

As has been discussed, fire suppression in a high-rise or high-hazard structure requires the establishment of a supply chain to shuttle equipment to different locations. Additionally, with increased resources and personnel, there is an increased need for additional supervision and accountability.

One critical support variable in high-rise fire operations is the availability of reliable elevators. If firefighters can safely use the elevators to move people and equipment, fire-ground logistics may be significantly improved. When the fire is located several floors above ground level, there is a strong inclination to use the elevators. However, fire service access elevators[33] may not be available in all buildings. Therefore, adequate stairways are necessary for firefighters to transport equipment and reach the fire floor for suppression.

Moving supplies and staff up 10, 20, 30, or more stories is an arduous task. If it is not properly managed, firefighters may be exhausted and unable to fight the fire or rescue trapped occupants.

[33] A fire service elevator is engineered to operate in a building during a fire emergency and complying with prescriptive building code requirements and the American Society of Mechanical Engineers (ASME) A 17.1 safety standard for elevators.

Additionally, joint use of stairways by firefighters moving upward and occupants attempting to evacuate may increase the overall evacuation time of the occupants, as well as delay the firefighters' efforts to begin critical tasks such as fire suppression or search and rescue operations. As such, it is important to have multiple firefighters to help carry equipment upstairs and manage resource distribution.

To accomplish the critical fireground tasks associated with high-rise firefighting and meet the minimum staffing objectives for task completion, NFPA 1710 recommends the following company sizes for the first arriving unit(s) on the scene within four minutes of travel time for response to high-hazard structure:

- In jurisdictions with a high number of incidents or geographical restrictions, as identified by the AHJ, these companies shall be staffed by a minimum of five on-duty members.[34]
- In jurisdictions with tactical hazards, high-hazard occupancies, or dense urban areas, as identified by the AHJ, these fire companies shall be staffed with a minimum of six on-duty members.[35]

As indicated by the tasks that must be accomplished on a high-rise fireground, understanding the required resources is critical. The number of firefighters needed to safely and effectively combat a high-rise fire may be large. Although an offensive fire attack is the preferred strategy whenever conditions and resources permit, a defensive attack that limits operations to the outside of a building and generally results in more property damage must be considered when risks to firefighter safety are too great and benefits to building occupants are negligible. The offensive vs. defensive decision is based on a number of factors: fireground staffing available to conduct an interior attack, a sustained water supply, the ability to conduct ventilation, and risk vs. benefit analysis regarding firefighter and occupant safety. Table 7, on the next page, displays the minimum number of firefighters required to arrive in the first full alarm assignment to a high-rise fire.

[34] NFPA 1710. §5.2.3.1.2
[35] NFPA 1710. §5.2.3.1.2.1, §5.2.3.2.2, and §5.2.3.2.2.1.

Assignment	*Required Personnel*
Incident Command	1 Incident Commander 1 Incident Command Aide
Uninterrupted Water Supply	1 Building Fire Pump Observer 1 Fire Engine Operator
Water Flow from Two Handlines on the Involved Floor	4 Firefighters (2 for each line)
Water Flow from One Handline One Floor Above the Involved Floor	2 Firefighters (1 for each line)
IRIC/RIC Two Floors Below the Involved Floor	6 Firefighters
Victim Search and Rescue Team	4 Firefighters
Point of Entry Accountability	1 Officer 1 Officer's Aide
Evacuation Management Teams	4 Firefighters (2 per team)
Elevator Management	1 Firefighter
Lobby Operations Officer	1 Officer
Trained Incident Safety Officer	1 Officer
Staging Officer Two Floors Below Involved Floor	1 Officer
Equipment Transport to Floor Below Involved Floor	2 Firefighters
Firefighter Rehabilitation	2 Firefighters (1 must be ALS)
Vertical Ventilation Crew	1 Officer 3 Firefighters
External Base Operations	1 Officer
2 EMS ALS Transport Units	4 Firefighters
Required Minimum Personnel for Full Alarm	**36 Firefighters** **1 Incident Commander** **6 Officers**

Table 5: Number of Firefighters for an Initial Full Alarm to a High-Rise Fire. Fighting fire in high-rise structures poses many unique obstacles and challenges other than are found in a residential structure fire. Hose cannot be deployed directly from fire apparatus and needs to be carried, with other equipment, to the location of the fire. Search and rescue is impacted by large areas and accessibility concerns. Additionally, because of delays in access, firefighters are likely to encounter a high volume of fire which will necessitate a supply chain to equip ongoing suppression efforts. A single alarm response to a high-rise building minimally requires 43 responders, consisting of 36 firefighters, 1 incident commander, and 6 officers.

Fire Department EMS Operations

In recent years, the provision of emergency medical services has progressed from an amenity to a citizen-required service. More than 90% of career and combination fire departments provide some form of emergency medical care, making fire departments the largest group of prehospital EMS providers in North America. In many fire departments that deliver prehospital care, EMS calls can equate to over 75% of total call volume.

In an analysis of data from over 300 fire departments in the United States, first responder units, which are typically fire engines, arrived prior to ambulances approximately 80% of the time.[36] This is likely due to the fact that fire stations housing first responder units, which are equipped and staffed with dual-role firefighter/emergency medical service technicians and supplies, are more centrally located and are able to effect a quicker response and provide life-saving procedures in advance of an ambulance. This reinforces why it is in the best interest of the public good for the fire department to provide EMS transport as well as first response.

The benefit of supporting EMS transport within fire department operations is that fire departments are already geared towards rapid response and rapid intervention. Strategically located stations and personnel are positioned to deliver time critical response and effective fire suppression and are therefore equally situated to provide effective response to time critical requests for EMS service. Both fire suppression and EMS response are required by industry standards to have adequate personnel and resources operating on scene within 8 minutes.[37] In both fire suppression and EMS incidents, time is directly related to the amount of damage, either to the structure or the patient. By providing EMS patient transport to the residents and visitors of the City, the Sheboygan Fire Department has been able to provide a value-added service to the community. Fire-based EMS in Sheboygan is dedicated to providing care to the citizens while they are at their most vulnerable.

When ambulance response is prolonged, a patient will be further delayed in reaching a medical facility to receive definitive care. This is especially dangerous for incidents of chest pain, stroke, and survivable cardiac arrest. Many times, patients experiencing symptoms associated with these events may not recognize the onset indicators and immediately call for assistance.[38,39,40,41]

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[36] Lori Moore-Merrell and others, Report on Residential EMS Field Experiments, (September, 2010); pp. 10.
[37] NFPA 1720: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments
[38] American Heart Association, *Heart Disease and Stroke Statistics-2005 update,* Dallas, TX: AHA 2005
[39] Time from Symptom Onset to treatment and outcomes after thrombolytic therapy. Newby LK, et al. *J Am Coll Cardiol.* 1996:27:1646-1655
[40] An International Perspective on the Time to Treatment of Acute Myocardial Infarction. Dracup, K. et al. *J Nurs Scholarsh* 2003;35:317-323
[41] Prehospital and In-hospital Delays in Acute Stroke Care. Evanson, KR, et al. *Neuroepidemiology* 2001;20:65-76

Acute Coronary Syndrome (ACS), or heart attack, is the number one leading cause of death in the United States. Experts agree that an ACS event should receive definitive care from a hospital within one hour of onset of symptoms. One study found that definitive care for ACS within one hour of onset improves survivability by 50% and 23% if definitive care was given within 3 hours.[42]

Strokes, which are the number three cause of death in the U.S., as well as a leading cause of disability, also benefit from expedient treatment in definitive care. Ischemic stroke, which is a stroke caused from a blood clot, can be effectively treated if definitive care is received within 3 to 4.5 hours[43] of onset of symptoms. The sooner a patient receives definitive treatment from onset of symptoms, the less likely a patient is to suffer disability from this type of stroke. However, it is important to emphasize that before the time critical treatment can be administered to the patient in the hospital, there is a time intensive assessment that must be performed to ensure the patient is qualified to receive the treatment.

The current benchmark for an ischemic stroke patient "door to needle"[44] is less than or equal to 60 minutes. However, Steps Against Recurrent Stroke (STARS) registry shows that the median door to needle time is 96 minutes or 1 hour and 36 minutes.[45]

When fire departments provided EMS it is typically reserved for emergency responses and there is an increased likelihood that a patient will receive an ambulance and a first responding fire apparatus in not only a timely manner, but also frequently at the same, or close to the same time. This is extremely beneficial to the patient as most EMS responses, particularly the previously mentioned conditions, are labor intensive. Patients suffering from ACS should not perform any form of exertion as to minimize any damage that is occurring. Patients suffering from strokes are frequently unable to exert due to physical disabilities caused by the incident. A large crew is able to provide simultaneous interventions while assessment is being performed thereby reducing the on-scene time. Following completion of critical tasks, the crew can then facilitate a safe removal of the patient to the ambulance and minimize the risk of injury to patient and provider.[46]

One of the most labor intensive and time critical requests for EMS response is cardiac arrest, which globally affects 20-140 out of every 100,000 people. Traditionally, the American Heart Association (AHA) taught a method of cardiac resuscitation that involved single rescuer

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[42] Association of patient delays with symptoms, cardiac enzymes, and outcomes in acute myocardial infarction. Rawles, JM. Et al. *Eur Heart J.* 1990; 11:643-648.

[43] Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke. Hacke, W. et al. *N Engl J Med*. 2008;359:1317-1329

[44] "Door to Needle" is an industry specific term that refers to the time the patient entered the emergency department to the time the received the treatment. A drug named recombinant tissue plasminogen activator (rt-PA) is utilized to dissolve the thrombosis causing the stroke. Current FDA approvals limit this drug's use to 3-4.5 hours from initial symptoms and require a CT scan and labs before administration.

[45] Improving Door-to-Needle Times in Acute Ischemic Stroke: The Design and Rational for the American Heart Association/American Stroke Association's Target: Stroke Initiative. Fonarow, Gregg, et al. *Stroke* 2011;42:00-00

[46] National Institute of Standards and Technology Report on Residential EMS Field Experiments September, 2010

performance of prioritized action.[47] However, there was a gap between instruction and practice which led to confusion and may have potentially reduced survival. In reality, providers respond and function in teams larger than two.

The AHA's guidelines for cardiac resuscitation focuses on a team-centric approach. Evidence-based research suggests that the manner in which CPR was being performed was inherently inefficient and only provided 10-30% of the normal blood flow to the heart and 30-40% to the brain.[48,49] This was linked to provider fatigue from administering chest compressions, and as such, these studies indicate that providers should be rotated to ensure effective depth and rhythm of chest compressions. Consensus documents from the AHA recommend that providers should rotate with every two-minute cycle of CPR. It was also recommended that requests for EMS service for cardiac arrest also have a team leader to organize priorities and direct resources as they arrive or are needed. The team leader would also be responsible for identifying symptoms of fatigue and making appropriate assignment adjustments to ensure maximally efficient CPR.

Although the AHA and other researchers have not identified what an optimally sized crew for effective team-centric CPR should be, some consensus literature from the AHA has mentioned that five providers were best suited to perform resuscitation. However, providers may be required to perform multiple tasks. Industry best practices, through the guidance of Medical Directors, have suggested six providers would be most successful in minimizing confusion and redundancy.

An EMS crew consisting of six personnel would require four personnel arriving with the first responding fire apparatus and two with the ambulance.[50] For an all-ALS system, two of the six should be Paramedics, with a minimum of one assigned to each of the responding apparatus. Some ALS systems require two Paramedics on the ambulance and a minimum of one on the first responding fire apparatus. However, these deployment options are determined by State directive or Medical Director's discretion. Regardless of the make-up of the EMS certification level of the providers on scene, an ALS integrated cardiac arrest response should provide for the following: a lead provider, an airway manager, two providers to interchangeably deliver chest compressions, a provider to establish an intravenous medication line and administer medications, and a provider to operate the monitor.

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[47] Highlights of the 2010 American Heart Association Guidelines for CPR and ECC

[48] Determinants of Blood Flow during Cardiac Resuscitation in Dogs. Halperin, HR et al. *Circulation* 1986;73:539-550

[49] Increased Cortical Cerebral Blood Flow with LUCAS, a New Device for Mechanical Chest Compressions Compared to Standard External Compressions during Experimental Cardiopulmonary Resuscitation. Rubertson S, et al. *Resuscitation*. 2005;65:357-363

[50] NFPA 1917: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments

In Sheboygan, the ambulances and engine companies respond together on all incidents. If ambulance crews are assisting on a fire response, EMS patients will wait longer for medical care, which has the potential to exacerbate the underlying condition. Additionally, if outside agencies are being used to pick up some of these calls, the City may be losing revenue generated by transports. The City should review all call data to determine the amount of calls that are responded to outside of adopted response time goals. The City should then make the determination to increase staff and apparatus utilization to ensure all citizens receive expedient and appropriate care.

Fire Department Deployment Analysis

Before discussing the staffing and deployment analysis of Sheboygan Fire Department resources, it is imperative to understand the intricacies of distribution and concentration. Although adequate staffing is a key element contributing to positive outcomes, fire station location and apparatus deployment are equally important.

The Importance of Adequate Resources: Distribution

Distribution involves locating geographically distributed, ideal first-due resources for all-risk initial intervention. Distribution describes first due arrival. Station locations are needed to assure rapid deployment for optimal response to routine emergencies within the response jurisdiction. Distribution can be evaluated by the percentage of the jurisdiction covered by the first-due units within adopted public policy service level objectives.[51] In this case, distribution is measured by the percentage of roads that are covered from each fire station within 4- and 8-minute travel times to adhere to NFPA 1710 standards.

Distribution study requires geographical analysis of first due resources. Distribution measures may include:[52]

- Population per first due company
- Area served per first-due company (square miles)
- Number of total road miles per first-due company (miles)
- Dwelling unit square footage per first due company
- Maximum travel time in each first-due company's protection area
- Catchment areas (4-minute road response from all fire stations) to determine gap areas and overlaps of first-due resources
- Areas outside of actual performance
    1. Population not served
    2. Area not served (square miles)
    3. Road miles not served (miles)

[51] Commission on Fire Accreditation International, 5th Edition. 2008. Page 52.
[52] Commission on Fire Accreditation International, 5th Edition. 2008. Page 52.

4. Dwelling unit square footage not served

- First-due unit arrival times (Engine, Truck, ALS unit, etc.)

A major item to be considered in the distribution of resources is travel time. It should be a matter of public policy that the distribution of fire stations in the community is based on the element of travel time and the response goal. Travel time should be periodically sampled and analyzed to determine whether or not the fire department is achieving a reasonable response performance to handle emergencies.[53]

Evaluating a small number of incidents for response time performance does not reflect the true performance of the Department. Analyzing incident demand measured over a 3-5 year period will provide a more accurate assessment of the delivery system performance. Completing the same analysis over a period of time will allow for trend analysis as well.[54]

[53] Commission on Fire Accreditation International, 5th Edition. 2008. Page 53
[54] Commission on Fire Accreditation International, 5th Edition. 2008. Page 53

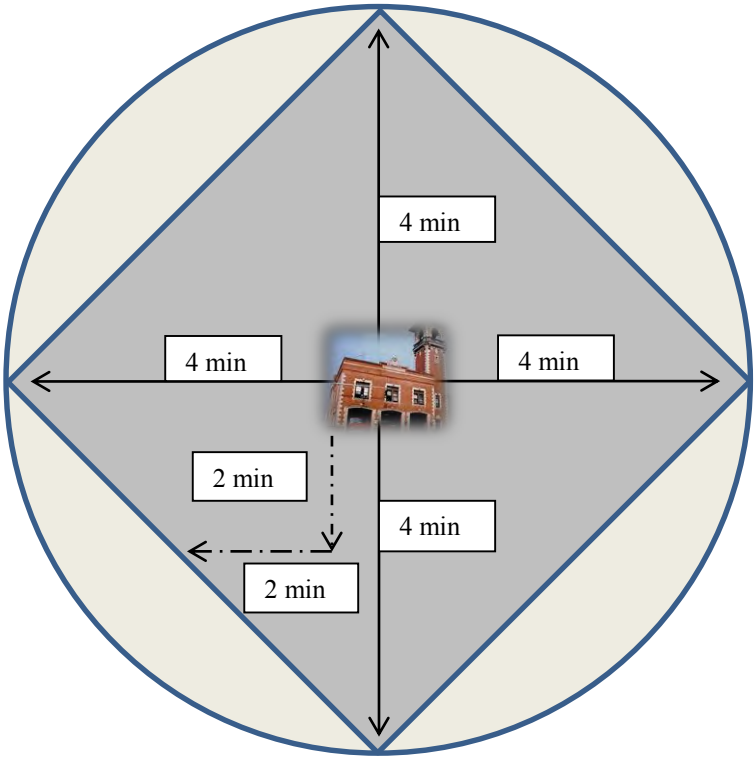


Figure 5: Normal Distribution Model for an Initial 4-Minute Response Area.[55] As depicted in the above figure, fire stations and emergency resources should be distributed throughout a community so that citizens receive equitable coverage and protection. However, there are additional points of concern when modeling a response district such as road network, traffic patterns, and building occupancies.

Distribution strives for an equitable level of outcome: Everyone in the community is within the same distance from a fire station. Distribution is based on probabilities that all areas experience equal service demands, but not necessarily the same risk or consequences as those demands for service in other areas. For example, suburban communities in the City may have the same service demand as an industrial factory area, but the level of risk is very different. This can have an impact on fire station locations as placement would probably put the stations near high risk areas with shorter travel times. Additionally, EMS response times based on medical emergencies will drive equal distribution in the community and negate distribution based on risk, as the risk is equal.

First unit arrival times are the best measure of distribution. It should be noted that if an area experiences fire unit arrival times outside the adopted performance measure, in this case 4-minute travel time per NFPA 1710, it does not necessarily mean it has a distribution issue. [56]

[55] Derived from Commission on Fire Accreditation International, 5th Edition. 2008. Page 53
[56] Commission on Fire Accreditation International, 5th Edition. 2008. Page 55

Other issues occur such as reliability, call processing times and turnout times, and traffic which can affect the overall performance of response times.

An effective response force for a fire department is impacted not only by the spacing of fire stations but also by the type and amount of apparatus and personnel staffing the stations. To assemble the necessary apparatus, personnel, and equipment within the prescribed timeframe, all must be close enough to travel to the incident, if available upon dispatch. The placement and spacing of specialty equipment is always challenging.[57] Specialty units tend to be trucks, rescue units, hazmat, or Battalion personnel. Most often there are less of these types of equipment and personnel compared to the first-line response of engines and medic units. Selecting where to put specialty units requires extensive examination of current and future operations within the fire department and a set goal of response time objectives for all-hazards emergencies within the City.

Distribution vs. Concentration

Major fires have a significant impact on the resource allocation of any fire department. The dilemma for any fire department is staffing for routine emergencies and also being prepared for the fire or emergency of maximum effort. This balancing of distribution and concentration staffing needs is one that almost all fire agencies face on an ongoing basis.

The art in concentration spacing is to strike a balance with respect as to how much overlap there should be between station areas. Some overlap is necessary to maintain good response times and to provide back-up for distribution when the first-due unit is unavailable for service or deployed on a prior emergency.

Concentration pushes and pulls distribution. Each agency, *after risk assessment and critical task analysis*, must be able to quantify and articulate why its resource allocation methodology meets the governing body's adopted policies for initial effective intervention on both a first-due and multiple-unit basis.[58]

[57] Commission on Fire Accreditation International, 5th Edition. 2008. Page 62
[58] Commission on Fire Accreditation International, 5th Edition. 2008. Page 62-63

Mapping Analysis of the Sheboygan Fire Department

In creating this document, it was important to ascertain where stations were located and if they were located to provide safe and effective coverage to the citizens. In order to make this assessment, the IAFF created maps of Sheboygan Fire Department response area and plotted the fire station locations.

Computer modeling was then used to determine the distance apparatus could travel in 4 and 8 minutes. The following table specifies the current locations of the five stations.

Station	Address	Apparatus	Staffing
1	833 New York Ave.	Engine 1 Med 1	**2 FF** **2 FF/Paramedic**
2	2413 S. 18th St.	Rescue 2 Med 2	**3 FF** **2 FF/Paramedic**
3 (Command)	1326 N. 25th St.	Engine 3 Med 3 Command	**2 FF** **2 FF/Paramedic** **Battalion Chief**
4	2622 N. 15th St.	Ladder 4	**3 FF**
5	4504 S. 18th St.	Ladder 5 Engine 5	**2 FF** **Cross-Staffed**

Table 6: Current Fire Station Locations. The above table displays where apparatus are housed and the typical on-duty staffing. The Department deploys the engines and medics together on all call types in order to supplement the engine company staff. This can create significant delays to the overall emergency response system. If the engine is assisting on a medical call, the engine crew will be unavailable to respond to a suppression incident. Likewise, if the EMS crew is assisting the engine with a fire call, patients may be delayed in receiving medical treatment until another unit becomes available. This reduces both fire protection and EMS response capabilities within the jurisdiction. Ladder 4 and 5 apparatus are quints and generally perform ladder operations. If the truck company arrives on scene first it may be directed to start engine operations. Once additional apparatus arrives on scene, the truck company will transition to ladder operations. This practice is inefficient as the truck company may have to re-position itself in order to perform ladder operations, thus delaying life-saving fire suppression and rescue tasks. Station 5 also employs cross-staffing to staff an engine and a ladder truck which can further create delays in response.

Responses Per Year				
Station	**2013**	**2014**	**2015**	**Total**
1	1,451	1,470	1,170	4,091
2	1,007	962	689	2,658
3	1,219	1,257	937	3,413
4	808	768	628	2,204
5	490	538	416	1,444
				13,810

Table 7: Unit Responses Per Year 2013-2015. The above table displays the number of runs per station each year for the years 2013, 2014 and 2015 (thru 09/30/2015). Station 1 and Station 2 (proposed stations for closure), rank 1st (29.6%) and 3rd (19.25%) respectively, in the number of responses per year.

Travel times were modeled using ESRI ArcGIS version 10.3. Fire stations were identified on Geographic Information System (GIS) maps as starting points with vehicles traveling at posted road speeds.

When generating the maps, a number of assumptions needed to be addressed prior to drawing conclusions from the analysis. These assumptions are as follows:

- Modeled travel speeds are based on reasonable and prudent road speeds. Actual response speeds may be slower, and the associated travel times greater, with any unpredictable impedances including, but not limited to:
    - Traffic Incidents: Collisions and vehicle breakdowns causing lane blockages and driver distractions.
    - Work Zones: Construction and maintenance activity that can cause added travel time in locations and times where congestion is not normally present.
    - Weather: Reduced visibility--road surface problems and uncertain waiting conditions result in extra travel time and altered trip patterns.
    - Special Events: Demand may change due to identifiable and predictable causes.
    - Traffic Control Devices: Poorly timed or inoperable traffic signals, railroad grade crossings, speed control systems, and traveler information signs contribute to irregularities in travel time.
    - Inadequate Road or Transit Capacity: The interaction of capacity problems with the aforementioned sources causes travel time to expand much faster than demand.[59]

[59] David Shrank and Tim Lomax, The 2003 Urban Mobility Report, (Illinois Transportation Institute, Illinois A&M University: September 2003).

In addition, it is reasonable to suggest that because larger emergency vehicles are generally more cumbersome and require greater skill to maneuver, their response may be more negatively affected by their weight, size, and in some cases, inability to travel narrow surface streets.

As discussed, computer modeling only considers travel time of apparatus. Decision makers should understand that once apparatus and personnel arrive on the incident scene there are other essential tasks that must be completed which require additional time before access, rescue, and suppression can take place. Tasks such as establishing a water supply, forcible entry (access), and deployment of an attack line are not considered in the computer modeling. Other additional factors also include:

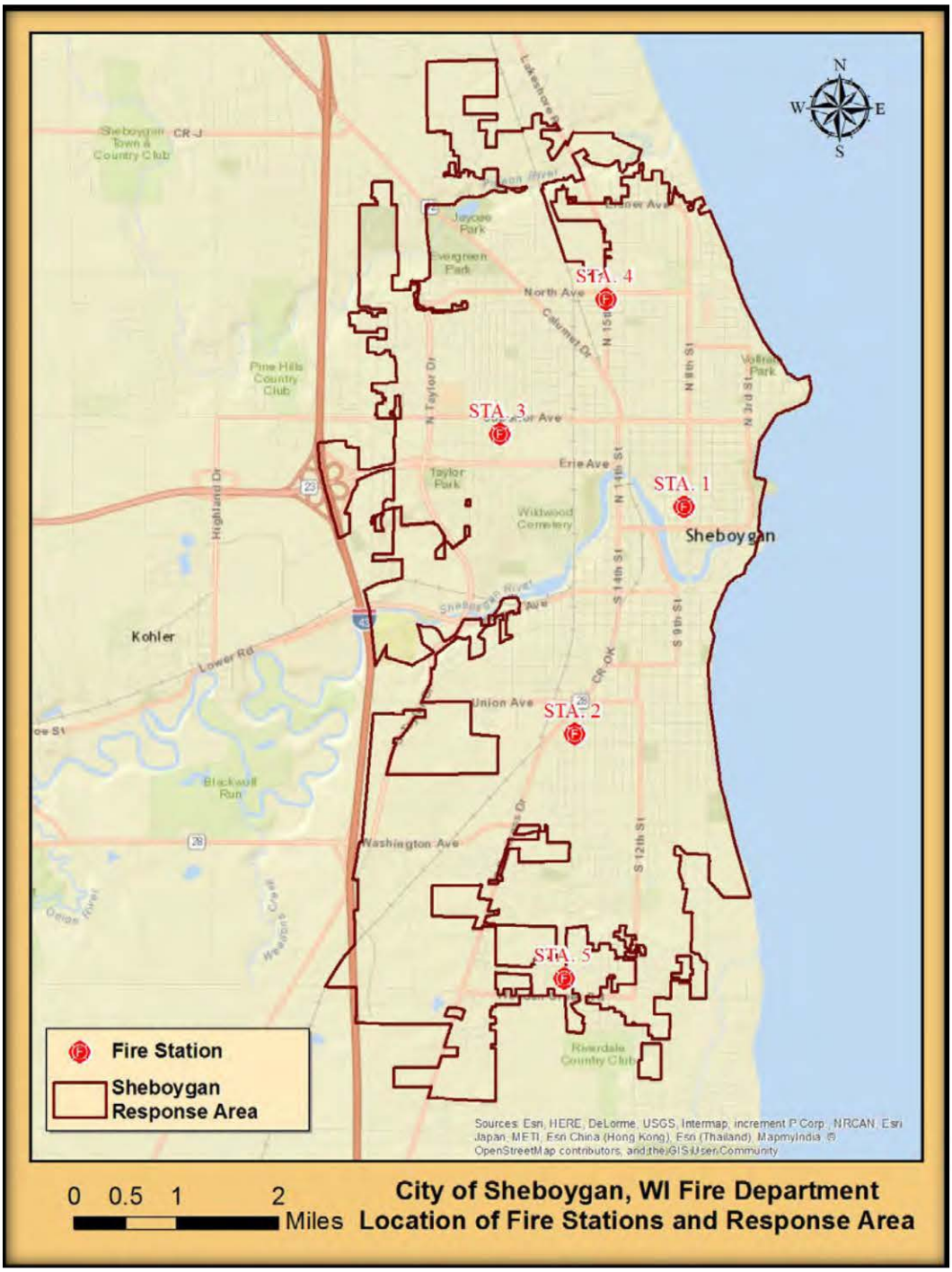
- The time from arrival of the apparatus to the onset of interior fire operations (access interval) must be considered when analyzing response system capabilities.
    - The access interval is dependent upon factors such as distance from the apparatus to the task location and the elevation of the incident and locked doors or security bars which must be breached.
    - Impediments like these may add to the delay between discovery of a fire and the initiation of an actual fire attack.

- The reliability of a community's hydrant system to supply water to fire apparatus.

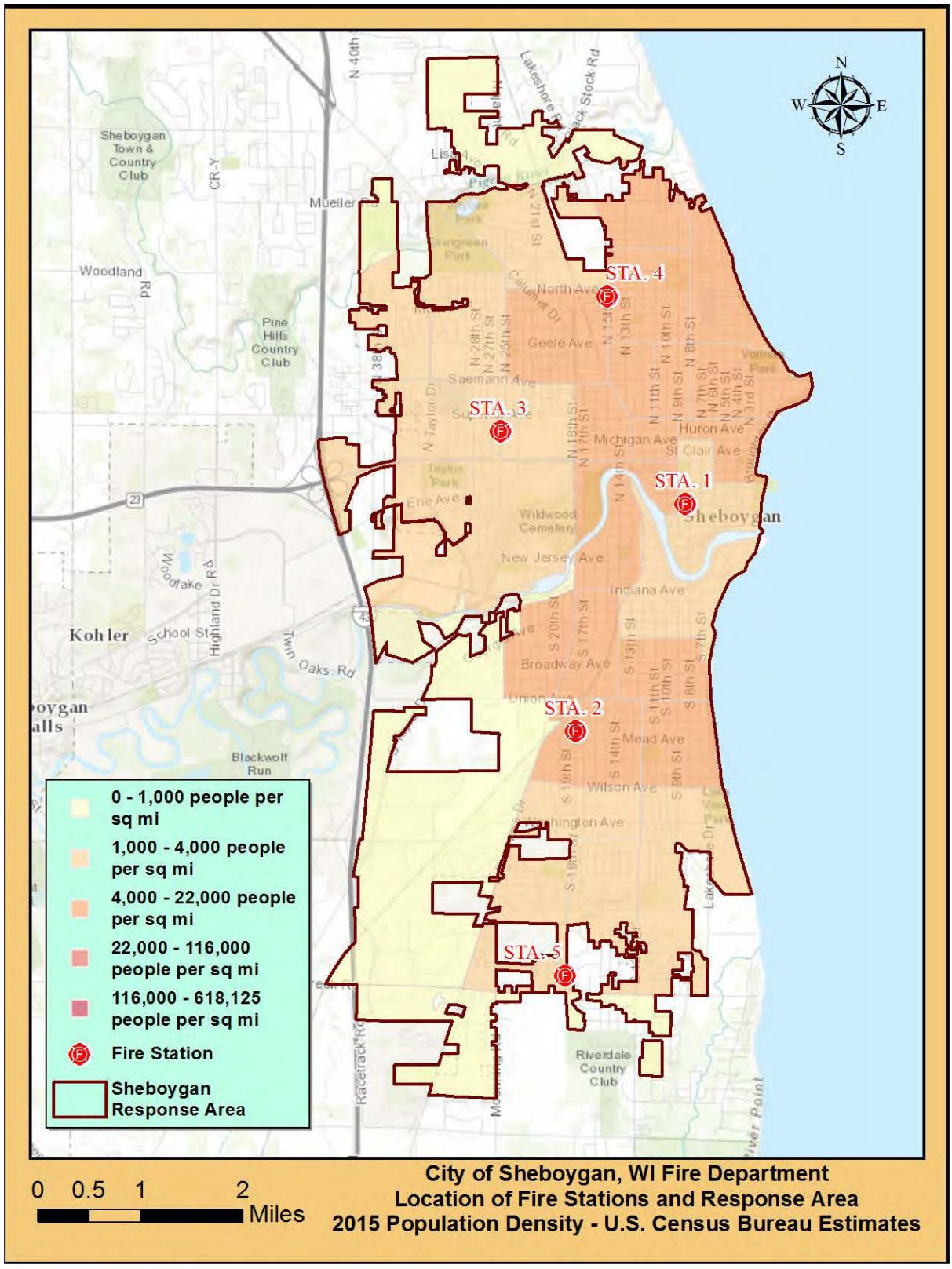
- Weather conditions

Existing Emergency Response Capabilities – Sheboygan Fire Department

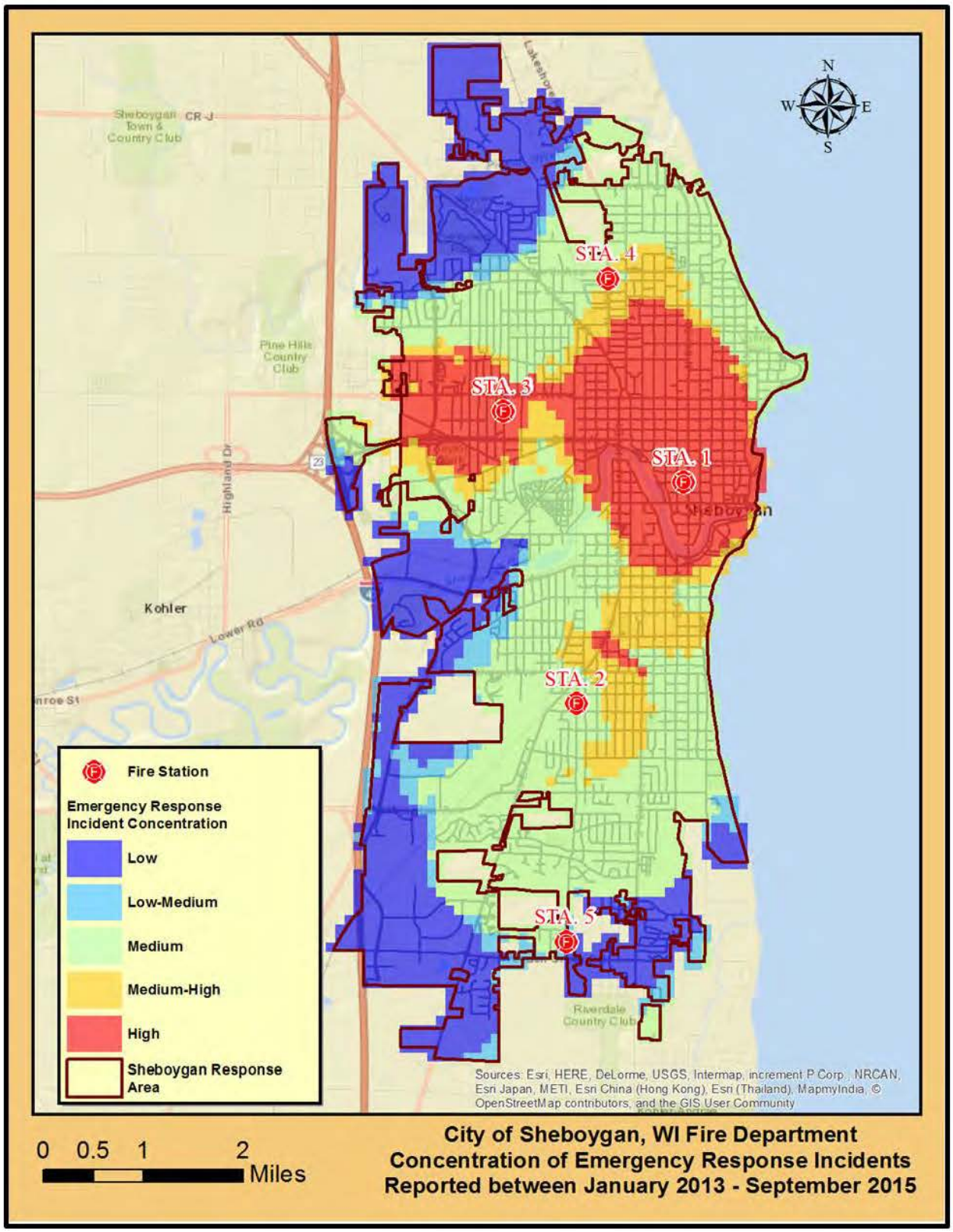
The following Geographic Information System (GIS) maps present the results of a response capabilities analysis of the Sheboygan Fire Department.



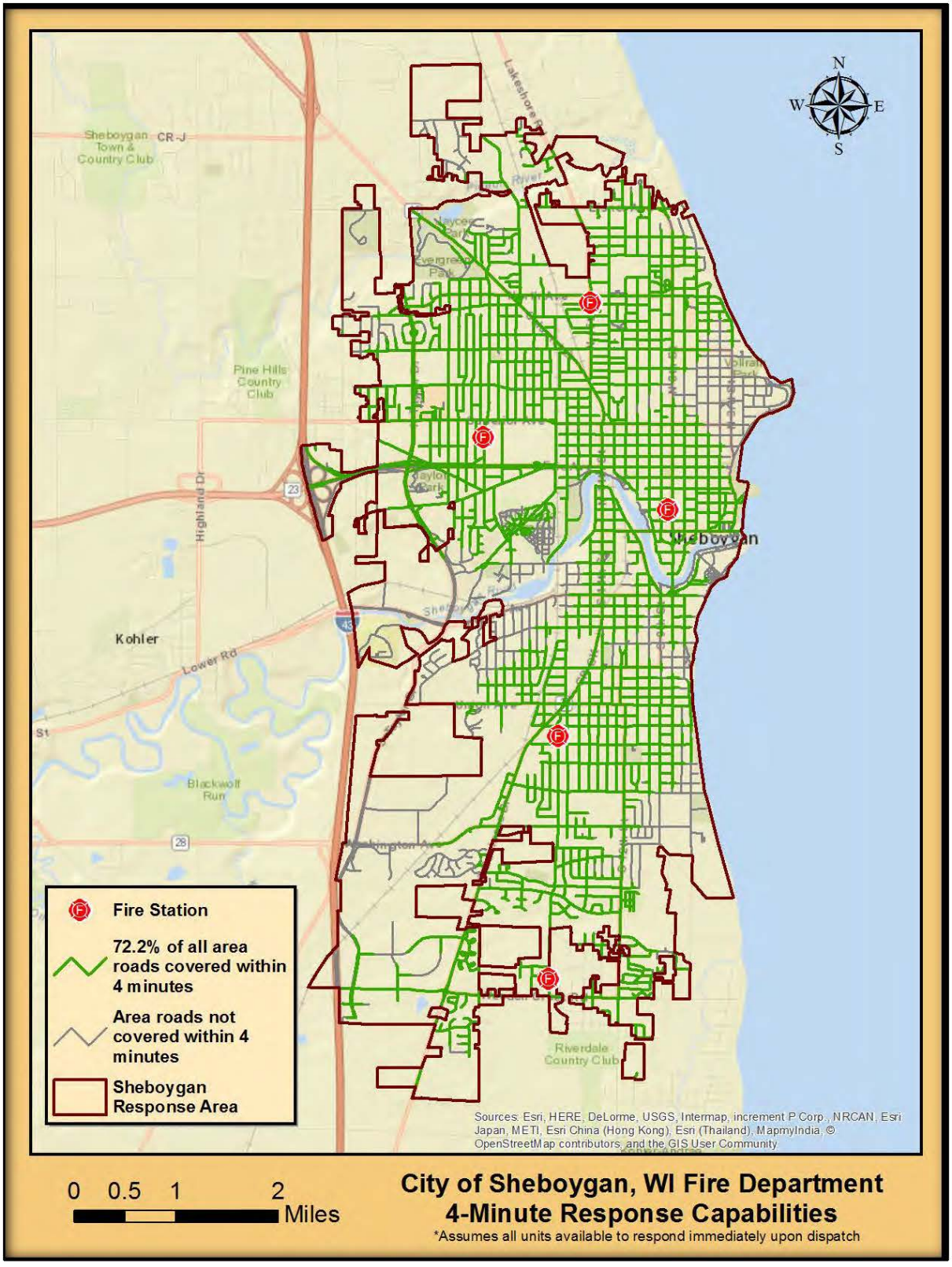
Map 1: Station Locations. Map 1 depicts the Sheboygan Fire Department response area boundaries and fire station locations.



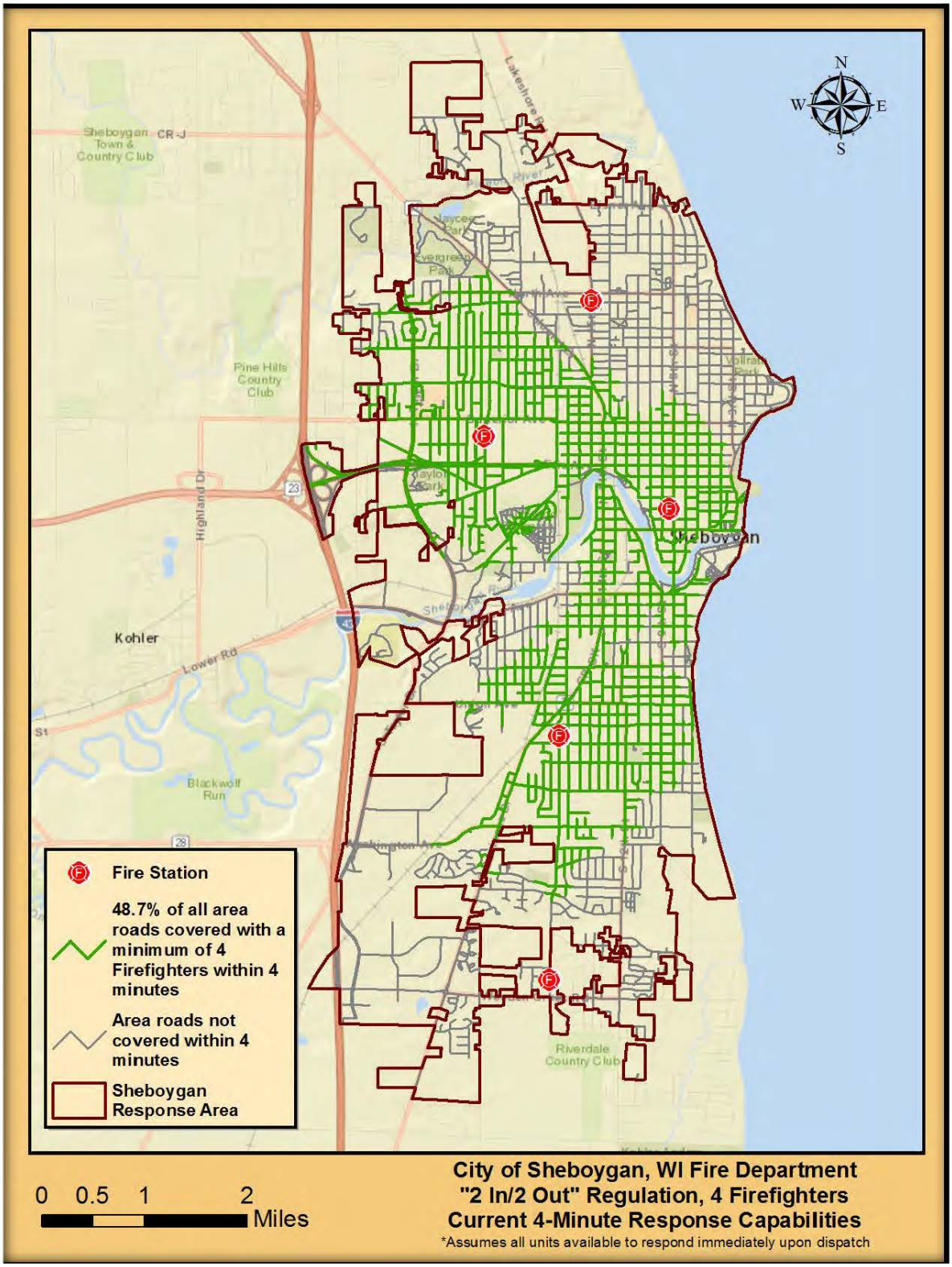
Map 2: 2015 Population Density – U.S. Census Bureau Estimates of Sheboygan, WI. Map 2 symbolizes the concentration of population based on census blocks in Sheboygan. Areas with higher population totals tend to place greater demand on emergency services.



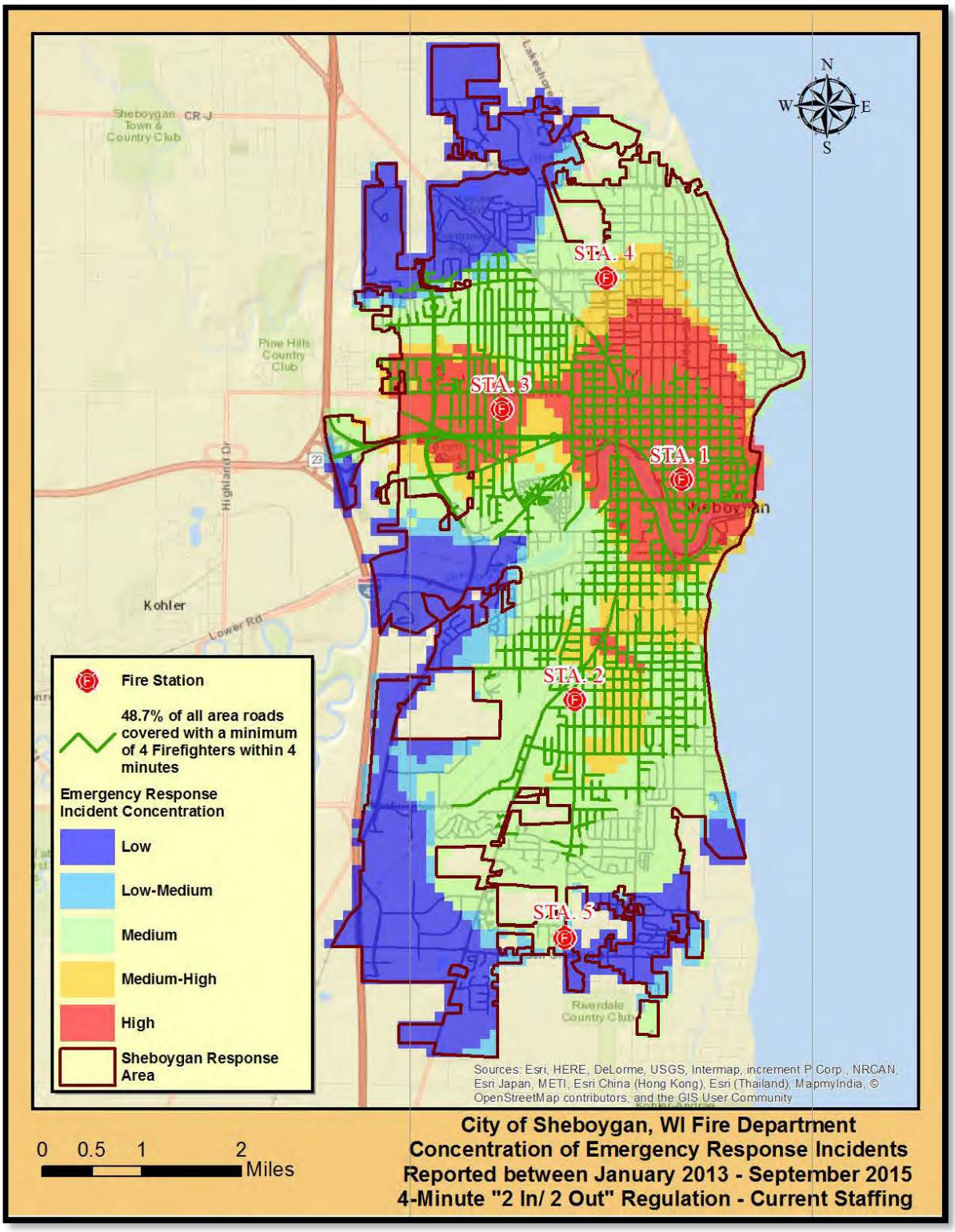
Map 3: Concentration of Emergency Responses in Sheboygan, WI. Map 3 models the concentration of emergency response incidents during the period of Jan. 2013 to Sept. 2015 in Sheboygan. Using computer aided dispatch (CAD) location-based incident data (refer to Table 7), geographic statistical analysis maps areas of incident concentration.



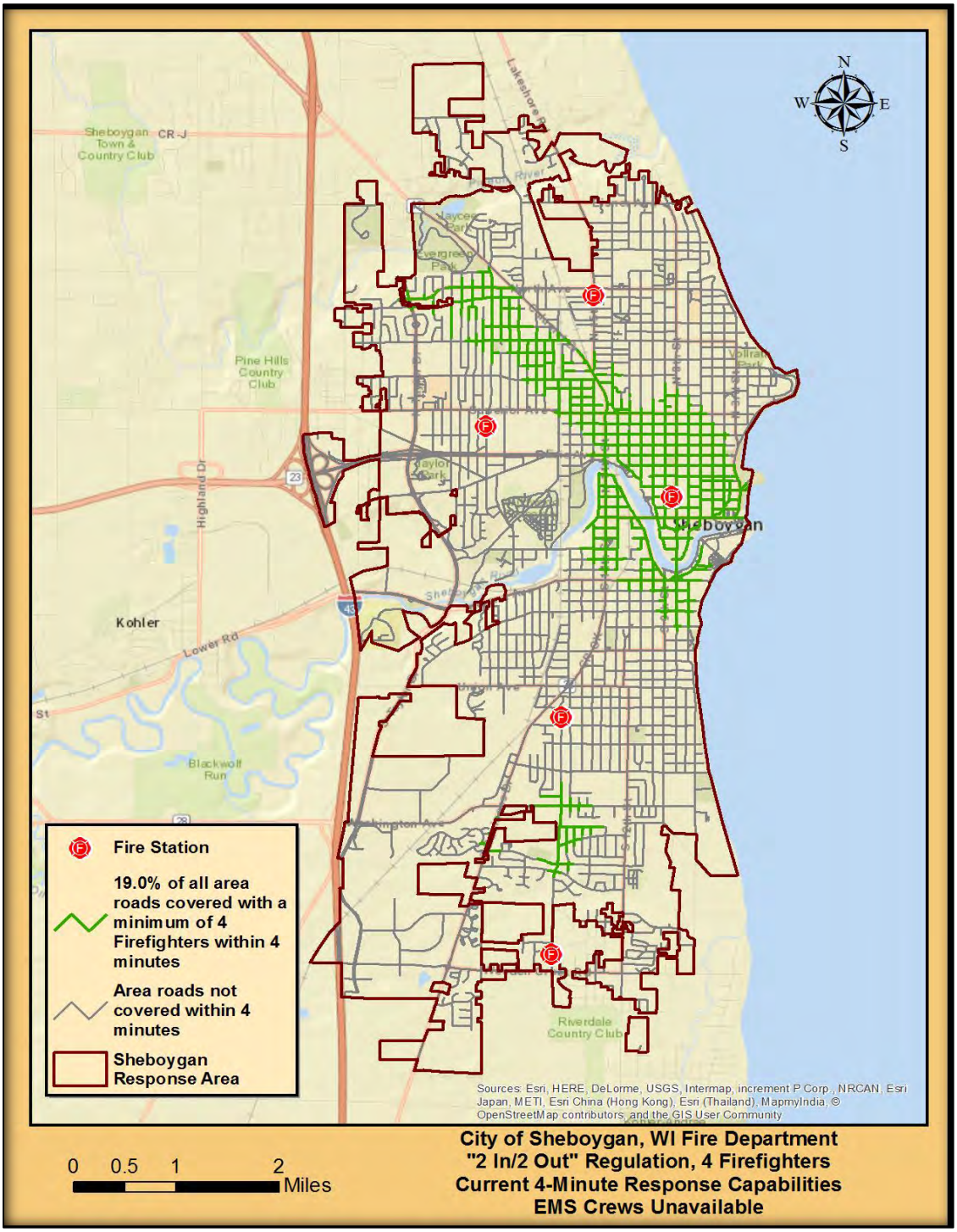
Map 4: Existing 4-Minute Response Capabilities. Map 4 identifies those roads where fire companies can reach within 4 minutes of travel. Currently, engine companies are capable of responding on 72.2% of roads within the Sheboygan Fire Department's Response Area within 4 minutes.



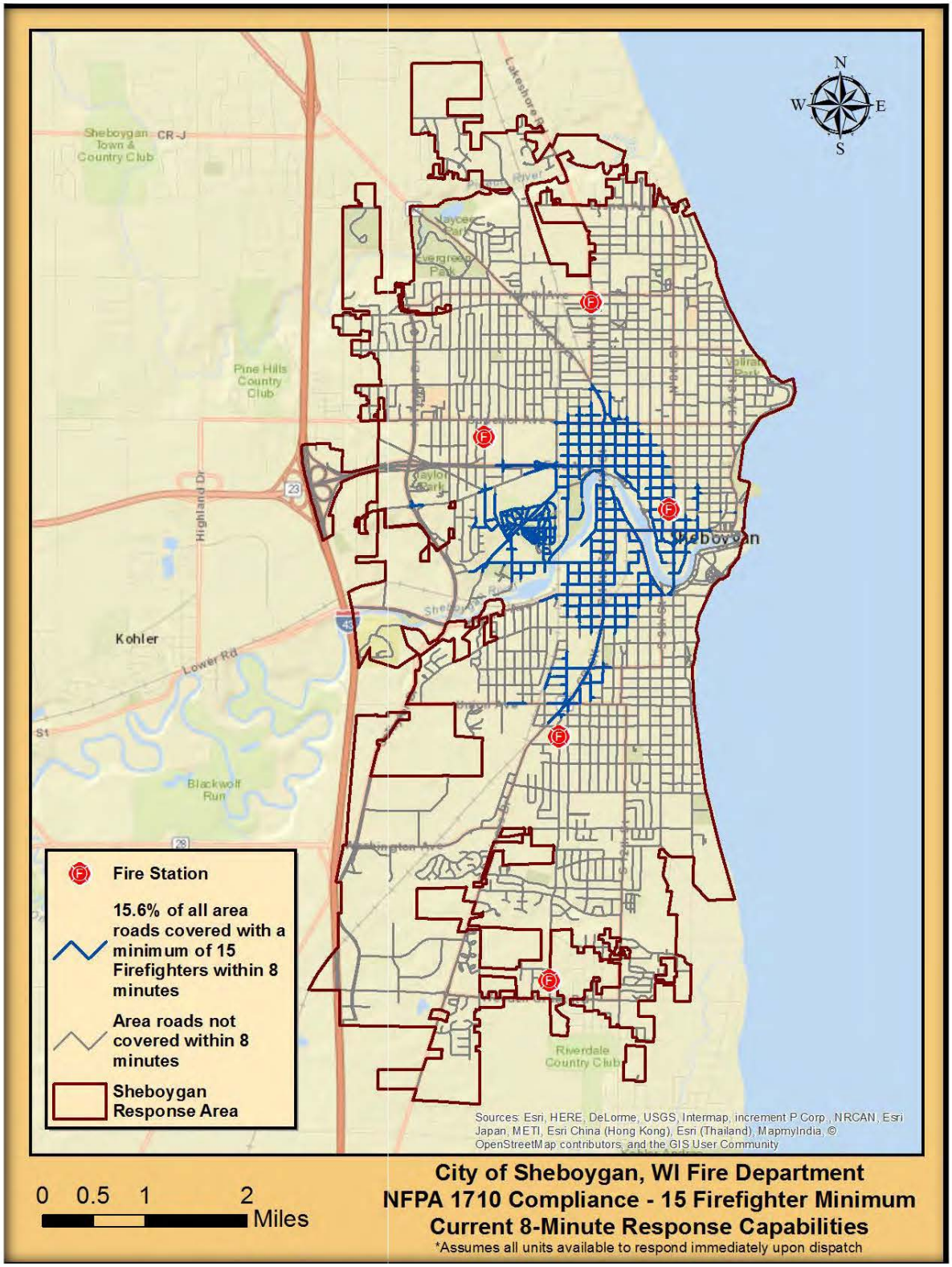
Map 5: Existing Emergency "2 In/2 Out" Capabilities, 4-Minute Response. Map 5 identifies those roads where a minimum of 4 firefighters can assemble on scene within 4 minutes of travel. Currently, the Fire Department is capable of assembling at least 4 firefighters on 48.7% of roads within the Sheboygan Fire Department's Response Area within 4 minutes.



Map 6: Concentration of Emergency Response in Sheboygan, WI and 4- Minute "2 In/2 Out" Regulation with Current Staffing. Map 6 depicts the concentration of emergency incidents during the period of Jan. 2013 to Sept. 2015 in Sheboygan overlaid with the current coverage in accordance with the industry standard "2 In/2 Out" regulation. Firefighters can respond with a minimum of 4 firefighters within 4 minutes to 48.7% of City roads. There are a few areas outside of the 4-minute response capabilities with high incident densities.



Map 7: Existing 4-Minute Suppression Response (EMS Crews Unavailable). If EMS crews are unavailable to assist engine companies due to transport or other obligations, engines may be deployed alone with a staff of two or three. Due to the volume of responses by Sheboygan EMS companies, as reflected in Table 7 of this report, this scenario is quite likely. Map 7 identifies those roads where suppression companies can assemble 4 personnel within 4 minutes. Currently, the Department is capable of reaching 19.0% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 60.9% *decrease* in response capabilities compared to all apparatus being available.



Map 8: Existing Effective Firefighting Force, 15 Firefighters. Map 8 identifies those roads where a minimum of 15 firefighters are able to assemble on scene within 8 minutes of travel. Currently, the Sheboygan Fire Department is capable of assembling a minimum of 15 firefighters on 15.6% of roads within the Sheboygan Fire Department's Response Area within 8 minutes.

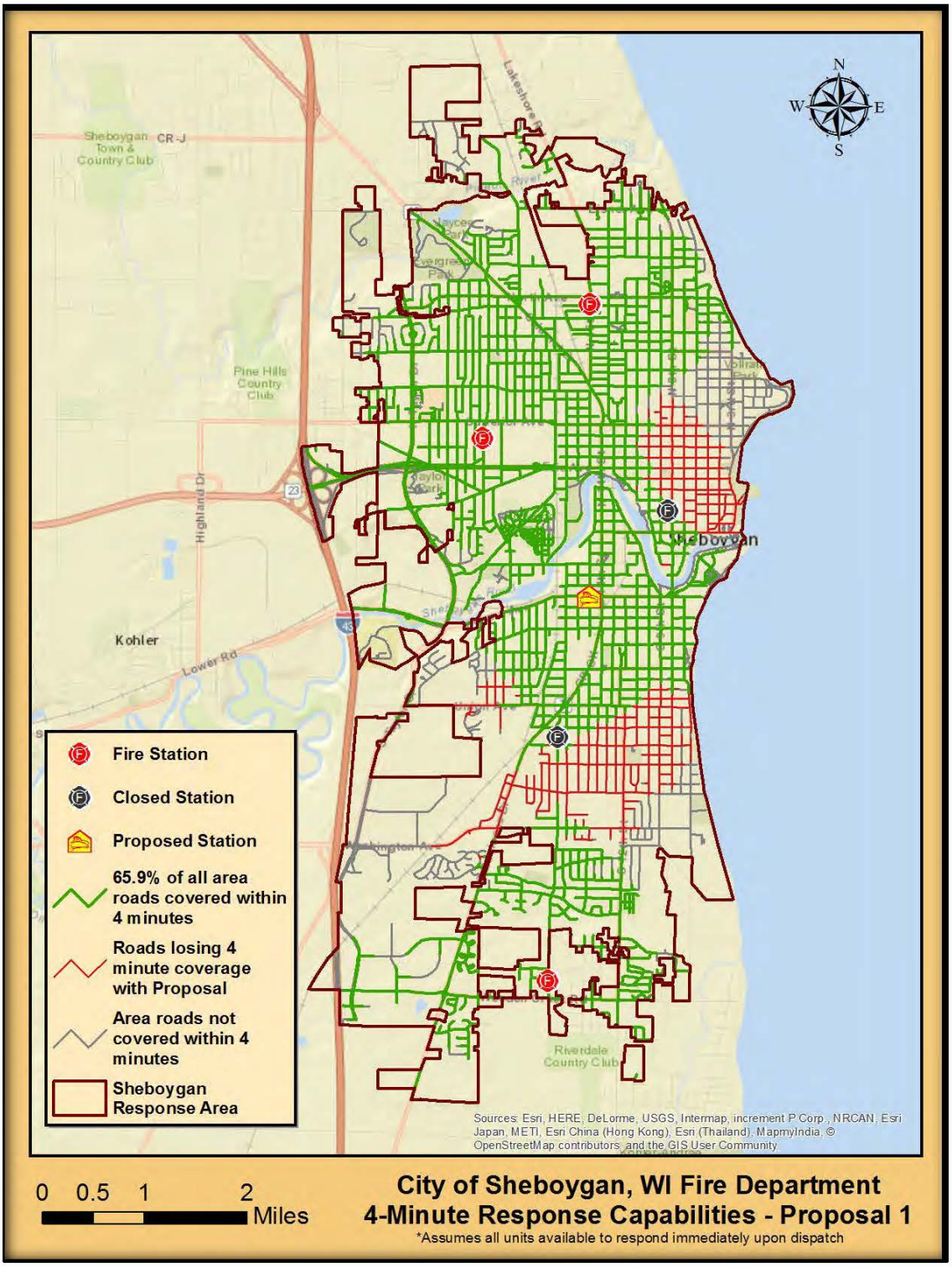
Proposal #1 Emergency Response Capabilities – New Station (15th St. & Indiana Ave.) Consolidating Station 1 and Station 2

For this portion of the study, an alternate (first of three proposed locations) staffing and deployment scenario was examined. This plan will effectively close Stations 1 and 2 and re-deploy a majority of resources currently in those stations from a new station located at the cross-section of 15th Street and Indiana Avenue in Sheboygan, WI. The proposed staffing and deployment configuration is detailed in Table 8, below. The maps in this section display the results of a 4- and 8-minute travel time analysis representing potential response capabilities of the department which would likely result pursuant to the implementation of this proposal.

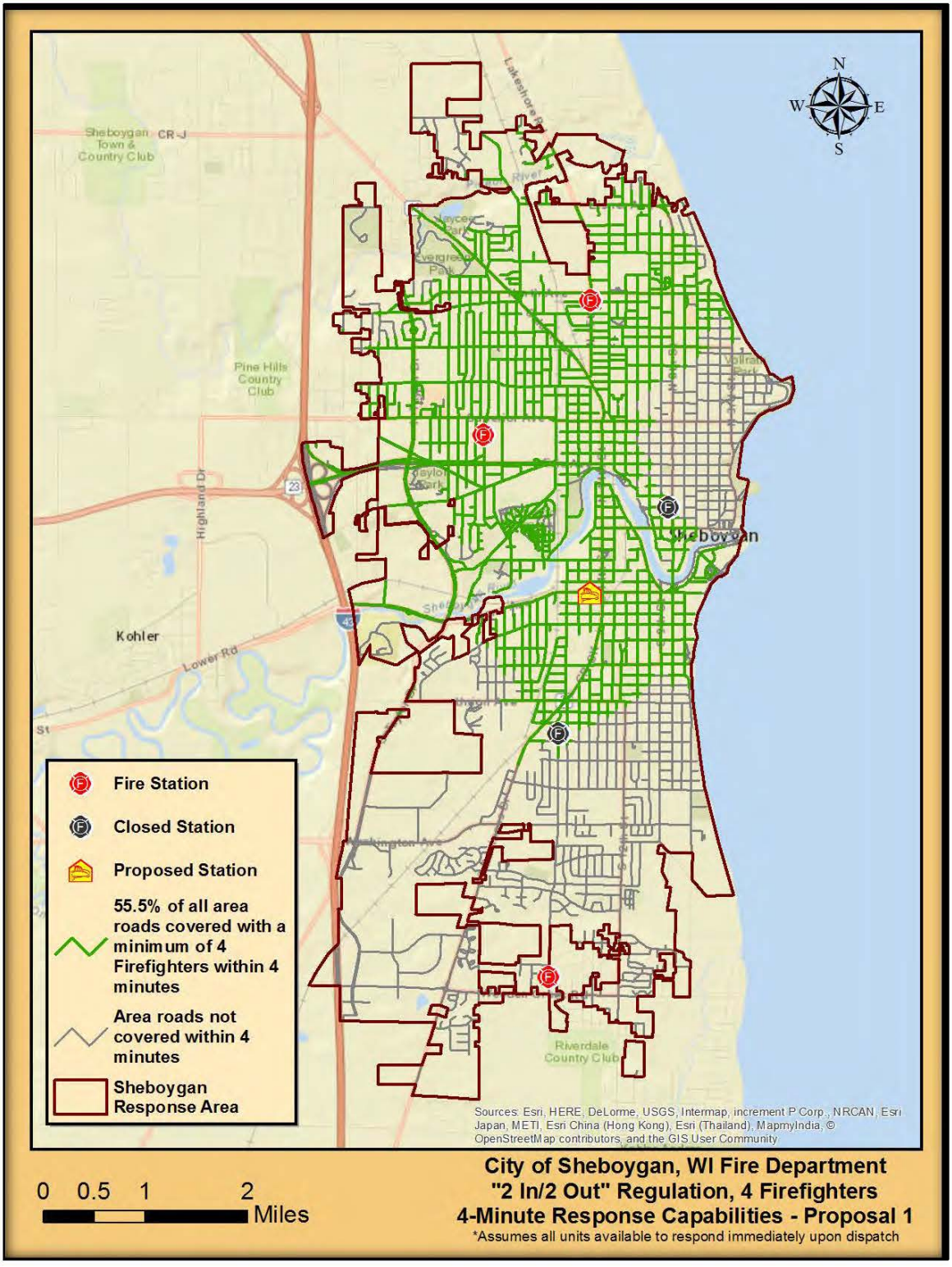
Station	Address	Apparatus	Staffing
3 (Command)	1326 N. 25th St.	Engine 3 Med 3 Command	**2 FF** **2 FF/Paramedic** **Battalion Chief**
4	2622 N. 15th St.	Ladder 4 Med 4	**3 FF** **2 FF/Paramedic**
5	4504 S. 18th St.	Ladder 5 Engine 5	**2 FF** **Cross-Staffed**
Proposed Station #1	15th St. & Indiana Ave.	Engine 1 Rescue 1 Med 2	**2 FF** **2 FF** **2 FF/Paramedic**

Table 8: Proposed Fire Station Locations and Staffing. The above table displays where apparatus will be housed and the proposed typical on-duty staffing. Under this consolidation proposal, the department would continue to supplement engine/ladder company personnel with firefighter/paramedics assigned to the medic units which would further compound existing staffing deficiencies and could significantly impact the overall emergency response system. Station 5 also utilizes cross-staffing of apparatus which can create response delays. As can be seen in the table, and will be discussed in the following section, the proposed staffing in the department is below industry standards.

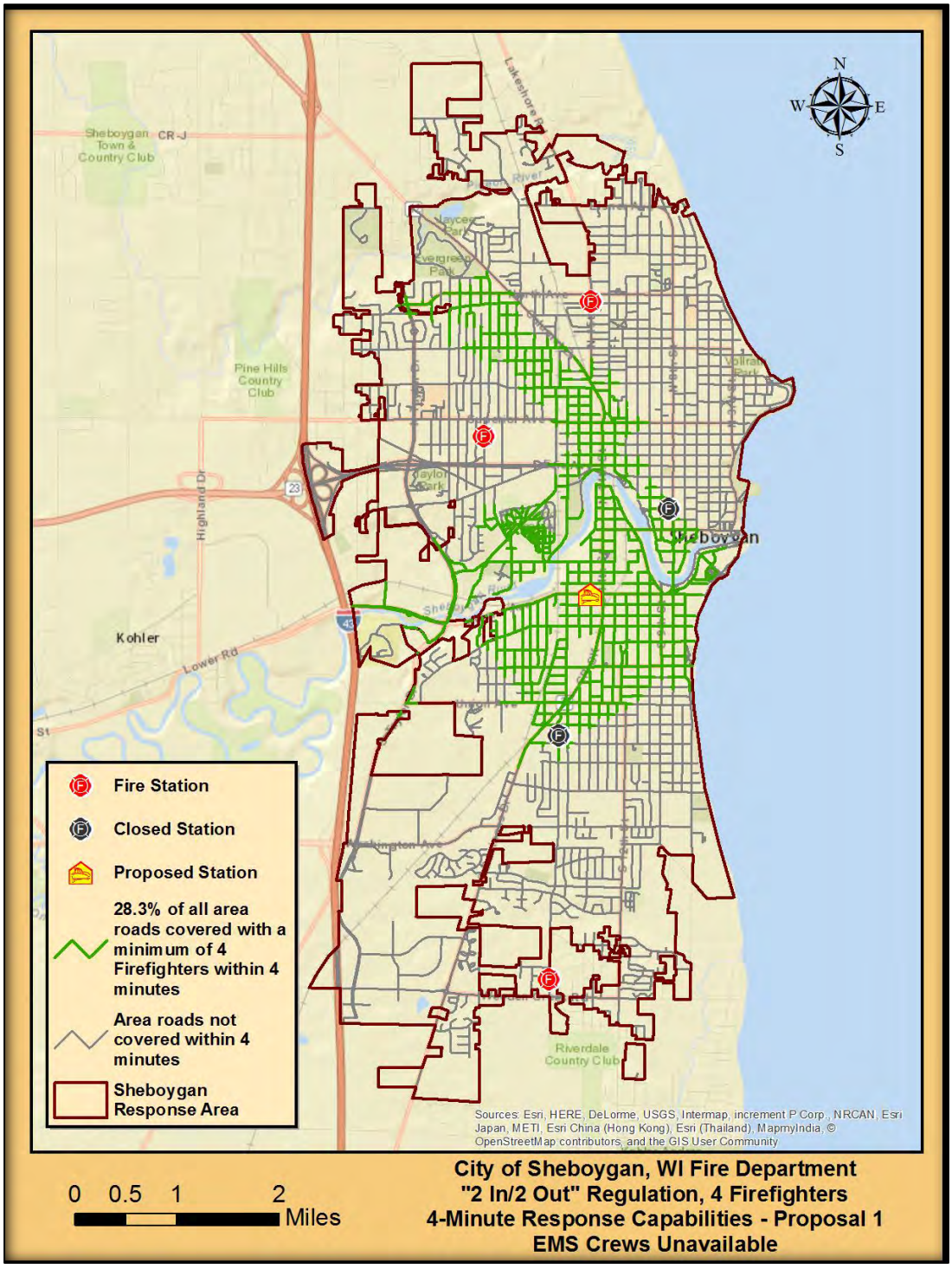
The following Geographic Information System (GIS) maps present an anticipated response capabilities analysis of the Sheboygan Fire Department pursuant to staffing according to the proposed configuration described in Table 8 above.



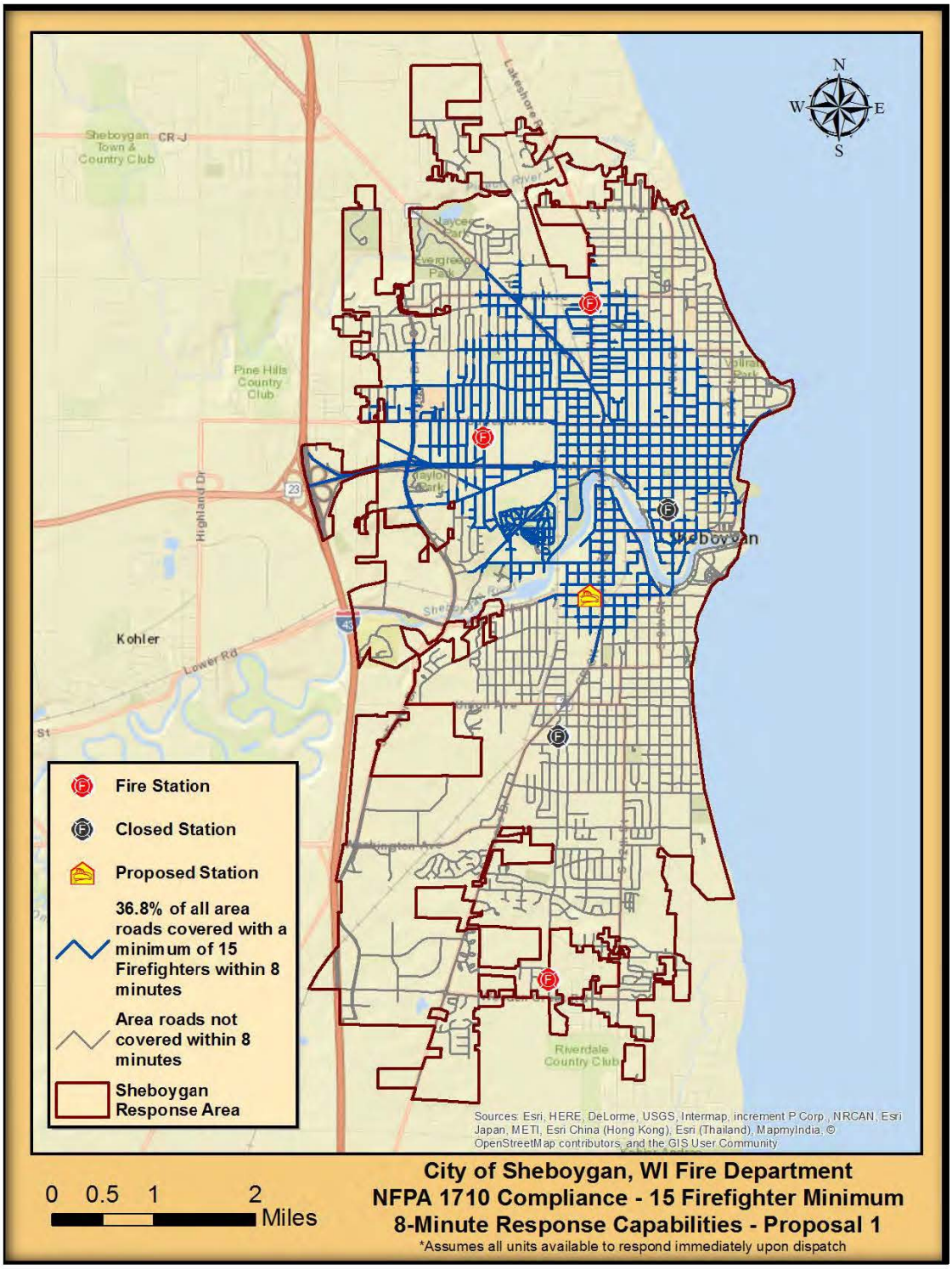
Map 9: Proposal 1, 4-Minute Response Capabilities. Map 9 identifies those roads where fire companies will likely be able to reach within 4 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, fire companies will likely be capable of responding on 65.9% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to an 8.8% *decrease* in response capabilities from existing conditions. (Roads losing coverage indicated in red roads on Map 9.)



Map 10: Proposal 1, Emergency "2 In/2 Out" Capabilities, 4-Minute Response. Map 10 identifies those roads where a minimum of 4 firefighters will likely be able to assemble on scene within 4 minutes of travel. Pursuant to relocating existing personnel to the proposed Consolidated Station and Station 4, the Fire Department will likely be capable of assembling 4 firefighters on scene on 55.5% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 14.0% *increase* in response capabilities from existing conditions.



Map 11: Proposal 1, Emergency "2 In/2 Out" Operations, 4-Minute Response (EMS Crews Unavailable). If EMS crews are unavailable to assist suppression companies due to transport or other obligations, apparatus may be deployed alone with a staff of two or three. Due to the volume of responses by Sheboygan EMS companies as reflected in Table 7 in this report, this scenario is quite likely. Map 11 identifies those roads where suppression companies can assemble 4 personnel within 4 minutes for Proposal 1. The Department will be capable of reaching 28.3% of roads within the Sheboygan Fire Department's Response Area. This translates to a 49.1% *decrease* in response capabilities compared to all apparatus being available.



Map 12: Proposal 1, Effective Firefighting Force, 15 Firefighters. Map 12 identifies those roads where a minimum of 15 firefighters will likely be able to assemble within 8 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, the Fire Department will likely be capable of assembling a minimum of 15 firefighters on 36.8% of roads within the Sheboygan Fire Department's Response Area within 8 minutes. This translates to a 135.5% *increase* in response capabilities from existing conditions.

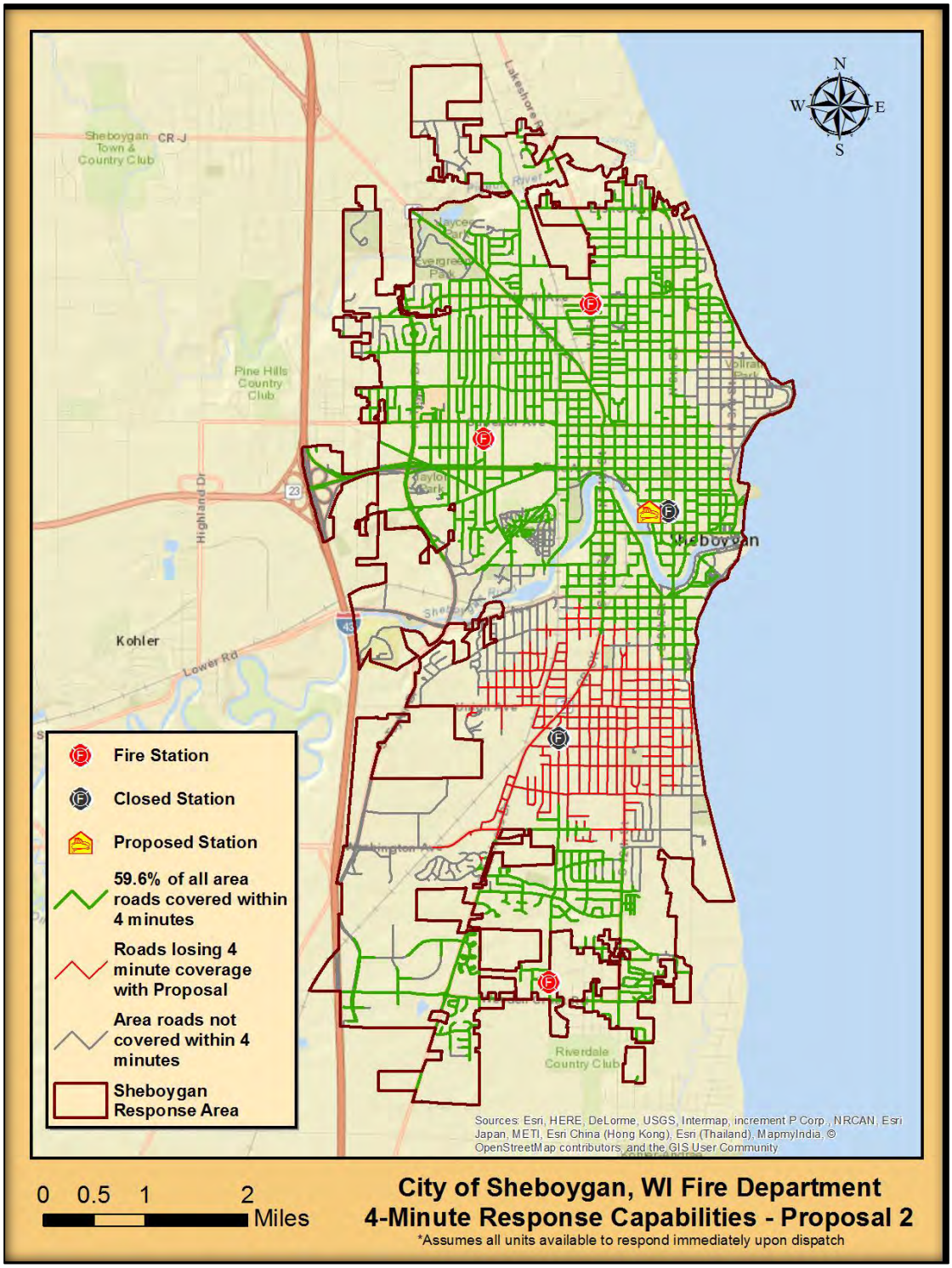
Proposal #2 Emergency Response Capabilities – New Station (New York Ave. & Water St.) Consolidating Station 1 and Station 2

For this portion of the study, an alternate (second of three proposed locations) staffing and deployment scenario was examined. This plan will effectively close Stations 1 and 2 and re-deploy a majority of resources currently in those stations from a new station located at the cross-section of New York Ave. & Water St. in Sheboygan, WI. The proposed staffing and deployment configuration is detailed in Table 9, below. The maps in this section display the results of a 4- and 8-minute travel time analysis representing potential response capabilities of the department which would likely result pursuant to the implementation of this proposal.

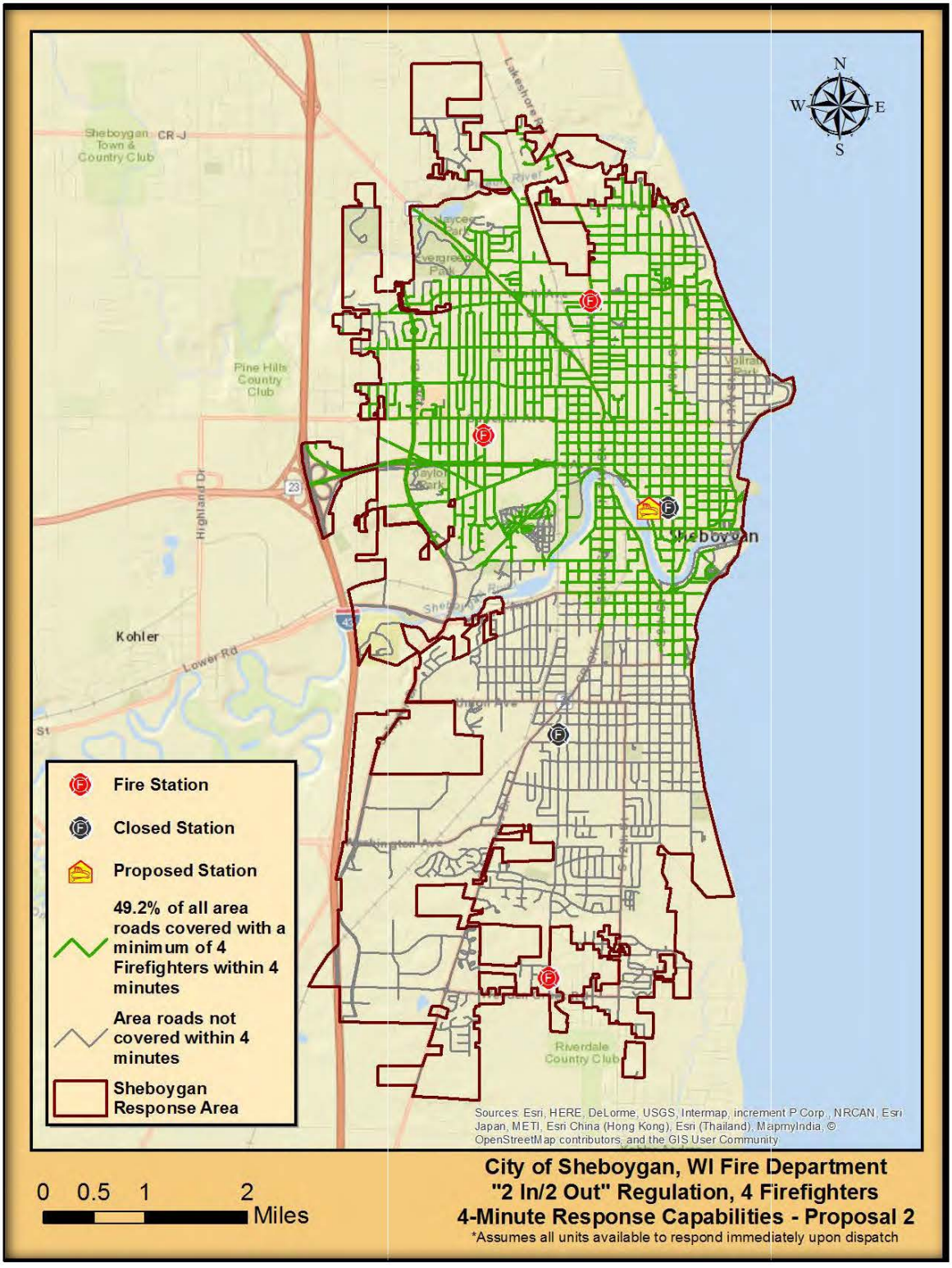
Station	Address	Apparatus	Staffing
3 (Command)	1326 N. 25th St.	Engine 3 Med 3 Command	**2 FF** **2 FF/Paramedic** **Battalion Chief**
4	2622 N. 15th St.	Ladder 4 Med 4	**3 FF** **2 FF/Paramedic**
5	4504 S. 18th St.	Ladder 5 Engine 5	**2 FF** **Cross-Staffed**
Proposed Station #2	New York Ave. & Water St.	Engine 1 Rescue 1 Med 2	**2 FF** **2 FF** **2 FF/Paramedic**

Table 9: Proposed Fire Station Locations and Staffing. The above table displays where apparatus will be housed and the proposed typical on-duty staffing. Under this consolidation proposal, the department would continue to supplement engine/ladder company personnel with firefighter/paramedics assigned to the medic units which would further compound existing staffing deficiencies and could significantly impact the overall emergency response system. Station 5 also utilizes cross-staffing of apparatus which can create response delays. As can be seen in the table, and will be discussed in the following section, the proposed staffing in the department is below industry standards.

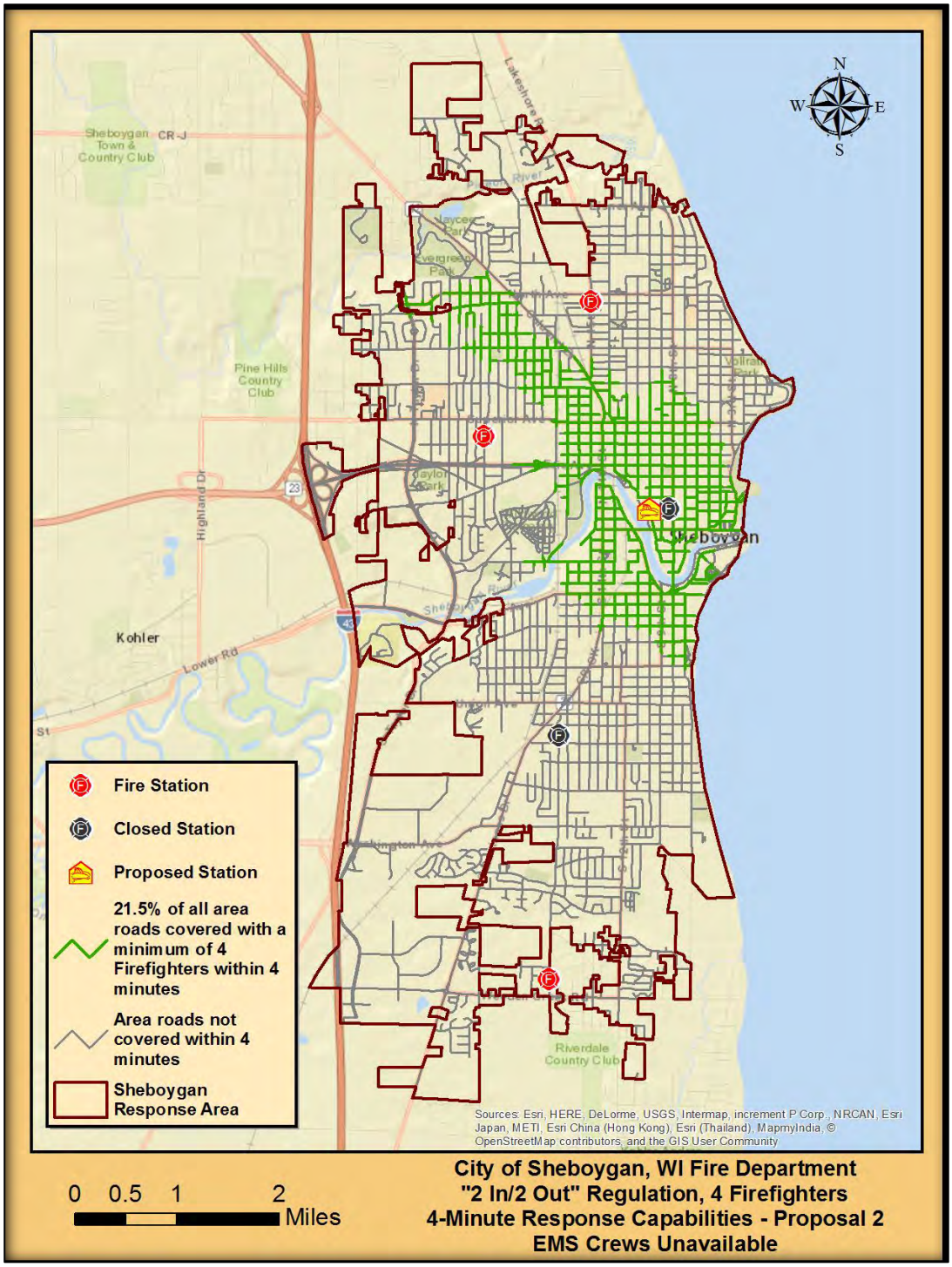
The following Geographic Information System (GIS) maps present anticipated response capabilities analysis of the Sheboygan Fire Department pursuant to staffing according to the proposed configuration described in Table 9 above.



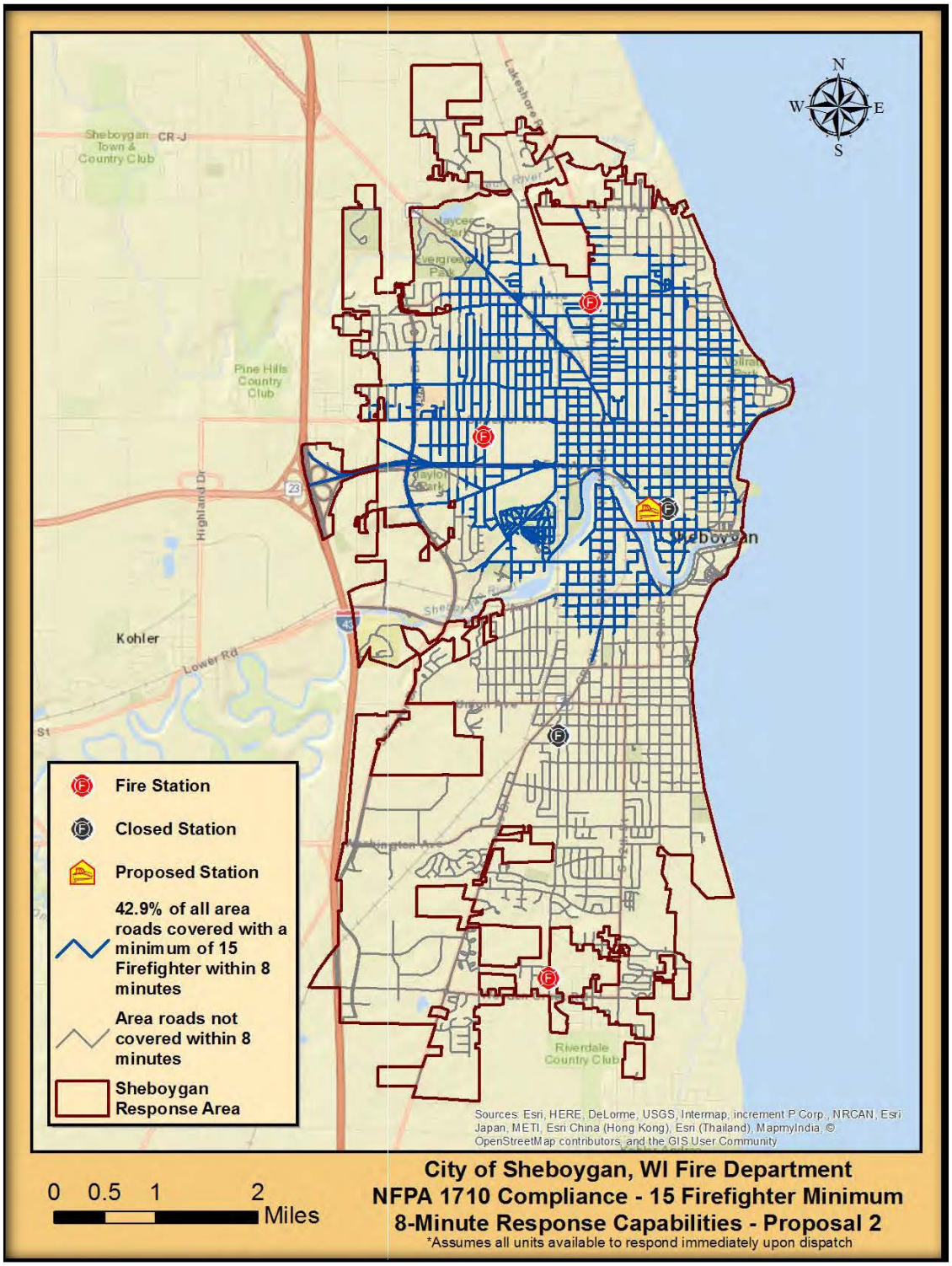
Map 13: Proposal 2, 4-Minute Response Capabilities. Map 13 identifies those roads where fire companies will likely have the capability to reach within 4 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, fire companies will likely be capable of responding on 59.6% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 17.5% *decrease* in response capabilities from existing conditions. (Roads losing coverage indicated in red on Map 13.)



Map 14: Proposal 2, Emergency "2 In/2 Out" Capabilities, 4-Minute Response. Map 14 identifies those roads where a minimum of 4 firefighters will likely be able to assemble within 4 minutes of travel. Pursuant to relocating existing personnel to the proposed Consolidated Station and Station 4, the Fire Department will likely be capable of assembling 4 firefighters on scene on 49.2% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 1.1% *increase* in response capabilities from existing conditions.



Map 15: Proposal 2, Emergency "2 In/2 Out" 4-Minute Response (EMS Crews Unavailable). If EMS crews are unavailable to assist suppression companies due to transport or other obligations, apparatus may be deployed alone with a staff of two or three. Due to the volume of responses by Sheboygan EMS companies as reflected in Table 7 in this report, this scenario is quite likely. Map 15 identifies those roads where suppression companies can assemble 4 personnel within 4 minutes for Proposal 2. The Department will be capable of reaching 21.5% of roads within the Sheboygan Fire Department's Response Area. This translates to a 56.3% *decrease* in response capabilities compared to all apparatus being available.



Map 16: Proposal 2, Effective Firefighting Force, 15 Firefighters. Map 16 identifies those roads where a minimum of 15 firefighters will likely be able to assemble within 8 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, the Fire Department will likely be capable of assembling a minimum of 15 firefighters on 42.9% of roads within the Sheboygan Fire Department's Response Area within 8 minutes. This translates to a 174.6% *increase* in response capabilities from existing conditions.

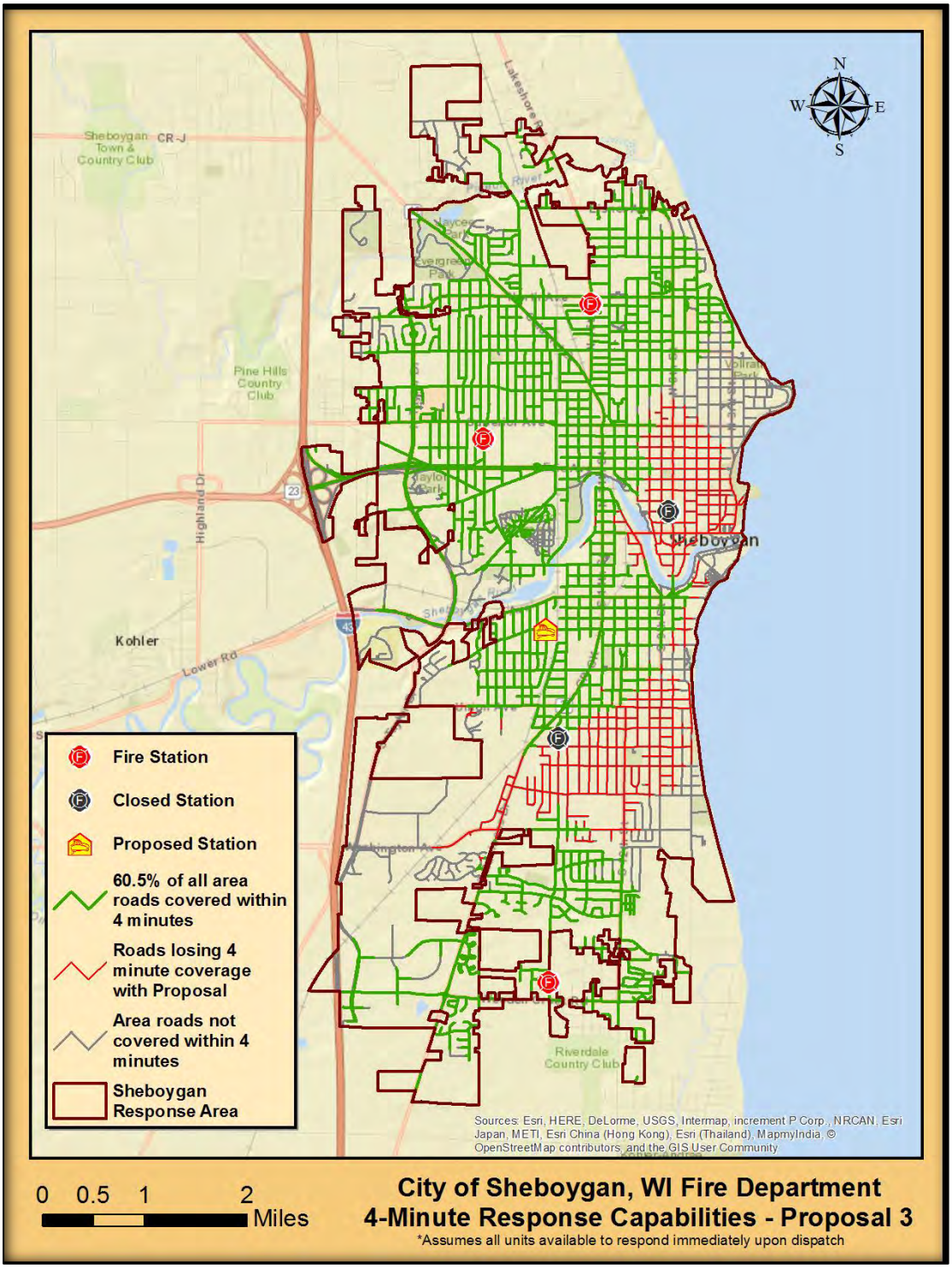
Proposal #3 Emergency Response Capabilities – New Station (19th St. & Georgia Ave.) Consolidating Station 1 and Station 2

For this portion of the study, an alternate (third of three proposed locations) staffing and deployment scenario was examined. This plan will effectively close Stations 1 and 2, and re-deploy a majority of resources currently in those stations from a new station located at the cross-section of 19th St. & Georgia Ave. in Sheboygan, WI. The proposed staffing and deployment configuration is detailed in Table 10, below. The maps in this section display the results of a 4- and 8-minute travel time analysis representing potential response capabilities of the department which would likely result pursuant to the implementation of this proposal.

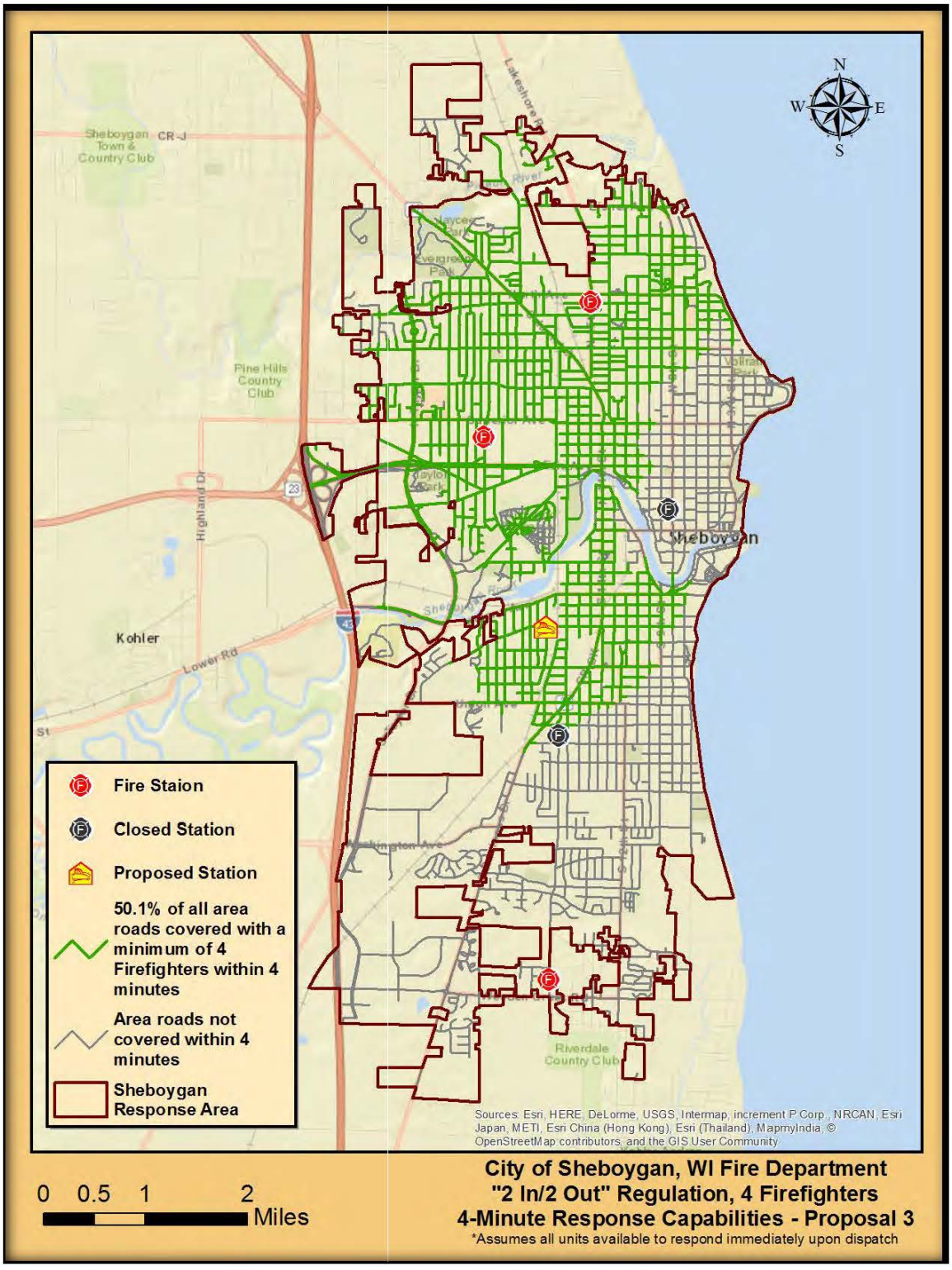
Station	Address	Apparatus	Staffing
3 (Command)	1326 N. 25th St.	Engine 3 Med 3 Command	**2 FF** **2 FF/Paramedic** **Battalion Chief**
4	2622 N. 15th St.	Ladder 4 Med 4	**3 FF** **2 FF/Paramedic**
5	4504 S. 18th St.	Ladder 5 Engine 5	**2 FF** **Cross-Staffed**
Proposed Station #3	19th St. & Georgia Ave.	Engine 1 Rescue 1 Med 2	**2 FF** **2 FF** **2 FF/Paramedic**

Table 10: Proposed Fire Station Locations and Staffing. The above table displays where apparatus will be housed and the proposed typical on-duty staffing. Under this consolidation proposal, the department would continue to supplement engine/ladder company personnel with firefighter/paramedics assigned to the medic units which would further compound existing staffing deficiencies and could significantly impact the overall emergency response system. Station 5 also utilizes cross-staffing of apparatus which can create response delays. As can be seen in the table, and will be discussed in the following section, the proposed staffing in the department is below industry standards.

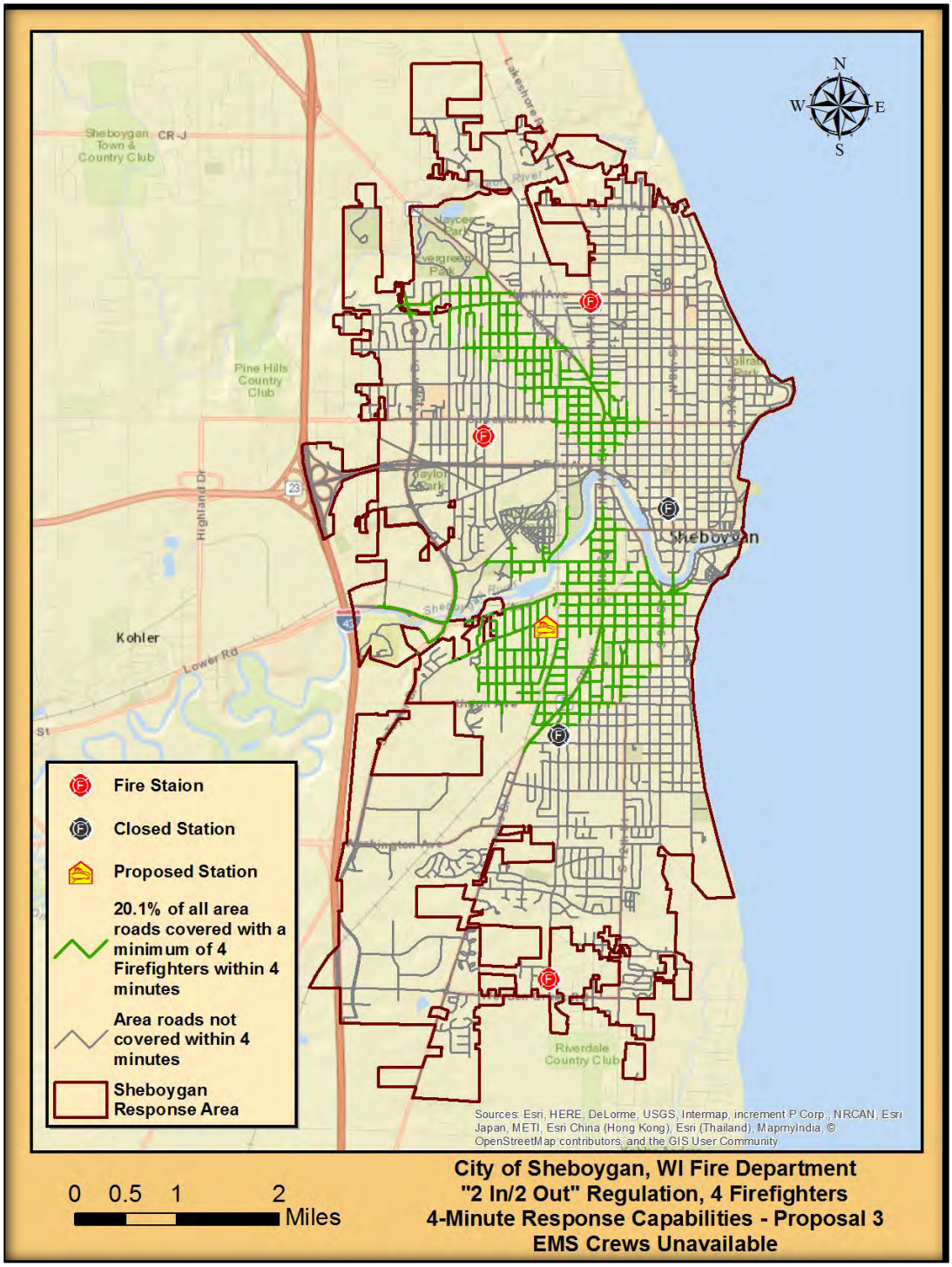
The following Geographic Information System (GIS) maps present anticipated response capabilities analysis of the Sheboygan Fire Department pursuant to staffing according to the proposed configuration described in Table 10 above.



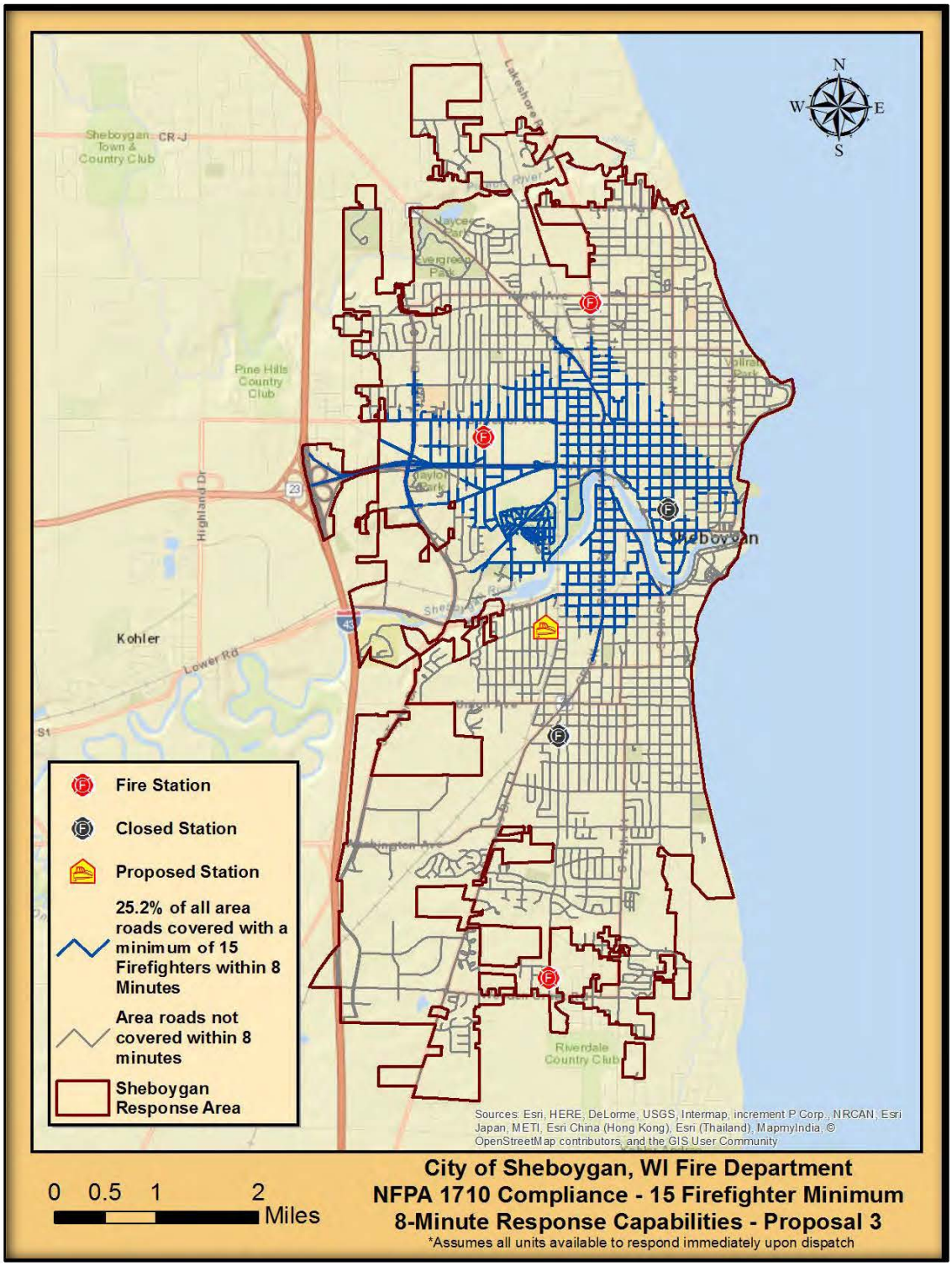
Map 17: Proposal 3, 4-Minute Response Capabilities. Map 17 identifies those roads where fire companies will likely have the capability to reach within 4 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, engine companies will likely be capable of responding on 60.5% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 16.3% *decrease* in response capabilities from existing conditions. (Roads losing coverage indicated in red on Map 17.)



Map 18: Proposal 3, Emergency 2 In/2 Out Capabilities, 4-Minute Response. Map 18 identifies those roads where a minimum of 4 firefighters will likely be able to assemble on scene within 4 minutes of travel. Pursuant to relocating existing personnel to the proposed Consolidated Station and Station 4, the Fire Department will likely be capable of assembling 4 firefighters on scene on 50.1% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 2.9% *increase* in response capabilities from existing conditions.



Map 19: Proposal 3, Emergency "2 In/2 Out" Operations, 4-Minute Response (EMS Crews Unavailable). If EMS crews are unavailable to assist suppression companies due to transport or other obligations, apparatus may be deployed alone with a staff of two or three. Due to the volume of responses by Sheboygan EMS companies as reflected in Table 7 in this report, this scenario is quite likely. Map 19 identifies those roads where suppression companies can assemble 4 personnel within 4 minutes for Proposal 3. The Department will be capable of reaching 20.1% of roads within the Sheboygan Fire Department's Response Area. This translates to a 60.0% *decrease* in response capabilities compared to all apparatus being available.



Map 20: Proposal 3, Effective Firefighting Force, 15 Firefighters. Map 20 identifies those roads where a minimum of 15 firefighters will likely be able to assemble within 8 minutes of travel. Pursuant to relocating 2 engine companies (4 firefighters) and an ambulance crew (2 firefighter/paramedics) to the proposed Consolidated Station and an ambulance crew (2 firefighter/paramedics) to Station 4, the Fire Department will likely be capable of assembling a minimum of 15 firefighters on 25.2% of roads within the Sheboygan Fire Department's Response Area within 8 minutes. This translates to a 61.0% *increase* in response capabilities from existing conditions.

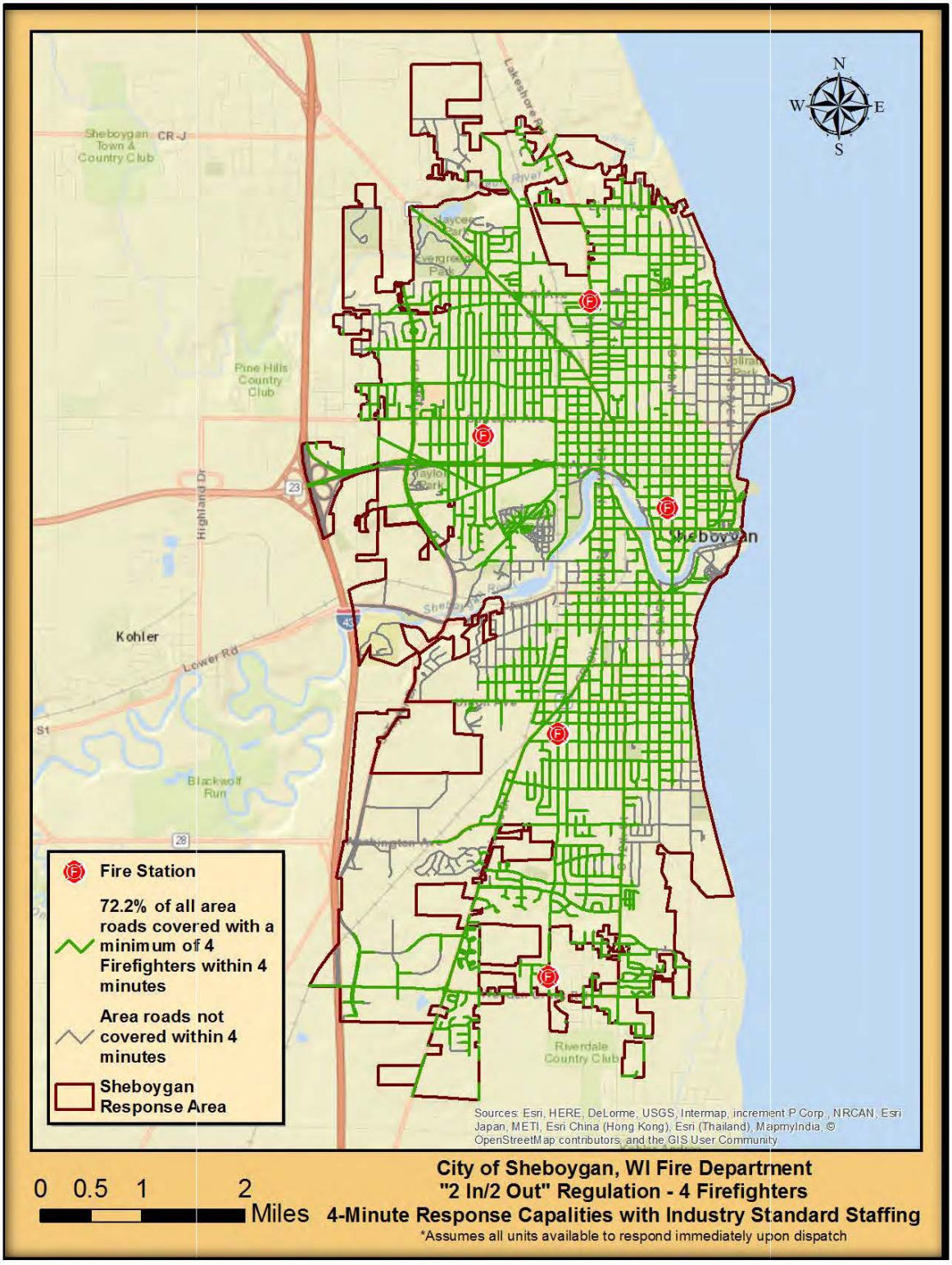
IAFF Recommended Response Capabilities

Additional staffing is required in order to bring the Sheboygan Fire Department closer to compliance with industry performance objectives and to allow for safer and more effective firefighting operations. It is recommended that all current stations remain open and that all suppression apparatus be staffed with a minimum of 4 firefighters at all times. Furthermore, it is recommended that the practice of supplementing the engines with EMS personnel be eliminated. It is all recommended to eliminate cross-staffing operations of fire apparatus at Station 5. All engines should be staffed with 4 personnel and the medics would be consistently staffed with 2 personnel. In this scenario, typical on-duty staffing would increase by 8 firefighters, plus a dedicated Battalion Chief and Chief's aide.

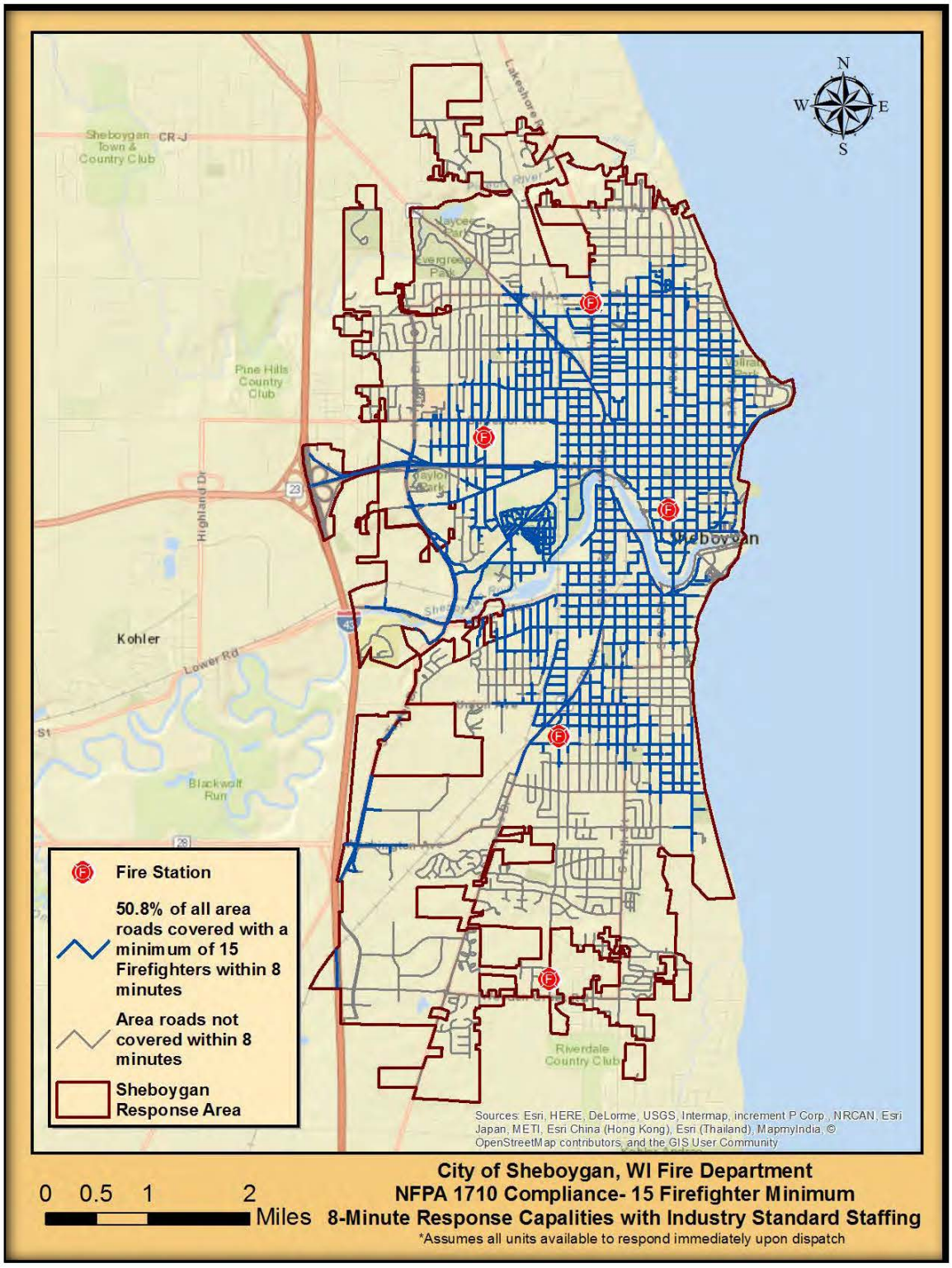
Station	Address	Apparatus	Min. Staffing
1	833 New York Ave.	Engine 1 Med 1	**4 FF** **2 FF/Paramedic**
2	2413 S. 18th St.	Rescue 2 Med 2	**4 FF** **2 FF/Paramedic**
3 (Command)	1326 N. 25th St.	Engine 3 Med 3 Command	**4 FF** **2 FF/Paramedic** **Battalion Chief & Chief Aide**
4	2622 N. 15th St.	Ladder 4	**4 FF**
5	4504 S. 18th St.	Ladder 5 Engine 5	**4 FF** **4 FF**

Table 11: IAFF Recommended Fire Station Locations and Staffing. The above table displays where apparatus are housed and recommended minimum on-duty staffing. The Department should also assign a Battalion Chief and a Chief's aide to every shift.

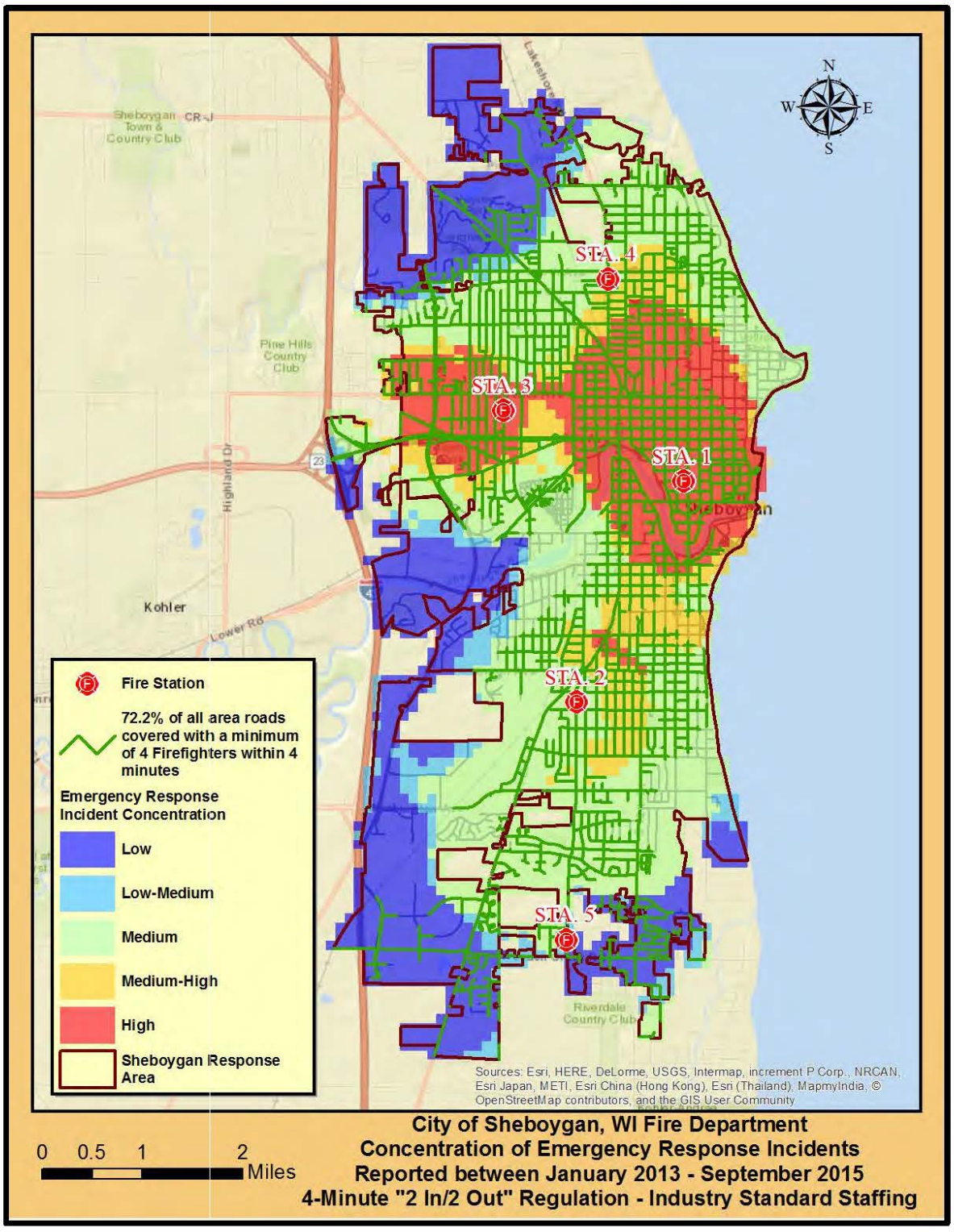
The following Geographic Information System (GIS) maps present anticipated response capabilities analysis of the Sheboygan Fire Department pursuant to implementation of the staffing and deployment configuration described in Table 11 above.



Map 21: Recommended Emergency "2 In/2 Out" Capabilities, 4-Minute Response. Map 21 identifies those roads where a minimum of 4 firefighters will likely be able assemble on scene within 4 minutes. Pursuant to the additional staffing, the Sheboygan Fire Department will likely be capable of assembling at least 4 firefighters on 72.2% of roads within the Sheboygan Fire Department's Response Area within 4 minutes. This translates to a 48.3% *increase* in response capabilities from existing conditions.



Map 22: Recommended Effective Firefighting Force, 15 Firefighters. Map 22 identifies those roads where a minimum of 15 firefighters will likely have the ability to assemble on scene within 8 minutes of travel. Pursuant to the additional staffing, the Sheboygan Fire Department will likely be capable of assembling a minimum of 15 firefighters on 50.8% of roads within the Sheboygan Fire Department's Response Area within 8 minutes. This translates to a 361.9% *increase* in response capabilities from existing conditions.



Map 23: Concentration of Emergency Response in Sheboygan, WI and 4- Minute "2 In/2 Out" Response with Industry Standard Staffing. Map 23 depicts the concentration of emergency incidents during the period of Jan. 2013 to Sept. 2015 overlaid with the 2 In/2 Out coverage if staffed in accordance with industry standards. This allows firefighters to respond with a minimum of 4 firefighters within 4 minutes to 72.2% of the city roads. Many areas with medium to high concentrations of incidents would likely be covered if recommendations were implemented.

Conclusion

In conclusion, regardless of the type of response, fire suppression companies are not compliant with industry standards for safe, efficient, and effective response to fires or rescue situations. The Department staffs most suppression apparatus with 2 or 3 firefighters rather than with 4, which is the minimum number required for efficient and effective fireground operations. Additionally, the Department uses the practice of supplementing engine companies with personnel assigned to the medic units. The Department also implements the method of cross-staffing apparatus located in Station 5. These practices contribute to delays in suppression, rescue, and response. The Department should increase staffing to improve response and enhance service to the citizens.

The City has put forward a plan proposing to consolidate the personnel and resources of two existing stations into a new location and the existing Station 4 that will not address the above mentioned problems. This decision will likely place the citizens and firefighters in a more precarious position, as this would result in a more limited distribution of Department resources as reflected in reduced 4-minute response capabilities. If the goal is safer, more efficient, and more effective response to fires or rescue situations, then the plan to merge the two fire stations is likely not the path to that objective.

While it is impossible to predict where most of a jurisdiction's fire and medical emergencies will occur, the Sheboygan Fire Department should examine where emergencies have typically occurred in the past and make efforts to ensure these areas continue to enjoy the same level of coverage, while adjusting resources and deployment in an effort to achieve complete compliance with NFPA Standard 1710. Areas with accelerated development and population growth will require additional coverage in the future. Any projected increase in emergency response demands should also be considered before changes are implemented, focusing on associated hazard types and planned response assignments.

As explained by the Commission on Fire Accreditation International, Inc. in its Creating and Evaluating Standards of Response Coverage for Fire Departments manual, "If resources arrive too late or are understaffed, the emergency will continue to escalate…What fire companies must do, if they are to save lives and limit property damage, is arrive within a short period of time with adequate resources to do the job. To control the fire before it reaches its maximum intensity requires geographic dispersion (distribution) of technical expertise and cost effective cluttering (concentration) of apparatus for maximum effectiveness against the greatest number and types of risks." Optimally, there needs to be a balance between both elements.

It is generally accepted that a municipality has the right to determine the overall level of fire protection it wants. However, regardless of the level of fire protection chosen by the citizens, neither they nor their elected representatives have the right to jeopardize the safety of the employees providing those services. Citizens pay for protection of life and property through their tax dollars, and they assume that their elected and appointed officials will make informed decisions regarding that protection. Too often, however, that decision-making process has been based solely on budgetary expedience. Irrespective of the resources provided, citizens continue to believe that firefighters are prepared to provide an aggressive interior assault on fires, successfully accomplishing victim rescue, fire control, and property conservation. They do not expect firefighters to take defensive actions- to simply surround and drown a fire- because to do so would be to concede preventable loss of both life and property

Considering the ramifications of station closures and staffing reductions as they pertain to the loss of life and property within a community, is essential when considering modifications to a fire department's deployment configuration. A fire department should be designed to adequately respond to a number of emergencies occurring simultaneously in a manner that aims to minimize the loss of life and the loss of property that the fire department is charged to protect. Any proposed changes in staffing, deployment and station location should be made only after considering the historical location of calls, response times to specific target hazards, compliance with departmental Standard Operating Procedures, existing industry standards, including NFPA 1500 and NFPA Standard 1710, and the citizens' expectation of receiving an adequate number of qualified personnel on appropriate apparatus within acceptable time frames to make a difference in their emergency.

Appendix

Performance Standards

The National Fire Protection Association (NFPA) produced NFPA 1710 *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. NFPA 1710 is the consensus standard for career firefighter deployment, including requirements for fire department arrival time, staffing levels, and fireground responsibilities.[60]

Key Sections included in the 1710 Standard that are applicable to this assessment are:

- 4.3.2
  - The fire department organizational statement shall ensure that the fire department's emergency medical response capability includes personnel, equipment, and resources to deploy at the first responder level with AED or higher treatment level.

- 5.2.3
  - **Operating Units**. Fire company staffing requirements shall be based on minimum levels necessary for safe, effective, and efficient emergency operations.

- 5.2.3.1 & 5.2.3.1.1
  - Fire companies, whose primary functions are to pump and deliver water and perform basic firefighting at fires, including search and rescue… shall be staffed with a minimum of four on-duty personnel.

- 5.2.3.2 & 5.2.3.2.1
  - Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work… shall be staffed with a minimum of four on-duty personnel.

[60] NFPA 1710, 2010

- 5.2.3.1.2 & 5.2.3.2.2
    - In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other factors as identified by the AHJ[61], these companies shall be staffed with a minimum of five or six on-duty personnel.

- 5.2.3.4.1
    - A fire company that deploys with quint apparatus designed to operate as either an engine company or a ladder company, shall be staffed as specified in 5.2.3.

- 5.2.3.4.2
    - If the company is expected to perform multiple roles simultaneously, additional staffing, above the levels specified in 5.2.3, shall be provided to ensure that those operations can be performed as required.

- 5.2.4.1.1
    - The fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 240-second travel time to 90 percent of the incidents.

- 5.2.4.2.1
    - The fire department shall have the capability to deploy an initial full alarm assignment within a 480-second travel time to 90 percent of the incidents.

[61] AHJ- Authority Having Jurisdiction

- 5.2.4.1.1
    - The initial full alarm assignment to a structure fire in a typical 2000 ft^2 … two-story single-family dwelling without basement and with no exposures shall provide for the following

Assignment	***Minimum Required Personnel***
Incident Command	1 Officer
Uninterrupted Water Supply	1 Pump Operator
Water Flow from Two Handlines	4 Firefighters (2 for each line)
Support for Handlines	2 Firefighters (1 for each line)
Victim Search and Rescue Team	2 Firefighters
Ventilation Team	2 Firefighters
Aerial Operator	1 Firefighters
Initial Rapid Intervention Crew (IRIC)	2 Firefighters
Required Minimum Personnel for Full Alarm	**14 Firefighters & 1 Scene Commander**

- 5.2.4.2.1
  - The initial full alarm assignment to a structure fire in a typical open-air strip shopping center ranging from 13,000 ft^2 to 196,000 ft^2 (1203 m^2 to 18,209 m^2) in size

And

- 5.2.4.3.1
  - The initial full alarm assignment to a structure fire in a typical 1200 ft^2 (111 m^2) apartment within a three-story, garden-style apartment building shall provide for the following:

Assignment	***Minimum Required Personnel***
Incident Command	1 Incident Commander 1 Incident Command Aide
Uninterrupted Water Supply (2)	2 Firefighters
Water Flow from Three Handlines	6 Firefighters (2 for each line)
Support for Handlines	3 Firefighters (1 for each line)
Victim Search and Rescue Teams	4 Firefighters (2 per team)
Ladder/Ventilation Teams	4 Firefighters (2 per team
Aerial Operator	1 Firefighter
Rapid Intervention Crew (RIC)	4 Firefighters
EMS Transport Unit[62]	2 Firefighters
Required Minimum Personnel for Full Alarm	**27 Firefighters** **1 Incident Commander**

[62] The Standard further states, "Where this level of emergency care is provided by outside agencies or organizations, these agencies and organizations shall be included in the department plan and meet these requirements."

- 5.2.4.4.1
    - Initial full alarm assignment to a fire in a building with the highest floor 75 ft. (23 m) above the lowest level of fire department vehicle access shall provide for the following:

Assignment	***Required Personnel***
Incident Command	1 Incident Commander 1 Incident Command Aide
Uninterrupted Water Supply	1 Building Fire Pump Observer 1 Fire Engine Operator
Water Flow from Two Handlines on the Involved Floor	4 Firefighters (2 for each line)
Water Flow from One Handline One Floor Above the Involved Floor	2 Firefighters (1 for each line)
IRIC/RIC Two Floors Below the Involved Floor	6 Firefighters
Victim Search and Rescue Team	4 Firefighters
Point of Entry Accountability	1 Officer 1 Officer's Aide
Evacuation Management Teams	4 Firefighters (2 per team)
Elevator Management	1 Firefighter
Lobby Operations Officer	1 Officer
Trained Incident Safety Officer	1 Officer
Staging Officer Two Floors Below Involved Floor	1 Officer
Equipment Transport to Floor Below Involved Floor	2 Firefighters
Firefighter Rehabilitation	2 Firefighters (1 must be ALS)
Vertical Ventilation Crew	1 Officer 3 Firefighters
External Base Operations	1 Officer
2 EMS ALS Transport Units	4 Firefighters
Required Minimum Personnel for Full Alarm	**36 Firefighters** **1 Incident Commander** **6 Officers**

- 5.3.3.2.2
    - EMS staffing requirements shall be based on the minimum levels needed to provide patient care and member safety.

- 5.3.3.2.2.2 & 5.3.3.2.2.3
    - Units that provide BLS (ALS re: 5.3.3.2.2.3) transport shall be staffed and trained at the level prescribed by the state or provincial agency responsible for providing EMS licensing.

- 5.3.3.3.3
    - When provided, the fire department's EMS for providing ALS shall be deployed to provide for the arrival of an ALS company within a 480-second travel time to 90 percent of the incidents, provided a first responder with AED or BLS unit arrived in 240 seconds or less travel time as established in Chapter 4.