Guidance on Using Traffic Management Centers for Work Zone Management

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U.S. Department of Transportation
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FOREWORD

This document is intended to be a resource for staff responsible for all stages of work zone planning and operations, as well as TMC managers and operators. A total of eight strategies are presented for utilizing TMC resources during the four stages of a work zone. Each strategy includes detailed descriptions and examples of use in practice. While strategies for using the TMC resources most common to all TMCs in aspects of work zone planning, operation and evaluation are described, a detailed table describing many TMC resources is provided to illustrate the many additional TMC resources that are possible. This final report presents guidance for DOTs to consider for how TMC resources (staff, data, and tools) can be used to support all stages of a work zone, providing examples of where these resources are used today.

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16. Abstract

Many Departments of Transportation (DOTs) at the state, county, and local levels operate Traffic Management Centers (TMCs). Typically, a TMC is a center where operators utilize software systems to control field devices (e.g., Dynamic Message Signs (DMS), ramp meters) and to view data and video collected throughout the monitored area.

In regards to work zones, TMCs are most commonly thought of during the active work zone phase, when the work zone is in operation and the TMC operators assist by disseminating information and managing the traffic through the work zone. However, there is potential for TMC resources to support all stages of the work zone, from the planning and design phase through active work zone operations and post-operation evaluation. This document presents guidance for DOTs to consider how TMC resources (staff, data, and tools) can be used to support all stages of a work zone, providing examples of where these resources are used today.

This document is intended to be a resource for staff responsible for all stages of work zone planning and operations, as well as TMC managers and operators. A total of eight strategies are presented for utilizing TMC resources during the four stages of a work zone. Each strategy includes detailed descriptions and examples of use in practice. While strategies for using the TMC resources most common to all TMCs in aspects of work zone planning, operation and evaluation are described, a detailed table describing many TMC resources is provided to illustrate the many additional TMC resources that are possible.

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ACRONYMS AND ABBREVIATIONS

ATR	Automatic Traffic Recorder
C03	Construction Congestion Cost
CAD	Computer Aided Dispatch
Caltrans	California Department of Transportation
CARS	Condition Acquisition and Reporting System
DMS	Dynamic Message Signs
DOT	Department of Transportation
FHWA	Federal Highway Administration
FREEVAL	FREeway EVALuation
GLRTOC	Great Lakes Regional Transportation Operations Coalition
HOV	High-Occupancy Vehicle
LCP Tool	Lane Closure Planning Tool
MOT	Maintenance of Traffic
PeMS	Performance Measurement System
RITIS	Regional Integrated Transportation Information System
RTMC	Regional Transportation Management Center
TICAS	Traffic Information and Condition Analysis System
TMC	Traffic Management Center
TMP	Transportation Management Plan
TOC	Traffic Operations Center
TOPs	Traffic Operations Plans
TRANSCOM	Transportation Operations Coordinating Committee

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

Many Departments of Transportation (DOTs) at the state, county, and local levels operate Traffic Management Centers (TMCs). Typically, a TMC is a center where operators utilize software systems to control field devices (e.g., Dynamic Message Signs (DMS), ramp meters) and to view data and video collected throughout the monitored area. TMCs are not necessarily fixed locations or centers; in some situations the TMC is 'virtual', with systems linked through Internet or Intranet communications.

In regards to work zones, TMCs are most commonly thought of during the active work zone phase, when the work zone is in operation and the TMC operators assist by disseminating information and managing the traffic through the work zone. However, there is potential for TMC resources to support all stages of the work zone, from the planning and design phase through active work zone operations and post-operation evaluation. This document presents guidance for DOTs to consider for how TMC resources (staff, data, and tools) can be used to support all stages of a work zone, providing examples of where these resources are used today.

1.2 WORK ZONE STAGES AND NEEDS LIKELY ADDRESSED BY TMC RESOURCES

The lifecycle of a work zone can be represented as four broad stages.

Work Zone Stage 1: Project Development – Planning and Design

This stage is when the planning and design of the construction or maintenance project is performed, and typically occurs before any work zone planning begins. During this stage, the projects are being scoped, designed, and procured. Early estimates of the capacity restrictions (e.g., lane and road closures) are discussed. The needs most likely supported by TMC resources include:

- Coordinating road work projects as much as possible to avoid simultaneous projects on parallel routes or corridors; and
- Understanding the impacts that the projects (and resulting work zones) will cause on safety and mobility at a time when the projects are still being planned, and innovative contracting or accelerated construction can be considered.

Work Zone Stage 2: Project Development – Work Zone Management

This stage occurs after the construction or maintenance project has been planned and designed and the focus is on developing the Transportation Management Plan (TMP) to maintain safety and mobility in the work zone throughout the road work project. The needs most likely supported by TMC resources include:

- Understanding travel demand patterns in order to predict the impacts that work zone-induced capacity restrictions (i.e., the needed traffic re-alignments, lane and/or road closures) will have on traveler safety and mobility; and
- Developing strategies to mitigate the impacts of the work zone and to include these strategies in the TMP.

Work Zone Stage 3: Active Work Zone Operations

This stage involves the actual work zone operations that establish and maintain the work zone for the project to be performed. The needs most likely supported by TMC resources include:

- Informing travelers prior to the start of the work zone of the likely impacts and areas impacted, to enable travelers to plan alternate routes and/or change their trip start/end times;
- Maintaining traveler safety to the extent possible during the work zone; and
- Promoting driver mobility during the work zone, both by informing travelers of real-time delays and by managing traffic and work zone activities to minimize delays as much as possible.

Work Zone Stage 4: Post-Work Zone Evaluation and Performance Management

This stage includes all post-work zone analyses to understand the actual impacts of the work zone and prepare for future work zones. The needs most likely supported by TMC resources include:

- Collecting data and information on the travel volumes, speeds/queues/delay, and incidents that occurred during the work zone; and
- Conducting analyses to compute actual impacts compared with estimated impacts.

1.3 NAVIGATING THIS DOCUMENT AND SEARCHING FOR INFORMATION

Intended Audience
This document is intended to be a resource for staff responsible for all stages of work zone planning and operations, as well as TMC managers and operators.

Intended Use
The intended use of this document is to assist efforts during each stage of a work zone, providing strategies for how TMC resources might be used.

Navigating the Document
This document is not likely to be read ‘cover to cover’, but rather it will serve as a resource used in anticipation of a work zone stage to gather ideas and concepts for benefitting from TMC resources.

Table 1 provides hyperlinks to sections within Chapter 2 of this document, enabling readers to quickly find the information desired. Table 1 presents the four stages of a work zone, together with strategies for utilizing TMC resources during each stage. When a reader clicks on a high-level strategy or sub-strategy in Table 1, they are linked to the section in this document to detailed descriptions and examples of use in practice. It is important to note that while there are many examples of DOTs using TMC resources for all stages of a work zone, one or more specific examples are included for each sub-strategy in this document.

Each TMC is unique and therefore resources available will vary. Chapter 2 describes strategies for using the TMC resources most common to all TMCs in aspects of work zone planning, operation, and evaluation. Chapter 3 includes a detailed table describing many TMC resources is provided to illustrate there are many additional TMC resources that are possible.

Table 1. Work Zone Stages and Strategies for Using Traffic Management Center (TMC) Resources

Work Zone Stages	Strategies for Using Traffic Management Center (TMC) Resources	Sub-strategies for Using TMC Resources
Stage 1: Project Development – Planning and Design	Strategy #1: Using TMC Resources to Coordinate Road Work Projects	Strategy 1A: Share access to TMC tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.
		Strategy 1B: Involve TMC staff in the planning of road work projects from the onset to enable TMC staff to understand the planned projects and impacts for all areas served by the TMC and therefore contribute to regional mobility planning.
		Strategy 1C: Organize annual meetings with TMC staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.
	Strategy #2: Using TMC Resources to Support Preliminary Work Zone Impact Analyses	Strategy 2A: Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects
		Strategy 2B: Develop Traffic Operations Plans for large projects before the Transportation Management Plan is developed and before final design, to define the planned use of intelligent transportation system components and maximize the input from the TMC.

Table 1. Work Zone Stages and Strategies for Using Traffic Management Center (TMC) Resources (Continued)

Work Zone Stages	Strategies for Using Traffic Management Center (TMC) Resources	Sub-strategies for Using TMC Resources
		Strategy 2C: Using TMC resources to support innovative contracting or accelerated construction considerations.
Stage 2: Project Development – Work Zone Management	Strategy #3: Using TMC Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report	Strategy 3A: Using TMC archived volume and speed data to estimate traffic demand, delays, queue lengths and reliability metrics during the upcoming work zone.
		Strategy 3B: Using TMC incident logs as a surrogate for crash data to estimate the number of crashes likely to occur during the work zone.
		Strategy 3C: Using Road Condition Reporting Systems to understand planned events causing vehicle restrictions or capacity reductions on alternate routes during the work zone.
	Strategy #4: Using TMC Resources to Support Development of the Transportation Management Plan Work Zone Impacts Management Strategies	Strategy 4A: Using TMC resources to understand the likely intelligent transportation system device outages due to work zones and prepare mitigation strategies to maintain critical field device operations.
		Strategy 4B: Using TMC resources to improve safety and mobility in and around the work zone.

Table 1. Work Zone Stages and Strategies for Using Traffic Management Center (TMC) Resources (Continued)

Work Zone Stages	Strategies for Using Traffic Management Center (TMC) Resources	Sub-strategies for Using TMC Resources
Stage 3: Active Work Zone Operations	Strategy #5: Using TMC Resources to Support Pre-Work Zone Information Dissemination	Strategy 5A: Using TMC-operated dynamic message signs in the vicinity of the work zone to describe upcoming work zone impacts (e.g., lane or route closures and dates) to travelers prior to the start of the work zone.
		Strategy 5B: Using TMC-operated traveler information systems and social media accounts to describe upcoming work zones and anticipated impacts to travelers pre-trip.
	Strategy #6: Using TMC Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Safety	Strategy 6A: Using TMC real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs.
		Strategy 6B: Using TMC-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream.
	Strategy #7: Using TMC Resources to Maintenance of Traffic During Active Work Zones – Traveler Mobility	Strategy 7A: Using performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools) to determine if any modifications to the work zone management approach are needed to maintain traffic mobility.
		Strategy 7B: Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.
		Strategy 7C: Using real-time traveler information dissemination systems and tools (including dynamic message signs, Highway Advisory Radio, 511 phone and websites, and social media) to provide content that informs travelers of work zone delays or incidents.
		Strategy 7D: Using TMC-operated traffic management tools (e.g., lane management systems, variable speed limit systems, and ramp meters) to manage traffic flow in and around the work zone.
		Strategy 7E: Using Freeway Service Patrols to assist in minimizing impacts of incidents in and around work zones.

Table 1. Work Zone Stages and Strategies for Using Traffic Management Center (TMC) Resources (Continued)

Work Zone Stages	Strategies for Using Traffic Management Center (TMC) Resources	Sub-strategies for Using TMC Resources
Stage 4: Post-Work Zone Evaluation and Performance Management	Strategy #8: Using TMC Resources to Support Work Zone Evaluation and Performance Management	Strategy 8A: Using TMC archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.
		Strategy 8B: Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.

CHAPTER 2. GUIDANCE FOR TMC RESOURCES SUPPORTING WORK ZONES

This section presents guidance for using TMC resources to support work zone planning and operations in the form of a set of strategies to be considered throughout the four stages of the work zone design, operations, and evaluation. Each recommended strategy is supported by one or more examples of successful implementation.

It is important to note that there are many areas within a DOT that will benefit from utilizing the strategies included in the sections below. Each DOT is organized differently and has expertise pulled from many different areas; however, the following groups within transportation agencies will benefit from the awareness and use of TMC resources.

- Construction and Maintenance staff;
- Project Planning/Design staff;
- Project Engineer/Manager;
- TMC Managers/Operators;
- Incident Response Personnel; and
- Traveler Information Coordinator.

In additional to staff within a transportation agency benefiting from the strategies the traveling public also benefits from the many DOT groups working with the TMC. Utilizing TMC resources provides another component when analyzing a work zone to improve safety and reduce overall delay for travelers.

2.1 WORK ZONE STAGE 1: PROJECT DEVELOPMENT – PLANNING AND DESIGN

Stage 1 of the work zone process occurs when the road work project is being planned and designed, and is prior to the detailed design of the work zone that will support the project. Two strategies are presented below to utilize TMC resources during this stage in the overall work zone process:

- Strategy #1: Using TMC resources to Coordinate Road Work Projects
- Strategy #2: Using TMC Resources to Support Preliminary Work Zone Impact Analyses

The remainder of Section 2.1 presents details of these strategies and examples of use.

2.1.1 Strategy #1: Using TMC Resources to Coordinate Road Work Projects

When two or more work zones are in operation simultaneously on the same route or adjacent parallel routes, the impacts on drivers are often increased. Coordination of road work projects considers other planned work zones and minimizes the impacts, either by adjusting the schedule or capacity restrictions of the work zone. ***Strategy #1 is using TMC resources to coordinate road work projects*** during the planning and design of the construction or maintenance projects.

Three specific strategies for using TMC resources (1A, 1B, and 1C) are identified in Table 2, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

Table 2. Strategy 1 – Guidance and Examples of Strategy Use

Strategy #1: Using Traffic Management Center (TMC) Resources to Coordinate Road Work Projects		
Guidance		**Examples of Strategy Use**
Strategy 1A	Share access to TMC tools used to record ongoing and planned road work projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects. Examples of tools and resources include: Road Condition Reporting Systems, archived probe data, and automated analytical tools such as the Regional Integrated Transportation Information System (RITIS)	• Minnesota Department of Transportation (DOT) • Michigan DOT
Strategy 1B	Involve TMC staff in the planning of road work projects from the onset to enable TMC staff to understand the planned projects and impacts for all areas served by the TMC and therefore contribute to regional mobility planning.	• Oregon DOT • Minnesota DOT
Strategy 1C	Organize annual meetings with TMC staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.	• Great Lakes Regional Transportation Operations Coalition (GLRTOC) • Transportation Operations Coordinating Committee (TRANSCOM)

Table 3. Strategy 1A – Description, Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #1: Using Traffic Management Center (TMC) Resources to Coordinate Road Work Projects**	
Strategy 1A	**Share access to TMC tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.**
Description	Each state Department of Transportation (DOT) operates some form of a traveler information system. The majority of DOTs use some type of a Road Condition Reporting System as the back-end data fusion engine that supplies the information that is displayed over phone, web, social media, and other traveler information dissemination mediums. A Road Condition Reporting System is most often a web-based tool that enables entry of information from DOT staff throughout the state, and often includes an automated data ingest from multiple systems. It is very common that the Road Condition Reporting System is 'owned' and operated by one of the TMCs in the state. Therefore, a Road Condition Reporting System is considered a TMC resource, common to many states. In order to disseminate information describing current and planned road work through the traveler information systems, most DOT staff enter planned road work projects into their Road Condition Reporting System, often for one or more years into the future. Therefore, in addition to supporting traveler information, the Road Condition Reporting System is also an effective management tool to enable road work project planners to be aware of other projects that may be planned by other groups within the DOT. ***This strategy is to share access to TMC tools to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals in the road work planning process to help in coordinating projects during the planning phase, and avoiding overlapping projects.*** Many states also operate or have access to automated analytical tools that fuse together data from multiple sources and perform analytical analyses to report predicted or actual historic performance measures. The Regional Integrated Transportation Information System (RITIS) is one example of an automated analytical tool used by many DOTs. With RITIS, it is possible to view predictions for impacts that work zones will have on the overall network considering other planned road work projects and historical data describing traffic volumes.
Anticipated Benefit(s)	Increased awareness of other construction and maintenance projects at a time when the road work project is still being planned, enabling adjustments to promote coordination over time and space

Table 3. Strategy 1A – Description, Benefits, and Implementation Steps (Continued)

Work Zone Stage 1: Project Development – Planning and Design **Strategy #1: Using Traffic Management Center (TMC) Resources to Coordinate Road Work Projects**	
Strategy 1A	**Share access to TMC tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.**
Implementation Steps	1. Identify the individual within the DOT responsible for managing the Road Condition Reporting System or Transportation Information System. 2. Request user access and training for individuals involved in work zone planning (typically access can be granted on a 'view-only' for individuals who do not enter events but need to view events). 3. Encourage Project Planning/Design Staff to log-in frequently and view other road work plans, and to enter descriptions of road work they are planning, in accordance with the Road Condition Reporting System entry guidelines.

Table 4. Strategy 1A – Example of Department of Transportation (DOT) Use

Strategy 1A	**Share access to Traffic Management Center (TMC) tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.**
1A Example 1 – Minnesota Department of Transportation (DOT)	
The Minnesota DOT operates a statewide road condition reporting system (Condition Acquisition and Reporting System (CARS)). Planned road work events are entered into CARS by the appropriate department within Minnesota DOT. Regional Transportation Management Center (RTMC) operators located in St. Paul, Minnesota and other DOT staff with access to the system are able to view and access current and future work zone information (e.g., location, description of work, lane restrictions) through CARS. The information entered is also posted to the public 511 traveler information website. The schedule for significant road work projects (e.g., long duration construction projects) within Minnesota DOT are typically well known throughout the organization, and conflicts with other projects are less likely since DOT staff are aware of these projects and coordinate with other projects accordingly. However, some maintenance and construction road work projects that may have shorter durations or less significant impacts to traffic may be less known throughout Minnesota DOT as they are planned. When this occurs, for example, two or more lane closures could occur on parallel routes simultaneously causing additional delay even if the information has been entered into CARS. It is critical CARS is reviewed by RTMC staff weekly as one final check, as well as by work zone planning staff to address any conflicts that may occur. Review of events entered into CARS has proven to avoid simultaneous work zones occurring on parallel routes. RTMC operators are able to view and access current and future work zone information (e.g., location, description of work, lane restrictions) through CARS as shown below. It is important to note that RTMC operators also have access to the CARS entry interface to view and enter events. The screenshot shown below shows how RTMC operators and the public can search for future road work project information and the details of construction information that is provided.	

Table 4. Strategy 1A – Example of Department of Transportation (DOT) Use (Continued)

Strategy 1A	Share access to Traffic Management Center (TMC) tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.

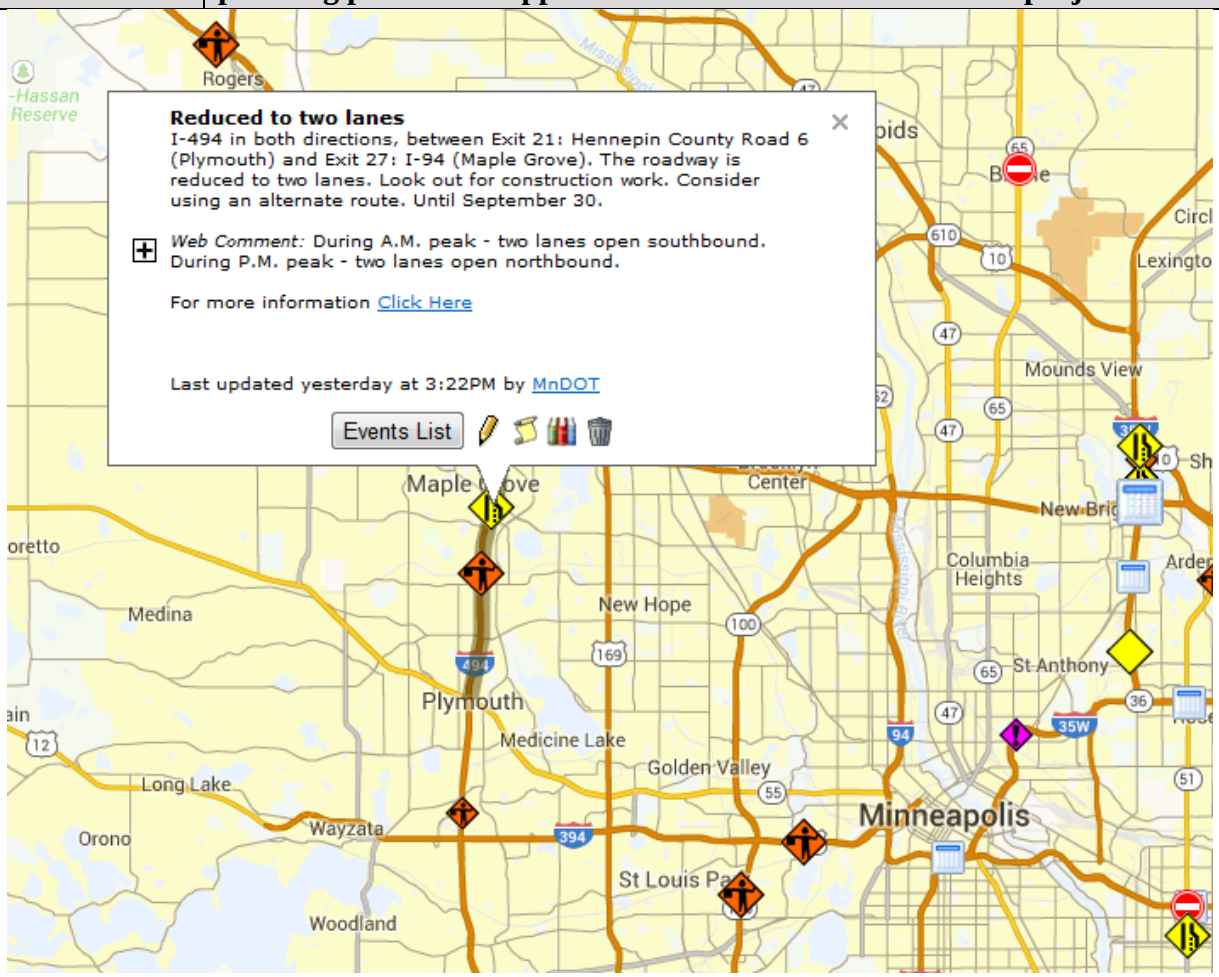


Figure 1. Map. Minnesota Department of Transportation's (DOT's) 511 Website showing the Option to Select Future Information

Source:http://hb.511mn.org/#roadReports/layers=allReports,roadReports,winterDriving,weatherWarnings,otherStates

1A Example 2 – Michigan DOT

Michigan DOT determines 10 minutes of additional work zone delay as a significant road work project and requires a Transportation Management Plan to be developed anytime the work zone delay exceeds this threshold. The estimated values for user delay costs are computed using the Construction Congestion Cost (C03) Software. The CO3 values are then compared to field measured speeds and Regional Integrated Transportation Information System (RITIS) is used to analyze and determine how closely the predicted values are with actual field results. This method has allowed Michigan DOT to improve work zone designs and is allowing Michigan DOT to more accurately predict work zone delays.

Table 4. Strategy 1A – Example of Department of Transportation (DOT) Use (Continued)

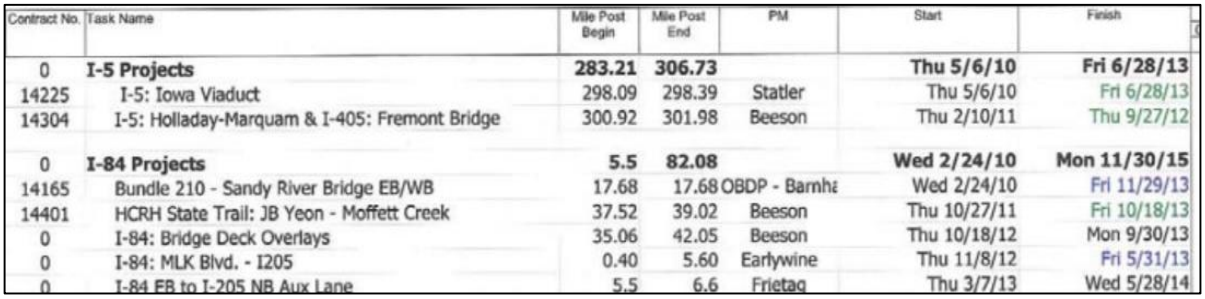
Strategy 1A	**Share access to Traffic Management Center (TMC) tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects.**
This improvement in forecasting of work zone delay helps Michigan DOT select an appropriate design for the location and roadway, in-turn improving the overall design process by having a better understanding of how different Maintenance of Traffic methods will affect the roadway network as a whole, not just at the project level.	

Table 5. Strategy 1B – Description, Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #1: Using Traffic Management Center (TMC) Resources to Coordinate Road Work Projects**	
Strategy 1B	**Involve TMC staff in the planning of road work projects from the onset to enable TMC staff to understand the planned projects and impacts for all areas served by the TMC, and therefore contribute to regional mobility planning.**
Description	TMCs often support operations of multiple geographic or institutional regions within a Department of Transportation (DOT). Similarly, TMCs often communicate and coordinate with TMCs in neighboring states. ***This strategy is to involve TMC staff early in the project development process to allow the TMC to contribute a regional perspective on other planned road work and events.***
Anticipated Benefit(s)	A regional perspective on other road work projects and events will be considered during the project development period to minimize agency/user costs
Implementation Steps	1. Identify the TMC staff most appropriate to be involved in coordination of road work projects during project development. 2. Arrange a meeting structure to engage TMC staff with Project Planning/Design Staff (roughly 3-4 times per year).

Table 6. Strategy 1B – Examples of Department of Transportation (DOT) Use

Strategy 1B	**Involve Traffic Management Center (TMC) staff in the planning of road work projects from the onset to enable TMC staff to understand the planned projects and impacts for all areas served by the TMC and therefore contribute to regional mobility planning.**
1B Example 1 – Minnesota Department of Transportation (DOT)	
Minnesota DOT road work projects in the St. Paul/Minneapolis Metro Area are divided into several areas. A resident engineer is assigned to each of these areas and all of areas work together to coordinate large road work projects that may affect a neighboring areas and identify potential conflicts across a region. The Minnesota DOT Regional Transportation Management Center (RTMC) is made aware by the resident engineers of the initial planning and schedule for road work projects. This coordination provides RTMC staff an opportunity to provide input on the project based on observations of similar road work projects and resulting impacts and an increased awareness of future projects.	
1B Example 2 – Oregon DOT	
For road work projects in Oregon, the Oregon DOT implements a regional construction coordination team that is led by a construction engineer and includes area managers, project managers as well as Traffic Management Operations Center managers and staff. The purpose of the team is to coordinate work affecting critical route pairs to ensure that key freight routes remain within recommended delay thresholds. A region mobility schedule is produced and shared among the regions at the Oregon DOT to coordinate road work projects as shown in Figure 2. For example, the schedule includes the location of the project and start and end dates of the project. Coordinating regional projects with staff from affected geographical regions provides input and expertise to enhance coordination and identify the best options to complete the work while maintaining unrestricted freight routes.	



Contract No.	Task Name	Mile Post Begin	Mile Post End	PM	Start	Finish
0	**I-5 Projects**	**283.21**	**306.73**		**Thu 5/6/10**	**Fri 6/28/13**
14225	I-5: Iowa Viaduct	298.09	298.39	Statler	Thu 5/6/10	Fri 6/28/13
14304	I-5: Holladay-Marquam & I-405: Fremont Bridge	300.92	301.98	Beeson	Thu 2/10/11	Thu 9/27/12
0	**I-84 Projects**	**5.5**	**82.08**		**Wed 2/24/10**	**Mon 11/30/15**
14165	Bundle 210 - Sandy River Bridge EB/WB	17.68	17.68	OBDP - Barnha	Wed 2/24/10	Fri 11/29/13
14401	HCRH State Trail: JB Yeon - Moffett Creek	37.52	39.02	Beeson	Thu 10/27/11	Fri 10/18/13
0	I-84: Bridge Deck Overlays	35.06	42.05	Beeson	Thu 10/18/12	Mon 9/30/13
0	I-84: MLK Blvd. - I205	0.40	5.60	Earlywine	Thu 11/8/12	Fri 5/31/13
0	I-84 EB to I-205 NB Aux Lane	5.5	6.6	Frietag	Thu 3/7/13	Wed 5/28/14

Figure 2. Chart. Example Regional Mobility for Coordinating Oregon Department of Transportation (DOT) Road Work Projects

Source: http://www.ops.fhwa.dot.gov/wz/construction/webinar92412/odot/odot.pdf

Table 7. Strategy 1C – Description, Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #1: Using Traffic Management Center (TMC) Resources to Coordinate Road Work Projects**	
Strategy 1C	**Organize annual meetings with TMC staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.**
Description	Coordination of road work projects expands beyond state boundaries, as the impacts of simultaneous road work on parallel or contiguous routes are often experienced across areas that extend into multiple jurisdictions (e.g., neighboring states, city or county routes). ***This strategy involves project planning/design staff and TMC staff from contiguous states meeting annually to review planned road work activities in order to understand any potential conflicts and/or opportunities to minimize impacts.*** While it may not be possible for the impacted jurisdictions to adjust their work zone schedules to coordinate with all affected jurisdictions, the understanding gained in these annual meetings can support each entity's work zone planning process.
Anticipated Benefit(s)	• Reduced situations where work zones in two or more neighboring states or city/county jurisdictions occur simultaneously on contiguous road segments • Minimized impacts of work zones on contiguous road segments through information dissemination or other similar strategies
Implementation Steps	1. Identify a core set of agencies (e.g., neighboring states, local counties or municipalities) that conduct road work projects with a likelihood of conflicting with the other agencies in the group. 2. Organize a process of meeting once per year, typically in the winter after the road work projects are planned. Note: Feedback from the examples in the following table suggest that keeping the same date each year helps all attendees plan and prepare for the meeting. 3. Define a structure that allows each participating agency to present all planned road work projects in the time allowed (i.e., encourage high-level summaries and avoid too much detail). 4. Determine if supporting resources are needed (e.g., a web-based mapping tool to display road work projects for all to view) and identify a source for these (e.g., internal developed tool, Google maps, etc.).

Table 8. Strategy 1C – Examples of Department of Transportation (DOT) Use

Strategy 1C	**Organize annual meetings with Traffic Management Center (TMC) staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.**
1C Example 1 – Great Lakes Regional Transportation Operations Coalition (GLRTOC)	
Members of the Great Lakes Regional Transportation Operations Coalition (GLRTOC) include the Chicago Skyway/Indiana Toll Road, Illinois Department of Transportation (DOT), Indiana DOT, Michigan DOT, Ministry of Transportation Ontario, Minnesota DOT, and Wisconsin DOT. The focus of the GLRTOC is to improve cross-regional transportation operations in support of regional economic competitiveness and improved quality of life. Representatives from the Chicago region (including Illinois DOT, City of Chicago, and local counties) have for many years held annual meetings to review road work projects for the upcoming year. When GLRTOC was initiated, the members suggested coordinating an annual meeting in conjunction with the meeting already established by the Chicago region. During the meeting each GLRTOC member that includes TMC staff and/or managers highlight upcoming road work projects that may have an impact on a neighboring agency. GLRTOC has developed an online Geographic Information Systems-based mapping system with an interface that enables multiple agencies to enter planned roadwork (see Figure 3). The tool displays major roadwork events as an internal tool (not accessed by the traveling public) to assist in work zone coordination across borders and throughout individual states. This tool is updated prior to an annual meeting that is held among that GLRTOC states and is displayed as individual road work projects are discussed.	

Figure 3. Map/Chart. 2013 Great Lakes Regional Transportation Operations Coalition Online Work Zone Map to Identify Impacts to Neighboring States
***Source:* http://www.glrtoc.org/workzones/**

Table 8. Strategy 1C – Examples of Department of Transportation (DOT) Use (Continued)

Strategy 1C	**Organize annual meetings with Traffic Management Center (TMC) staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.**
1C Example 2 – Transportation Operations Coordinating Committee (TRANSCOM)	
TRANSCOM is a coalition of 16 public safety agencies in the New York, New Jersey, and Connecticut metropolitan region. TRANSCOM's construction coordination efforts hinge on its construction coordination database and an annual construction meeting in which the member agencies discuss upcoming road work projects. There are two annual meetings in March of each year, one each for the southern and northern parts of the region. Some of the major agencies (16 transportation agencies in the New York, New Jersey and Connecticut Metropolitan region) in the center of the region attend both. In preparation for the meeting, in December TRANSCOM sends the member agencies the database of road work projects and asks them to update it with their projects for the coming year. Projects that are planned for more than a year out may be included if they are anticipated to have significant impacts. Utility projects are not included as part of this effort, however, information is collected from member agencies on special events. Special event information is not stored in the construction database, but it is shared with all members at the construction coordination meeting. After collecting inputs, TRANSCOM produces a report listing all of the upcoming projects and potential conflicts and a special events calendar. The report and special events calendar are sent out to the member agencies two weeks prior to the annual meeting. The projects and special events are then all discussed among the members at the annual meeting. During the annual meeting, agencies are given the opportunity to ask questions of each other in order to learn more about the projects and potential impacts. Police and transit member agencies attend, as well. The agencies also begin to work together at this meeting to identify hotspots and formulate plans for how to best handle and mitigate impacts. Follow-up meetings between the appropriate agencies are typically held to identify impacts mitigation strategies and how to handle traffic management for those projects that potentially have large regional impacts. Member agencies have indicated that they find the annual meeting valuable because it is a meeting with a tangible outcome — it allows agencies to become aware of and begin to proactively mitigate work zone impacts and increase customer satisfaction, thereby reducing the daily challenges of managing multiple roadway construction projects. They also enjoy coming to the meeting as it gives them a chance to network with their peers across the region.	

Table 8. Strategy 1C – Examples of Department of Transportation (DOT) Use (Continued)

Strategy 1C	**Organize annual meetings with Traffic Management Center (TMC) staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.**
Following each annual meeting, TRANSCOM provides a summary of the discussion to the member agencies. For the projects that could potentially have greater regional impacts, TRANSCOM continues to meet with the agencies involved on a regular basis. For some projects, monthly face-to-face meetings are held, while others might involve weekly phone calls and emails. These meetings enable TRANSCOM to monitor the projects and also provide suggestions and guidance to the agencies impacted by the projects. Recommendations provided by TRANSCOM may include scheduling changes, sequencing changes (i.e., one agency works in one direction of the roadway while the other works in the other direction), or timing changes (i.e., one agency works at night while the other works during the day). Typically, the attendees discuss coordination of road work projects during the meetings and formal agreements do not need to be made among agencies, although written confirmation is often produced to confirm the mutual understanding among the agencies. *Source: http://www.ops.fhwa.dot.gov/wz/construction/crp/nynjctcasestudy/*	

2.1.2 Strategy #2: Using TMC Resources to Support Preliminary Work Zone Impact Analyses

Preliminary work zone impact analyses are useful for understanding the likely traveler delays and queues caused by the work zone that will exist while the road work project is performed. While the Transportation Management Plan (TMP) developed at a later stage in the work zone deployment process will include a more in-depth impact analysis, this stage helps DOTs understand the overall 'big picture' view of the expected impacts in order to support coordination with other projects and to consider innovative contracting or accelerated construction. ***Strategy #2 is using TMC resources to support preliminary work zone impact analyses.*** The specific strategies for using TMC resources (2A, 2B, and 2C) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

Table 9. Strategy 2 – Guidance and Examples of Strategy Use

Strategy #2: Using Traffic Management Center (TMC) Resources to Support Preliminary Work Zone Impact Analyses		
Guidance		**Examples of Strategy Use**
Strategy 2A	Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects	• New Jersey Department of Transportation (DOT) • District of Columbia DOT • Iowa DOT
Strategy 2B	Develop Traffic Operations Plans for large projects before the Transportation Management Plan is developed and before final design, to define the planned use of intelligent transportation system components and maximize the input from the TMC.	• Utah DOT
Strategy 2C	Using TMC resources to support innovative contracting or accelerated construction considerations.	• Minnesota DOT • Utah DOT • Michigan DOT

Table 10. Strategy 2A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #2: Using Traffic Management Center (TMC) Resources to Support Preliminary Work Zone Impact Analyses**	
Strategy 2A	**Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects**
Description	TMCs typically assemble and store a wide variety of data that can be valuable when performing demand-to-capacity calculations. For example, volume, speed, and occupancy data are often collected by any number of detectors, probes, and other mechanisms throughout the roadway network. Similarly, TMCs often calculate seasonal travel patterns and time-of-day patterns. TMC staff also will typically have some data describing the capacity of alternate routes to the candidate work zone area. ***This strategy is to use TMC data, together with performance measurement and management tools available to the TMCs (i.e., vendor products or in-house developed tools), to understand likely traffic pattern changes, estimate demand through the work zone, and identify potential impacts based on expected capacity restrictions due to the work zone.*** During non-work zone periods, the highway capacity is typically well understood by TMC staff, as is the traffic demand during different periods such as AM and PM peaks. During the road work planning stage, early estimates of capacity restrictions (e.g., lane shifts, lane closures, road closures) are discussed. These capacity restrictions can be combined with historic volume data to understand the likely ratio of volume-to-capacity, and ultimately to predict delays, queues, or route diversions.
Anticipated Benefit(s)	• Early project planning understanding of the extent to which road work projects are likely to cause volume-to-capacity ratios greater than 1 to assist in road work planning • Early project planning understanding to the extent to which road work projects are likely to cause queues and delays to assist in road work planning

Table 10. Strategy 2A – Description, Anticipated Benefits, and Implementation Steps (Continued)

Work Zone Stage 1: Project Development – Planning and Design **Strategy #2: Using Traffic Management Center (TMC) Resources to Support Preliminary Work Zone Impact Analyses**	
Strategy 2A	**Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects**
Implementation Steps	1. Once the location of the work zone is defined, Project Planning/Design Staff request archived volume, occupancy, and speed data from the TMC (or use TMC tools to access archived data). 2. Request input from the TMC to understand any recent capacity or demand changes that would affect how reliable historic volume data is for projecting demand during the upcoming work zone period. 3. Volume-to-capacity calculations may be done by hand, spreadsheet, or by using tools. Determine if the current approach for performing volume-to-capacity calculations is effective and efficient. If not, consider developing or procuring a tool to assist this process. 4. After performing demand-to-capacity calculations and predicting queues and delay, request that the TMC staff review the results and share their perspective.

Table 11. Strategy 2A – Examples of Department of Transportation (DOT) Use

Strategy 2A	**Using Traffic Management Center (TMC) data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects.**
2A Example 1 – Iowa Department of Transportation (DOT) Traffic Data and the Lane Closure Planning Tool	
Iowa DOT uses volume data together with a Lane Closure Planning Tool (LCP Tool) to perform preliminary estimates of the traffic level of service expected during road work projects to provide an early understanding of the likely impacts of capacity restrictions. Volume data is collected from permanent Automatic Traffic Recorder (ATR) data and supplemented by data from the Iowa statewide Transportation Operations Center. The LCP Tool performs calculations and prepares graphs for analysis. For example, a graph may display hourly volumes showing impacts if a two lane road is temporarily modified to one lane. The LCP Tool is a web-based program, and is used internally by Iowa DOT for work zone planning. However, it is anticipated that additional data (e.g., sensor data) and more users will be added in the future.	

Table 11. Strategy 2A – Examples of Department of Transportation (DOT) Use (Continued)

Strategy 2A	Using Traffic Management Center (TMC) data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects.

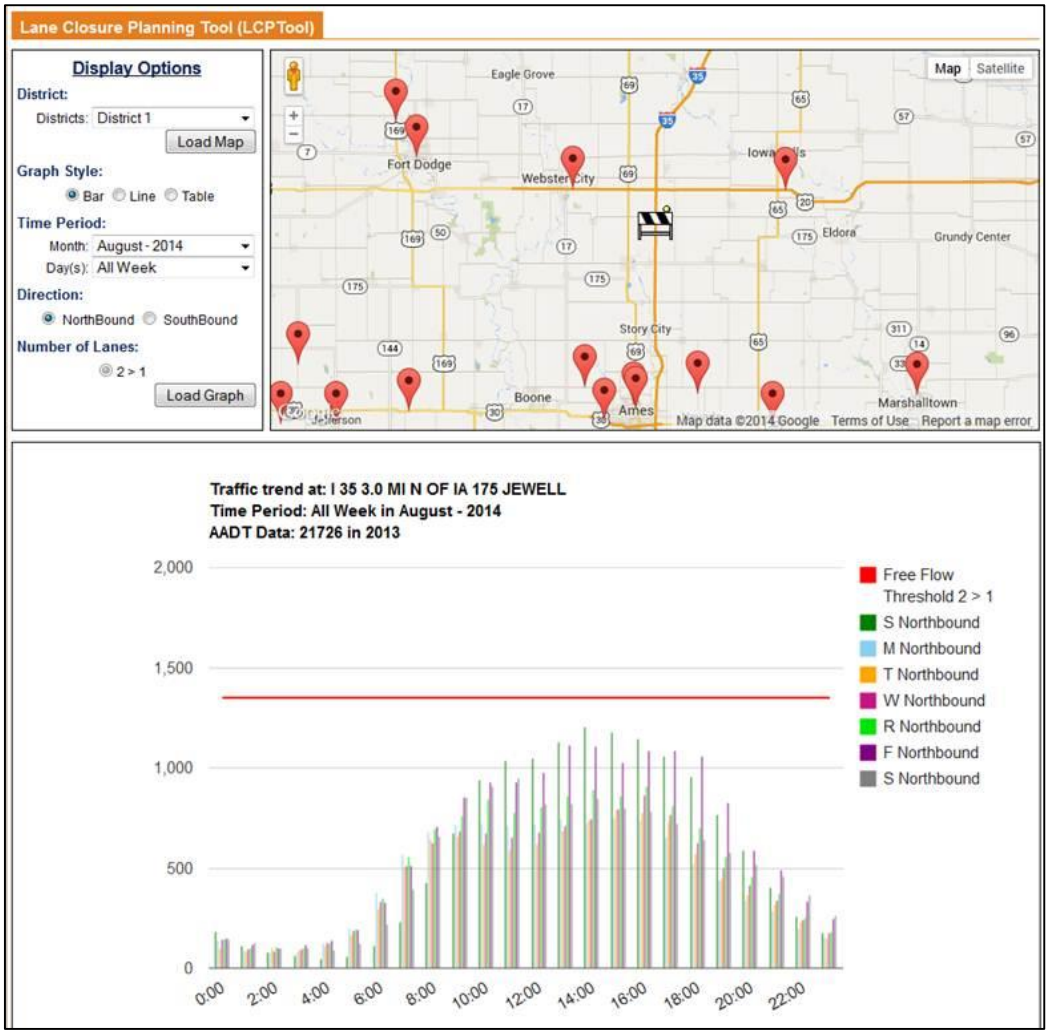


Figure 4. Map/Graph. Iowa Department of Transportation (DOT) Lane Closure Planning Tool

Table 11. Strategy 2A – Examples of Department of Transportation (DOT) Use (Continued)

Strategy 2A	**Using Traffic Management Center (TMC) data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects.**
2A Example 2 – New Jersey DOT	
An intensive study was conducted at the New Jersey DOT to analyze the impacts of a large road work project on the Pulaski Skyway. A six-year project plan was reviewed, as well as a two-year project plan. After a detailed analysis of alternate routes was conducted to establish travel times and detours, a two-year project plan was selected prior to the Transportation Management Plan development process. The Regional Integrated Transportation Information System (RITIS) application was used to conduct volume/capacity analysis. RITIS collects data provided by the DOT (e.g., detector data, speed data), as well as from other sources, and provides it in real-time and archived data formats.	
2A Example 3 – District of Columbia DOT Work Zone Project Management System Use	
The District of Columbia DOT has developed a comprehensive Work Zone Project Management System to facilitate the coordination of work zone projects throughout DC for a five-year period using a predictive model to determine potential impacts and identify related work zone conflicts. All projects, including capital, utility, developer and special events, are integrated into the graphical, web-based, software tool. The Work Zone Project Management System includes three components — a Work Zone Tracking Tool, a Traffic Analysis Tool, and a Citywide Transportation Management Plan. *Source: USDOT FHWA Coordinating Road Projects, website.*	

Table 12. Strategy 2B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #2: Using Traffic Management Center (TMC) Resources to Support Preliminary Work Zone Impact Analyses**	
Strategy 2B	**Develop Traffic Operations Plans for large projects before the Transportation Management Plan is developed and before final design, to define the planned use of intelligent transportation system components and maximize the input from the TMC.**
Description	***This strategy is to create Traffic Operations Plans (TOPs) for large road work projects by including TMC staff early in the road work planning process (prior to the Transportation Management Plan development process) and utilizing TMC resources.*** TMC operators have the best knowledge of intelligent transportation system field devices and TMC supporting tools and best understand the capabilities of these to help maintain mobility and safety. This early planning can identify the extent to which existing field devices will meet the work zone needs, and identify whether additional temporary devices will be needed. Identifying these needs at this stage enables the road work project to consider procuring these temporary devices as part of the project procurement.
Anticipated Benefit(s)	• Early identification of planned operations strategies to minimize work zone impacts • Understanding of the temporary field devices that will be needed to supplement permanent devices during the work zone at a stage where these can be included in the road work project budget and procurement
Implementation Steps	1. Conduct a meeting with Project Planning/Design Staff and TMC staff to discuss the timing, capacity restrictions expected, and duration of the work zone. 2. Invite TMC staff to describe their capabilities to minimize impacts with existing TMC resources, any losses to TMC-controlled field equipment, and their suggestions for temporary technologies to be deployed in the work zone.

Table 13. Strategy 2B – Department of Transportation (DOT) Examples of Use

Strategy 2B	**Develop Traffic Operations Plans for large projects before the Transportation Management Plan is developed and before final design, to define the planned use of intelligent transportation system components and maximize the input from the Traffic Management Center (TMC).**
2B Example 1 – Utah Department of Transportation (DOT) Preliminary Meetings for Large Construction Projects	
At the Utah DOT, operations of the Traffic Operations Center (TOC) is a central function that supports 4 regions. TOC staff attend meetings at the regional level for large road work projects. The expected traffic impact from the road work project is discussed first during initial planning meetings. The TOC then works with the project planning/design staff to provide the traffic analysis for each of these large road work projects.	

Table 14. Strategy 2C – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 1: Project Development – Planning and Design **Strategy #2: Using Traffic Management Center (TMC) Resources to Support Preliminary Work Zone Impact Analyses**	
Strategy 2C	**TMC resources support innovative contracting or accelerated construction considerations.**
Description	Accelerated construction and innovative contracting approaches use various techniques and technologies to help reduce the duration or costs of road work projects. Though useful, they often require a decision early in the process when these approaches, such as design-build, can still be selected. ***This strategy is using TMC data and performance management tools to calculate expected r**oad* u***ser** c**osts of a road work project so that accelerated construction or innovative contracting may be considered at a stage when it is still possible to utilize these approaches.*** A critical factor in the consideration of accelerated or innovative contracting is the estimated road user costs per day that the work zone is in progress. Work Zone road user costs are defined as "the additional costs borne by motorists and the community at-large as a result of work zone activities"[1], and typically include user delay costs, vehicle operating costs, crash costs, and emissions costs.
Anticipate Benefit(s)	• Early understanding of whether or not the impacts and road user costs of the work zone merit consideration of alternate contracting approaches or accelerated construction technologies • Potential cost saving/impact, if alternate contracting or accelerated construction is appropriate and implemented
Implementation Steps	1. Once the location of the work zone is defined, Project Planning/Design Staff should request archived volume, occupancy, and speed data from the TMC (or use TMC tools to access archived data). 2. Request input from the TMC while performing road user cost calculations. Some TMCs have automated analytical tools in place (e.g., Regional Integrated Transportation Information System (RITIS)) that work together with TMC archived data to automatically calculate user costs along segments or corridors. 3. After performing road user cost calculations, request that the TMC staff review the results and share their perspective.

[1] Work Zone Road User Costs – Concepts and Applications. Prepared for USDOT by Applied Research Associates, Inc. FHWA-HOP-12-005
http://www.ops.fhwa.dot.gov/wz/resources/publications/fhwahop12005/fhwahop12005.pdf

Table 15. Strategy 2C – Examples of Department of Transportation (DOT) Use

Strategy 2C	Traffic Management Center (TMC) resources to support innovative contracting or accelerated construction considerations.
2C Example 1 – Minnesota Department of Transportation (DOT)	
Traffic engineering and Regional Transportation Management Center staff at the Minnesota DOT are involved early in the traffic management planning process to identify ways to minimize impacts with a road work project. The Minnesota DOT Regional Transportation Management Center archives volume, occupancy, and speed data from all operational traffic detectors. This data is accessed by the Freeway Performance Measurement System (PeMS) to analyze the impacts of work zones. During the analysis of the work zone, if negative impacts are identified, accelerated construction or innovative contracting may be considered to minimize the impacts.	
2C Example 2 – Utah DOT	
The Utah DOT Transportation Operations Center traffic analysis group is involved early in the planning process to help leadership understand how impacts might be reduced through contracting options such as accelerated construction. For example, Utah DOT has completed projects where bridges are assembled off the roadside and then slid in place, and impacts of these work zones were analyzed by the Transportation Operations Center, together with Transportation Operations Center archived data, to support these decisions. Accelerated construction is expensive, but can be a huge success if the impacts of the work are mitigated.	
2C Example 3 – Michigan DOT	
Since 2012, Michigan DOT has used the Regional Integrated Transportation Information System (RITIS) automated analytical tool to compute road user costs. Michigan DOT has a goal of no more than 10 minutes of work zone delay for any one road work project and a maximum delay of 40 minutes for all of I-94. RITIS is used to predict whether projects will exceed these thresholds and therefore if alternate approaches should be considered.	

2.2 WORK ZONE STAGE 2: PROJECT DEVELOPMENT – WORK ZONE MANAGEMENT

Stage 2 of the work zone process occurs after the road work project has been planned and designed. This stage is when a Transportation Management Plan (TMP) is developed. "A TMP lays out a set of coordinated transportation management strategies and describes how they will be used to manage the work zone impacts of a road work project"[2]. Two strategies are presented below to utilize TMC resources during this stage in the overall work zone process:

- Strategy #3: Using TMC resources to support development of the TMP Work Zone Impact Assessment Report
- Strategy #4: Using TMC resource to support development of the TMP Work Zone Impacts Management Strategies

The remainder of Section 2.2 presents details of these strategies and examples of use.

2.2.1 Strategy #3: Using TMC Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report

Strategy #3 is using TMC resources to support the development of the Work Zone Impact Assessment Report by predicting impacts of the work zone. Often, DOTs will predict two types of impacts:

1. Impacts to travelers – the mobility and safety impacts that travelers are likely to experience traveling through the work zone and on alternate routes around the work zone
2. Impacts to infrastructure – the impacts on field devices (e.g., if the work zone will disrupt communications to cameras or dynamic message signs (DMS), or if the work zone will make DMS or cameras inoperable or not visible to travelers through the work zone)

Three specific strategies for using TMC resources (3A, 3B, and 3C) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

[2] Developing and Implementing Transportation Management Plans for Work Zones; USDOT. December 2005. http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/trans_mgmt_plans.pdf

Table 16. Strategy 3 – Guidance and Examples of Strategy Use

Strategy #3: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report		
Guidance		**Examples of Strategy Use**
Strategy 3A	Using TMC archived volume and speed data to estimate traffic demand, delays, queue lengths and reliability metrics during the upcoming work zone.	• Utah Department of Transportation (DOT)
Strategy 3B	Using TMC incident logs as a surrogate for crash data to estimate the number of crashes likely to occur during the work zone.	• Minnesota DOT
Strategy 3C	Using Road Condition Reporting Systems to understand planned events causing vehicle restrictions or capacity reductions on alternate routes during the work zone.	• District of Columbia DOT • Minnesota DOT • Caltrans

Table 17. Strategy 3A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 2: Project Development – Work Zone Management **Strategy #3: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report**	
Strategy 3A	**Using TMC archived volume and speed data to estimate traffic demand, delays, queue lengths and reliability metrics during the upcoming work zone.**
Description	Work zones typically cause some degree of capacity restriction. The extent to which the capacity is reduced, combined with the estimated travel demand can be used to predict traveler delay and queue lengths in the work zone to be considered in the Transportation Management Plan. Many TMCs collect and store traffic volume, occupancy, and speed data that is collected from sensors or reported by data service providers. ***This strategy is using TMC data to forecast the traffic and travel patterns through the work zone.*** Traffic forecasts combined with capacity restriction predictions can allow agencies to predict delay and queue lengths. Agency approaches to calculating delay and queue lengths range from spreadsheets that perform basic queueing theory calculations, to software products such as FREEVAL (FREeway EVALuation) or other vendor products.
Anticipated Benefit(s)	Improve work zone mobility
Implementation Steps	1. Once the location of the work zone is defined, those responsible for the Transportation Management Plan work zone impact assessment should request archived volume, occupancy, and speed data from the TMC (or alternatively, if there is a mechanism to download TMC data directly without TMC operator assistance, utilize this approach). 2. Use TMC data in the processes typically performed for the Transportation Management Plan impact analysis.

Table 18. Strategy 3A – Example of Department of Transportation (DOT) Use

Strategy 3A	**Using Traffic Management Center (TMC) archived volume and speed data to estimate traffic demand, delays, queue lengths, and reliability metrics during the upcoming work zone.**
3A Example 1 – Utah Department of Transportation (DOT) use of TMC traffic data to predict delays during work zones	
Utah DOT has found that work zone related traffic impacts that cause up to 15 percent delays to traffic can be handled operationally. When delays are expected to exceed 15 percent, Utah DOT will include public outreach to encourage diversions or seek changes to the Transportation Management Plan to reduce the delays. To estimate the volume data, Utah DOT utilizes volume data from the Traffic Operations Center. Estimating the capacity reduction that will be caused by the work zone is a key part of this prediction and is often challenging to predict. Transportation Operations Center staff experience is a key resource when estimating the capacity during the work zone period.	

Table 19. Strategy 3B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 2: Project Development – Work Zone Management **Strategy #3: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report**	
Strategy 3B	**Using TMC incident logs as a surrogate for crash data to estimate the number of crashes likely to occur during the work zone.**
Description	When crashes occur on metropolitan highways, the crash clearance process often creates delays to travelers. When crashes occur in and around work zones where capacity is already reduced, the delays and impacts can be increased significantly. Estimating the likely number of crashes to occur during a work zone period to be considered in the Transportation Management Plan can help understand and plan countermeasures for the crashes that occur. Numbers of actual crashes that have occurred in recent years are one indicator that can be used to estimate crash numbers for work zones. ***This strategy is using TMC incident logs describing crashes in recent years as a surrogate to predict the number and types of crashes likely to occur during the period of the work zone.*** TMCs typically keep some form of incident log of the incidents that occurred and were responded to by the TMC. While quantitative crash statistics for the exact location of the work zone may not be available, this surrogate can help in estimating crashes.
Anticipated Benefits(s)	Understanding the likely location and types of crashes that may occur during the work zone can enable the Transportation Management Plan planning process to prepare countermeasures to minimize mobility and safety impacts when if crashes should occur
Implementation Steps	1. Contact the TMC to understand the availability of crash information (note: this might include TMC incident logs, a Road Condition Reporting System archived data describing incidents TMC staff entered in the Road Condition Reporting System, or law enforcement logs or access to law enforcement Computer Aided Dispatch (CAD) data). 2. Work with TMC staff to understand an appropriate period of time to consider crashes in the area of the work zone (for example if a lane was added or a geometric change occurred, the crash rates before such a change are less likely to represent the current situation). 3. Once a period is defined, examine available data to understand how many crashes have occurred, and if there are any patterns to the crashes that could be used to predict the likelihood of crashes during the work zone (e.g., rear-end crashes during stopped traffic). 4. Document the thought process and assumptions used to predict the likelihood of crashes during the work zone period.

Table 20. Strategy 3B – Examples of Department of Transportation (DOT) Uses

Strategy 3B	**Using Traffic Management Center (TMC) incident logs as a surrogate for crash data to estimate the number of crashes likely to occur during the work zone.**
3B Example 1 – Minnesota Department of Transportation (DOT) Regional Transportation Management Center Use of Incident Logs	
Operators in the Minnesota DOT Regional Transportation Management Center use incident logs and crash reports from the Minnesota State Patrol to understand estimates of the crash rates in areas near the planned work zone. Estimates of the likely number of crashes to occur during the work zone allow project planners and designers to prepare countermeasures.	

Table 21. Strategy 3C – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 2: Project Development – Work Zone Management **Strategy #3: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impact Assessment Report**	
Strategy 3C	**Using Road Condition Reporting Systems to understand planned events causing vehicle restrictions or capacity reductions on alternate routes during the work zone.**
Description	In situations where work zones restrict capacity, travelers often divert to alternate routes to avoid the work zone. If there are planned events on the alternate routes (e.g., other work zones, temporary closures, special events causing increased demand) the impacts to travelers can be multiplied. ***This strategy is using a Road Condition Reporting System to understand planned capacity reductions on alternate routes or special events that may increase demand in and around the work zone.*** TMCs operate a variety of tools that can be used during the Transportation Management Plan development process to examine alternate routes for such planned events. One tool that is common to almost all state Departments of Transportation (DOTs) is a Road Condition Reporting System. The Road Condition Reporting System is typically used to store information about road work, lane closures, planned events, and driving conditions. It is common for the Road Condition Reporting System to be the primary source for traveler information. However, the Road Condition Reporting System is also an effective tool for inter-agency information sharing.
Anticipated Benefits(s)	Reduced situations where travelers selecting alternate routes to avoid work zones encounter closed roads or capacity restrictions
Implementation Steps	1. Identify the individual within the DOT responsible for managing the Road Condition Reporting System. 2. Request user access and training for individuals involved in developing the Transportation Management Plan (typically access can be granted on a 'view-only' for individuals who do not enter events but need to view events). 3. Encourage those involved in Transportation Management Plan development to log-in and view other road work plans frequently, and to enter descriptions of road work they are planning, in accordance with the Road Condition Reporting System entry guidelines.

Table 22. Strategy 3C – Examples of Department of Transportation (DOT) Uses

Strategy 3C	**Using Road Condition Reporting Systems to understand planned events causing vehicle restrictions or capacity reductions on alternate routes during the work zone.**
3C Example 1 – District of Columbia Department of Transportation (DOT)	
The District of Columbia DOT has developed a comprehensive Work Zone Project Management System to facilitate the coordination all work zones throughout DC for a five-year period using a predictive model to determine potential impacts and identify related work zone conflicts. All projects, including capital, utility, developer, and special events, are integrated into the graphical, web-based, software tool. The Work Zone Project Management System includes three components — a Work Zone Tracking Tool, a Traffic Analysis Tool, and a Citywide Transportation Management Plan. *Source: USDOT FHWA Coordinating Road Projects, website.*	
3C Example 2 – Minnesota DOT	
The Minnesota DOT inputs current and future work zone information into their road reporting systems (Condition Acquisition and Reporting System (CARS)). The work zone information entered is displayed on Minnesota's 511 traveler information website and phone. CARS provides the Minnesota DOT with a final check of identifying any conflicts with overlapping work zones on near-term projects. However, the goal is to identify any conflicts before they are entered into CARS and displayed on 511 traveler information. The Regional Transportation Management Center operators are able to access work zone information through CARS. Providing Project Planning/Design Staff with access to CARS entries provides the ability to identify large or small projects planned for parallel routes to the work zone site during the Transportation Management Plan planning process, which results in travelers being less likely to encounter simultaneous work zones on parallel routes.	
3C Example 3 – Caltrans	
The California Department of Transportation (Caltrans) uses the Performance Measurement System (PeMS) as the main software for deriving freeway system performance measures. PeMS includes current and historic 30-second volume and occupancy data by lane.[3] PeMS is also used by Caltrans as an Archived Data User Service with over ten years of data describing such things as incidents, lane closures, roadway inventory, vehicle classifications, traffic detectors, and other roadway inventories.[4]	

[3] See: http://www.dot.ca.gov/cwwp/InformationPageForward.do

[4] See: http://pems.dot.ca.gov/?redirect=%2F%3Fdnode%3DState

2.2.2 Strategy #4: Using TMC Resources to Support Development of the Transportation Management Plan Work Zone Impacts Management Strategies

One component of the Transportation Management Plan (TMP) is the Work Zone Impacts Management Strategies to minimize the potential impacts of the work zone. Management strategies may involve limiting the time periods when work zones cause capacity reductions, expanding capacity through the use of the shoulder as a travel lane through the work zone, or other similar approaches.

Strategy #4 is using TMC resources to support development of the TMP Work Zone Impacts Management Strategies, enabling the work zone planners to fully utilize TMC resources. Three specific strategies for using TMC resources (4A and 4B) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

There are several TMC resources that are used to actually mitigate the impacts of work zones. Examples of these resources include:

- Freeway service patrols assigned to areas in and around the work zone;
- Ramp meters;
- Real-time traveler information dissemination tools (511 phone, websites, social media, dynamic message signs, Highway Advisory Radio); and
- Lane management systems (including variable speed limit [VSL] systems).

These resources are identified and described in Strategy #7: Using TMC Resources to Support Maintenance of Traffic (MOT) During Active Work Zones – Traveler Mobility.

The resources described here as part of Strategy #4 describe those resources used during the TMP development process to identify likely impacts of the work zone and plan strategies in the TMP to address them.

Table 23. Strategy 4 – Guidance and Examples of Strategy Use

Strategy #4: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impacts Management Strategies		
Guidance		**Examples of Strategy Use**
Strategy 4A	Using TMC resources to understand the likely intelligent transportation system device outages due to work zones and prepare mitigation strategies to maintain critical field device operations.	• Missouri Department of Transportation (DOT) • Minnesota DOT • Utah DOT
Strategy 4B	Using TMC resources to improve safety and mobility in and around the work zone.	• Washington State DOT

Table 24. Strategy 4A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 2: Project Development – Work Zone Management **Strategy #4: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impacts Management Strategies**	
Strategy 4A	**Using TMC resources to understand the likely intelligent transportation system device outages due to work zones and prepare mitigation strategies to maintain critical field device operations.**
Description	Intelligent transportation system devices in the field are used to collect data, manage traffic, and disseminate information to travelers. Work zone activities may make these devices inoperable, either by severing communications to them, realigning traffic out of sight of cameras or signs, or otherwise terminating operation of the device during the work zone. ***This strategy is to use TMC resources to understand the likely intelligent transportation system device outages due to the work zones and to prepare mitigation strategies.*** TMC resources will include design plans for the field devices and communications to the field devices. TMC staff have knowledge of the use of devices (e.g., the field of vision of a camera, the lanes detected from non-intrusive detectors) and can provide details on the impacts should the work zone prevent these from operation. Involving TMC staff and using their design plans can enable the Transportation Management Plan to properly identify outages and accommodate for them through temporary deployments.
Anticipated Benefit(s)	• Reduce unexpected losses of intelligent transportation system device operations during work zones • Maintain the same level of information dissemination, data collection, and traffic management during the work zone period
Implementation Steps	1. Arrange a meeting with TMC staff to become familiar with "as-built" and design documents describing the location of field devices controlled by the TMC as well as contracting options. 2. As specific work zones are planned, meet with TMC staff to review the field devices most likely impacted by the location and activities planned for the work zone. 3. Discuss needs for temporary field equipment with TMC staff, both to support TMC operations and to support specific activities of the work zone. 4. Document the planned approach as part of the Transportation Management Plan.

Table 25. Strategy 4A – Examples of Department of Transportation (DOT) Uses

Strategy 4A	**Using Traffic Management Center (TMC) resources to understand the likely intelligent transportation system device outages due to work zones and prepare mitigation strategies to maintain critical field device operations.**
4A Example 1 – Missouri Department of Transportation (DOT) Work Zone Contract Incentives	
In order to ensure that routine equipment is maintained and operational, or supplemented with portable devices during work zone periods, Missouri DOT includes incentives in work zone contracts. The TMC typically specifies that at least 75 percent of detectors remain operational in the work zone area. Similarly, the TMC often requires that closed-circuit television and dynamic message signs remain 100 percent operational. Another requirement is that any communication of existing devices or temporary devices be tied back to the TMC. The contractors are given liberties with figuring out how to establish communications to the TMC.	
4A Example 2 – Minnesota DOT Guidelines for Deploying Temporary Intelligent Transportation System Devices	
In Minnesota, if a work zone will be deployed for less than a month, a portable dynamic message sign is typically not installed to display travel times, but would be considered on work zones lasting over a month. The Minnesota DOT operates closed-circuit television cameras roughly spaced at no more than 1 mile apart. These cameras are key to incident detection and management of traffic. Typically, if a work zone will cause two or more successive closed-circuit television to be lost during the work zone period, one or more portable closed-circuit television will be installed to replace them during the work zone period. Additionally, the nature of the construction and geometrics of the area may merit supplemental closed-circuit television even in situations where none of the permanent closed-circuit television are lost. In all cases, the temporary closed-circuit television installed would be controlled through the Minnesota DOT Regional Transportation Management Center.	
4A Example 3 – Utah DOT: I-15 CORE project	
The Utah DOT Transportation Operations Center in Salt Lake City was involved in planning and managing traffic during the I-15 widening project through Orem and Provo. System officials identified technology components at critical locations (e.g., sensors, cameras, ramp meters, and permanent dynamic message signs) that were needed to help support traffic management during construction, and that could also be useful additions to the system once construction was complete. These components were procured and installed in time to be useful for the road work project. *Source: Work Zone ITS Implementation Guide (2014), page 13.*	

Table 26. Strategy 4B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 2: Project Development – Work Zone Management **Strategy #4: Using Traffic Management Center (TMC) Resources to Support Development of the Transportation Management Plan Work Zone Impacts Management Strategies**	
Strategy 4B	**As part of the Transportation Management Plan (TMP) development process, consider TMC resources to improve safety and mobility in and around the work zone.**
Description	When travel delays or safety concerns are predicted during work zone periods, either in the work zone or along alternate routes, one strategy for minimizing work zone impacts is to consider TMC resources available within the planned work zone and include these in the Transportation Management Plan. Depending upon the Department of Transportation (DOT), a number of TMC resources may help to mitigate the impacts of the work zone, including but not limited to: - Freeway service patrols; - Traffic signals controlled by the TMC; - Ramp meters; - Real-time traveler information dissemination tools (including phone, web, social media, dynamic message signs, Highway Advisory Radio, etc.); - Lane management systems; and - Queue detection and reporting systems. These and other resources operated by the TMCs can be included in the Transportation Management Plan to describe approaches for minimizing the impacts of work zones.
Anticipated Benefit(s)	Increased capacity in the direction of travel through signalized intersections that experience increased demand during work zones
Implementation Steps	1. Meet with TMC staff to determine which of the above mentioned tools are available and controlled by the TMC. 2. Meet with TMC staff to discuss factors that will be used to determine when to implement control of intelligent transportation system devices to mitigate the impacts of the work zone. 3. Document the planned approach as part of the Transportation Management Plan.

Table 27. Strategy 4B – Examples of Department of Transportation (DOT) Uses

Strategy 4B	**As part of the Transportation Management Plan development process, consider Traffic Management Center (TMC) resources to improve safety and mobility in and around the work zone.**
4B Example 1 – Washington State Department of Transportation (DOT)	
Description	During the work zone planning process, Washington State DOT conducts a series of project meetings called 'huddles' to communicate and plan for the work zone. Intelligent transportation system capabilities (e.g., permanent and temporary field devices, systems, or equipment in and around the work zone) are considered when planning for the work zone.

2.3 WORK ZONE STAGE 3: ACTIVE WORK ZONE OPERATIONS

Stage 3 of the work zone process is considered the active work zone. This stage follows the development of the TMP and includes the physical operation of the work zone to maintain safety and mobility to travelers and safety to the road work project workers. Three strategies are presented below to utilize TMC resources during this stage in the overall work zone process:

- Strategy #5: Using TMC resources to support pre-work zone ***information dissemination***
- Strategy #6: Using TMC resources to support maintenance of traffic (MOT) during work zones specifically related to ***traveler safety***
- Strategy #7: Using TMC resource to support maintenance of traffic (MOT) during work zones specifically related to ***traveler mobility***

The remainder of Section 2.3 presents details of these strategies and examples of use.

2.3.1 Strategy #5: Using TMC Resources to Support Pre-Work Zone Information Dissemination

In the days leading up to the start of a work zone, informing the drivers who frequently drive through the area to be impacted by the work zone is helpful to alert them to the potential for delays and to encourage alternate routes or departure times, when appropriate. ***Strategy #5 is using TMC resources to support pre-work zone information dissemination***. Two specific strategies (5A and 5B) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

Table 28. Strategy 5 – Guidance and Examples of Strategy

Strategy #5: Using Traffic Management Center (TMC) Resources to Support Pre-Work Zone Information Dissemination		
Guidance		**Examples of Strategy Use**
Strategy 5A	Using TMC-operated dynamic message signs in the vicinity of the work zone to describe upcoming work zone impacts (e.g., lane or route closures and dates) to travelers prior to the start of the work zone.	• Michigan Department of Transportation (DOT)
Strategy 5B	Using TMC-operated traveler information systems and social media accounts to describe upcoming work zones and anticipated impacts to travelers pre-trip.	• Washington State DOT • Utah DOT

Table 29. Strategy 5A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #5: Using Traffic Management Center (TMC) Resources to Support Pre-Work Zone Information Dissemination**	
Strategy 5A	**Using TMC-operated dynamic message signs in the vicinity of the work zone to describe upcoming work zone impacts (e.g., lane or route closures and dates) to travelers prior to the start of the work zone.**
Description	TMC operators control permanent or portable dynamic message Signs in the field to display information or alerts to travelers along specific routes. ***This strategy is to use permanent or portable dynamic message signs operated by the TMC to disseminate notices to travelers that work zones will impact their trip in the near future.*** Dynamic message sign messages are typically displayed up to a week in advance of the work zone, describing the dates of the work zone and any details available about lane or road closures.
Anticipated Benefit(s)	• Travelers are able to plan alternate routes, modes, or departure times for trips performed during the work zone period • Travelers are not surprised by excessive delays resulting from work zones • Reduced negative feedback from travelers to the Department of Transportation (DOT)
Implementation Steps	1. Arrange to meet with TMC staff in advance of the work zone start date to discuss the use of existing or portable dynamic message signs to describe the upcoming work zone. 2. Request and discuss with TMC staff the potential to display advanced messages about the work zone. 3. Inform the TMC in the event that any information about the work zone changes (e.g., a change in the start date or plans for closures).

Table 30. Strategy 5A – Examples of Department of Transportation (DOT) Uses

Strategy 5A	**Using Traffic Management Center (TMC)-operated dynamic message signs in the vicinity of the work zone to describe upcoming work zone impacts (e.g., lane or route closures and dates) to travelers prior to the start of the work zone.**
5A Example 1 – Michigan Department of Transportation (DOT)	
The Michigan DOT Lansing Transportation Operations Center is informed of a road work project a couple weeks prior to the start of construction. At this point, the Transportation Operations Center is involved in planning the permanent and portable dynamic message sign message(s) established for the project. Advanced message warnings are included in this plan. For example during the day a Transportation Operations Center operator will post on a dynamic message sign "NIGHTLY ROAD CLOSURE, 9PM TO 5AM". However it is important to note that these advanced warning messages are less of a priority than the use of dynamic message signs to inform travelers of current active alerts or condition reports. Posting advanced warnings of work zone impacts provides travelers with information to make decisions and plan which route to utilize based on the schedule for a known closure, for example.	

Table 31. Strategy 5B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #5: Using Traffic Management Center (TMC) Resources to Support Pre-Work Zone Information Dissemination**	
Strategy 5B	**Using TMC-operated traveler information systems and social media accounts to describe upcoming work zones and anticipated impacts to travelers pre-trip.**
Description	Each state Department of Transportation (DOT) operates some form of traveler information system. Also, many counties and local cities offer some degree of traveler information. These include systems such as 511 phone systems, web sites, mobile apps, and posts to social media outlets such as Facebook and Twitter. TMCs are not always the primary 'owner' of such tools within the DOT, but TMC staff are almost always involved in some way with information content. This strategy is to utilize TMC resources that disseminate information over traveler information systems (including social media) to inform travelers about upcoming work zones. Public traveler information websites typically include map displays with icons placed on the map identifying road work. Travelers clicking these icons can read details about planned or current work zones. 511 phone systems often operate similarly, with travelers hearing about current or future road work causing impacts. There are other variations of pre-work zone information. Cities that operate a Facebook account will often use this to provide a notice of upcoming work zones, often offering details about the work to be performed.
Anticipated Benefit(s)	Travelers are able to plan alternate routes, modes, or departure times for trips performed during the work zone period
Implementation Steps	1. Arrange to meet with TMC staff and the traveler information coordinator in advance of the work zone start date to discuss the use of existing traveler information mediums to communicate messages to travelers before and during the work zone. 2. Discuss methods for work zone staff members to update and add specific details to information being disseminated to the traveling public (e.g., by reporting to the TMC what the daily lane closure plan is, by directly entering plans into the Road Condition Reporting System, etc.). 3. Inform the TMC and the traveler information coordinator in the event that any information about the work zone changes (e.g., a change in the start date or plans for closures).

Table 32. Strategy 5B – Examples of Department of Transportation (DOT) Uses

Strategy 5B	**Using Traffic Management Center (TMC)-operated traveler information systems and social media accounts to describe upcoming work zones and anticipated impacts to travelers pre-trip.**
5B Example 1 – Washington State Department of Transportation (DOT)	
A work zone analysis in the summer of 2014 for a road work project in the Washington State DOT Olympia area predicted 15 miles of backup. A pre-messaging campaign using web, phone, and social media resources was conducted to warn drivers and advise them of alternate routes. The campaign was so successful that there was almost no backup for the work zone. Information provided prior to the traveling public notifying them of an upcoming work zone provides an opportunity for travelers to alter their schedules or consider alternate routes. Pre-messaging using web, phone, and social media resources can be extremely effective at altering travel patterns. However, many of the diversion patterns depend heavily on the options for alternate routes. Pre-messaging is less effective when alternate routes are available. Internal coordination within the Washington State DOT on pre-messages provides operators with information on which routes to monitor.	
5B Example 2 – Utah DOT	
For one particular multi-billion dollar project, the Utah DOT created a separate Twitter feed, telephone hotlines, and separate website to provide information about the work zone. This strategy proved to be effective because the information provided offered opportunities for travelers to alter their schedules or consider alternate routes. Utah DOT has used separate website/Twitter/hot lines for major road work projects, but discourages it for smaller projects because this would significantly increase the number of separate communications medium created by the agency, leading to several sites/feeds/phone lines that are only temporary.	

2.3.2 Strategy #6: Using TMC Resources to Support Maintenance of Traffic (MOT) During Active Work Zones – Traveler Safety

TMC staff actively monitors work zones and assist in real-time traffic management and information dissemination. ***Strategy #6 is using TMC resources to support maintenance of traffic (MOT) during the work zone, with an emphasis on traveler safety***. Two specific strategies (6A and 6B) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and to the examples of use.

Table 33. Strategy 6 – Guidance and Examples of Strategy Use

Strategy #6: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Safety		
Guidance		**Examples of Strategy Use**
Strategy 6A	Using TMC real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs.	• Utah Department of Transportation (DOT) • Iowa DOT
Strategy 6B	Using TMC-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream.	• New Jersey DOT • Minnesota DOT

Table 34. Strategy 6A – Description, Anticipate Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #6: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Safety**	
Strategy 6A	**Using TMC real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs.**
Description	Travelers driving at or near highway speeds who come upon stopped vehicles at the end of a queue are often surprised, which presents a situation that can result in rear-end collisions. Some geometric situations, such as horizontal or vertical curves can increase the risks associated with queue related collisions. ***This strategy is using TMC resources to detect queues that form as traffic stops in and near work zones, and to alert upstream drivers about the queues in a timely manner, such that they can prepare to stop.*** This strategy utilizes existing detectors and/or surveillance cameras connected to the TMC to detect queues, and permanent or portable dynamic message signs controlled by the TMC to inform drivers upstream. There are examples of self-contained queue detection and warning systems where detectors automatically activate messages on upstream signs. These self-contained systems may or may not involve interaction with TMCs.
Anticipated Benefit(s)	• Prevent rear-end collisions at the point where traffic meets the queues • Eliminate the costs of self-contained queue detection systems
Implementation Steps	1. Arrange to meet with TMC staff in advance of the work zone start date to discuss the potential use of existing or temporary dynamic message signs to describe anticipated queues that will form in or near the work zone. 2. Rely on TMC expertise to determine if queue detection and reporting is possible with existing TMC resources, or if separate stand-alone queue detection systems should be considered. 3. If TMC-supported queue detection and reporting is selected, discuss with TMC staff whether manual observations of queues is possible at this location or if additional sensors need to be installed and connected with the TMC. 4. Discuss with TMC staff whether additional temporary dynamic message signs are needed, or if existing permanent dynamic message signs are sufficient.

Table 35. Strategy 6A – Examples of Department of Transportation (DOT) Uses

Strategy 6A	**Using Traffic Management Center (TMC) real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs.**
6A Example 1 – Utah Department of Transportation (DOT) Queue Detection and Alerts Using TMC Resources	
Utah DOT has implemented both stand-alone queue warning systems and systems that incorporate field detectors that report back to the TMC, which then controls the dynamic message sign (typically portable) to report warnings of queues. The selection of a stand-alone system or centralized system with the TMC is a case-by-case decision. If there is project funding, local stand-alone systems often make sense, but ideally the TMC has access to all the data. An example in Utah is the road work performed on US 40 where data on stopped or slowed vehicles was reported to the TMC, and messages selected for display on the signs, warning of delays and/or queues. When the Utah DOT deploys stand-alone queue warning systems, there is a preference for communications to the TMC, so that TMC operators are aware of what is being displayed on the dynamic message sign. If the communications to the TMC are not possible, there is potential for conflicting messages to travelers.	
6A Example 2 – Iowa DOT Queue Detection and Alert Using TMC Resources	
Iowa DOT utilizes queue warning systems to alert drivers of slow or stopped traffic ahead. Iowa DOT will either use existing permanent detectors or deploy temporary sensors to detect slowing traffic and the formation of queues. The data collected is brought back to the TMC. The Iowa DOT Advanced Traffic Management System software[5] includes logic to automatically display messages on dynamic message signs when slow traffic or queues are detected. In addition to automated messages, the system is also capable of emailing TMC staff and supervisors to alert them about the situation. The staff may then look at camera images (if available) to assess the situation and recommend overriding a sign message if needed.	

[5] Iowa DOT operates the TransSuite® System by TransCore

Table 36. Strategy 6B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #6: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Safety**	
Strategy 6B	**Using TMC-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream.**
Description	TMCs typically control a network of closed-circuit television cameras and traffic detectors that can be used together to monitor traffic in and around work zones. TMC staff typically have the ability to notify law enforcement, maintenance crews, and freeway service patrols to assist in incident clearance. ***This strategy is using TMC staff visual observations and TMC access to traffic data to detect incidents or slow traffic in and around work zones and to initiate a response to clear incidents as quickly as possible, while also informing travelers of the impacts.*** Any reduction in the time it takes for responders to react to incidents helps to reduce the overall time that the incident is impacting traffic, and therefore improves the safety in and around the work zone.
Anticipated Benefit(s)	• Reduced incident response times • Reduced situations of vehicles approaching slow or stopped traffic in and around work zones
Implementation Steps	1. Meet with TMC staff to ensure they are aware of the work zone and the plans for areas to be impacted by the work zone. 2. Request that TMC staff monitor the work zone to the extent possible, in order to detect any incidents that occur in or around the work zone.

Table 37. Strategy 6B – Examples of Department of Transportation (DOT) Uses

Strategy 6B	**Using Traffic Management Center (TMC)-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream.**
6B Example 1 – New Jersey Department of Transportation (DOT) Dedicated Staff Time to Monitor and Report Conditions	
For the large New Jersey DOT Pulaski Skyway project, a dedicated person was assigned at the TMC to monitor and report delays, keep traveler information current and communicate with local police on issues observed on cameras.	
6B Example 2 – Minnesota Regional Transportation Management Center Monitoring Work Zones	
The Minnesota Regional Transportation Management Center actively monitors work zones operating along the metro area freeways. Regional Transportation Management Center operators monitor closed-circuit television cameras and traffic data, but also maintain communications with the contractors and maintenance personnel in the area to detect and report traffic disruptions.	

2.3.3 Strategy #7: Using TMC Resources to Support Maintenance of Traffic (MOT) During Active Work Zones – Traveler Mobility

TMC staff actively monitor work zones and assist in real-time traffic management and information dissemination. ***Strategy #7 is using TMC resources to support maintenance of traffic (MOT) during the work zone, with an emphasis on traveler mobility***. Five specific strategies (7A, 7B, 7C, 7D, and 7E) are identified in the table below, together with hyperlinks to the descriptions of each specific strategy and the examples of use.

Table 38. Strategy 7 – Guidance and Examples of Strategy Use

Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility		
Guidance		**Examples of Strategy Use**
Strategy 7A	Using performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools) to determine if any modifications to the work zone management approach are needed to maintain traffic mobility.	• Michigan Department of Transportation (DOT)
Strategy 7B	Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.	• Washington State DOT • Michigan DOT
Strategy 7C	Using real-time traveler information dissemination systems and tools (including dynamic message signs, Highway Advisory Radio, 511 phone and websites, and social media) to provide content that informs travelers of work zone delays or incidents.	• Missouri DOT • Wisconsin DOT
Strategy 7D	Using TMC-operated traffic management tools (e.g., lane management systems, variable speed limit systems, and ramp meters) to manage traffic flow in and around the work zone.	• Minnesota DOT
Strategy 7E	Using Freeway Service Patrols to assist in minimizing impacts of incidents in and around work zones.	

Table 39. Strategy 7A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility**	
Strategy 7A	**Using performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools) to determine if any modifications to the work zone management approach are needed to maintain traffic mobility.**
Description	Once the work zone is established and operational, resources within nearby TMCs can help inform the extent of traffic delays and queue lengths in and around the work zone. This analysis can be helpful to determine if changes are needed to the work zone management approach to reduce negative impacts to travelers and/or workers. Without appropriate tools, this analysis may require extensive manual data collection and may not produce reliable results. ***This strategy is to use TMC resources, such as volume, occupancy, and speed data, combined with measurement and management tools to generate reports on the effectiveness of the work zone and enable adjustments while the work zone is still active.***
Anticipated Benefit(s)	• Reduced situations where work zone impacts are extensive and do not improve throughout the work zone • Reduced work zone staff time performing manual analyses of work zone management performance
Implementation Steps	1. Meet with TMC staff to understand performance management tools already in use by the TMC, and their capabilities. 2. Determine specific parameters to be used to assess work zone performance (e.g., speed through the work zone, queue lengths), and compare these parameters with the functionality of existing TMC performance management tools. If all desired parameters are not all possible, ask the vendor of the performance management tool (if appropriate) if those parameters can be measured. 3. Participate in any training or user sessions to become familiar with using the TMC performance management tools. 4. Identify a schedule for when analysis of the work zone will be performed (e.g., weekly or daily) to make adjustments that are needed.

Table 40. Strategy 7A – Examples of Department of Transportation (DOT) Uses

Strategy 7A	**Using performance measurement and management tools available to the Traffic Management Center (TMC) (i.e., vendor products or in-house developed tools) to determine if any modifications to the work zone management approach are needed to maintain traffic mobility.**
7A Example 1 – Michigan Department of Transportation (DOT)	
Michigan DOT uses Regional Integrated Transportation Information System (RITIS) reports and data analyses performed during active work zones to determine if any modifications to the work zone management approach are needed. RITIS has provided Michigan with a tool to quantify detailed snapshots of a work zone. Prior to RITIS, Michigan DOT would take screen captures of Google speed maps to review how the work zone was operating. By providing a more accurate analysis of work zone management, the use of RITIS supports consideration of changes to the work zone management approach.	

Table 41. Strategy 7B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility**	
Strategy 7B	**Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.**
Description	As travelers plan their trips or approach work zones while en-route, information describing current travel times through the work zone is very valuable. ***This strategy is to use TMC resources to generate current travel times through work zones.*** The TMC resources to support this strategy may include: - Speed data collected or computed from volume and occupancy data; - Speed data from roadside speed detection sensors and systems; and - Speed data purchased from third-party data providers. TMCs often have traffic data detectors spaced throughout metro areas to enable real-time travel time calculations, or purchase speed or travel time data from a third-party provider. During work zones, TMCs will often supplement data collection by adding loop detectors, non-intrusive detectors, or purchasing additional third-party data. These resources can be very effective to disseminate the travelers as they approach work zones, using dynamic message signs, 511 phone systems, Highway Advisory Radio, or web and social media outlets.
Anticipated Benefit(s)	Travelers informed of actual travel times through the work zone
Implementation Steps	1. Arrange to meet with TMC staff in advance of the work zone start date to discuss existing field equipment and/or procured data that could be used to compute travel times through the work zone. 2. Discuss with TMC staff whether existing dynamic message signs or information delivery mechanisms are adequate to inform travelers approaching the work zone of the travel times, or if additional temporary field equipment is needed.

Table 42. Strategy 7B – Examples of Department of Transportation (DOT) Uses

Strategy 7B	**Using Traffic Management Center (TMC) resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.**
7B Example 1 – Washington State Department of Transportation (DOT)	
The TMC in the Olympia, Washington area is responsible for posting dynamic message signs and Highway Advisory Radio messages, as well as providing traveler information updates, as appropriate, to inform drivers about work zones. Messages may include travel times, description of lane closures and descriptions of alternate routes. Travel times through work zones are the most demanded and effective en-route information type provided by Washington State DOT.	
7B Example 2 – Michigan DOT	
In locations where congestion occurs due to a work zone deployed by the Michigan DOT, probe data is used to generate and automatically post travel times to dynamic message signs.	

Table 43. Strategy 7C – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility**	
Strategy 7C	**Using real-time traveler information dissemination systems and tools (including dynamic message signs, Highway Advisory Radio, 511 phone and websites, and social media) to provide content that informs travelers of work zone delays or incidents.**
Description	Every state Department of Transportation (DOT) operates some form of travel information dissemination system. Additionally, selected counties, cities, and metropolitan planning organizations may also operate travel information systems. Often, the TMC software systems and/or staff members contribute to the content of these information dissemination systems. A challenge facing every agency is keeping work zone information up to date and accurate enough to adequately inform travelers of the likely delays or lane restrictions. TMC tools (e.g., dynamic message signs, Highway Advisory Radio, 511 phone and websites, and social media) that display content as entered into the information dissemination system at the TMC, can assist in supplying this timely and accurate information about work zones. ***This strategy is to include the information content provided by the TMC to add work zone related content to the information disseminated by the DOT traveler information system.*** This content can include advanced notifications of planned closures of lanes or roads, or real-time notifications of delays or travel restrictions.
Anticipated Benefit(s)	• Travelers access to pre-trip information describing likely impacts of work zones • En-route travelers alerted to current delays or other impacts
Implementation Steps	1. Arrange to meet with TMC staff and the traveler information coordinator in advance of the work zone start date to discuss the use of existing traveler information mediums to communicate messages to travelers before and during the work zone. 2. Discuss methods for the project engineer/manager to update and add specific details to information being disseminated to the traveling public (e.g., by reporting to the TMC what the daily lane closure plan is, by directly entering plans into the Road Condition Reporting System, etc.). 3. Inform the TMC and the traveler information coordinator in the event that any information about the work zone changes (e.g., a change in the start date or plans for closures).

Table 44. Strategy 7C – Examples of Department of Transportation (DOT) Uses

Strategy 7C	**Using real-time traveler information dissemination systems and tools (including dynamic message signs, Highway Advisory Radio, 511 phone and websites, and social media) to provide content that informs travelers of work zone delays or incidents.**
7C Example 1 – Missouri Department of Transportation (DOT)	
At the Missouri DOT, when a contractor is selected, the contractor works together with the construction inspector and the Traffic Management Center (TMC) to monitor the work zone daily and weekly. Information about the work zone is shared both ways from the contractor and from the TMC. Details about lane closures are shared so that information can be maintained in TMC systems (e.g., travel information, travel times, etc.) and then displayed to travelers through information dissemination tools. This process is being used with all new road work projects.	
7C Example 2 – Wisconsin DOT	
The Wisconsin DOT Lane Closure System is used to enter intended lane closures in order to receive the permits to operate a lane closure. This ensures that all lane closures are represented and that traveler information systems are current and accurate.	

Table 45. Strategy 7D – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility**	
Strategy 7D	**Using TMC-operated traffic management tools (e.g., lane management systems, variable speed limit systems, and ramp meters) to manage traffic flow in and around the work zone.**
Description	A number of TMCs now operate lane management systems, often with dynamic lane control signage located above lanes that are used to describe lane closures, advisory or enforceable speeds, or other directions to drivers. When work zones exist in the vicinity of these lane management systems, these TMC resources can be used to direct traffic to the desired lane and/or travel speed to safely and efficiently move through the work zone. Variable speed limit systems that compute advisory or enforceable speeds and display these to travelers may exist as part of lane management systems or as stand-alone systems. These are used to maintain a safe and efficient speed of travel. Finally, ramp metering in another tool used to control the rate that vehicles enter a stretch of roadway. Each of these traffic management tools can be used to maintain mobility in and around the work zone. ***This strategy is to use available TMC traffic management tools to manage traffic flow in and around the work zone.***
Anticipated Benefit(s)	• Travelers advised of lane control and speed limits/advisories as they approach the work zone increases safety • Ramp metering helps vehicles entering the freeway merge more efficiently
Implementation Steps	1. If your agency operates lane control signs, variable speed limit, or ramp meters, request that the TMC consider the upcoming work zone when planning the use of these traffic management tools. 2. Provide any available information about planned lane closures each day of the work zone to TMC staff to assist them in considering work zone related messages on the lane control signs, variable speed limit postings, and ramp meter rates. 3. Inform the TMC in the event that any information about the work zone changes (e.g., a change in the start date or plans for closures).

Table 46. Strategy 7D – Examples of Department of Transportation (DOT) Uses

Strategy 7D	**Using Traffic Management Center (TMC)-operated traffic management tools (e.g., lane management systems, variable speed limit systems, and ramp meters) to manage traffic flow in and around the work zone.**
7D Example 1 – Minnesota Department of Transportation (DOT) Managed Lanes Support to Work Zone Operations	
Minnesota DOT operates lane management systems on I-94 and I-35 in the St. Paul/Minneapolis metro area, which are monitored and operated by the Regional Transportation Management Center. If a work zone occurs in this area, the system is utilized to automatically direct traffic away from a closed lane.	

Table 47. Strategy 7E – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 3: Active Work Zone Management **Strategy #7: Using Traffic Management Center (TMC) Resources to Support Maintenance of Traffic During Active Work Zones – Traveler Mobility**	
Strategy 7E	**Using Freeway Service Patrols to assist in incidents in and around work zones.**
Description	Many TMCs operate Freeway Service Patrols that include dedicated vehicles driving the freeways to assist motorists who run out of gas, encounter stalled vehicles, or other operational problems. Many Freeway Service Patrol vehicles are equipped with flashing lights and directional arrows so that they can position behind a stalled vehicle and encourage traffic to merge. **This strategy is to increase the focus of Freeway Service Patrol vehicles in and around work zone areas in anticipation of the increased likelihood of incidents.** This can allow Freeway Service Patrol vehicles to quickly respond to incidents near the work zone and increase the overall mobility of the work zone.
Anticipated Benefit(s)	Minimized impacts of incidents in and around work zones
Implementation Steps	1. If your agency operates a Freeway Service Patrol program, meet with the manager of the Freeway Service Patrol to discuss opportunities to increase the presence of Freeway Service Patrol vehicles in and around the work zone during key times. 2. Provide any available information about planned lane closures each day of the work zone to the Freeway Service Patrol manager to help them determine when to direct Freeway Service Patrol vehicles to the work zone area.

2.4 WORK ZONE STAGE 4: POST-WORK ZONE EVALUATION AND PERFORMANCE MANAGEMENT

Stage 4 of the work zone process is considered Work Zone Evaluation and Performance Management. This stage follows the active work zone stage and includes activities to retrospectively assess the work zone to determine if the expected impacts were the actual impacts, and to learn ways to improve future work zones. One strategy is presented below to utilize TMC resources during this stage in the overall work zone process:

- Strategy #8: Using TMC Resources to Support Work Zone Evaluation and Performance Management

The remainder of Section 2.4 presents details of this strategy and examples of use.

2.4.1 Strategy #8: Using TMC Resources to Support Work Zone Evaluation and Performance Management

The Federal Highway Administration (FHWA) *Best Practices in Work Zone Assessment, Data Collection, and Performance Evaluation*[6] document describes how agencies should decide what data is required to measure performance, invest the necessary resources to obtain that data, and decide how the measures that are computed will be used to affect decisions or, in some cases, agency processes, for a given road work project. ***Strategy #8 is using TMC resources to support work zone evaluation and performance management.*** Two specific strategies for using TMC resources (8A and 8B) are identified in the table below, together with hyperlinks to the description of each specific strategy and examples of use.

Table 48. Strategy 8 – Guidance and Examples of Strategy Use

Strategy #8: Using Traffic Management Center (TMC) Resources to Support Work Zone Evaluation and Performance Management		
Guidance		**Examples of Strategy Use**
Strategy 8A	Using TMC archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.	• Minnesota Department of Transportation (DOT) • Washington State DOT • Michigan DOT
Strategy 8B	Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.	• Maryland State Highway Agency

[6] *Source: Best Practices in Work Zone Assessment, Data Collection, and Performance Evaluation*

Table 49. Strategy 8A – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 4: Post-Work Zone Evaluation and Performance Management **Strategy #8: Using Traffic Management Center (TMC) Resources to Support Work Zone Evaluation and Performance Management**	
Strategy 8A	**Using TMC archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.**
Description	Post-work zone evaluation and performance management is an important aspect to learn from and plan for future road work projects. By reviewing the actual impacts of a work zone and comparing these to the anticipated impacts, the lessons learned can be applied to other similar road work projects. The same data and performance management tools that are useful planning and executing the work zone are also valuable for post-work zone evaluations. Without appropriate tools, this analysis may require extensive manual data collection and may not produce reliable results. ***This strategy is using TMC resources, such as volume, occupancy, and speed data combined with measurement and management tools to conduct work zone evaluations after the work zone is complete to understand the actual impacts of the work zone on mobility and safety.***
Anticipated Benefit(s)	• Ability to understand how the actual impacts compare to the predicted impacts of a work zone • Apply lessons learned from previous project to future work zone planning
Implementation Steps	1. Meet with TMC staff to understand performance management tools already in use by the TMC, and their capabilities. 2. Determine specific parameters to be used to conduct post-work zone assessments (e.g., speed through the work zone, queue lengths), and compare these parameters with the functionality of existing TMC performance management tools. If all desired parameters are not currently being measured, ask the vendor of the performance management tool (if appropriate) if those parameters can be measured. 3. Participate in any training or user sessions to become familiar with using the TMC performance management tools. 4. Request and/or gather all pertinent data that is collected by the TMC (e.g., volume, occupancy, speed) and prepare for post-work zone evaluation.

Table 50. Strategy 8A – Examples of Department of Transportation (DOT) Uses

Strategy 8A	**Using Traffic Management Center (TMC) archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.**
8A Example 1 – Minnesota Department of Transportation (DOT)	
The Minnesota DOT Regional Transportation Management Center (RTMC) uses the Performance Measurement System (PeMS) and the Traffic Information and Condition Analysis System (TICAS) traffic data programs for work zone analyses. PeMS provides the Minnesota DOT RTMC with archived data for historical analysis by collecting and storing data from the RTMC detectors. PeMS data is also available in real-time. TICAS uses archived detector data (speed, total flow, density, average lane flow, occupancy and acceleration) from Minnesota DOT's RTMC to calculate corridor based traffic information. Minnesota DOT utilizes the PeMS and TICAS software programs to compare the predicted delay prior to the work zone to the actual volume and speed data collected while the work zone was in operation. By comparing predicted delays in a work zone to the actual delay, Minnesota DOT planning staff are able to apply lessons learned from previous projects to similar projects. Alternate route use can be difficult to predict when planning a work zone especially when closing entrance ramps towards a work zone. In one instance, PeMS predicted that delay would increase with the opening of an entrance ramp; when TICAS was used to analyze actual traffic data, it indicated that delay was decreased. The Minnesota DOT RTMC provides and analyzes archived data (e.g., volume, speed) before, during and after a road work project. RTMC staff then works with other departments within the agency to provide customized reports of RTMC data to assist with summarizing how the work zone performed.	
8A Example 2 – Washington State DOT	
The Washington State DOT Olympic Region TMC Traffic Analyst is responsible for reporting the work zone impacts that were anticipated compared with the actual impacts that occurred. A spreadsheet tool is used, with volumes as the input and queues computed. By conducting a performance measure analysis, Washington State DOT is able to understand the impacts of the work zone and how well they were predicted compared to actual performance.	
8A Example 3 – Michigan DOT	
The Regional Integrated Transportation Information System (RITIS) has provided Michigan DOT with a tool to provide detailed snapshots of a work zone in order to analyze the degree to which delay is increasing or decreasing. RITIS collects data provided by the DOT (e.g., detector data, speed data) as well as other sources and provides the data in real-time and archived data formats.	

Table 50. Strategy 8A – Examples of Department of Transportation (DOT) Uses (Continued)

Strategy 8A	**Using Traffic Management Center (TMC) archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.**
Performance goals, for example, were set for a road work project on I-94. The overall goal for setting performance measures was customer satisfaction. The goals were assigned and reviewed weekly by analyzing work zone data through RITIS. By modifying the work zone on a week-by-week basis, Michigan DOT aimed to reduce delay and incidents along the corridor. Assigning weekly goals for the I-94 corridor project increased awareness of how other departments within the agency play a role and contribute to the work zone planning and implementation.	

Table 51. Strategy 8B – Description, Anticipated Benefits, and Implementation Steps

Work Zone Stage 4: Post-Work Zone Evaluation and Performance Management **Strategy #8: Using Traffic Management Center (TMC) Resources to Support Work Zone Evaluation and Performance Management**	
Strategy 8B	**Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.**
Description	Analysis of traffic data (volume, occupancy, speed) through a work zone is helpful to conduct post-work zone evaluations and performance management. However, additional non-traffic data from the TMC can be a useful part of the performance management process. ***This strategy is using TMC incident logs, dynamic message sign message logs, and road condition reports to supplement the traffic analysis and support work zone performance evaluations.***
Anticipated Benefit(s)	Consideration of additional factors beyond traveler mobility when conducting work zone analyses
Implementation Steps	1. Meet with TMC staff prior to the work zone to understand any additional information (beyond traffic data) that the TMC can provide to help post-work zone evaluation. 2. Based on the information discussed, arrange a timely schedule for obtaining the data after the work zone is complete.

Table 52. Strategy 8B – Example of Department of Transportation (DOT) Use

Strategy 8B	**Using Traffic Management Center (TMC) incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.**
8B Example 1 – Maryland State Highway Agency	
The Maryland State Highway Agency uses the Regional Integrated Transportation Information System (RITIS) to view how many crashes/incidents have occurred in the work zone, analyze the queue lengths, and identify user delay costs. RITIS collects data provided by the State Highway Agency (e.g., detector data, speed data) as well as other sources and provides the data in real-time and archived data formats. The RITIS tool displays which corridors or work zone has the largest delay to then further analyze the causes of delay (e.g., crashes/incidents). Data reviewed can then also support work zone management approaches selected. Utilizing the data and reports in the RITIS tool assists the Maryland State Highway Agency staff in identifying any trends due to crashes/incidents and modify the work zone on current or future projects. Maryland State Highway Agency is able to analyze delay through the RITIS tool and modify work zone strategies to decrease delay that can be applied to future similar projects.	

CHAPTER 3. SUMMARY OF TMC RESOURCES

Each TMC is unique, and therefore the resources available will vary. A number of strategies for using TMC resources most common to all TMCs have been defined in previous sections of this document; however, as detailed in the table below there are many TMC resources available. The resources documented provide an overall view of the capabilities of a TMC.

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions

Traffic Management Center (TMC) Capability/Data	Definition
Archived dynamic message sign messages	Historical information about messages posted to dynamic message signs (e.g., timestamp, message text)
Archived environmental sensor data	Historical data about weather, air quality, or noise
Archived traffic data	Data collected for the highway network in the proximity of the work zone. Data collected continuously, archived, and made available at time intervals of 15 minutes or less. Volume data is required to perform volume-to-capacity calculations. Volume, occupancy, and speed are required to support delay, road user costs, and to predict queues. Data may also consist of vehicle classification and travel time data
Archived video footage	Historical footage of video captured by closed-circuit television
Area traffic generators	Information describing local venues and relevant schedules known to generate significant amounts of traffic (e.g., schools, stadiums, conference centers) *Note: May include anecdotal information known by TMC operators or a formal list/database of local venues with schedules.*
Area transit services	Information about area transit providers and their general operations
Centralized Traffic Signal Control	The capability to implement traffic signal control timing plans from the TMC for arterial roads in the proximity of the work zone.
Dynamic message sign message logs	Recordings of the actual dynamic message sign messages posted to portable and permanent dynamic message signs by the TMC, including a date/time stamp of when the messages where posted

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions (Continued)

Traffic Management Center (TMC) Capability/Data	Definition
Environmental monitoring and reporting	Surveillance of weather, air quality, or noise related aspects of the environment that affect roadways *Note: The operation of environmental monitoring systems may be operated by various groups within the Department of Transportation (DOT). Some agencies incorporate the real-time environmental condition reports in the Road Condition Reporting System. In these situations, the TMC has the capability of environmental monitoring and reporting.*
Highway Advisory Radio control	Managing the content that is broadcast over Highway Advisory Radio transmitters to deliver en-route information to travelers
Incident management	Detection of and response to incidents. Incident detection may include the use of resources such as visual roadway surveillance and traffic data collection. Incident response may include the use of tools such as dynamic message sign control, lane management and control, and ramp meter control
Lane management and control	Dynamically managing speeds and lane functions (e.g., high-occupancy vehicle (HOV), reversible lane travel, lane pricing)
Lane management control plans	Information about operational conditions and controls used to manage lanes
Locations of communication infrastructure	Maps showing agency-owned or leased communication (landline and wireless) for TMC field devices
Locations of evacuation routes	Maps and operational plans of designated evacuation routes
Locations of TMC-controlled field devices	Maps, geolocations, or text descriptions of field devices controlled or accessed by TMCs. Field devices may include: • Detectors (e.g., in-pavement devices or roadside devices) • Ramp meters (including roadside signs, controllers, and communications) • closed-circuit television cameras (including camera locations and local communications) • dynamic message signs (including locations of permanent dynamic message signs and portable dynamic message signs) • Highway Advisory Radio broadcast transmitters • Managed Lane Devices (e.g., locations where individual lane signing is used to manage travel within lanes)

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions (Continued)

Traffic Management Center (TMC) Capability/Data	Definition
	• Environmental sensor stations (including descriptions of sensors located at specific sites) • Communications infrastructure (including agency-owned or leased communication (landline and wireless) for TMC field devices)
Maintenance dispatch	Dispatching agency maintenance forces for roadway clean-ups, snow and ice removal, and other routine maintenance activities *Note: Depending upon the DOT approach, this may or may not be a capability of the TMC. Some agencies dispatch maintenance activities from locations outside the TMC.*
Performance measurement and management tools	TMC access to tools to assist in analyzing the extent of traffic delays or queue lengths in an around the work zone. Use is either to perform analyses during the work zone (to determine if adjustments are needed) or post-work zone analyses to understand the actual impacts *Note: Also requires access to volume, occupancy, speed data.*
Performance measurement reports	Historical analyses of traffic and incident data to identify trends in congestion, safety, and other areas of roadway performance
Queue detection	Existing or temporary field equipment, access to probe data, or video analytics systems to detect queues on the roadway. Automated queue detection is preferred for real-time reporting to travelers, however manually observed queue reporting is possible
Ramp metering control	Managing traffic control signals that regulate the flow of traffic entering a freeway
Ramp metering control plans	Information about operational conditions and timing used to manage ramp meters (e.g., times of the day ramp meters operate, a description of the algorithm that determines metering rates, and any demand responsive capabilities)
Real-time traffic data collection and access	Data collected for the highway network in the proximity of the work zone and made available to TMC operators as it is collected. Speed, travel time, or occupancy data are most often used to identify slow traffic or operational problems. Travel time data (either measured directly or computed from volume and occupancy data) are required to disseminate work zone travel times to drivers

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions (Continued)

Traffic Management Center (TMC) Capability/Data	Definition
Real-time traveler information	TMC operates or participates in the operation of a system to provide drivers with information about current travel conditions pre-trip (e.g., traveler information website) and en-route (e.g., mobile devices, 511 phone, social media, dynamic message signs, etc.)
Road condition and lane closure reporting	Real-time reporting of incidents, roadwork, lane closures, driving conditions, and other capacity limiting events; may include manual entry of events or automated ingest of data from external systems (e.g., law enforcement Computer Aided Dispatch [CAD] systems) *Note: Depending upon the system used, events may only include short- to medium-term events (e.g., the current construction season) or may include future planned lane closures for upcoming years. The TMC is typically only one group that enters events. Other groups (e.g., construction, maintenance) would also enter events. This capability is listed as a TMC capability, as the tool used is often operated from within the TMC.*
Road conditions and lane closure reports	Planned and real-time information about road work, lane closures, road conditions, unplanned incidents, and planned events *Note: TMC operators typically only enter current conditions or near-term planned events. Depending upon the approach, other sources from within the DOT may or may not enter long-term planned road work.*
Service patrol	Staff who patrol select roadways to provide motorist assistance and support incident management, typically dispatched from TMC operators
Signalized intersection capabilities	Information about operational capabilities at signalized intersections (e.g., coordinated, stand-alone) *Note: DOTs vary in their approach to arterial signal control. Some TMCs include arterial signal control and would typically have this data as a resource within the TMC, while other TMCs do not perform or store information about signal control.*
Special event traffic management	Surveillance, incident management and traveler information tailored to special events (e.g., sporting events, concerts, rallies)

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions (Continued)

Traffic Management Center (TMC) Capability/Data	Definition
Temporary height/weight/ width restrictions	Information about temporary overdimension restrictions *Note: Temporary overdimension restrictions are conditions commonly reported into road condition reporting tools operated by TMCs. However, the permanent overdimension restrictions are commonly not included. Therefore, there is limited functionality that TMC data can perform in situations where overdimension restrictions are required.*
Third-party data	Supplemental traffic data procured from a third-party service often based on probe data
TMC incident logs	Records of the incidents (crashes, stalled vehicles, overturned loads) detected by or reported to TMC operators, typically with the incident type, location, and a reported date/time and cleared date/time associated to each incident *Note: Logs are not a comprehensive list of crashes or crash reports, but rather those incidents known by TMC operators.*
TMC operated lane management systems	Systems capable of posting messages to drivers that are specific to each lane (typically through overhead dynamic message signs above each lane) to dynamically manage speeds and lane functions. This may include message that lanes are closed ahead, speeds are reduced, or suggestions to merge to other lanes
TMC Staff Time	Time that TMC staff can dedicate to coordinating work zone activities, participating in work zone planning meetings and discussions. TMC staff possess knowledge about the traffic patterns and likely impacts of capacity reduction
Traffic data collection	Real-time collection of traffic data, typically volume, occupancy, and speed; may include vehicle classification
Traffic signal timing plans	Information about operational timing in place at signalized intersections *Note: Some TMCs include arterial signal control and would typically have this data as a resource within the TMC, while other TMCs do not perform or store information about signal control.*
Travel time calculation	Determining travel times for stretches of highway based on real-time traffic data collection and surveillance
Variable (advisory) speed limit posting	Displaying enforceable variable speed limits (or advisory speeds) to drivers based on current traffic or road conditions and/or queues ahead

Table 53. Common Traffic Management Center (TMC) Capability and Data Definitions (Continued)

Traffic Management Center (TMC) Capability/Data	Definition
Visual roadway surveillance (TMC operators and traveling public)	Real-time monitoring of the roadway conditions using full motion or still cameras. For the traveling public, access to camera video or images are typically available through traveler information websites. For transportation management, this typically includes access to and control of the pan/tilt/zoom positioning of the cameras to observe stopped or stalled vehicles, incidents, queue lengths, overall traffic flow, or other conditions that could influence real-time management of work zones
Visualization mapping tool for interagency road work and/or lane closures	A tool and approach of entering planned road work, together with adjacent agencies entering planned roadwork for the primary purpose of visualizing potential conflicts and/or overlapping road work activities
Volume-to-Capacity Calculation Tool or Process	A mechanism to perform volume-to-capacity calculations. Mechanisms range from simple processes (e.g., calculations by hand or using a spreadsheet) to complex (e.g., using a self-developed tool or a procured tool that may include graphics and extensive calculations)

APPENDIX – GUIDANCE ON USING TMC FOR WORK ZONE MANAGEMENT – SELF-ASSESSMENT QUESTIONNAIRE

Many Departments of Transportation (DOTs) at the state, county, and local levels operate Traffic Management Centers (TMCs). Typically, a TMC is a center where operators utilize software systems to control field devices (e.g., dynamic message signs (DMS), ramp meters) and to view data and video collected throughout the monitored area. TMCs are not necessarily fixed locations or centers, in some situations the TMC is 'virtual', with systems linked through Internet or Intranet communications.

In regards to work zones, TMCs are most commonly thought of during the active work zone phase, when the work zone is in operation and the TMC operators assist by disseminating information and managing the traffic through the work zone. However, there is potential for TMC resources to support all stages of the work zone, from the planning and design phase through active work zone operations and post-operation evaluation. A separate document was created "Guidance on Using TMC for Work Zone Management" to present guidance for DOTs to consider how TMC resources (staff, data, and tools) could be used to support all stages of a work zone.

This self-assessment questionnaire document was created in conjunction with the "Guidance on Using TMC for Work Zone Management" report, which allows DOTs to assess their TMC's availability and functionality and create an action plan to increase the use of their TMC resources. The self-assessment questionnaire for using TMC resources in work zone management in Table 1 includes the information below.

- **Column 1** – **TMC Resource Identification.**
- **Column 2** – **TMC Resource and Definition.** Column 2 identifies and briefly describes common TMC Resources researched in this project. It is important to note that each TMC is unique and that there are many other TMC resources available. Column 2 provides the most common TMC resources available.
- **Column 3** – **TMC Resource Self-assessment.** Questions in Column 3 are intended to assist agencies in self-assessing the resources of their TMC by working with TMC staff to identify the availability and functionality of each TMC resource.
- **Column 4** – **TMC Resource Level.** In Column 4, agencies are able to assess the extent to which they currently use the TMC resource for work zone management, based on the following levels:
  - Level 0: TMC Resource is not used to support work zone management and/or not available
  - Level 1: TMC Resource is available and has been used in limited situations to support work zone management
  - Level 2: TMC Resource is available and used regularly (i.e., processes are developed, work zone staff are trained, but there is limited accountability or performance measurement).
  - Level 3: TMC Resource is used extensively, use is budgeted, and performance measured.

- **Column 5** – **Strategies for Using the TMC Resource for Work Zone Management.** Column 5 identifies one or more strategies for how the TMC resource may support work zone management if it exists within the TMC. These strategies are defined in more detail in other sections of the "Guidance on Using TMC for Work Zone Management" Final Report.
- **Column 6** – **Recommendations for Increasing TMC Resource Use.** Column 6 includes general recommendations for increasing the use of the TMC Resource for work zone management.
- **Column 7** – **Action Plan for implementing Recommendation.** Column 7 provides agencies a mechanism to self-define an action plan and timeline for increasing the use of their TMC resource.

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
1	**Road Condition Reporting System** Real-time reporting of incidents, roadwork, lane closures, driving conditions, and other capacity limiting events; may include manual entry of events or automated ingest of data from	1. Is a Road Condition Reporting System available and used by the agency? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 1A:** Share access to TMC tools used to record ongoing and planned projects, analyze corridor performance, and predict road user costs with all individuals involved in the road work planning process to support the coordination of road work projects. **Strategy 3C:** Using Road Condition Reporting	1. Provide Project Planning/Design with Road Condition Reporting System access and training to view and enter road work plans.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
	external systems (e.g., law enforcement Computer Aided Dispatch systems). *Note: All strategies require full functioning Road Condition Reporting System*	2. Are planned lane and road closures entered into the Road Condition Reporting System for all known closures? ☐ Yes ☐ No		Systems to understand planned events causing vehicle restrictions or capacity reductions on alternate routes during the work zone. **Strategy 8B:** Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.	2. Identify Road Condition Reporting System information that the TMC can provide to help post-work zone evaluation.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
2	**TMC Staff Time** Time that TMC staff can dedicate to coordinating work zone activities, participating in work zone planning	1. Are TMC staff members available to support meetings throughout the work zone	Our current level of use of this resource for work zone management is: ☐ Level 0	**Strategy 1B:** Involve TMC staff in the planning of road work projects from the onset to enable TMC staff to understand the planned projects and impacts for all areas served by the TMC	1. Identify TMC staff most appropriate to be involved in coordination of projects during project development.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
	meetings and discussions. TMC staff possess knowledge about the traffic patterns and likely impacts of capacity reduction.	management stages? ☐ Yes ☐ No	☐ Level 1 ☐ Level 2 ☐ Level 3	and therefore contribute to regional mobility planning. **Strategy 1C:** Organize annual meetings with TMC staff from neighboring jurisdictions (states, cities, counties) to discuss upcoming road work plans.	**2.** Arrange a meeting structure to engage TMC staff with Project Planning/Design Staff.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					3. Identify a core set of neighboring jurisdictions and arrange an annual meeting with TMC staff to review projects with potential impacts.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
3	**Archived Traffic Data** Data collected for the highway network in the proximity of the work zone. Data collected continuously, archived, and made available at time intervals of 15 minutes or less. Volume data is required to perform volume-to-capacity calculations. Volume, occupancy, and speed are required to support delay, road user costs, and to predict queues. Data may also consist of vehicle classification and travel time data.	1. What type of data is collected? ☐ Volume ☐ Occupancy ☐ Speed Data ☐ Travel Time ☐ Vehicle Classification ☐ Other 2. At what time intervals is the data collected and recorded? ☐ 15 minutes ☐ 10 minutes ☐ 5 minutes ☐ Other	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 2A:** Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects **Strategy 2C:** Using TMC resources to support innovative contracting or accelerated construction considerations. **Strategy 3A:** Using TMC archived volume and speed data to estimate traffic demand, delays, queue lengths, and reliability metrics during the upcoming work zone.	1. Request TMC staff review demand-to-work zone management related calculations from archived data to share their perspective and offer insight to increased use.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Outreach to work zone project engineers and managers to share ideas for increased use of archived traffic data.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					3. Outreach to TMC managers and operators to explain the benefits of increased coverage of archived traffic data to work zone management.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
4	**Volume-to-Capacity Calculation Tool or Process** A mechanism to perform volume-to-capacity calculations. Mechanisms range from simple processes (e.g., calculations by hand or using a spreadsheet) to complex (e.g., using a self-developed tool or a procured tool that may include graphics and extensive calculations).	1. Is a volume-to-capacity tool available? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 2A:** Using TMC data together with TMC performance management tools, to conduct preliminary demand-to-capacity calculations for upcoming road work projects	1. Determine if current approach for performing volume-to-capacity calculations is effective and efficient with input from TMC staff.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
5	**TMC Documentation of Existing Intelligent Transportation System Devices** TMC documentation of intelligent transportation system field devices (permanent and portable) installed and/or used in the proximity of the work zone. This would include functionality and location of intelligent transportation system devices to understand the role the devices can play in the work zone, and information about communications, power, and other utilities that may be impacted by the work zone.	1. What type of intelligent transportation system Device information is available? ☐ intelligent transportation system device location and functionality ☐ intelligent transportation system Device communi-cation and utility information ☐ No information available	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 2B:** Develop Traffic Operations Plans for large projects before the Transportation Management Plan is developed and before final design to define the planned use of intelligent transportation system components and maximize the input from the TMC. **Strategy 4A:** Using TMC resources to understand the likely intelligent transportation system device outages due to work zones and prepare mitigation strategies to maintain critical field device operations.	1. TMC staff provide the locations of intelligent transportation system devices and communications and provide input on temporary technologies to be deployed in the work zone based on devices impacted.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Work with TMC Managers and Operators to understand any TMC documentation that may benefit work zone management.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
6	**TMC Incident Logs** Records of the incidents (crashes, stalled vehicles, overturned loads) detected by or reported to TMC operators, typically with the incident type, location, and a reported date/time and cleared date/time associated to each incident. *Note: Logs are not a comprehensive list of crashes or crash reports, but rather those incidents known by TMC operators.*	1. Are TMC incident logs available that record location and date/time of incidents? ☐ Yes ☐ No 2. Are historic TMC incident logs available for months/years in the past to understand patterns of crashes? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 3B:** Using TMC incident logs as a surrogate for crash data to estimate the number of crashes likely to occur during the work zone. **Strategy 8B:** Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.	1. Request access to TMC incident logs and develop an understanding of any patterns (e.g., crashes in the area).	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Identify TMC incident log information that the TMC can provide to help post-work zone evaluation.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
7	**Centralized Traffic Signal Control** The capability to implement traffic signal control timing plans from the TMC for arterial roads in the proximity of the work zone.	1. Is central signal control capability available within the TMC? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 4B:** As part of the Transportation Management Plan development process, consider TMC resources to improve safety and mobility in and around the work zone.	1. Meet with TMC staff to discuss factors that will be used to determine when to implement traffic signal control timing plans to benefit activities in the work zone.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

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# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
8	**TMC Control of Dynamic Message Signs Immediately Upstream of the Work Zone** TMC management of messages displayed on permanent or portable dynamic message signs located in the vicinity of work zones. Message management may be automated or manual. Queue detection and reporting requires dynamic message signs immediately upstream. Pre-work zone information only requires dynamic message signs to be in the vicinity of the planned work zone.	1. What is the extent of coverage of dynamic message signs throughout the road network (to understand which work zones could benefit from upstream dynamic message signs)? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 5A:** Using TMC-operated dynamic message signs in the vicinity of the work zone to describe upcoming work zone impacts (e.g., lane or route closures and dates) to travelers prior to the start of the work zone. **Strategy 6A:** Using TMC real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs. **Strategy 7B:** Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.	1. Meet with TMC staff in advance of the work zone start date to discuss the locations, use of portable and permanent dynamic message signs, and any information about work zone changes.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Meet with TMC staff in advance of the work zone start date to discuss if queue detection is possible with existing TMC resources or if additional resources are needed.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					3. Meet with TMC staff in advance of the work zone start date to discuss if travel time calculations are possible with existing TMC resources or if	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
					additional resources are needed.	

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
9	**Real-time Traveler Information System** TMC operates or participates in the operation of a system to provide drivers with information about current travel conditions pre-trip (e.g., traveler information website) and en-route (e.g., mobile devices, 511 phone, social media, dynamic message signs, etc.)	1. Does traveler information dissemination exist and is work zone information an option to be included? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 5B:** Using TMC-operated traveler information systems and social media accounts to describe upcoming work zones and anticipated impacts to travelers pre-trip. **Strategy 7B:** Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools. **Strategy 7C:** Using real-time traveler information dissemination systems and tools (including dynamic message signs, highway advisory radio, 511 phone and websites, and social media) to provide content that informs travelers of work zone delays or incidents.	1. Meet with TMC staff in advance of the work zone start date to discuss the use of existing traveler information mediums to communicate messages to travelers before and during the work zone.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Meet with TMC staff annually to discuss recent advances in the traveler information system and new possibilities for benefiting work zone management.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

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# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
10	**Queue Detection** Existing or temporary field equipment, access to probe data, or video analytics systems to detect queues on the roadway. Automated queue detection is preferred for real-time reporting to travelers, however manually observed queue reporting is possible.	1. Is automated queue detection available? ☐ Yes ☐ No 2. Is manual queue detection available? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 6A:** Using TMC real-time traffic data and closed-circuit television cameras to detect stopped traffic and/or queues approaching work zones, and inform travelers upstream of queues using TMC-controlled dynamic message signs.	1. Meet with TMC staff in advance of the work zone start date to discuss if queue detection is possible with existing TMC resources or if additional resources are needed.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
11	**Visual Roadway Surveillance** Real-time monitoring of the roadway conditions using full motion or still cameras. This typically includes access to and control of the pan/tilt/zoom positioning of the cameras to observe stopped or stalled vehicles, incidents, queue lengths, overall traffic flow, or other conditions that could influence real-time management of work zones.	1. Do TMC operators have access to visual surveillance cameras and controls? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 6B:** Using TMC-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream.	1. Meet with TMC staff in advance of the work zone start date to discuss areas to be impacted by the work zone and request TMC staff monitor the area to assist in detecting incidents that occur in or around the work zone or if additional temporary cameras are needed.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

Table A-1. Self-Assessment Questionnaire for Using Traffic Management Center (TMC) Resources in Work Zone Management (Continued)

# (1)	Traffic Management Center (TMC) Resource and Definition (2)	TMC Resource Self-assessment (3)	TMC Resource Level (4)	Strategies for Using the TMC Resource for Work Zone Management (5)	Recommendations for increasing TMC Resource Use (6)	Action Plan for implementing Recommendation(s) (7)
12	**Real-time Traffic Data Collection and Access** Data collected for the highway network in the proximity of the work zone and made available to TMC operators as it is collected. Speed, travel time, or occupancy data are most often used to identify slow traffic or operational problems. Travel time data (either measured directly or computed from volume and occupancy data) are required to disseminate work zone travel times to drivers.	1. What type of data is collected and made available in real-time to TMC staff and/or automated systems? ☐ Volume ☐ Occupancy ☐ Speed Data ☐ Travel Time ☐ Other	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 6B:** Using TMC-operated closed-circuit television cameras and traffic data to detect or verify incidents in and around work zones to support quicker incident clearance and to alert travelers upstream. **Strategy 7B:** Using TMC resources to compute travel times through work zones for dissemination using pre-trip and en-route dissemination tools.	1. Meet with TMC staff in advance of the work zone start date to discuss areas to be impacted by the work zone and request TMC staff monitor the area to assist in detecting incidents that occur in or around the work zone.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Meet with TMC staff in advance of the work zone start date to discuss if it is possible to calculate travel times.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

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13	**Performance Measurement & Management Tools** TMC access to tools to assist in analyzing the extent of traffic delays or queue lengths in an around the work zone. Use is either to perform analyses during the work zone (to determine if adjustments are needed) or post-work zone analyses to understand the actual impacts. Note: also requires access to volume, occupancy, speed data	1. Are performance management tools (e.g., Performance Measurement System (PeMS), Regional Integrated Transportation Information System (RITIS), or other similar systems) available? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 7A:** Using performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools) to determine if any modifications to the work zone management approach are needed to maintain traffic mobility. **Strategy 8A:** Using TMC archived traffic data, together with performance measurement and management tools available to the TMC (i.e., vendor products or in-house developed tools), to analyze actual delays during the work zone.	1. Meet with TMC staff to understand performance management tools used by the TMC, their capabilities, and how Project Planning / Design staff and Project Engineers and Managers could have access to the tools and schedule of when analysis is to be performed.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

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14	**TMC-operated Lane Management Systems** Systems capable of posting messages to drivers that are specific to each lane (typically through overhead dynamic message signs above each lane) to dynamically manage speeds and lane functions. This may include message that lanes are closed ahead, speeds are reduced, or suggestions to merge to other lanes.	1. Are lane management systems available on the road network? ☐ Yes ☐ No 2. Does your agency operate Freeway Service Patrols? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 7D:** Using TMC-operated traffic management tools (e.g., lane management systems, variable speed limit systems, and ramp meters) to manage traffic flow in and around the work zone. **Strategy 7E:** Using Freeway Service Patrols to assist in minimizing impacts of incidents in and around work zones.	1. Provide TMC staff with any information available about planned lane closures prior and during a work zone and inquire about using managed lanes to benefit the work zone.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:
					2. Meet with Freeway Service Patrols to discuss opportunities to increase the presence of patrols in and around the work zone.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

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15	**Dynamic Message Sign Message Logs** Recordings of the actual dynamic message sign messages posted to portable and permanent dynamic message signs by the TMC, including a date/time stamp of when the messages where posted.	1. Are dynamic message sign message logs archived and available? ☐ Yes ☐ No	Our current level of use of this resource for work zone management is: ☐ Level 0 ☐ Level 1 ☐ Level 2 ☐ Level 3	**Strategy 8B:** Using TMC incident logs, dynamic message sign message logs, and Road Condition Reporting Systems to supplement traffic data and support performance evaluations.	**1.** Identify if dynamic message sign message logs are available that the TMC can provide to help post-work zone evaluation.	☐ Immediate ☐ Short Term ☐ Long Term ☐ N/A NOTES:

U.S. Department of Transportation

Federal Highway Administration

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