

GEOGRAPHIC INFORMATION SYSTEM EMERGENCY SERVICES RESPONSE CAPABILITIES ANALYSIS



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

LEE COUNTY, FL
SOUTHWEST FLORIDA PROFESSIONAL FIRE FIGHTERS & PARAMEDICS
IAFF LOCAL 1826

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TABLE OF CONTENTS

I	List of Tables, Maps, & Figures	 ii
II	Executive Summary	 1
III	Introduction	 5
IV	Fire Department Suppression Operations	 6
V	Fire Department EMS Operations	 21
VI	Staffing and Deployment Analysis	 26
VII	Recommendations	 66
VIII	Summary & Conclusion	 67

LIST OF TABLES, MAPS, & FIGURES

TABLE 1:	NFPA 1710 FULL ALARM ASSIGNMENT	... 2
TABLE 2:	LEE COUNTY REGIONAL RESPONSE CAPABILITIES	... 3
TABLE 3:	IMPACT OF CREW SIZE ON A LOW-HAZARD RESIDENTIAL FIRE	... 9
TABLE 4:	THE RELATIONSHIP BETWEEN CREW SIZE AND SCENE TIME	... 11
TABLE 5:	THE RELATIONSHIP BETWEEN FIRE EXTENSION AND FIRE LOSS	... 17
TABLE 6:	OVERALL SUMMARY OF STUDY RESULTS	... 25
TABLE 7:	CURRENT STAFFING MODEL	... 26
MAP 1:	LEE COUNTY WILDLAND FIRE RISK	... 20
MAP 2:	REGIONAL STATION LOCATION	... 28
MAP 3:	4-MINUTE REGIONAL ENGINE COVERAGE	... 29
MAP 4:	4-MINUTE REGIONAL RESCUE COVERAGE	... 30
MAP 5:	8-MINUTE REGIONAL ENGINE COVERAGE	... 31
MAP 6:	8-MINUTE REGIONAL RESCUE COVERAGE	... 32
MAP 7:	8-MINUTE REGIONAL TRUCK COVERAGE	... 33
MAP 8:	8-MINUTE REGIONAL COMMAND COVERAGE	... 34
MAP 9:	8-MINUTE REGIONAL OSHA “2-IN/2-OUT” COVERAGE	... 35
MAP 10:	REGIONAL NFPA 1710 INITIAL ALARM 15 FF ASSEMBLY	... 36
MAP 11:	REGIONAL NFPA 1710 HIGH-HAZARD ASSEMBLY	... 37
MAP 12:	BAYSHORE FIRE RESCUE AOR & STATION LOCATIONS	... 38
MAP 13:	BFR 4-MINUTE RESPONSE COVERAGE	... 39
MAP 14:	BFR 8-MINUTE RESPONSE COVERAGE	... 40
MAP 15:	BFR 8-MINUTE “2-IN/2-OUT” RESPONSE COVERAGE	... 41
MAP 16:	FMFD 4-MINUTE ENGINE COVERAGE	... 42
MAP 17:	FMFD 8-MINUTE ENGINE COVERAGE	... 43
MAP 18:	FMFD 4-MINUTE RESCUE COVERAGE	... 44
MAP 19:	FMFD 8-MINUTE RESCUE COVERAGE	... 45
MAP 20:	FMFD 8-MINUTE TRUCK COVERAGE	... 46
MAP 21:	FMFD 8-MINUTE OSHA “2-IN/2-OUT”	... 47
MAP 22:	FMFD NFPA 1710 INITIAL ALARM 15 FF ASSEMBLY	... 48
MAP 23:	FMFD NFPA 1710 HIGH-HAZARD ASSEMBLY	... 49
MAP 24:	FMFD 8-MINUTE COMMAND COVERAGE	... 50
MAP 25:	LHFD AOR & 4-MINUTE ENGINE COVERAGE	... 51
MAP 26:	LHFD 8-MINUTE ENGINE COVERAGE	... 52
MAP 27:	LHFD 4-MINUTE RESCUE & “2-IN/2-OUT” COVERAGE	... 53
MAP 28:	LHFD 8-MINUTE RESCUE & “2-IN/2-OUT” COVERAGE	... 54
MAP 29:	LHFD 8-MINUTE LADDER & COMMAND COVERAGE	... 55
MAP 30:	LHFD NFPA 1710 INITIAL ALARM 15 FF ASSEMBLY	... 56
MAP 31:	NFMFD AOR, 4-MINUTE ENGINE AND RESCUE COVERAGE	... 57
MAP 32:	NFMFD 8-MINUTE ENGINE, RESCUE, & OSHA ‘2-IN/2-OUT’ COVERAGE	... 58
MAP 33:	NFMFD NFPA 1710 INITIAL ALARM 15 FF ASSEMBLY	... 59
MAP 34:	NFMFD 8-MINUTE COMMAND COVERAGE	... 60
MAP 35:	TFR 4-MINUTE ENGINE COVERAGE	... 61
MAP 36:	TFR 8-MINUTE ENGINE COVERAGE	... 62
MAP 37:	TFR 4-MINUTE RESCUE & “2-IN/2-OUT” COVERAGE	... 63
MAP 38:	TFR 8-MINUTE RESCUE & “2-IN/2-OUT” COVERAGE	... 64
MAP 39:	TFR NFPA 1710 INITIAL ALARM 15 FF ASSEMBLY	...
FIGURE 2:	FIRE DEPARTMENT RESPONSE TIMELINE	... 8
FIGURE 3:	ENGINE COMPANY FIREGROUND OPERATIONS WHEN STAFFED WITH FOUR FIREFIGHTERS	... 14
FIGURE 4:	NFPA 1710 INITIAL FULL ALARM ASSIGNMENT DEPLOYED WITHIN 8 MINUTES	... 16
FIGURE 5:	OSHA ‘2 IN/2 OUT’ ILLUSTRATED	... 18
FIGURE 6:	EMERGENCY ‘2 IN/2 OUT’ OPERATIONS WHEN FIRE COMPANIES ARE STAFFED WITH 4 FIREFIGHTERS	... 19
FIGURE 7:	TIMELINE OF A FIRE DEPARTMENT RESPONSE TO AN INCIDENT OF CARDIAC ARREST	... 21

Executive Summary

Fire and rescue services in Lee County, Florida are provided by several fire departments and independent fire districts. It should be noted, however, that not every agency within the county was involved in this study. Geographically, the county has a total area of 1,212 square miles, 428 of which are water. The US Census estimated a 2013 population of 661,115. The county has a population density of 789/square mile, compared to a statewide population density of 351/square mile.¹

The agencies involved in this study provide a variety of emergency services to the local area including fire suppression, Basic and Advanced Life Support emergency medical response and transportation, wildland fire operations, hazardous materials response, technical rescue (including water, confined space, trench, vehicle extrication, and high angle), marine firefighting, emergency management, as well as fire prevention & safety programs, and inspections (not all agencies may provide all listed services). Because of the many variables associated with volunteer response (such the time required to go to the station prior to responding, and unknown availability), the volunteer components of Lee County emergency services agencies are not included in this analysis. Lee County fire departments and districts have automatic-aid agreements with several surrounding jurisdictions and participate in the Florida State-Wide Emergency Response Plan. Critical infrastructure within the response area includes water treatment facilities, electrical sub-stations, high voltage transmission lines, high pressure natural gas pipelines, rail lines, inter- and intrastate highways, healthcare facilities, transportation systems, and large public gathering spaces.

Municipalities within Lee County have experienced the same financial challenges as the rest of the country, and this has impacted emergency service delivery. Insufficient staffing of many first arriving fire suppression companies delays the initiation of interior firefighting operations, allowing fires to grow exponentially for each minute aggressive attack operations are delayed. The response distance of many automatic-aid companies means a fire will very likely have reached, or be reaching, flashover conditions at the same time that an effective fire ground force is assembled. Interior conditions at this point would be untenable, with survival of a flashover by either civilian or emergency personnel unlikely.

National 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

¹ U.S. Census Bureau, <http://quickfacts.census.gov/qfd/states/12/12071.html>

career fire fighter deployment, including requirements for fire department arrival time, staffing levels, and fireground responsibilities.²

Key Sections included in the 1710 Standard are:

- 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 and 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.
- 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.
- 5.2.4.2.2
 - The initial full alarm assignment to a structure fire in a typical 2000 ft² ... two-story single-family dwelling without basement and with no exposures shall provide for the following.

<u>Assignment</u>	<u>Required Personnel</u>
Incident command	1 Individual
Uninterrupted Water supply	1 Pump Operator
Water flow from two handlines	4 Individuals (2 for each line)
Support for hand lines	2 Individuals (1 for each line)
Victim search and rescue team	2 Individuals
Ventilation team	2 Individuals
Aerial operator	1 Individual
Initial Rapid Intervention Crew (IRIC)	2 Individuals
Required minimum personnel for full alarm	14 fire fighters & 1 scene commander

TABLE 1: NFPA 1710 FULL ALARM ASSIGNMENT

² NFPA 1710, 2010.

Key Findings

The fire and rescue agencies included in this study do not comply with the performance or staffing objectives of NFPA Standard 1710. This finding is based on the following:

- 1) Fire suppression apparatus are staffed with fewer than the minimum of 4 personnel called for in NFPA 1710.
- 2) The lack of personnel, as mentioned in finding #1 above, is a major factor in the fire department's inability to assemble the appropriate number of personnel, as defined in NFPA 1710 (Table 1, previous page), on the scene of a structure fire or ALS medical emergency in a timely manner.
- 3) The following table lists the results of the GIS modeling of the included agencies' current staffing and deployment practices.

<u>Response Scenario</u>	<u>Percent of streets covered</u>
4-Minute Travel Time	29.88%
2 In/2 Out (8-minute)	75.43%
8-Minute Travel Time	75.99%
NFPA 15-Personnel Assembly within 8 minutes	11.36%

TABLE 2: "LEE COUNTY FIRE & RESCUE REGIONAL RESPONSE CAPABILITIES"

Recommendations

Some agencies within Lee County have recently experienced major staffing reductions, significantly reducing emergency operations capabilities, particularly when responding to a structure fire. Overall, Lee County fire & rescue agencies are facing a likely reduction of over 100 additional personnel, potentially crippling fire and rescue services in one of the most populous counties in the state of Florida. Staffing should be returned to a minimum of four personnel on all structural fire companies and alternatives to future cuts pursued.

The following recommendations are based on the results of the GIS evaluation of current staffing models which showed that staffing and deployment were already noncompliant with national standards. Additional staffing reductions will take the impacted agencies even further from compliance.

- Fire suppression apparatus should be staffed with a minimum of 4 fire fighters at all times.
 - Staffing at this level complies with industry standards for crew size in a low hazard residential environment and reduces the risk to fire fighters and trapped occupants.
 - Sending larger a crew on a single apparatus allows the on scene assembly of an effective firefighting force during the early stages of a fire when risks to both fire

fighters and building occupants are lower. Since fire growth is exponential, growing in a non-linear manner over time, delays associated with the assembly of an effective firefighting force using smaller crews arriving on multiple apparatus results in increased risk to fire fighters and civilians. The higher the risks at the time fire fighters engage in fire suppression operations, the greater the chance of poor outcomes such as civilian injury or death, fire fighter injury or death, and increased property loss.

- Additional stations may be required in the future to improve 4-minute and 8-minute response coverage.
 - Locating stations and deploying resources in areas where there are insufficient response capabilities will further reduce risks to the public and fire fighters responding in these areas. People living or working in areas where first due engines require greater than 4 minutes travel time to arrive on scene and engage in fire suppression or EMS activities are more vulnerable to negative outcomes from fire, illness, or injury. As noted above, increasing the time to fire fighter intervention also increases the risk for both fire fighters and the public.
 - A fire department needs to maintain acceptable levels of both concentration and distribution of resources. An adequate distribution of resources will allow for quick responses to different areas of the district, while the concentration element will assist in the assembly of an initial effective response force consisting of both personnel and apparatus within a specified time frame.
 - Fire suppression response should be included in any and all documents or discussions concerning future developments and growth (buildings and populations). Any areas with accelerated development and growth will require additional coverage in the future. Projected increases in emergency response demands should be considered and focus should be centered on hazard and risk assessments and planned response requirements.

Introduction

The International Association of Fire Fighters (IAFF) was contacted by the South West Florida Professional Firefighters & Paramedics, IAFF Local 1826, to perform a Geographic Information System (GIS) analysis of the response capabilities of the fire departments and independent fire districts of Bayshore, Lehigh Acres, Fort Myers, North Fort Myers, and Tice, all located within Lee County, Florida. Local 1826 requested that the GIS study evaluate the current agency deployment and staffing models against both National Fire Protection Association (NFPA®) industry standards and U.S. Occupational Safety and Health (OSHA) regulations. The procedures involved in the evaluation included generating GIS maps, comparison of model results against industry standards, and explanation of the results. The steps included in the evaluation include:

- 1) GIS analysis of current staffing and deployment configurations.
- 2) Statistical analysis of fire department response capabilities.
- 3) Evaluation of resource deployment outcomes measured against NFPA standards and OSHA regulations.

Scope and Objectives

This report provides the results of the emergency response system evaluation and the GIS assessment of Lee County fire department and district response capabilities. The report refers both to the current performance of the department and its staffing and deployment practices. Items specifically covered in this report include:

- Fire department response capabilities and compliance with industry standards
- Staffing configurations and safe work practices
- Strengths and weaknesses of the fire service in Lee County, FL
- Recommendations to improve service

Fire Department Suppression Operations

The business of providing emergency services has historically been labor intensive, and remains so today. Although new technology has improved firefighting equipment and protective gear, as well as advances in modern medicine, it is the fire fighters and emergency medical personnel 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 a matter of minutes a small flame can grow exponentially to become a major fire. During fire growth, the temperature in a fire rises to between 1,000° and 1,200° F. It is generally accepted in the fire service that for a medium growth rate fire³, flashover – defined as the very rapid spreading of the fire due to super heating of room contents and other combustibles - can occur in as little as 10 minutes. Allowing time for discovery of the fire, a call to 911, and dispatch of emergency responders, **flashover is likely to occur within 8 minutes of fire fighter dispatch.** It is also worth noting that flashover may occur more quickly depending on building construction methods and materials, and room contents that act as fuel.

At the point of flashover, the odds of survival for unprotected individuals, as well as fire fighters, inside the structure are virtually non-existent. The rapid response of an appropriate number of fire fighters 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.

Fire Growth, Flashover, and the Importance of a Rapid Response to a Fire in a Residential Structure:

The Incipient Phase

The first stage of any fire is the incipient stage. When heat is applied to a combustible material, the heat oxidizes the material's surface, releasing combustible gases. The oxidation process is exothermic, meaning the oxidation process itself produces heat. The heat from oxidation raises the temperature of surrounding materials, increasing their rate of oxidation and beginning a chemical chain reaction. A fire can progress from the incipient phase quickly or slowly, depending upon the fuel, nearby combustibles, and the availability of oxygen in the surrounding air.

The Free Burning Phase

The second stage of fire growth is the “free” or “open burning” stage. When the temperature of a fire gets high enough, flames will become visible. The visible burning at this stage is still

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.

limited to the immediate area of origin. The combustion process continues to release more heat, raising the temperature of nearby objects to their ignition point, where they will begin burning. In a wildland fire the surrounding fuels will ignite. The rate of flame spread in a wildland fire will depend on terrain, weather conditions, and the moisture contents of available fuels. A structure fire is different, because the gaseous products of combustion, most of which are flammable and lighter than air, rise and are contained within the structure and become fuel themselves. The structure fire has now reached a critical point: either the fire has insufficient oxygen available to burn and it progresses back to the incipient stage, or it has sufficient oxygen available to move on to the next stage.

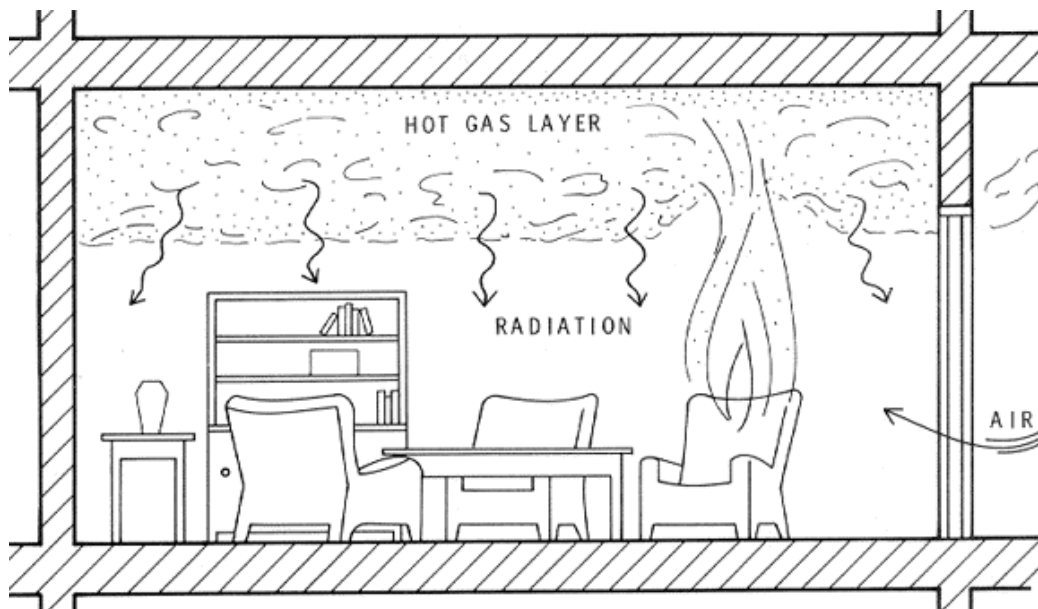


FIGURE 1: "FIRE GROWTH IN A CONFINED SPACE"⁴

When an object in a room starts to burn (such as the armchair in Figure 1), it burns in much the same way as it would in an open area. After a short period of time, however, confinement of the structure begins to influence fire development. The smoke produced by the burning object rises to form a hot gas layer below the ceiling which heats the ceiling and upper walls of the room. Thermal radiation from the hot layer, ceiling, and upper walls begins to heat all objects in the lower part of the room and may augment both the rate of burning of the original object and the rate of flame spread over its surface.

At this point, the fire may go out if, for example, the first object completely burns before another object ignites, or if there is insufficient oxygen available to support continued free burning. The heating of other combustibles in the room may continue to the point that they reach their ignition temperatures nearly simultaneously. If this occurs, flames engulf the entire room, involving all

⁴ Image courtesy of University of California at Davis Fire Department

combustibles. This transition from the burning of one or two objects to full room involvement is referred to as “flashover.”⁵

Flashover

Flashover, when it occurs, is the most significant events during a structure fire. As combustible gases are produced in the previous stages of the fire, they are not entirely consumed and become 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 1,500° F (815.5° C). With enough existing oxygen at the floor level, flashover occurs, burning everything in the room at once. The instantaneous eruption into flame generates a tremendous amount of heat, smoke, and pressure. The pressure wave 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, increasing the fire’s temperature and spreading the fire beyond the room of origin.

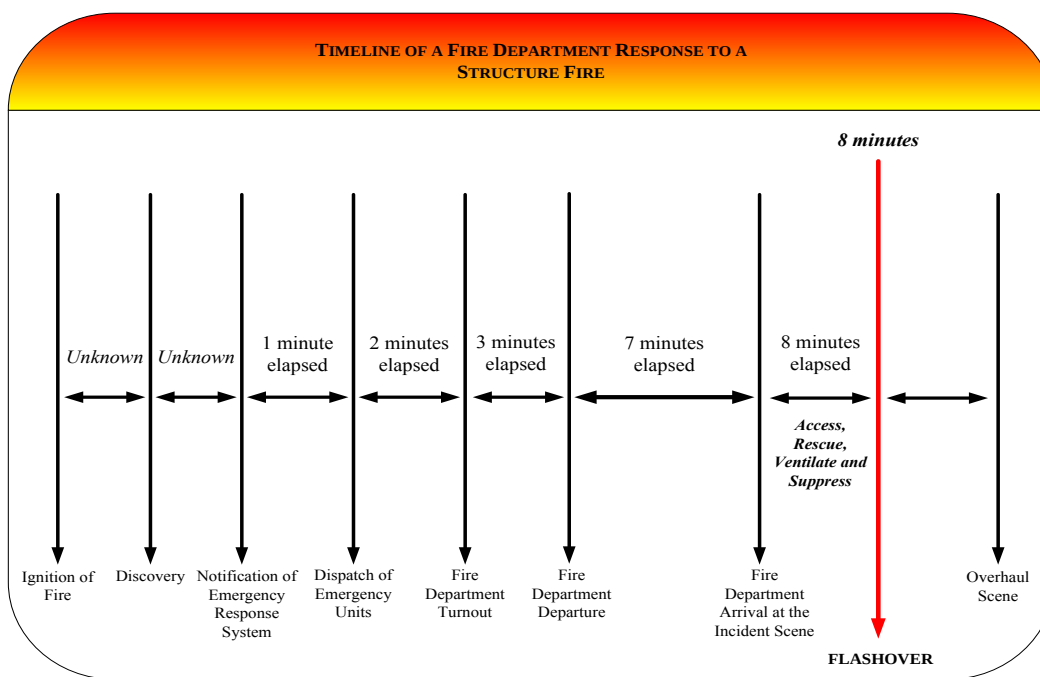


FIGURE 2: “STRUCTURE FIRE RESPONSE TIMELINE”

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 loss of life, property, and economic strength.

⁵ J.R. Mehaffey, Ph.D., Flammability of Building Materials and Fire Growth, Institute for Research in Construction (1987)

The Importance of Adequate Staffing to Conduct Safe and Effective Fire Suppression and Rescue Operations:

Staffing deficiencies on primary fire suppression apparatus 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 fire fighter arrival on scene, is directly linked to the time it takes to initiate fire suppression operations. As indicated in Table 3, responding companies staffed with four fire fighters are capable of initiating critical fire ground operational tasks more efficiently than those with crew sizes below industry standards.

Fireground Tasks	Engine Company Duties				Ladder Company Duties			
	Advance Attack Line	% Change	Water on Fire	% Change	Primary Search	% Change	Venting Time	% Change
4 FFs	0:03:27		0:08:41		0:08:47		0:04:42	
3 FFs	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 FFs	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 3: "IMPACT OF CREW SIZE ON A LOW-HAZARD RESIDENTIAL FIRE"⁶

First-arriving companies staffed with four fire fighters are more efficient in all aspects of initial fire suppression and search and rescue operations when compared to two- or three-person companies. There is a significant increase in completion time for all fireground tasks if a company arrives on scene staffed with only three fire fighters when compared to a company staffed with four fire fighters. Furthermore, the NIST Report on Residential Fireground Field Experiments found that 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 fire fighters and trapped occupants.

With four-person crews, the effectiveness of first-arriving engine company interior attack operations *increases* by 12% to 29% efficiency when compared to three- and two-person crews respectively. The efficacy of search and rescue operations also *increases* by 4% and 28% with four-person crews, compared to three- and two-person crews respectively. 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.

⁶ Derived from NIST "Report on Residential Field Experiments", Jason D. Averill, et. al., 2010.

Insufficient numbers of emergency response units or inadequate staffing levels on arriving units expose civilians and fire fighters to increased risk, further drain already limited fire department resources, and stresses the entire 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 fire spread, combat the fire, conduct a search, and rescue any trapped occupants, puts responding fire fighters and occupants in an increasingly dangerous environment with an associated escalation in risk. Conditions can deteriorate to the point that it is difficult to catch up and manage the event to a positive outcome.

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 rapid arrival of sufficient numbers of personnel and equipment, allowing a quick initial attack and the extinguishment of the fire as close to the point of origin as possible. This also speeds the rescue of any trapped occupants and initiation of care for the injured. Rapid and aggressive interior attack of structure fires, as close as possible to the point of origin, can reduce loss of life as well as property loss. Sub-optimal staffing of arriving units may delay such an attack, allowing the fire to progress to more dangerous conditions for both fire fighters and involved civilians. “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

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 each ladder company responding to any type of fire**. Recall that at the scene of an emergency, the driver/operator of the engine must remain with the apparatus to operate the pump. Likewise, the driver/operator of the ladder must remain with the apparatus to safely operate the aerial device. Due to the demands of fireground activities, any fewer than four fire fighters will not be capable of effecting safe fire suppression and/or rescue operation until sufficient personnel arrive. Industry studies have confirmed that **four fire fighters are capable of performing the rescue of potential victims 80% faster than a crew of three fire fighters**.⁹

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 Injures Another Career Fire Fighter (Captain) – Texas, 13 October 2001

⁹ McManis Associates and John T. O’Hagan & Associates, Dallas Fire Department Staffing Level Study, (June 1984); pp. 1-2 and II-1 through II-7; Richard C. Morrison, Manning Levels for Engine and Ladder Companies in Small Fire Departments, (1990)

Typically, the first company arriving on scene is responsible for multiple critical tasks. These include establishing a reliable water supply, stretching an attack line from the apparatus to the point of entrance of the structure (with a second hose line stretched to protect the exterior), forcing entry into the structure, initial ventilation, scene size-up, and primary search and rescue activities. The first arriving company is also responsible for assessing the situation and determining the extent of the emergency to establish the type and number of additional resources necessary to mitigate the event. By the time a sufficient number of fire fighters arrive on scene to assist in performing these duties, the fire may be beyond control and property and lives may be lost.

The Importance of Crew Size to Overall Scene Time:

Studies have shown that more personnel arriving at the scene of a fire on individual engine and ladder companies will take less time to complete tasks associated with fire suppression and search and rescue activities. As the number of appropriately staffed companies arriving on scene increases, the overall on-scene time decreases. In other words, the more fire fighters 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, thereby reducing the risk of injury and death to both fire fighters and trapped occupants as well as reducing primary and secondary economic losses associated with the property.

Overall Scene Time Breakdown By Crew Size					
2 Person Close Stagger	3 Person Close Stagger	4 Person Close Stagger	2 Person Far Stagger	3 Person Far Stagger	4 Person Far Stagger
0:22:16	0:20:30	0:15:44	0:22:52	0:21:17	0:15:48
29% Less Efficient	25% Less Efficient		31% Less Efficient	26% Less Efficient	

TABLE 4: "THE RELATIONSHIP BETWEEN CREW SIZE AND SCENE TIME" ¹⁰

As Table 4 above shows, units that arrive with only two fire fighters on an engine or truck are on the scene of a fire almost 7 minutes longer than units that arrive with four fire fighters on each crew. Responding units arriving with only 3 fire fighters on an apparatus are on the scene of a fire 5 to 6 minutes longer than units that arrive with four fire fighters on each apparatus. In addition to crew size, the time between the arriving crews also influences overall effectiveness and total on scene time.

In the NIST study on low hazard residential fires, 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

¹⁰ NIST "Report of Residential Fireground Field Experiments", Jason D. Averill, et. al., 2010

¹¹ NIST "Report on Residential Fireground Field Experiments", Jason D. Averill, et. al., 2010, pg. 24

pattern of units arriving with four fire fighters in a close stagger *or* far stagger are more efficient when conducting fire suppression operations, decreasing the overall time at the scene of the emergency when compared to units that arrive with two or three fire fighters.

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

Fire modeling was used by researchers to mark the toxicity of the environment for a range of different fire growth rates (slow, medium, and fast). Occupant exposures were calculated for when fire fighters arrived earlier to the scene, and for when fire fighters arrived later. The modeling proved that the longer it takes for fire fighters to rescue trapped occupants, the greater the risk posed to both the fire fighters and occupants by increasing atmospheric toxicity within the structure.

The Importance of a Rapid Response in Initiating Safe and Effective Fire Suppression and Rescue Operations:

Any delay in the initiation of fire suppression and rescue operations translates directly into a proportional *increase* in expected life, property, and economic losses. 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 members, compromising the structural integrity of a building and forcing operations to shift from an offensive to defensive mode.¹⁴ As with inadequate staffing, this type of operation will continue until enough resources can be assembled to then change to an aggressive, offensive attack.

Typical Initial Attack Response Capabilities Assuming Interior Attack and Operations Command Capabilities for Differing Fire Hazard Environments:

High-Hazard Environments:

Type of Occupancy

- Schools
- Hospitals
- Nursing Homes
- Explosives Plants
- Refineries

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 from fire department operations conducted by the International Association of Fire Chiefs and the International Association of Fire Fighters.

¹³ NIST “Report on Residential Fireground Experiments”, Jason D. Averill,, et. al, 2010, pg. 50.

¹⁴ 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.”

- High-Rise Buildings
- Other high life hazard or large fire potential occupancies.

Response Capability

- 4 Engines / Staffed with 5 fire fighters
- 2 Ladder Trucks/ Staffed with 5 fire fighters (or combination apparatus with equivalent capabilities.)
- 2 Chief Officers
- Other Specialized Apparatus as may be needed to cope with the combustible involved.

Personnel Resources

- 30 Fire Fighters
- 2 Chief Officers
- Extra staffing of units first due to high-hazard occupancies is advised.
- One or more safety officers
- Rapid intervention team(s) also necessary.

Medium-Hazard Environments:

Type of Occupancy

- Apartments
- Offices
- Mercantile and Industrial not normally requiring extensive rescue or fire-fighting forces.

Response Capability

- 3 Engines/ Staffed with 4 or 5 fire fighters
- 1 Ladder Truck/ Staffed with 4 or 5 fire fighters (or combination apparatus with equivalent capabilities.)
- 1 Chief Officer
- Other Specialized Apparatus as may be needed or available.

Personnel

- 16 – 20 Fire Fighters
- 1 Chief Officer
- Safety Officer
- Rapid Intervention Team

Low-Hazard Environments:

Type of Occupancy

- One-, two-, or three-family dwellings
- Scattered Small Business
- Scattered Small Industrial Occupancies

Response Capability

- 3 Engines/ Staffed with minimum of 4 fire fighters

- 1 Ladder Truck/ Staffed with minimum of 4 fire fighters (or combination apparatus with equivalent capabilities.)
- 1 Chief Officer
- Other Specialized Apparatus as may be needed or available.

Personnel

- 16 Fire Fighters
- 1 Chief Officer
- Safety Officer
- Rapid Intervention Team

The Importance of the 8-minute Engine Company Response during Structural Fire Fighting Operations:

One of the first priorities in fireground operations is to get water on the fire to extinguish it. When initiating fire attack, a single engine company would not be capable of affecting a safe and effective fire attack or rescue operation in compliance with “2 In/2 Out” requirements unless staffed with *at least* four fire fighters. Engine companies with less than four personnel must wait until a second fire suppression company arrives to support the fire attack and/or rescue operation and to assist the first crew in the event of an unexpected emergency during interior attack.

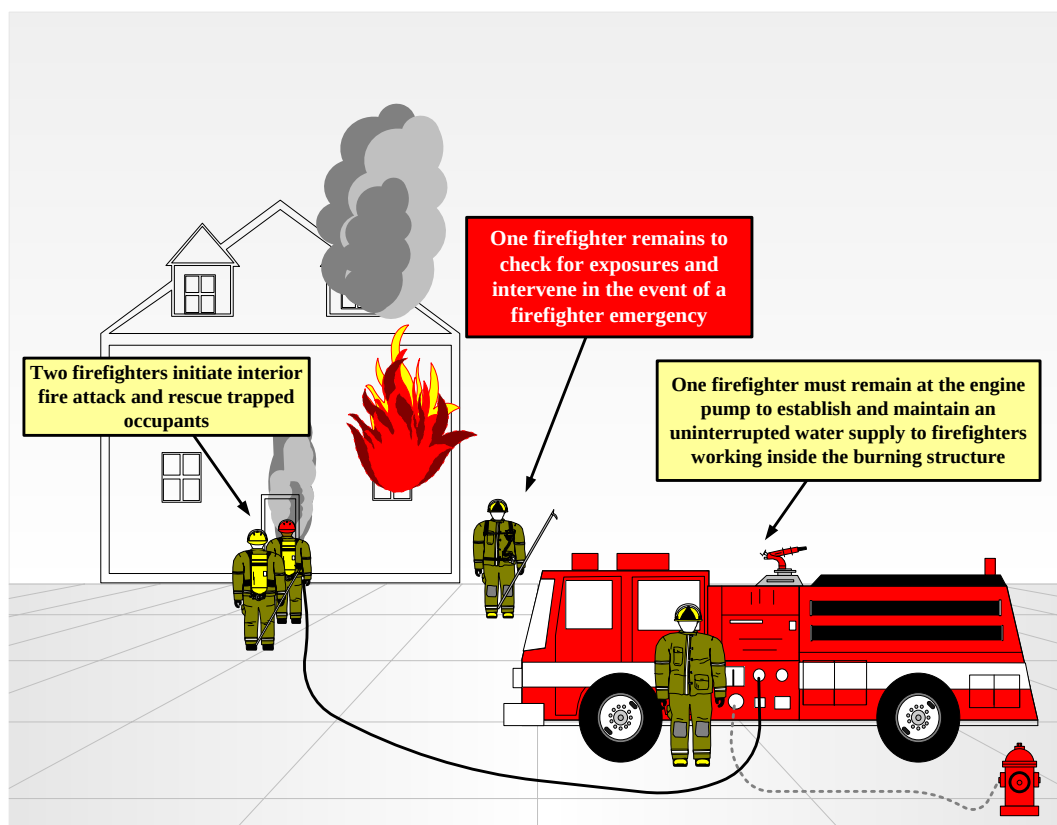


FIGURE 3: “ENGINE COMPANY FIREGROUND OPERATIONS WHEN STAFFED WITH FOUR FIRE FIGHTERS”

For these reasons, it is recommended that Lee County fire and rescue agencies ensure the safe and effective delivery of emergency services by staffing fire suppression apparatus with *at least* four multi-role fire fighters.¹⁵

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: establishment of incident command outside of the hazard area for the overall coordination and direction of the initial alarm assignment with a minimum of one individual dedicated to this task; establishment of an uninterrupted water supply of a minimum of 400 gpm (1520 L/min) for 30 minutes with supply line(s) maintained by an operator; establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines, each of which has a minimum flow rate of 100 gpm (380 L/min) with each handline operated by a minimum of two individuals to effectively and safely maintain the line; provision of one support person for each attack and backup line deployed to provide hydrant hookup and to assist in laying of hose lines, utility control, and forcible entry; provision of at least one search and rescue team with each such team consisting of a minimum of two individuals; provision of at least one team, consisting of a minimum of two individuals, to raise ground ladders and perform ventilation; if an aerial device is used in operations, one person to function as an aerial operator and maintain primary control of the aerial device at all times; establishment of an IRIC consisting of a minimum of two properly equipped and trained individuals.”¹⁶ This breakdown of the expected capabilities of a full alarm assignment, in compliance with NFPA Standard 1710, requires a minimum contingent of fifteen fire suppression personnel, including the Incident Commander (IC) and the IC’s aide¹⁷, to arrive at the scene of a structure fire within 8 minutes of receiving the alarm.

In addition, NFPA 1710, §5.2.4.3.1 states, “The Fire Department shall have the capability for additional alarm assignments that can provide for additional personnel and additional services, including the application of water to the fire; engagement in search and rescue, forcible entry, ventilation, and preservation of property; accountability for personnel; and provision of support activities...” Currently, several Lee County agencies lack sufficient resources for a full alarm response without the use of mutual aid companies from surrounding jurisdictions. Any response beyond the initial company would have to rely on volunteers and neighboring agencies. As these departments may not have consistent availability (particularly volunteer departments), these additional resources cannot be depended upon to arrive within recommended time frames. Simultaneous calls for emergency service will experience delays when waiting for assistance.

¹⁵ NFPA 1710, §5.2.2.1.2 and §5.2.2.2.2 - “In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members.”

¹⁶ NFPA 1710, § 5.2.4.2.1 and § 5.2.4.2.2, (1) – (8)

¹⁷ NFPA 1710, § 5.2.2.2.5

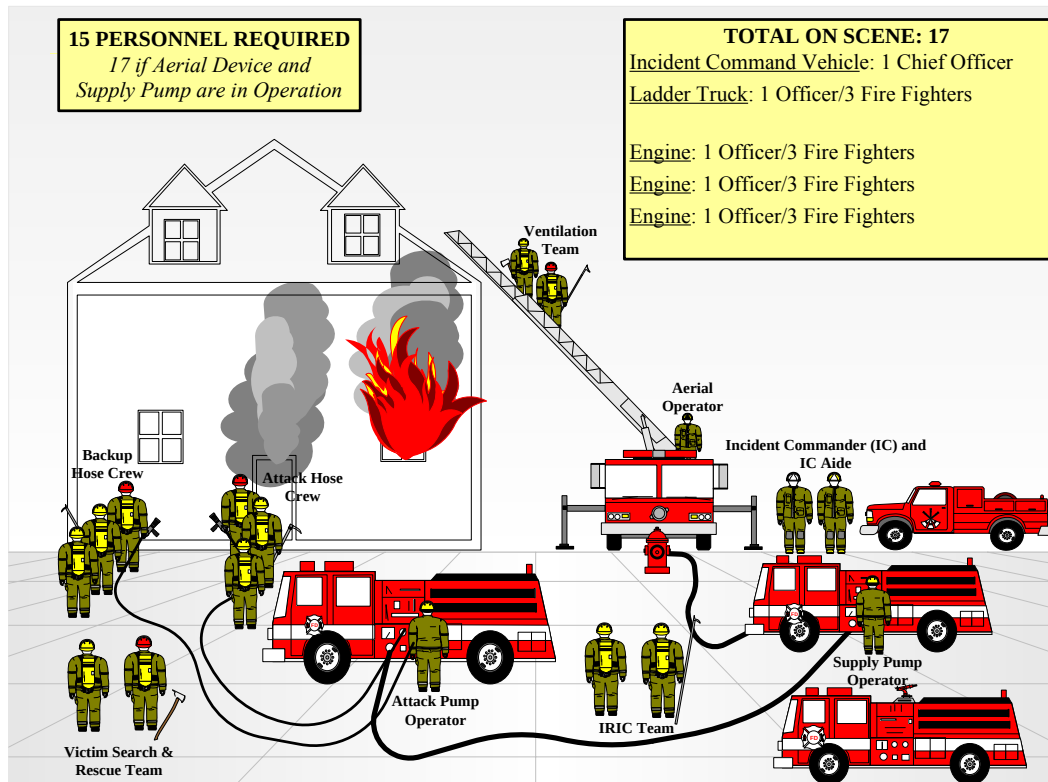


FIGURE 4: “NFPA 1710 INITIAL FULL ALARM ASSIGNMENT DEPLOYED WITHIN 8 MINUTES”

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 property associated with structure fires. Each stage of fire extension beyond the room of origin directly increases the rate of civilian deaths, injuries, and property damage.

<i>Rate Per 1,000 Fires</i>			
Fire Extension in Residential Structures:	Civilian Deaths	Civilian Injuries	Average Property Damage
Confined fires (identified by incident type)	0.08	9.25	\$313.00
Confined to room of origin	4.99	47.00	\$8,948.00
Confined to room of origin, including confined fires by incident type*	2.15	25.18	\$3,958.00
Beyond the room, but confined to floor of origin	17.62	80.45	\$34,001.00
Beyond floor of origin	27.48	59.38	\$58,820.00

TABLE 5: "THE RELATIONSHIP BETWEEN FIRE EXTENSION AND FIRE LOSS"¹⁸

*NFIRS 5.0 has six categories of confined structure fires, including cooking fires confined to the cooking vessel, confined chimney or flue fire, confined incinerator fire, confined fuel burner or boiler fire or delayed ignition, confined commercial compactor fire, and trash or rubbish fire in a structure with no flame damage to the structure or its contents. Although causal information is not required for these incidents, it is provided in some cases. In this analysis (NFPA Fire Extension in Residential Structures 2002-2005), all confirmed fires were assumed to be confined to the room of origin.

OSHA's "2 In/2 Out" Regulation:

The "2 In/2 Out" policy is described in paragraph (g)(4) of the United States' Occupational Safety and Health Administration's (OSHA) revised respiratory protection standard, 29 CFR 1910.134. The focus of this section is the safety of fire fighters engaged in interior structural firefighting. OSHA's requirements for the number of workers 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 structure fire. An interior structure 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 personnel, in addition to the minimum of two persons inside needed to fight the fire, must be present before fire fighters may enter the building.^{19, 20} 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

¹⁸ Source: National Fire Protection Association, NFPA 1710 (2010), Table A.5.2.2.2.1(b) Fire Extension in Residential Structures, 2002-2005.

¹⁹ 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.

²⁰ Paula O. White, letter to Thomas N. Cooper, 1 November 1995 (OSHA)

longer be considered in the ‘initial stage,’ and at least one rapid intervention crew shall be required.”

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

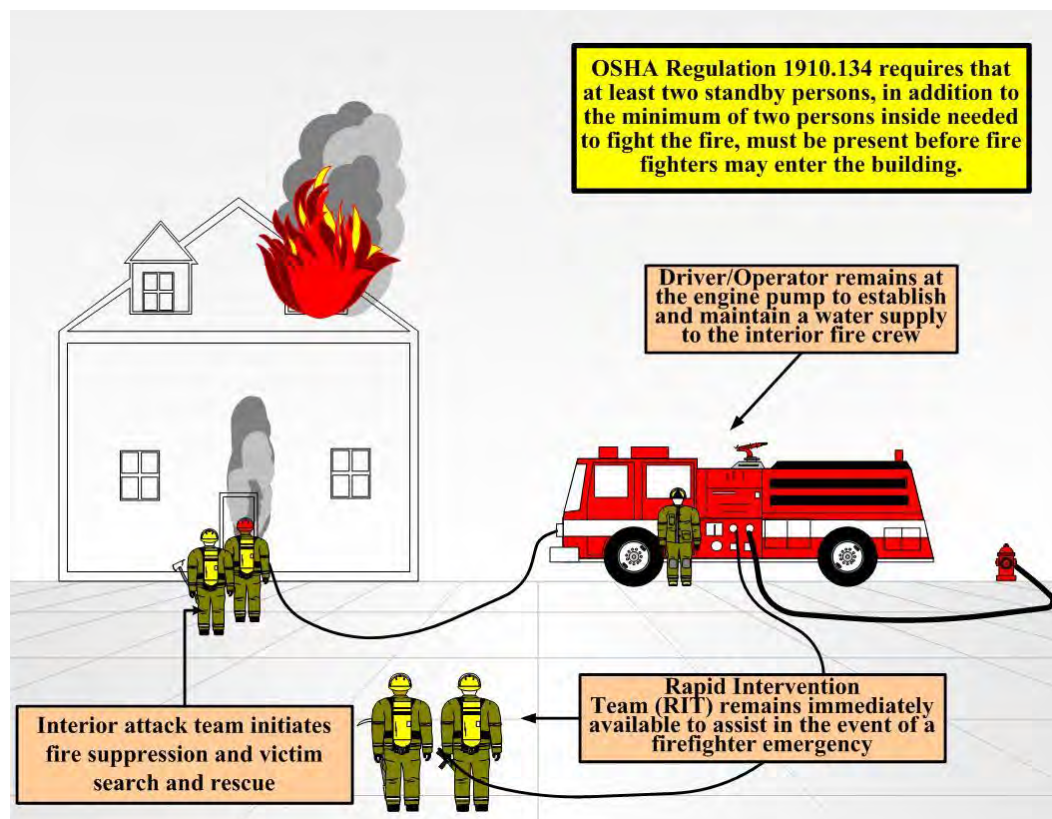


FIGURE 5: “OSHA ‘2 IN/2 OUT’ ILLUSTRATED”

When confronted with occupants trapped in a burning structure and a single fire company is on scene, only a company staffed with four fire fighters is able to initiate emergency search and rescue operations in compliance with “2 In/2 Out” policies. As indicated in the previous graphic, this requires the complete engagement of every fire fighter 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 fire fighters performing the initial attack and search and rescue operations and be prepared to make entry with the remaining fire fighter should the crew operating inside become trapped.

Regardless, when there exists an immediate threat to life, only a company of four fire fighters can initiate fire suppression and rescue operations in compliance with the “2 In/2 Out” policies in a manner that minimizes the threat of personal injury. In crews with fewer than 4 fire fighters, 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 fire fighters, 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.

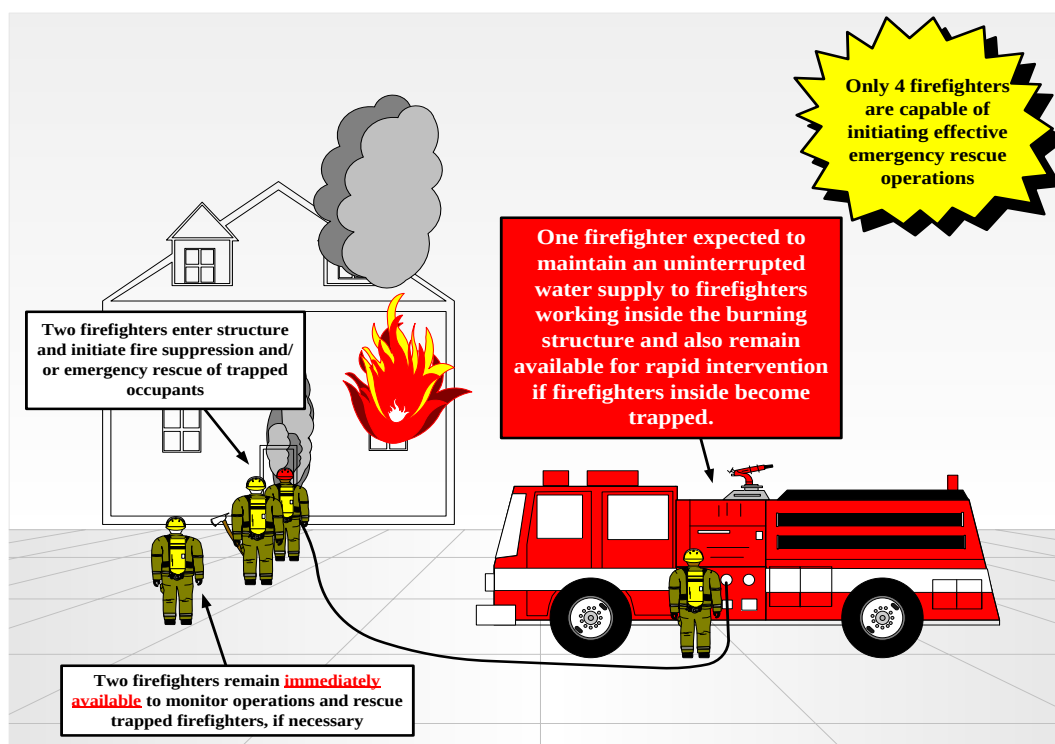


FIGURE 6: “EMERGENCY ‘2 IN/2 OUT’ OPERATIONS WHEN FIRE COMPANIES ARE STAFFED WITH 4 FIRE FIGHTERS”

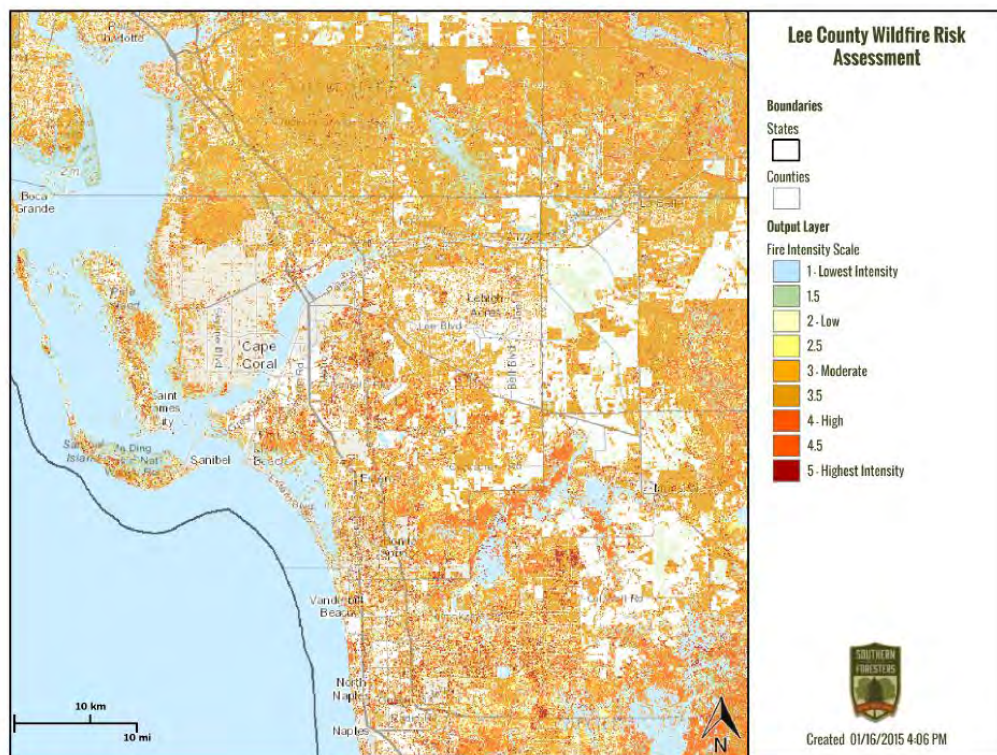
Wildland Fire:

Lee County has a considerable wildland fire risk. In the 1950’s and 1960’s two large residential developments were built that left most trees and plants in place in what was a fire-dependent ecosystem. The current trends in conservation development, while protecting ecological resources, are resulting in further development within the wildland urban interface. Nationwide, historical attitudes towards wildland fire suppression, extinguishing fires as quickly as possible, have led to a significant increase in fuel load in the wildland urban interface. The economic downturn of the last few years has resulted in an increase in vacant/abandoned structures as well as an increase in insurance fraud and arson fires within the county.²¹ When all of these factors

²¹ Identifying ‘Fire-Adapted Communities’: A Framework of Adaptive Capacity. Northern Research Station, U.S. Forest Service, retrieved 16 Jan 2015 from https://www.firescience.gov/projects/10-3-01-7/project/10-3-01-7_ISSRM_2011-newman.pdf

are considered, it is easy to see the potential wildland fire risk in the county. A 2013 hazard vulnerability assessment found that 40% of the county's population could be affected by a major wildland fire every 1-3 years, while 55% of the population can be impacted by minor wildland fires on an annual basis.²² Map 1, below, generated using the Southern Group of State Foresters Wildfire Risk Assessment tool illustrates the significance of the wildland threat in Lee County; much of the county is at a moderate or greater risk of wildland fire. It should be noted that, because of the seasonal variation in wildland fire risk, assessed risk will change with changing environmental conditions. Map 1 provides a snapshot of the risk at the time it was created.

Map 1



Wildland Fire Risk in Lee County, Florida

Wildfire Risk Reduction In Florida: Home, Neighborhood, and Community Best Practices, published by the Florida Department of Agriculture and Consumer Services, Division of Forestry in 2010 identified inadequate fire-fighting resources and infrastructure as factor aggravating the WUI problem in Florida. The Florida Department of Forestry relies on a partnership with local resources to meet wildland fire suppression and mitigation needs. Any reductions to already understaffed resources will further aggravate the problem, placing the public and the fire service at greater risk.

²² Lee County 2013 Hazard Vulnerability Analysis. Retrieved 16 Jan 2015 from <https://www.leeec.com/Pages/vulnerabilityanalysis.aspx>

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 the fire service the largest provider of pre-hospital EMS in North America. In many fire departments that deliver pre-hospital care, EMS calls can account for 75% or more 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.²³ This is likely due to the fact that fire stations housing first responder units, which are equipped and staffed with dual-role fire fighter/emergency medical technicians and EMS supplies, are more centrally located and are able to affect 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 EMS response and transport provided by the fire department is that fire departments are already geared towards rapid response and 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.²⁴ In both fire suppression and EMS incidents, time is directly related to the amount of damage, either to the structure or the patient.

Incidents with prolonged ambulance response times will likely have delays in delivering the patient to a medical facility where they may 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 seriousness of their symptoms, delaying a call for assistance.^{25,26,27,28} 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

²³ Lori Moore-Merrell and others, Report on Residential EMS Field Experiments, (September, 2010); pp. 10.

²⁴ 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

²⁵ American Heart Association, *Heart Disease and Stroke Statistics-2005 update*, Dallas, TX: AHA 2005

²⁶ Time from Symptom Onset to treatment and outcomes after thrombolytic therapy. Newby LK, et al. *J Am Coll Cardiol*. 1996;27:1646-1655

²⁷ An International Perspective on the Time to Treatment of Acute Myocardial Infarction. Dracup, K. et al. *J Nurs Scholarsh* 2003;35:317-323

²⁸ Prehospital and In-hospital Delays in Acute Stroke Care. Evanson, KR, et al. *Neuroepidemiology* 2001;20:65-76

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.²⁹

Strokes, which are the third leading cause of death in the U.S., as well as a leading cause of disability, also benefit from expedient treatment in a facility providing definitive care. Ischemic stroke, a stroke caused by a blood clot, can be effectively treated if definitive care is received within 3 to 4.5 hours³⁰ of symptom onset. The sooner a patient receives definitive treatment, the less likely a patient is to suffer disability from this type of stroke. However, it is important to emphasize that before time critical treatment can be provided 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”³¹ 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.³²

Because fire department-provided EMS is typically reserved for emergency responses, 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 exert themselves in an effort to minimize any damage to cardiac muscle. Patients suffering from strokes are frequently unable to assist themselves because of physical effects of the event. An optimally sized 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.³³

One of the most labor intensive and time critical requests for EMS response is cardiac arrest, which 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 performance of prioritized action.³⁴ However, there was a gap between instruction and practice

²⁹ 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.

³⁰ Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke. Hacke, W. et al. *N Engl J Med.* 2008;359:1317-1329

³¹ “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.

³² 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

³³ National Institute of Standards and Technology Report on Residential EMS Field Experiments September, 2010

³⁴ Highlights of the 2010 American Heart Association Guidelines for CPR and ECC

which led to confusion and may have potentially reduced survival. In reality, providers respond and function in teams larger than two.

In 2010, the AHA released a newly-revised guideline for cardiac resuscitation that focused on a team-centric approach. More important than this change was evidence-backed research that suggested 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.^{35,36} This was linked to provider fatigue from administering chest compressions, indicating that providers should be rotated frequently to ensure effective depth and rhythm of chest compressions. Consensus documents from the AHA recommend that providers rotate with every two-minute cycle of CPR. It is also recommended that requests for EMS response for cardiac arrest 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 effective 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 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.³⁷ 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.

This breakdown of the expected capabilities of a medical alarm assignment requires a minimum contingent of four EMS personnel to arrive at the scene of a cardiac arrest within 5 minutes of receiving an alarm. Most experts agree that four responders are the minimum required to

³⁵ Determinants of Blood Flow during Cardiac Resuscitation in Dogs. Halperin, HR et al. *Circulation* 1986;73:539-550

³⁶ 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

³⁷ 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

provide ACLS to cardiac arrest victims and that “two-tier systems in which the first responders are trained in early defibrillation are most effective in providing *rapid*³⁸ Advanced Cardiac Life Support.”³⁹ Also, in addition to their medical needs, patients may require simultaneous physical rescue or extrication, protection from the elements, a safe physical environment, and management of surrounding non-medical sociologic concerns.⁴⁰ As fire fighters provide an “all-hazards” level of response, they are trained in rescue, extrication, scene safety and security.

As the following figure demonstrates, the response to medical emergencies, such as a cardiac arrest, mirrors the time-temperature curve for fire growth.

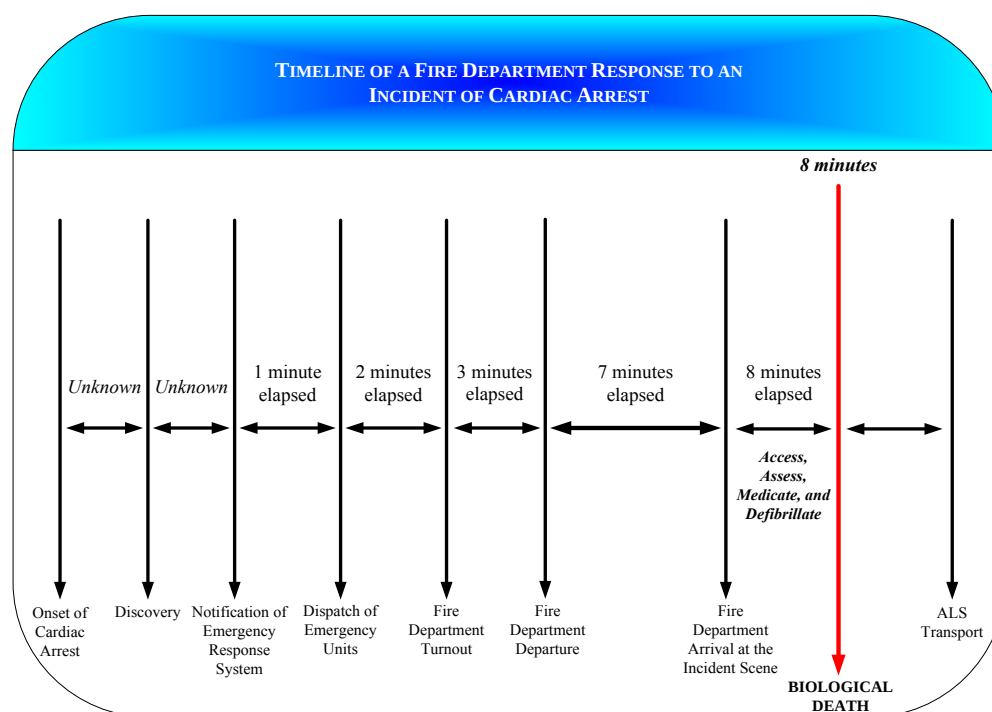


FIGURE 7: “TIMELINE OF A FIRE DEPARTMENT RESPONSE TO AN INCIDENT OF CARDIAC ARREST”

What occurs in the first few minutes after the onset of a medical emergency, particularly in cardiac emergencies, can impact the lasting health of a patient. The rapid, efficient, and effective delivery of pre-hospital emergency medical care is dependent upon the rapid response of adequately trained personnel. Response time is a key component of an effective EMS system, and rapid response times are a fundamental advantage of fire-based EMS systems.⁴¹

³⁸ Emphasis added.

³⁹ The Journal of the American Medical Association (October 28, 1992): 2290.

⁴⁰ Pratt, E.D.; Katz, S.; Pepe, P.E>; Persse, D. (2007). Prehospital 9-1-1 Emergency Medical Response: The Role of the United States Fire Service in Delivery and Coordination. White paper.

⁴¹ Pratt, E.D.; Katz, S.; Pepe, P.E>; Persse, D. (2007). Prehospital 9-1-1 Emergency Medical Response: The Role of the United States Fire Service in Delivery and Coordination. White paper.

A study conducted in coordination with the National Institutes of Standards and Technology (NIST), the International Association of Fire Chiefs (IAFC), the International Association of Fire Fighters (IAFF), Worcester Polytechnic Institute (WPI), and the Commission on Fire Accreditation International (CFAI) examined the effects of varying ALS personnel configurations on first responder companies and ambulances. The field experiments investigated the connection between appropriate staffing levels and the completion of typical EMS pre-hospital assignments for trauma and cardiac EMS scenarios. The following table summarizes the results of this study:

	Staffing	Performance (minutes : seconds)
Overall Trauma Scene Time	1 ALS on Engine +1 ALS on Ambulance	10:50
	Engine +2 ALS on Ambulance	13:06
Overall Cardiac Arrest Scene Time	1 ALS on Engine + 1 ALS on Ambulance	10:55
	Engine +2 ALS on Ambulance	11:39
All Tasks After Witnessed Cardiac Arrest	1 ALS on Engine +1 ALS on Ambulance	6:35
	Engine +2 ALS on Ambulance	5:43

TABLE 6: "OVERALL SUMMARY OF STUDY RESULTS"

Results suggest that the early arrival of an ALS provider improves total on scene time from at-patient to packaging, evidence that ALS placement can make a difference in response efficiency. Crews with one ALS provider on the engine and one ALS provider on the ambulance completed all required tasks faster than crews with a BLS engine and two ALS providers on the ambulance, demonstrating increased on-scene operational efficiency.

The difference in the results for "All Tasks After Witnessed Cardiac Arrest" may be attributable to the fact the arrest was scripted to take place immediately after the 12-lead ECG task end time in the task sequence. In experiments where the engine had no ALS providers and the ambulance arrived with two ALS providers, the ECG arrived with the ambulance so that there were instantly two ALS personnel on-scene rather than one as in the ALS engine/ALS ambulance scenarios.

Staffing and Deployment Analysis

Staffing and Deployment

The following table specifies the current station locations, staffing and apparatus deployed by the agencies included in this study:

<u>Jurisdiction</u>	<u>Station</u>	<u>Address</u>	<u>Apparatus</u>	<u>Min. Staff</u>
Bayshore				
	Stn. 131	17350 Nalle Road,	Engine 131 Chief 1 Engine 132	2 FF 1 Chief
Fort Myers				
	Stn. 11	2404 Dr. Martin Luther King Jr. Blvd	Engine 11 Rescue 11	3 FF 2 FF/EMT-P
	Stn. 12	1035 Terry Ave	Engine 12 Ladder 12	3 FF 2 FF
	Stn. 13	1915 Jefferson Ave	Engine 13 Rescue 13	3 FF 2 FF/EMT-P
	Stn. 14	4520 Cummins Ct	Engine 14	3 FF
	Stn. 15	9700 Treeline Ave	Engine 15	3 FF
	Stn. 16	3600 Veronica S Shoemaker Blvd	Engine 16 Ladder 16	3 FF 2 FF
Lehigh Acres				
	Stn. 101	1000 Joel Blvd	Engine 101 Rescue 101	3 FF 2 FF/EMT-P
	Stn. 102	11 Homestead Rd, S	Ladder 102 Rescue 102	3 FF 2 FF/EMT-P
	Stn. 103	308 Gunnery Rd, S	Engine 103	3 FF
	Stn. 104	3102 16 th St, SW	Engine 104 Rescue 104	3 FF 2 FF/EMT-P
North Fort Myers				
	Stn. 2	1280 Barrett Rd	Engine 2 Rescue 2	3 FF 2 FF/EMT-P
	Stn. 3	16290 Slater Rd	Engine 3 Rescue 3	2 FF 2 FF/EMT-P
	Stn. 4	2900 Trail Dairy Cir.	Engine 4 Rescue 4	3 FF 2 FF/EMT-P
Tice				
	Stn. 211	9351 Workmen Way	Engine 211 Rescue 211	2 FF 2 FF/EMT-P
	Stn. 213	5850 Buckingham Rd	Engine 213	3 FF
Total Minimum On-Duty Staffing:				68

Table 7: Current Staffing Model

Assumptions:

Several key assumptions must be addressed prior to drawing any conclusions from this analysis.

- 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 excess 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.
 - Demand changes: Traffic volume varies from hour to hour and day to day and this may cause travel time, congestion, and crowding to worsen in some locations.
 - 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.⁴²

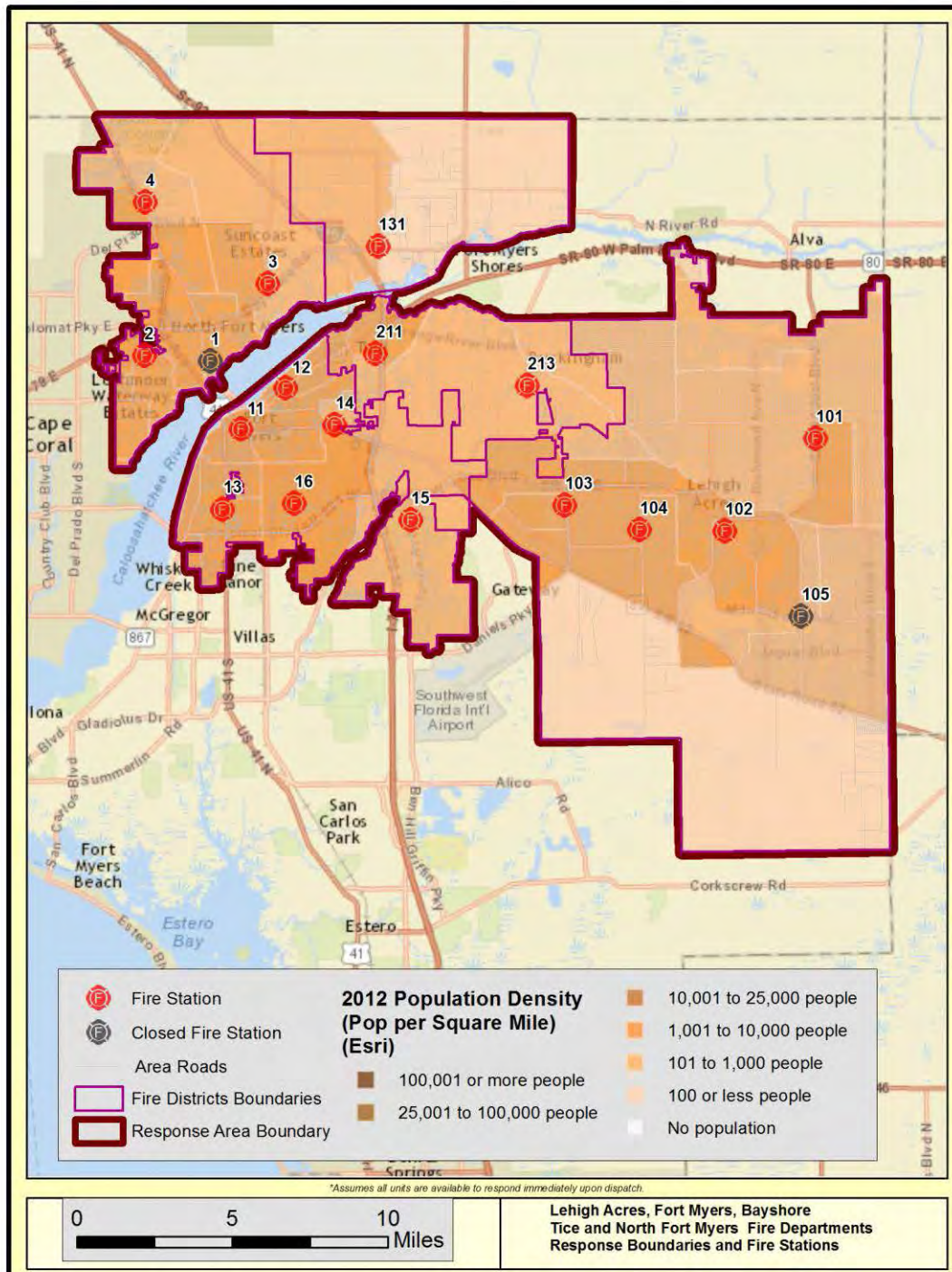
In addition, it is reasonable to suggest that because larger emergency vehicles are generally more cumbersome and require greater skill to maneuver, their response may be more negatively affected by their weight, size, and in some cases, inability to travel narrow surface streets.

- The time from arrival of the apparatus to the onset of interior fire operations or patient treatment (access interval) must be considered when analyzing response system capabilities. Unpredictable impedances may include, but are not limited to:
 - 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.

⁴² David Shrank and Tim Lomax, The 2003 Urban Mobility Report, (Texas Transportation Institute, Texas A&M University: September 2003).

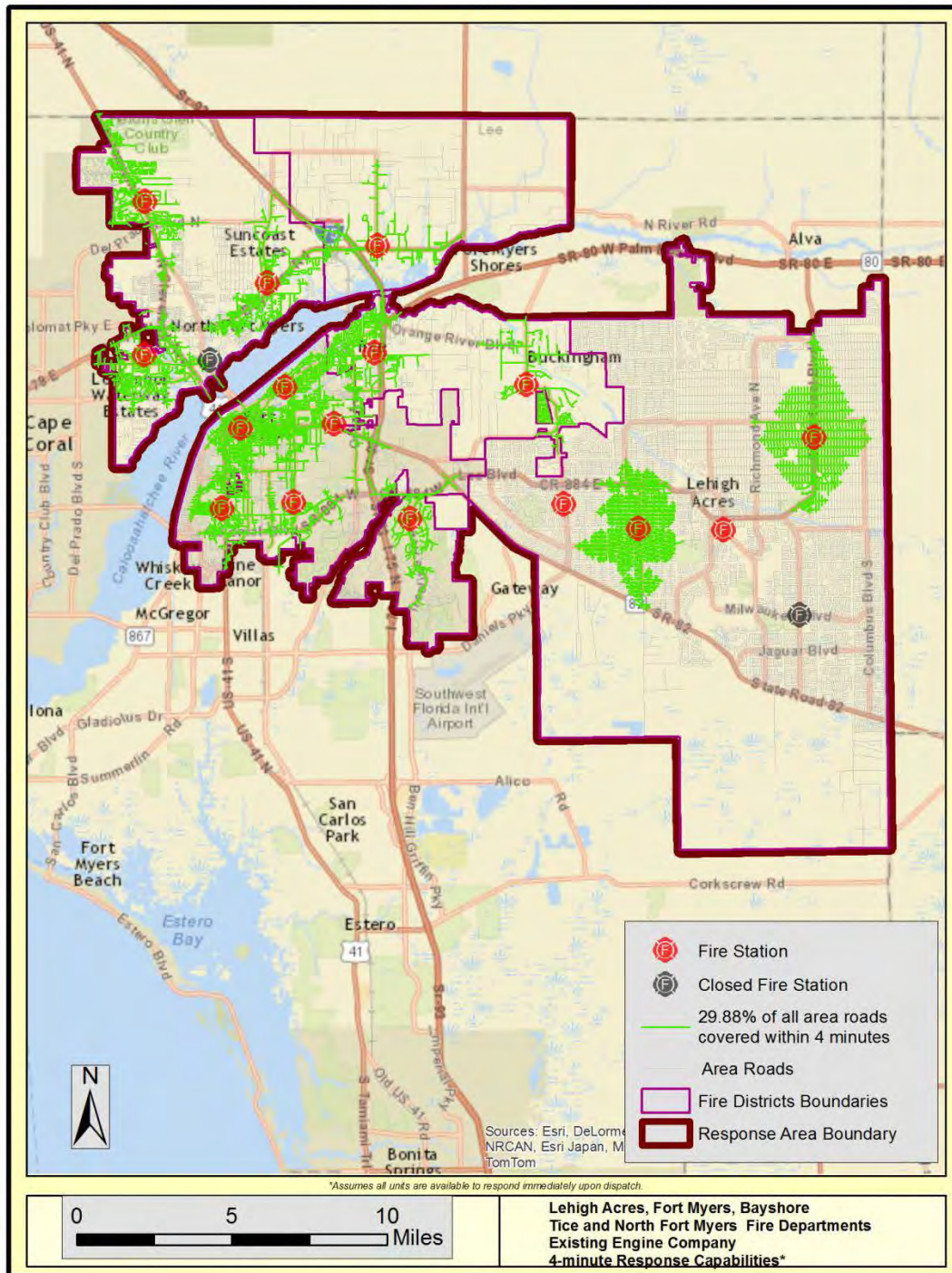
Regional Model Analysis:

Map 2



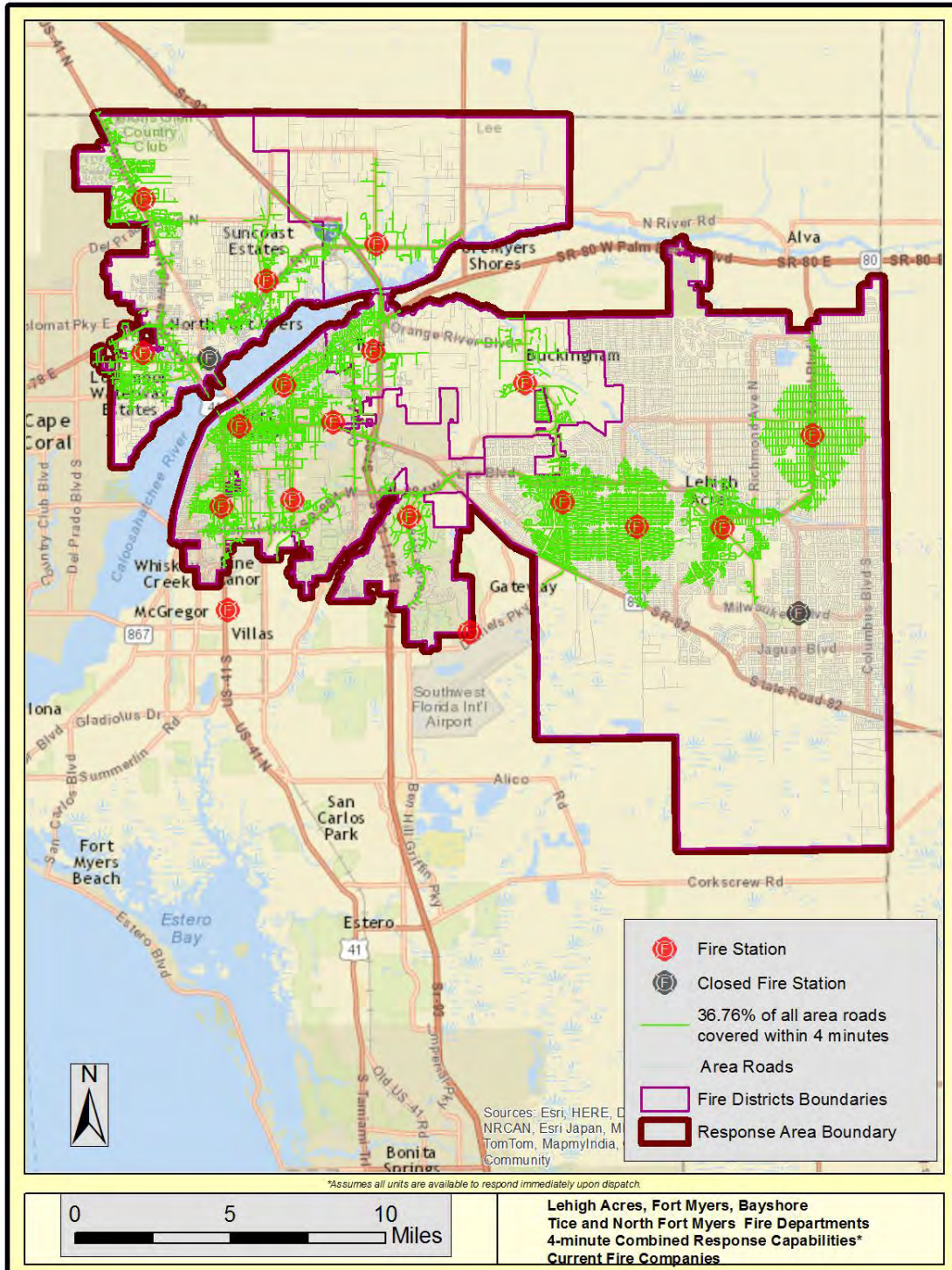
Map 2 illustrates the fire station locations of each agency that participated in the study, along with the population density based on 2012 census data.

Map 3



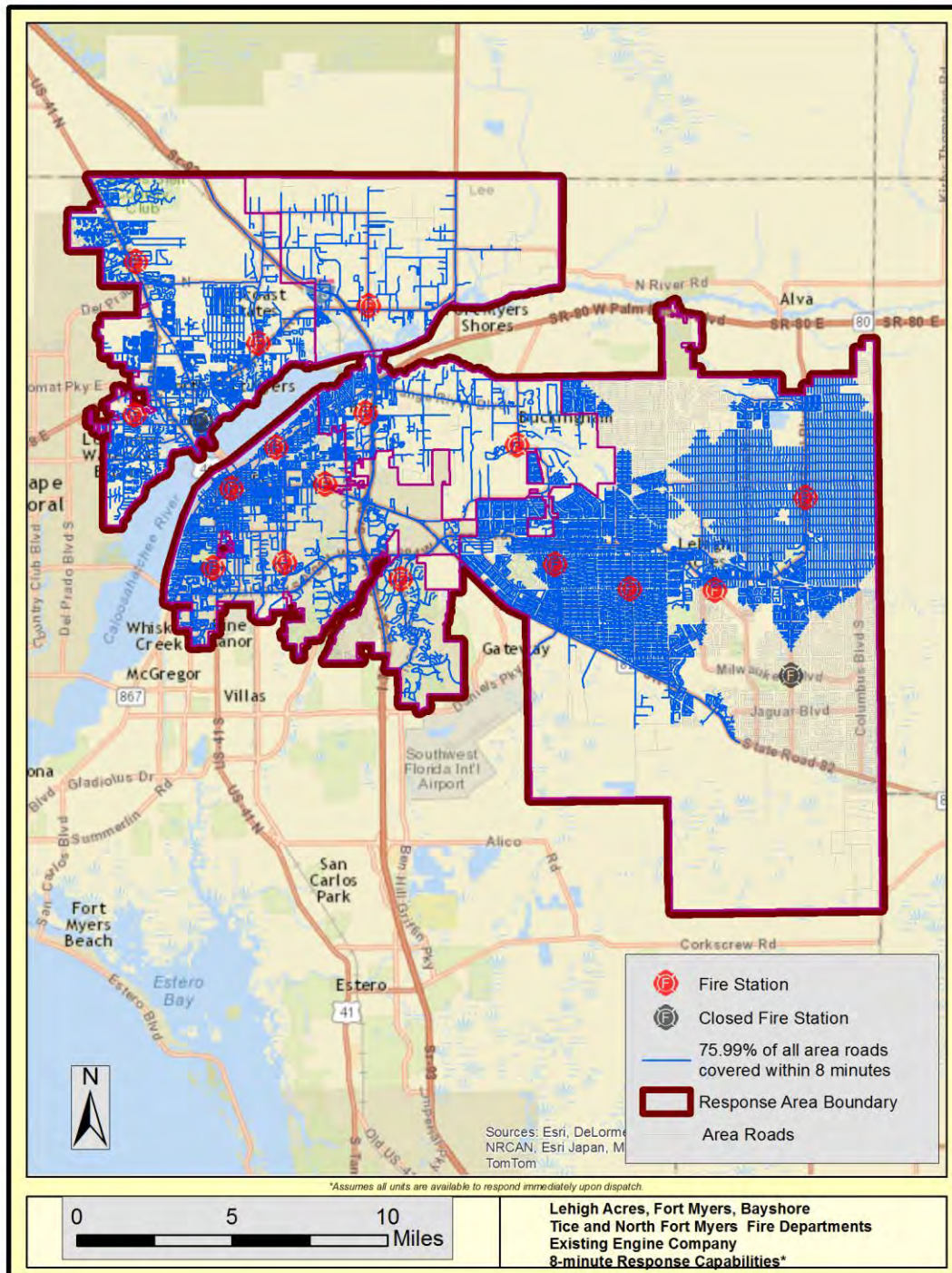
Map 3 shows the current county-wide 4-minute engine company coverage; assuming units are staffed, in station, and available for immediate response when dispatched. Currently, an engine company can reach **29.88%** of roads within Lee County within 4-minutes, well below national standards.

Map 4



Map 4 illustrates the current 4-minute response coverage for all EMS first-response units involved in the study. Assuming units are staffed, in station, and available for immediate response, **36.76%** of county roads can be reached within 4 minutes.

Map 5



Map 5 shows the current engine company 8-minute response coverage, assuming units are staffed, in station, and available for immediate response when dispatched. Engine companies are capable of responding to incidents on 75.99% of county roads within 8 minutes, below national standards.

Lehigh Acres, Fort Myers, Bayshore Tice and North Fort Myers Fire Departments 8-minute Combined Response Capabilities* Current Fire Companies

Legend:

- Fire Station
- Closed Fire Station
- 82.11% of all area roads covered within 8 minutes
- Area Roads
- Fire Districts Boundaries
- Response Area Boundary

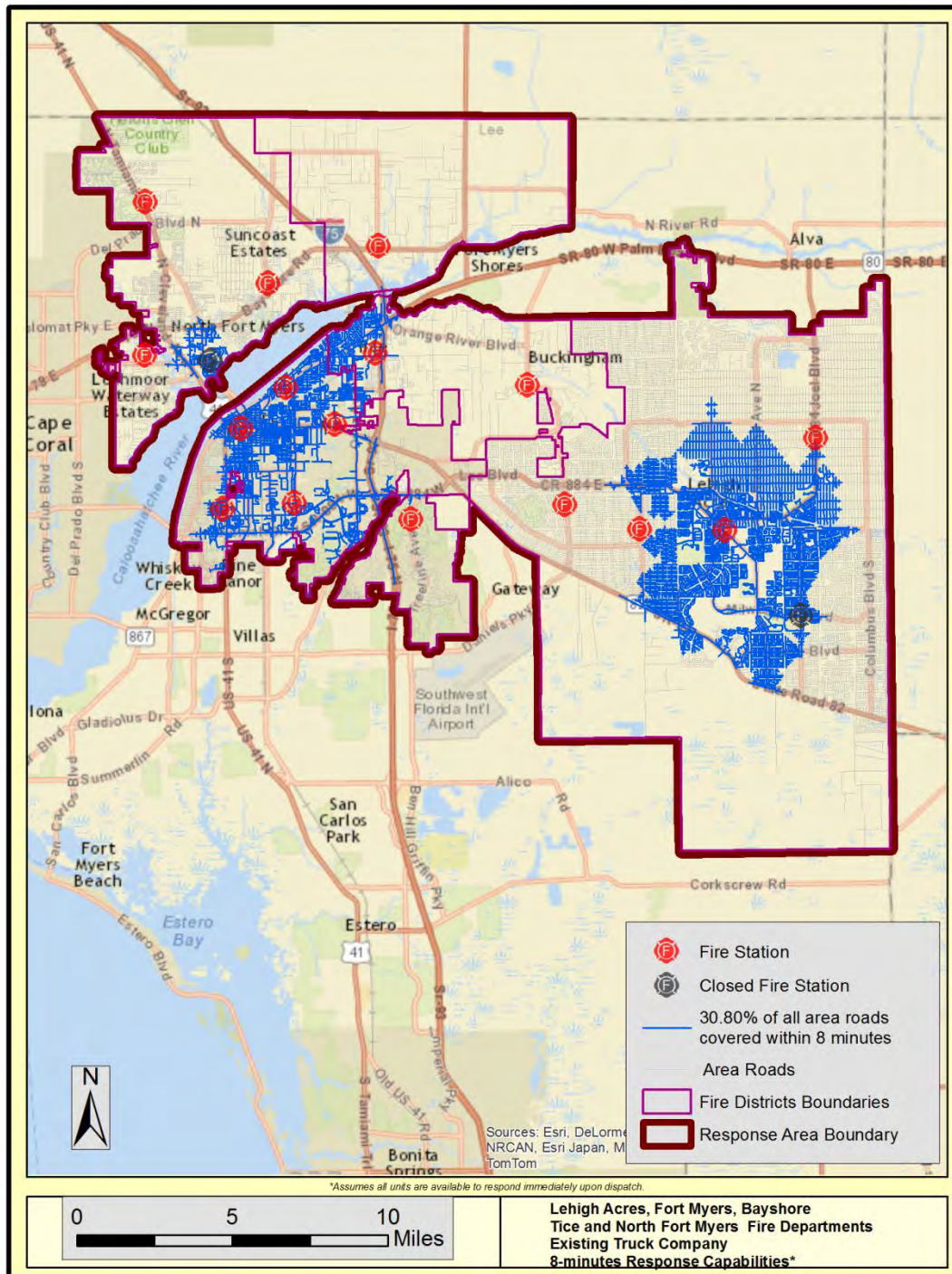
Scale: 0 5 10 Miles

Sources: Esri, HERE, DeLorme, NRCAN, Esri Japan, Microsoft, TomTom, MapmyIndia, Community

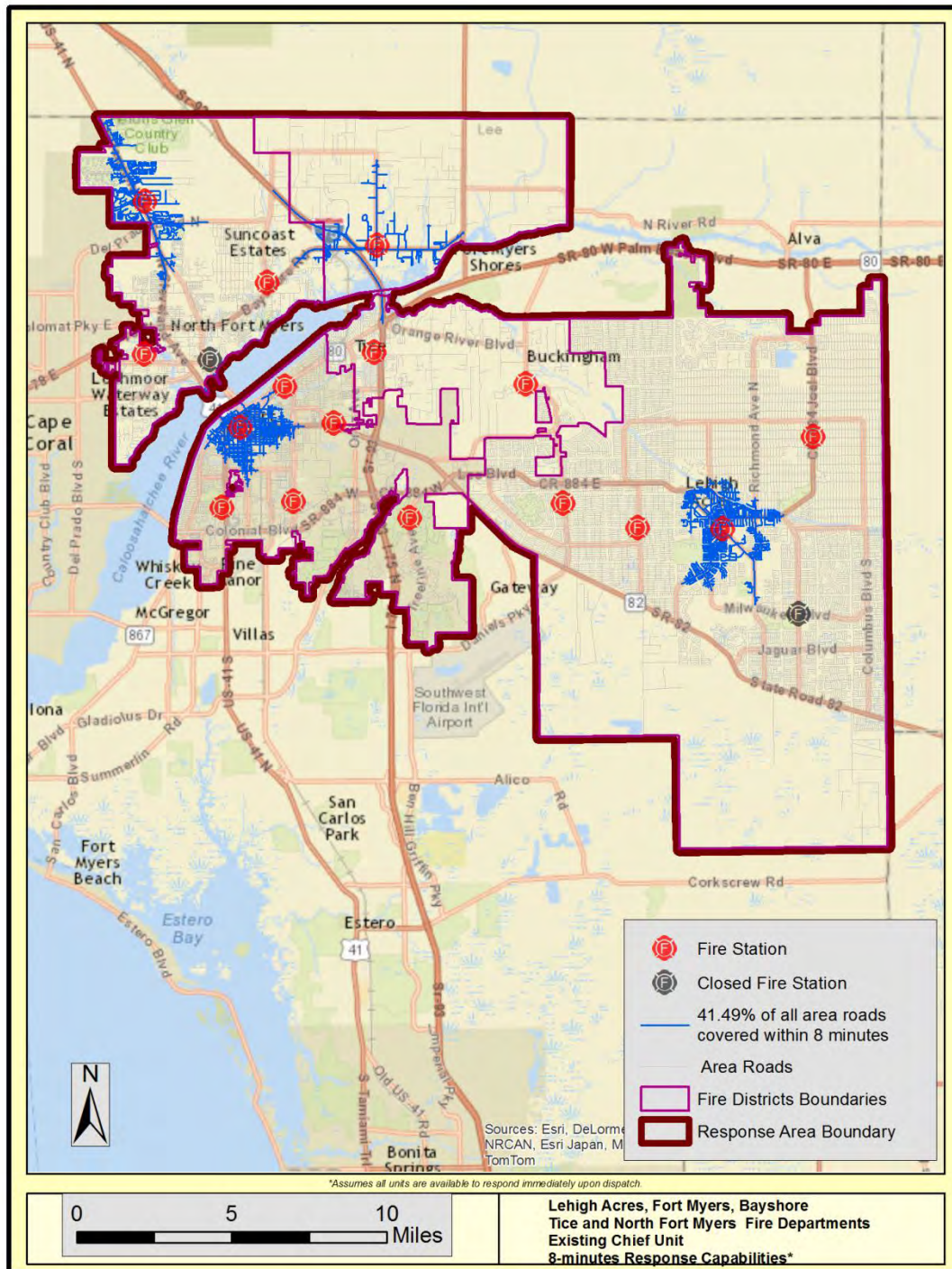
*Assumes all units are available to respond immediately upon dispatch.

32

Map 7

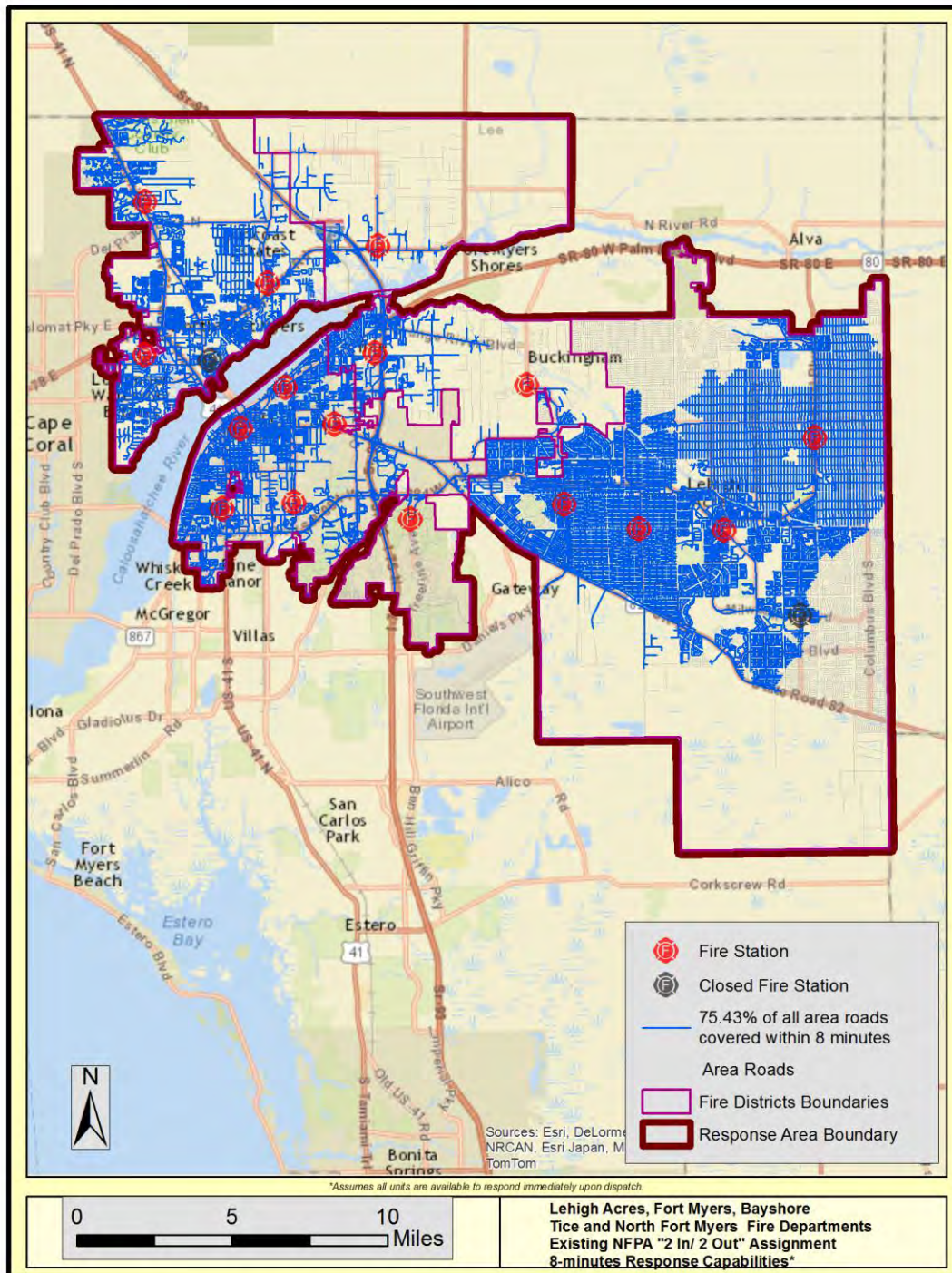


Map 8



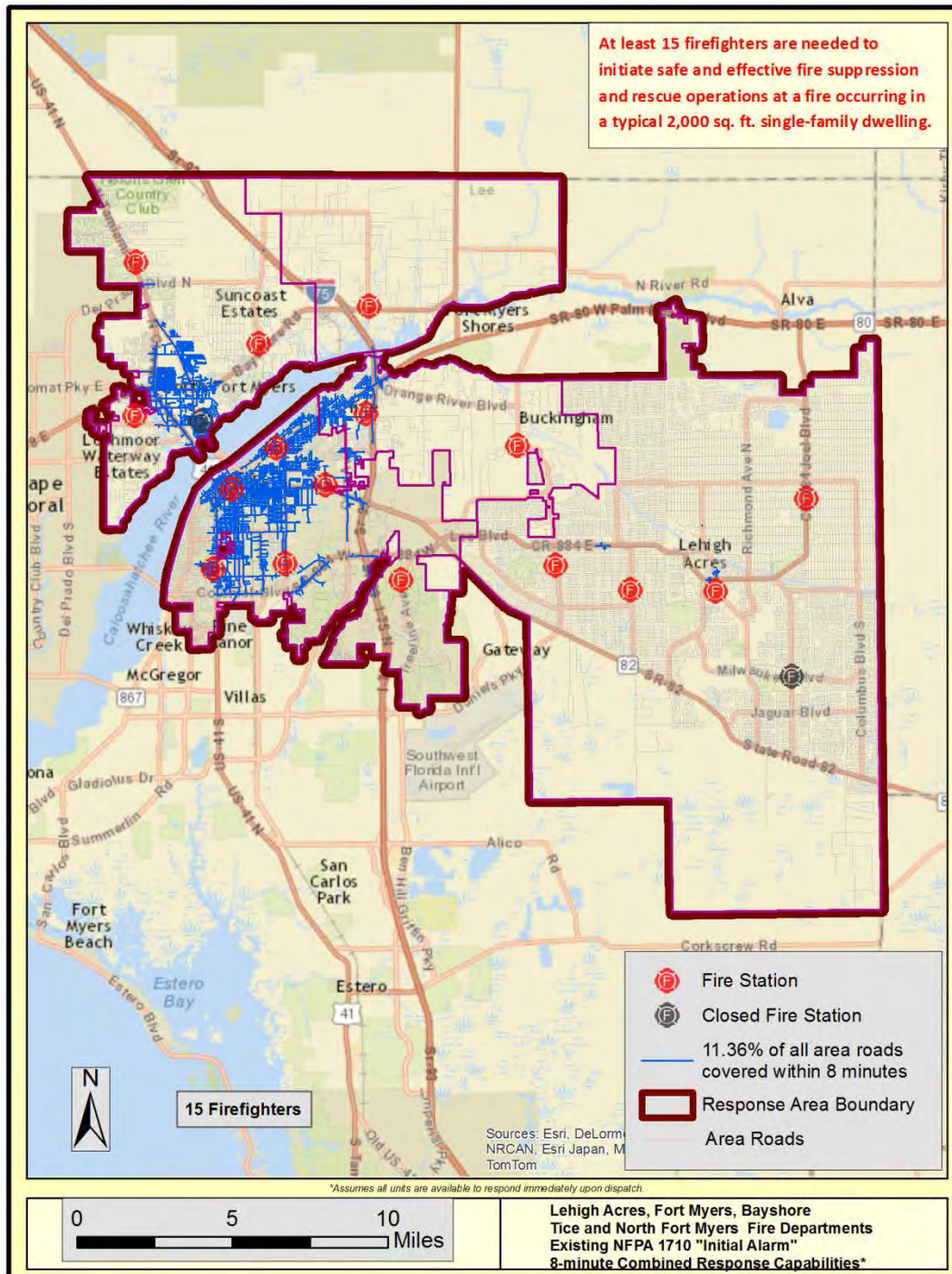
Map 8 (above) shows the current 8-minute response coverage for chief officers, assuming in station, and available for immediate response when dispatched. They are capable of responding to incidents on **41.49%** of county roads within 8 minutes, well below national standards.

Map 9



Map 9 shows the current, combined "2 In/2 Out" response coverage (8-minute travel time) from stations within the study. With the use of automatic aid, agencies are able to meet "2 In/2 Out" requirements on **75.43%** of county roads, which is below national standards.

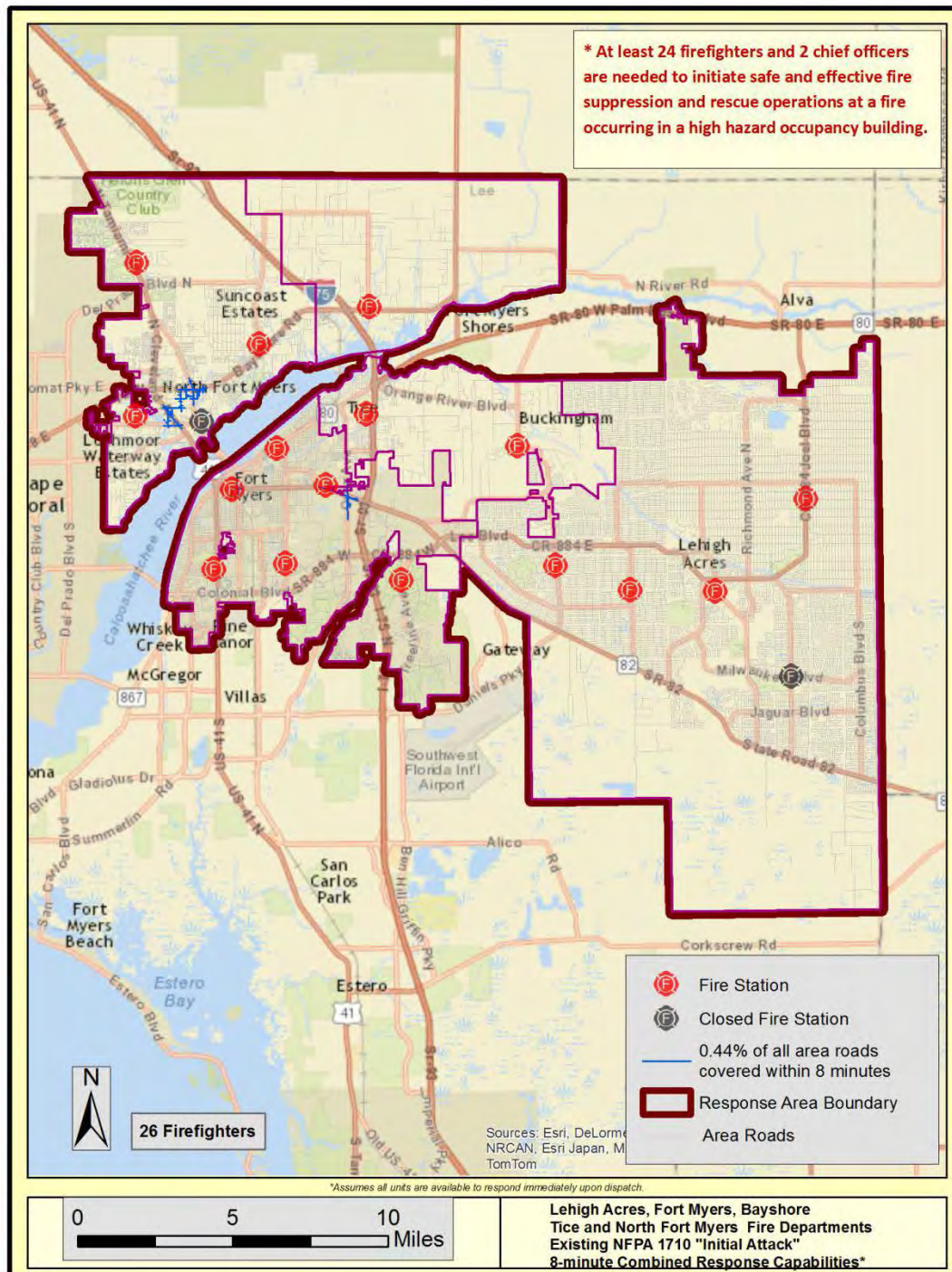
Map 10



Map 10 illustrates the ability to assemble a minimum of 15 personnel on the fireground within 8-minutes travel time. At current staffing levels, **11.36%** of county roads can be covered within 8 minutes, well below national standards. Coverage is even worse when considering the ability to assemble the minimum recommended number of personnel for incidents in a high-hazard environment, as illustrated in Map 11 below. **Less than one-half of one percent (0.44%)** of

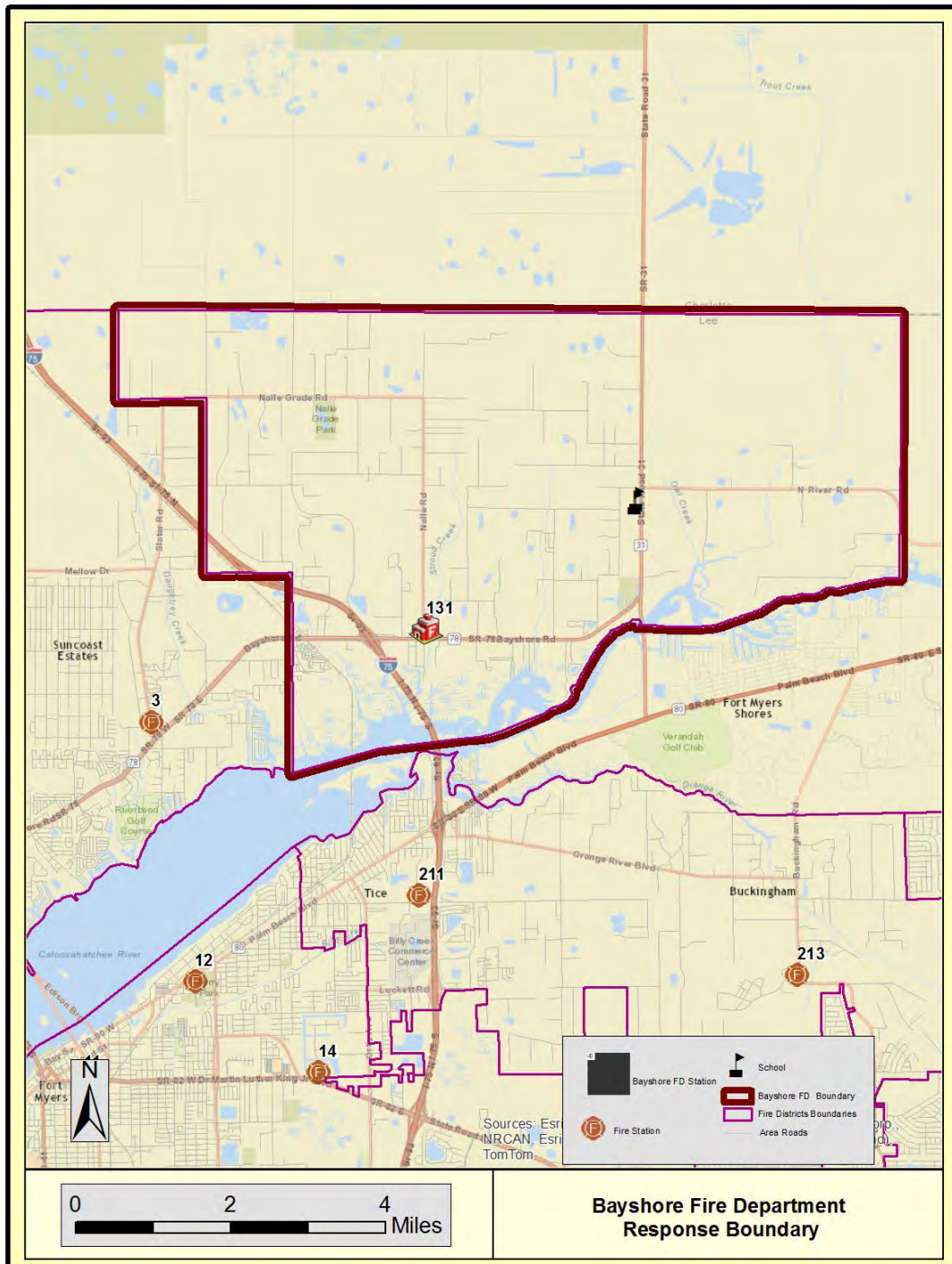
county roads can be covered within 8 minutes. While this map looks at the regional response, it should be noted that none of the districts are able to meet the personnel requirements for a high hazard response, meaning a greater mutual aid response will be needed, further diminishing response capabilities across multiple Districts.

Map 11



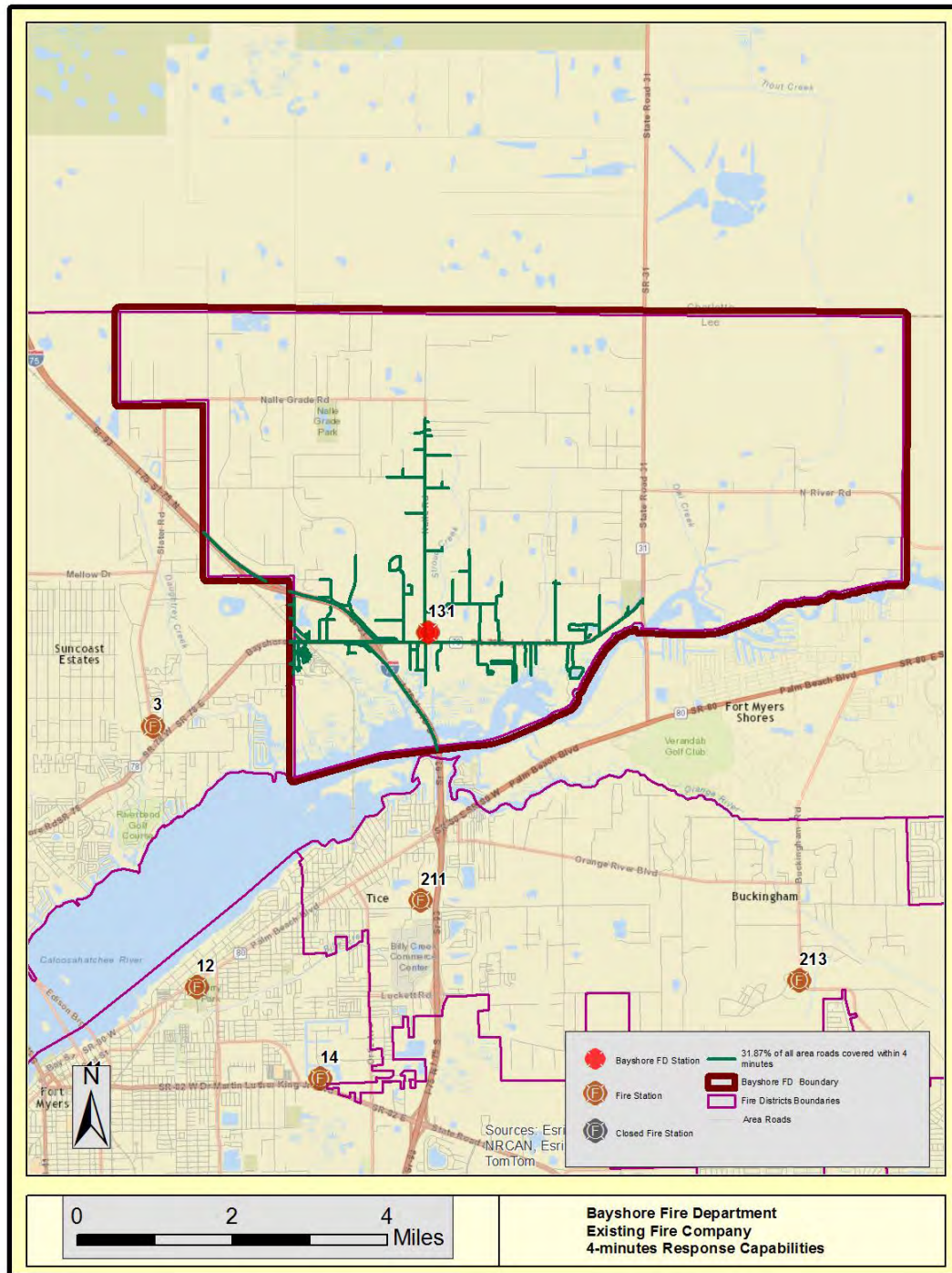
Bayshore Fire Rescue (BFR):

Map 12

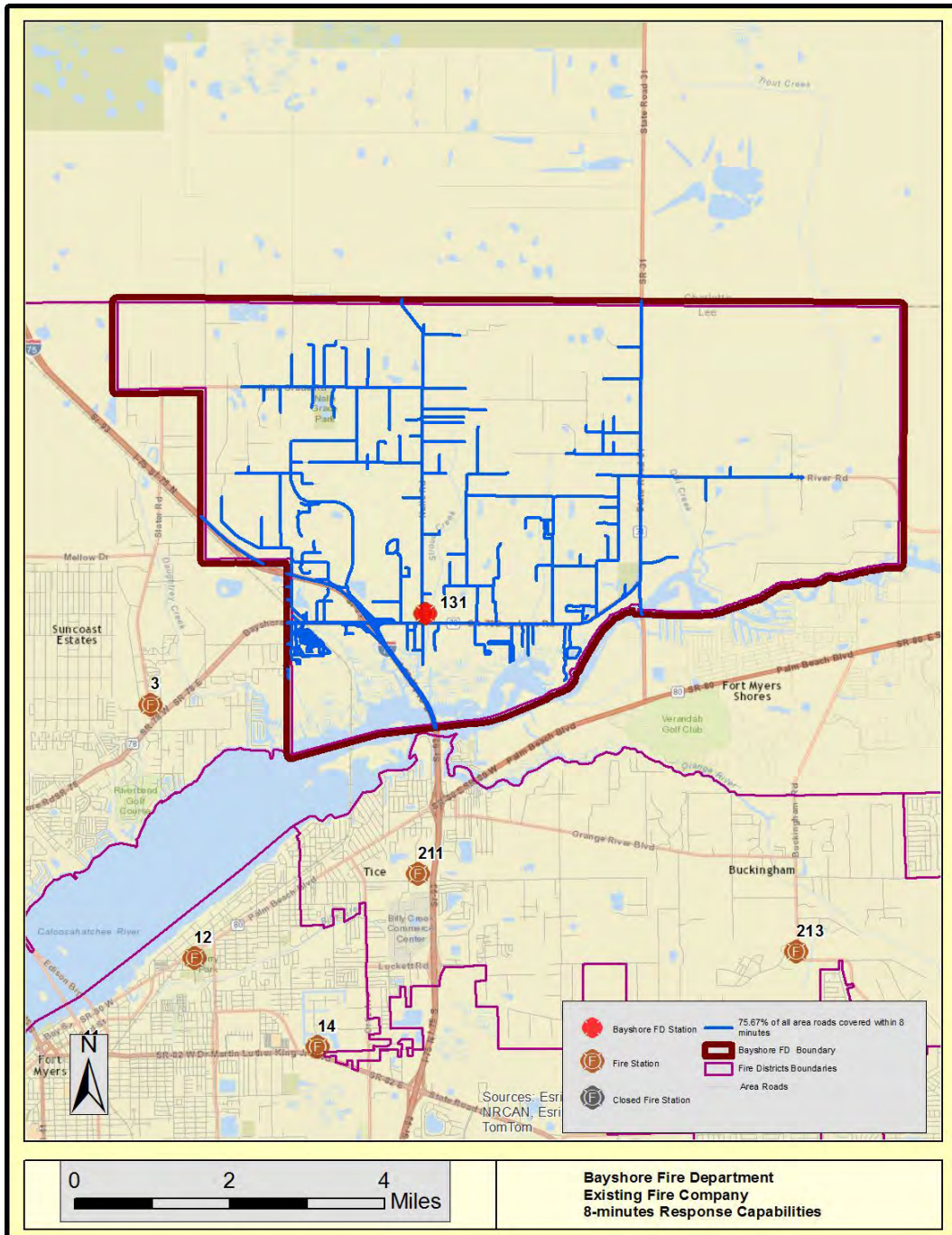


Map 12 shows the current BFR fire station locations and response boundary.

Map 13

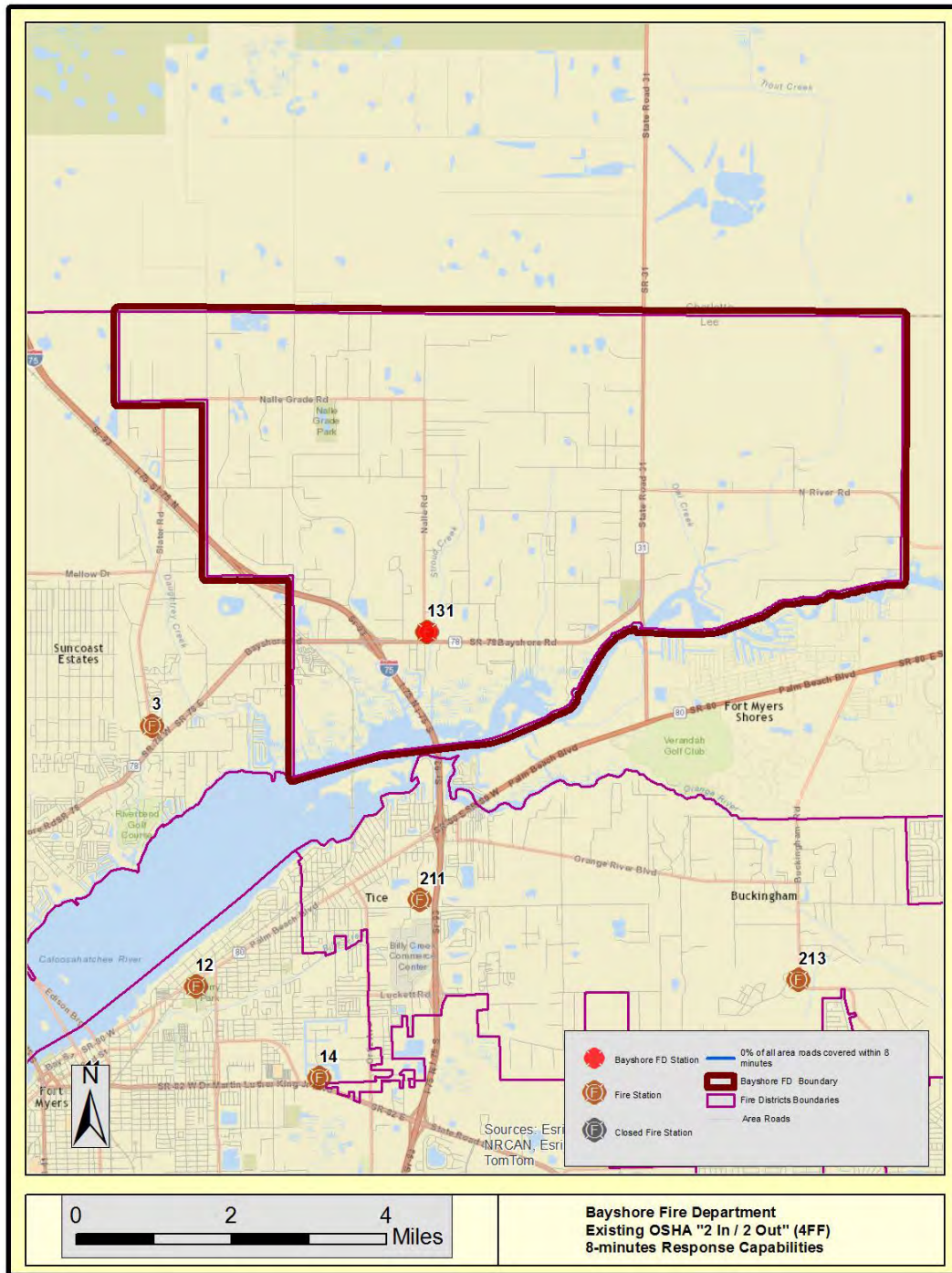


Map 14



Map 14 shows the current 8-minute response coverage from Station 131, assuming units are staffed, in station, and available for immediate response when dispatched. BFR is capable of responding to incidents on 75.7% of jurisdiction roadways within 8 minutes, below national standards.

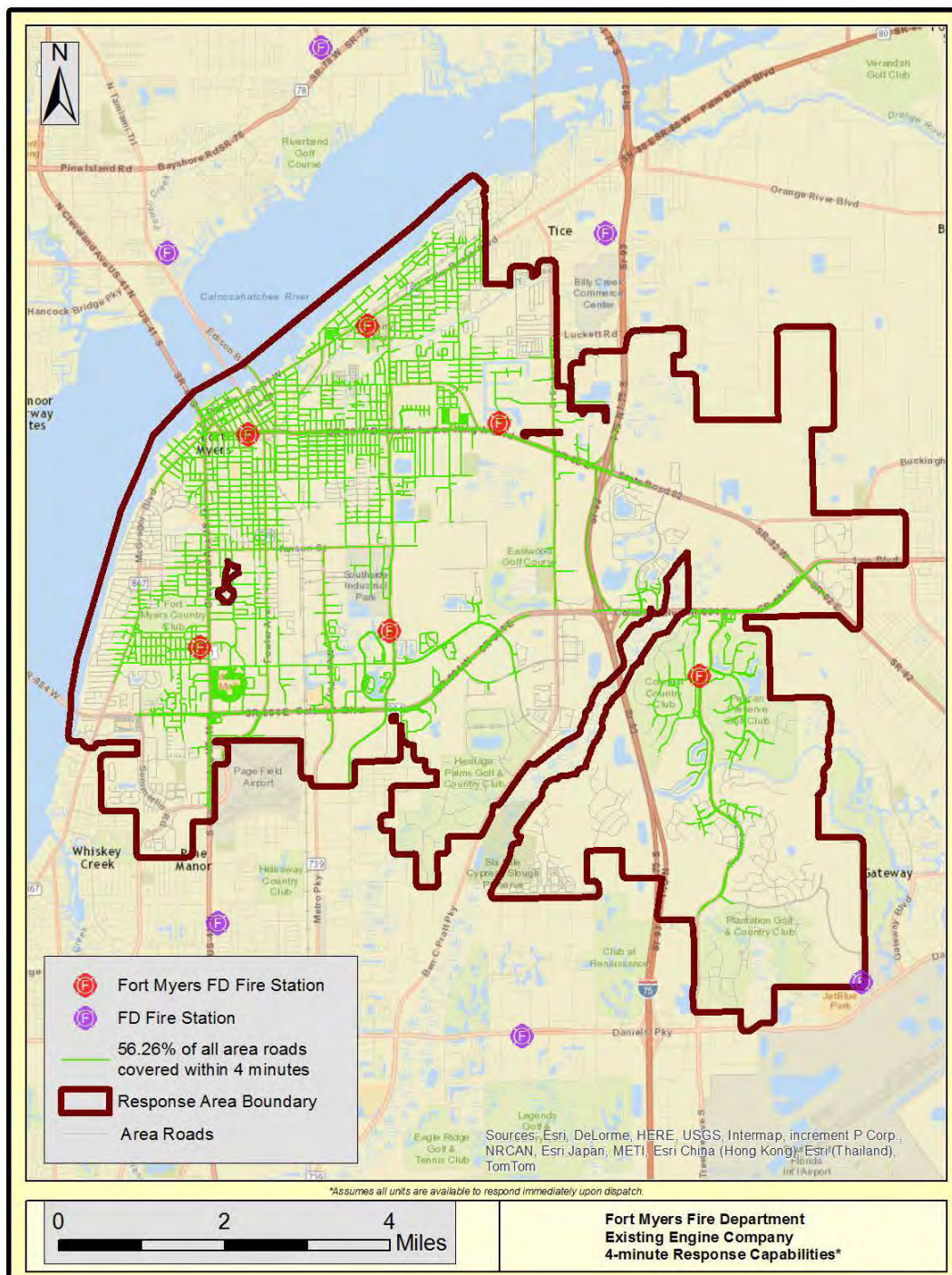
Map 15



Map 15 illustrates the current “2 In/2 Out” response coverage (8-minute travel time) from Station 131. At current minimum staffing levels of 2 personnel, BFR is not able to meet OSHA “2 In/2 Out” requirements.

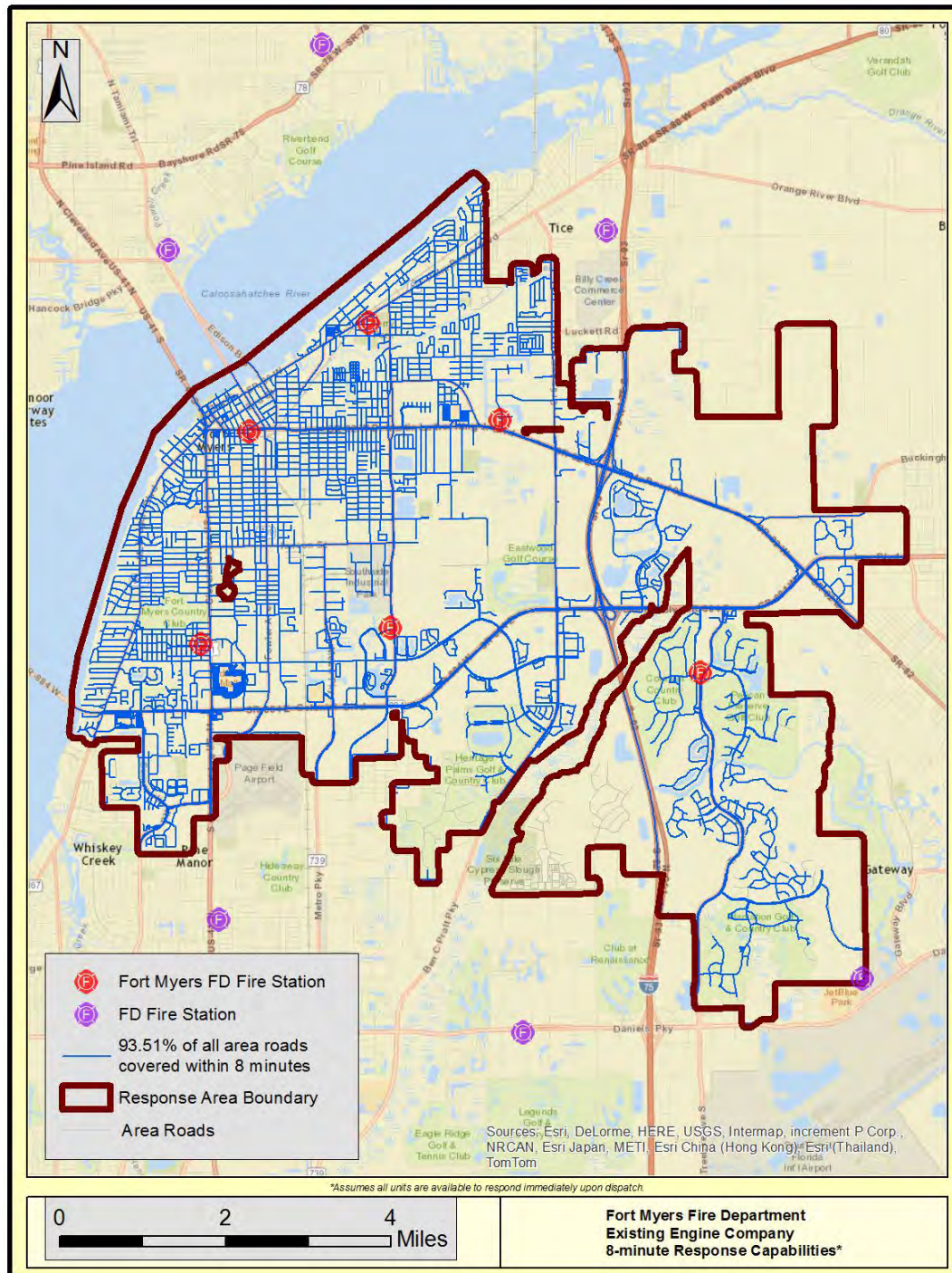
Fort Myers Fire Department (FMFD):

Map 16



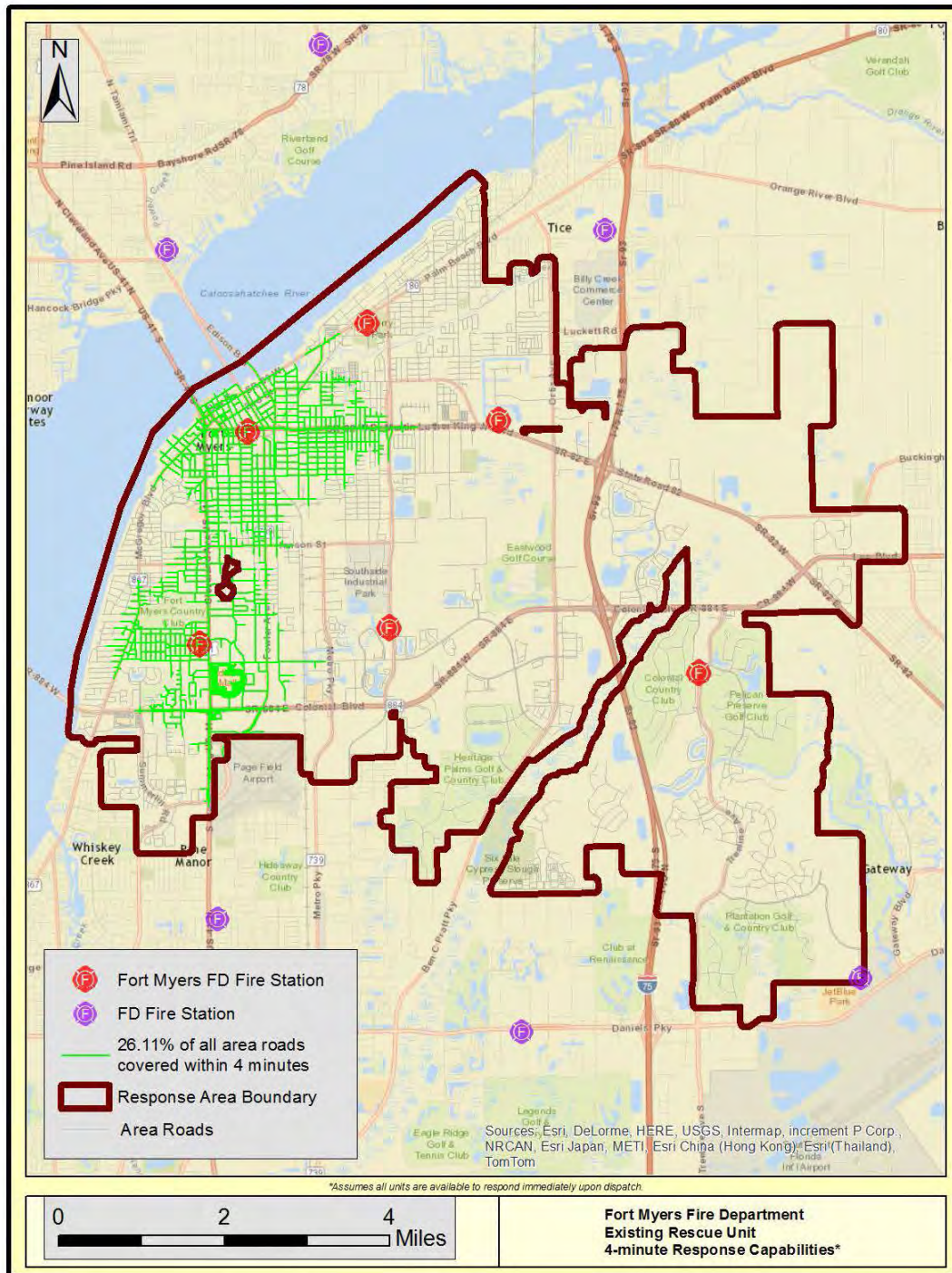
Map 16 shows the current 4-minute engine company coverage, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD companies are capable of responding to incidents on **56.26%** of jurisdiction roadways, well below national standards.

Map 17



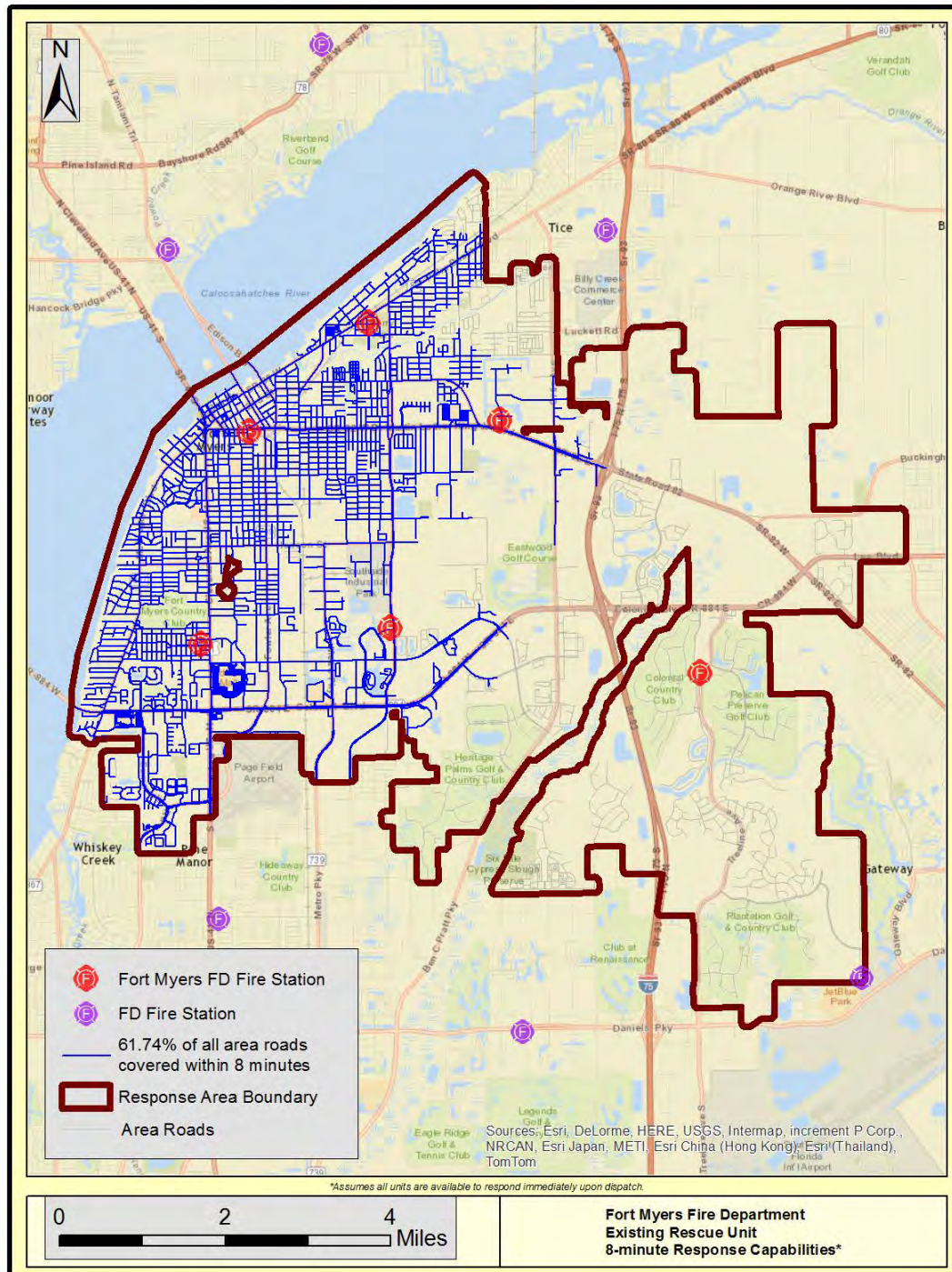
Map 17 illustrates the current 8-minute travel time for FMFD engine companies, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD is capable of responding to incidents on 93.51% of jurisdiction roadways within 8 minutes.

Map 18



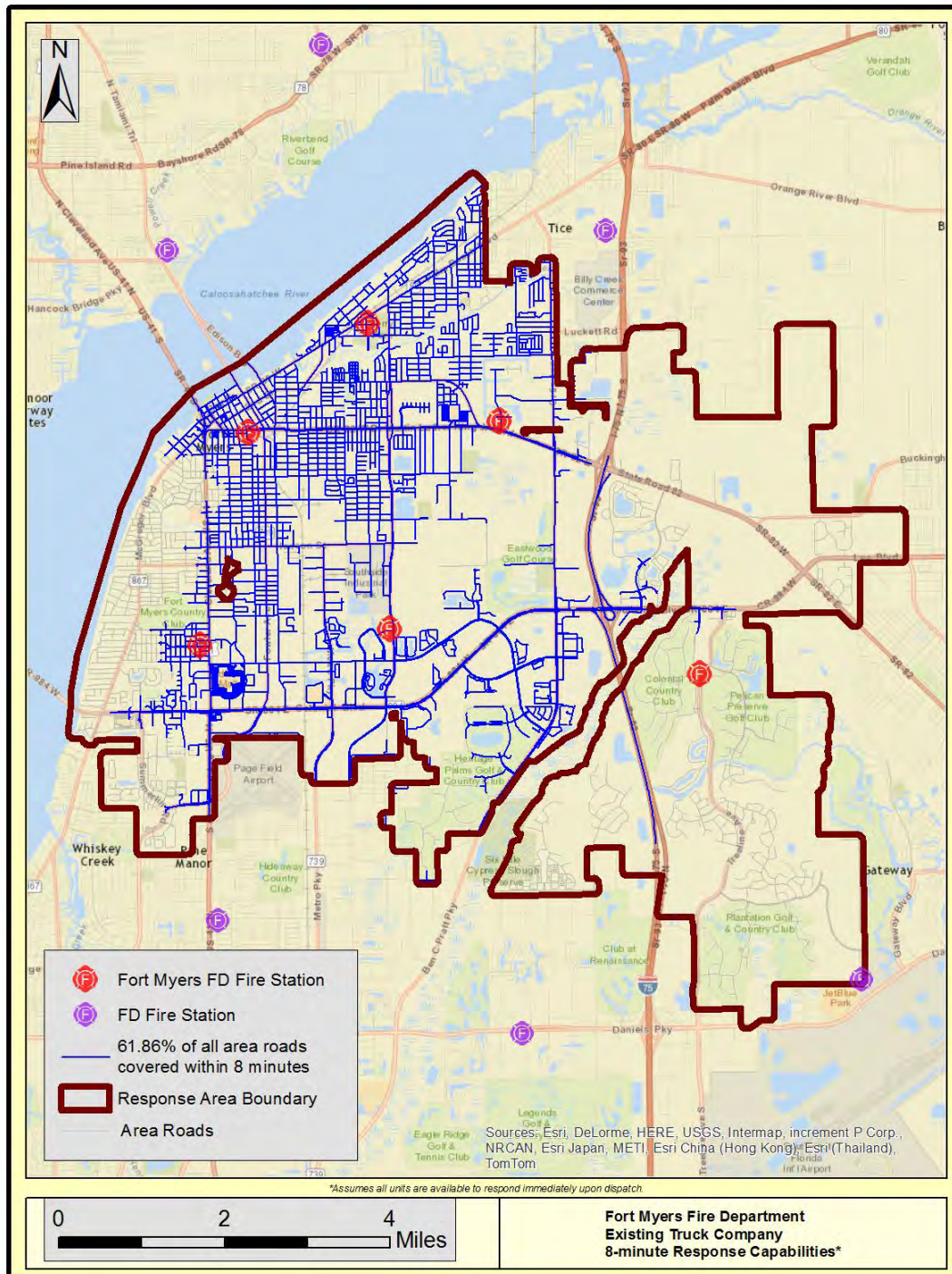
Map 18 shows current 4-minute rescue coverage, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD rescues are capable of responding to incidents on **26.11%** of jurisdiction roadways, well below national standards.

Map 19



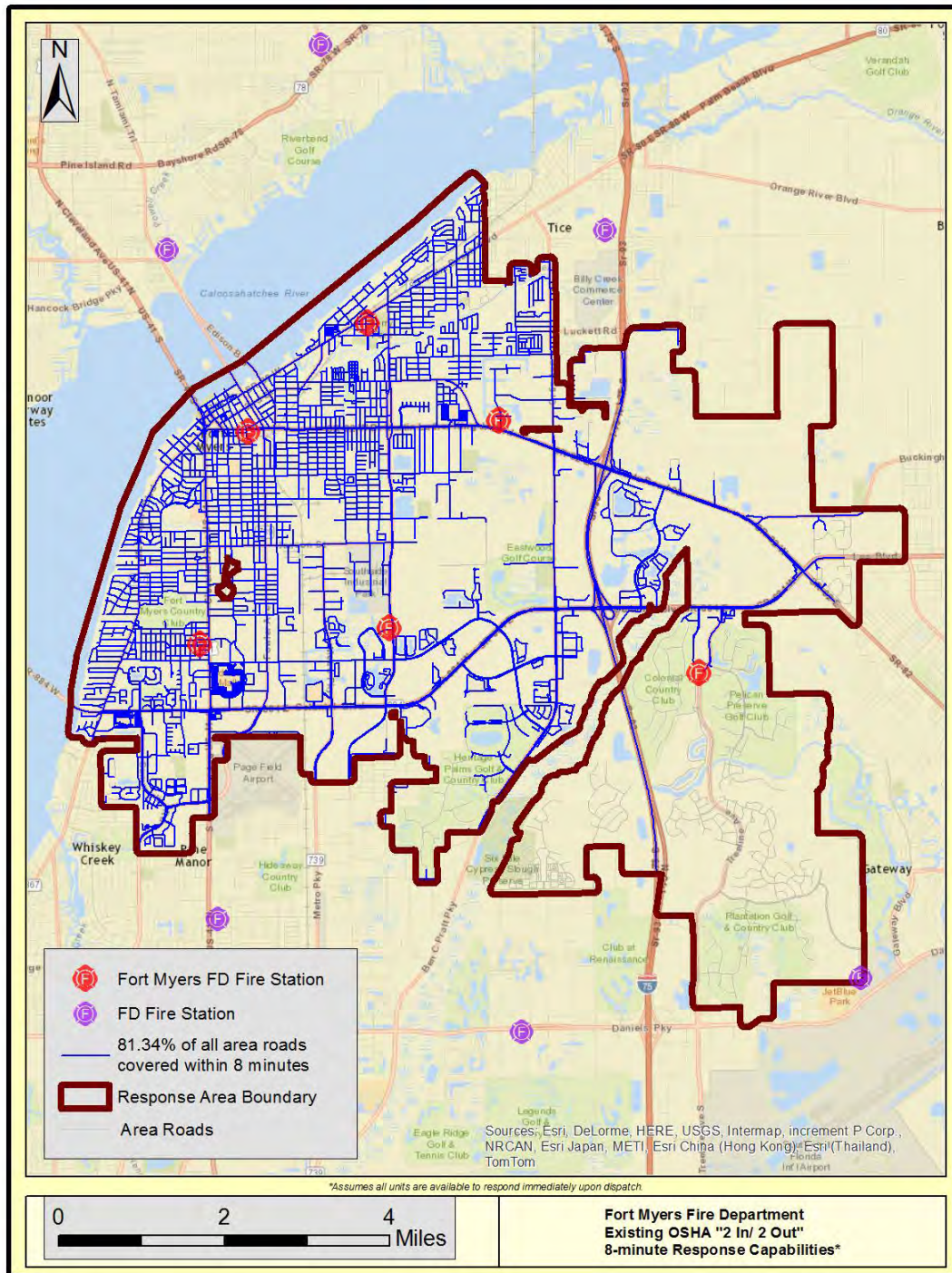
Map 19 shows current 8-minute travel time for FMFD rescues, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD is capable of responding to incidents on **61.74%** of jurisdiction roadways within 8 minutes, which is below national standards.

Map 20



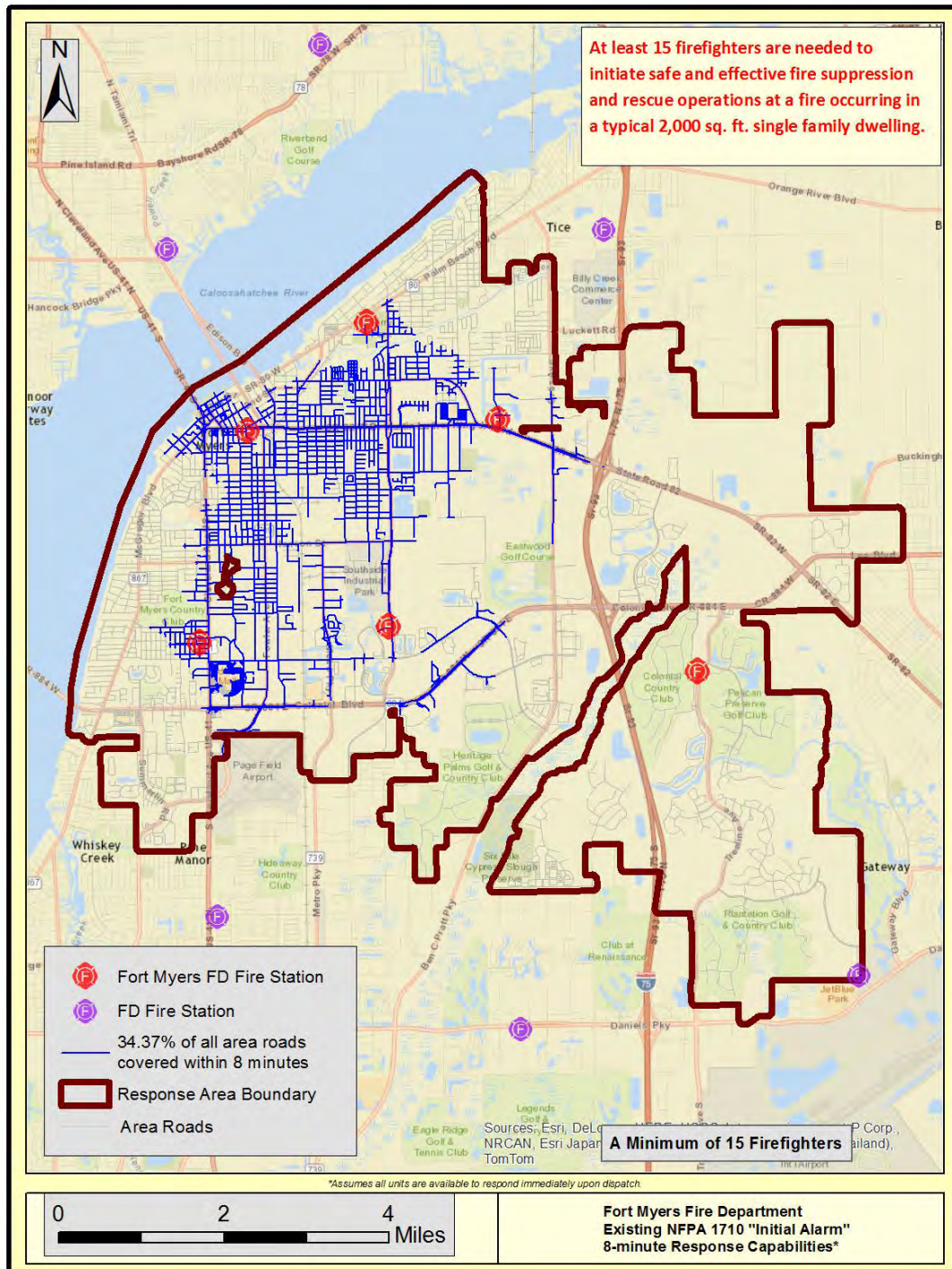
Map 20 shows the current ladder company 8-minute response coverage, assuming units are staffed, in station, and available for immediate response when dispatched. These companies are capable of responding to incidents on **61.86%** of jurisdiction roadways within 8 minutes, below national standards.

Map 21



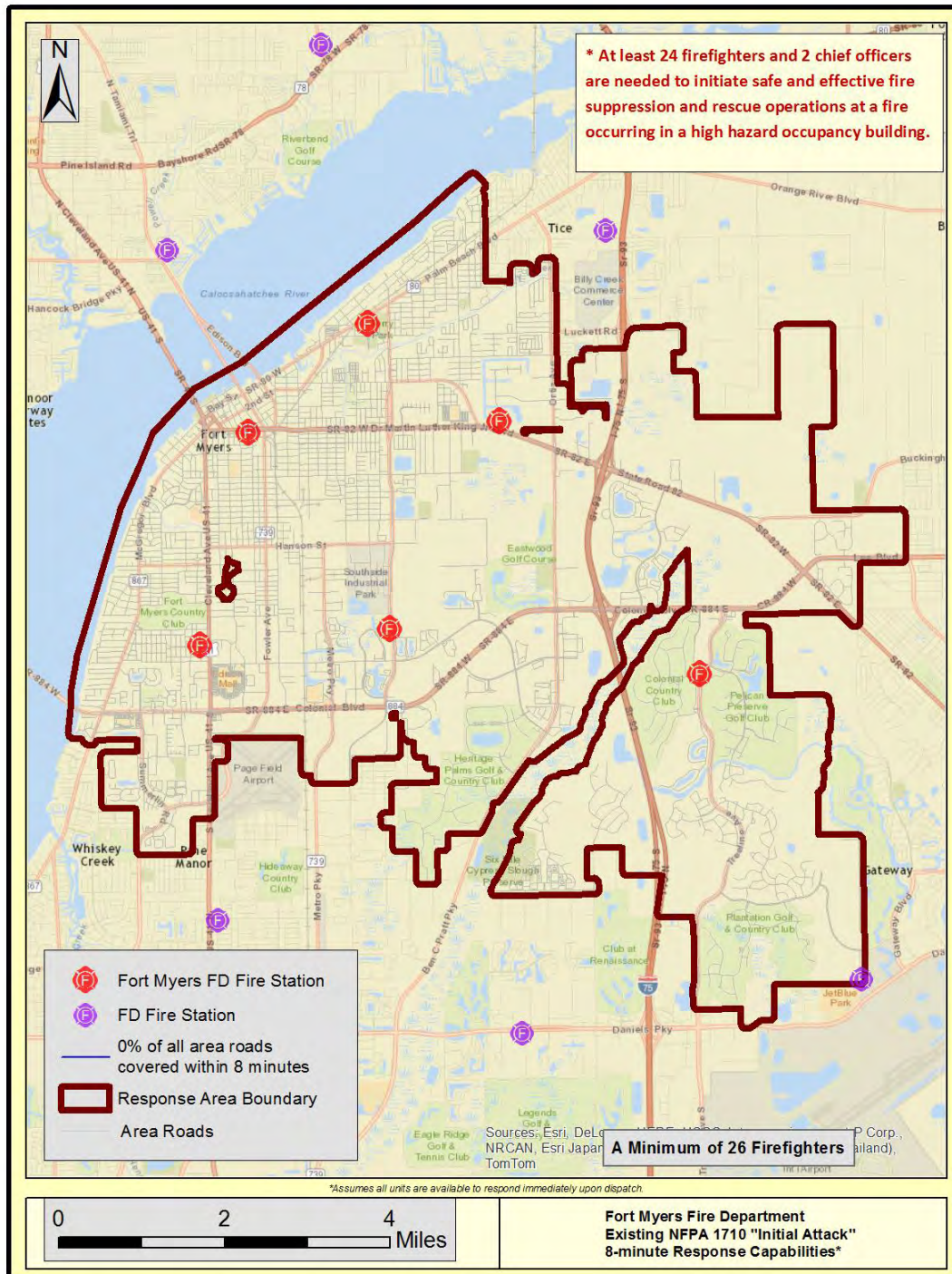
Map 21 shows the roads where 4 fire fighters are estimated to respond and assemble simultaneously within 8 minutes, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD is capable of meeting the requirements of “2-In/2-Out” within 8 minutes on **81.34%** of jurisdiction roadways within 8 minutes.

Map 22



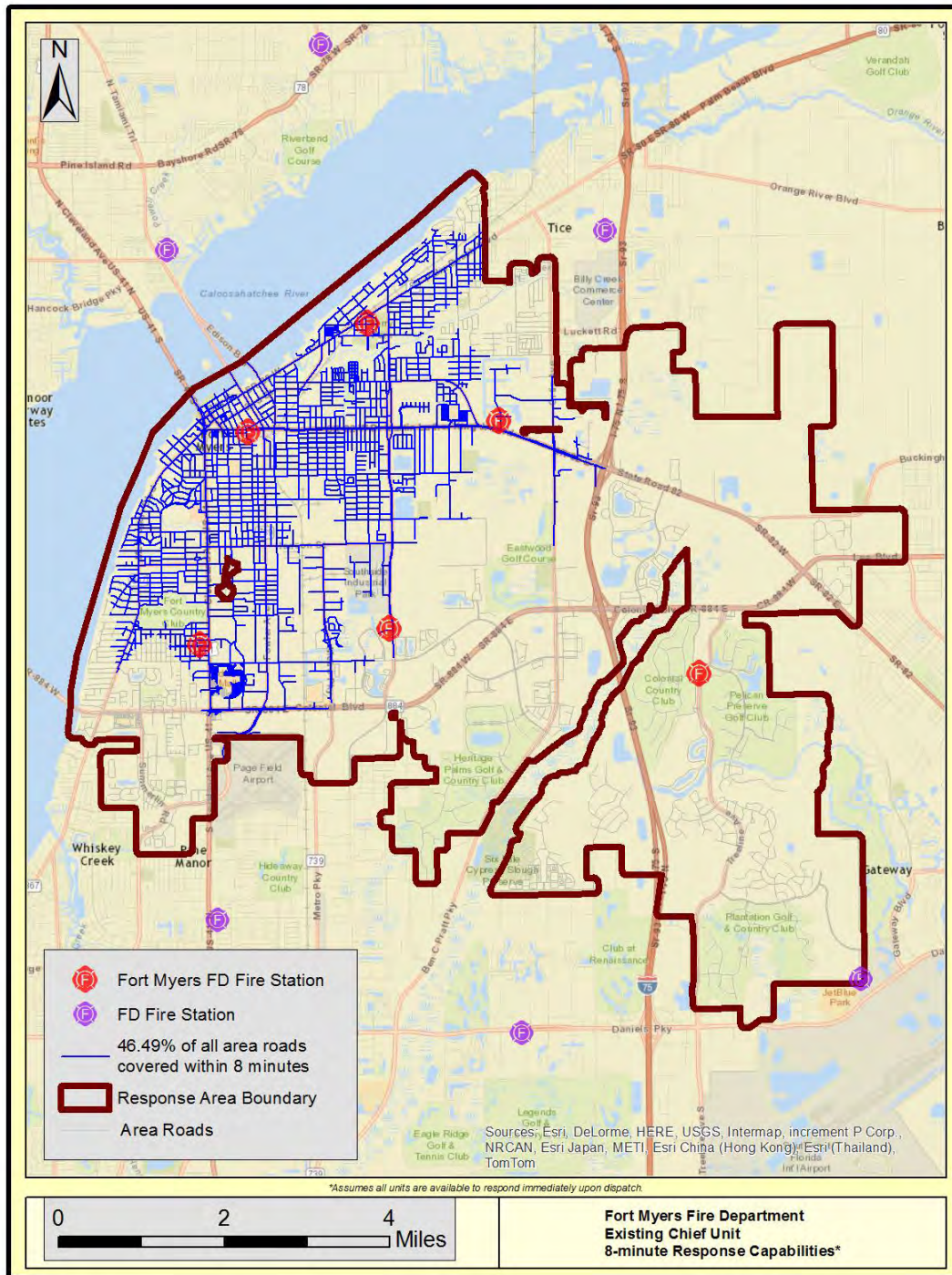
Map 22 shows the roads where 15 fire fighters are estimated to be able to respond and assemble simultaneously within 8 minutes, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD is capable of meeting the fireground assembly requirements of NFPA 1710 within 8 minutes on 34.37% of jurisdiction roadways, which is below the 90% requirement of the standard.

Map 23



Map 23 shows the current *inability* of FMFD to assemble a minimum of 26 personnel on the fireground for a high-hazard incident. An incident at a high-hazard occupancy will require automatic/mutual aid resources, further impacting response coverage in involved Districts.

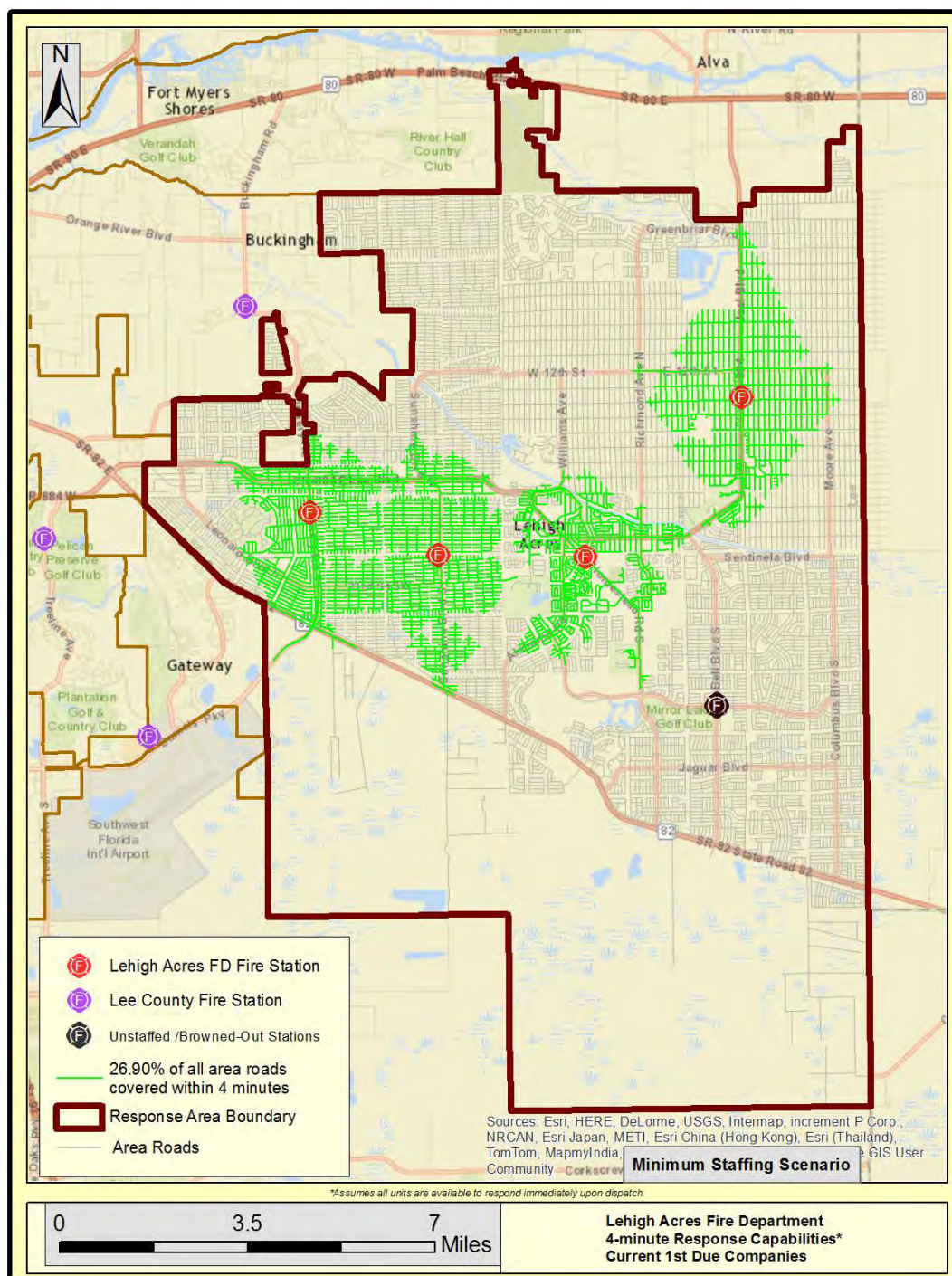
Map 24



Map 24 shows the current 8-minute response coverage for FMFD's on-duty command officer, assuming they are in station and available for immediate response when dispatched. FMFD command is capable of responding to **46.49%** of jurisdiction roadways within 8 minutes.

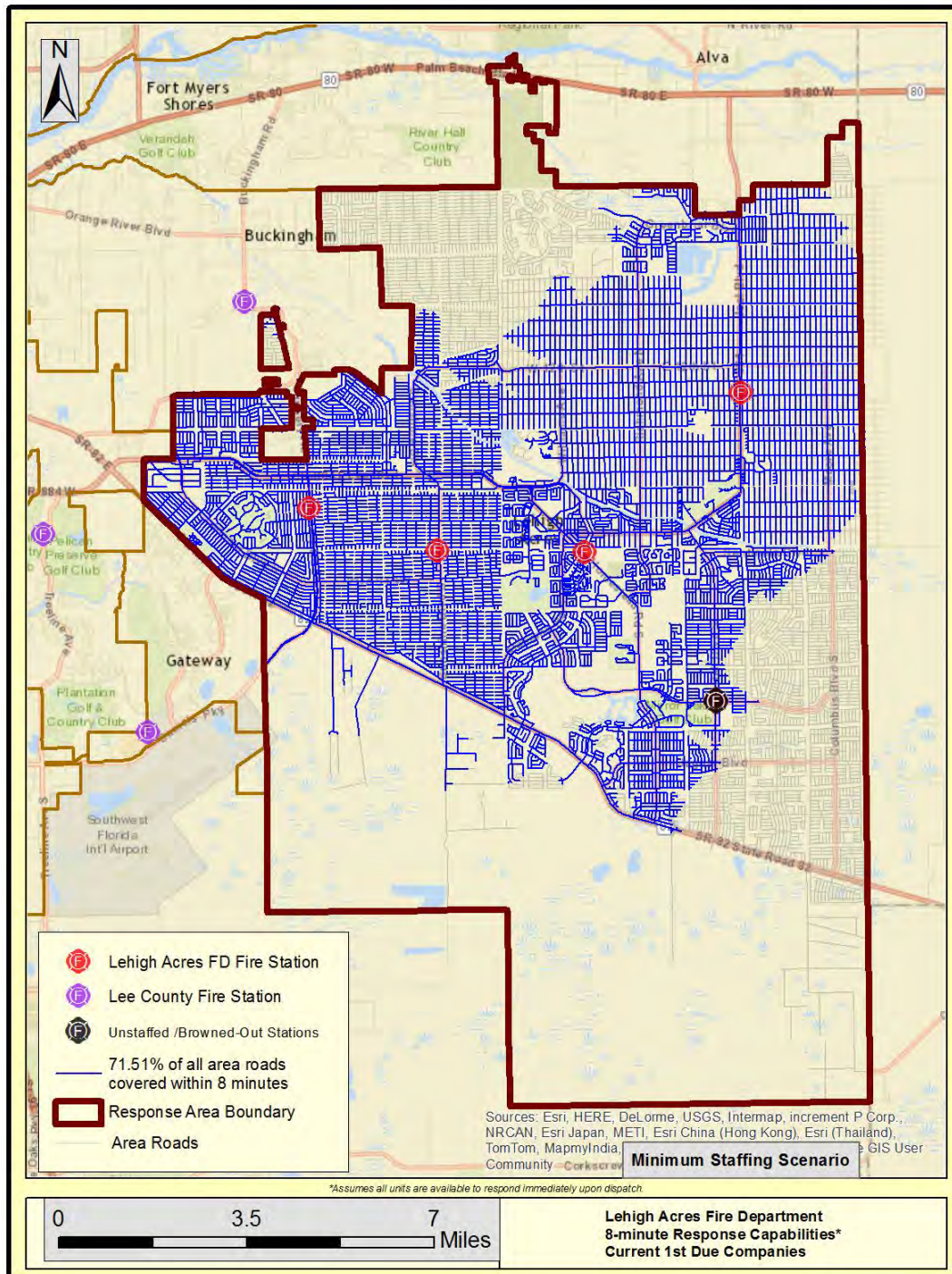
Lehigh Acres Fire Control and Rescue District (LHFD):

Map 25



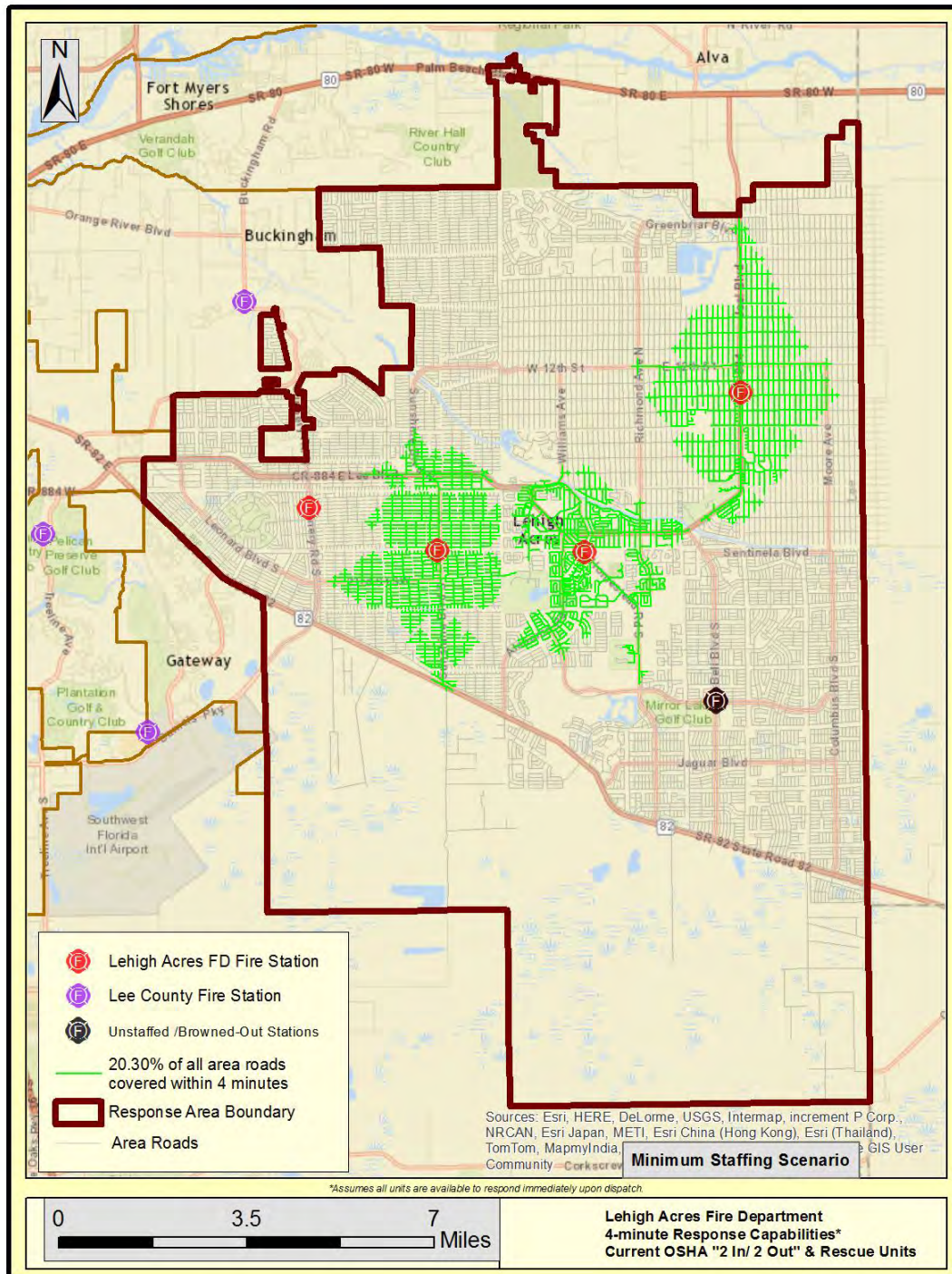
Map 25 shows the current LHFD 4-minute engine company coverage, assuming units are staffed, in station, and available for immediate response when dispatched. LHFD companies are capable of responding to incidents on **26.90%** of jurisdiction roadways, well below national standards.

Map 26



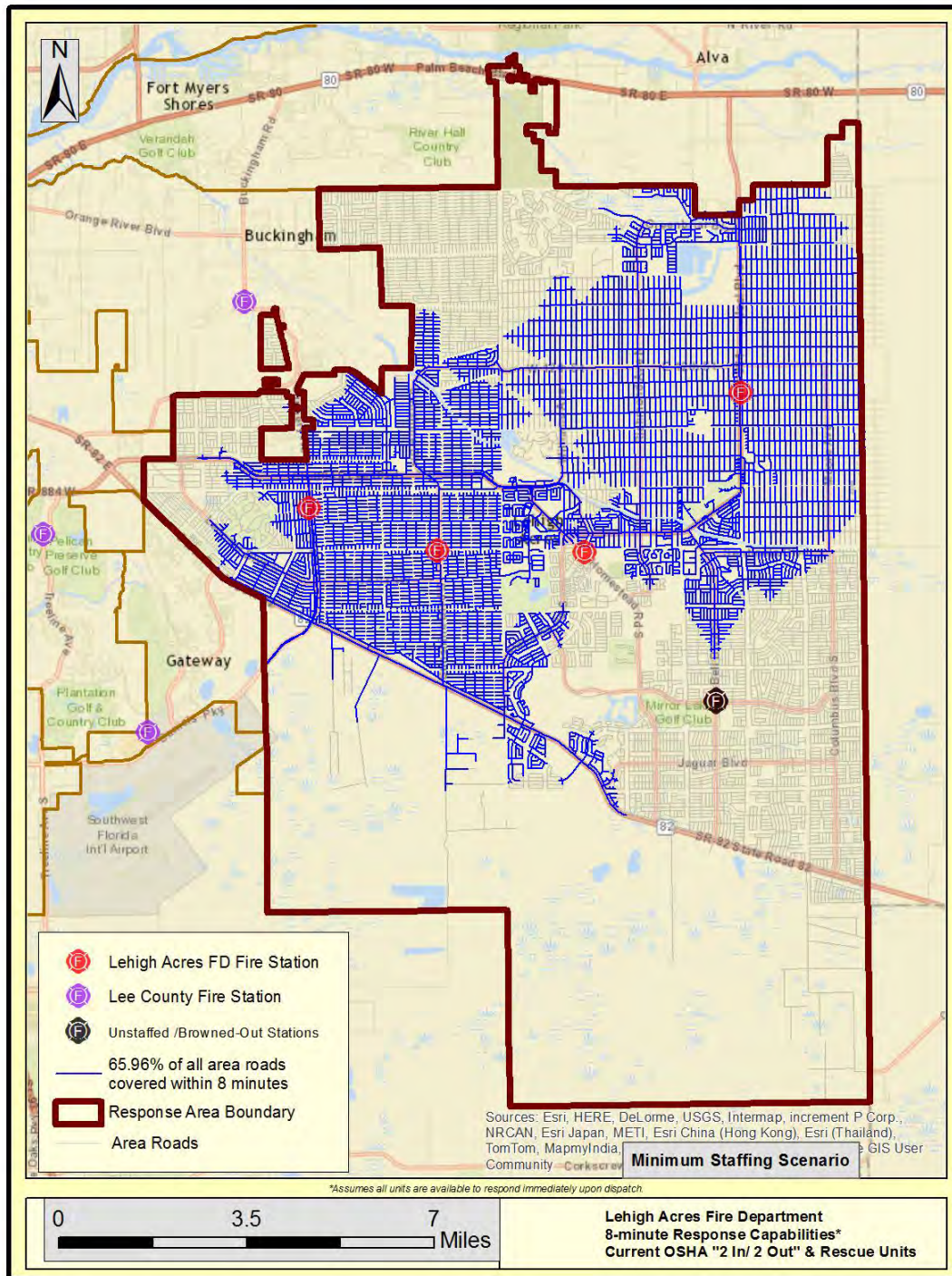
Map 26 illustrates the current 8-minute travel time for LHFDD engine companies, assuming units are staffed, in station, and available for immediate response when dispatched. LHFDD is capable of responding to incidents on **71.51%** of jurisdiction roadways within 8 minutes, which is below the requirements of national standards.

Map 27



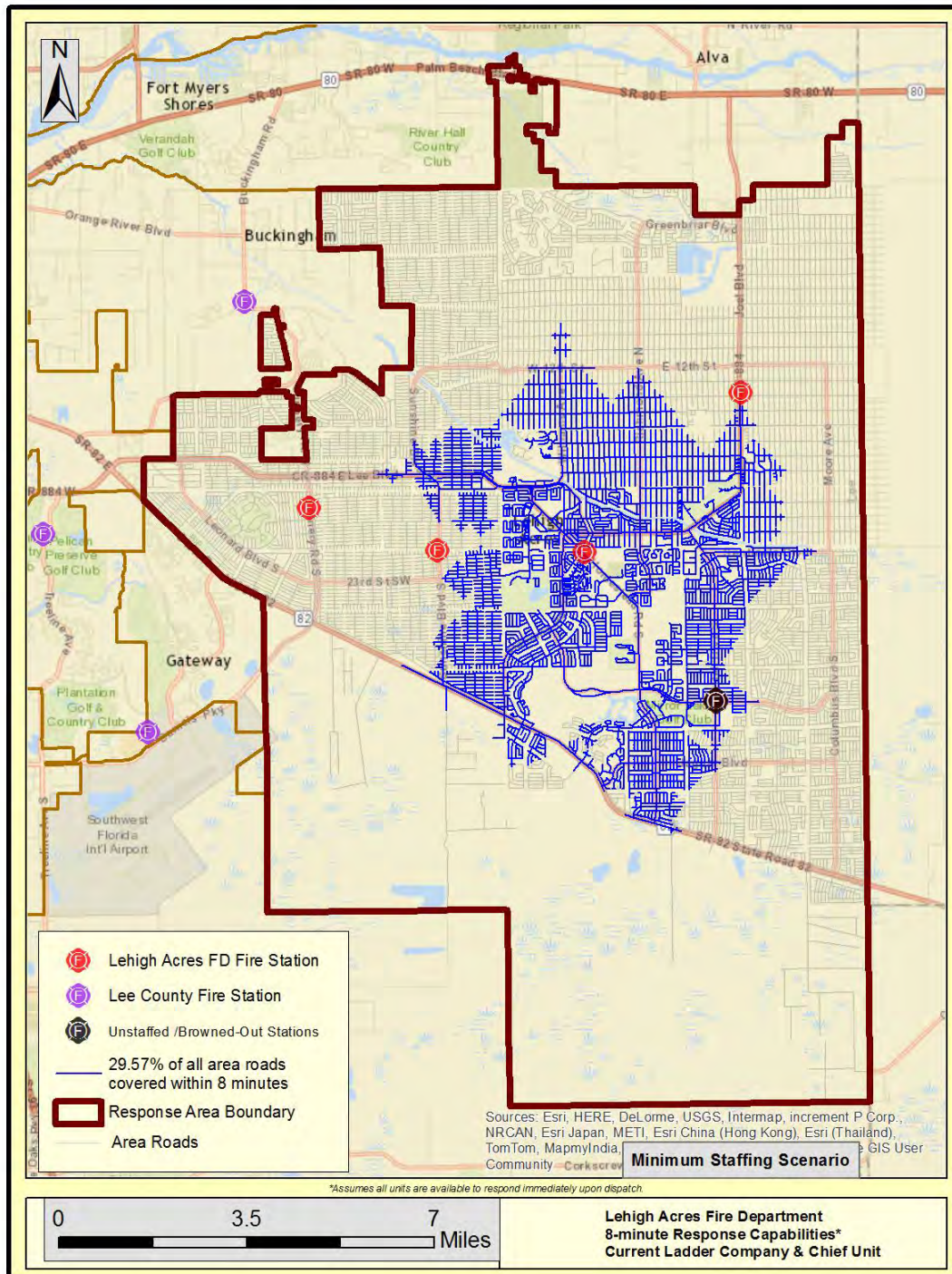
Map 27 shows both the 4-minute rescue and “2-In/2-Out” coverage, assuming units are staffed, in station, and available for immediate response when dispatched. LHFD rescues are capable of responding to incidents on **20.30%** of jurisdiction roadways, well below national standards for EMS 4-minute coverage and OSHA “2-In/2-Out” requirements.

Map 28



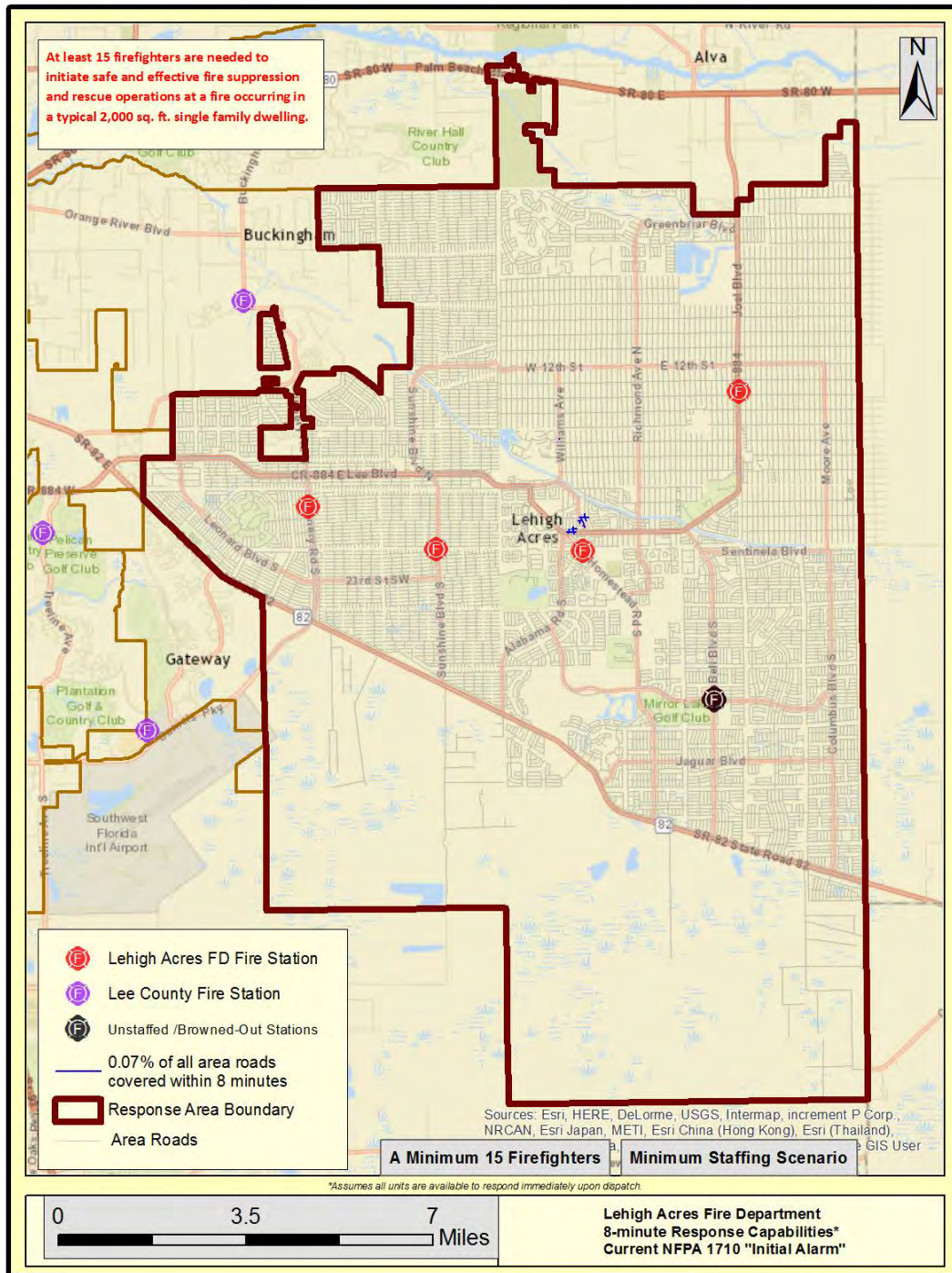
Map 28 shows the current 8-minute travel time for LHFD rescues as well as the departments 8-minute “2-In/2-Out” coverage, assuming units are staffed, in station, and available for immediate response when dispatched. LHFD is capable of responding to incidents on **65.96%** of jurisdiction roadways within 8 minutes, which is below national standards.

Map 29



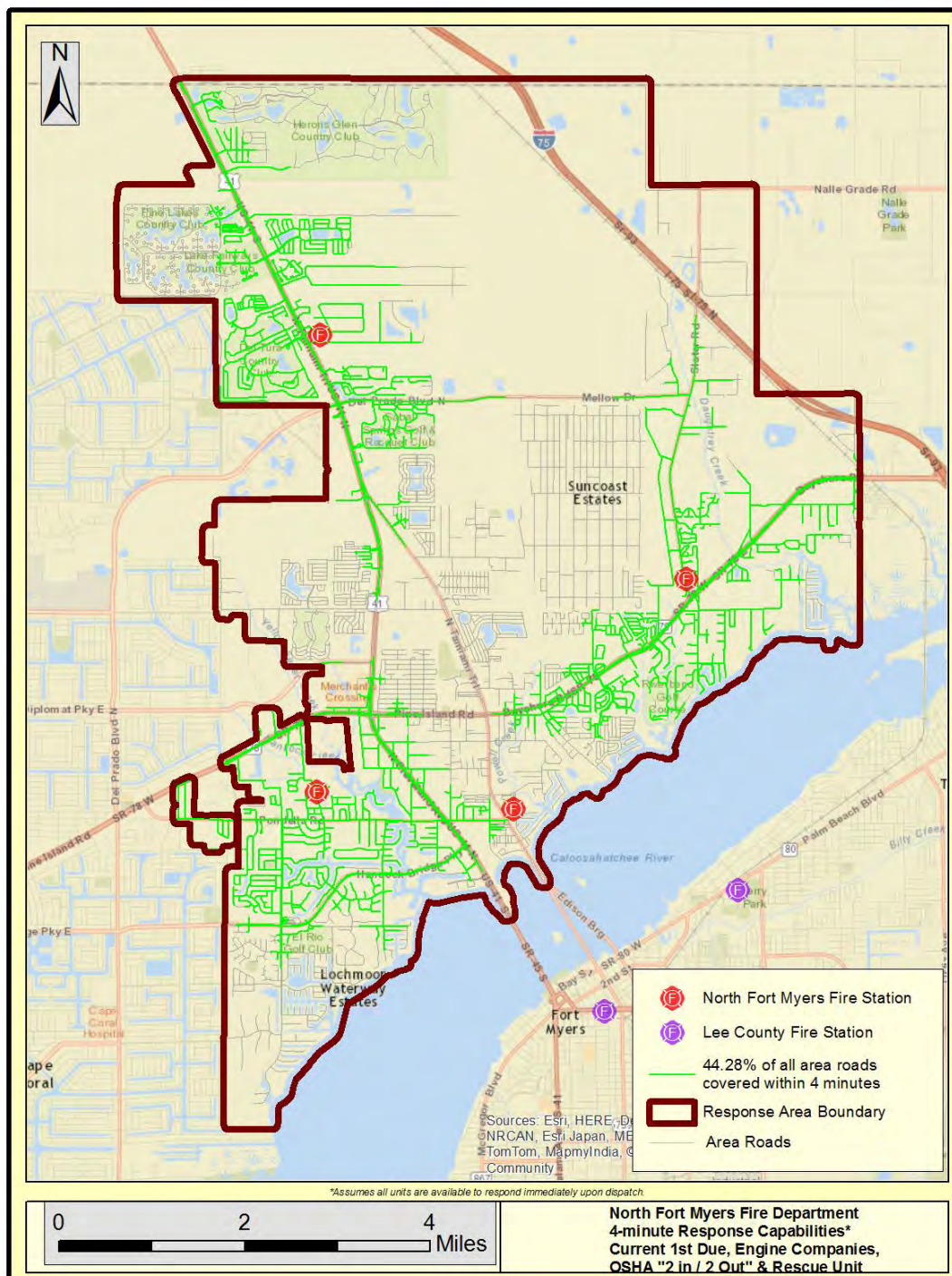
Map 29 shows the current ladder company, and command, 8-minute response coverage, assuming units are staffed, in station, and available for immediate response when dispatched. These companies are capable of responding to incidents on **29.57%** of jurisdiction roadways within 8 minutes, which is below national standards.

Map 30



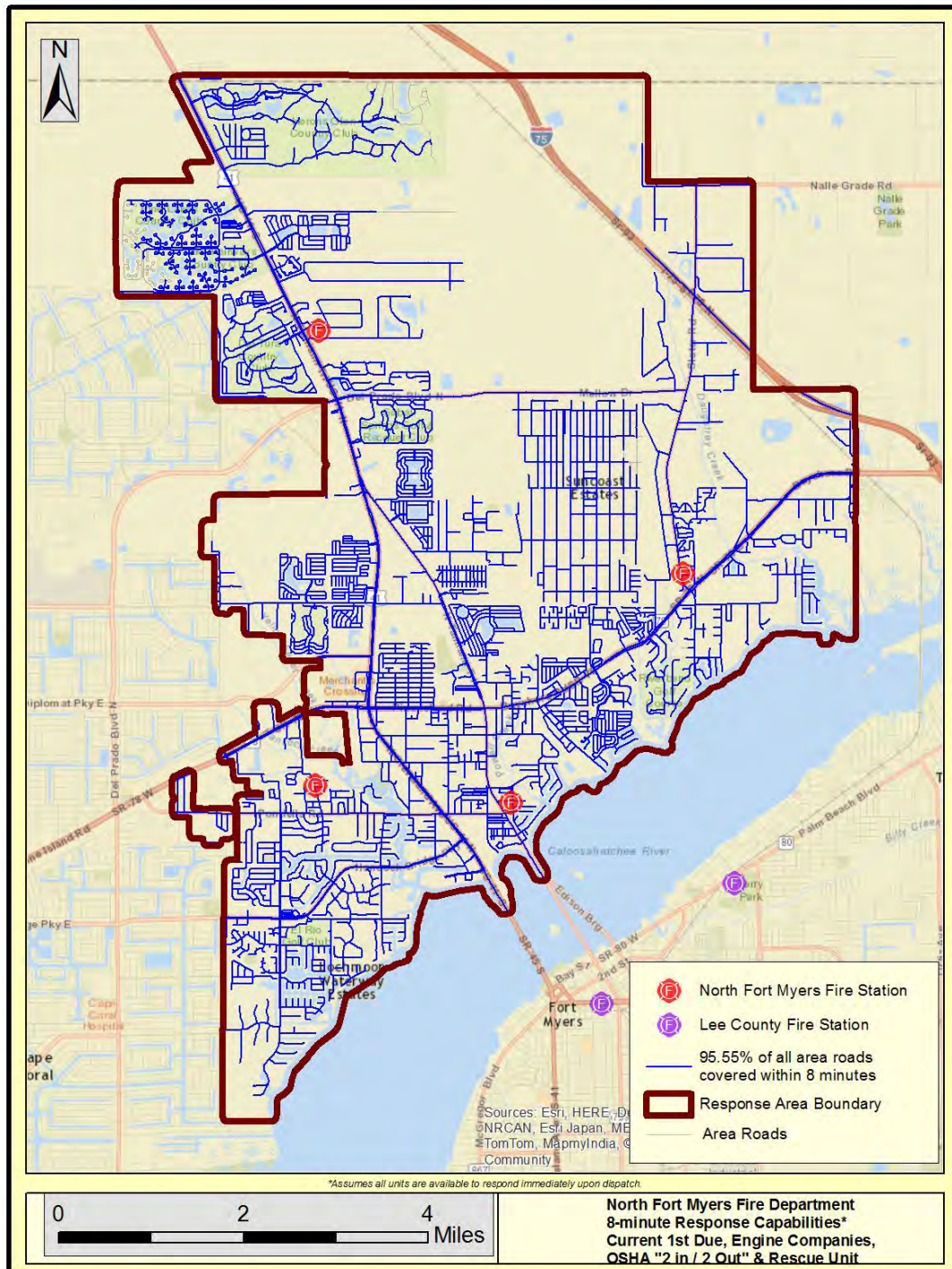
Map 30 shows where LHFD is able to assemble 15 fire fighters within 8 minutes, assuming units are staffed, in station, and available for immediate response when dispatched. LHFD is capable of meeting the fireground assembly requirements of NFPA 1710 within 8 minutes on **0.07%** of jurisdiction roadways, which is significantly below the 90% requirement of the standard.

*North Fort Myers Fire Control District (NFMFD):
Map 31*



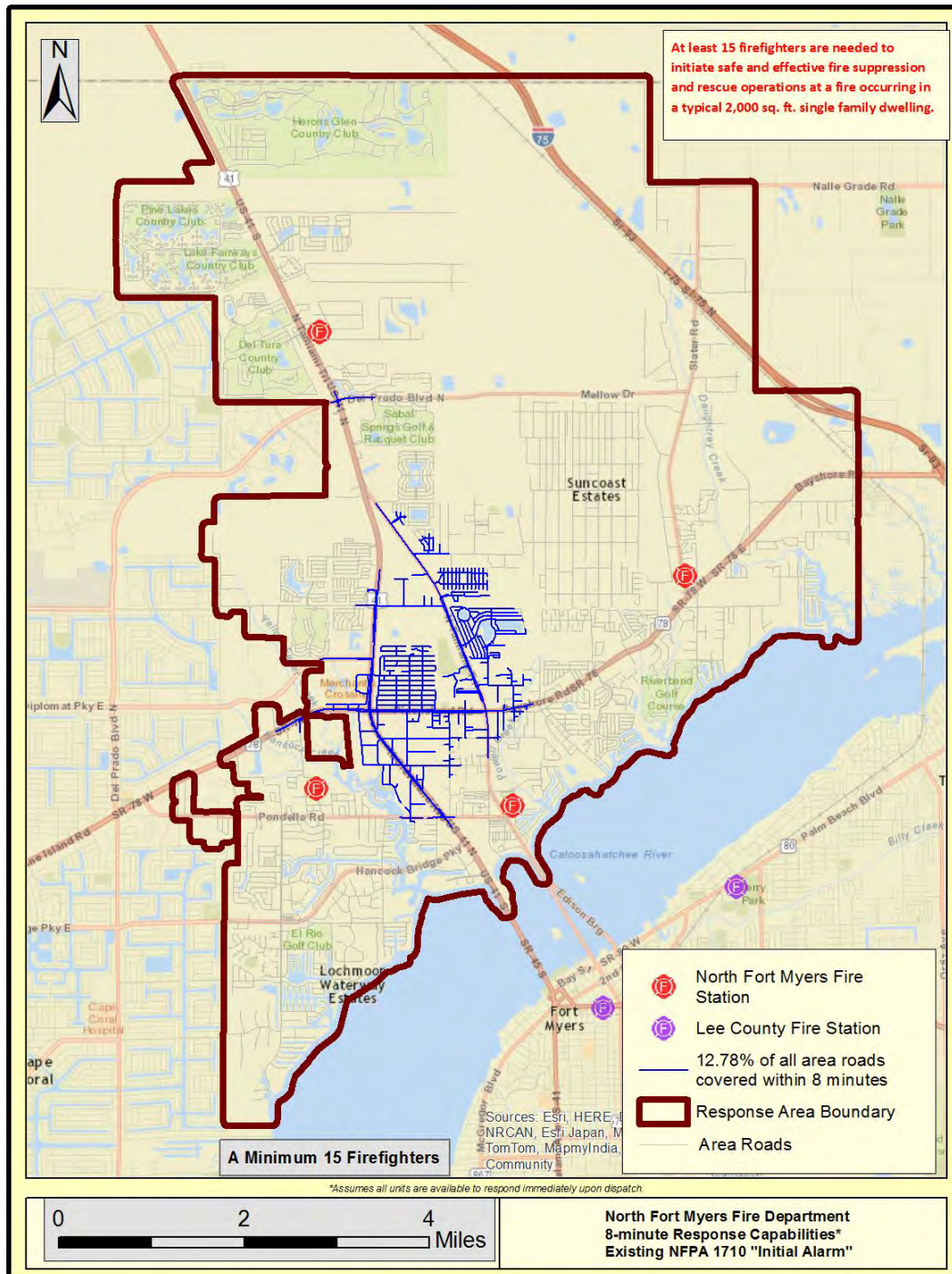
Map 31 illustrates NFMFD 4-minute engine company and rescue coverage, assuming units are staffed, in station, and available for immediate response when dispatched. NFMFD companies are capable of responding to incidents on **44.28%** of roads within the district, well below national standards.

Map 32



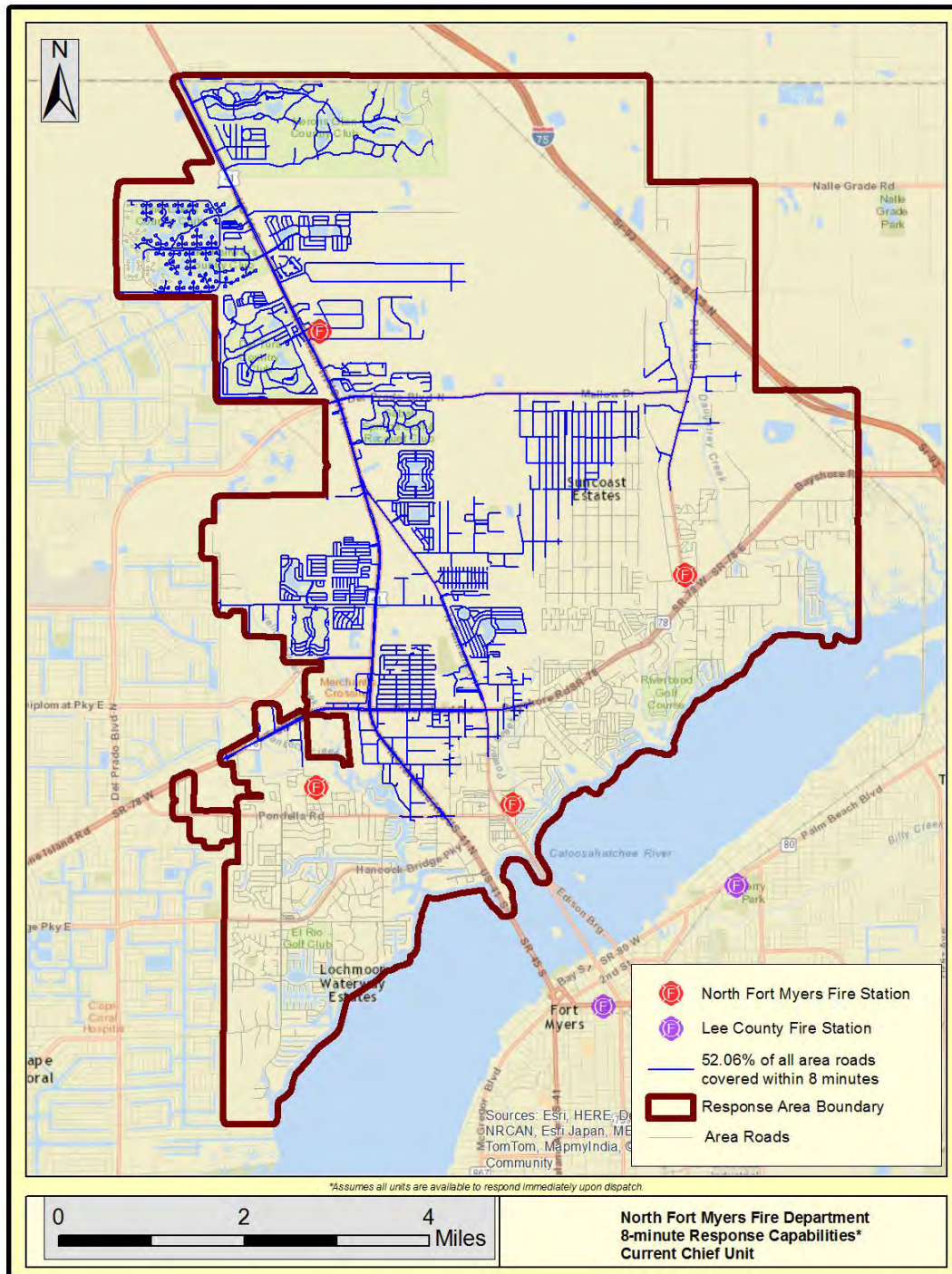
Map 32 shows the current 8-minute response coverage for NFMFD engine companies and rescues, as well OSHA "2-In/2-Out" coverage, assuming units are staffed, in station, and available for immediate response when dispatched. NFMFD is capable of responding to incidents on **95.55%** of district roadways within 8 minutes.

Map 33



Map 33 shows roads where NFMFD is able to assemble 15 fire fighters on the fireground within 8 minutes, assuming units are staffed, in station, and available for immediate response when dispatched. FMFD is capable of meeting the fireground assembly requirements of NFPA 1710 within 8 minutes on **12.78%** of jurisdiction roadways, well below the 90% requirement of the standard.

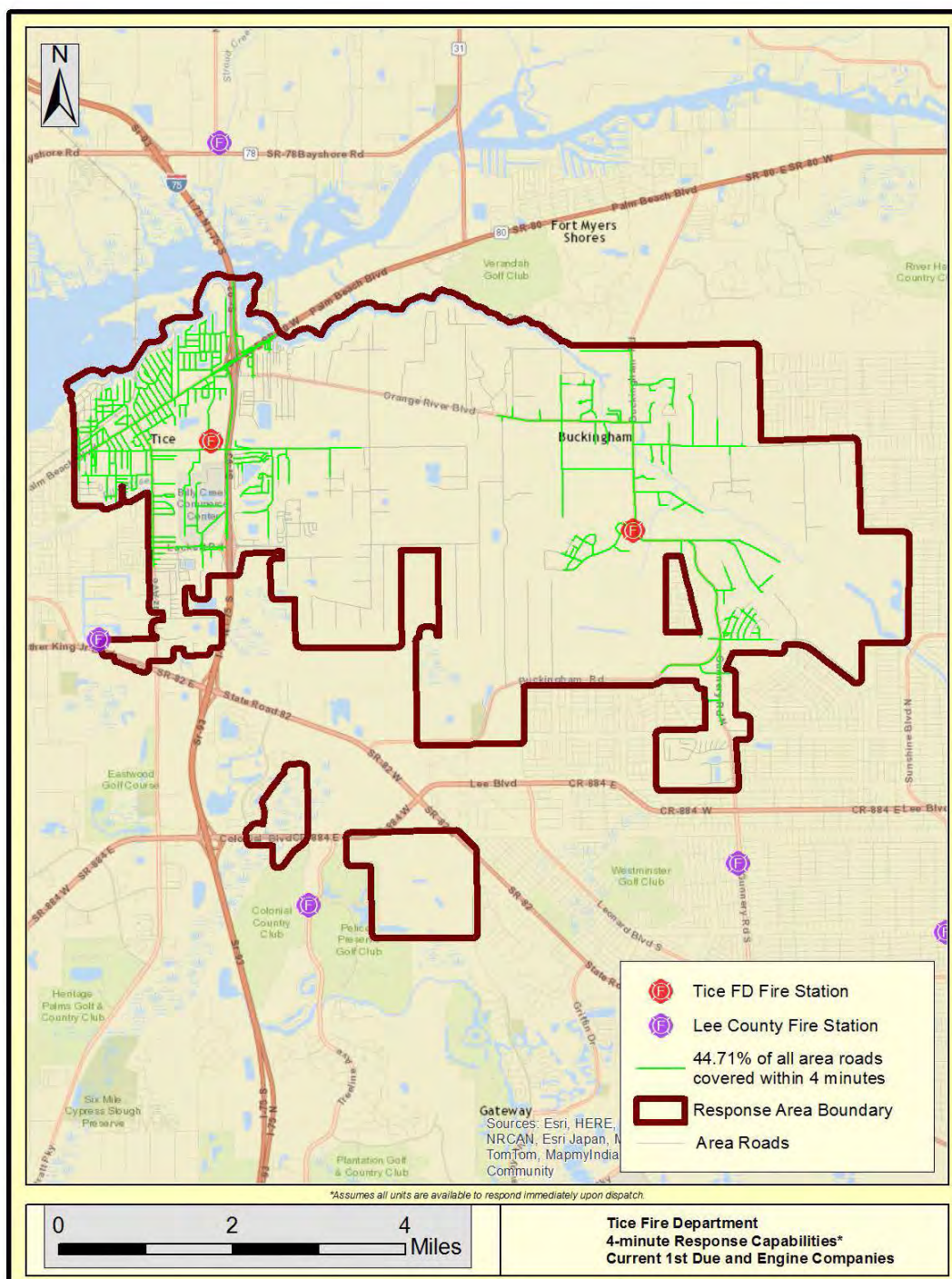
Map 34



Map 34 shows the existing 8-minute response coverage for NFMFD's on-duty command officer, assuming they are in station and available for immediate response when dispatched. FMFD command is capable of responding to **52.06%** of jurisdiction roadways within 8 minutes or less.

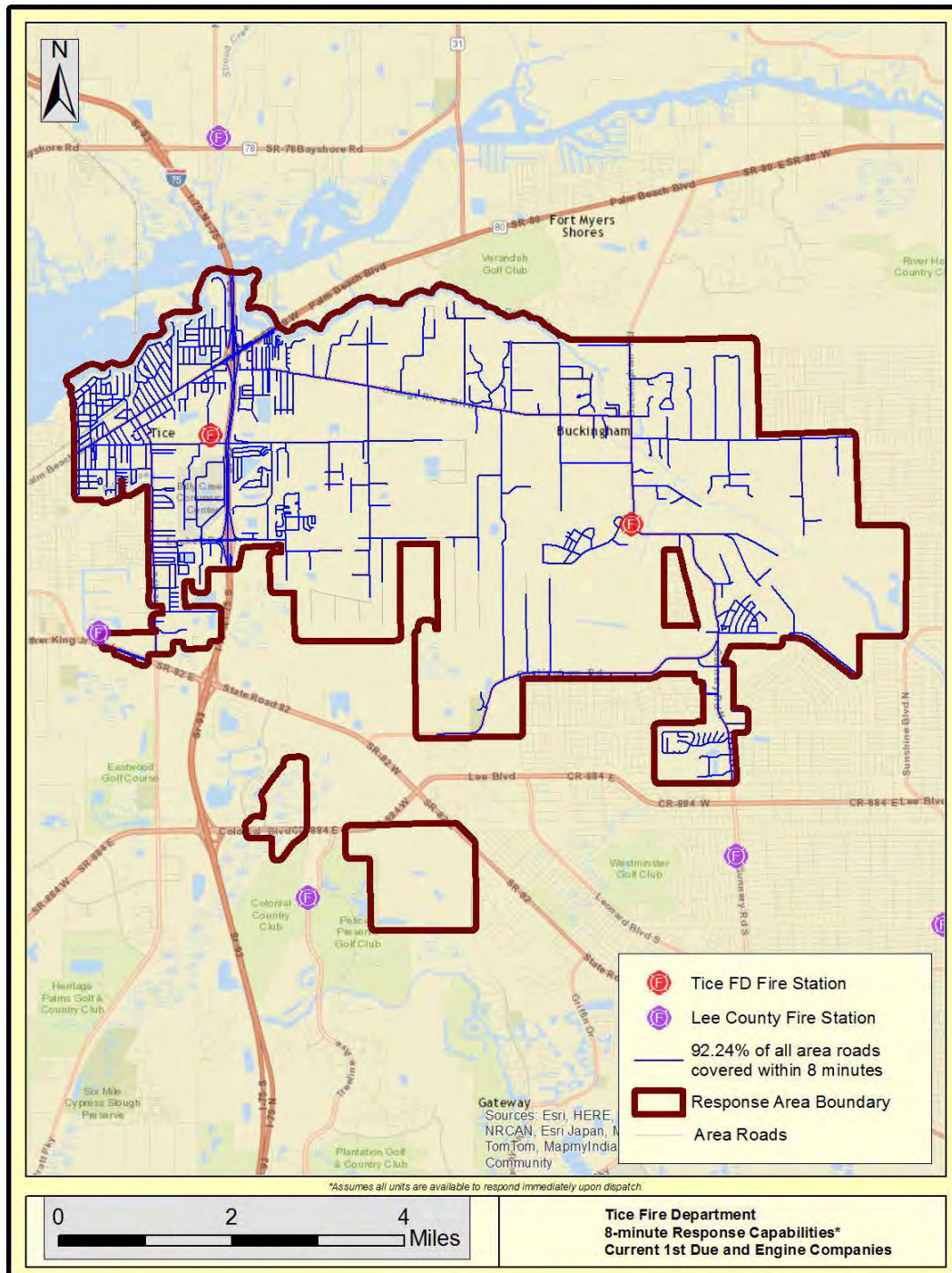
Tice Fire Protection & Rescue District (TFR):

Map 35



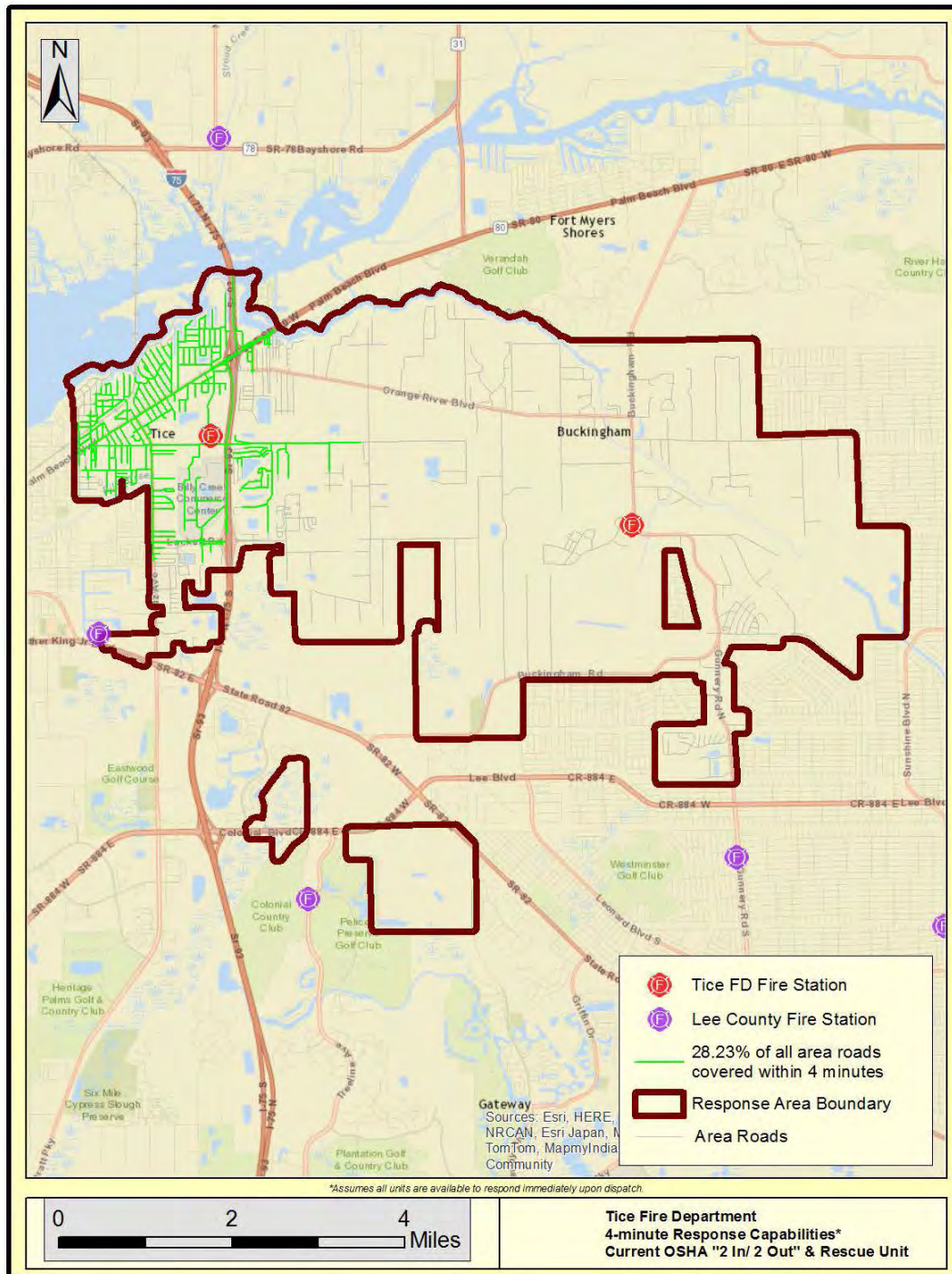
Map 35 shows TFR 4-minute engine company coverage, assuming units are staffed, in station, and available for immediate response when dispatched. TFR companies are capable of responding to incidents on **44.71%** of roadways within the district in 4 minutes or less, well below national standards.

Map 36

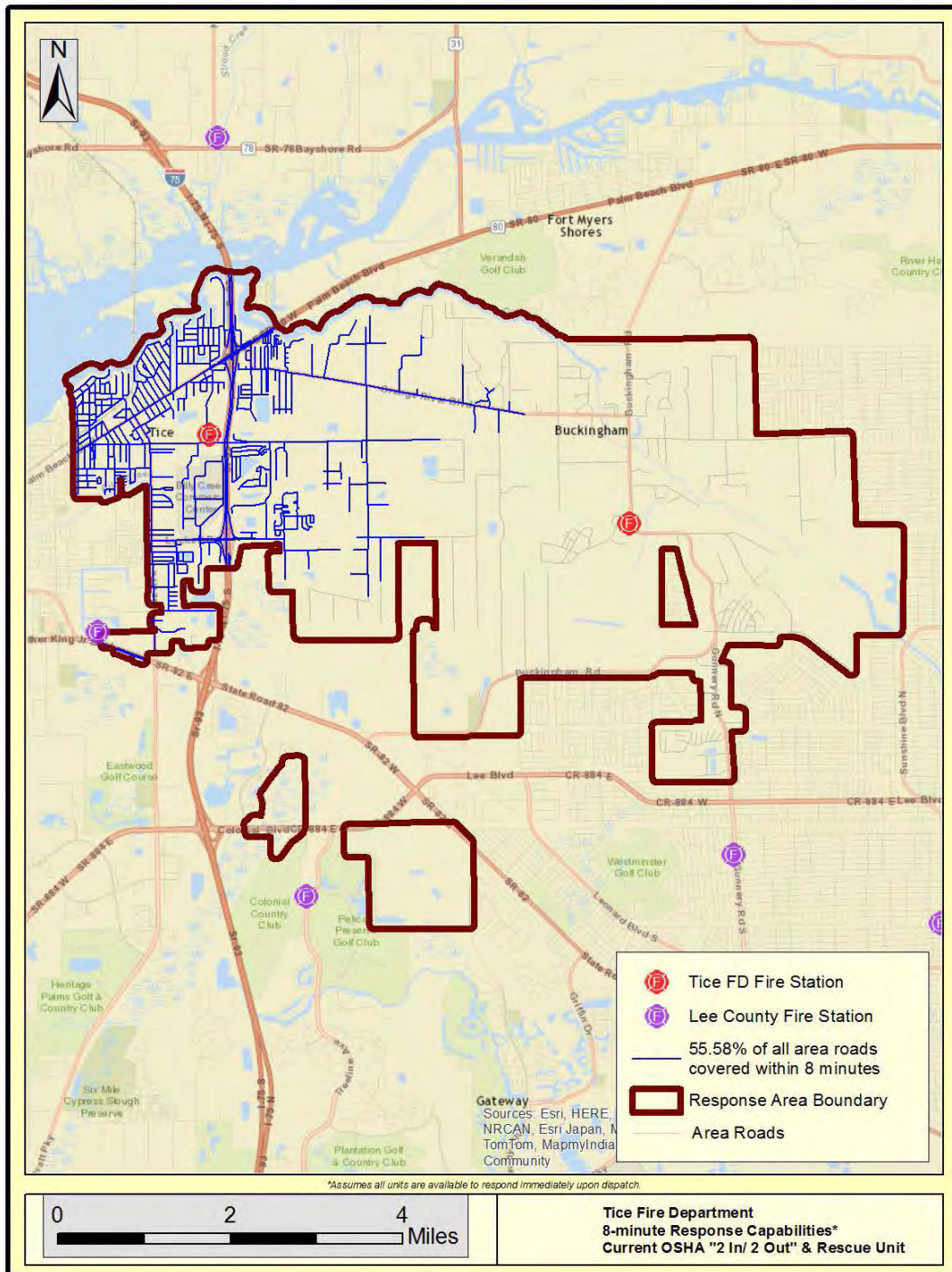


Map 36 shows the current 8-minute response coverage for TFR engine companies, assuming units are staffed, in station, and available for immediate response when dispatched. TFR is capable of responding to incidents on **92.24%** of district roadways within 8 minutes.

Map 37

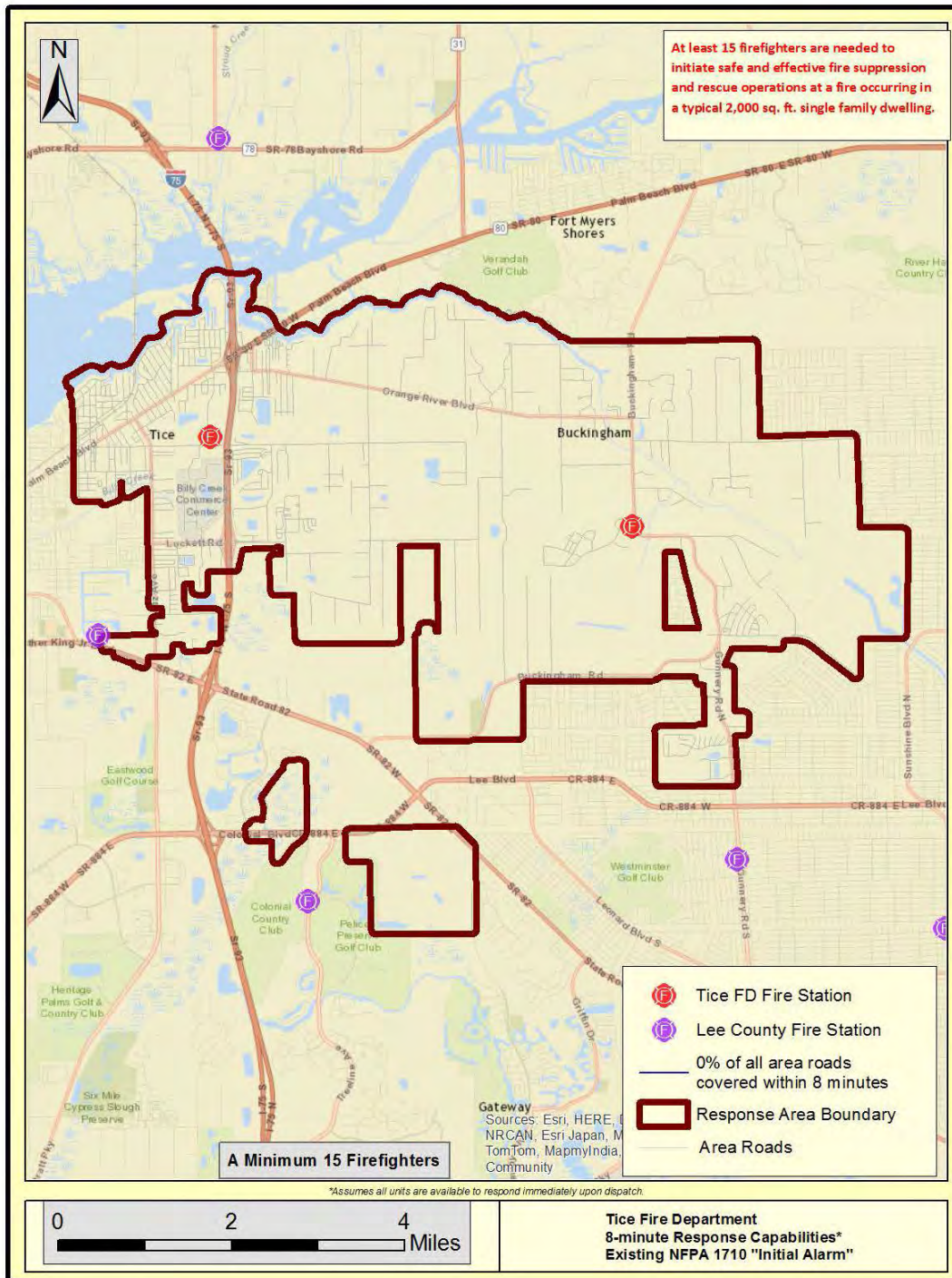


Map 38



Map 38 shows the current 8-minute rescue and OSHA “2-In/2-Out” coverage, assuming units are staffed, in station, and available for immediate response when dispatched. TFR is able to have at least four personnel on the scene, or have a rescue respond within 8 minutes on 55.58% of roadways within the district, well below national standards.

Map 39



Map 39 illustrates TFR inability to assemble 15 fire fighters within 8 minutes. Tice Fire Rescue does not have a sufficient number of on-duty personnel to meet the requirements of NFPA 1710 for fireground assembly without the use of mutual/automatic-aid.

Recommendations

The agencies included in this study respond to thousands of calls within Lee County and their own jurisdictional boundaries, for fire suppression, medical, and other emergencies. Existing staffing and deployment levels do not comply with industry standards and are insufficient for safe, effective, and efficient emergency operations. The recommendations listed below are based on the findings of the GIS evaluation of current deployment models.

- Fire suppression apparatus should be staffed with a minimum of 4 fire fighters at all times.
 - Staffing to this level complies with industry standards for crew size in a low-hazard residential environment and reduces the risk to fire fighters and occupants during emergency incidents.
 - Sending larger crew sizes on a single apparatus allows crews to assemble on the scene more quickly during early stages of a fire when risks to both fire fighters and building occupants are lower. Since fire growth is exponential, growing in a non-linear manner over time, extending the time for crew assembly by waiting for smaller crews to assemble after arriving from further distances causes on scene risk to escalate. The higher the risks at the time fire fighters engage in fire suppression operations, the greater the chance of poor outcomes including civilian injury or death, fire fighter injury or death, and property as well as economic loss.
- Additional stations may need to be opened in the future to achieve adequate 4-minute initial unit arrival and 8-minute full alarm assembly coverage.
 - Locating stations and deploying resources in areas where there are deficient response capabilities will further reduce risks to the public and fire fighters responding in these areas. People living or working in areas where first due engines require greater than 4 minutes travel time to arrive on scene and engage in fire suppression or EMS activities are more vulnerable to negative outcomes from fire or medical emergencies. As noted above, increasing the time to fire fighter intervention also increases the risk for both fire fighters and the public.
 - A fire department needs to maintain acceptable levels of both concentration and distribution of resources. An adequate distribution of resources will allow for rapid response, while the increased concentration will assist in the assembly of an initial effective response force.
 - Fire department response should be included in any discussions concerning future growth and jurisdictional planning (buildings and/or population). Any areas with accelerated development and growth will require additional coverage.

Summary & Conclusion

While it is impossible to predict where most of a jurisdiction's fire and medical emergencies will occur, the agencies included in this study should examine where emergencies have typically occurred in the past and make efforts to ensure all areas have sufficient fire department coverage by improving staffing and deployment in an effort to achieve compliance with NFPA Standard 1710.

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." Ideally, a jurisdiction will balance both elements.

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. Areas with accelerated development and growth will require additional coverage in the future. Changes in staffing and deployment should be made while considering historical location of calls, response times to specific target hazards, existing industry standards, and the citizens' expectations of receiving an adequate number of qualified personnel on appropriate apparatus within acceptable time frames. Returning minimum staffing to 4 personnel will ensure that an initial response to fire or medical emergencies will have sufficient personnel to begin safe, efficient, and effective emergency operations. This would also improve response coverage for high-hazard occupancies which are currently, even with the extensive use of mutual/automatic aid resources, well below national standards.

Lee County faces several challenges, from the slow economic recovery impacting the entire country, to varying levels of fire department staffing throughout the county. Addressing these challenges will require planning and cooperation between all agencies, including those outside the fire service, in order to continue providing the quality of emergency services that county residents have come to expect. That IAFF Local 1826 and multiple different agency heads are able to come together to study and work towards improvements in service delivery to the general public while also focusing on increased fireground safety, effectiveness, and efficiency should reassure residents and county leaders alike that they have an emergency service system that keeps the people it serves at the forefront of efforts to meet these challenges.