

FULL ROAD CLOSURE FOR WORK ZONE OPERATIONS: A Case Study

**Reducing the Impact of
Construction During the
Rehabilitation of a Major
Interstate Highway**

**Interstate 95 in
Wilmington, Delaware**



December 2004

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Preface

This case study is one in a series of documents that examine the use of Full Road Closure in work zones. More information on this methodology, and variations of full road closure, is available in the companion document, *Full Road Closure in Work Zones—A Cross-Cutting Study* (Report No. FHWA-OP-04-009).

Information from this case study was gathered during interviews with project personnel, following completion of the I-95 rehabilitation project. Information was also gathered through Internet searches and review of related material. The authors greatly appreciate the cooperation of the Delaware Department of Transportation and its partners and thank them for sharing their experiences and insights from the I-95 project.

Table of Contents

Introduction	1
Project Specifications and Background	2
Planning	4
Operations	6
Benefits/Impacts of Full Road Closure	8
Issues and Lessons Learned	9
Summary	10

Introduction

State highway agencies and transportation professionals face the challenge of balancing essential roadway repairs and maintenance with mobility and safety concerns. As a result, some agencies are looking at nontraditional construction methods to rehabilitate roadways while reducing the negative impacts of construction. One such methodology achieving success is full road closure.

A full closure is the removal or suspension of traffic from a particular section of roadway for the purpose of rehabilitation and/or maintenance. Full closures may be short term, lasting for a weekend, or longer term, lasting for months or more than a year. A growing number of rehabilitation projects have been done using a full closure approach, often with similar successful results. Contractors that are given full access to the road gain efficiencies that often reduce project duration and costs as well as improve the quality of the end product. These positive effects usually lead to increased favorable public sentiment, and potentially reduce both short- and long-term user costs.

This document describes the planning, implementation, benefits, and lessons learned by the Delaware Department of Transportation (DelDOT) during an Interstate 95 (I-95) rehabilitation project. This case study illustrates a successful application of the full closure approach. It is intended to provide transportation agency personnel and elected officials with a better understanding of the considerations necessary to implement full road closure on a project, and the benefits that can be obtained.

DelDOT was challenged to repair a 30-year-old section of I-95 that was in poor condition, while maintaining mobility and safety for workers, motorists, and commercial

truck traffic. The 6.1 mile section of roadway between Wilmington, Delaware, and the Pennsylvania state line called for rehabilitation of pavement, bridges, the drainage system, lighting, and safety features, as well as 10 interchange ramps.

In order to reduce the impact on motorists and workers, and given the availability of an alternate route with ample capacity, DelDOT decided to use a full road closure approach for the I-95 project. I-95 would be shut down completely, one direction at a time, with traffic detoured to I-495. Alternate routes would need improvement in anticipation of increased congestion during the full closure. DelDOT partnered with other agencies, the public, and private businesses to ensure project success. Together, the stakeholders developed a traffic management plan titled *The Five Elements of Mobility*.

Overall, the I-95 rehabilitation project was viewed as a successful project. Project personnel estimate that the project would have taken approximately two years to complete using traditional maintenance of traffic and half-width construction, while full road closure allowed the project to be completed in 185 calendar days. DelDOT engineers also felt that the I-95 project was completed with better quality and increased safety for motorists and workers.

The type of rehabilitation required on I-95 was not innovative. However, using full closure on the primary north/south route along the East Coast and implementing an extensive transportation management plan put Delaware on the forefront for innovative work zone planning and operation.

Project Specifications and Background

In 1996, DeIDOT began planning for the rehabilitation of I-95. The 6.1 mile northern section of I-95 from Wilmington, Delaware, to the Pennsylvania state line was more than 30 years old and in need of repair. Population growth and economic development along the northeastern coast had led to a significant increase in average daily traffic. Peak periods for traffic congestion had lengthened, leaving little time to conduct roadwork during non-peak periods. DeIDOT developed an innovative strategy that would provide mobility and safety, while returning the road to full operational status as soon as possible. The plan was to completely eliminate and detour one direction of traffic along I-95. This would provide the contractor

with an expanded work area that would enable work to be done more efficiently, reducing the construction time. Figure 1 shows the location of the full closure and the recommended alternate route.

Project specifications called for pavement rehabilitation, bridge repair, interchange ramp repairs, drainage system improvements, lighting installation, and safety feature repairs and improvements. Full-depth reconstruction was used to maintain areas of critical clearance under bridges.¹ The existing 10-inch concrete pavement was rubblized and topped with asphalt. Rubblization allowed the contractor to leave the old concrete material on-site,

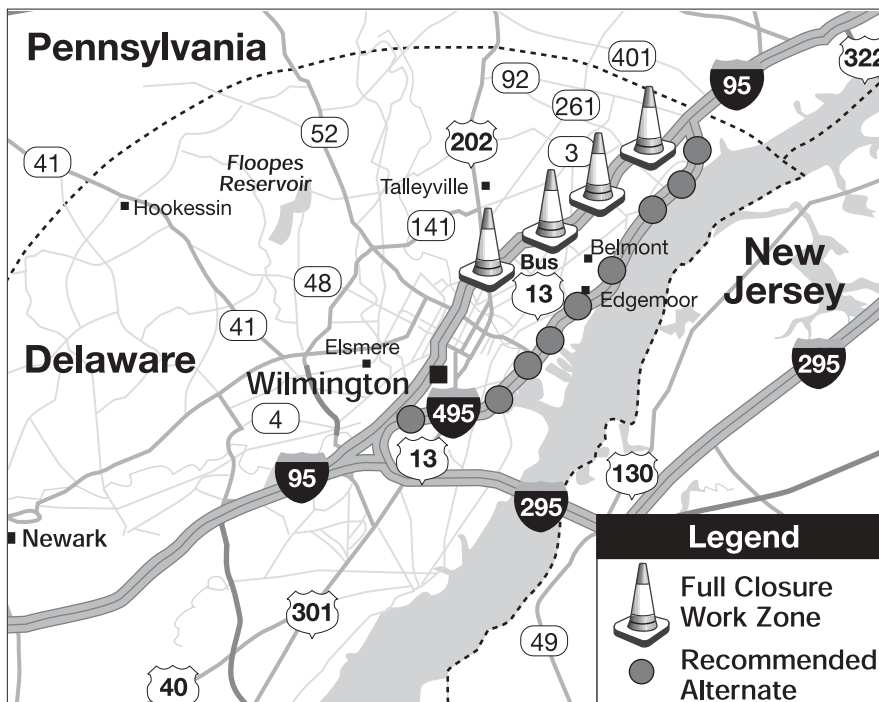


Figure 1 – Full closure of I-95 with alternate route (I-495) recommended

¹ American Society of Civil Engineers – Maryland Section (2000). *Delaware I-95 Reconstruction*. June 2000 Newsletter, Vol. 100 No. 10.

eliminating the need to haul it away, which saved valuable time and effort. The decision to use asphalt eliminated the cure time necessary with concrete, further reducing overall project duration.

With the high levels of traffic that would be affected by the I-95 roadwork, DelDOT took steps to minimize the impacts. DelDOT's analysis estimated an approximate user delay cost of \$88,000/day for the maintenance of traffic plan they were using. To encourage timely completion of the work, DelDOT developed an incentive/disincentive package based on four project phases, lasting approximately 30 to 50 days each. DelDOT placed a \$25,000 per day bonus or penalty for up to 10 days on each of these four phases. The contractor had the possibility of earning an additional \$1,000,000 in bonus money for early completion or \$1,000,000 in penalty for a late completion.²

Project characteristics:

- \$23.5 million cost for construction
- 100,000 average daily traffic
- 11 percent commercial vehicle traffic
- Reconstruction of a 6.1-mile section of roadway (24.4 lane miles)
- Project dates—April to October 2000.

Why Use Full Road Closure?

DelDOT used full road closure to lessen the impact of rehabilitation on travelers. Given the availability of an alternate route with sufficient capacity (I-495), DelDOT engineers knew that traffic could be successfully rerouted during construction activities. From the contractor's perspective, using full closure would minimize construction time, provide a safer and more efficient work area, and reduce conflicts with motor vehicles.³

² O'Neill, Darren (2001). *I-95 Reconstruction and The Five Elements of Mobility*. Delaware Department of Transportation.

³ O'Neill, Darren (2001).

Planning

Planning for the I-95 full closure began four years prior to construction. The DelDOT team planned extensively for the project by creating a partnership with stakeholders including political leaders, community activists, business leaders, government officials, and the general public. DelDOT, along with its partners and stakeholders, instituted a transportation management plan (TMP) appropriately titled *The Five Elements of Mobility*. The five elements of mobility were: (1) Public Information; (2) Transportation Management Improvement (TMI) Projects; (3) Integrated Transportation Management Systems (ITMS); (4) Traveling Together; and (5) Capital Improvement Program (CIP) Coordination. Mitigation activities also included the purchase of new buses, and public outreach efforts.

The TMP was a major effort that not only contained elements that were done specifically for the I-95 full closure, but also contained elements that addressed other transportation needs. Through the TMP, the schedules for the projects addressing these other needs were coordinated with the I-95 closure schedule so that the other projects were completed before the closure and could provide benefits during the closure. Implementing the TMP cost \$13 million. Implementation of the TMP enabled DelDOT to mitigate the impacts of full closure reconstruction on the transportation system, with some aspects of the program, particularly the TMI projects and ITMS, intended to provide mobility benefits well beyond this I-95 rehabilitation project.

Public information, TMI, and CIP coordination are discussed in the Planning section here, while ITMS and Traveling Together (transit and carpooling) are included in the Operations section below.

Maintenance of Traffic Planning

The portion of I-95 that would be affected by the closures carried significant amounts of personal vehicle and truck traffic, both commuter and through traffic. As part of the maintenance of traffic planning, regional models of New Castle County were used to identify diversion alternatives associated with various maintenance-of-traffic options.⁴ From the regional models, intersections and roadways predicted to experience severe increases in traffic were identified. The resulting congested sites were then examined further to identify capacity-related improvements that would accommodate projected trip diversion. Prior to beginning the mainline project, capacity improvements were made on alternative routes and intersections. Capacity improvements included sequencing lights, adding turn lane capacity, and improving ramps.

Public Information

The public outreach component of the I-95 rehabilitation project was far-reaching. Beginning two years prior to project implementation, DelDOT initiated a public outreach strategy that resulted in advertisement space in local newspapers, outreach events, public meetings, and a “Survival Guide,” which explained to the public what would happen, when it would happen, and how to plan ahead. As part of the outreach effort, a colorful character known as the traffic “creep” was created; travelers were encouraged to “beat the creep” by taking alternate ramps or routes, allowing for extra travel time, and using carpool or transit options. Figure 2 shows the traffic “creep” visiting with children, and the “Survival Guide” that was distributed to motorists and residents.

⁴ American Society of Civil Engineers – Maryland Section (2000). *Delaware I-95 Reconstruction*. June 2000 Newsletter, Vol. 100 No. 10.

DelDOT also made investments that will reap benefits into the future. For example, one notable step was purchasing a radio station (1380 AM), prior to the project, that relates traffic and travel information on a 24-hour basis. The station was purchased for use both during the project and in the future. The outreach

strategy targeted both in-state/local motorists and out-of-state travelers. Providing information to meet the needs of each group was critical to the success of the outreach effort.

Transportation Management Improvement (TMI) Projects

DelDOT identified congestion problems on local routes prior to beginning rehabilitation on I-95. Given that traffic would worsen during the full closure, small TMI projects were initiated and completed prior to the start of the I-95 closure. Projects included adding turn lane capacity, curb and pedestrian improvements, bus stop enhancements, emergency access ramps, and new interstate access connections.⁵ These projects created efficiencies that reduced congestion during the full closure, and they continue to reap benefits following project completion.

Capital Improvement Program (CIP) Coordination

A six-year program of capital improvements was taking place on many of the alternate routes prior to construction on I-95. To mitigate the impact of other construction projects on the I-95 full closure, scheduling and sequencing of CIP projects that were already underway were adjusted. In some cases, the Delaware General Assembly provided accelerated funding to complete projects earlier. Coordination and completion of CIP projects allowed traffic to flow uninterrupted on alternate routes during the I-95 full closure.

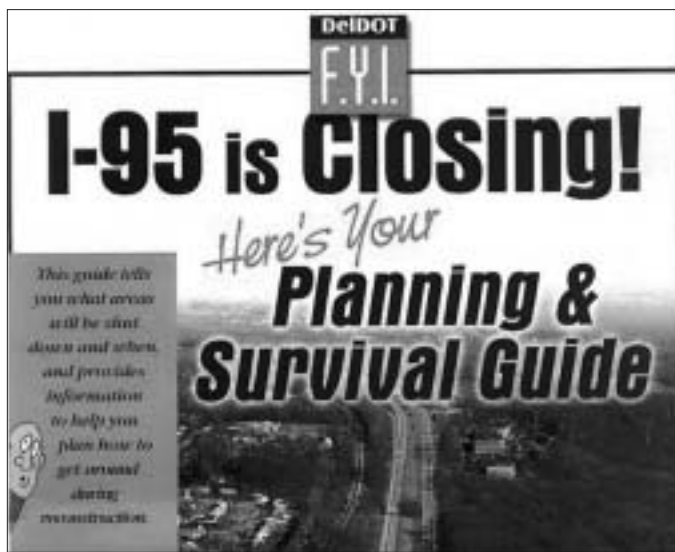


Figure 2 – DelDOT used a character known as the traffic “creep” in public outreach efforts

⁵ O’Neill, Darren (2001). *I-95 Reconstruction and The Five Elements of Mobility*. Delaware Department of Transportation.

Operations

Deployment

Alternate route signage was deployed along I-95 north of the Pennsylvania state line for southbound traffic, and at the I-95 toll plaza near the Delaware state line for northbound traffic. Roadway construction signs were deployed approximately one month prior to beginning construction. Deploying the actual full closure took approximately two to three hours. The DelDOT team used state police officers to perform a rolling roadblock along the route, ensuring that no cars remained on the highway. Project personnel closed and signed entrance ramps to I-95 as the rolling roadblock passed. According to DelDOT personnel, traffic transitioned smoothly.

Integrated Transportation Management System (ITMS)

The DelDOT team used innovations to manage traffic from the Transportation Management Center (TMC). As part of the mitigation cost, DelDOT spent \$4 million to get cameras, detection devices, changeable message signs, and counting programs in place and operational prior to starting work on I-95. The ITS application enabled traffic flow to be monitored and managed 24 hours a day, seven days a week, providing traffic flow information and adjustments to better mitigate the impacts of the full closure. If a phase of construction was expected to cause significant impacts to traffic, the information was conveyed to the TMC, where signal timings could be adjusted, and information could be related to travelers through radio and DelDOT's website.

Traffic Impacts

In considering full closure on a major route, it is essential to have an adequate alternate route. I-495 served as the primary alternate route during the closure. DelDOT had

determined during project planning that I-495 was an adequate alternate route, based on several reasons:

- I-495 is a six-lane highway with annual average daily traffic (AADT) of approximately 36,000 vehicles. This level of traffic uses approximately 25 percent of the existing capacity, leaving sufficient additional capacity to handle the increased traffic during the full closure.
- Project personnel estimate that the level of service (LOS)⁶ on I-495 prior to the I-95 full closure was A or B.
- I-495 does not go through the city center of Wilmington.

During the full closure, the LOS on I-495 dropped to C, with interchanges causing the majority of the delay.

The LOS provided on I-95 prior to the full closure was close to D. DelDOT did not see the reduced level of service on I-495 as an issue, as it was good before the full closure, and the relative decrease in LOS was still better than existing traffic levels on I-95.

The morning of the full closure deployment, media, including helicopters, were on hand to witness the congestion expected to ensue. Questioning whether they were in the right place, the media were confused by the lack of congestion that resulted. Project personnel noted that no real issues related to traffic congestion occurred during the project. To help address any problems quickly during the project, DelDOT had tow trucks stationed at nearby critical intersections where project personnel thought there was potential for increased problems.

Traveling Together

The Traveling Together initiative consisted of two elements that involved the Delaware Administration for Regional

⁶ LOS is a set of classifications (A to F) used to describe the performance of a roadway. Each classification represents a range of the perceived quality of service provided by a roadway, with A representing the most favorable, least congested driving conditions. It is a derived metric rather than an observed measurement and takes into account traffic volume and road capacity.

Transit (DART) and the Transportation Management Association (TMA) of Delaware. The DART provided alternate methods of travel, including two new bus routes. TMA Delaware partnered with DeIDOT to communicate with the business community about the I-95 project and alternate means of travel. TMA Delaware was part of the construction meetings, enabling the association to keep businesses up to date on project status and issues.

The DART added two new bus routes (Routes 951 and 952) that were called “Expresso.” The new routes included four morning and four evening rush-hour trips each. Riders were able to take the Expresso buses from the perimeter of the project directly to downtown Wilmington with only two stops along the way. Riders were offered free coffee at participating coffee shops as an incentive. According to the Delaware Transit Corporation, the Expresso buses transported about 1,648 commuters each month, reducing the total number of vehicles from the network during the full closure. The costs for transit improvements and rider incentives were covered under the \$13 million spent as part of *The*

Five Elements of Mobility. The Expresso service was initially planned to be in place for the duration of the construction, but was continued for 15 months after project completion based on popularity; ultimately, the routes were discontinued during annual route adjustments due to reduced ridership. Figure 3 shows the ridership of each Expresso bus route by month.

The DART provides a free rideshare program that helps commuters get matched to carpools. The program includes a “home free” guarantee for unexpected schedule changes for carpool commuters. TMA Delaware administers the rideshare program and promoted the program during the I-95 project by having rideshare fairs and meeting with businesses that could be affected by the full closure. Sign-ups for the rideshare program grew to more than 5,000 people during the I-95 project. The opening of a new commuter rail station along the Amtrak northeast corridor was coordinated with the closing of I-95. Rail transit was promoted by eliminating parking fees. Both TMA Delaware and the DART ran a monthly radio commercial about the alternate means of travel.⁷

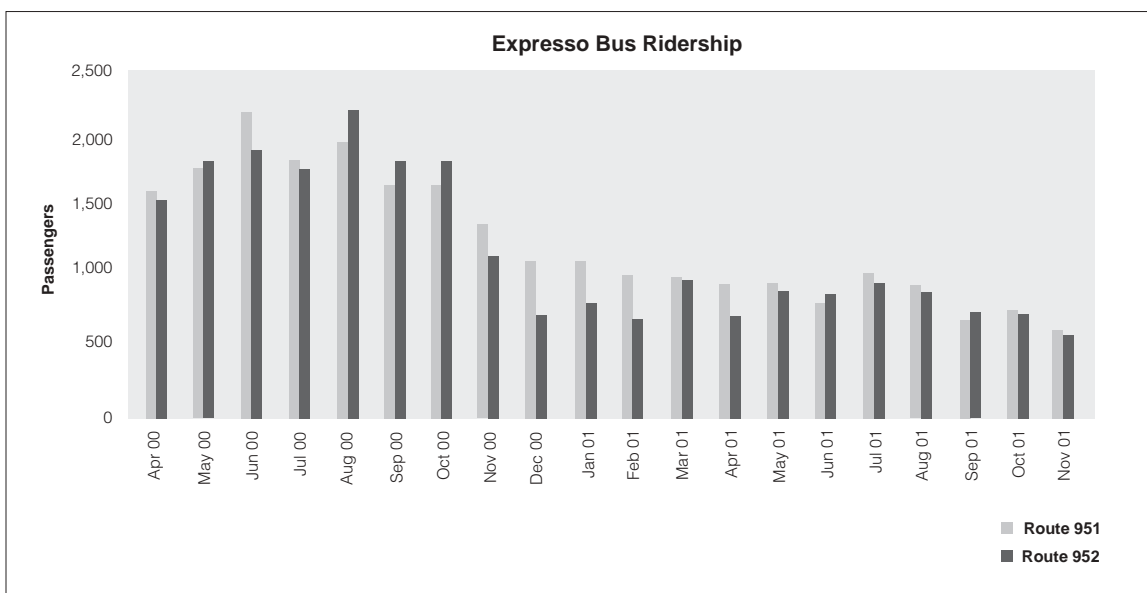


Figure 3 – Number of riders on two new bus routes added to reduce congestion on the road network during the full closure

⁷ O’Neill, Darren (2001). *I-95 Reconstruction and The Five Elements of Mobility*. Delaware Department of Transportation.

Benefits/Impacts of Full Road Closure

Duration

In order to expedite the construction process and minimize the impact on I-95 corridor traffic, DelDOT developed an innovative plan for rehabilitation. From the contractor's perspective, this would minimize construction times, provide a safer and more efficient work area, and reduce conflicts with motor vehicles.⁸ Overall project duration was reduced from two years to 185 calendar days, resulting in a 75 percent reduction in traveler and worker exposure time. Reduced duration was key on this highly traveled route connecting major cities.

Cost

According to project personnel, maintenance-of-traffic costs for the project were reduced since temporary Portland Cement Concrete barriers were not needed during the I-95 reconstruction. Project personnel estimate that maintenance-of-traffic costs were reduced from approximately 10 percent of the total project budget to 2 percent. Project personnel noted that when the cost of implementing the TMP is factored in, the total cost of the I-95 road project using full closure was more expensive compared to traditional maintenance-of-traffic projects. However, included in the increased costs are elements such as operational improvements made to alternate routes, many of which have long-term value beyond the full closure project.

Quality

Project personnel noted that allowing the contractor full access to the roadway resulted in pavement built to the highest standards of efficiency and quality. A smoother surface, with a notably quieter ride, resulted from the reconstruction effort. The 40-year design life includes regularly scheduled maintenance and overlays; it is yet

to be determined if the full closure approach enhanced the durability of the roadway.

Safety

Project personnel thought that using full closure would result in improved safety by separating construction activities from through-traffic. Prior to implementing the full closure, DelDOT examined crash data for intersections where traffic was expected to increase to assess whether any safety problems existed or were likely to result from the full closure. While a crash analysis was not performed following the project, DelDOT did not observe a noticeable increase in crashes in the area during the project.

Public Sentiment

As noted by project personnel, the success of the I-95 project has "raised the bar" for future public projects, requiring innovative thinking and strategic planning with the public in mind. Positive comments and very few complaints were received from the public during the project. According to project personnel, the success of the I-95 project has created a new level of appreciation and respect for the DelDOT team as a whole.

Investment for the Future

Many of the congestion mitigation initiatives that were implemented during the early stages of the I-95 rehabilitation are permanent improvements to the traffic network. Traffic management initiatives implemented during the project have continued to reduce congestion levels following project completion. Variable message boards, detection devices, intersection improvements, and emergency access ramps have greatly benefited the entire network by providing improved traffic flow and real-time information for travelers and DelDOT employees.

⁸ O'Neill, Darren (2001). *I-95 Reconstruction and The Five Elements of Mobility*. Delaware Department of Transportation.

Issues and Lessons Learned

Contracting

Prequalifying contractors allowed DeIDOT to choose the right candidate with adequate experience and resources to complete the job successfully.

Prequalification of contractors was critical to project success on the I-95 full closure. Contractors were required to qualify twice during the process. Initially, contractors were qualified on overall merit, availability, and manpower. When advertisement of the project was delayed for approximately three months, the contractors prequalified the first time were asked to resubmit materials to ensure that significant changes had not taken place in their qualifications. Final bids were then solicited from the remaining contractors, based on determined contract specifications.

Public Relations

Including the public relations group as part of the project team is important and allows the public to remain informed as the project moves forward.

With the complexity of closing a major route, the public relations component was critical to project success. Beginning the public outreach campaign two years prior to project implementation enabled DeIDOT to distribute information that was far-reaching and comprehensive.

Stakeholder Support/Buy-In

A champion with technical knowledge and excellent communication skills should be identified early on to sell the public, elected officials, and senior DOT personnel on the use of full road closure.

One of the keys to the success of the I-95 closure was having a champion with technical project knowledge and the ability to persuade the public, elected officials, and senior DOT personnel. Typically the public will interface with an external affairs spokesperson for projects; however, during the I-95 closure, project personnel intimately familiar with technical aspects of the project were able to connect with the public during meetings and during call-in radio shows. DeIDOT believes that this contributed greatly to public acceptance and cooperation with the full closure methodology.

Multidisciplinary Team

Early involvement of the construction group during planning and design allows for constructability issues to be resolved early.

The construction group is given great credit for the success of the project. Being involved early in the planning and design process, the construction group provided input that would alleviate change orders and revisions to plans and design during construction, ultimately saving time and effort. Early involvement of construction personnel reduces potential roadblocks to project success, resulting in smooth construction with fewer disruptions.

Summary

Overall, the I-95 rehabilitation that took place north of Wilmington, Delaware was an overwhelming success. The availability of an alternate route, prior improvements to local routes, the massive public outreach effort, and the high level of interagency coordination resulted in timely project completion with a likely improvement in quality and a perceived safety benefit for workers and motorists. Through this project, the DelDOT team successfully “raised the bar” for customer expectations on future projects. For transportation professionals who must rehabilitate roadways and reduce the impacts of work zones on workers and motorists, full road closure is one potential method that can achieve both goals. With adequate planning, public outreach, stakeholder involvement, and alternate routes, full road closure has the potential to simultaneously accelerate projects, improve quality and safety, and reduce costs.

Other Selected FHWA Work Zone Publications

- *Work Zone Best Practices Guidebook* (FHWA-OP-00-010) (2000)
- Best Practices Fact Sheets
 - Fact Sheet 1:
Oregon's QuickFax Service (FHWA-OP-00-022) (2000)
 - Fact Sheet 2:
Customer Driven Construction in Illinois (FHWA-OP-00-023) (2000)
 - Fact Sheet 3:
Work Zone Safety Awareness Week (FHWA-OP-00-024) (2000)
 - Fact Sheet 4:
Delaware's Survival Plan for the I-95 Shutdown (FHWA-OP-00-025) (2000)
 - Fact Sheet 5:
Innovation During Bridge Rehabilitation Improves Mobility (FHWA-OP-01-008) (2001)
 - Fact Sheet 6:
Work Zone Best Practices Guidebook (FHWA-OP-01-009) (2001)
 - Fact Sheet 7:
Compendium of Work Zone Research, Development and Technology Transfer (FHWA-OP-02-054) (2002)
 - Fact Sheet 8:
Ohio Keeps Motorists and Road Rehabilitation Moving Forward (FHWA-OP-03-190) (2003)
 - Fact Sheet 9:
Arkansas Uses Public Outreach to Pave The Way During Interstate Rehabilitation (FHWA-HOP-04-031) (2004)
- *Shorter Duration, Safer Work Zones, More Satisfied Travelers: Successful Applications of Full Road Closure in Work Zones* (FHWA-OP-03-086) (2003)
- *Full Road Closure for Work Zone Operations: A Cross-Cutting Study* (FHWA-OP-04-009) (2003)
- *Intelligent Transportation Systems in Work Zones: A Cross-Cutting Study* (FHWA-OP-02-025) (2002)
- Intelligent Transportation Systems in Work Zones Case Studies
 - *Work Zone Traffic and Incident Management System: Keeping Traffic Moving During Reconstruction of the Big I, a Major Interstate-Interstate Interchange in Albuquerque* (FHWA-OP-04-072) (2004)
 - *Work Zone Travel Time System: Reducing Congestion with the Use of a Traffic Management Contract Incentive During the Reconstruction of Arizona State Route 68* (FHWA-HOP-04-032) (2004)
 - *Real-Time Work Zone Traffic Control System: Using an Automated Traffic Information System to Reduce Congestion and Improve Safety During Reconstruction of the I-55 Lake Springfield Bridge in Illinois* (FHWA-HOP-04-018) (2004)
 - *Dynamic Lane Merge System: Reducing Aggressive Driving and Optimizing Throughput at Work Zone Merges in Michigan* (FHWA-HOP-04-033) (2004)
- *Informed Motorists, Fewer Crashes: Using Intelligent Transportation Systems in Work Zones*
- *Positive Protection: Reducing Risk, Protecting Workers and Motorists* (2003)
Joint publication with AASHTO, ARTBA, AGC, ATSSA, LHSFNA
- *Creating Safer Work Zones: Five Brochures* (FHWA-SA-03-007) (2003)
- *Compendium of Work Zone Research, Development, and Technology Transfer Projects 1997 to 2002* (FHWA-OP-02-053) (2002)
- *Methods and Procedures to Reduce Motorist Delays in European Work Zones* (FHWA-PL-01-001) (2000)

To obtain a copy of a publication, visit our website at <http://www.fhwa.dot.gov/workzones>.

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