CDOT

Work Zone Safety and Mobility Rule

Procedures Document

DEPARTMENT OF TRANSPORTATION

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INTRODUCTION

A Transportation Management Plan (TMP) lays out a set of coordinated strategies and describes how these strategies will be used to manage the work zone impacts of a project. The key to a successful TMP is early development in the project's life-cycle and the use of a multidisciplinary approach.

TMP development occurs during the preliminary engineering and design phases of a project. During project development (i.e., preliminary engineering), the potential work zone impacts of a project should be assessed and work zone transportation management strategies and associated costs identified. The level of detail of this assessment may increase as more project specific information becomes available. The TMP development process is intended to work in an iterative manner that helps identify the work zone impacts of a project, given a certain combination of construction phasing and impacts management strategies.

The scope, content, and degree of detail of a TMP may vary based on the expected work zone impacts of the project.

OVERVIEW OF TMP DEVELOPMENT

TMP development occurs during the preliminary engineering and design phases of a project. During project development (i.e., preliminary engineering), the potential work zone impacts of a project should be assessed and work zone transportation management strategies and associated costs identified. The level of detail of this assessment may increase as more project specific information becomes available. The TMP development process is intended to work in an iterative manner that helps identify the work zone impacts of a project, given a certain combination of construction phasing and impacts management strategies.

SCOPE, CONTENT, AND DEGREE OF DETAIL

The TMP consists of strategies to manage the work zone impacts of a project. Its scope, content, and degree of detail may vary based on the expected work zone impacts of the project. All projects must comply with the Region's Lane Closure Policy. The Region Traffic Engineer must approve all work that does not comply with the Region's Lane Closure Policy.

Significant Project

A significant project is defined as one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts at a location for three or more consecutive days with either intermittent or continuous lane closures. A significant project impacts the traveling public at the metropolitan, regional or the Interstate level and has a moderate to very high level of public interest. It will directly impact a moderate to very large number of travelers and will have moderate to very high user cost impacts.

For significant projects, the TMP consists of three components: a TCP, TO, and PI. For individual projects or classes of projects that are not classified as significant, the

TMP, at a minimum, will consist of a TCP. The TO and PI components are optional but should always be considered.

	TMP Components		
	TCP	**PI**	**TO**
Significant Projects	**Required**	**Required** (The Project must obtain written approval from the FHWA to be exempt from this requirement)	**Required** Comply with the requirements of the project regions **Lane Closure Policy** (The Project must obtain written approval from the FHWA to be exempt from this requirement)
Non-Significant Projects	**Required**	**If ANY of the following characteristics applies a PI is REQUIRED:** □ High level of Public Interest □ Significant impact on public/private access (e.g. businesses, communities, park & ride lots, schools, fire stations, etc.) □ Project timing (e.g. special events, etc.) that will result in an increase in traffic volumes **If NONE of the above apply, PI is Optional**	Must comply with the requirements of the project region's **Lane Closure Policy***

***** A full TO analysis is required if the Region does not have a lane closure policy.

Traffic Control Plan

Construction phasing greatly affects the safety and mobility of work zone users. It is important that designers and construction engineers who develop the construction phasing plans consult and appropriately involve safety experts, traffic engineers and other technical specialists in the project development process. Construction phasing and traffic control plans (TCPs) must be developed concurrently. A review should be conducted to verify the feasibility of the TCP and phasing. Transportation Operations (TO) and Public Information (PI) components should be considered at the same time as construction phasing and TCP development to generate a well-thought-out TMP. The best TMP development process involves developing and evaluating the best combination of project design, TCP, TO strategies, PI strategies, and construction phasing.

The TCP describes measures to be used for guiding road users through a work zone or an incident area. The TCP plays a vital role in providing continuity of reasonably safe and efficient road user flow and highway worker safety when a work zone, incident, or other event temporarily disrupts normal road user flow. The TCP shall be consistent with the provisions of the *CDOT Standard Specifications for Road and Bridge Construction*, *CDOT M&S Standard Plans*, *Manual on Uniform Traffic Control Devices* (MUTCD), and any applicable incident management plans. The scope of the TCP is determined by the project characteristics, and the traffic safety and control requirements identified for the

project. The TCP shall include specific elements from *CDOT Standard Specifications for Road and Bridge Construction*, *CDOT M&S Standard Plans*, MUTCD, or be designed specifically for the project in the form of Method of Handling Traffic (MHT) plans.

Transportation Operations Component

The TO component of the TMP consists of compliance with the Region's Lane Closure Policy. (The Region Traffic Engineer must approve all work that does not comply with the Region's Lane Closure Policy.) In addition, TO strategies should be identified that will be used to mitigate impacts of the work zone on the operation and management of the transportation system within the work zone impact area. Typical TO strategies may include, but are not limited to, demand management, corridor/network management, work zone safety management, and Traffic/Incident Management and enforcement (p. 26). The scope of the TO component should be determined by the project characteristics, and the identified transportation operations and safety strategies.

Public Information Component

The PI component of the TMP includes communications strategies that inform affected road users, the general public, area residences and businesses, and appropriate public entities about the project, the expected work zone impacts, and the changing conditions on the project (p. 34). This may include motorist information strategies. The scope of the PI component should be determined by the project characteristics and the identified public information and outreach strategies. Public information should be provided through methods best suited for the project and may include, but not be limited to, information on the project characteristics, expected impacts, closure details, and commuter alternatives.

DEVELOPMENT AND IMPLEMENTATION OF THE TMP

The project designer should compile available project materials, such as the project definition (project scope, roadway/traffic characteristics, other factors such as public outreach/community information, etc.), construction phasing approaches/plans, preliminary work zone management strategies, and preliminary cost estimates for TMP development and implementation. Information for other projects within the corridor should also be compiled to assess the combined/cumulative impact of the projects.

TMP Development During Preliminary Engineering and Design

The designer works with traffic engineering/operations personnel and other relevant technical specialists in moving forward with the project design. As more information and data become available, preliminary work zone strategies and their costs should be reassessed and refined. The following points should be considered in the development of TMPs:

1. The first step in the development of a TMP is to identify the stakeholders that should be involved. CDOT stakeholders may include staff from design, traffic/operation, safety, construction, planning, and maintenance as well as other technical specialists. Other stakeholders may include other local traffic agencies, railroad agencies/operators, freight companies, utility providers, law enforcement, emergency services, courtesy patrols, businesses, schools, and/or community groups, and transit providers.

2. Congestion Mitigation strategies should be identified based on the project constraints, costs, and construction phasing plan. The role of the stakeholders is to provide input for the document. CDOT has lane closure policies that must be followed. The use of simulation and analysis tools are used to predict delays, queues, and impacts of detours.

3. The PS&Es shall include all required TMP components or the provisions for a consultant developed TMP. For example, all projects are required to have a TCP. Projects requiring a TO component must specify the TO strategies to be utilized on the project in the general notes and include all contract language, plan sheets, and specifications required to implement the selected strategies. Projects requiring a PI component must utilize the Public Information Services specification. The TMP components needed for the project are based on whether the project is significant or non-significant (pp. 4-5). TMPs must be approved by the CDOT project engineer prior to implementation. Once approved, the TMP and the phasing plans are finalized. The PS&Es shall include appropriate pay item provisions for implementing the TMP. For method-based specifications, individual pay items, lump sum payment, or a combination of the two may be used. For performance-based specifications (incentive/disincentive), applicable performance criteria and standards shall be used (e.g., safety performance criteria such as number of crashes within the work zone; mobility performance criteria such as travel time through the work zone, delay, queue length, and traffic volume; incident response and clearance criteria; and work duration criteria).

TMP Implementation and Monitoring During Construction

1. CDOT and the contractor shall each designate a trained person at the project level who has the primary responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project.

   The designated person:
   - makes routine inspections to determine that the Transportation Management Plan (TMP) is properly implemented and functioning in compliance with the plans, specifications, the MUTCD, and the Colorado Supplement to the MUTCD
   - ensures that traffic control device inspections are conducted every calendar day per CDOT Standard Specification 630.10
   - has authority to halt work until applicable or remedial safety measures are taken
   - reports needed changes to the Project or Resident Engineer
   - documents any major changes to the TMP
   - assists Department staff with work zone crash reviews
   - coordinates with and assists the Public Information Office with any information needed for implementation of PI strategies for which the Contractor is not responsible

2. The consultant and/or project designer may re-evaluate or modify components of the TMP due to alternate construction phasing or other recommended work zone management strategies. All TMP modifications must be approved by the CDOT project engineer prior to implementation.

3. Some of the components may need to be implemented prior to construction (e.g., public relations campaign, improvements to detour routes). During construction, implementation of the TMP and the performance of the work zone must be continuously monitored (per section 630.10 of the *CDOT Standard Specifications for Road and Bridge Construction* book) to verify that the predicted impacts closely resemble the conditions in the field. Example performance measures are volume, travel time, queue length, delay, number of incidents, incident response and clearance times, contractor incidents, community complaints, user costs, and cumulative impacts from adjacent construction activities. Delays or queue lengths shall be measured on a weekly basis using the CDOT WorkZone RUC program and CDOT form 103 (WorkZone RUC program information can be found at the following URL: http://www.dot.state.co.us/ECSU/Download.asp#CdotWorkZone) to ensure that they are within the acceptable limits set by the Region's Lane Closure Policy. Performance measures shall be based on current CDOT policies, standards, specifications and procedures and shall be included in the contract. If performance requirements are not met, CDOT and/or a consultant shall revisit the TMP and consider alternate management strategies and/or phasing approaches that meet the approval of the CDOT project engineer. Adjustments shall be made to the TMP as necessary and documented (see p.17).

Post-Construction Performance Evaluation

1. Prior to project acceptance, the contractor shall submit a report that contains an evaluation of the TMP. The post-project evaluation report shall contain successes and failures, changes made to the TMP and the results of those changes, public input, actual versus predicted measures, cost for implementation of the strategies, and suggested improvements (per CDOT Standard Specification 630.09).

QUALITY ASSURANCE REVIEWS FOR WORK ZONE TRAFFIC CONTROL (TRAFFIC CONTROL REVIEWS)

CDOT places a high priority on the safety of workers and the traveling public in the management of its construction and maintenance programs. Minimizing traffic congestion and adverse impacts on the local community are also important considerations. To support these objectives, work zone traffic control is an integral element in the management of Department programs. Work zone management in turn is comprised of several distinct elements. These include:

- establishment of overall goals and objectives
- development of standards and specifications
- provisions for project-specific traffic control plans
- providing staff training and development
- Contractor/industry outreach
- maintaining an accident reporting and analysis system
- maintaining an ongoing traffic control quality assurance program

23 CFR 630.1010(e) requires that CDOT annually review randomly selected projects throughout its jurisdiction for the purpose of assessing the effectiveness of its procedures.

The CDOT Quality Assurance program will be utilized for all temporary traffic control on CDOT roadways and projects–construction, maintenance, and permits. The statewide work zone review program, also known as the Traffic Control Review (TCR) program, was initiated in July 2004 in response to management concerns for the quality of temporary traffic control, and to comply with FHWA requirements.

The purpose of the program is to gather information to evaluate the overall quality and effectiveness of work zone traffic control throughout the Department, to identify areas where improvement is needed, and to facilitate open discussion of traffic control issues. Regions are expected to use the review results to address and correct both project-specific and Region-wide issues.

The responsibility for administration of these requirements will rest with the Project Development Branch and the Safety and Traffic Engineering Branch.

DESCRIPTION OF REVIEW PROCEDURE

The work zone review procedure involves an on-site review of a sample of projects in each Region. The standard procedure for the reviews is described in the sections that follow.

1. **Review scheduling** - Reviews will be conducted statewide each year. Each Region will be scheduled separately. Two or three review days will be scheduled in each Region. In addition, time will be allotted at night to conduct reviews at a limited number of sites to observe nighttime operations if suitable projects are available. Following completion of each review, a debriefing meeting will be held with Region staff to provide a preliminary discussion of the results. Depending on the schedule, this meeting may be held the same day as the reviews or the following day.

2. **Sample size and selection** - The reviews will include a number of projects in each Region. The goal is to inspect at least five (5) projects and activities per Region, which may encompass traffic control for a full range of activities from minor utility repairs to full-scale construction. The construction sample will be selected in advance by the Review Team, based on several factors. At least one project will include nighttime operations, if a suitable project is available, and at least one CDOT Maintenance operation will be reviewed. Factors considered include geographic location to economize on travel time and distance, type of work, and Contractor. The intent is to select a range of characteristics that provide a representative sample of work active at that time. Adjustments are made to the initial list to account for actual work status on individual projects. Maintenance work activities are typically not scheduled far in advance. Therefore, each Region will compile a list of maintenance work scheduled for the week of the reviews. The Review Team then selects the sites to be inspected. Advance notice has been given for Traffic Control Reviews conducted on construction projects over the past several years (including drive-through and office reviews), but due to the short-term nature of their scheduling, not for the maintenance activities. The notification policy will be revisited for calendar year 2008 reviews.

3. **Review Team makeup** - The Review Teams will typically consist of five to six members. A Project Development Area Engineer, a Staff Traffic Engineer, an FHWA Operations Engineer and/or the FHWA Traffic Engineer, a Regional Maintenance Representative and the Region Traffic Engineer (or designee) will form the nucleus of the Team.

4. **Review process** - Reviews will consist of a drive-through of each project with information and comments recorded on the standard form. No overall quality rating will be assigned to each project or maintenance operation until a final decision is reached by the Chief Engineer on the final disposition of the scoring system. In addition, an office review will be performed on one project in each Region. The office review will include review of the Methods of Handling Traffic (MHTs) and other traffic control related documentation. The office review will also include a review of the Project Safety Management Plan (PSMP) by the Region Safety Officer. The standard form will record descriptive information about the project or maintenance operation and the temporary traffic controls observed. Features are listed in ten broad categories: traffic control management, method of handling traffic, worksite traffic control supervisor, flaggers, construction/maintenance signing, traffic control devices, pavement markings, miscellaneous items, traffic impacts and work zone area and inspector safety. In addition to check-offs on the form, narrative comments will be added to describe individual features observed. These will typically include points of concern and areas that need improvement, as well as features or treatments viewed as positive. The review will consist of driving through the project in each direction, generally on each of the main approaches. In addition, one or more minor approaches, such as intersecting roadways or major driveways, will also be examined. The Review Team's vehicle may stop from time to time to observe specific features in more detail, as traffic conditions and space permit. However, nearly all observations are completed from inside the vehicle. Depending on the nature and complexity of the project, multiple trips through the project may be required to obtain the needed details. On simple projects, a single drive-through in one direction may suffice. The objective is to obtain adequate information to characterize the project. On projects with multiple work sites, one or more sites may be omitted. Because the focus of the program is on obtaining a representative sample for quality assurance purposes, rather than detailed project management, this is a reasonable compromise. In every case, the project description will clearly indicate the portions of the project reviewed, if not reviewed in its entirety.

5. **Quality rating** - The final step in the review process is assignment of an overall average percentage that defines traffic control effectiveness at the time of the review. This is based on the resulting score on the Traffic Control Review form (p. 14) and team consensus on the overall effectiveness of the traffic control. The ranges are shown below. Project Ratings will be averaged to formulate Region and Statewide ratings. Maintenance operations will be reported separately.

95%-100% Excellent design and implementation of MHT: controls provide adequate driver guidance for virtually all situations. No significant deficiencies encountered, and comments were limited to fine-tuning or other minor adjustment. All traffic control devices are in good condition, appropriate for the actual situation, and properly placed.

85%-94% Good design and implementation of MHT: controls provide adequate driver input for most situations likely to be encountered. Some minor deficiencies may be present, such as less than optimum choice, condition or placement of individual device.

80%-84% Design and implementation of MHT is generally acceptable: there may be a number of specific points that can be improved or refined, and occasional points that may be only marginally effective.

70%-79% Design and implementation of MHT is only marginally effective. Many specific points need refinement or adjustment, or a number of individual points are marginally effective. Although drivers familiar with the work zone can be expected to traverse it safely, unfamiliar drivers may experience difficulty, especially during adverse conditions, such as heavy traffic, rain, or darkness.

Below 70% Although some traffic controls have been provided, they are not adequate to provide guidance through the work zone. Drivers familiar with the site may not experience difficulty during favorable conditions, but unfamiliar drivers will probably have problems in traversing the site during all conditions, and even familiar drivers may experience difficulty during adverse conditions.

A. Each year the department will set a performance goal (e.g. 85%). A description of the deficiencies and best practices will be provided so the project can focus on actions for improvement instead of just a score.
B. The final report and scores will be delivered as follows:
    1) Each regions RTD, Program Engineers, Regional Traffic Engineer and Maintenance Superintendent will receive a regional final report with their regions project scores and a statewide average score. The report will also include a description of any regional or statewide issues and a description of the % scoring system.
    2) Each Resident Engineer will receive the scores for their projects and the statewide average score. Their report will also include a description of any regional or statewide issues and a description of the % scoring system.
    3) Each Project Engineer will receive their projects score and the statewide average score. Their report will also include a description of any regional or statewide issues and a description of the % scoring system.

4) FHWA and Traffic and Safety Unit will receive a copy of all regional final reports with all project scores and issues.

C. Beginning with FY 2009, Traffic Control Reviews for projects will be done without prior notification. The TCR team will take precautions to insure information concerning which projects are to be reviewed and when is kept confidential.

6. **Review follow-up** - Following each Region review, a debriefing meeting will be held to discuss results. Debriefing meetings may be conducted by conference call and should include all Review Team members, the Region Traffic Engineer, and the Region Program Engineer. Maintenance and project personnel should also attend the debriefing if their schedules permit. Copies of the review forms will typically be transmitted to the Region Program, Resident, and Project Engineers one to two weeks after the review to allow time to correct any errors in the form and clarify comments as necessary. While the completed forms will not be available for several days, Region participants are expected to take adequate notes during reviews to permit timely follow-up on points requiring field changes. Since Project Personnel are expected to be familiar with their project plans and specifications and the applicable standards and other traffic control requirements, disagreements with the Review Team's comments should be raised and resolved at the time of the de-briefing.

Following completion of each annual review, two separate reports are prepared. The first is addressed to the Region Transportation Director and provides an overall summary of the Regional reviews, including construction and maintenance work. The second report is submitted to the FHWA in fulfillment of requirements for the federal-aid highway program. Results of the annual reviews form the basis for identifying needed changes and improvements to ensure continuous improvement in program results. Regional staff are expected to make changes as appropriate in the Regional design process and in maintenance procedures, as well as in individual project management. The results may also indicate the need to conduct training. Staff Branches will use the results to identify and support needed improvements in standards, specifications, and procedures, as well as other program needs. Results will also be used to provide executive management an overview of progress in meeting Department goals and objectives for work zone traffic control.

Anticipated Program Results

Establishment of Program Goals - Once sufficient data is compiled from annual reviews, it will become possible to establish performance goals for work zone traffic control on Department projects.

Combined with information from review program results identifying specific strengths and weaknesses, resources can be directed to resolve specific concerns needed to improve performance.

Traffic Control Review Form

Project: _____ **Date:** _____
Subaccount: _____ **Time:** _____
Location: _____

Project Engineer: _____ **Prime Contractor:** _____
Resident Engineer: _____ **Traffic Control Contractor:** _____
Reviewer: _____ **Traffic Control Supervisor:** _____

Use Yes, No, NA (Not applicable), or NC (Not Checked)

[NOTE: References are to CDOT's 2005 Standard Specifications, standard special provisions (SSP), Construction Bulletins (CB), M&S standards (M- or S-xxx-x), Construction Manual (CM), Manual on Uniform Traffic Control Devices (MUTCD), or 2002 Roadside Design Guide (RDG)]

	I. TRAFFIC CONTROL MANAGEMENT (Weight = 1)	Yes/No/NA		
A.	TCS's Traffic control daily diaries on file (630.10(5))			
B.	Diaries reviewed by CDOT (CM 630.3.2)			
C.	Discrepancies...noted in diary, CDOT Form 7 & corrected (630.10(5)(viii))			
D.	Night inspections conducted weekly, documented (630.10(6))			
E.	MUTCD (Current) in CDOT field office (CM 630.3.1 #1)			
F.	Resident Engineer Traffic Control Review done (CM 630.3.1 #7, CM 630.2.2 #1)			
G.	Public Info. Spec implemented as required, including up-to-date phone message, daily phone call log, fliers, etc. (Project Special Provision 626)			

	II. METHOD OF HANDLING TRAFFIC (MHT) (Weight =2)	Yes/No/NA		
A.	MHT on file in project records, for each work zone operation (630.09)			
B.	All CDOT Personnel and superintendents have received WZTC training (SSP 630)			
C.	MHT in compliance with TCP (630.09)			
D.	CMO prepared for major change of TCP (630.09)			
E.	MHT reviewed and initialed by Prime contractor (CM 630.2.4 #1)			
F.	MHT approved and initialed by proper CDOT person (630.09)			
G.	MHT sufficiently detailed per 630.09.			
	1. Detailed diagram (630.09(1))			
	2. Tabulation of devices for each phase (630.09(2))			
	3. MUTCD, Plans, Specs & other sources referenced (630.09(3))			
	4. Estab. access mtce. plan, turn around locs., equip. storage, etc. (630.09(4))			
	5. Pedestrian (ADA), bicycle & non vehicular access addressed (630.09(5))			
	6. Plan for emergency vehicle access (630.09(6))			
H.	Vert. and horiz. clearances (630.09(7)&(8), CM 630.2.4, #7a & 7b, CB 2006-1)			

	III. WORKSITE TRAFFIC CONTROL SUPERVISOR (TCS) (Weight =1)	Yes/No/NA		
A.	Current ATSSA or CCA Certification on file in project records (630.10)			
B.	TCS has current flagger card (630.10)			
C.	TCS available on project (630.10, last paragraph)			
D.	TCS has current MUTCD (630.10(8))			
E.	TCS has current TCP, MHT, M&S-Standards and revisions (630.10(8))			
F.	TCS appropriately dressed (fluorescent orange-red or yellow-green hardhat, vest, reflectorization at night, sturdy boots) (630.13) (appropriate PPE)			

IV.	FLAGGERS (Weight = 1) (see MUTCD Chapter 6E)	Yes/No/NA		
A.	Current flagger card (630.13(a))			
B.	Appropriately dressed (fluorescent orange-red or yellow-green hardhat, vest, reflectorization at night, sturdy boots). (630.13) (appropriate PPE)			
C.	Proper flagging methods used (630.13, MUTCD 6E.04)			
D.	Flagger location (630.13, MUTCD 6E.05):			
	1. Visible to traffic.			
	2. Proper distance in advance of work.			
	3. Station illuminated at night (630.13)			
E.	"STOP/SLOW" Paddle (630.13, MUTCD 6E.03):			
	1. Correct size and shape.			
	2. Satisfactory condition.			
	3. Correct sheeting (Type III or fluorescent).			

V.	CONSTRUCTION/MAINTENANCE SIGNING (Weight = 3)	Yes/No/NA		
A.	Placement (spacing/mounting height/angle/offset/sight distance) conforms to approved MHT/MUTCD/S-Stds.	YES		
B.	Conforms to MUTCD/S-Standards/TC plans (size, layout, color).			
C.	Satisfactory condition (clean, readable, no wear/tear/wrinkling/bowing).			
D.	Temporary signs			
	1. 1' minimum above pavement elevation (S-630-1, Sht 11, note 12)			
	2. Stored out of clear zone (630.12, SSP 630)			
E.	Satisfactory breakaway posts or NCHRP 350 compliant (630.02, 614.02, 630.08, SSP 630, CB 2005-10)			
F.	Correct signing for situation			
G.	Conflicting signs properly treated (masked, turned, removed) (630.11, 630.12)			
H.	Appropriate fluorescent & reflective sheeting on all signs. (630.02, SSP 614/630)			
I.	Flashing beacons installed/working properly (S-614-14)			
J.	VMS message/placement (MUTCD 6F.55, MUTCD 1A.14)			

VI.	TRAFFIC CONTROL DEVICES (Weight =3)	Yes/No/NA		
A.	Arrow panel (MUTCD 6F.56, 630.03)			
	1. Correct size, number of lights etc.			
	2. Correct mounting height.			
	3. Correct placement.			
	4. All lights working.			
	5. Correct operating mode.			
	6. Auto dimmer for night use operational.			
B.	Channelizing devices (barricades, cones, drums, etc.) (630.05, 630.06, MUTCD 6F.58 to 6F.63):			
	1. Correct dimensions.			
	2. Clean, adequately maintained, and functional (upright, etc.)			
	3. Correct taper length			
	4. Correct spacing between devices.			
	5. Warning lights working.			
C.	Concrete barrier (temporary):			
	1. Correctly pinned. (630.07, M-606-14, RDG 9.2.1.1)			
	2. Proper reflector spacing. (S-630-2 Note 9, max 50 feet)			
	3. Proper reflector color (S-612-1)			
	4. End treatment installed, or “Clear zone” established. (S-630-2, Note 9)			

	5. Correct Taper (RDG 9.2.1.1.1, 4:1 to 8:1, S-630-1, Sht 11, Note 16)			

VI I.	**PAVEMENT MARKINGS (Weight =2)**	Yes/No/NA		
A.	Pavement marking plan on file. (627.03)			
B.	Conflicting markings properly removed. (627.03(d), 202.05, MUTCD 6F.71)			
C.	Pavement markings placed correctly (full compliance, width, length, location, waviness) (627.03) (per plans, specs, and MUTCD)			
	1. No passing zones in full compliance. (627.03)			
D.	Satisfactory condition (not overly faded, damaged or obscured)			
	Section Score (Sum X Wt)			

VI II.	**MISCELLANEOUS ITEMS (Weight = 3)**	Yes/No/NA		
A.	"Clear Zone" free of obstructions. (per plans or RDG 9.1.1)			
	1. Construction materials/equipment out of clear zone or protected			
	2. Hazards in clear zone (other than barrier) delineated or protected			
	3. Pavement edge drop-offs minimized, marked if present (MUTCD 6F.42)			
B.	Impact attenuators:			
	1. Installed per specifications (proper array and pad).			
	2. Lids in place, dry sand, good condition.			
	3. Other attenuator types installed properly and maintained			
C.	Pilot car operation correct. (630.13)			
D.	Compliance with Project Special Provisions (working hours, etc.).			
E.	Traffic Signal operations/installation (630.04, 614)			
	1. Timing adequate			
	2. Vertical clearance adequate/Proper location of heads			

IX .	**TRAFFIC IMPACTS (Weight = 2)**	Yes/No/NA		
A.	Adequate driver guidance (Drivers understand where to go)			
B.	Traffic delays being mitigated (Alt Rte, delays advertised etc.)			
C.	Accidents documented (630.10(5)(viii))			
D.	Work Zone speed limit			
	1. Form 568 on file (CM, Appendix B)			
	2. Speed reduction appropriate for operation (not too slow/not too fast)			
	3. "Fines Doubled" and return to speed limit properly placed (S-630-1, Sht 10)			

X.	**WORK ZONE AREA AND WORKER SAFETY (Weight = 2)**	Yes/No/NA		
A.	Safe entrance/exit to work zone for equipment and workers (630.09(4))			
B.	Work zone buffer adequate (MUTCD 6C.06)			

(See next page for comments)

COMMENTS:
Section I General Comments:

A:
B:
C:

D:
E:
F:
G:
Section II General Comments:

A:
B:
C:
D:
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G:
Section III General Comments:

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Section X General Comments:

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Overall Comments:

TMP CONTENT

TMP consists of three components: a TCP, TO, and PI. For individual projects or classes of projects that are not classified as significant, the TMP, at a minimum, will consist of a TCP. The TO and PI components should be considered. This section is intended to serve as overall guidance that sets forth some basic principles and issues to consider in developing TMPs. The following is a list of the TMP development items that should be considered. Each item is described in more detail in the sections that follow.

1. Project Description
2. Project TMP Roles and Responsibilities
3. Existing and Future Conditions
4. Work Zone Impacts Assessment
5. Work Zone Impacts Management Strategies
6. TMP Monitoring Requirements
7. Traffic Incident Management Plans (TIMP)
8. Key Findings
9. Appendices

1. Project Description

The project description presents the scope and definition of the project. It may include:

- project type
- project area/corridor/limits
- project goals and constraints
- proposed construction phasing
- general schedule and timeline
- related and/or adjacent projects

2. Project TMP Roles and Responsibilities

The roles and responsibilities for the development, implementation, monitoring, and evaluation of the TMP should be documented. These may include, but are not limited to:

- Design Engineer
- Project Engineer
- Resident Engineer
- Program Engineer
- Maintenance Superintendents
- Maintenance Supervisors
- Stakeholders
- Contractors
- Public Information Manager
- CDOT Office of Public Relations
- Incident Management Coordinator
- Emergency Contacts

3. Existing and Future Conditions

This includes information on existing and anticipated future conditions in the study area including traffic, safety, and business/community access. Examples are:

- data collection and modeling approach
- existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural)
- existing and historical traffic data (volumes, speed, capacity, volume/capacity, percent trucks, queue length, peak traffic hours)
- existing traffic operations including signal timing, delay, and traffic control types
- crash data
- incident data
- local community and business concerns/issues
- traffic growth rates (for future construction dates)
- traffic predictions during construction (volume, delay, queue)

4. Work Zone Impacts Assessment

Depending upon the project type, the TMP may include a qualitative and/or quantitative analysis of work zone impacts, impacts assessment of alternative strategies (in conjunction with each other), and the impacts of the chosen management strategies. Examples are:

- region lane closure policies
- qualitative summary of anticipated work zone impacts
- impacts assessment of alternative project design and management strategies (in conjunction with each other)
- construction approach/phasing strategies
- work zone impacts management strategies
    - traffic analysis results (if applicable)
    - traffic analysis strategies
    - analysis tool selection methodology and justification
    - analysis results
- constructability issues
- selected alternative

5. Work Zone Impacts Management Strategies

The objectives of work zone impact management strategies are to minimize traffic delays, maintain or improve motorist and worker safety, and maintain access for businesses and residents. For the TMP, work zone impact management strategies should be identified for both the mainline and detour routes for the construction phasing approach(es). Where appropriate, the management strategies should be documented on plan sheets and the CDOT form “Significant Projects Form” (http://internal/centralfiles/FormsCatalog.htm). A list of work zone strategies for the temporary traffic control, traffic operations, and public information components are discussed in more detail in Section 5.

6. TMP Monitoring

Monitoring Requirements

This should include or refer to any CDOT policies, standards, requirements, and procedures for TMP implementation. The monitoring should consider both the performance of individual TMP strategies and overall performance of the work zone and work zone impact area during construction. The following items, as appropriate, shall be included in the formal project documentation:

- verification of work zone setup (via MHTs and Daily TCS Diaries)
- identification of the process for monitoring TMP performance (e.g., volume counts, queue length, accidents, complaints, surveys)
- tracking TMP implementation costs and comparing them to the budgeted costs via Change Modification Orders (CMO's) and/or SiteManager
- approach for and performance of corrective actions when TMP performance requirements are not met (e.g. when maximum queue lengths or delays specified in the Region's lane closure policy are exceeded)
- when alternative TMPs or changes to the TMP are submitted via revised MHTs, CMOs, or revised Phasing plans
- identification of the person responsible for monitoring each component of the TMP before or during the pre-construction meeting (typically the CDOT Project Engineer/Manager and the Region's Public Information representative)

Evaluation Report Requirements:

The TMP should include a reference to the development of an evaluation report upon completion of construction to document lessons learned and provide recommendations on how to improve the TMP process and/or modify guidelines. The report should include the following:

- an overall statement reflecting the usefulness of the TMP
- changes necessary to correct oversights in the TMP
- changes made to the original plan and their level of success
- public reaction to the TMP
- the maximum and average delay time encountered (e.g., average queues, slowdowns) during peak and off-peak periods, and delay history over the duration of the project
- identification of the peak traffic periods
- frequency of legitimate complaints and the nature of the complaints
- types and numbers of crashes that occurred during construction
- types and numbers of safety service patrols incidents
- level of success and performance log for each strategy of the TMP implemented
- suggested improvements or changes for similar future projects

7. Traffic Incident Management Plan

Contingency plans are required for all planned work and should comply with *Guidelines for Developing Traffic Incident Management Plans* (http://www.dot.state.co.us/Traffic_Manuals_Guidelines/Traffic_Guidelines_and_Information.asp). The plan specifies activities that should be undertaken to minimize traffic impacts when unexpected events occur in the work zone (e.g., accidents, unforeseen traffic demand, inclement weather). This plan, developed by CDOT or a consultant, addresses specific actions to restore or minimize the effects of unexpected congestion or delays that exceed the original estimates or acceptable levels.

8. Key Findings

This section highlights some of the key findings for the selected alternative and discusses feasibility, anticipated traffic, or safety concerns (e.g., specific roadways with long estimated queues, accessibility issues, ability of the detour routes to handle diverted traffic) and any special provisions or issues.

9. Appendices

Appendices include information that may be relevant or of interest to the implementer of the TMP, TMP manager, CDOT, or other stakeholders. This could include, but should not be limited to, observed, historical, and/or estimated traffic volumes, speeds, travel times, level of service, delay, and accidents; maps; phasing plans; lane closure charts; and detailed analysis methodology, assumptions, parameters used; etc.

LIST OF WORK ZONE STRATEGIES

TEMPORARY TRAFFIC CONTROL PLAN (TCP) STRATEGIES

Full roadway closure. This strategy involves the complete closure of the roadway during the construction. It necessitates being able to detour traffic adequately onto existing routes. The advantage of this strategy is that it provides for faster construction by allowing the contractor full access to the work area and eliminates exposure of motorists to work zones and workers to traffic. It increases construction efficiencies, eliminates traffic control devices, and reduces overall project duration.

Full closure strategies (off-peak, night, intermittent). These strategies involve complete closure of the roadway for various time periods. Off-peak and night closures require detour routes and other strategies to manage the work zone traffic. For intermittent closures, traffic is stopped for short period(s) (one or both directions). Intermittent closures should be used only on roadways with low volumes or during periods of lower volumes (mid-day, night, weekends, etc.).

Reduced lane width (constriction). This involves reducing the width of one or more lanes to maintain the existing number of lanes on the facility. The width reduction may be less if the shoulder is available for use (width and structural adequacy). However, reduced lane widths reduce the facility's capacity and may require lane marking changes.

Lane closure. This type of work zone closes one or more existing traffic lanes. This strategy should be analyzed to determine if significant impacts would result from the loss of capacity.

Reduced shoulder width. This involves reducing the width of the inside and/or outside shoulder for construction purposes.

Shoulder closure. Shoulder closure prevents vehicles from using a shoulder or any portion of the shoulder for its intended legal use. This strategy should be avoided in areas with high incident rates. It may also require provisions for towing disabled vehicles and construction of shoulder pull-outs.

Lane shift to shoulder/median. This strategy involves traffic being diverted onto the shoulder, or a portion of the shoulder, for use as a traffic lane. If the construction period is of long duration, a pavement engineer should determine if the pavement is adequate to support the traffic (consider the percentage of heavy vehicles for this corridor).

One-lane, two-way operation. One lane, two-way traffic control involves using one lane for both directions of traffic. It is usually implemented for short-term projects on bridges or in rural areas over a short distance. This may include the use of flaggers or temporary/portable traffic signals to control traffic and minimize delay and safety concerns.

Two-way traffic operations on one side of divided facility (crossover). Also known as reconstruction by halves, this involves the reconstruction of all lanes in one direction while the opposing lanes share the roadway with traffic in the opposite direction. Shoulders and/or lane constrictions may be used to maintain the number of lanes in each direction. This strategy provides an effective work area, and workers are generally separated from the traffic stream;

however, there is the need for crossovers and positive separation. This strategy should be considered when it can reduce the construction period, safety concerns can be addressed, and there is adequate geometry to allow for crossovers. Standards should be developed and used for this strategy (e.g., crossover lengths, pavement, speeds, and positive separation devices).

Reversible lanes. This strategy involves sharing lane(s) of travel to accommodate peak period traffic flow. It is also known as variable lanes or contra-flow lanes. The direction of travel varies by time of day, or maybe day of week. Some sort of barrier (e.g., movable barrier system) should be used to maintain safety and direct traffic flow. However, the cost of this type of barrier system often limits the use of this strategy.

Ramp closures/relocation. Ramp closure involves closing one or more ramps in or around the work zone (for specific time periods, days of week, or all day). It may be necessary for construction purposes or to improve traffic flow on the mainline. Ramp relocation may be used to maintain accessibility to the freeway and/or local businesses or community. Consideration should be given to additional signage and public information campaigns to forewarn motorists, the potential impact to business and community access, and detour route and information. For safety reasons, adjacent ramps should not be closed at the same time unless absolutely necessary.

Freeway-to-freeway ramp closures. This strategy involves closing one or more freeway-tofreeway interchange connectors over a period of time. It may be necessary to close interchange connectors depending on the design characteristics and right-of-way availability. This type of closure will significantly impact the capacity of the facility, particularly on roadways with high volumes and/or congestion. Construction duration for this strategy can be reduced in conjunction with a design-build contracting approach. Provisions must be made for detouring traffic.

Temporary structures/lanes/shoulders (temporary diversion or runaround). This work zone type involves the use of a temporary roadway for diverting traffic so the structure, roadway, or shoulders can be closed for the project. This type of work zone typically involves significant work preparing the temporary roadway prior to actual construction of the roadway and may involve additional right-of-way or easements. It is recommended that the temporary facility be designed such that capacity and safety impacts are the same as or better than the existing facility.

Construction phasing. The impacts of a work zone on traffic may be limited by the project phases, thus completing portions of a construction project one part at a time.

Work hour restrictions (peak hours, holidays, special events). This involves restricting work hours such that work does not occur during periods of peak travel demand and congestion. Work zone phasing will need to be considered to accommodate periods where a longer construction duration is necessary.

> **Night work.** Work is performed at night (end of evening peak period to beginning or morning peak period) to minimize the work zone impacts on motorists. Night work may occur during specific phases of the project or for the entire project duration. Night work has increased because of the need to maintain roads operating at or near capacity during the day. Safety issues may be of concern for night work as motorists' driving

skills are typically impaired (e.g., lighting distractions, reduced perception, excessive travel speeds through the work zone). In addition, it is more difficult for contractors to get resources and labor for night work.

Weekend work. Construction work (all or phases) is restricted to weekends, i.e., the period from the end of the Friday afternoon peak period to the beginning of the Monday morning peak period.

Traffic screens. Also known as glare or gawk screens, traffic screens consist of vertical panels that are attached on top of concrete barriers to minimize glare from opposing traffic and prevent motorists from viewing the construction activity. This is intended to be used to minimize rubbernecking delays and increase the safety of motorists and highway construction workers.

Signage. Signage should accurately describe the situation in and around the work zone. The content of the signs should reflect what action should be taken by motorists and provide relevant and current information. Advance warning signs need to be spaced accurately to allow for motorists' action.

Construction signs. Advance signing should be used to notify the motoring public of the work zone and/or offer options for alternative routes. Signs should include dates and/or locations of construction and/or closures.

Detour signs. Detour signs should clearly direct motorists onto detour routes, through the detour, and back to the route from which they were detoured. Advance notice is required so that the motorists have time to choose an alternate route.

Traffic control officers. This involves the use of traffic control officers to direct traffic. It is most often used at heavily congested intersections or during special events, typically for a short duration.

Flaggers. Flaggers are persons who control traffic and assign right of way at approaches to work zones. They slow traffic to ensure the safety of the construction workers and motorists. Flaggers should be used only after all other suitable methods of traffic control are considered and should be limited to rural, low-volume roadways. Flaggers should be clearly visible to approaching traffic and located far enough upstream so that motorists will have time to respond.

Flashing arrow signs. These signs consist of a message board with a flashing arrow and are intended to aid motorists in navigating and merging through and around the work zone. They are particularly effective in alerting motorists of lane closures and/or the need to change lanes. They are intended to supplement conventional traffic control devices.

Off-site detours. This strategy involves re-routing traffic to other roadways and should be considered with total closure of the roadway or where capacity is significantly reduced (one or both directions). Attempts should be made to synchronize the detour route with the beginning and end of construction. Facilities with large volumes should be detoured to other major routes (if feasible), whereas local route detours can generally be used for four-lane facilities. In either case, improvements may be necessary to accommodate the diverted traffic on the

detour routes. Some of the factors that should be considered include available capacity, geometrics, detour route speeds, pedestrian concerns, rail crossings, and oversize/overweight/over height vehicle concerns. Some of the improvements that may be needed for detour routes include:

> **Capacity/geometric improvements**. Improvements to the detour route may be necessary to accommodate the diverted traffic from the roadway impacted by the work zone. These may include improvements to the mainline and/or intersections, including roadway and/or shoulder widening, and additional through and/or turn lanes.

Signal timing/coordination. This involves retiming or coordinating (interconnecting) traffic signals to increase the capacity of the roadway and improve traffic flow.

Signing and striping enhancements. Signs and/or striping enhancements are provided to guide motorists through the detour route.

Parking restrictions. This strategy involves eliminating parking on the facility or instituting parking restrictions by time of day and/or day of week. The objectives can be either to use the parking area as an additional lane, increase capacity, or reduce traffic conflicts. Availability of parking for local businesses will need to be addressed, as well as the need to improve intersection geometrics to accommodate an additional lane.

Changeable/dynamic/variable message signs (CMS/DMS/VMS). CMS/DMS/VMS are message boards placed along roadways (typically freeways) that notify travelers of incidents, travel time information, construction/road closures, and other potential hazards in or around the work zone. Careful placement of the roadway equipment provides the information at points where drivers have recourse and can adjust their routes to account for the information. These message signs should be used when the condition of the work zone is changing and where a static sign is not sufficient to provide the information to motorists.

Pedestrian/bicycle access improvements. This strategy involves improvements for pedestrians and/or bicyclists where the work zone impacts their accessibility. They may include physical separation of pedestrians and vehicles, temporary or permanent sidewalks or bike lanes, protection from drop-off locations, temporary or permanent lighting, and/or signal adjustments. Pedestrians/bicyclists should be directed to a safe location if walkways and paths cannot be provided. Special pedestrian/bicyclist considerations may be needed in locations where sidewalks traverse the work zone, where a school route traverses the work zone, where there is significant pedestrian/bicyclist activity, or where existing land use generates such activity (e.g., parks, schools, shopping).

Business access improvements. Some projects will have a direct impact on businesses, particularly accessibility. Accessibility improvements for businesses may include signage or information to direct motorists to the business(es) and/or relocation of access locations.

CONSTRUCTION MANAGEMENT TECHNIQUES

Innovative construction techniques (e.g., precast members, rapid cure materials). These strategies involve the use of special materials such as quick curing concrete or precast items (e.g., culverts) to minimize the duration of the work zone or where traffic restrictions need to be minimized (e.g., roadways with high volumes).

Design-build. This strategy involves the use of one contractor to design and build the project. This decreases the project duration by allowing construction to begin prior to design completion. The results are reduced administrative costs; a single point of contact for design and construction issues; and flexibility for innovative designs, materials, and construction techniques.

A+B bidding. A+B bidding can be used to encourage contractors to minimize construction impacts by reducing the exposure time. This method is used to determine the winning bid, not actual payments to the contractor. Part A refers to the contractor's estimated cost of the work, and Part B refers to the total dollar amount based on a set user or agency cost per day times the number of days proposed by the contractor to complete the work.

No excuse bonus clauses. This strategy provides for a clause in the contract that awards the contractor a cash bonus for finishing the project or a significant item in the contract by a specified date. No excuses or outside impacts by weather, utilities, right of way, other contractors, unknown conditions, etc., are allowed that would change the set date. This strategy is particularly effective on projects that have utilities or right-of-way problems not cleared by the time work begins.

Incentive/disincentive clauses. This strategy involves the use of incentives and/or disincentives in the construction contract to minimize construction duration (e.g., additional funds may be paid to the contractor if the project is completed early or the contractor may be penalized if late). Incentive/disincentive provisions should be considered for projects that: have high traffic volumes; significantly impact traffic flow, businesses, and/or the community; replace a facility out of service (e.g., bridge or roadway damaged by a disaster); or have detours that are significant in length.

Milestones. This strategy sets milestones for different phases of a project to be complete to provide for earlier opening of a section of roadway or a bridge to traffic. Usually, incentive/disincentive or bonus clauses are added to give more emphasis to the milestone.

Lane rental. Lane rental involves a charge that is assessed to the contractor when a portion of the roadway is obstructed. The charge can vary according to time of day, day of week, number of lanes impacted, and duration. Contractors include in their bid an estimate to accommodate the number of hours they expect to keep a particular number of lane-miles closed. The contractor can make or lose money depending on how the actual number of lane miles involved compares to the bid.

Disincentives for lane closures. Under this strategy the contractor is assessed a specified amount for each quarter hour or other time period increment that he or she has not opened a lane or roadway to traffic during peak period rush hours. The penalty is usually very high and is generally based on road user costs. It is effective in ensuring that his or her work operations are complete prior to rush hour.

OTHER STRATEGIES

Severe weather conditions. Severe weather information systems can be used to alert motorists of potential weather conditions to improve safety conditions through the work zone. However, because of increased difficulty in vehicle control and distraction and/or anxiety for road users during severe inclement weather, work on the project should be postponed, if possible, until the weather conditions improve. Planned work zone management strategies for the project should continue if inaction would be worse than allowing the work zone to be unattended.

Bicycle/pedestrian traffic controls. These may include physical separation of pedestrians and vehicles, temporary or permanent sidewalks or bike lanes, protection from drop-off locations, temporary or permanent lighting, and/or signal adjustments. Pedestrians/bicyclists should be directed to a safe location if walkways and paths cannot be provided. Special pedestrian/bicyclist considerations may be needed in locations where sidewalks traverse the work zone, where a school route traverses the work zone, where there is significant pedestrian/bicyclist activity, or where existing land use generates such activity (e.g., parks, schools, shopping).

TRANSPORTATION OPERATIONS (TO) STRATEGIES

Demand Management

Automated Flagger Assistance Devices (AFADs). AFADs are portable traffic control systems that assist a flagger operation for short-term lane closures, on two-lane highways. For a typical flagging operation with AFADs, one or both flaggers can be positioned a short distance away from the roadway and moving traffic. A flagger(s) can operate an AFAD(s) by using a radio control unit or an attached cable. This strategy should be considered in areas with high crash rates and on short-term lane closures where flaggers are needed.

Transit service improvements. Where appropriate, transit service improvements may include the modification of transit schedules and/or routes, increases in frequency, or the establishment of transit service in the corridor. This strategy should be considered only in areas where transit use is likely.

Late Merge (Utilizing multiple lanes to the merge point). Where appropriate, signs may be placed through the work zone to encourage motorists to use all available lanes to the physical merge point. By utilizing all lanes and taking turns to merge, more traffic can move through the work zone; thus, reducing the queue length.

Reduced fares. Payments are made to a transit provider to subsidize fare costs to encourage increased ridership during the period of construction to reduce vehicles through the project.

Transit incentives. Transit incentives include employer transit subsidies and guaranteed ride home programs. These strategies work best when there are adequate transit routes and frequencies that serve major origins and destinations of motorists through the work zone.

Ridesharing/carpooling incentives. This strategy involves the use of rideshare/carpool incentives to reduce the number of vehicles going through a work zone. This could include preferential parking for carpools, the addition of mainline HOV lanes or bypass lanes on ramps, provision of vanpool vehicles, etc. These incentives should be used only in areas where a benefit such as reduced travel time or reduced user costs may be expected.

Park and ride promotion. This strategy involves the creation, expansion, and/or promotion (advertising) of park and ride lots to encourage ridesharing or transit use and reduce the number of vehicles traveling through the work zone.

Shuttle services. Shuttles and charter buses may be considered if a large number of users along the corridor are anticipated to use this service. Users would need to realize a benefit in travel time, parking costs, etc., in order for this strategy to be effective.

Pedestrian/bicycle access improvements. This strategy involves improvements for pedestrians and/or bicyclists where the work zone impacts their accessibility. These may include physical separation of pedestrians and vehicles, temporary or permanent sidewalks or bike lanes, protection from drop-off locations, temporary or permanent lighting, and/or signal adjustments. Pedestrians/bicyclists should be directed to a safe location if walkways and paths cannot be provided. Special pedestrian/bicyclist considerations may be needed in

locations where sidewalks traverse the work zone, where a school route traverses the work zone, where there is significant pedestrian/bicyclist activity, or where existing land use generates such activity (e.g., parks, schools, shopping).

HOV lanes. High-occupancy vehicle (HOV) lanes, also known as carpool lanes, require two or more persons per vehicle for use (exceptions may include motorcycles and/or low-emission vehicles). HOV lanes can provide better efficiency for the roadway by moving more people per lane than does a general purpose lane. However, there needs to be a large amount of similar origins and destinations, and/or incentives (park-and-ride lots, preferential parking, time savings, ridesharing match program, etc.), for this strategy to work. HOV lanes could involve using a shoulder, using the median, or dedicating a travel lane for this purpose (likely to be controversial) and can be used during peak periods or for 24 hours/day.

Parking supply management. This strategy involves managing the parking supply typically through cost strategies to reduce the traffic demand. This strategy is difficult to implement unless parking at the origin/designation is controlled by CDOT and/or parking is limited.

Toll/congestion pricing. Tolls are fees paid by motorists to drive in a particular area. Congestion pricing, or value pricing, involves the use of higher tolls under congested conditions and lower tolls at less congested times and is intended to reduce peak-period vehicle trips. This could be implemented in several ways: construct a new toll road to provide an alternative route or toll the roadway through the work zone to reduce the demand for the roadway; enforce during peak periods, weekdays only, or all day; collect tolls automatically or manually; or collect fixed or varied tolls (on a set schedule or based on changes in the level of congestion).

Variable work hours. This strategy involves encouraging motorists who typically travel through the work zone during periods of high demand to work variable hours (off-peak) to reduce the demand for travel during peak periods.

Telecommuting. Telecommuting involves employees working at home, or at a telecommuting center near their home, full time or part time. Motorists who normally travel through the work zone would be encouraged to telecommute during the duration of the project to reduce the demand.

Corridor/Network Management

Advance/delay planned projects. This strategy advances or delays projects in the nearby network that are scheduled for construction during the same time that the project will be underway. Advancing the work so that it is complete prior to the beginning of project construction will provide more network capacity or better traffic operations. Delaying the work will prevent traffic impacts on both projects at the same time.

Signal timing/coordination improvements. This involves retiming traffic signals to increase the capacity of the roadway(s) and improve traffic flow.

Temporary signals. This involves the installation of temporary traffic signals to improve traffic flow through and near the work zone and/or address safety concerns.

Street/intersection improvements. Improvements on streets and intersections for the roadway and/or alternate routes may be necessary to handle the traffic through the work zone area. These may include improvements to the mainline and/or intersections such as roadway and/or shoulder widening and additional through and/or turn lanes.

Turn restrictions. This strategy restricts turning movements for driveways and/or intersections and can be implemented during peak periods or all day. Turn restrictions are typically used to increase roadway capacity and reduce potential safety issues.

Parking restrictions. This strategy eliminates parking on the facility or calls for parking restrictions by time of day and/or day of week. The objectives of restricting parking can be either to use the parking area as an additional lane, increase capacity, or reduce traffic conflicts. Availability of parking for the local businesses will need to be addressed, as will the need to improve intersection geometrics to accommodate an additional lane.

Separate truck lanes. This strategy involves the construction of new/separate truck lanes, use of one of the existing lanes for only trucks, or conversion of a shoulder or median for truck only use. This should be considered only in areas with a high percentage of trucks, for projects of long duration, and where there is a capacity (e.g., reduced lane widths) and/or safety concern in the work zone with truck movements. Appropriate design and geometric concerns related to trucks would need to be addressed if these were implemented.

Ramp metering. Ramp meters are traffic signals located on the freeway on-ramp or on freeway-to-freeway connectors that control the entry of vehicles onto the freeway to maintain safe and smooth freeway operations. Ramp metering can include pre-set timing, traffic-actuated (metering changes based on mainline traffic) metering, or centrally controlled metering and may be used during peak periods or all day. If ramp metering is considered, potential impacts due to ramp queues on local streets should be evaluated.

Truck/heavy vehicle restrictions. Trucks may be prohibited from using the facility completely by time of day or day of week. Implementing truck restrictions can increase the capacity of the roadway, particularly for facilities with a high percentage of trucks. Availability and sustainability of alternate routes for the trucks must be considered, as well as any state and/or local ordinances that govern truck traffic access.

Temporarily suspend ramp metering. This strategy involves turning off existing ramp meters during specific time periods or for the duration of the project. This strategy may be considered where it is necessary to get traffic onto the freeway quickly (e.g., at the end of a detour route).

Bus turnouts. This involves the construction of bus stop areas that are recessed from the traveled roadway. This strategy should be considered on detour routes or on highway facilities with a high occurrence of bus traffic and stops. This strategy improves traffic flow and delays by minimizing the occurrence of buses blocking the roadway. Bus turnouts should be designed for clear rear vision for safe re-entry into traffic.

Reversible lanes. This strategy involves sharing lane(s) of travel to accommodate peak period traffic flow. It is also known as variable lanes or contra-flow lanes. The direction of travel varies by time of day, or maybe day of week. Some sort of barrier (e.g., movable barrier system)

should be used to maintain safety and direct traffic flow. However, the cost of the barrier system often limits the use of this strategy.

Dynamic lane closure system. This system would involve advance warning signs for the lane closure, use of variable-length barriers making up a tapered lane closure system; and a control cabinet to operate the system (e.g., supervisory control PC, radio unit). The objective is to enhance mobility and the safety of highway workers.

Railroad crossings controls. If a rail crossing is located within the work zone and/or on the detour or diversion routes, improvements may need to be considered for safety purposes. These could include advanced warning signs, railroad crossing signs, pavement markings, flashing lights, and gate arms. The type of control would depend on the level of traffic and what rail crossing controls exist.

Speed limit reduction/variable speed limits. A reduced speed limit may be needed when the work zone may become a traffic hazard or to help protect construction workers. Speed limit changes may be implemented before traffic is detoured, through the work zone, or adjacent to unprotected construction workers. Unfortunately, adherence to speed limit reductions is often poor. To encourage adherence, additional enforcement and/or increased fines (with signage to reflect the increase) may be necessary.

Coordination with adjacent construction site(s). This involves combining or coordinating projects (scheduling) within a specific corridor to minimize the impacts to the motoring public and potentially result in cost savings to the state.

Work Zone Safety Management

Changeable/dynamic/variable message signs (CMS/DMS/VMS). CMS/DMS/VMS are message boards placed along roadways (typically freeways) that notify travelers of incidents, travel time information, construction/road closures, and other potential hazards in or around the work zone. Careful placement of the roadway equipment provides the information at points where drivers have recourse and can adjust their routes to account for the information. These message signs should be used when the condition of the work zone is changing and a static sign is not sufficient to provide the information to motorists.

Radar speed monitoring/display units. This is a portable system that can be mounted on a sign or located on a portable trailer that uses radar to measure vehicle speed and that informs motorists of their speed. A sign with the speed limit for the roadway should be at or near the panel sign to inform motorists of the speed limit. The objective of this system is to enhance safety by reducing vehicle speeds and speed variations.

Temporary traffic signals. This involves the installation of temporary traffic signals to improve traffic flow through and near the work zone and/or address safety concerns.

Temporary traffic barrier. A temporary traffic barrier is some sort of a barrier system to separate traffic flow physically from construction workers during the duration of the project. It could range from a narrow bituminous island with delineator tubes to concrete barriers (moderate to long duration). The objective is to provide a physical separation for safety purposes.

TMP monitor/inspection team. This would require the establishment of a team (or person) to monitor and inspect implementation and monitoring of the work zone transportation management strategies.

Windshield surveys. This involves having a person drive (or walk) through the work zone and conduct an assessment of traffic flow and safety.

Movable traffic barrier systems. This involves a mechanical system to move temporary barriers (e.g., portable concrete barriers) quickly within the work zone. Barrier systems are typically used for reversible lanes and for providing additional space for the contractor to work during off-peak hours.

Crash-cushion (fixed and mobile). Also known as an impact attenuator, a crash cushion is a fixed or mobile device placed at a specific location to prevent an errant vehicle from entering a work zone or crashing into a hazard by gradually decelerating the vehicle to stop or by directing the vehicle away from the hazard.

Temporary rumble strips. Rumble strips are temporary grooves or raised strips placed across a travel lane to alert motorists of the change in roadway conditions or a hazardous curve, slowing condition, or other hazard ahead.

Intrusion alarms. This strategy involves the use of a technology that detects vehicles entering the area between the motorists and the construction workers. When an intrusion is detected, workers in the area are warned via a loud siren.

Warning lights. Warning lights include flashing warning lights on barricades or signs to delineate a barrier or warn motorists of the work zone or other conditions ahead.

Construction safety inspectors. This strategy involves having one or more construction safety inspectors on-site.

Project task force/committee. A project task force/committee would be created to address the issue of safety within and near the work zone. The goal would be to identify and recommend actions to improve worker safety without sacrificing motorist safety and mobility.

Road safety audits. Road safety audits involve analysis of the future or existing roadway by an independent expert on safety issues. It is a proactive way to reduce crashes and identify potential safety hazards. Audits may be performed during any stage of a road project, including planning, preliminary design, detailed design, traffic control planning, construction, pre-opening, and on existing roads.

Safety awards/incentives. This strategy involves the use of awards or incentives for innovations that reduce the safety impacts associated with the work zone.

Team meetings. This involves conducting project team meetings on a regular basis to discuss TMP strategies, implementation, and monitoring, particularly related to safety concerns.

Traffic/Incident Management and Enforcement

Tow. This strategy involves the use of on-site (or near site) tow trucks to reduce the time an incident (breakdown or accident) affects the work zone. This strategy should be considered in areas where a breakdown or accident will significantly impact traffic flow or safety. Parking areas and turnaround locations for the tow trucks should be provided.

ITS for traffic monitoring/management. ITS can be used in work zones to identify areas where traffic flow is impeded so that traveler information can be provided and/or adjustments to the work zone can be made. A work zone ITS deployment uses sensors to detect traffic conditions and can automatically feed this information to motorist information outlets such as CMS and websites, or to a TMC. Monitoring traffic cameras can help detect places where drivers are having difficulty negotiating a work zone and then the layout can be adjusted.

Mile-post markers. Mile-post markers consist of a sign located in the median or shoulder, which lists location information (direction, route, mile, and tenths of a mile). Some areas may refer to these as location reference markers, since they can be used to mark direction; route, bridge or overpass names; intersection names; etc. in addition to mileage information.

Photogrammetry. Photogrammetry involves the use of photos taken in the field and computer software for documenting and measuring incident-related data (e.g., skid marks, vehicle location, etc.) which may reduce incident clearance times.

Safety service patrols. These are specific motorist service patrols to assist motorists who are disabled in order to get them on their way to reopen the roadway or shoulder traffic.

Surveillance (CCTV, loop detectors, lasers, probe vehicles). This strategy involves the use of surveillance, also known as monitoring or detector stations, to detect, verify, and respond to incidents in the work zone.

Changeable/dynamic/variable message signs (CMS/DMS/VMS). CMS/DMS/VMS are message boards placed along roadways (typically freeways) that notify travelers of incidents, travel time information, construction/road closures, and other potential hazards in or around the work zone. Careful placement of the roadway equipment provides the information at points where drivers have recourse and can adjust their routes to account for the information. These message signs should be used when the condition of the work zone is changing and a static sign is not sufficient to provide the information to motorists.

Highway advisory radio (HAR) (fixed and mobile). Longer, more accurate messages than what are available using signage may be necessary for the work zone. HAR involves the dissemination of traffic control information to motorists while en route over wide-area wireless communications directly to the vehicle's radio. Signage will need to be used to inform travelers of the number to obtain the information.

CB Wizard Warning System. The CB Wizard Warning Device is designed to send prerecorded messages across two selected CB channels and is geared toward truck drivers. The CB Wizard Warning Device automatically kicks into a channel when there is a break in the action.

Smart work zone technologies. These are work zone devices and/or systems that use automatic sensors to measure traveler travel time or delay and display this information via PCMAs, HARs, the Internet, and other means in “real-time” conditions.

Call boxes. Temporary or permanent call boxes may be installed through the work zone to provide motorists with a means to contact incident response personnel. This expedites the process by which accidents and breakdowns can be removed.

Transportation management center (TMC). This strategy involves the use of and coordination with an existing TMC to aid in incident management. If the project is large and of long duration and a TMC does not exist, a TMC may be constructed and operated to help maintain traffic flow and manage incidents. Information, such as traffic data and incident information, can be communicated and shared.

Distance/milepost markers. Distance/milepost markers consist of a mounted sign located in the median or shoulder that lists location information (milepost, route, county, etc.). This strategy is effective in responding to incidents or breakdowns as motorists can quickly and correctly inform emergency or response personnel of their location. To be effective, these markers should be placed no further than 1/10 mile apart.

Accident staging/investigation areas. Areas located off the roadway where enforcement officials can complete their accident reports without blocking traffic.

Total station units. This involves the use of survey equipment for documenting/mapping major incidents to reduce the clearance time.

HAZMAT trailers. These provide for having readily available materials to clean up hazardous spills in the close proximity of the project. They speed up reopening the roadway to traffic.

Fender bender signing. This strategy places static signing at various locations along the road indicating to the public that in minor accidents they should move their vehicles out of the roadway and onto the shoulders until enforcement officials arrive so as not to obstruct traffic lanes.

Local detour routes. Identification and approval/authorization of local detour routes in the case of incidents is an important strategy to consider, particularly for high-volume and incident-prone facilities. This would involve identifying possible local detour routes throughout the work zone and obtaining approval or authorization from the local agency for the use of the roadway(s) as a detour route(s) in the event of an incident.

Contract support. This strategy involves additional contract support than what is available by the contractor to support incident management. This could be with law enforcement, 911 dispatch, TMC support, towing and recovery providers, emergency medical services, or others.

Dedicated (paid) police enforcement. This strategy involves the use of paid police patrols in the work zone. Enforcement in the work zone can be used to deter speeding, provide for removal of vehicles involved in incidents or breakdowns, assist in traffic control, enforce other traffic laws, and prevent intrusions.

Cooperative police enforcement. Cooperative enforcement is similar to paid police enforcement except it is implemented through a cooperative agreement with the DOT.

Helicopter. This strategy involves the use of aerial surveillance to identify and verify incidents. This is rarely used unless it is available at no or a low cost (e.g., share expenses with a radio station traffic reporter).

Enforcing penalties. This strategy involves the use of enhanced fines for speeding or other violations in traffic work zones (e.g., fines may be increased to up to $500 in Colorado work zones). The intent is to deter speed violation and improve safety through the work zone.

Incident/emergency management coordinator. A person would be dedicated to overall incident and emergency management for the project. Some of the responsibilities might include developing incident and/or emergency response plans, overseeing implementation and monitoring of the work zone transportation management strategies, and managing incidents or emergencies. This strategy should be considered for large projects of long duration.

Incident/emergency response plan. This strategy involves the development of an incident response plan. This plan should include, but not be limited to, roles and responsibilities, response agencies, processes/procedures, actions to take for various incident types and levels, contact information, alternate routes, personnel and equipment information, and staging area locations.

Automated enforcement. Automated enforcement involves the use of various technologies such as radar, cameras, video, and sensors to detect and record vehicle speed or traffic signal violations. When a vehicle speed exceeds a specified threshold or a red signal violation occurs, the vehicle's license plate and/or driver are photographed. The citation with the photo(s) is then mailed to the registered owner of the vehicle.

Media briefings. This strategy involves working with the media to provide information for procedures to be used during an actual incident as well as proactive information to help inform the public.

PUBLIC INFORMATION (PI) STRATEGIES

The inclusion of a public information and/or relations campaign can be very effective in keeping the public informed of the project and its potential work zone impacts. The public (particularly the impacted communities and businesses) should be included in the TMP process early and should be informed in a timely manner of potential work zone impacts and issues. Coordination with the agency's public affairs office will be necessary, particularly for significant projects.

Public Awareness

Brochures and mailers. Brochures and mailers are printed material containing project-related information such as advanced notice of the project's start date, schedules, pictures/graphics of the project, a description of the need for the project, alternative routes, etc. These may be passed out to motorists at key locations (e.g., large employers in the project area, rest stops, automobile associations, travel information centers) or mailed to affected businesses or communities.

Rideshare promotions. These include creating or marketing an existing rideshare program through signage, advertisements, brochures, and events. The purpose is to encourage ridesharing to reduce the number of vehicles traveling through the work zone.

Press releases/alerts. These involve the provision of project-related information to the news media, affected businesses, and other affected or interested parties. They can include print and/or electronic media and are almost always used to announce the start of a project and, for medium to large projects, to provide updates and report progress.

Paid advertisements (newspaper, radio, television). Paid advertisements announce the coming of a major project and can involve newspaper, radio, television, billboards, etc. Planning is necessary prior to construction of the project for scheduling and developing such advertisements. Paid advertisements can also be used for progress updates or to provide information regarding major changes to the work zone configuration and management.

Public information center. This is a facility that may be located near the project site that may contain scale model displays, maps, brochures, videos, etc., about the project.

Public meetings/hearings. This strategy involves using project or public relations staff to present project-related information to the public, community, and/or businesses.

Community task forces. This strategy involves the development of community task force(s), which includes various stakeholders from the community that may be impacted by the work zone (businesses, neighborhood groups, interested individuals, public officials, or other representatives). The task force(s) could be developed as early as the planning stage of the project or during construction. The objective is for the group(s) to provide input and review/comment on the construction and management strategies and implementation to minimize the impacts of the project on the community. The contractor and agency would be responsible for meeting with the task force(s) to obtain their input and recommendations.

Telephone hotline. This traveler information system provides traffic or travel information for the work zone via telephone. It can include static broadcast information and/or real-time interactive request/response information.

Visual information (videos, slides, presentations) for meetings or for web-based dissemination. This involves the use of videos, slides, and presentations to supplement public meetings, public information center displays, or press releases.

Planned lane closure website. This strategy is typically not for one specific project but rather is usually implemented for an entire state, district, or geographic region. It includes a web page that provides planned lane closures of freeways for public information. It should include the routes involved as well as the start and end dates of the lane closure information, both in text and graphical form.

Project website. This traveler information system provides traffic or travel information for the work zone via the web/Internet. It can include static information and/or real-time interactive request/response information.

Coordination with local/cable TV newsrooms, schools and school districts, local major employers/businesses, and local emergency services (fire, police, and ambulance). This strategy involves coordinating with various community and business groups that are likely to be impacted by the work zone. Mechanisms (fax, e-mail, phone message, mailings) can be established to communicate project-related information including start dates, significant changes in the project, project schedule, and occurrences of incidents within the work zone.

Motorist Information Strategies

Portable and stationary changeable/dynamic/variable message signs (CMS/DMS/VMS). CMS/DMS/VMS are message boards placed along roadways (typically freeways) that notify travelers of incidents, travel time information, construction/road closures, and other potential hazards in or around the work zone. Careful placement of the portable roadway equipment provides the information at points where drivers have recourse and can adjust their routes to account for the information. These message signs should be used when the condition of the work zone is changing and a static sign is not sufficient to provide the information to motorists.

Ground-mounted signs. These are signs mounted in the ground with information to guide motorists through the work zone and warn of potential hazards.

Commercial traffic radio. The dissemination of project-related information via the radio.

Highway advisory radio (HAR) (fixed and mobile). Longer, more accurate messages than what are available using signage may be necessary for the work zone. HAR involves the dissemination of traffic control information to motorists while en route over wide-area wireless communications directly to the in-vehicle radios. Signage is needed to inform travelers of the telephone number and/or the radio channel where the information may be obtained.

Highway information network (web-based). A highway information network is a website where multiple stakeholder groups can place information related to the roadway. The website

is shared among the various stakeholder groups, each with their own data storage areas (including control of functionality, security, data quality, etc.).

Radar speed message sign. A portable system mounted on a sign or located on a portable trailer that uses radar to measure vehicle speed and informs motorists of their speed. A sign with the speed limit for the roadway should be at or near the panel sign to inform motorists of the speed limit. The objective of this system is to enhance safety by reducing vehicle speeds and speed variations.

Traveler information systems (wireless, handhelds). For this strategy, motorists can be provided with information related to the work zone, static and/or real time, via wireless or handheld devises. These can be in the form of cell phones, pagers, in-vehicle systems, or e-mail notifications. Depending on the size, nature, and duration of the project, hand-held-type devices could be purchased or made available to motorists who regularly travel through the work zone to warn them of potential delays on a real-time basis.

Freight-travel based information. This strategy should be considered only when there is a moderate to high percentage of freight movement through the work zone area. This involves working with the freight community (trucking companies, truck drivers, etc.) to identify information they would like to be informed of in the work zone area (e.g., truck restrictions, occurrences of incidents, planned closures) and provides a mechanism for the information to be disseminated to freight stakeholders.

TRAINING

Work Zone Safety and Mobility training courses are listed below:

A	1-day Traffic Control Technician (Zerah Inc or ATSSA) (prerequisite for the ATSSA 2-day Traffic Control Supervisor course)
B	2-day Traffic Control Supervisor (CCA or ATSSA)
C	1-day Traffic Control Supervisor refresher course (CCA or ATSSA) [1]
D	3-day Advanced Work Zone Management and Design (NHI course #3800072)
E	½-day Safe and Effective Use of Law Enforcement Personnel in Work Zones (ATSSA or FHWA)
F	½-day Flagger Certification (LTAP or ATSSA)
G	½-day Traffic Incident Management Plans (CDOT)
H	½-day Work Zone Safety/Flagging Certification (CDOT)
I	2 ½-hour Incident Management (CDOT)

[1] Upon completion of the 2-day Traffic Control Supervisor course, a refresher course must be taken every three years.

The following outlines the minimum training required for the listed positions:

Work Zone Safety and Mobility Training Requirements		
Functional Class	**Job Title**	**Required Training**
CDOT Personnel	Project Managers Project Engineers Designers Maintenance	B or C B or C B or C, D[2], G B or C, D[2], F, H, I
Project Designers	Designers	B or C, D[3], G
Project Builders (General Contractors and Subcontractors)	Project Superintendents Traffic Control Supervisors Flaggers	B or C B or C, F F
Law Enforcement	Local Police Departments County Sheriff Departments State Patrol	E[4] E[4] E[4]

[2] Applies to design and maintenance personnel who design Traffic Control Plans.
[3] Applies to designers who design Traffic Control Plans.
[4] Applies to law enforcement personnel who provide uniformed traffic control on federal-aid projects.
[2, 3, & 4] Training must be completed by **January 1, 2010**.