

Improving Highway Safety for Emergency Responders

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used language, ideas, expressions or writings of another.

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Date: 10/20/15

Abstract

The problem is that the Canton Fire Department personnel are exposed to serious injury or death while operating on the interstate highway system in Norfolk County. Currently the department has no standard operating guideline (SOG) for operating on multi-lane roadways. The purpose of this research project is to identify the essential elements that should be included in a highway response procedure and develop a standard operating guideline for the Canton Fire Department for fire and emergency medical service responses to the interstate highway system in the Town of Canton. The specific method used for this applied research project is the Action Research method. The research questions that this project attempts to answer are:

1. What are the factors that cause motorists to become involved in secondary accidents with first responders on the highway?
2. What procedures are currently being utilized by other departments to keep first responders safe while operating on the highway?
3. What equipment is being deployed on the highway to increase the visibility of first responders?
4. What training is available to increase firefighter safety on the highway?

The research was conducted utilizing journal articles, EFO papers, standards, codes, operating procedures and laws to ascertain the important elements relative to the safety of firefighters operating on highways. In addition, a questionnaire was distributed to 28 Fire Chief's in Norfolk County whose departments respond to similar stretches of highway in their own communities. The questionnaire attempted to identify techniques, equipment, training and procedures employed by other departments to ensure firefighter safety on the highway. The research indicates that although a plethora of reports, model guidelines, codes and standards exist

to increase firefighter safety on the roadways, there are still departments that do not have an official standard operating guideline for safe highway operations. Fire Departments, including Canton, should develop safety procedures, provide proper safety equipment and conduct training with firefighters who are tasked with responding to emergencies on multi-lane roadways.

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Introduction

The Canton Fire Department desires to create a work environment in which firefighter safety is paramount. The department employs a full time Captain of Training and Safety to ensure the members are adequately trained and educated about safety on the fire ground and on the emergency scene. Crews participate in both classroom learning and live training on a daily basis in order to support a culture of firefighter safety and survival. Part of this training process includes the periodic review and revision of department standard operating guidelines. A problem was recently identified when it was discovered there was no guideline for operating safely on the many miles of interstate highway that transect the Town of Canton. Although the Canton Fire Department has never suffered a fatality while operating on any roadway, the possibility of a secondary accident on the highway was very real.

The purpose, then, of this applied research project (ARP) is to improve firefighter safety while operating on our interstate highway system. This objective will be accomplished by creating a standard operating guideline to be used by all members when responding and working on a multi-lane roadway. This applied research project will utilize the action research methodology. The research approach will include a situational analysis of our current highway response practices, a review of local laws and industry standards and a questionnaire distributed to the Norfolk County Fire Chief's Association specific to the highway safety practices of our mutual aid communities. In so doing, this researcher will attempt to answer the following questions:

1. What are the factors that cause motorists to become involved in secondary accidents with first responders on the highway?

2. What procedures are currently being utilized by other departments to keep first responders safe while operating on the highway?
3. What equipment is being deployed on the highway to increase the visibility of first responders?
4. What training is available to increase firefighter safety on the highway?

In addition to a data analysis of primary and secondary resources, a literature review will be conducted through examination of journal articles, textbooks and internet sites.

Background and Significance

The Town of Canton is situated just outside the City of Boston, Massachusetts and has a population of approximately 22,000 people. It has a healthy commercial/industrial tax base and a top rated public school system. On the municipal side, both the police and fire departments are full time career departments that are adequately staffed twenty-four hours a day.

Several major highways are contained within the Town of Canton's boundaries. Interstate route 93, for example, travels east through Canton and into the City of Boston and then north to New Hampshire and Maine. (Wikipedia, 2015) Route 93 is a four lane highway that is particularly busy during the morning and afternoon commute to and from Boston. Interstate route 95, another four-lane highway, travels north to New Hampshire and Maine, looping around Boston and then south to Providence Rhode Island. (Wikipedia, 2015) Route 95 is a heavily travelled highway during all hours. In addition, Route 138, a divided highway, travels north and south through Canton and has a cloverleaf interchange with Route 93. (Wikipedia, 2015) Finally, Route 24, a divided highway with two lanes in each direction, runs on the southeasterly border of Canton to Rhode Island and runs parallel to Route 138. (Wikipedia, 2015) In all, there

are approximately 28 miles of highway that are situated within the Town of Canton, Massachusetts. (Wikipedia, 2015)

In addition, the Canton Fire Department responds in a mutual aid capacity to the Towns of Norwood, Westwood, Stoughton, Sharon and Dedham, adding an additional 101 miles of interstate highway to the response plan. According to Canton Fire Department dispatch data, out of the 3,800 emergency response calls per year in the Town of Canton, approximately 250 (6.5%) of those calls require fire apparatus and/or ambulances to respond to one of the aforementioned highways. With an average of 30 fires per year or less than 1% of all calls, Canton's firefighters are more likely to be killed or injured while operating on a highway than in a structure fire. The demographics and call volume highlight the need to develop up to date operating guidelines for highway response.

Further, national statistics also support the need for addressing roadway safety for first responders. In an NFPA report titled, *On Duty Deaths of Fire-Police Officers, 1991-2010*, the report indicates that 67 firefighters, over a 20-year period, were struck and killed by vehicles while working on roadways. (Fahy, 2010) According to the 2013 *NFPA Firefighter Fatalities in the United States* report, 6 firefighters were struck and killed by vehicles or 6.1% of all fatalities for that year. (National Fire Protection Association, 2015)

Addressing the need for firefighter safety on the highway in some ways is an adaptive challenge. Instituting a significant change in roadway operating procedures will require firefighters to change the way they have been accustomed to working at accident scenes. As such, implementation of a standard operating guideline will require a systemic change clearly supported by data and research. Therefore, there is a clear linkage to the Executive Leadership module of the Executive Fire Officer Program, as systems change is addressed in Unit 3 of the course.

Finally, the establishment of a standard operating guideline for highway operations meets the United States Fire Administration's goal of reducing risk through prevention and planning. The researcher intends to reduce the risk of line of duty deaths and injury to Canton's firefighters by providing a guideline that will address first responder safety on the highway.

Literature Review

The literature review utilized the National Fire Academy's on-line Learning Resource Center to examine similar research on the topic of roadway safety. In addition, an internet search generated many articles, standard operating procedures and studies related to first responder safety on the highway. These secondary sources were utilized to provide context for the research questions and to help design the research approach.

For agencies that operate at a highway emergency scene, one of the greatest concerns should be minimizing the likelihood of a secondary accident. Most often, firefighters and police officers who are injured or killed on the accident scene are the victims of a passing vehicle either striking them directly or colliding with stationary emergency vehicles. The Federal Highway Administration defines secondary incidents as "unplanned incidents (starting at the time of detection) for which a response or intervention is taken, where a collision occurs either a) within the incident scene or b) within the queue. (Kristoff, 2015) It is within the incident scene that first responders need to be most concerned. One method of decreasing the likelihood of a secondary crash is to clear the incident as quickly as possible. The likelihood of a secondary crash increases by 2.8% for each minute the primary incident continues to be a hazard. (Kristoff, 2015)

In order to develop an effective procedure for operating on a highway, the causal factors of secondary accidents within the incident scene need to be identified. Essentially, why do motorists crash in to first responders? There appear to be several reasons. Lt. Colonel Jack

Hegarty of the Arizona Highway Patrol cites congestion as a significant safety issue that leads to traffic crashes. (Hegarty, 2011) He reports that crashes due to a previous traffic incident – secondary crashes – not only cause congestion and impact highway safety, they also have the potential to create a cycle resulting in exponential decreases in transportation efficiency and safety. (Hegarty, 2011) Motorists traveling in an unobstructed path at 65 miles per hour who suddenly need to decelerate at an accident scene, run the risk of causing a secondary crash with another vehicle or with first responders. Firefighters operating on the highway need to be aware that their presence exacerbates congestion and will increase the likelihood of a secondary accident.

Further, the use of warning lights has been cited by public safety experts as another factor that may lead to secondary accidents involving firefighters on the highway. Typically referred to by first responders as “moths to the light” syndrome, motorists can be drawn to or distracted by emergency warning lights. Emergency vehicle lighting and audible devices are often distracting and confusing to road users, especially at night. (Responder Safety, 2015) Other factors can be linked to secondary crashes such as road conditions and weather. Winter months provide news outlets with endless footage of vehicles sliding down icy highways causing a ripple effect of secondary crashes. The same holds true for firefighters struck and killed by motor vehicles. The CDC reports that road conditions can reduce a motorist’s ability to see and avoid fire fighters and apparatus. (National Institute for Occupational Safety and Health, 2001)

In one case study by NIOSH, on August 5, 1999, a firefighter died and a second firefighter and another person were severely injured when they were struck by a motor vehicle that lost control on a wet and busy interstate highway. Approximately 2 minutes after they arrived on scene and took a position at the rear of the rescue squad, another car collided with the back of the ladder truck. While attending to the injured driver, two firefighters and the injured

driver were struck by a third vehicle causing one firefighter to be fatally injured. (National Institute for Occupational Safety and Health, 2001) In this case, both weather (leading to poor roadway conditions) and congestion were contributing factors to the secondary accident.

Once it is understood why secondary crashes occur, fire departments can put in place procedures to increase the safety of firefighters working on the highway. One of the basic principals in creating safe work zones is apparatus positioning. The lane plus one blocking techniques is recommended when working on a multi-lane roadway. In this technique, apparatus is angled upstream from the accident to create a physical barrier between the crash scene and approaching traffic. (University of Extrication, 2015) At least one additional travel lane more than is already obstructed by the crashed vehicle(s) is blocked by responding apparatus with the front wheels of the blocking vehicle turned away from the downstream work area. (University of Extrication, 2015) The relatively innocuous action of turning the wheel away from the work area offers an extra level of protection if the apparatus is struck from behind, allowing the truck to move forward at the turning angle of the wheels rather than straight ahead into firefighters working in the accident area.

In addition to lane blocking, advanced warning to motorists of the emergency scene ahead can increase the safety of firefighters working on the highway. Much like private contractors working on the highway set up safe work zones, emergency responders can help oncoming motorists recognize the hazard and slow down. For example, additional emergency vehicles should be positioned 150 to 200 feet behind the shielding vehicle to act as an additional barrier between responders and the flow of traffic. (International Association of Firefighters, 2010)

Further, the Traffic Incident Management Handbook highlights the importance of a unified incident command procedure when working on the highway. Each agency that may be

involved in the incident should be clear about their defined roles: (Federal Highway Administration, 2015)

- Law enforcement: Secure accident scene, first responder, traffic control and crash investigation
- Fire: Rescue/extricates victims, mitigates and contains hazardous materials release, protects incident scene
- EMS; Provides treatment and transportation of victims, determines destination and transportation requirements for victims
- DOTs: Protects incident scene, provides traffic information, develops and operates alternative routes, implements traffic control strategies

In many cases law enforcement will be the first to arrive and should establish command. All agencies need to be familiar the Incident Command System as a component of the National Incident Management System. In the State of New Jersey, for example, the Highway Incident Traffic Safety Guideline identifies the senior trooper on the scene as the Incident Commander as the State Police have statutory authority over all incidents that occur on state highways, but in incidents involving multiple agencies, a Unified Command structure is recommended. (State of New Jersey, 2015)

Preplanning of traffic control and traffic diversion strategies for likely incident scenarios on the transportation network are important techniques for reducing the likelihood of secondary accidents because preplanning enables first responders to implement traffic safety plans more quickly. (NTIMC, 2015) Similarly, while fire departments have developed a myriad of life safety guidelines when operating on the fire ground, preplanning of target hazards allows those guidelines to be implemented quickly and efficiently. Multi-lane roadways are another type of

target hazard that fire departments need to preplan for as road characteristics and potential hazards may be different depending on the location of the crash.

There are many types of devices that can be utilized to control the flow of traffic approaching the highway emergency scene. NFPA 1500 recommends fluorescent and retro-reflective warning devices such as traffic cones, signs and illuminated warning devices such as highway flares be used to warn oncoming traffic of an emergency operation. (National Fire Protection Association, 2013) Proper implementation of these devices can assist drivers in recognizing the potential hazard ahead and increase the safety of first responders. The Manual of Uniform Traffic Control Devices (MUTCD) is perhaps the most comprehensive manual on establishing temporary traffic control (TTC) on the highway. All traffic control devices needed to set up temporary traffic controls at a traffic incident should be available so that they can be readily deployed for all major traffic incidents. The TTC should include the proper traffic diversions, tapered lane closures, and upstream warning devices to alert traffic approaching the queue and to encourage early diversion to an appropriate alternative route. (Federal Highway Administration, 2009)

When planning for the deployment of traffic control devices, the temporary traffic control (TTC) zone needs to be defined. From the direction of travel toward the accident scene the areas can be defined as follows: (Responder Safety, 2015)

- Advance Warning Area
- Transition (Taper) Area
- Buffer Space
- Protection Vehicle Area
- Work Space
- Termination Area

A combination of signs and cones are used from the Advanced Warning Area, along the outside of the work area and tapering off in the Termination Area to slow approaching traffic and channel vehicles safely around the work zone.

In addition to traffic devices, fire department personnel are required to don high visibility PPE while working on the highway. NFPA 1901, (2009 edition) requires one traffic vest for each seating position, with each vest to comply with ANSI/ISEA 207, Standard for High-Visibility Public Safety Vests, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front. (Stewart, Larry, 2015) 23 CFR 634: Use of High-Visibility Apparel When Working on Federal-Aid Highways allows for both ANSI/ISEA 107 or 207 vests. (Stewart, Larry, 2015)

Personal protective equipment in the form of turnout gear is not a substitute for high visibility vests. However, firefighters and other emergency responders while engaged in emergency operations that directly expose them to flame, fire, heat and/or hazardous materials may wear retro-reflective turnout gear that is specified and regulated by other organizations such as the National Fire Protection Organization. (Federal Highway Administration, 2009) The issue is that turnout gear does not provide enough reflectivity because typical turnout gear has only a series of reflective bands. Because the background material on turnout gear is non-reflective, firefighter visibility may be compromised, especially at night. In addition, fluorescent fabrics can only be effective when kept clean. The nature of fire ground operations results in fabrics being easily soiled, which quickly diminishes their daytime visibility qualities. (Stull & Stull, 2015)

In addition to deployable equipment and personal protective equipment, fire apparatus warning devices in the form of emergency lighting and markings can have a direct impact on

firefighter safety on highway. Apparatus “conspicuity”, or the ability of a vehicle to draw attention to its presence, for motorists approaching an accident scene on the highway can aid in the safe passage of vehicles around the emergency scene. There is evidence to suggest that amber lighting on the rear of fire apparatus can be very effective at warning motorists while reducing the “rubbernecking” that often occurs around emergency scenes. (Sullivan, Innovations in Apparatus Conspicuity, 2015) Amber lights are “boring” and to most people signal caution for construction or roadway hazards while red and blue flashing lights may signal more authority and may attract more attention.

Traditionally, many fire departments design the color scheme and striping for their fire apparatus, In 2009, NFPA 1901, Standard for Automotive Fire Apparatus, changed the way the fire service looked at the issue of conspicuity. NFPA 1901 recommended the following minimum amount and type of retro-reflective striping on fire apparatus: (Sullivan, Innovations in Apparatus Conspicuity, 2015)

- Fifty percent of the cab and body length (excluding pump panel) on each side with four inch wide striping
- Twenty-five percent of the front of the apparatus with four inch wide striping
- Fifty percent of rear facing vertical surfaces (excluding pump panels not covered by a door) in a forty-five degree down and away chevron pattern with alternating red and yellow/fluorescent yellow/fluorescent yellow-green fluorescent stripes.

Once fire departments have developed standard operating procedures for highway operations, procured the recommended safety equipment and designed the apparatus with conspicuity in mind, firefighters need to train on highway safety just as they would for safe structural firefighting practices. In his article *Protecting Firefighters at Roadway Incidents*, Jack Sullivan

recommends the following elements for each fire department Roadway Incident Safety Program:

(Sullivan, Protecting Firefighters at Roadway Incidents, 2015)

- Initial orientation for new recruits before they respond to any emergency
- Annual in-service training
- All training in line with standard operating procedures and national standards, rules, regulations and “best practices” (Sullivan, Protecting Firefighters at Roadway Incidents, 2015)

The Cumberland Valley Volunteer Fireman’s Association (CVVA) published a White Paper in 1999 that put forth a number of training recommendations for first responders operating on the highways. One in particular called for Incident Commanders, whether police or fire officers, should be better trained to appreciate the task of, hazards implicit in, and training needed to safely perform traffic direction and control. (Cumberland Valley Volunteer Firemen's Association, 2015) The early decisions of initial Incident Commander on the highway can impact the safety, either negatively or positively, of firefighters working on the highway.

The CVVA’s 1999 White Paper was a forerunner to today’s Traffic Incident Management (TIM) training. As outlined in Objective 1 of the National Unified Goal for Traffic Incident Management, TIM stakeholders will develop, through a multi-disciplinary consensus process, recommended practices to promote responder safety at traffic incident scenes through multi-disciplinary training. (NTIMC, 2015) Many states, including Massachusetts, offer regional TIM training to fire, police, transportation departments and towing companies to foster communication and partnerships between those agencies responding to highway incidents.

Procedures

This researcher determined that Action Research would be the most appropriate method to develop a standard operating guideline to improve the safety of Canton Firefighters operating on the highway. First, a situational analysis of the Canton Fire Department was conducted in August of 2015 to identify current practices and response procedures to the highway. The analysis was conducted by observing highway responses over a two-week period. A variety of blocking procedures were observed and no equipment recommended by the MUTCD was deployed. Following the situational analysis, a review of the Canton Fire Department's written Standard Operating Guidelines was conducted to identify any existing procedures being utilized for highway response. It was found that no written guidelines existed and fire department personnel were operating on the highway based on past practices or general industry knowledge. An internet search was then conducted to identify sample standard operating procedures for highway safety. Dozens of examples are available on line, in addition to a variety of templates that could be adapted for a department's use.

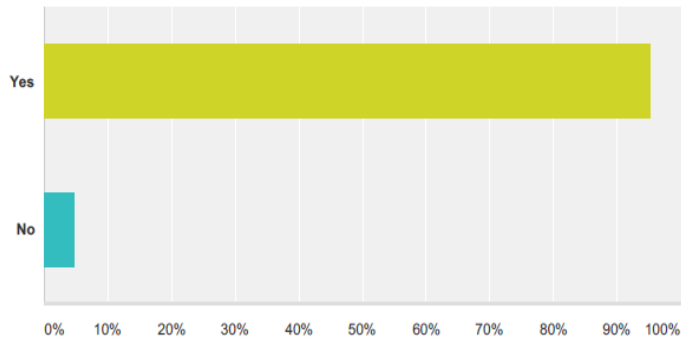
Next, research was conducted to identify relevant reports, standards, guidelines and laws that provide the framework for improving highway safety for first responders. Several important industry publications were identified including the Manual of Uniform Traffic Devices, the National Unified Goal for Traffic Incident Management and NFPA 1500 and 1901. In addition, an entire website dedicated to first responder safety on the highway was identified. The website, Firstrespondersafety.org, serves a clearinghouse for best practices and current research that impact highway safety.

Finally, on October 2, 2015, a questionnaire was distributed via Survey Monkey to the twenty-eight fire chiefs that comprise Norfolk County, Massachusetts. This group of fire chiefs was selected due to their geographical proximity to the Town of Canton and to the highways that

transect the towns in Norfolk County. Question number two showed that twenty of the twenty-one departments respond to highways in their community.

Q2 Does your department respond to a multi-lane roadway or highway

Answered: 21 Skipped: 0

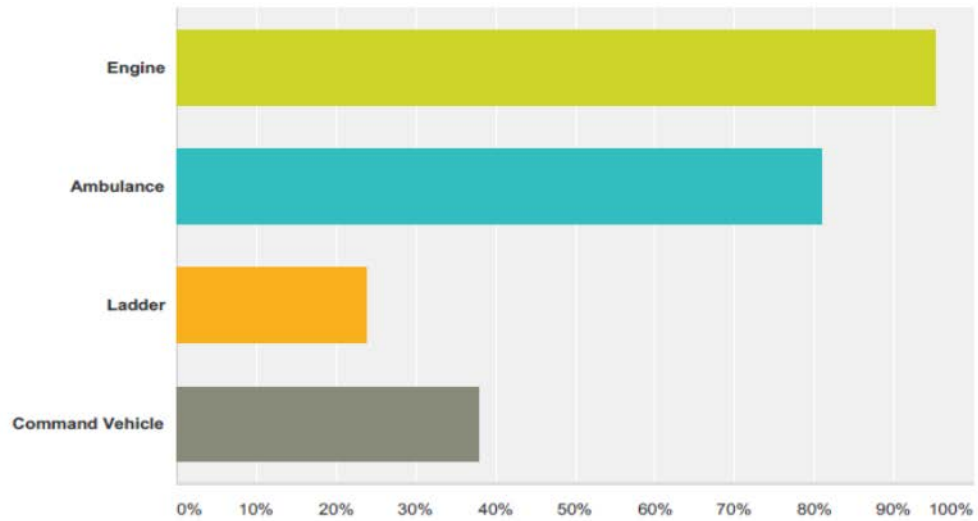


Answer Choices	Responses
Yes	95.24% 20
No	4.76% 1
Total	21

Also, twenty of the twenty-one respond to the highway with at least an engine and seventeen respond with ambulance. In addition, eight communities responded with a command vehicle and six sent the ladder truck.

Q3 What type of vehicle(s) does your department respond to the highway with MOST FREQUENTLY? (you can choose more than 1)

Answered: 21 Skipped: 0



Answer Choices	Responses
Engine	95.24% 20
Ambulance	80.95% 17
Ladder	23.81% 5
Command Vehicle	38.10% 8
Total Respondents: 21	

Further, twenty-six of the twenty-eight departments serve suburban communities outside but in proximity to the City of Boston. Many of those communities also provide emergency medical services to their towns. In addition to providing answers to the research questions, the questionnaire helped to determine how many of the Norfolk County fire departments respond to the highway and operate under a specific and written procedure. Twenty-one fire chiefs from Norfolk County responded to the survey or seventy-five percent (75%) of those surveyed.

The research has limitations. First, the situational analysis was conducted over a two-week period. Observations over a longer period of time and interviews with responding officers may have identified additional response procedures that could be discontinued or included in the

proposed standard operating guideline. Further, the sample size of the questionnaire recipients was relatively small. In addition, the fire chiefs who received the questionnaire are a relatively homogeneous group that utilizes similar apparatus and equipment. A more diverse sample which would include rural and urban departments may have provided additional detail that would be useful in developing a standard operating guideline for improving highway safety for first responders.

Results

Information gathered from the literature review, questionnaire and the examination of relevant codes, standards, laws and procedures were utilized in answering the research questions.

Question 1 - What are the factors that cause motorists to become involved in secondary accidents with first responders on the highway?

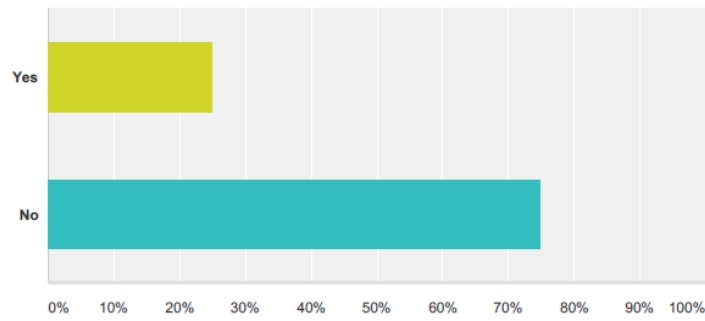
The research indicates that there are several factors that cause secondary accidents to occur on the nation's highways. In the report, *Responder Safety*, published by the National Traffic Incident Management Coalition (NTIMC), it was found that conditions can reduce a motorist's ability to see and avoid firefighters and apparatus. Some examples include weather, time of day, scene lighting (area lighting, and optical warning devices, traffic speed and volume), and road configuration (hills, curves and other obstructions that limit visibility. (Responder Safety, 2015)

Two of the questions included on the questionnaire to the Norfolk County Chiefs relate to the outcome of secondary accidents on the highway. Five of the twenty-one respondents (23%) indicated that their departments had experienced a "struck by" or secondary accident on the highway. Although the causal factors were not identified in the questionnaire, it is reasonable to

infer that some of the causes listed in the NTIMC report were a factor. None of the departments had experienced a fatality caused by a secondary accident on the highway.

Q4 Has your department ever been involved in a "struck by" or secondary accident while operating on a highway?

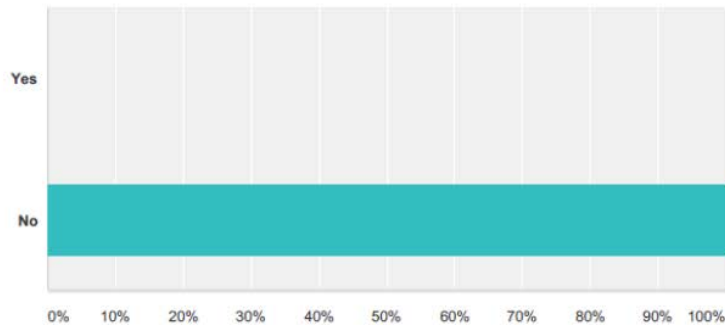
Answered: 20 Skipped: 1



Answer Choices	Responses	
Yes	25.00%	5
No	75.00%	15
Total		20

Q5 Has your department ever had a fatality caused by a "struck by" or secondary accident while operating on the highway?

Answered: 21 Skipped: 0



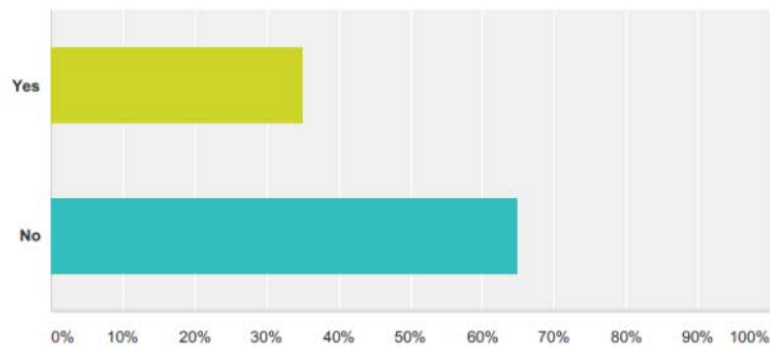
Answer Choices	Responses	
Yes	0.00%	0
No	100.00%	21
Total		21

Question 2 - What procedures are currently being utilized by other departments to keep first responders safe while operating on the highway?

First, question ten sought to identify whether or not fire departments in Norfolk County had a written standard operating procedures (SOP's) for safe highway operations. Thirteen respondents (65%) had no SOP's in place. Seven departments (35%) indicated that they had an SOP for highway operations.

Q10 Does your department have a written SOP for highway operations?

Answered: 20 Skipped: 1

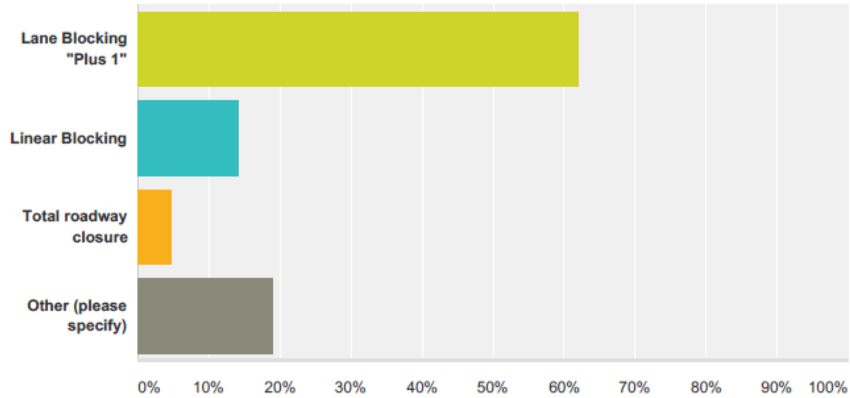


Answer Choices	Responses	
Yes	35.00%	7
No	65.00%	13
Total		20

Next, the questionnaire identified several techniques or procedures for safe highway operations. Thirteen departments (61%) utilized the lane plus one blocking model. Three respondents (14%) utilized the linear blocking model. Only one department indicated they implemented total roadway closure as a standard operating procedure. Additional responses included (a) all of the above based on conditions, (b) angle parking and (c) utilization of the State Trooper on scene.

Q8 What techniques does your department employ on the highway to ensure firefighter safety?

Answered: 21 Skipped: 0



Answer Choices	Responses
Lane Blocking "Plus 1"	61.90% 13
Linear Blocking	14.29% 3
Total roadway closure	4.76% 1
Other (please specify)	19.05% 4
Total	21

In the February 2014 FEMA report titled *Emergency Vehicle Safety Initiative*, emergency vehicle placement is addressed. It identifies three primary concerns for the first arriving vehicle operator: (Federal Highway Administration, 2015)

1. Park the vehicle in a manner that reduces the chance of the vehicle being struck by oncoming traffic.
2. Park the vehicle in a manner that shields emergency responders and the operational work area from being exposed to oncoming traffic.
3. Park the vehicle in a location that allows for effective deployment of equipment and resources to handle the incident.

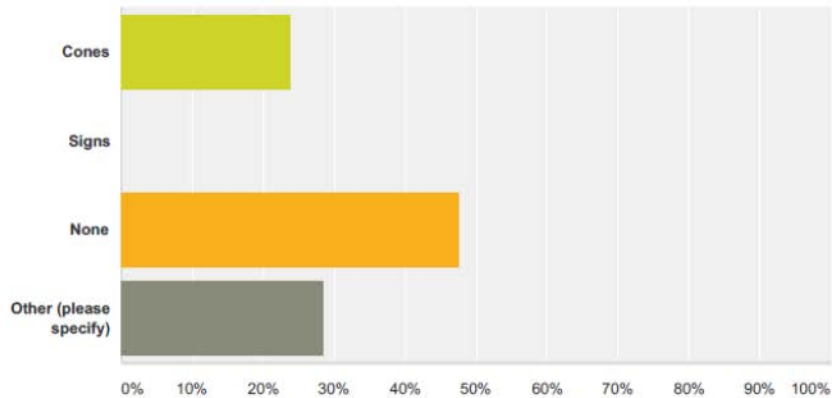
All three of these recommendations can be accomplished by the techniques identified in question 8 of the survey.

Question 3 - What equipment is being deployed on the highway to increase the visibility of first responders?

The questionnaire asked respondents two questions relative to equipment used to improve firefighter safety on the highway. Question seven showed that almost half of all departments (47%) deployed no safety devices on the highway. Five department utilized cones, not a single department deployed signage, three respondents referenced chevrons and lighting as a safety device and one department utilized road flares.

Q7 What type of safety devices does your department deploy on the highway?

Answered: 21 Skipped: 0



Answer Choices	Responses
Cones	23.81% 5
Signs	0.00% 0
None	47.62% 10
Other (please specify)	28.57% 6
Total	21

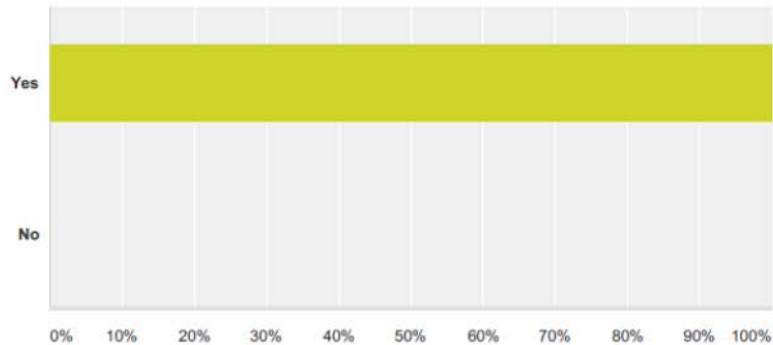
The 2009 edition of the Manual on Uniform Traffic Control Devices (MTTCD) defines a “traffic incident management area” as an area of a highway where temporary traffic controls are

installed as authorized by a public authority or the official having jurisdiction of the roadway, in response to a road user incident, natural disaster, hazardous material spill, or other unplanned incident. (Federal Highway Administration, 2009) It is a type of temporary traffic control zone (TTC) and extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where vehicles return to the original lane alignment and are clear of the incident. (Federal Highway Administration, 2009) The MUTCD provides detailed specifications on the types of devices, such as cones, signs and flares that can be deployed in a TTC.

In addition to devices, other equipment is being utilized by fire departments responding to the highway; specifically high visibility vests worn over turnout gear. Twenty one departments (100%) indicated that their firefighters are required to wear high visibility vests while operating on the highway.

Q6 Are your firefighters required to wear high visibility vests while operating on the highway?

Answered: 21 Skipped: 0



Answer Choices	Responses
Yes	100.00% 21
No	0.00% 0
Total	21

The FEMA *Vehicle Safety Initiative* report recommends that ANSI 207 compliant high-visibility vests be used at all times at crashes on the roadway. The only exception would be when

a firefighter is directly involved in firefighting (wearing an SCBA) or hazardous materials tactical activities (wearing chemical protective clothing). (Federal Highway Administration, 2015)

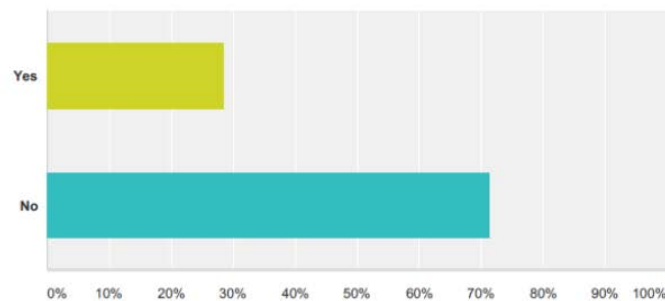
Question 4 - What training is available to increase firefighter safety on the highway?

In response to Congress’ directive to improve the efficiency and safety of the U.S. highway system, The Federal Highway Administration (FHWA) is offering the first national, multi-disciplinary traffic incident management (TIM) process and training program. (Federal Highway Administration, 2015) Using a multiple discipline perspective, first responders within States, regions and localities learn how to operate more efficiently and collectively. (Federal Highway Administration, 2015)

With TIMS training recognized as the standard for highway safety training in Massachusetts, the Norfolk County Chiefs were asked if they have provided this training to their respective departments. Fifteen of the twenty-one respondents (71%) had not yet provided TIMS training.

Q9 Have you provided TIMS (Traffic Incident Management Systems) training to your department?

Answered: 21 Skipped: 0



Answer Choices	Responses	
Yes	28.57%	6
No	71.43%	15
Total		21

In Massachusetts, the Department of Transportation sponsors multi-disciplinary TIM training for law enforcement, fire and EMS personnel in addition to public works, transportation and tow company employees. The training is free and Massachusetts has approved the course for continuation education credits through the Office of Emergency Medical Services. Canton recently hosted a TIM training program.

Discussion

Highway safety for first responders has evolved dramatically since Vincent Dunn's 1992 book *Safety and Survival on the Fireground* in which he cautions, "He (firefighters) must always face oncoming traffic and be prepared to jump out of the way at a moment's notice". (Dunn, 1992) There are a multitude of templates for standard operating guidelines that will help increase the safety of firefighters and first responders operating on the highway. Lane plus one blocking, linear blocking, conspicuity of fire apparatus and high visibility PPE are the new standard in roadway survival. Dunn's caution is not without merit however, as he recognized that situational awareness was a vital component of keeping firefighters safe on the roadway. Although the fire service has placed greater emphasis on technique, training and equipment, understanding and pre-planning for the hazard of secondary accidents is still an important component in safe highway operations.

In March of 2009, Massachusetts passed what's commonly referred to as the "Move Over" law. General Law 89, Section 7C mandates that when a motorist approaches an emergency vehicle with flashing lights the operator shall proceed with due caution, reduce speed and yield the right of way by making a lane change away from the stationary emergency vehicle. (Massachusetts, 2015) The statute, in response emergency responders and tow truck operators being struck and in some instances killed, raised public awareness of the hazards present on the roadways. When combined with the volume of safety information available in documents such

as the Emergency Vehicle Safety Initiative (FEMA) and the Manual on Uniform Traffic Control Devices, our ability to keep our people safe on the highway has never been greater.

The results of this study, however, indicate that not all fire departments in Norfolk County, Massachusetts have addressed firefighter safety on the highways even though the resources available to do so. While twenty out of the twenty-one departments surveyed respond to the highway, thirteen departments (65%) do not have any standard operating guideline for responding safely to the highway – the Canton Fire Department included. It is possible, that because none of departments surveyed had experienced a highway fatality, the issue of highway safety was not viewed as a priority when developing standard operating guidelines. In addition, because struck by fatalities statistically account for a small percentage of firefighter deaths, fire departments may not view highway safety as a pressing safety concern. However, as FEMA's report points out, while vehicle-related events tend to be lower in frequency, when they do occur, they are serious events. (United States Fire Administration, 2014)

Further, it is interesting to note that more than half of the respondents to the questionnaire utilized many of the recommendations that can be found in the MUTCD (Chapter 61) in setting up Temporary Traffic Control zones (TTC) utilizing blocking techniques and deploying equipment like cones and flares. All twenty-one departments required high visibility vests. While fire departments in Norfolk County, including Canton, are using elements of a standard operating guideline for highway safety, as mentioned earlier, more than half do not have an official SOG for highway safety. This safety concern can be addressed by developing a policy utilizing a number of resources such as the International Association of Fire Chief's Guide to Model Policies and Procedures for Emergency Vehicle Safety available on their website.

Recommendations

This research has identified the need for a formal standard operating guideline for highway operations in the Canton Fire Department. In developing this guideline, model procedures should be researched and adapted for the needs of the specific department. The guideline should utilize recommendations from various sources such as the MUTCD, NFPA 1500 and FEMA's Emergency Vehicle Safety Initiative among the many other resources available.

Next, the Canton Fire Department should provide training to its members on two fronts. First, once the standard operating guideline (SOG) has been adopted, each group will familiarize themselves with the SOG and meet with the Captain of Training and Safety to review the criteria for setting up a TTC and the equipment necessary to do so. Also, the Deputy Chief of Operations will verify that an adequate amount of cones and proper signage are available for each vehicle that responds to the highway. Next, the Captain of Training and Safety will verify that all members have an ANSI 107 compliant highway safety garment. In addition, each fire officer who may be responsible for supervision of firefighters on the highway, shall be enrolled in Traffic Incident Management training sponsored by the Massachusetts Department of Transportation. Finally, when designing new fire apparatus, conspicuity should be an issue that is addressed in the new vehicle specifications. Some of the proactive design recommendations in NFPA 1901 like emergency lights mounted up high on the back of the apparatus and amber lighting on the rear of the apparatus may assist motorists in identifying the location of emergency crews.

In summary, for readers who wish to address highway safety in their organizations and replicate some or all of this research, this researcher suggests a thorough situational analysis be conducted within the department. This can be accomplished by observation of actual highway

responses and the techniques and equipment currently being utilized. In addition, a comparison of current procedures to model polices available on line and by neighboring departments should be undertaken. Finally, an internet search of best practices for improving firefighter safety on the highway will yield a multitude of reports, codes, standards and articles that can be utilized in developing a department policy.

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Appendix A

Fire Departments Surveyed

1. Avon Fire Department
2. Bellingham Fire Department
3. Canton Fire Department
4. Cohasset Fire Department
5. Dedham Fire Department
6. Easton Fire and Rescue Department
7. Foxoboro Fire Department
8. Franklin Fire Department
9. Holbrook Fire Department
10. Medway Fire Department
11. Milton fire Department
12. Needham Fire Department
13. Norwood Fire Department
14. Plainville Fire Department
15. Sharon Fire Department
16. Walpole Fire Department
17. Wellesley Fire Department
18. Westwood Fire Department
19. Weymouth Fire Department
20. Wrentham Fire Department
21. Not Identified

Appendix B

Highway Safety Questionnaire

1. What is the name of your department

2. Does your department respond to a multi-lane roadway or highway

Yes

No

3. What type of vehicle(s) does your department respond to the highway with MOST FREQUENTLY? (you can choose more than 1)

Engine

Ambulance

Ladder

Command Vehicle

4. Has your department ever been involved in a "struck by" or secondary accident while operating on a highway?

Yes

No

5. Has your department ever had a fatality caused by a "struck by" or secondary accident while operating on the highway?

Yes

No

6. Are your firefighters required to wear high visibility vests while operating on the highway?

Yes

No

7. What type of safety devices does your department deploy on the highway?

- Cones
- Signs
- None
- Other (please specify)

8. What techniques does your department employ on the highway to ensure firefighter safety?

- Lane Blocking "Plus 1"
- Linear Blocking
- Total roadway closure
- Other (please specify)

9. Have you provided TIMS (Traffic Incident Management Systems) training to your department?


- Yes
- No

10. Does your department have a written SOP for highway operations?

- Yes
- No

Appendix C

Canton Fire Department Standard Operating Guideline – EM OPS 12 – Highway Operations

	<p>Canton Fire Department Standard Operating Guideline</p>		
<p>Effective Date: 10/26/15</p>	<p>SOG Category & Identification Number: EM-OPS-12</p>	<p>Revision: 10/26/15</p>	
<p>SOG Title Highway Operations</p>			
<p>Approved by: Chief Charles Doody</p>	<p>Re-evaluation Date: 01/01/2017</p>	<p>Number of Pages: 5</p>	

Policy

It shall be the policy of the Canton Fire Department to initially position apparatus and other emergency vehicles at an incident on any street, road, highway or expressway in a manner that best protects the incident scene while at the same time providing for traffic movement past the incident scene as much as reasonably possible. Such positioning shall afford protection to fire department personnel, law enforcement officers, tow service operators, other emergency personnel while working in or near moving traffic.

Safety

All personnel should understand and appreciate the high risk that personnel are exposed to when operating in or near moving vehicle traffic. Responders should always operate within a protected environment at any roadway incident.

Always look before opening doors and stepping out of apparatus or emergency vehicle into any moving traffic areas. When walking around fire apparatus or emergency vehicle, be alert to your proximity to moving traffic. Maintain a 'reduced profile' when moving through any area where a minimum 'buffer zone' condition exists.

Nighttime incidents and inclement weather conditions are particularly hazardous. Visibility is reduced and driver reaction time to hazards in the roadway is slowed. Be aware of the negative effects of warning and scene lights to vision of approaching traffic. Adjust operations accordingly.

Terminology

Advance Warning - notification procedures that advise approaching motorists to transition from normal driving status to that required by the temporary emergency traffic control measures ahead of them.

Block - positioning a fire department apparatus on an angle to the lanes of traffic creating a physical barrier between upstream traffic and the work area. Includes 'block to the right' or 'block to the left'.

Buffer Zone - the distance or space between personnel and vehicles in the protected work zone and nearby moving traffic.

Downstream - the direction that traffic is moving as it travels away from the incident scene.

Safety Officer - a fire department member assigned to monitor or direct approaching traffic and activate an emergency signal if the actions of a motorist do not conform to established traffic control measures in place at the highway scene

Linear - positioning a fire department apparatus parallel to or within a travel lane or shoulder of a roadway. Linear positioning only creates a physical barrier within that lane or shoulder of the roadway.

Taper - the action of merging lanes of moving traffic into fewer moving lanes.

Temporary Traffic Control Zone (TTC) - the physical area of a roadway within which emergency personnel perform their fire, EMS and rescue tasks at a vehicle-related incident.

Transition Zone - the lanes of a roadway within which approaching motorists change their speed and position to comply with the traffic control measures established at an incident scene.

Upstream - the direction that traffic is traveling from as the vehicles approach the incident scene.

Apparatus Placement

The following are guidelines for Safe Positioning of apparatus and emergency vehicles when the crash-damaged vehicle cannot be moved out of the travel lanes of the roadway and crews must work the incident at the location found upon arrival.

Position first-arriving apparatus to protect the scene, patients, and emergency personnel.

Initial apparatus placement should create a TTC Zone protected from traffic approaching in at least one direction. Intersections or where the incident may be near the middle lanes of a multi-lane roadway require two or more sides of the incident to be protected.

Angle apparatus on the roadway with a "block to the left" or a "block to the right" to create a physical barrier between the crash scene and approaching traffic. **Block at least one additional traffic lane more than that already obstructed by the crashed vehicle(s); obstructed Lane + 1 strategy.** Shoulder of the highway can be counted as a lane.

The front wheels of blocking vehicles should be turned **away** from the downstream work area

For first arriving fire department units where a charged hose line may be needed, block so that the pump panel is downstream, on the opposite side of on-coming traffic. This will protect the pump operator.

Ambulances should be positioned within the protected work area and have their rear patient loading area angled away from the nearest lanes of moving traffic

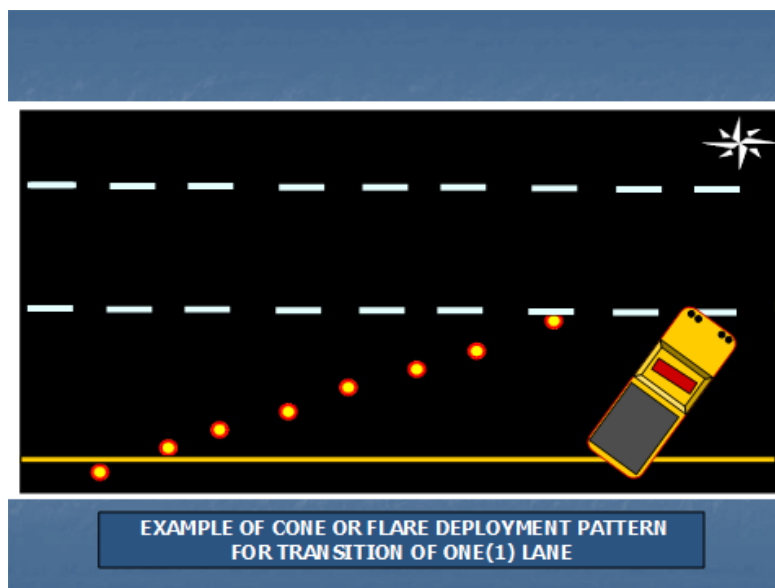
Additional responder vehicles and personnel working the incident should either support advanced warning efforts or be positioned within the protected area created by the blocking apparatus.

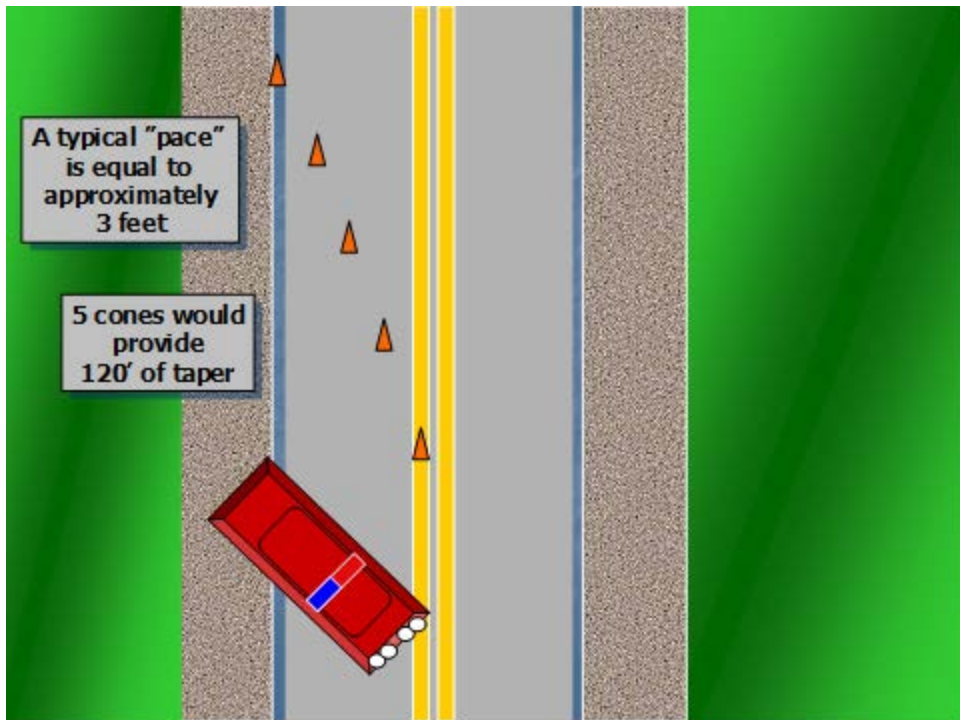
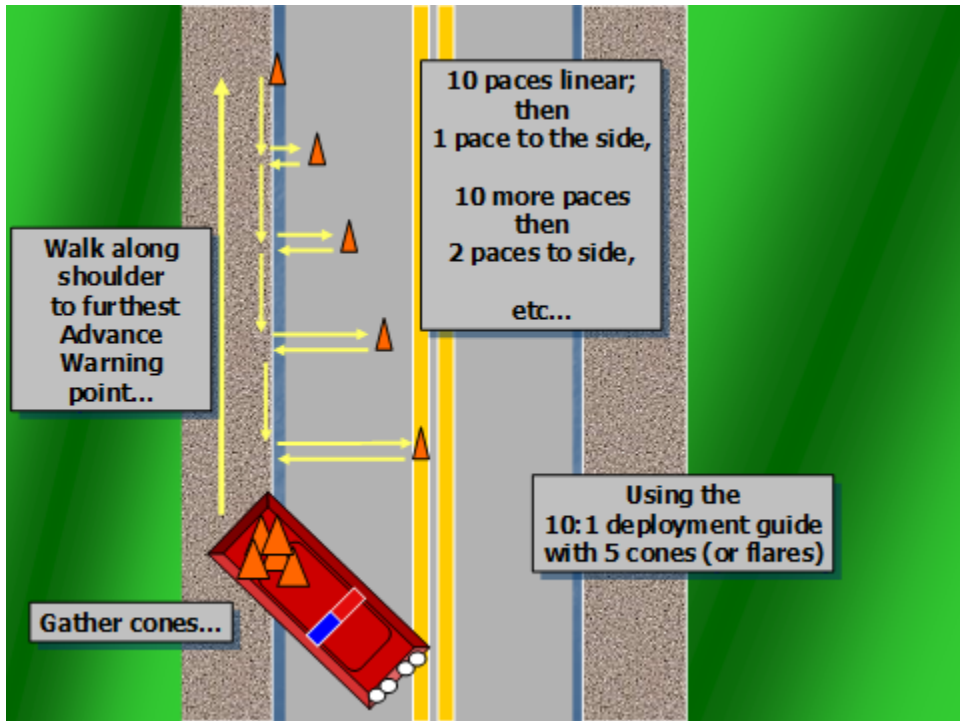
The Officer shall stage unneeded emergency vehicles off the roadway, place them in a Staging area on the downstream side of the incident, or return these units to service.

Lanes of traffic shall be identified numerically as “Lane 1”, “Lane 2”, etc., beginning from the left to the right when considered from the motorist’s point of view driving in those lanes.

Traffic cones alongside should be gathered and made ready to be deployed beginning at **150 feet** upstream of the apparatus to establish the Transition Zone and increase the advance warning for approaching motorists. Personnel shall place cones as well as shall retrieve cones while facing oncoming traffic. A Buddy system is recommended for deployment and retrieval.

The Transition Zone should be put in place using traffic cones deployed at intervals of **no greater than 30’ apart (10 paces)** upstream of the blocking apparatus. The furthest traffic cone that begins the taper and closing of a travel lane should be positioned upstream along the edge or shoulder of the roadway.





Highway Command

The first in officer shall establish highway command when additional resources (other than Canton) are responding to the scene.

The Command officer should establish a liaison with supervising law enforcement official as soon as possible. This Unified Command team will jointly coordinate activities and determine how to most efficiently resolve the extended duration incident and clear the obstructed travel lanes in as safe and efficient manner as practical.

The termination of the incident must be managed with the same aggressiveness as initial actions. Crews, apparatus and equipment must be removed from the highway promptly, to reduce exposure to moving traffic and minimize traffic congestion.

For extended duration incidents (greater than 60 minutes) such as hazardous materials situations, Command should request appropriate traffic incident management personnel and resources via the supervising law enforcement official on scene .

High Visibility Garments

All members shall be issued and ANSI 107 Class 2 or ANSI 207 compliant high visibility garment.

All members shall wear an ANSI 107 Class 2 or ANSI 207 compliant high visibility garment anytime they are performing duties on a public roadway open to traffic or other vehicles.

Members shall NOT wear the high visibility garment when they have a reasonable expectation of exposure to fire, high heat or hazardous materials. Members shall wear PPE appropriate for the expected exposure. If the member needs to don SCBA, the high visibility garment is NOT to be worn.

When the reasonable expectation of exposure to fire, high heat or hazardous materials has ended the member must don the high visibility garment. Members in the "Cold Zone" of a roadway incident shall don the high visibility garment.

High visibility shall be cleaned when dirty and damaged high visibility garments shall be documented and reported to the Captain of Training and Safety.