



Report Title		Report Date: 2003
Effectiveness of Extra Law Enforcement in Construction and Maintenance Zones		
Principle Investigator Name Kamyab, Ali Affiliation Western Transportation Institute Address c/o Caltrans, 1227 O Street, 5th Floor Sacramento, CA 95814-5840 Phone 916-657-4062 Fax Email ali_Kamyab@dot.ca.gov		Vendor Name and Address N/A
Author(s) and Affiliation(s) Ali Kamyab, Tom McDonald, Brandon Storm, and Mark Anderson-Wilk (Iowa State Univ)		
Supplemental Funding Agency Name and Address (if applicable)		
Supplemental Notes		
Abstract		

EFFECTIVENESS OF EXTRA ENFORCEMENT IN CONSTRUCTION AND MAINTENANCE WORK ZONES



Sponsored by
the Midwest States Smart Work Zone Deployment Initiative
Mid-America Transportation Center
University of Nebraska-Lincoln



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Technical Report Documentation Page

1. Report No. MwSWZDI Year 4 Technology Evaluation #1	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Effectiveness of Extra Enforcement in Construction and Maintenance Work Zones		5. Report Date May 2003	
		6. Performing Organization Code	
7. Author(s) Ali Kamyab, Tom McDonald, Brandon Storm, and Mark Anderson-Wilk		8. Performing Organization Report No.	
9. Performing Organization Name and Address Center for Transportation Research and Education Iowa State University 2901 South Loop Drive, Suite 3100 Ames, IA 50010-8634		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No.	
12. Sponsoring Organization Name and Address Midwest States Smart Work Zone Deployment Initiative Mid-America Transportation Center University of Nebraska-Lincoln W333.2 Nebraska Hall Lincoln, NE 68588-0530		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract As traffic-related work zone crashes continue to increase across the nation, safety of road users and workers has become a top priority for transportation agencies. Since inattention and irresponsible behavior by drivers are surmised to contribute to the frequency of work zone crashes, a program featuring extraordinary presence of and enforcement by law officers has been implemented in many states to address this concern. A literature search of such programs and related research was conducted. While the overall benefits of these activities have been found positive, much of the evidence has been anecdotal. To assess the scope of extra work zone enforcement programs, a survey was developed and distributed to state departments of transportation across the nation. This survey sought information regarding these efforts such as criteria for selection of target work zones, methods of enforcement operations, and beneficial results. A special survey was also designed and distributed to enforcement agencies in Iowa and other selected states. In addition to the surveys, personal contacts and office visits were conducted by the research team staff. The study found that use of extra enforcement in work zones is a common practice in many states and these activities appear to be increasing. Current literature, survey responses, and interviews have all indicated a prevalent opinion for the benefits of increased law enforcement presence and activity in work zones. Very few comments offered conclusions of negative impacts, such as additional congestion, from these efforts. However, the beneficial effects of focused enforcement have not been intensively quantified. In addition, procedures for the use of law officers in work zones are quite inconsistent across the nation, as is the general implementation of specific legislation addressing work zone traffic violations. Similar variation can be found in funding levels and sources for enforcement activities in work zones among the states. Training of law officers prior to work zone duty does not appear to be commonly required, though the value of focused training is being recognized in some states. As crashes and deaths continue to rise annually in our nation's work zones, it is imperative that demonstrated beneficial programs such as the expanded use of law officers in these locations be continued, refined, and expanded. Future study is needed to supplement the knowledge base and provide guidance to agencies when considering the use of law enforcement to calm traffic, ensure compliance with traffic laws, and thus provide for safer work zones.			
17. Key Words construction and maintenance work zone, extra enforcement		18. Distribution Statement No restrictions.	
19. Security Classification (of this report) Unclassified.	20. Security Classification (of this page) Unclassified.	21. No. of Pages 108	22. Price N/A

Effectiveness of Extra Enforcement in Construction and Maintenance Work Zones

Principal Investigator

Ali Kamyab, Former Research Scientist
Center for Transportation Research and Education, Iowa State University

Co-Principal Investigator

Tom McDonald, Safety Circuit Rider
Center for Transportation Research and Education, Iowa State University

Research Assistant

Brandon Storm
Center for Transportation Research and Education, Iowa State University

Editor

Mark Anderson-Wilk
Center for Transportation Research and Education, Iowa State University

Authors

Tom McDonald, Brandon Storm, and Mark Anderson-Wilk

Preparation of this report was financed in part through funds provided by the Midwest States Smart Work Zone Deployment Initiative, a pooled-fund study administered at the Mid-America Transportation Center, University of Nebraska-Lincoln.

Center for Transportation Research and Education

Iowa State University

2901 South Loop Drive, Suite 3100

Ames, IA 50010-8634

Phone: 515-294-8103

Fax: 515-294-0467

www.ctre.iastate.edu

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ACKNOWLEDGMENTS

The authors would like to thank the Midwest States Smart Work Zone Deployment Initiative for sponsoring this research.

The Iowa Department of Transportation has used extra law enforcement in selected work zones for several years. Iowa Department of Transportation staff members with this knowledge and experience rendered most valuable guidance and advice throughout the project.

EXECUTIVE SUMMARY

The incidence of traffic crashes with resultant deaths and injuries has continued to increase in our nation's work zones over the past several years. States have developed and implemented several strategies to address this issue; one of the most successful has been use of extra law enforcement activities to calm traffic and ensure compliance with traffic regulations. However, these efforts have not been uniform in application or emphasis. This study investigates the effects of extraordinary enforcement in work zones and offers recommendations for effective and more uniform utilization.

A review of literature found numerous studies relating to extra enforcement in work zones and identified several existing programs in states that utilize this potential safety benefit extensively. Topics of interest include functions, impacts, and guidelines for use of additional enforcement, new and emerging technology, funding aspects, supportive legislation, and opinions regarding benefits. In addition, ongoing programs in several states offer excellent examples of good practice. These programs include criteria for selection of appropriate projects and situations for extra enforcement, deployment and use of officers, specialized enforcement techniques, focused training for participating officers, and beneficial results.

To augment the information found in existing literature, surveys were developed and distributed to all states and several turnpike authorities. In consideration of unique backgrounds and experience, special surveys were distributed to selected law enforcement agencies. All survey distribution was made electronically. Survey responses from the states indicated extra enforcement selection to be primarily based on traffic volumes and class of roadway, with long-term work zones most commonly addressed. Funding sources vary but most frequent are construction funds from either or both federal and state origins. Volunteer, off-duty officers from state agencies using marked vehicles are more generally used in extra enforcement efforts. Only a few states indicated that special training is required for officers prior to work zone duty. Officers are commonly deployed both day and night and in a variety of locations within and in advance of actual work activities. The states' survey responses stated an overwhelming opinion that extra enforcement has benefits in both lowering speeds and improving safety in work zones.

The law agency survey responses offered similar results. Officers mostly serve on a volunteer basis, both on and off regular duty. Some training is offered, but it is not extensive nor specific for work zone activity. Law agency opinion is that extra enforcement does result in lower speeds and thus safer work zones.

In addition to surveys, personal interviews of engineering and law enforcement professionals added details for actual applications of extra enforcement efforts. Officer selection, deployment, reimbursement procedures, and opinions of benefits were discussed in these conversations.

While opinions and testimony for the valuable impacts of extra enforcement efforts are common, few studies actually document those benefits. Some research has shown speed

reductions with various law enforcement efforts. A review of crash history in consecutive years with and without extra enforcement showed a significant reduction in crashes when special enforcement efforts were utilized.

The study concluded that extra enforcement in work zones has become a quite common practice in the states. However, a great deal of variation in practices and procedures exists. Non-uniform application of work zone enforcement legislation and use of formalized policies and interagency agreements were found. Source and type of funding used for these services are also quite variable, and requirements for specialized officer training is not common.

Need for additional research was identified in several areas. Definitive guidelines for project selection, officer deployment, and training could be developed. Guidance for cooperative agreements between transportation and law agencies could be devised through further research. Benefits of various extra enforcement strategies, such as higher incidence of citations and increased fines, could be better identified through focused study. A detailed analysis relating speed reduction in work zones to crash history would also be valuable.

Recommendations based on study findings include the following:

- Provide predictable funding sources and levels.
- Negotiate cooperative agreement between agencies and adopt formalized policies describing extra enforcement activities.
- Develop and implement focused training for officers.
- Establish individual points of contact in each agency.
- Compile and maintain detailed records of program activities.
- Prepare and publish an annual report describing extra enforcement activities.

Extra enforcement activities in work zones has proven beneficial in reducing speeds, ensuring compliance with traffic regulations, and improving safety for workers and motorists. Additional study resulting in more uniform practices may expand the utilization of this successful strategy.

1. INTRODUCTION

Background

As traffic-related work zone crashes continue to increase across the nation, safety of road users and workers has become a top priority for transportation agencies. Numerous innovations in temporary traffic control materials and techniques have been developed and deployed in recent years. Since inattention and irresponsible behavior by drivers are surmised to contribute to the frequency of work zone crashes, a program featuring extraordinary presence of and enforcement by law officers has been implemented in many states to address this concern. While the overall benefits of these activities have been found positive, much of the evidence has been anecdotal. This study examines extra enforcement programs implemented nationally to address safety concerns in work zones and identifies data that quantify beneficial results.

Project Overview

A review of literature identified several studies and programs relating to extra enforcement activities in work zones, and these are described in detail in Chapter 2.

To assess the scope of extra work zone enforcement programs, a survey was developed and distributed to state departments of transportation across the nation. This survey sought information regarding these efforts such as criteria for selection of target work zones, methods of enforcement operations, and beneficial results. To determine the unique insight from law officers, a special survey was designed and distributed to enforcement agencies in Iowa and other selected states. A summary of responses to both surveys is included in Chapter 3. Samples of the survey forms can be found in the appendix.

In addition to surveys, personal contacts and office visits were conducted by the research team staff. Several interesting details were related in these discussions and a synopsis is included with the survey responses. A full listing of contacts is contained in the appendix.

Many benefits of extra enforcement are found; these are described in Chapter 3. In Chapter 4, study conclusions and limitations are presented and recommendations for effective utilization are proposed.

2. LITERATURE REVIEW

Introduction

Controlling vehicle speeds through work zones is accepted as an important factor in improving the safety of workers and motorists. A number of techniques are currently used by transportation agencies throughout the country to control speeds and reduce speed variation in work zones. Increasing work zone speed enforcement is a common strategy taken by states. A previous study conducted by the Center for Transportation Research and Education (CTRE) concluded that law enforcement is one the most effective management techniques with a very positive impact in reducing work zone speeds (1). A 1998 Federal Highway Administration (FHWA) report stated that the most effective way of controlling speeds in work zones is to have a staffed police car with flashing lights at the beginning of the work zone (2). That document also lists several contacts for more information about various enforcement techniques. This chapter examines states' existing policies and practices for conducting focused police enforcement in work zones.

Work Zone Law Enforcement Functions

Police officers can be utilized in work zones in many different applications, such as the following (3):

- keeping travel lanes free of illegally parked or stalled vehicles on detour routes and major traffic arteries by arranging for removal
- controlling illegal turning movements that might restrict capacity at intersections
- directing traffic in congested situations
- providing advance warning of heavily congested or stopped traffic in advance of a problem area, such as a lane closure
- assisting in traffic control for special construction events, such as bridge beam erection, changes in traffic patterns, and blasting
- observing and reporting traffic problems on state highways or detour routes to the appropriate engineering staff
- enforcing speed and any other restrictions in or near the work zone area
- aiding in traffic control during the daily signing setup and takedown activities
- preventing intrusions into closed lanes, exits, and so forth

Another possible use for police officers is assisting or supplementing flaggers to provide a more authoritative appeal to motorists.

The National Cooperative Highway Research Program (NCHRP) Report 476 (3) lists operational requirements to help fulfill these functions for night work, as follows.

- When a lane closure or full road closure is being set up on high-speed highways, police should be stationed upstream with flashing lights operating.

- After a lane closure has been implemented and work is underway, patrol cars should normally be stationed upstream of the work area, with flashing lights in operation.
- Patrol cars can be used to temporarily stop traffic or to create a rolling roadblock to provide full access to the roadway when installing lane and/or road closures and to shift traffic from one side of the road to the other.
- To maintain credibility of enforcement efforts, a second patrol car should occasionally be stationed downstream from the work area to issue citations for speeding or other violations.
- Patrol cars should operate radar to activate detectors on vehicles approaching the work zone.
- Patrol cars should assist with clearing crashes or incidents such as vehicle breakdowns.
- Patrol cars should assist with controlling traffic at potential problem locations, such as ramp closures, and other possible intrusion locations.

Impact of Extra Enforcement in Work Zones

Police presence and enforcement efforts generally involve the use of law officers in two strategies: stationary and mobile. An officer stationed at a specific location significantly increases speed limit compliance in that immediate area (4). A circulating police vehicle can cover a larger area but may be less effective at speed reduction.

Richards, Wunderlich, and Dudek (1985) examined the effectiveness of focused law enforcement using stationary and mobile applications in six work zones on rural and urban highways in Texas (5). The study indicated that a stationary patrol car reduced mean speeds by 5–12 mph (6 to 22 percent). A circulating patrol car was found to reduce speeds by only 2–3 mph (3 to 5 percent), indicating a lessened effectiveness compared to a stationary approach.

McCoy and Bonneson (1993) conducted a study of law enforcement in a work zone featuring a single-lane closure on an urban multilane street in Sioux Falls, South Dakota (6). An officer in a squad car was parked just downstream from a “ROAD CONSTRUCTION AHEAD” sign with lights flashing and radar active. The police vehicle in this experiment remained stationary and did not attempt to stop speeding motorists. Only free-flowing vehicles were examined in this study, defined as those with more than four seconds of headway. Other motorists were considered to be unable to proceed at a desired speed because of traffic interference. The study concluded that average traffic speeds at the beginning of the work zone were lowered from 30 to 25 mph, although even these average speeds were still above a posted 20-mph advisory speed limitation.

Noel et al. (1988) conducted a study on a six-lane freeway in suburban Wilmington, Delaware, to analyze the effects of several work zone speed reduction techniques (7). Four applications were utilized: (a) standard flagging techniques as described in the *Manual on Uniform Traffic Control Devices* (MUTCD), (b) innovative flagging, using

standard techniques plus pointing at a speed limit sign, (c) stationary police vehicle with flashing lights and active radar, and (d) unformed officer on foot signaling drivers to slow. Work zones featuring both single- and two-lane closures were studied as well as short-term (less than three days) and long-term (greater than 10 days) exposures. Two points of analysis were considered: beginning of taper and adjacent to work area. For the latter location with short-term exposure, the study found both police radar and officer on foot more effective than either flagging methods, with reductions of 4.0 and 3.5 mph, respectively, observed. Standard flagging actually resulted in a speed increase of 2.6 mph at the work site. For short-term two-lane closures, all four study methods found very similar results in slowing traffic. For long-term exposures (more than 10 days) with a single-lane closure, police radar was most effective with an observed speed reduction of 8.4 mph at the work site, followed by officer on foot with a reduction of 3.3 mph. Neither standard flagging method was found effective. For two-lane closures with long-term exposures, all treatments were observed to be effective, but police radar again was better with a speed reduction of 6.4 mph. The study concluded that law enforcement methods demonstrated strong long-term benefits in speed reduction; however, drivers in that area were familiar with a high level of police patrols as standard practice and thus reacted positively with police presence. Also, the improved results with two-lane closures could have been affected by a natural slowdown reaction by drivers when three lanes are constricted to one.

Benekohal, Resende, and Orloski (1992) evaluated the impact of the presence, then absence of marked police cars on vehicle speeds in rural interstate work zones in Illinois (8). The first part of the study measured average traffic speeds while a marked police car circulated through the work zone for four hours. The second component assessed whether a lasting impact on speeds would occur after the patrol car left at the end of this period. The study found that mean speeds of both cars and trucks in the work zone were reduced by about 4 and 5 mph, respectively, while a police car was circulating through the area. Cars and trucks exceeding the posted speed limit through the work zone were reduced by 14 and 32 percent, respectively. However, one hour after the police car left the work zone, the mean speed of cars and trucks increased by about 2.5 and 0.5 mph, respectively. This study concluded that, at least for trucks, a lasting speed reduction could be obtained by periodically assigning mobile police cars to work zones.

The Minnesota DOT examined the effectiveness of police enforcement in work zones at three different sites during 1999: a rural interstate, an urban freeway, and a metro location (9). Using a laser gun, speed data were collected with and without enforcement vehicle presence. The patrol car was located approximately 500–600 feet upstream of the work zones, with lights and flashers activated. The posted speed limit on the four-lane divided interstate was 70 mph; this was reduced to 40 mph in the work zone area during construction. The study found that the 85th percentile speed was reduced from 51 to 43 mph when a police vehicle was parked upstream of the work zone. Similarly, for the urban freeway with a posted speed limit of 55 mph and for the metro location with a posted speed limit of 50 mph, the 85th percentile speeds were reduced from 66 to 58 mph and from 58 to 47 mph, respectively. The study confirmed that the presence of law enforcement results in considerably improved compliance with posted speed limits.

The lasting effects of police presence were evaluated in a recently increased speed zone (65 to 70 mph) in Michigan on Interstate 96 during 1996 (10). The study indicated an average speed reduction of 5.5 mph for vehicles approaching a parked police car. Upon passing the police car, however, drivers tended to return to original speeds or higher. The study reported no discernible changes in speeds one, two, and three hours following police presence. The study concluded that due to limited resources of law agencies, this speed reduction strategy might be less effective than other options.

During the summer of 1993, a study in Iowa's Scott County was undertaken to assess the impact of police presence in work zones. Using special funding from the Governor's Traffic Safety Bureau and Iowa DOT, the Bi-State Regional Commission conducted an investigation of the effects of extra enforcement activities in work zones (11). Three project locations were selected: U.S. 61 in Davenport, U.S. 67 in Bettendorf, and Interstate 80 in rural Scott County. The enforcement techniques used involved an officer in a police vehicle positioned just prior to the work zone, roving throughout the area, positioned at various locations within the work zone, and positioned after the work zone. All projects primarily used a marked enforcement vehicle parked within view of oncoming traffic at the beginning of the work zone. Vehicle speed data were collected using NuMetrics traffic monitoring devices affixed to the road surface. All three study areas exhibited a marked decrease in traffic speed with the onset of construction activities. Introduction of extra enforcement resulted in additional decreases of 1–2 mph. It was concluded that while extra enforcement did not have a significant impact on individual vehicle speeds, a decrease in average speed was observed in all three locations and the number of vehicles exceeding the posted limit was drastically reduced when law enforcement was present. A survey was conducted of law enforcement officers and contractors involved in the study. All stated that the presence of law enforcement made the work zone a safer environment for work crews and road users traveling through the site. Law enforcement officers also concluded that speeds were reduced and best results are achieved by their presence in advance of work zones. Sergeant Jerry Behning of the Davenport Police Department stated that the most effective technique for apprehending violators in a work zone was to conduct a speed check of vehicles entering the area, then radio to other enforcement officers just beyond the work zone for citation of offenders. This method reduced both congestion and distraction to motorists when passing through the work area.

In 2002, a study of enforcement practices was completed using data collected through telephone interviews. Schrock, Ullman, and Trout conducted surveys of 20 randomly selected law agencies across the country (12). Major topics of the interviews included funding, techniques and procedures used, locations of officer placement, coordination efforts, and most effect strategies. The study found that most responding agencies use off-duty officers on an overtime basis for work zone patrols either in total or to supplement other on-duty officers. A few states assign officers to these duties as standard practice. About one-half of the surveyed states require contractors to hire officers directly; in the other half, extra enforcement officers are paid by the contracting authority. The interviews found that stationary positioning of officers is most popular, but

about 45 percent prefer to circulate through the work zone area. Some officers opined that circulation was more effective, citing an increased ability to issue citations for violations, an effective deterrent in reducing speeds. About 25 percent of the states also require officers to perform as traffic controllers, but some states prohibit this activity for safety considerations. In coordination, approximately one-half of responding law agencies become involved in the project planning process or at the pre-construction conference where the need for extra enforcement is assessed. However, about one-third of interviewed officers indicated no advance knowledge of this required activity. For effective strategies, visibility of officers was found to be most advantageous followed by a concerted media awareness campaign. A double fine law was not concluded to be especially effective in reducing work zone speeds. The study concluded that cost of extra enforcement officers is a major factor in many states, and therefore more effective and innovative use is important. Specialized units such as those described in New Jersey and South Dakota are cited as examples of effective and efficient use of officers, particularly retired staff, thus relieving pressure on reduced available on-duty officers.

Work Zone Enforcement Technology

Radar and Laser

Police enforcement relies on personal observation supplemented with technology. Jones and Lacey (1997) conducted a study in Iowa to determine the effectiveness of laser-based speed enforcement programs compared with radar during 1994–1995 (13). Radar and laser speed measurement devices were used extensively in the cities of Dubuque and Council Bluffs, respectively. Both cities increased speed enforcement activities during the study period and raised public awareness of the risk for being cited for speeding violations. Speed data were collected once each week at 10 locations in each city before and after the enforcement program implementation. The study found that the radar-based speed enforcement program decreased the percentage of vehicles traveling more than 5 mph over the posted speed limit by about 20 percent. Laser-based speed enforcement did not result in a discernible reduction of speeding in Council Bluffs. This observation may be partially explained by the prior existence of a higher level of speed compliance in that community. The researchers concluded that laser-based speed measuring devices should supplement rather than replace existing radar measuring technology.

Remote Speed Enforcement

Another technology and strategy currently considered in work zones is real-time remote speed enforcement. Due to high speeds and traffic volumes in many work zones, stopping drivers for traffic violations may be dangerous for both motorists and officers. A remote speed enforcement program uses an automated speed enforcement (ASE) system to detect violators and alert an officer located beyond the work zone of the violation (14). ASE can use a variety of technologies (e.g., radar, LIDAR, elapsed travel measurements, and in-pavement sensors) to detect vehicle speeds. When a violation is detected, a photograph of the vehicle license plate is taken and transmitted to officers stationed outside of the work area. After the violating vehicle has passed through the work area the

motorist can be stopped safely. ASE programs can also mail tickets to the owner after a vehicle has been identified. In most states criminal citations cannot be issued using only ASE evidence. Legislation would be needed for tickets to be issued without a law officer personally witnessing the violation.

ASE has been widely used around the world to enforce speed laws for many years. Currently, over 75 countries (including Australia, Canada, Germany, Kuwait, the Netherlands, Norway, Sweden, and the United Kingdom) are using ASE systems. Many studies indicate a decline in speeds on roadways using an ASE program, but no completed studies addressing the effectiveness of ASE systems in work zones specifically were identified.

One of the many worldwide jurisdictions having experience with ASE is Victoria, Australia (15). The state of Victoria maintains an extensive photo radar enforcement program initiated in December 1989 and expanded to 54 cameras by January 1991. Along with installation of cameras, a massive public information campaign advising of enforcement camera use and raising awareness about speeding and safety was undertaken. A study completed in 1996 showed that the percentage of vehicles exceeding the established limit by 10 percent dropped from 23 to 2.9 percent. A 30 percent reduction of casualty crashes on arterial roads in Melbourne and a 20 percent reduction on the 60 kilometer-per-hour rural roads were found. A goal of reducing annual fatalities to 500 by the year 2000 in Victoria was established in a 1989 safety management plan. By 1992 this goal was met and by 1994 only 378 fatalities were recorded in Victoria.

The United Kingdom Department for Transport has investigated the effectiveness of cameras to control speed (16). In April 2000, mobile and fixed-site speed and red-light cameras were installed in eight areas in England, Wales, and Scotland. Decreases in both speed and casualties have been observed in installation areas. An average speed decrease of 10 percent was found across all sites.

ASE systems have also been employed in the United States. Several communities have used or are currently using ASE. It is common for communities using ASE to experience a decline in both speeding violations and crashes (17). For example, Paradise Valley, Arizona, noted a decrease in crashes from 460 in 1986 to 224 in 1992 after implementing an ASE program. Similarly, West Valley, Utah, observed a decline from 2,130 to 1,710 crashes annually after using ASE for two years.

A Texas Transportation Institute study (14) examined whether a remote enforcement system was technically feasible and whether vehicles could be correctly identified downstream, and surveyed the attitudes of law enforcement agencies regarding the system. The study found that a downstream observer could correctly match about 84 to 88 percent of the offending vehicles. One problem observed was in transmission of photographs to an officer downstream. Speed thresholds may need to be established to ensure hardware/software processing capabilities are not overloaded. The law enforcement community expressed concerns with the legal aspects of the system. Some

officers and officials believe that modifications would need to be made to the system and/or to state codes to permit enforcement using only photographic evidence.

South Dakota completed a study during 1998 using three deterrents to reduce speeds in work zones: video/LIDAR, a Highway Patrol car, and a decoy car (18). The study found the most effective option was a decoy car parked on the shoulder. A problem found with the active Highway Patrol car was that when the officer left in pursuit of a violator, he/she was absent from his/her position at the beginning of the work zone for 15 minutes or more.

The South Dakota DOT is currently collecting data using an ASE system in work zones. South Dakota DOT is planning to present the findings at a future legislative session in support of legislation to permit direct mailing of citations.

All violators cannot be detected with ASE, especially on high speed and high volume roadways, but it is still believed that an ASE system can identify many more violators than a single police officer (14).

Work Zone Legislation

The Texas Transportation Institute (TTI) conducted a survey regarding work zone legislation in 1997 (19) and provided updated related information on the National Work Zone Safety Information Clearinghouse (NWZSIC) website in 2002 (20). The survey found that 47 states have implemented higher fines for traffic violations in work zones (see Appendix A).

Enhanced enforcement penalties in most states are applicable in all types of work zones: construction, maintenance, and utility. However, some states limit application to construction areas only.

Of the 47 states with increased fines in work zones, 32 apply the higher penalties only to speed violations, while increased fines can be issued for all traffic violations in 11 of the states. Four states describe specific traffic violations where higher fines can be applied, such as reckless driving, driving under the influence, improper passing/overtaking, and following too closely.

Some states actively enforce more than just moving violations in work zones. The states of Michigan, Montana, Oregon, and Washington have enacted legislation allowing a driver to be charged with reckless endangerment of highway workers in a work zone. The state of Oregon also permits drivers to be cited for refusing to obey a flagger. Similarly, Utah allows tickets to be issued for failure to obey a peace officer or other traffic controllers in construction or maintenance zones.

Increased fine amounts vary from state to state; most commonly, standard fine rates are doubled for work zone violations. Some Midwestern states that apply double fines are Iowa, Kansas, Nebraska, and South Dakota. Fifteen states with increased fines in work

zones use fixed amounts for violations. In Missouri, for example, moving violations in work zones are assessed the standard fine amount plus 35 dollars.

The TTI survey found that about one-half of responding states with higher work zone fines require appropriate signing to notify motorists of this fact. Furthermore, approximately half of the states apply increased fines only if workers are present in the work zone. In addition to requiring workers to be present for higher fine application, Illinois has a policy and Tennessee a code provision requiring flashing lights to indicate workers are present.

South Dakota is the only state that authorizes agents or employees of the state department of transportation to issue citations within work zones for speeding and other violations.

Despite the commonality of increased penalties for violations among the states, analyses of fatal crashes in work zones between 1984 and 1995 indicated no consistently measurable effect on fatal work zone crash frequency due to higher fines (19).

According to NWZSIC (20), six states have adopted legislation allowing a speed limit reduction within a work zone without a traffic engineering investigation.

Guidelines for Use of Extra Enforcement

Studies have been undertaken to establish guidelines for assigning law enforcement officers to work zones.

In 1995, the FHWA developed guidelines for use of uniformed police officers on federal-aid projects in Massachusetts (21). The FHWA conducted interviews with Massachusetts Highway Department personnel from construction, traffic, and design divisions. Interviews were also conducted with Massachusetts Turnpike Authority, Massachusetts State Police, and Boston Police Department staff. Considering information gathered from the interviews along with consulting the national MUTCD, state of Massachusetts and local training manuals, and current nationwide practices, the FHWA recommended guidelines to determine when uniformed police officers or civilian flaggers should be used for traffic control on federal-aid projects in Massachusetts. The FHWA determined that flaggers and uniformed traffic officers should be used only when standard temporary traffic control measures do not adequately guide traffic and provide safety for motorists and workers. The guidelines also state that use of flaggers may be necessary to control traffic on alternating one-way operations or other situations where supplemental information must be provided. Flaggers may be replaced with police officers when high traffic speeds, high traffic volumes, or other extenuating circumstances occur. The guidelines suggest that a uniformed traffic officer with a marked patrol car and flashing lights should be assigned to nighttime operations. Table 1 from the FHWA study was created for guidance when assigning flaggers and uniformed police officers to work zones.

Table 1. Guidelines for Flaggers and Uniformed Police Officers in Work Zones

Work Activity	Low Speed & Low Volume	High Speed & High Volume
Work in the median or roadside area (no infringement on the roadway)	Neither flaggers nor uniformed officers are required	Neither flaggers nor uniformed officers are required
Shoulder closed with concrete barrier	Neither flaggers nor uniformed officers are required	Neither flaggers nor uniformed officers are required
Shoulder closed without concrete barrier (work adjacent to traffic)	Neither flaggers nor uniformed officers are required	1 uniformed officer suggested
Setting up or removing lane closures, lane shift, or other changes in traffic pattern	1 flagger per traffic approach suggested	1 uniformed officer per traffic approach suggested
Lane closed on multi-lane roadway with concrete barrier	Neither flaggers nor uniformed officers are required	Neither flaggers nor uniformed officers are required
Lane closed on multi-lane roadway without concrete barrier (active work adjacent to traffic)	Neither flaggers nor uniformed officers are required	1 uniformed officer per traffic approach suggested
Survey crew—roadway centerline	1 flagger per traffic approach suggested	1 uniformed officer per traffic approach suggested
Temporary Road closure (15–20 minutes)	1 flagger per traffic approach suggested	1 uniformed officer per traffic approach suggested
Ramp work	1 flagger suggested	1 flagger suggested
Moving operation in travel lane	1 flagger suggested	1 uniformed officer suggested
One lane, alternating traffic (no signal)	1 flagger at each end and at each cross street suggested	1 uniformed officer at each end and 1 flagger at each cross street suggested
Work within intersection	Flagger(s) suggested (number dependent upon field conditions)	Flagger(s) suggested (number dependent upon field conditions)

Mounce and Brackett (1989) (22) also developed guidelines for use of law enforcement in urban freeway work zones. The guidelines were based on an extensive literature review, field observations, and interviews with enforcement officers and traffic engineers. The researchers found that under conditions of high traffic demand, complicated roadway geometrics, unprotected and/or unusual work activity, or nighttime operations, uniformed police officers at work sites provide safer and more efficient traffic control. As illustrated in Figures 1 and 2, when any of the above conditions are encountered, uniformed police officers may effectively be used to replace or support flaggers. Mounce and Brackett state that additional flaggers and police support may be necessary in advance of work zone transitions for speed control and/or immediately adjacent to the work area if no other physical protection such as temporary barrier rail is provided for shielding equipment and workers.

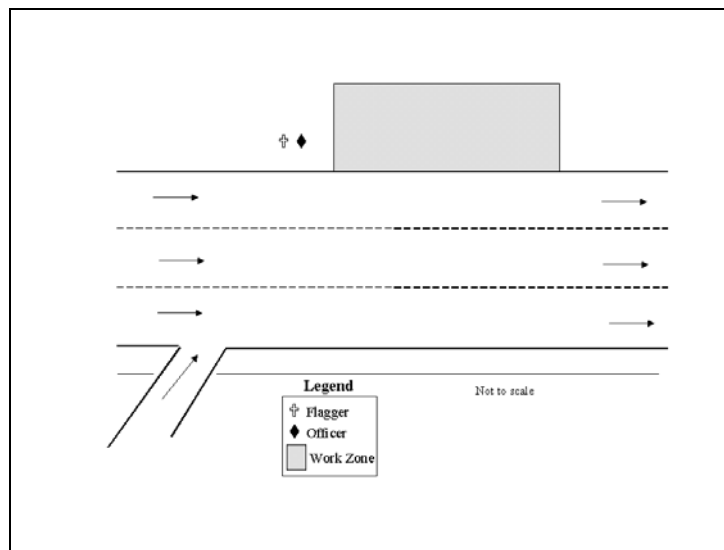


Figure 1. Traffic Control for Work Area Adjacent to Freeway

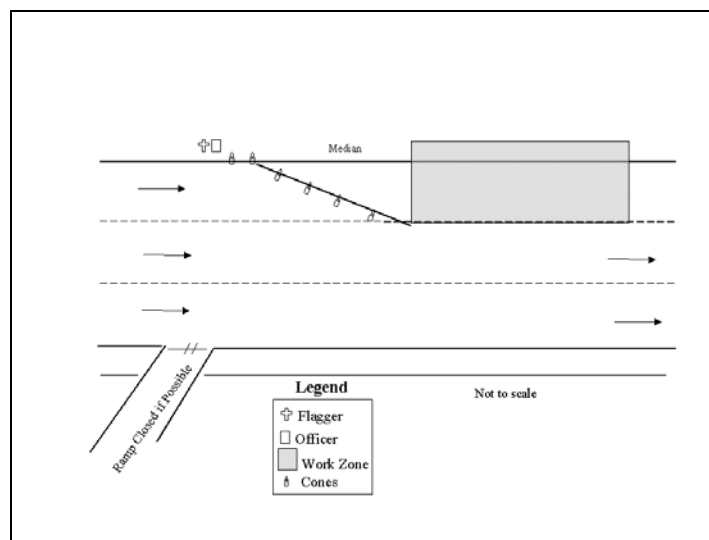


Figure 2. Traffic Control for Single-Lane Closure on Freeway

The NCHRP Report 476 developed traffic control guidelines for nighttime maintenance and construction projects during 2002 (3). The report states that for all nighttime work activities, the need for and extent of police services should be considered. It was concluded that visible police enforcement is highly desirable in nighttime operations to encourage driver adherence to traffic regulations and to manage incidents such as crashes, breakdowns, and major congestion. Criteria suggested police services might be advisable for nighttime operations as follows:

- construction activities closely adjacent to traffic without positive protection
- restrictions to traffic flow based on work zone features (e.g., no shoulder, reduced shoulder width, reduced lane width, or reduced number of travel lanes)
- locations where incidents are expected to produce substantial congestion and delays
- special operations that require traffic control or shifts of the traffic pattern
- locations where traffic conditions and crash history indicate that substantial problems may be encountered during construction
- projects with heightened public concern regarding the impacts of the traffic control plan

Other factors that should be considered include traffic speed and volume through the construction site. Engineers may also wish to refer to these criteria when deciding whether or not to use extra enforcement during daytime activities.

Enforcement Activities and Funding

If extra police enforcement is desired for a construction or maintenance project one of two options could be negotiated by agencies: cooperative enforcement or dedicated enforcement.

Cooperative Enforcement

Cooperative enforcement is defined as services for which a police agency agrees to participate at a predefined level, without direct compensation (3). On-duty officers are assigned to patrol work zones when possible. A disadvantage of this practice is that officers may not be available when needed (lane closures, setting up and taking down traffic control devices, directing traffic in during congested times). However, the level of service provided by the law enforcement agency may be appropriate on some projects, and cost to the transportation agency is minimal.

Dedicated Enforcement

Dedicated enforcement is defined as services for which a law enforcement agency is reimbursed under a formal agreement with either a state or local agency, or a contractor (3). Typically, arrangements are made with the police agency before the project begins to establish the assignment of officers and reimbursement of costs. Some highway agencies

develop a blanket agreement to document a basic understanding. Funding sources for extra enforcement include revenues generated from enhanced fines in work zones, general construction funds, FHWA funds, specifically allocated state funds, and particularly when enforcement is included as a contract item, project construction funds. A significant advantage of dedicated enforcement is that required officers and equipment are generally available when needed.

Public Opinion of Extra Enforcement in Work Zones

Surveys have been previously conducted to assess public opinion of focused law enforcement in work zones.

In 1995, the Iowa DOT conducted a survey addressing perceptions of work zones by motorists and truck drivers (23). When motorists were asked if a higher level of law enforcement would make them feel safer in work zones, 41 percent replied they would feel safer and 50 percent believed it wouldn't make a difference. When asked if they would drive more carefully in work zones with higher law enforcement, 54 percent responded positively and 36 percent indicated there would be no difference. Sixty-two percent of the respondents would be more likely to obey the reduced speed limits in work zones if additional enforcement were applied, and 33 percent said they would not change their behavior. When truck drivers were asked if they would feel safer in work zones with more stringent law enforcement, 49 percent said they would feel safer, 39 percent said more law enforcement would not improve their safety, and 12 percent were unsure if additional enforcement would improve or not improve their safety. Fifty-eight percent of the responding truck drivers would drive more carefully when law enforcement was present, and 27 percent said it would make no difference. Similar results were found when truckers were asked if they would be more likely to obey reduced speed limits in work zones with stiffer enforcement. Fifty-nine percent said they would be more likely to comply with reduced speeds, and 29 percent said it would make no difference in their driving behavior.

The Oregon DOT conducted an extensive survey in 2001 to gather information about highway users and their priorities relating to work zones using additional speed enforcement (24). When motorists were asked how important it would be to improve law enforcement in work zones on Oregon highways, 60 percent responded as very important, 26 percent said somewhat important, and the remaining 14 percent responded either not very important, not important, or don't know.

State Work Zone Enforcement Programs

Some state agencies have adopted various policies and programs regarding focused law enforcement efforts in work zones. Following are descriptions of selected states' initiatives in extra enforcement. An overview of a FHWA and American Association of State Highway and Transportation Officials (AASHTO) survey addressing extra enforcement in work zones is also presented.

Overview of FHWA and AASHTO Survey

The FHWA and AASHTO conducted a survey in 1999 regarding the use and effectiveness of uniformed police officers (UPO) on federal-aid highway construction projects. Responses were received from 70 sources, and 25 respondents offered general comments as well. State transportation agencies provided 46 responses and others were received from law enforcement agencies and organizations, highway industry associations, contractors and suppliers, and even state legislators.

A majority of responding states use uniformed police officers in at least some of their work zones, and on-duty and/or off-duty officers are utilized for these duties. Seven states allow only on-duty officers to be assigned to work zones. Common applications for use of extra enforcement include night operations, lane closures, and high-volume/high-speed traffic locations. Most responding agencies use marked police vehicles for patrolling work zones but a few also allow unmarked police vehicles to be used. In addition, some states require officers to be outside the vehicles and visible to traffic but only a few agencies have developed special training for officers assigned to work zones. It was also determined that only a few states require officers to wear protective or high-visibility clothing when outside the vehicle.

The survey also found that the most common source of funds to pay for police officers in work zones was highway construction funds. Other sources of funding included highway administration funds and specific law enforcement appropriations.

Arizona

Arizona's *Construction Manual* includes local law enforcement or Department of Public Safety (DPS) officers as recognized flaggers. Generally DPS officers are used on interstate and urban freeway projects, but off-duty local enforcement officers are often assigned to projects on other types of roadways. The local resident engineer determines whether state or local law enforcement officers will be used. If local law enforcement officers are used as flaggers, they are usually hired by the contractor. If DPS officers are employed, the resident engineer is responsible for negotiations.

California

The California DOT has developed a program known as the Construction Zone Enhanced Enforcement Program or Maintenance Zone Enhanced Enforcement Program (COZEEP/MAZEEP) by which the California Highway Patrol is contracted to enforce speed compliance in work zones. The primary goal of this program is to maintain reasonable levels of safety and mobility in high-risk construction areas. Conditions where the COZEEP/MAZEEP program is considered include the following:

- night time closures in general
- night construction activity that is not obvious when inactive
- night work in an identified work zone that requires a lane closure

- daytime construction activity that is not obvious when inactive
- work zones protected by flaggers with or without pilot cars
- end of queue management
- poor highway alignment approaching work zones, high truck counts, or other unique situations
- workers exposed to traffic and escape route blocked
- activities with a large number of truck movements at the work area
- work on freeways with 6 or more lanes

Colorado

Colorado has initiated a program called the Chill Campaign to warn and slow motorists in work zones. Chill is a public awareness and enforcement effort that primarily targets aggressive drivers and has been active since 1999. A total of 53 agencies have participated in the Chill Campaign, including the Colorado DOT, Colorado State Patrol, and local law enforcement agencies. The Colorado State Patrol alone has cited 993 hazardous violations penalties, 271 seat belt violations, 18 for DUI/DUID, and 283 vehicles for other penalties during the Chill Campaign in 2001. Local law enforcement agencies issued 1,233 citations for speeding in a work zone in that same year. Purchased radio airtime informing motorists of dangers in work zones reached 94 percent of adults in Denver and Colorado Springs between the ages of 25 and 54. Funding for the program is part of the Colorado DOT's safety budget, allocated by the State Transportation Commission.

Florida

Florida's use of on-duty Florida Highway Patrol officers for patrolling work zones began in 1995. Prior to 1995, off-duty officers were used. The Highway Patrol is reimbursed by the Florida DOT from project funds per a program agreement. Officers are mostly assigned to urban or rural freeways and limited access roadway projects. Florida notes that the need for extra law enforcement for a specific project should be made during development of the traffic control plan. Some potential conditions for the use of extra law enforcement in Florida are listed below:

- work zone requiring reduced speed
- work zones where barrier wall is used adjacent to through traffic
- nighttime work zones
- areas with intense commuter use where peak traffic may require speed enforcement
- work zone where workers are exposed to nearby high-speed traffic.
- work in high traffic signalized intersections
- high volume urban roadways with lane closures during peak hour traffic periods

In addition, law enforcement officers may be used for speed control on non-limited access highways with prior approval from the district director of operations.

Florida has recently initiated a unique program for monitoring and apprehending speeding drivers. An officer disguised as a road worker checks for speeders with a radar unit then radios to other officers waiting beyond the work zone on motorcycles. These officers stop the speeders in a safe location and issue citations. This initiative has been quite successful; variations have been adopted and used in other states as well.

Iowa

Iowa has utilized extra enforcement in work zones to slow traffic and enforce vehicle regulations for many years, beginning with a pilot project in Scott County in 1993 (11) (as described previously). This initial effort was considered to be successful and local news media supported the campaign. In 1996, funding was allocated to expand the use of extra enforcement in work zones to other areas of the state. Project funds are used in Iowa to support extra enforcement activities (see Figure 3). Additional enforcement is assigned to work zones taking the following major factors into consideration:

- traffic volumes
- enforcement personnel availability
- potential work zone congestion
- remaining highway capacity
- construction work zone type

Although projects in the entire state are technically eligible for these efforts, historically most extra enforcement has been applied in eastern and central Iowa. Projects are recommended by field offices and selected for the program by central construction office staff. Actual Iowa DOT annual extra enforcement expenditures since 1996 are shown in Figure 3.

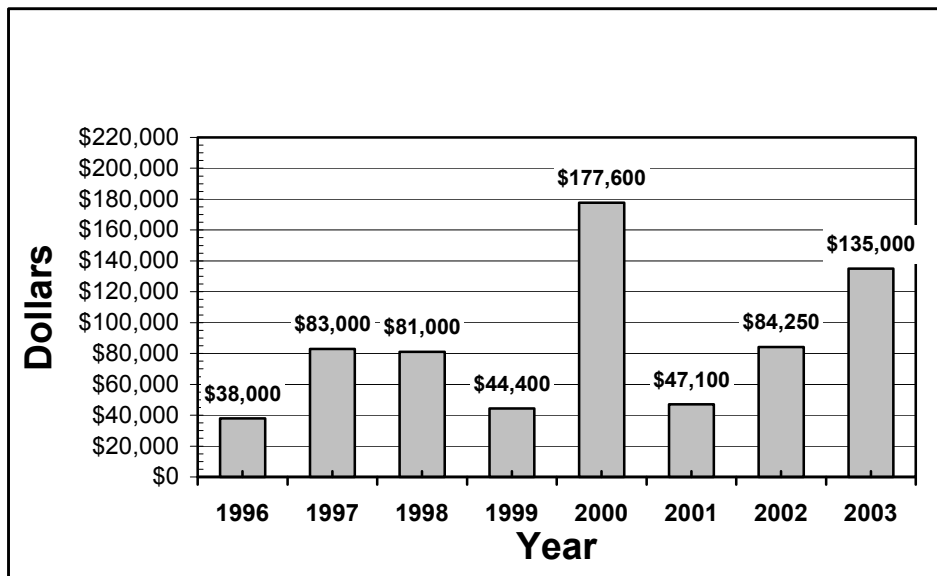


Figure 3. Iowa DOT Extra Enforcement Funding 1996–2003

New Hampshire

New Hampshire DOT specifications allow contractors to furnish uniformed officers or commercial security or subcontractors to help direct traffic in work zones. According to New Hampshire's *Standard Specifications for Road and Bridge Construction* (25), Section 618 (Uniformed Officers and Flaggers), uniformed officers can be used to direct and control traffic through or around work zones. Uniformed officers are required to use official police vehicles with roof-mounted flashing blue lights visible to oncoming traffic and appropriate police markings. The officers are also required to have completed formal traffic control training, as provided by New Hampshire's Police Standards and Training Council, and to wear regulation duty uniforms along with headgear, reflective vests, and an exposed badge.

New Jersey

In 1994, New Jersey established a dedicated New Jersey State Police (NJSP) Construction Unit assigned to New Jersey DOT construction projects. This unit assists the New Jersey DOT in monitoring and enforcing provisions of the approved traffic control plans. All members of this unit must receive specific work zone safety training. The NJSP Construction Unit is deployed on an as-needed basis at the request of the local resident engineer on a variety of projects and work classifications. The agreement between the NJSP and New Jersey DOT can be found in Appendix B.

New York

New York occasionally employs extra enforcement in work zones; however, possible adverse effects of overuse lessening the otherwise positive impacts of a police presence and the potential impact on program funding are also considered by the state.

New York's policy for staffing extra enforcement efforts is to initially request State Police assistance. Local agencies may be utilized if State Police are unavailable. A recommendation to use focused law enforcement in New York work zones is normally made during the design process of a specific project. High speed, high volume traffic flow in combination with any of the following factors are considered to guide decisions for inclusion of extra enforcement as part of a project traffic control plan:

- construction activities closely adjacent to an active traffic lane without positive protection (barrier rail, etc.)
- restrictions to traffic flow based on work zone features; no shoulder, reduced shoulder width, reduced lane width, and reduced number of travel lanes
- locations where incidents will produce substantial congestion and delays
- special operations that require temporary or frequent shifts in traffic patterns
- locations where traffic conditions and crash history indicate substantial problems may be encountered during construction
- nighttime construction that may create adverse conditions
- projects with heightened public concern

A recommendation to utilize extra enforcement in a work zone may also be made after a project is underway if there is an unusual occurrence of traffic crashes, objectionable delays and congestion, and/or widespread driver disregard for speed limits and other regulations.

The New York program has included parking a police car between traffic and work crew with a mobile crash cushion positioned behind vehicle. Blue strobe lights on flashing arrow boards have also been added to give the impression that additional officers were on site. However, this tactic has had only limited success.

Extra law enforcement costs are paid through a region's capital program. These costs are eligible for reimbursement on federal aid projects. The project engineer generally controls the number of hours officers are present in the work zone.

Oklahoma

In Oklahoma, the Oklahoma DOT determines when projects should have state troopers present in work zones. Off-duty officers are used for extra enforcement in work zones. Payment is made directly to the Department of Public Safety. Factors considered when choosing work zones for extra enforcement include night work, high volume areas, and areas of complex geometry with known high speed history.

Oklahoma has utilized law enforcement officers disguised as workers on construction equipment. Disguised officers check motorists' speeds with radar, laser, or LIDAR, and then radio to uniformed officers outside of the work zone with descriptions of violating vehicles. After offending vehicles are beyond the work zone and in a safe environment, uniformed officers issue tickets to violators. One city in Oklahoma that has used this technique is Broken Arrow. The local police department has received positive publicity in local news media informing the public about this new technique used to slow traffic.

South Dakota

The South Dakota DOT employs retired and local law officers for extra enforcement duties and provides distinctive uniforms and marked South Dakota DOT vehicles for the officers' use. In addition, specific training and authority is provided for these South Dakota DOT employees or agents to stop and ticket speeders in work zones with a program called DOT/COP. The DOT/COP initiative uses retired highway patrol cars marked with South Dakota DOT work-zone enforcement decals. Other older highway patrol cars are used as decoys in work zones.

3. SURVEYS AND INTERVIEWS

CTRE conducted two surveys and several interviews with transportation officials and law enforcement officers to obtain information and opinions about the use of extra law enforcement in work zones. Following are summaries of those surveys and interviews.

State DOT Survey

An electronic survey (see Appendix E) was developed and distributed to all 50 state DOTs and seven turnpike or thruway agencies by e-mail. Twenty-eight state DOTs responded. No surveys were returned from turnpike or thruway agencies. A complete summary of states' survey responses can be found in Appendix F.

Formal Policy

Survey responses indicated that 21 of 28 responding states (75%) have adopted a formal policy or program to provide extra enforcement in work zones during construction projects and/or maintenance operations. For example, both Virginia and Oregon have adopted policies and guidelines describing criteria to determine when extra enforcement will be used in a work zone as well as responsibilities of cooperating police officers when assigned to work zones (see Appendixes C and D).

Selection Criteria and Work Duration

States rely on various criteria to determine if and where extra enforcement will be used (see Figure 4). Traffic volumes and classification of road are used by most responding states to determine what projects have extra law enforcement. Other factors include peak congestion, lane closures, night work, and risk to workers. It was found that responding states mostly use extra law enforcement in long-term work zones.

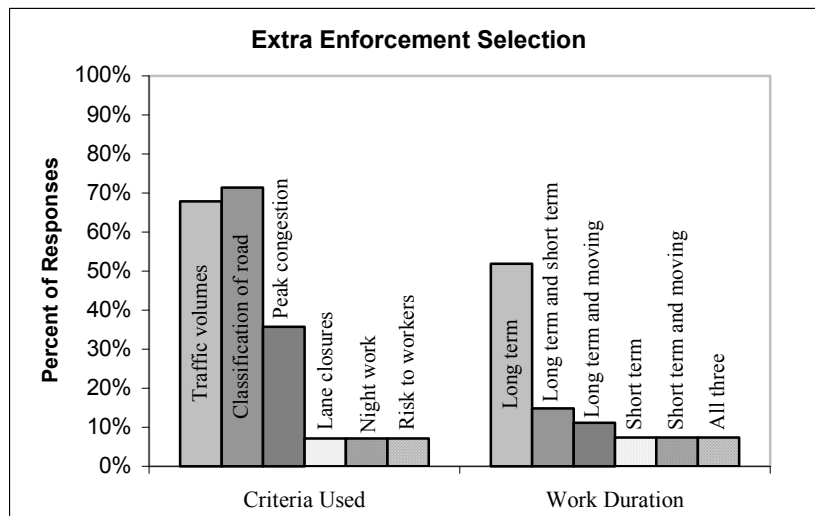


Figure 4. Survey Response Regarding Extra Enforcement Selection Criteria

Funding Sources

Questions addressing funding sources for extra enforcement and method of reimbursement were included in the survey (see Figure 5).

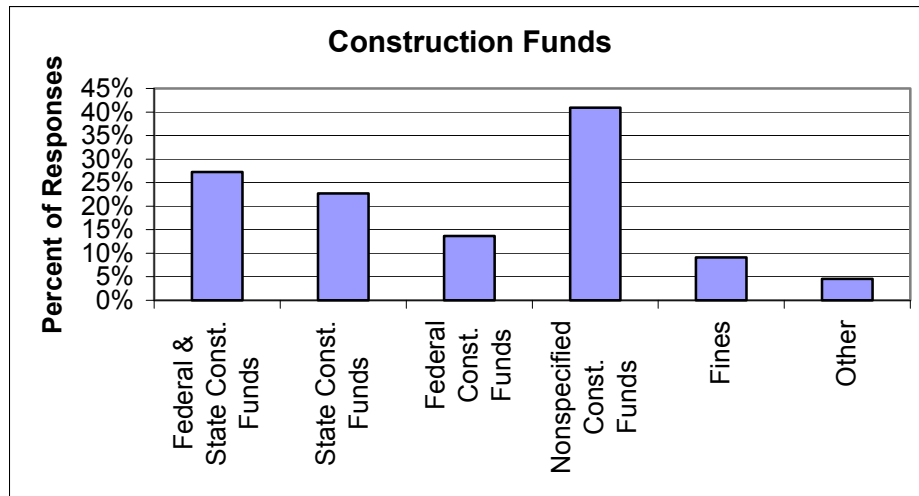


Figure 5. Survey Response Regarding Extra Enforcement Funding Sources

A majority of responding states fund work zone law enforcement with construction funds. “Construction funds” as described in the responses include project funds, construction funds, project money, highway improvement project funding, and road funds. Of the states that use construction funds for extra enforcement, six states indicated that both state and federal money is utilized. Three states rely only on federal construction funds to pay for enforcement, and five states rely only on state funds. Nine states using construction funds did not indicate the specific source. Kentucky and Indiana indicated that money generated from “double fines” is designated to pay for extra enforcement in work zones, although details of funding transfer between agencies was not provided.

A majority of responding states indicated that law agencies are reimbursed for services through the state DOT. In some states, the State Highway Patrol is in the same agency as the DOT, making it easier for funds to be transferred. Five states responded that the contractor is responsible for paying for extra enforcement.

Law Enforcement Details

The survey asked for specific details of enforcement activities (see Figure 6). Of the states that responded, 61 percent use only volunteer off-duty officers for extra enforcement duties. Other states use both on and off-duty officers, and three states exclusively use on-duty officers. A majority of respondents (78 percent) primarily use state law officers for extra enforcement in work zones, and the remaining states use local law enforcement only or both state and local officers. Most states (89 percent) use

marked police vehicles when patrolling work zones. Only 10 responding states require warning lights to be operating during work zone patrols. Eight states replied that law enforcement officers are required to wear protective apparel when out of a vehicle in work zones.

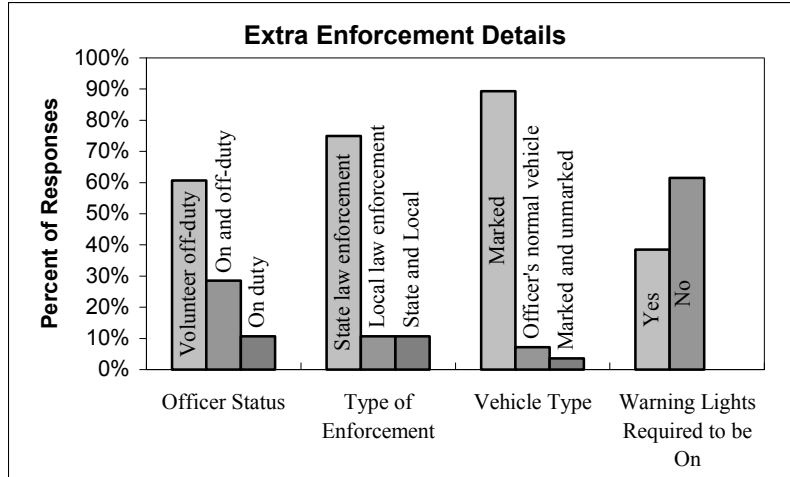


Figure 6. Survey Response Regarding Extra Enforcement Details

Training for Law Enforcement Officers in Work Zones

Several states including Maryland, Missouri, South Dakota, and Washington indicated that special training is provided to officers patrolling work zones. In addition, Tennessee is developing a training program for special enforcement officers through a cooperative effort by the Highway Patrol, DOT, FHWA, and University of Tennessee Center for Transportation Research. New Jersey and New Hampshire also require special training for officers patrolling work zones.

Time of Enforcement and Officer Placement

Sixty-one percent of states stated that extra enforcement is used during both day and nighttime hours. When asked where officers are usually located with respect to the work zone, 30 percent of states responded within, 22 percent responded in advance, and 26 percent responded that officers are located both in advance and within work zones. Four states added that specially designed and located safety pull-off areas are provided for ticketing operations. See Figure 7.

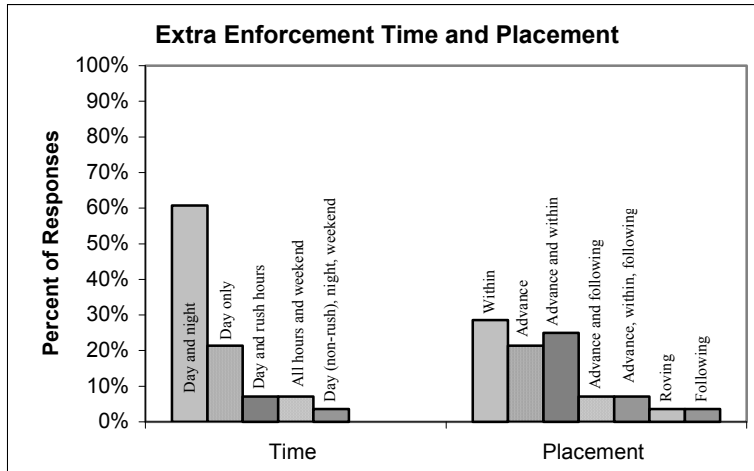


Figure 7. Survey Response Regarding Time and Placement of Extra Enforcement

Effectiveness of Law Enforcement Presence

Perceived effectiveness of extra law enforcement in work zones was requested in the survey (see Figure 8). Eighty-five percent of responding states said that extra enforcement efforts have been effective in reducing speeds. Similarly, 69 percent of states said they believe that these efforts improve safety. However, only five states indicated that benefits were quantifiable. Six responding states indicated some adverse effects from increased enforcement in work zones primarily due to congestion resulting from lower travel speeds.

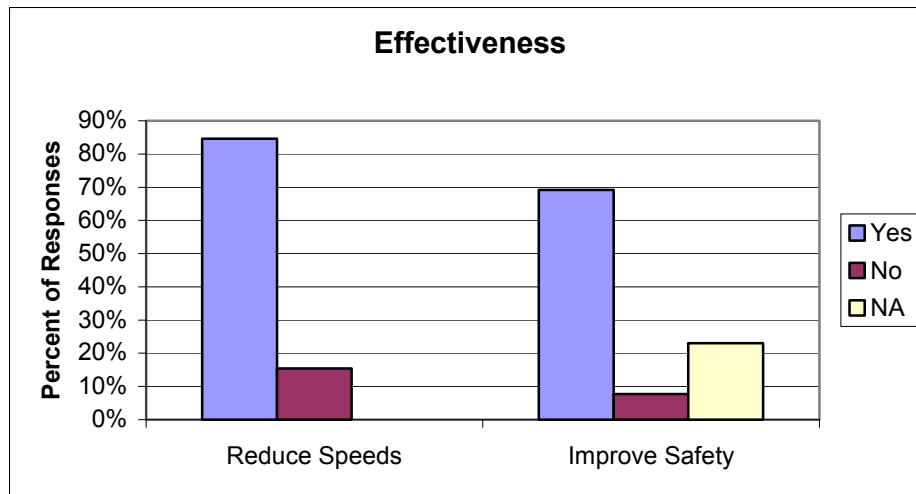


Figure 8. Survey Response Regarding Extra Enforcement Effectiveness

Law Enforcement Survey

Specially designed surveys were also distributed to several law enforcement agencies in Iowa and other states (see Appendix G). Completed surveys were received from the Iowa State Patrol, Iowa City Police Department, Coralville Police Department, Des Moines Police Department, and Missouri Highway Patrol. When asked what criteria are used to select officers for extra enforcement duties, four departments stated that all officers serve strictly on a volunteer basis. The Des Moines Police Department also requires officers to be radar and OWI certified. Iowa City and Des Moines use off-duty officers, and the State Patrol in Iowa and Missouri use both on-duty and off-duty officers. The Coralville Police Department only uses on-duty officers on an overtime basis.

Both the Iowa State Patrol and Coralville provide some special training to officers patrolling in work zones. The Iowa State Patrol discusses side approaches to vehicles in work zones with officers. Discerning a need for directing traffic when trucks are entering and leaving the work zone is also discussed. The Coralville Police Department offers verbal instructions on responsibilities and position placement to officers. Most responding agencies indicated the primary duties for officers assigned to work zone duty are warning and slowing traffic in addition to actual enforcement of traffic laws.

All responding enforcement agencies were confident that these extra efforts have been effective in reducing speeds and improving safety in work zones and none indicated observing any adverse effects from additional enforcement activities. A complete summary of enforcement survey responses can be found in Appendix H.

Interviews

Several interviews were conducted with Iowa DOT officials and law officers regarding extra enforcement in work zones (contacts are provided in Appendix I). These inquiries were used to gather information and opinions from those most directly involved in enforcement efforts.

A meeting with Kevin Merryman, Iowa DOT resident construction engineer in the Des Moines area, was held on September 6, 2002. In addition to CTRE research staff, Mark Bortle from the Iowa DOT construction office participated in the meeting. The Des Moines area has been popular for extra enforcement primarily due to a heavy construction program on high traffic roadways and participation interest from law enforcement agencies and Iowa DOT office staff. Although the extra enforcement program in Iowa is initiated annually through the central office, administration of contract details is a local office responsibility. For example, negotiation with enforcement agencies for officers and payment by external vouchers are activities handled by the local resident construction office. The Iowa State Patrol, Des Moines Police Department, and Polk County Sheriff's Office all participate in extra enforcement activities in this area. Normally, the Iowa DOT pays for only one officer per project, but the Iowa State Patrol may supplement the work zone with more officers. Polk County has been paid \$20/hour for patrolling work zones. The Iowa Highway Patrol is paid overtime for hours worked

plus an hourly rate for the patrol car. At night, officers are mainly used as traffic controllers, especially during road/lane closures. Officers also provide motorist assistance and speed enforcement. Many speeding citations are issued during these activities. On I-235, Des Moines police officers are used to help direct traffic along detours and sometimes assist as flaggers. Merryman believes that extra enforcement has been beneficial in reducing speeds and making work zones safer and also recommended that the extra enforcement program in Iowa should continue.

On September 27, 2002, a similar meeting was conducted in the Cedar Rapids resident construction office. Participating in this discussion were Cedar Rapids police officer Lt. Charles Mincks, Iowa DOT resident construction engineers Ken Yanna from Cedar Rapids and Mark Brandl from Davenport, Kent Ellis from the Cedar Rapids construction office, Dan Sprengeler from the Iowa DOT Office of Traffic and Safety, and CTRE staff.

In contrast to the Des Moines area, Cedar Rapids construction projects rely almost exclusively on local police departments from Iowa City, Coralville, and Cedar Rapids for extra enforcement assistance in work zones. Davenport also uses local law agencies for staffing but has received assistance from the Iowa State Patrol. Reimbursement for these duties is handled much as in Des Moines, including officers' overtime, an agreed rate for squad cars, and payment made through external vouchers. Costs for enforcement is re-negotiated each year. Both of these construction offices work with officers to decide the most appropriate time for extra enforcement. While Cedar Rapids has used extra enforcement at night, Davenport has only applied these services during daylight hours. Contractors in the Cedar Rapids area appreciate the slow down response by truckers due to extra enforcement in work zones.

Lt. Mincks suggested that officers should be located in advance of the work area, especially at night, for maximum effectiveness. Citations by special enforcement officers are not a high priority in the Cedar Rapids area; most emphasis is to slow traffic. Positioning of officers is important; generally about one mile in advance of the work area is most effective. Marked police vehicles are best for warning and slowing traffic. Special devices such as speed trailers and changeable message signs provide supplemental benefits. Cedar Rapids police officers only receive general traffic enforcement training, nothing special for work zones. However, officers wear safety vests when out of the vehicles in Cedar Rapids. These officers may or may not handle crash investigations during extra enforcement activities, depending on availability of other staff.

Although quite similar in major details, there are a few differences in programs between Cedar Rapids and Davenport. The Davenport DOT office has used officers from the Iowa State Patrol, cities of Bettendorf and Davenport, and Scott County for extra enforcement duties. The Davenport construction office makes recommendations of when, where, and how to apply focused enforcement efforts. Initially citations were issued as part of these enforcement activities in the Davenport area, but later the major duties evolved into warning and slowing traffic.

From the interviews, it was learned that contractors on occasion make requests for extra enforcement assistance to the Iowa DOT or even directly to law agencies.

4. BENEFICIAL RESULTS OF EXTRA ENFORCEMENT

Survey responses and interviews of DOT and law enforcement personnel agree on the general inherent benefits of a law enforcement presence in work zones exposed to free-flowing traffic. Participating officers, road workers, and affected agency staff all typically support these efforts, pointing to decreased traffic speeds and generally improved safety conditions that result. Much of this testimony is anecdotal in nature.

As described in the literature review, some studies have produced quantifiable evidence demonstrating a benefit in speed reduction from extra enforcement. Speed analysis before and after implementation of law enforcement programs in Iowa and other states has identified reductions in traffic speeds due to enforcement activities.

Reduction in work zone crashes is certainly an important goal of extra enforcement efforts. Discussion with Iowa DOT staff and Iowa State Patrol officers indicated probable crash reduction on a section of Interstate 35/80 in Polk County due to increased enforcement activities. In 1999, major reconstruction was contracted on I-35/80 between NW 72nd Street and NE 14th Street in Des Moines. No extra enforcement occurred during the project work. The following year, a much more extensive improvement was undertaken and focused law enforcement was conducted in 4–9 hours shifts, two in daylight hours and two at night. Table 2 reveals a substantial decrease in crashes for a comparable period between 1999 and 2000. While other unidentified factors may have contributed to this decline, certainly the concerted law enforcement presence is a major consideration.

Table 2. Interstate 35/80 Work Zone Crash Frequency Comparison: 1999 (No Extra Enforcement) vs. 2000 (Extra Enforcement)

Crash Location, Road Characteristic	Crash Frequency	
	1999*	2000*
Non-intersection, no special features	21	13
Non-intersection, bridge/overpass/underpass	7	0
Non-intersection, Railroad crossing	0	1
Non-intersection, other	2	4
Intersection, within intersection	0	1
Intersection, not within intersection but intersection related	0	3
Interchange, ramp	2	2
Interchange, entrance ramp on major road	3	3
Interchange, on major road between ramps	12	0
Interchange, major road at exit ramp	4	4
Interchange, bridge/overpass/underpass	5	1
Interchange, not within interchange but interchange related	2	0
Total	58	32

* For the period March–June.

5. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Current literature, survey responses, and interviews have all indicated a prevalent opinion for the benefits of an increased level of law enforcement presence and activity in work zones. Very few comments offered conclusions of negative impacts, such as additional congestion, from these efforts.

The study found that use of extra enforcement in work zones is a common practice in many states and these activities appear to be increasing. More intense, aggressive efforts are being implemented in a growing effort to address the rising level of crashes in work zones. However, the beneficial effects of these efforts have not been intensively quantified. In addition, practices for the use of law officers in work zones is quite inconsistent across the nation, as is the general implementation of specific legislation addressing work zone traffic violations. While many states have adopted formalized policies and programs to implement and govern the use of law enforcement officers in work zones, many states rely on informal agreements with law agencies. A similar inconsistent approach can be found in funding sources and levels for enforcement activities in work zones among the states. Some use dedicated funding sources; others rely on annual appropriations or utilize construction project funds. Training of law officers prior to work zone duty does not appear to be commonly required. The value of focused training is being recognized in some states, and training programs are being developed and implemented.

Future Research

The scope of this study did not allow for a complete investigation of the topic. Future work is needed to supplement the knowledge base and provide guidance to agencies when considering the use of law enforcement to calm traffic, monitor compliance with laws, and provide for safer work zones.

Further study in the following areas would be critical to quantify the potential benefits of extra enforcement in work zones and to develop a well-supported set of guidelines and recommendations for such programs:

- For transportation agencies, research is needed to develop definitive guidelines for selection of projects where law enforcement presence would be most beneficial.
- Additional data would be beneficial regarding the most effective locations for police officers within or near work zones. Evaluations could be performed to determine the optimum distance between an officer and work zone activities. Different techniques used by officers (e.g., lights flashing and officer out of vehicle) could be analyzed for effectiveness.
- The effectiveness and benefits of various methods of enforcement activity could be analyzed. For example, a study comparing the value of issuing a high number

of citations versus simply slowing traffic would provide important results. The comparative benefits of increased levels of law enforcement such as higher fines and issuance of citations should be quantified.

- The value and need for specific officer training programs could be determined. In addition, research efforts in developing and providing specific enforcement training would be important.
- A detailed analysis of the relationship of speed reduction to crash incidence would be of great worth.
- Cooperative agreements between transportation departments and law enforcement agencies can be very effective. Research to establish guidelines for developing and implementing such agreements could be undertaken.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are offered for consideration:

- To provide a predictable funding level for both transportation agency and law enforcement, a dedicated source of funds might be established. This would allow agencies and departments to plan activities and staffing in advance of actual need.
- States could develop and adopt policies and guidelines for selection of appropriate projects and situations that warrant extra enforcement. Several states have existing policies and procedures in place for models.
- State transportation departments and law enforcement agencies could negotiate formal agreements and adopt policies describing extra enforcement activities in work zones, modeled after established programs in other states. These policies could outline the use and duties of officers assigned to work zone activities.
- The potential benefits of automated speed enforcement could be considered, including lobbying for legislative action where needed to allow citations using the evidence alone.
- A training program specifically addressing the needs of law officers in work zones might be developed and implemented. This training would include safety guidelines for activities, use of safety apparel when out of a vehicle, pursuit and apprehension of violators, assistance in safe contractor operations such as slowing traffic for hauling units, and general work zone safety indoctrination to ensure familiarity with MUTCD standards and other state traffic control practices.
- Each agency and department could appoint an individual to act as point of contact for extra enforcement activities. This would result in more efficient program operations.
- Detailed records might be maintained of all program activities and results. These records would include but not be limited to crashes during enforcement, citations issued, speed reduction data, and any special incidents of note.
- An annual report of program activities could be prepared outlining the level of activities and results, citing the records described above.

As crashes and deaths continue to rise annually in our nation's work zones, it is imperative that demonstrated beneficial programs such as the expanded use of law officers in these locations be continued, refined, and expanded. The inherent value of focused enforcement efforts in these hazardous areas is evident in observations by both transportation agency staff and law agency professionals. Quantification of benefits in this report and future research efforts will support continued use of extra enforcement in construction and maintenance work zones on our nation's highways.

**APPENDIX A:
WORK ZONE LEGISLATION**

**APPENDIX B: NEW JERSEY MEMORANDUM OF UNDERSTANDING
BETWEEN THE DEPARTMENT OF TRANSPORTATION
AND THE DEPARTMENT OF LAW AND PUBLIC SAFETY**

**APPENDIX C: GUIDELINES FOR USE OF VIRGINIA STATE POLICE IN
CONSTRUCTION/MAINTENANCE WORK ZONES**

APPENDIX D: OREGON WORK ZONE ENFORCEMENT PROJECT

OREGON WORK ZONE ENFORCEMENT PROJECT

In recent years there has been a decrease in traffic deaths and injuries in roadway work zones. In 2000, the lowest number of fatalities since 1995 was reached. The decrease may be attributable to the combined efforts of law enforcement, engineering improvements and an increased education effort. It's important to remember, though, that since most of today's work is done "under traffic" and traffic volumes continue to increase, risk exposure is still on the rise for both drivers and construction workers. Federal studies show that work zone crashes tend to be more severe than other types of crashes. It's also important to note that over 40 percent of work zone crashes occur in the transition zone prior to the work area.

Under this agreement, ODOT will enlist the forces of the Oregon State Police and/or other law enforcement agencies as authorized by ODOT and in compliance with the provisions of local cooperative policing agreements, to patrol specified work zones on State highways. The prevailing wage rates paid under this agreement will include salary, OPE and vehicle/equipment costs. The overtime rate will also include salary, OPE and vehicle/equipment costs. This provision will apply to both state and local law enforcement agencies.

Crash Data from Oregon Work Zones

Year	Fatalities	Crashes	Construction \$ in Millions	% Change in \$
1985	3	N/A	149.7	N/A
1986	12	360	166.2	11%
1987	12	395	158.9	-4%
1988	11	416	240.8	52%
1989	17	492	230.6	-4%
1990	11	504	283.3	23%
1991	15	371	209.6	-26%
1992	4	429	195.1	-7%
1993	12	416	278.0	42%
1994	20	447	292.9	5%
1995	3	488	208.7	-29%
1996	8	549	343.4	65%
1997	21	370	392.3	14%
1998	14	485	264.5	-33%
1999	9	412	305.0	15%
2000	6	374 [†]	271.4	-11%
To date	178	6,508		

[†]Estimate based on 81 percent of year 2000 crashes recorded.

Source: ODOT Crash Analysis and Reporting Unit.

APPENDIX E: STATE DOT SURVEY

APPENDIX F: STATE DOT SURVEY RESPONSES

Survey responses to questions 1-4

<i>State</i>	<i>Formal policy</i>	<i>Funding source</i>	<i>Method</i>	<i>Costs quantified</i>	<i>Criteria</i>	<i>Type of work zones</i>
Arkansas	Yes	Additional funding is appropriated by change order to allow overtime payments to Arkansas Highway Police officers who provide traffic control in work zones in addition to their regular duties. (AHP is a division of the Arkansas Highway and Transportation Department.)	Construction funds (FHWA participates)	Yes	Traffic volumes, classification of road, peak hour congestion, and primarily on interstate routes	Long term
Georgia	Yes	Federal and State highway construction funds	Paid an hourly rate through the contractor	No	Traffic volumes, and classification of road	Long term
Idaho	No	Paid with project money.	Overtime paid by DOT	No	Typically used on urban interstates where conformance to speed limits is low.	Long term
Illinois	Yes	Illinois Road Fund	IDOT/ IL State Police have an Inter-agency agreement to transfer the funds to ISP. ISP handle payroll to troopers. They are paid overtime rate of 1.5 times salary for hours worked.	Yes	Traffic volumes, and classification of road	Long term
Indiana	Yes	Grants and work zone tickets	NA*	Yes	Traffic volumes, classification of road, and peak hour congestion	Long term
Iowa	Yes	Project Funds	External Voucher	Yes	Traffic Volumes, classification of road, and peak hour congestion	Long term
Kansas	No	Construction funds	Overtime pay	No	Upon request of field personnel based on problems encountered.	NA*

<i>State</i>	<i>Formal policy</i>	<i>Funding source</i>	<i>Method</i>	<i>Costs quantified</i>	<i>Criteria</i>	<i>Type of work zones</i>
Kansas Highway Patrol	Yes	Funding is provided by the Kansas Department of Transportation	Overtime for hours worked in excess of the normally scheduled 80 hours in a pay period. Straight time for hours not constituting overtime. (I.e. if leave was taken during a pay period)	No	Traffic volumes, classification of road, peak hour congestion, and final determination made by resident engineer.	Short term
Kentucky**	Yes	Statute includes "double fines" and designates the extra portion of the fine to be used specifically to pay for the extra time.	Overtime pay or regular salary can be charged to the special fund discussed in Source.	Yes	Project design team decision, resident engineer, contractor request, etc...	Long term and moving operations
Kentucky**	Yes	Funds from citations in work zones are used to fund enhanced law enforcement in work zones.	Funds are deposited into an account within the Transportation Cabinet.	No	Normally at the request of the resident engineer on the construction project.	Long term
Louisiana	No	Usually included in cost of project with State or Federal funding.	Contractor pays going rate for off-duty officers plus vehicle cost.	No	Classification of road (Interstate highways only at this time).	Long term most frequently, but some moving operations for pavement markings replacement.
Maryland	Yes	Charged to the project (with FHWA as appropriate)	Highway Agency billed.	Yes	Traffic volumes, classification of road, peak hour congestion, lane closures, and temporary road closures.	Long term
Michigan	No	Construction funds	Police charge MDOT an agreed amount on per hour for officer and vehicle.	Yes	At the sole discretion of the project office or region, overseeing a particular project. Criteria is based on available funds for the enforcement along with volumes, peaks, and perceived high speeds in area.	Long term

<i>State</i>	<i>Formal policy</i>	<i>Funding source</i>	<i>Method</i>	<i>Costs quantified</i>	<i>Criteria</i>	<i>Type of work zones</i>
Minnesota	Yes	Construction funds tied to project.	Inter agency agreement	Yes	Traffic volumes, classification of road, peak hour congestion, and night	Short term, and moving operations
Mississippi	No	State and/or Federal funds	The DOT pays the Highway Patrol hourly wages and some expenses, when specified for particular projects.	No	Traffic volumes, classification of road, peak hour congestion, closing of roadways for short durations, setting bridge beams over traffic, demolishing existing bridges, etc.	Long term, short term, and moving operations
Missouri	Yes	A combination of Federal (90% or 80%, as applicable) and State (10% or 20%, as applicable) funds are used to pay for the cost of dedicated law enforcement on construction projects.	Is paid at a contract unit price to the contractor provided provisions are included for such in the contract documents. The contractor in turn has an agreement with the jurisdiction providing law enforcement services to pay for said services.	Yes	Road, traffic, work and environmental characteristics, as well as past history should be taken into account when deciding whether or not to use this tool.	Specifies, dedicated law enforcement only in long term and moving construction work zones. While ad hoc law enforcement is used in short term and moving construction and maintenance work zones.
Nebraska	No	Currently use a budgeted amount of contractual service using state funds.	Patrol overtime work is billed to the department via interagency billing.	Yes	Arranged as needed by District Engineers and the Highway Patrol.	Long and short term
Nevada	Yes	Law enforcement is paid for under traffic control, therefore, depending on the job, the funding could be Federal and/or State dollars.	Officers are paid by the hour at their overtime rate.	NA*	Traffic volumes, classification of road, signalized interruption and moving operations on Interstates.	Short term, and moving operations

<i>State</i>	<i>Formal policy</i>	<i>Funding source</i>	<i>Method</i>	<i>Costs quantified</i>	<i>Criteria</i>	<i>Type of work zones</i>
New Mexico	No	Federal Safety Funds, Cooperative Agreements with the local agencies, State Safety Funds, Regular Project Funds via charge orders.	Payment thru their agency (normal paycheck or overtime pay).	Yes	Traffic volumes, and classification of road	Long and short term
Ohio	No	State funds	Extra duty pay	No	As needed	Long term
Oregon	Yes	Federal Construction funds	Hours (either OT or regular hours) are verified and approved by ODOT staff. Approved hours are returned to the enforcement field station for forwarding to General Headquarters. GHQ aggregates the billings from the various field stations and forwards a single bill to the Transportation Safety Division of ODOT on a regular basis.	Yes	Complexity of the project number of stages, traffic volumes and perceived risk to workers.	Long term
Pennsylvania	Yes	Project funds	The State Police bill the DOT directly, local police are paid by the contractor by pay item in contract.	Yes	Traffic volumes, classification of road, peak hour congestion, and workers on foot.	Long term and moving operations
Rhode Island	Yes	FHWA funds	Detail slips are submitted by the officer and paid by construction section.	Yes	Classification of road	Long and short term
South Dakota	Yes	Regular State funding	Highway Patrol are paid through the Highway Patrol - regular time and overtime. Those hired by SDDOT are paid directly.	Yes	Traffic volumes, classification of road, type of work, and proximity of worker to traffic	Long term

<i>State</i>	<i>Formal policy</i>	<i>Funding source</i>	<i>Method</i>	<i>Costs quantified</i>	<i>Criteria</i>	<i>Type of work zones</i>
Tennessee	Yes	Interagency agreement between TDOT and The Department of Safety.	They are paid through the Department of Safety, they then journal voucher To TDOT for the costs.	Yes	Traffic volumes, classification of road, and peak hour congestion	Short term
Vermont	Yes	VTrans uses Federal funds to pay for the State Police to control speeding in their work zones on the interstates. Also estimate Uniform Traffic Officers with car to be used on paving projects and large projects.	To control speeding in work zones use a yearly contract with State police depending on how many project miles of interstate work is necessary. UTO are paid and hired by contractor.	Yes	Traffic volumes, classification of road, peak hour congestion, and work zone speed,	Long and short term
Virginia	Yes	State funded	Paid overtime (time and a half)	No	Traffic volumes, classification of road, and night work on limited access highways.	Long term, short term, and moving operations
Washington	Yes	State Funds	Overtime	No	Type of Traffic control and time of day	Long term
West Virginia	Yes	Project funds	The contractor is responsible for payment.	Yes	Traffic volumes, classification of road, and nature of work	Long term
Wisconsin	Yes	Highway improvement project funding.	Overtime wages charged by State Patrol to the highway improvement project.	Yes	Traffic volumes, classification of road, peak hour congestion, posted speeds, type of project (roadway reconstruction, bridge, etc.), and length of work zone.	Long term

* No answer was submitted.

** Answers submitted by two individual DOT staff.

Survey responses to questions 5-11

<i>State</i>	<i>On-duty / off-duty</i>	<i>State / local</i>	<i>Hours of operation</i>	<i>Special training provided</i>	<i>Types of vehicles used</i>	<i>Warning lights required</i>	<i>Officer placement</i>	<i>Protective apparel required</i>	<i>Pull-off areas provided</i>
Arkansas	Both on and off duty	State law enforcement	Day and night	No	Regular patrol vehicles	No	Advance and within	No	No
Georgia	Volunteer off-duty only	Local law enforcement	Day and night	No	Marked	Yes	Advance and within	No	No
Idaho	Volunteer off-duty only	State law enforcement	Daytime only	No	Marked	No	Typically are roving through work zone.	No	No
Illinois	Volunteer off-duty only	State law enforcement	Daytime only	No	Marked	No	Advance and within	No	No
Indiana	Volunteer off-duty only	State law enforcement	Daytime and rush hours	No	Marked and unmarked	No	Advance and following	No	No
Iowa	Volunteer off-duty only	State law enforcement	Day and night, weekends (based on input from enforcement and project engineer.	No	Marked and unmarked (officers normal vehicle)	No	Advance	No	No
Kansas	Volunteer off-duty only	State law enforcement		No	Marked	No	Advance, within, and following	No	No
Kansas Highway Patrol	Volunteer off-duty only	State law enforcement	Day and night	No	Marked	Yes	Within	No	No
Kentucky**	Both on and off-duty, but mostly off-duty	Use KY State Police and KY Motor Vehicle Enforcement.	Used during daytime and rush hours. Can only be enforced when workers present.	No	Marked	No	Within	No	No
Kentucky**	Both on and off-duty	State law enforcement	Daytime only	No	Marked	No	Advance and within	No	No

<i>State</i>	<i>On-duty / off-duty</i>	<i>State / local</i>	<i>Hours of operation</i>	<i>Special training provided</i>	<i>Types of vehicles used</i>	<i>Warning lights required</i>	<i>Officer placement</i>	<i>Protective apparel required</i>	<i>Pull-off areas provided</i>
Louisiana	Both on duty and volunteer off-duty are used.	State law enforcement	Day and night	No	Marked	Yes	Within	Yes	No
Maryland	Volunteer off-duty only	State law enforcement	Day and night	Yes	Marked	Yes	Within	No	No
Michigan	Volunteer off-duty	State law enforcement	Day and night	No	Marked	No	Within	No	No
Minnesota	Volunteer off-duty only	State law enforcement, and local law enforcement now and then	Day and night, rush hours, and weekends	No	Marked	Yes	Advance. within and following, on large urban freeways use one advance and another within or roving.	Yes	Yes
Mississippi	Both on-duty 50%, and volunteer off-duty, 50%	State law enforcement	Day and night	No	Marked	No	Advance, and within	Yes	No
Missouri	Both on and off duty	State and local law enforcement	Contractors decision when to use law enforcement. Use ad-hoc law enforcement during daylight hours.	Yes	Marked and unmarked (Officer's normal vehicle)	No	The location of enforcement is of the officer's choice	No	No
Nebraska	Volunteer off-duty	State law enforcement	Day and night	No	Marked vehicles	No	NA*	No	No
Nevada	Volunteer off-duty	State law enforcement	Day and nigh	NA*	Marked	Yes	Within	NA*	Yes
New Mexico	On-duty only	Local law enforcement	Day and night	No	Marked	No	Within	No	No

<i>State</i>	<i>On-duty / off-duty</i>	<i>State / local</i>	<i>Hours of operation</i>	<i>Special training provided</i>	<i>Types of vehicles used</i>	<i>Warning lights required</i>	<i>Officer placement</i>	<i>Protective apparel required</i>	<i>Pull-off areas provided</i>
Ohio	Volunteer off-duty only	State law enforcement	Daytime only	No	Marked	Yes	Advance	Yes	Yes
Oregon	50% on duty and 50% volunteer off-duty	State law enforcement	Day and night	No	Marked	No	Advance	No	No
Pennsylvania	Volunteer off-duty only	State law enforcement	Day and night	NA*	Marked	Yes	Advance	NA	Yes
Rhode Island	Volunteer off-duty only	Local law enforcement	Day and night	NA*	Marked	NA*	Advance and within	Yes	NA*
South Dakota	60% on-duty and 40% volunteer off-duty	Use on duty state law enforcement and off-duty local enforcement	Daytime only	Yes	Marked	No	Following	Yes	No
Tennessee	On-duty only	State law enforcement	Daytime only	No	Marked	No	Advance	No	No
Vermont	Volunteer off-duty only. UTO are both on-duty and volunteer	Speed Control: state law enforcement UTO : local law enforcement	Day and night, rush hours, and weekends	No	Marked	Yes	Advance, and within	Yes	No
Virginia	Volunteer off-duty only	State law enforcement	Day and night	No	Marked	Yes	Within	Yes	No
Washington	Volunteer off-duty	State law enforcement	Day and night	Yes	Marked	No	Advance	Yes	No

<i>State</i>	<i>On-duty / off-duty</i>	<i>State / local</i>	<i>Hours of operation</i>	<i>Special training provided</i>	<i>Types of vests used</i>	<i>Waiver required</i>	<i>Officer placement</i>	<i>Protective apparel required</i>	<i>Pull-off areas provided</i>
West Virginia	Volunteer off-duty only	State and local law enforcement	Day and night	NA*	Marked	Yes	Within	NA*	NA*
Wisconsin	On-duty	State law	Day and night	NA*	Marked		Advance and within	NA*	

NA*

* No answer was submitted

** Answers submitted by two separate DOT employees.

NA*

Survey responses to questions 12-16

<i>State</i>	<i>Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
Arkansas	No	No	Yes	Yes	No	No		
Observed Georgia	No	No	Yes	NA*	No	No	Specific code provisions for work zones	
Idaho	No	No	No	NA*	No	No		Possibly looking into a policy, have formed a Work Zone Safety Team that is looking at this option. ITD is working on same issues, are very interested in results of survey
Illinois	No	No	Yes	Yes	No	No	A formal policy / program regarding extra law enforcement in work zones. Specific Code provisions for work zones.	
Indiana	No	No	Yes	Yes	No	No	A formal policy/program regarding extra law enforcement in work zones. Specific code provisions for work zones.	
Iowa	Yes. Sometimes increased congestion due to more vehicles traveling the speed limit adjacent to and following the enforcement vehicle.	No	Yes	Yes	No	No	A formal policy/program regarding extra law enforcement in work zones. Specific code provisions for work zones.	

<i>State</i>	<i>Observed Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
Kansas	No	No	Yes	Yes	No	No		
Kansas Highway Patrol	No	No	Yes	Yes	No	No	Specific Code provisions for work zones.	
Kentucky**	No	No	Yes	Not quantified	No	No	Specific Code provisions for work zones, such as double fines, etc.	May also contact Jeff Bibb with the Division of Driver Safety 502-564-3276 and Steve Maffett 502-564-3276 with KY Motor Vehicle Enforcement for more information on training and law enforcement
Kentucky**	No	No	Yes	No	No	No	Specific Code provisions for work zones.	
Louisiana	No	No	Yes	Yes	No	No	Specific Code provisions for work zones, such as double fines.	
Maryland	No	No	Yes	Yes	No	Yes	A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones, such as double fine. Special training materials for police officers patrolling work zones. Research or documentation on the effectiveness of police presence in work zones.	Your use of the word "extra" had us wondering some what was meant. We interpreted your questionnaire to mean any police usage.

<i>State</i>	<i>Observed Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
Michigan	Yes	No	Yes	Yes	No	No	Specific code provisions for work zones.	
Minnesota	NA*	No	Yes	Yes	Yes	Yes	A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones. Research or documentation on the effectiveness of police presence in work zones. Legislation enabling automated enforcement in work zones	Special training material for police officers is a good idea. Talked about doing training but never actually did it four state patrol. It's all on the job training.
Mississippi	Yes, can create added congestion when used in work zones.	No	Yes	Yes and no	No	No		
Missouri	Unable to provide an answer to this question.	No	No	NA*	No	No	A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones.	In 2000 and 2001, MoDOT had 10 and 45 projects in which the law enforcement provisions was included in the contract, respectively. While these projects were mostly confined to the Kansas City and St. Louis metropolitan areas, the statewide average bid price for this service was \$52.91 and \$43.29 per hour based on an estimated 2,008 and 42,460 hours of need, respectively.

<i>State</i>	<i>Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
<i>Observed</i>								
Nebraska	Yes, some on major interstates that operate near capacity, however that is where they request their enforcement more.	No	No	NA*	No	No		Receive a monthly report of hours worked by area and trooper.
Nevada	No	NA*	Yes	Yes	No	NA*	A formal policy/program regarding extra law enforcement in work zones. Specific code provisions for work zones.	Safety pull off areas are located in Las Vegas only, and are not specifically designed for traffic control during construction, but designed as part of the roadway.
New Mexico	No	No	Yes	Yes	No	No	Specific Code provisions for work zones.	Considering adopting a formal policy.
Ohio	Yes, traffic begins to slow down to below the posted speed.	No	Yes	No	No	No	Specific code provisions for work zones	

<i>State</i>	<i>Observed Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
Oregon	No	No	Yes	Yes	Yes	Yes	A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones, such as double fines, etc. Research or documentation on the effectiveness of police presence in work zones.	Attached are the program guidelines for Work Zone Enforcement in Oregon. Due to Constitutional limitations (Oregon), no state highway funds may be used for enforcement. The program is run as a statewide program, not at the project level. It is managed (policy and procedures) centrally and administered (project identification, hours assignment, police scheduling) at the local level. All ODOT projects are eligible for special work zone patrol funding as long as the project design meets federal standards. Maintenance projects are not eligible.
Pennsylvania	Yes, if highway is running below capacity, vehicles will slow down creating congestion.	NA*	No	Yes	Yes		A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones.	
Rhode Island	No	NA*	Yes	Yes	No		Specific code provisions for work zones.	

<i>State</i>	<i>Observed Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
South Dakota	No	No	Yes	Yes	Yes	Yes	Formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones. Special training materials for police officers patrolling work zones. Research or documentation on the effectiveness of police presence in work zones.	There are two things being done along interstate projects where traffic is adjacent to the lane closed to traffic and when workers are present. One is an increased Highway Patrol presence. The other is the "DOTCOP" program in which the Department hires and outfits off duty local law enforcement officers for work zone speed enforcement.
Tennessee	No	No	Yes	Yes	No	No	A formal policy/program regarding extra law enforcement in work zones. Specific Code provisions for work zones.	
Vermont	No	No	Yes	NA*	No	No	Specific code provisions for work zones.	Are starting work zone training where all sheriff departments will get at least 4 hours of Flagger training and work zone sign setups.

<i>State</i>	<i>Observed Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
Virginia	No	No	Yes	Yes	Yes	No	A formal policy/program regarding extra law enforcement in work zones. Specific code provisions for work zones.	Pull off areas are not provided per se, but are usually sought out by the police in advance of working a shift. Believe improvements are quantifiable since motorists are observed slowing down and driving slower than normal through the work zone. Are in the process of conducting a research project on the effectiveness of state police in work zones. A work team consisting of Virginia State Police, VDOT work zone coordinators and project construction personnel is being assembled to meet early October to begin the project. Contact Mr. Gene Arnold of the University of Virginia at (434) 293-1931
Washington	No	No	Yes	Yes	No	No	A formal policy/program regarding extra law enforcement in work zones.	Are beginning a pilot to use speed emphasis roving in work zones coupled with speed trailers to re-educate motorists with a report to follow.

<i>State</i>	<i>Adverse effects</i>	<i>Use Automated enforcement</i>	<i>Effective in reducing speed</i>	<i>Effective in improving safety</i>	<i>Improvement quantifiable</i>	<i>Research performed</i>	<i>Formal Documentation</i>	<i>Additional Comments</i>
<i>Observed</i> West Virginia	No	NA*	Yes	Yes	No	NA*	A formal policy/program regarding extra law enforcement in work zones. Specific code provisions for work	
Wisconsin	No	NA*	Yes	Yes	No	NA*	A formal policy/program regarding extra law enforcement in work zones. Specific codes provisions for work zones, such as double	

* No answer was submitted

** Answers submitted by two separate DOT employees.

APPENDIX G: LAW ENFORCEMENT SURVEY

APPENDIX H: LAW ENFORCEMENT SURVEY RESPONSES

Survey response to questions 1-6

Department	Level of participation	Officer selection criteria	On-duty / Off-duty	Hours of operation	Special training provided	Vehicle type
Coralville Police Department	Each year since 1998	Volunteer only	On-duty only (overtime)	Nights	Yes, instructions of responsibilities and position	Marked
Des Moines Police Department	NA*	Volunteer only and radar/OWI certified	Volunteer off-duty only	Day and Night	No	Marked
Iowa City Police Department	Three occasions. This may have involved several weekends of participation, but it was for three separate projects.	Selection based on contract languages as it applies to overtime duty.	Volunteer off-duty only	Day and Night (Primarily evening, night, early morning)	No	Marked
Iowa State Patrol	620 shifts in 4 work zones	Volunteer only	Both on-duty (25%) and volunteer off-duty (75%)	Rush hours, weekends. Try to target high traffic volume times, rush hours and Sunday afternoons on weekends. Also take in account special events i.e. football games, concerts, etc. when traffic may be heavy.	Yes, discuss passenger side approaches and whether we want traffic direction for trucks entering/leaving the work zone.	Marked
Missouri State Patrol	300 times	Volunteer only	both on-duty (25%) and volunteer off-duty (75%)	Day and night	No	Marked

* No answer was provided.

Survey responses to questions 7-12

<i>Department</i>	<i>Officer placement</i>	<i>Special protective apparel</i>	<i>Primary activities</i>	<i>Pull-off areas provided</i>	<i>Observed Adverse effects</i>
Coralville Police Department	Within by the work crew	No requirement for foot work. Vests are available.	Warning and slowing traffic	NA*	No
Des Moines Police Department	Advance and within	No	Both enforcement and warning, slowing traffic	No	No
Iowa City Police Department	Advance	No	Warning and slowing traffic	No	No
Iowa State Patrol	Within	No	Enforcement and warning, slowing traffic. Depends on the work zone and area. If there is paving, a lot of times is spent warning and slowing. If it is shoulder work conduct enforcement efforts.	No	No
Missouri State Patrol	Within	No	Both enforcement and warning, slowing traffic	No	No

*No answer was provided.

Survey responses to questions 12-15

<i>Department</i>	<i>Specialized Enforcement Equipment</i>	<i>Effective in Reducing Speeds</i>	<i>Effective in Improving Safety</i>	<i>Benefits Documented</i>	<i>Comments</i>
Coralville Police Department	Yes	Yes	yes	No	Use of high visibility lights and LED lights.
Des Moines Police Department	Yes	Yes	Yes	No	Test began in April 2002 with the initial stages of the I-235 re-construction. When possible assign police officers in strategic locations for the following reasons: Enforcement, staffing along detour routes, and work zone protection. Electronic message boards are invaluable during major construction projects that require large traffic volumes to use detour routes. Heavy enforcement/incident management activities will be implemented over the coming years as remove/replace the existing I-235 surface.
Iowa City Police Department	No	Yes	Yes	No	Although the evidence would be anecdotal, discussion of efficacy of extra enforcement with the construction crews may be of benefit to the researchers.
Iowa State Patrol	No	Yes	Yes	Yes	Degree of focus depends on the type of work zone. May feel it is necessary to slow people down prior to the zone so focus on the area preceding the construction zone. If a lot of trucks are entering or exiting an area may station a trooper by the location the trucks enter and exit to slow traffic in that area.
Missouri State Patrol	Yes	Yes	Yes	No	

APPENDIX I: STATE DOT AND OTHER CONTACTS

State DOT Contacts

State	Name	Title/Position	Phone Number	Address	E-mail
AR	Steve Peeples	Staff Construction Eng.	(501) 569-2582	Arkansas DOT P. O. Box 2261 Little Rock, Arkansas 72203-2261	Steve.Peeples@ahtd.state.ar.us
CO	Karen Duffala	Safety Programs Administrator	(303) 757-9273	Traffic & Safety Engineering Branch 4201 E. Arkansas Ave. Denver, CO 80222-3400	karen.duffala@dot.state.co.us
GA	David Graham	State Construction Engineer	(404) 656-5306	NA	david.graham@dot.state.ga.us
ID	Lance Johnson	Asst. State Traffic Eng.	(208) 334-8557	Idaho DOT P.O. Box 7129, Boise, ID 83707	ljohnson@itd.state.id.us
IL	Kenneth Wood	Engineer of Traffic Operations	(217) 782-2076	Illinois DOT 2300 S. Dirksen Springfield, IL 62764	WOODKC@nt.dot.state.il.us
IN	Timothy D. Bertram	Division Chief of Contracts and Construction	(317) 232-5502	100 N. Senate Ave. Room 855 Indianapolis, IN 46204	tbertram@indot.state.in.us.
IA	Mark Bortle	Traffic Safety and Automation Eng.	(515) 239-1587	Iowa DOT 800 Lincoln Way Ames, IA 50010	Mark.Bortle@DOT.STATE.IA.US
KS	Mike Crow	Bureau of Traffic Engineering	(785) 296-3618	NA	mikec@ksdot.org
	Mark Bruce	Kansas Highway Patrol	(785) 296-6800	122 SW Seventh Street Topeka, KS 66603	MBruce@mail.khp.state.ks.us
KY	Jeff Wolfe	Transportation Engineer Specialist	NA	NA	jeff.wolfe@mail.state.ky.us
	Paul David Cornett	Vice Management of Division of Operations	(502) 564-4556	Kentucky DOT State Office Building Room 705 Frankfurt, KY 40622	davidp.cornett@mail.state.ky.us
	Duane Thomas	NA	(502) 564-3020	NA	Duane.Thomas@mail.state.ky.us
LA	Thomas Payment	Traffic Engineering & Services Administrator	(225) 935-0131	LA DOT 7686 Tom Drive Baton Rouge, LA 70806	tompayment@dotd.state.la.us
MD	Tom Hicks	Director, Office of Traffic and Safety	(410) 787-5815	7492 Connelley Dr. Hanover, MD 21076	thicks@sha.state.md.us
	Jawad Paracha	Office of Traffic Safety	(410) 787-5860	MD State Highway Administration Traffic Development & Support Division 7491 Connelley Drive Hanover MD 21076	jparacha@sha.state.md.us

MI	Jeff Grossklaus, P. E.	Construction Staff Engineer	(517) 322-5769	Michigan DOT Construction and Technology Division P.O. Box 30049 8885 Ricks Rd. Lansing, MI 48909	grossklausj@michigan.gov
MN	Bill Servatius	Transportation Program Supervisor Sr.	(651) 296-2721	MN DOT TRANSPORTATION DEPARTMENT 395 John Ireland Blvd. Mailstop: 650 S; Paul, MN 55155-1899	Bill.Servatius@state.mn.us
MO	Scott Stotlemeyer	Technical Support Engineer Maintenance Operations	(573) 751-2785	MO DOT 2211 St. Mary's Blvd. Jefferson City, MO 65109	stotls@mail.modot.state.mo.us
MS	Brad Lewis	Asst. State Traffic Eng.	(601) 359-7301	NA	BLewis@mdot.state.ms.us
NE	Daniel Waddle	Signing and Marking Engineer	(402) 479-4325	NE Dept. of Roads 1500 Nebraska Hwy. 2 Lincoln, NE 68509	dwaddle@dor.state.ne.us
NV	Ruedy Edgington	Chief Construction Eng.	(775) 888-7469	NV DOT 1263 S. Stewart St. Rm 210 Carson City, NV 89712	redgington@dot.state.nv.us
NM	John Uher	NA	(505) 827-9896	NA	John.Uher@nmshtd.state.nm.us
OH	McCarthy Braxton	Transportation Work Zone Engineer	(614) 752-8829	Office of Traffic Engineering Ohio DOT 1980 West Broad St. Columbus, OH 43223	Mack.Braxton@dot.state.oh.us
OR	Steve Vitolo	Program Manager Law Enforcement and Judicial Programs	(503) 986-4446	NA	steve.d.vitolo@odot.state.or.us
	Larry Christianson	Program contact for all work zone related items in Oregon	(503) 986-4195	ODOT Transportation Safety Division 235 Union Street, NE Salem, OR 97301-1054	Larry.P.CHRISTIANSON@odot.state.or.us
PA	Richard Sesney	Regulations and Work Zone	(717) 783-6080	PA DOT Commonwealth Keystone Bldg. 400 N. St., 6th Fl. Harrisburg, PA 17120	rsesny@penndot.state.pa.us
RI	Frank Corrao	Chief Civil Engineer	(401) 222-2694	Traffic Engineering Rhode Island DOT Two Capitol Hill Providence, RI 02903	fcorrao@dot.state.ri.us
SD	John Adler	Traffic Operations Engineer	(605)773-4759	South Dakota DOT 700 East Broadway Pierre, SD 57501	John.Adler@state.sd.us

TN	David Donoho	Construction Director	(615) 741-2414	Tennessee DOT 505 Deaderick Street Suite 700 James K. Polk Bldg Nashville, TN 37243	david.c.donoho@state.tn.us
VA	David Rush	Traffic Engineering Division	(804) 371-6672	VA DOT 1401 E. Broad St. Room 26 Richmond, VA 23219	rush_db@vdot.state.va.us
VT	John Perkins	Traffic Operations Engineer	802-828-2603	VT DOT 1221 E. Broad St. Richmond, VA 23219	john.perkins@state.vt.us
WA	Roger Steinert	Const. Traffic Coordinator	(206) 440-4471	WA DOT 15700 Dayton Ave. N. Seattle, WA 98133-9710	steinert@wsdot.wa.gov
WV	Charles Lewis	Planning and Research Eng.	(304) 558-8912	NA	rlewis@dot.state.wv.us
WI	Tom Notbohm	Traffic Operations Eng.	(608) 266-0982	WI DOT 4802 Sheboygan Ave. Room 501, PO Box 7986 Madison, WI 53707-7986	tnotbohm@mail.state.wi.us

Other Contacts

Name	Department	Title/Office	Phone Number	Address	E-mail
Kevin Merryman	Iowa DOT	Resident Engineer	(515) 262-5692	P.O Box 4043 Highland Park Station Des Moines 50333	Kevin.merryman@dot.state.ia.us
Ken Yanna	Iowa DOT	Resident Engineer	(319) 365-6986	5455 Kirkwood Blvd. SW Cedar Rapids 52404	Kenneth.yanna@dot.state.ia.us
Mark Brandl	Iowa DOT	Resident Engineer	(319) 391-2750	P.O. Box 2646 Iowa 130 Davenport 52809	Mark.brandl@dot.state.ia.us
Kent Ellis	Iowa DOT	Assistant Resident Engineer	(319) 365-6986	5455 Kirkwood Blvd. SW Cedar Rapids 52404	kent.ellis.@dot.state.ia.us
Jerry Dickinson	Iowa DOT	Media and Marketing Service	(515) 239-1667	800 Lincoln Way Ames 50010	Jerry.Dickinson@dot.state.ia.us
Deanna Maifield	Iowa DOT	Design Department	(515) 239-7888	800 Lincoln Way Ames 50010	Deanna.maifield@dot.state.ia.us
Mark Campbell	Iowa GTSB	Area Administrator	(515) 281-5430	215 East 7th St. Des Moines 50319	Campbell@dps.state.ia.us
Bob Rushing	Iowa GTSB	Law Enforcement Liaison	(515) 281-8836	215 East 7th St. Des Moines 50319	rushing@dps.state.ia.us
Lt. Gary Nieuwsma	Iowa State Patrol	—	(515) 725-0010	260 NW 48th Place Des Moines 50333	NA
Sgt. Dana Wingert	Des Moines PD	—	(515) 283-4816	25 E. 1st St. Des Moines 50309	NA
Lt. Terry Koehn	Coralville PD	—	(319) 354-1100	1503 5th St. Coralville 52241	NA

Ct. Matt Johnson	Iowa City PD	—	(319) 356-5440	410 Washington St. Iowa City 52240	Matt-johnson@iowa-city.org
Sgt. Allan Heseman	Missouri State Highway Patrol	Patrol-Research and Development Division	(573) 526-6253	1510 E. Elm St. P.O. Box 568 Jefferson City, MO 65102	hesema@mshp.state.mo.us
Jay Wall	Oklahoma State Patrol	—	NA	NA	jwall@dps.state.ok.us
Karen Brunelle	TN FHWA	—	NA	NA	Karen.brunelle@fhwa.dot.gov
Jerry Behning	Davenport PD	Retired	(563) 843-2533	NA	Ch3b@aol.com
Gordon LaFrance	ND Law Enforcement Liaison	-	(701) 328-4252	NA	glafranc@state.nd.us
Cpt. Paul Dean	NH Police Standards and Training	-	(603) 862-1427	NA	NA
Cpt. Tom Walsh	NH Police Standards and Training	-	(603) 271-2133	NA	NA

