TRAFFIC OPERATIONS MANUAL

Chapter 125
Transportation Management Plans
Part 1 Transportation Management Plans
Appendices

March 2026

California Department of Transportation
Division of Traffic Operations

Table of Contents

List of Tables

List of Figures

Appendix 125 A Full Closure of Highway Guidelines

Topic 1 Purpose

These guidelines are to support ongoing efforts to educate and encourage project development teams (PDT) to consider and evaluate full closures as an effective and viable transportation management plan (TMP) strategy for positive work zone protection (PWP), accelerated project delivery, or to meet the needs of projects that require full closures. These guidelines establish uniform practices and guidance for the use of full closures for work zones on the State Highway System (SHS).

Topic 2 Introduction

Traffic management professionals are challenged with enhancing the safety of highway workers and road users, minimizing travel delays during project construction, and delivering highway projects expeditiously and efficiently.

Work on highways with high traffic volume is typically restricted to night hours. The reduced number of working hours may extend the project duration for several months and possibly years. Since it takes time to set up and break down equipment, mobilize labor, and provide materials, a short work window is not the most productive. In areas where work is only restricted to weekends, commercial and tourist activities could be significantly impacted.

Full closure (either in one or both directions as needed and feasible) is one of the TMP strategies that should be considered in transportation management planning during the project initiation phase and design phase. This will enhance safety through work zones and expedite project completion with minimal overall delay to the traveling public on highways.

Topic 3 Application

Full closure of highways can be implemented in capital projects, maintenance activities, or encroachment permit activities. Full closures are useful when multiple construction tasks can be completed at the same time, when the work itself requires a closure (such as building or demolishing a structure), or when full closures speed up project completion.

Topic 4 Benefits of Using Full Closure

Full closures can significantly speed up project completion by allowing uninterrupted work, while also enhancing safety for both workers and drivers. This approach often results in lower overall congestion and potential cost savings.

Topic 5 Challenges of Using Full Closure

When evaluating full closures as a TMP strategy, the following challenges must be considered:

- Full closures are not suitable for all construction situations and locations.
- They may lead to increased traveler delays for shorter durations.
- Full closures may impact alternate routes that serve as detours since they are not designed to meet the increased traffic volumes caused by highway closures.
- Movement of goods may be impacted as detour routes may not be designed using the same design vehicle as the closed route.
- Full closures will require increased communication, planning, and engagement with all impacted local agencies, communities, and stakeholders.
- Socio-economic impacts include increased travel times with excessive fuel consumption, revenue loss for local businesses, and impacts on emergency services and school operations.

Full closures often result in significant impacts to traffic due to longer detours or delays caused by congestion. In some cases, the delays may exceed 30 minutes or more than an hour. All closures resulting in significant delays, as defined in Deputy Directive 60-R2 (DD-60-R2) on "Transportation Management Plans," require the approval of the District Lane Closure Review Committee (DLCRC). Oftentimes, the public is open to being inconvenienced for a brief period with a full closure if it will expedite the construction work rather than an extended duration of work on highways with closures. An example would be completing major items of work using a weekend closure instead of multiple weeks of lane closures.

Topic 6 Implementation

Full closures have been successfully implemented in projects with scopes such as:

- Pavement rehabilitation that requires removal and replacement of the pavement structural section.
- Complex switches in traffic handling.
- Realignment of connector ramp.
- Realignment of bridge approach.

- Culvert replacement.
- Bridge demolition.
- Bridge replacement.
- Blasting and slope repair.

Topic 7 Considerations

The following outlines the projects and activities where full closure should be considered as a viable TMP strategy, and other applicable key factors to be considered that determine the viability of full closure.

Projects or Work Activities

The PDT must consider the use of full closures as a PWP mitigation measure as required in Design Information Bulletin 91-02 "Guidelines on the Use of Positive Work Zone Protection and Mitigation Measures," and the Project Engineer must document the decision on forms DOT CEM-1301, "Construction Work Zone Speed Limit Reduction Determination" and DOT CEM-1302, "Construction Work Zone Positive Protection Determination."

The PDT should consider the use of full closures as a TMP strategy under any of the following conditions:

- If estimated working days can be reduced by >75% (highly recommended) or 50% to 75% (recommended).
- If required for completion of certain activities (e.g., demolition of overcrossing structures, etc.).
- If materials or methods require extended closures (e.g., innovative bridge construction techniques).
- Concurrent work with other activities can be performed to improve productivity, reduce overall delays, and enhance safety.

Traffic and Detour

There must be a viable alternate route with enough capacity to accommodate the diverted traffic flow.

Potential bottlenecks along any proposed alternate route must be identified. Key areas that will be significantly impacted by the detours should be identified, and an effective monitoring plan should be put in place to promptly identify and resolve any issues at those locations.

To alleviate traffic impacts from full closures, demand management should be addressed through methods such as park-and-ride lots, ridesharing, and staggered

work hours for major employers. Alternate transportation modes such as ferries, buses, trains, shuttle service, and light rail must also be provided.

Additional funding or project work or both may need to be included to implement traffic management strategies that would enhance capacity on the alternate route.

Evaluate and leverage technology-integrated traffic control devices, such as Automated Work Zone Information Systems (AWIS), that enable dynamic traffic management and traveler information to mitigate traffic impacts.

During construction, the alternate route should be monitored in case other measures are required to improve traffic flow (such as restricted parking, etc.).

Public Communication and Local Impact

External partners' support for full closures is critical for successful implementation. External partners can be very helpful in promoting and demonstrating the benefits of a full closure to the public.

Adequate lead time must be available to provide information to the public and coordinate with impacted stakeholders (such as local agencies, local communities, transportation partners, first responders, hospitals, schools, public transit providers, businesses, and major employers, etc.) to gain support for the full closure and plan mitigations for the impacts of the full closure.

Information on project details and schedules must be provided to the public in advance so that they can plan travel accordingly. With advance notice, the public is usually supportive of completing the work as quickly as possible rather than extending it over several weeks or months.

Topic 8 Management Engagement and Approval

The following actions are advised for PDT to gain support and approval from management for the effective and successful implementation of full closures:

- Engage DLCRC early in the process to evaluate the need, feasibility, and impacts.
- Evaluate and present short- and long-term impacts and benefits for consideration.
- Assess all feasible alternatives for impacts and benefits in terms of safety, traveler delays, local communities' needs, and costs.
- Brief the District Director as needed based on anticipated impacts, duration of closures, etc.
- Update Management at 30%, 60%, and 90% reviews.

- Notify Headquarters (HQ) public information officer and management if significant impacts are anticipated and engagement with wider media or legislative members is needed.

Topic 9 Public Outreach Plan

To successfully implement a short- or long-term full closure, an effective communication plan should engage key stakeholders. The following are the key aspects of public outreach plans that should be implemented by the PDT and DLCRC:

- Engage all external stakeholders for support with full closures and expedited project completion.
- Distribute information effectively to highway users and local communities to avoid unnecessary travel during that closure period and plan alternate routes for essential travel.
- Identify and leverage all methods of communication for keeping stakeholders informed. Examples include public service announcements, social media, press releases, radio announcements, and changeable message signs (CMSs).
- Reach out to elected officials or legislative members of the affected areas and use their assistance to share the information.
- Notify essential services such as fire departments, hospitals, schools, and law enforcement agencies. Work with first responders to identify the impacts and have alternate routes planned to meet the needs of any emergencies.
- Engage and gain support from local agencies and communities that will be impacted by the detoured traffic.
- Craft a communication plan that clearly communicates the benefits and impacts. This will help gain public support and help impacted stakeholders and the public plan to mitigate the impacts.

Topic 10 Project Initiation Phase Full-Closure Conditions to Consider

Consider using the full-closure traffic control strategy during the project initiation phase if the following conditions exist and in coordination with the PDT:

- Do materials or methods require day work conditions?
- Are longer work windows required to complete certain activities?
- Would nighttime or weekend closures lead to significant delays?
- Does the extended construction period have significant impacts on commercial interests in the project area?

- Are significant reductions in working days possible (e.g., 50-75%)?
- Is a viable alternate route with adequate capacity available?
- Is there local support for this project?

Topic 11 Resources

For additional information on highway full closures, refer to the Federal Highway Administration Work Zone Management Program "Full Road Closure".

Appendix 125 B Sample Transportation Management Plan Datasheet

Figure B-1 Transportation Management Plan Estimate Form

Transportation Management Plan (TMP) Estimate Form

Co/Rte/PM: _____ **EA/EFIS:** _____

Project Limit: _____ **Alternative No.:** _____

Project Description: _____

Expected Construction Schedule: _____

1) Public Information

☐ a. Brochures and Mailers $_____

☐ b. Press Release/Media Alerts $_____

☐ c. Advertisements $_____

☐ d. Public Information Center/Information Kiosk $_____

☐ e. Public Meetings/Hearings/Speakers Bureau $_____

☐ f. Telephone Hotline $_____

☐ g. Internet/Project Website/Social Media $_____

☐ h. Others _____ $_____

2) Motorist Information Strategies

☐ a. Changeable Message Signs $_____

☐ b. Portable Changeable Message Signs $_____

☐ c. Radar Speed /Temporary Motorist Information Signs $_____

☐ d. Highway Advisory Radio $_____

☐ e. California Highway Information Network (CHIN) $_____

☐ f. Automated Workzone Information System (AWIS) $_____

☐ g. Others _____ $_____

3) Incident Management

☐ a. Construction Zone Enhanced Enforcement Program (COZEEP) $_____

☐ b. Construction Tow Service/Freeway Service Patrol $_____

☐ c. Traffic Management Team $_____

☐ d. Aerial Surveillance $_____

☐ e. Traffic Management Center/Surveillance Equipment $_____

☐ f. Others _____ $_____

4) Construction Strategies

☐ a. Lane Requirement Chart $_____

☐ b. Reversible Lanes $_____

☐ c. Full-Facility Closure $_____

☐ d. Contra Flow $_____

☐ e. Truck Traffic Restrictions $_____

☐ f. Reduced Speed Zone $_____

☐ g. Connector and Ramp Closure $_____

☐ h. Extended Weekend Work $_____

☐ i. Incentive and Disincentive Clause $_____

☐ j. Moveable Barrier $_____

☐ k. Others _____ $_____

5) Demand Management

☐ a. HOV Lanes/Ramps (New or Convert) $_____

☐ b. Park-and-Ride Promotion $_____

☐ c. Ridesharing and Carpool Incentives $_____

☐ d. Variable Work Hours $_____

☐ e. Telecommute $_____

☐ f. Ramp Metering (Temporary Installation) $_____

☐ g. Ramp Metering (Modify Existing) $_____

☐ h. Others _____ $_____

6) Alternative Route Strategies

☐ a. Add Capacity to Freeway Connector $_____

☐ b. Street Improvement (widening, traffic signal, etc.) $_____

☐ c. Traffic Control Officers $_____

☐ d. Parking Restrictions $_____

☐ e. Others _____ $_____

7) Other Strategies

☐ a. Application of New Technology $_____

☐ b. Temporary Automated End of Queue Warning System $_____

☐ c. End of Queue Monitoring and Warning Using Pick-up Truck Mounted Changeable Message Sign (PTMCMS) $_____

☐ d. Others _____ $_____

TOTAL ESTIMATED COST OF TMP ELEMENTS = **$**_____

The following are examples from a Caltrans district for reference only.

Table B-1 Example Public Information Costs

Public Information	Cost
Hiring Consultant to do Public Relations	$100,000-$250,000
Mailer (printing)	$0.50-$1.00/1,000 Mailers
Mailer (cost to distribute)	$ 0.73/Mailer
Flyers (printing)	$0.10-$1.00/1,000
Flyer (cost to distribute by outside company)	$65/1,000
Billboards	$2,500/month
Press Release, Flyer, Bulletins (Develop, State Force)	$224
Newspaper Ad (black and white, one-quarter page)	$6,000/day
Newspaper Ad (Black and white, one-half page)	$12,000/day
Newspaper Ad (Black and white, full page)	$18,000/day
Newspaper Ad (Color, one-quarter page)	$8,000/day
Newspaper Ad (Color, one-half page)	$14,000/day
Newspaper Ad (Color, full page)	$22,000/day
Press Conference/Public Meeting (Depends on Location/Room Size)	$0-1,000/day
Open House	$3,000
Radio Ad (varies greatly)	$800/minute
Telephone Hotline (+$250 Hook-up)	$45/month
Television Commercial (Local Cable)	$4,000+

Public Information	Cost
Television Commercial (Broadcast Channel)	$20,000+
Kiosk Rental (Small)	$1,200/month
Kiosk Rental (Large)	$1,500/month

Table B-2 Example Motorist Information Costs

Motorist Information	Cost
Permanent Changeable Message Sign (CMS)	$ 450,000
Portable Changeable Message Sign (PCMS)	$10,000
Portable CMS (Rental)	$350/day, $1,500/week, $3,500/month
Portable Highway Advisory Radio	$60,000/unit
Highway Advisory Radio (Super)	$70,000/unit
Ground Mount Signs	$300 each

Table B-3 Example Incident Management Costs

Incident Management	Cost
Construction Zone Enhanced Enforcement Program (COZEEP) or Maintenance Zone Enhanced Enforcement Program (MAZEEP). (One officer for daytime and two officers for nighttime). Contact the COZEEP manager for the latest rate and refer to the COZEEP Interagency Agreement.	$2,200/nighttime $2,200/daytime
Freeway Service Patrol (including admin cost, contingency, and California Highway Patrol dispatch)	$119.07/hr (regular time) $116.45/hr (overtime)
Loop Detector	$300 each
Closed-Circuit Television	$20,000 to $200,000

Incident Management	Cost
Traffic Management Team (State Force)	$0
Transportation Management Center (State Force)	$0
Helicopter Surveillance	$600/hour
Mobile Command Center (State Furnished)	$0

Table B-4 Example Construction Strategies Costs

Construction Strategies	Cost
Temporary Barrier	$35-40/Linear Foot (LF)
Movable Concrete Barrier (Rental)	$30/LF
Movable Concrete Barrier – Transportation Machine (Rental)	$170,000/6 months
Gawk Screen (optional)	$3/LF
Temporary Signal	$30,000 each

Table B-5 Example Demand Management Costs

Demand Management	Cost
Park and Ride	$50/hour
Ramp Metering	$50,000/location

Table B-6 Example Alternative Route Costs

Alternative Routes	Cost
Traffic Control Officers	$50/hour

Appendix 125 C Extended Work Windows for Highway Work Activities

Topic 1 Introduction

Caltrans is committed to implementing extended work windows for work activities on the State Highway System (SHS). The extended work windows include:

- Closing lanes for longer periods of time.
- Closing lanes during any available off-peak period (including midday).
- Closing more than one lane at a time.
- Reducing the distance between each closure.
- Completely closing roads.
- Closing lanes for longer distances.

This appendix provides guidance on extended work windows.

Topic 2 Use of Extended Work Windows

Deputy Directive 60-R2 (DD-60-R2) on "Transportation Management Plans" states that staff involved in highway work activities are to consider alternatives that balance project duration against disruption to the public. When there is a potential mutual benefit to both Caltrans and the public, it is acceptable and may be necessary at times to allow for increased traffic delay when determining when lanes can be closed. It may not be possible to provide extended work windows in every situation, but extended work windows must be considered and implemented whenever possible for all work activities, including construction, maintenance, and encroachment permit work on the SHS. Using extended work windows is expected to reduce the number of days needed to complete work activities, which reduces worker exposure in work zones. In addition, by reducing the number of required closures to complete work activities, motorists may experience an overall reduction in traffic delays over the course of the project.

When extended work windows are expected to result in significant traffic delays, the District Lane Closure Review Committee (DLCRC) must review and approve those proposed work activities, as required in DD-60-R2. In case of activities that are interregional, statewide, impact the environment, or are potentially controversial, the DLCRC shall propose the TMP to the Headquarters Lane Closure Review Committee (HLCRC) for review and approval during project development. Closures with significant impacts to freight access and transit or are expected to result in traffic delays exceeding 90 minutes should be referred to the HLCRC for awareness, and if needed, concurrence. For planned closures with significant impacts, the district should seek input

and support from local partners, impacted communities, and the California Highway Patrol (CHP). The district should also communicate the potential impacts of planned closures with impacted entities and the public well in advance of the closures. Planned closures with significant impact may also require more involvement from the district executive management. The district should continue its effort to ensure adherence to Lane Closure Status reporting to provide accurate traveler information on all Caltrans public information platforms. Efforts should be made to ensure planned extended work windows have sufficient time for external engagement, internal analysis, and approvals.

Extended work windows must be considered during project development. If extended work windows are determined to be viable for a project, the necessary resources to incorporate extended work windows should be requested as early as possible for the appropriate project phase. Potential additional costs include supplementary public outreach, construction zone enhanced enforcement program (COZEEP), maintenance zone enhanced enforcement program (MAZEEP), and end-of-queue warning systems.

Requests for extended work windows by outside entities conducting work on the SHS under an encroachment permit must be considered, and districts should provide the analysis and approval process requirements for extended work windows as early as possible in the consultation and eventual application process.

Topic 3 Application

The maximum allowable lane closure periods and lengths of lane closures specified by the standard special provisions in contracts must be determined to ensure that the work can be completed with the least amount of lane closures. Extended work windows should result in both shorter project durations and reduced impact on the public.

Contractors can be more efficient and can increase productivity when lane closures allow for the use of full work-shifts for crews. The standard work shift is eight hours, so the allowable lane closure time specified should account for both the 8-hour work shift and the time to set up and remove the lane closure. For construction work within a lane closure that requires two separate operations to complete, the lane closure time must be increased to allow for both operations. For example, milling asphalt pavement and placing hot mix asphalt within the same work shift requires one crew to perform the milling operation and another crew to place the hot mix asphalt. Therefore, the milling crew starts one hour before the paving crew, and the paving crew ends one hour after the milling crew, so the optimum work period is 10 hours plus the time required to set up and remove the lane closure.

For consistency in establishing allowable hours for lane closures and the length of lane closures, the following information is provided for project design engineers to use when requesting project lane restriction charts. For specific construction activities not shown, consult with district construction to determine the most efficient lane closure period and allowable length of closure to complete the work.

Topic 4 Closure Time Period

The time allowed on the lane requirement charts must allow for the lane closure set up and removal time, in addition to the time that the contractor will be performing the work activity. To determine the time period to request for lane closures, first determine the time required for lane closure set up and removal based on the roadway conditions, including the number of lanes, entrance and exit ramps, and the length of closure. Determine the most efficient time to perform the work based on the work type. Add up the lane closure set up and removal time required and the efficient work time for each lane closure request.

The time required for lane closure set up is measured from placing the first cone in the lane to placing the last cone for a 1-mile closure, including the time required for placing arrow boards for multilane closures. The time required for lane closure removal is measured from picking up the lane closure in reverse order, starting with the last cone in the lane closure, to picking up the first cone in the lane at the start of the lane closure taper, including removal of arrow boards for multilane closures.

Use the time estimates shown in Table C-1 for setting up and removing lane closures for a 1-mile highway lane closure, including required cone tapers for lane drops.

Table C-1 Setting and Removal Time Estimates by Type

Lane Closure Type	Setting Time (Minutes)	Setting Time (Hours)	Removal Time (Minutes)	Removal Time (Hours)
Single Lane	20	0.33	25	0.42
Two Lanes	25	0.42	30	0.50
Three Lanes	30	0.50	35	0.58

Add the additional time shown for each lane closure component required for the closure, as shown in Table C-2.

Table C-2 Setting and Removal Time Estimates by Component

Lane Closure Component	Setting Time (Minutes)	Setting Time (Hours)	Removal Time (Minutes)	Removal Time (Hours)
Single Lane	10	0.17	10	0.17
Two Lanes	10	0.17	10	0.17
Three Lanes	7	0.12	7	0.12

For efficient use of work crews, 8 hours should normally be used. For lane closures, the following time periods should be considered based on the construction activity.

Table C-3 Time Periods by Construction Activity

Construction Activity	Removal Time (Hours)	Placement Time (Hours)	Cure Time (Hours)
Asphalt Concrete Milling and Paving	1	8	0
Concrete Slab Removal and Placement Ready Mix	2	8	3*
Concrete Slab Removal and Placement Rapid Strength Concrete	2	8	2
Seal Coats	0	8	2

Note*: In cold weather, the cure time could be four hours.

Topic 5 Closure Length

The maximum length of allowable lane closures also has a great effect on the efficiency of contractor work crews. Contractor efficiency is based on matching the rate of work or material production to the work zone area where work can be performed.

Topic 6 Closure Length for Lane Closure Requests

For two-lane conventional highways, lane closures above 2 miles should be avoided as they can lead to dangerous access conflicts due to the long waiting time for vehicles at intermediate roads and driveways, and because the traffic stream may begin to form discrete platoons. Lane closures above 2 miles should only be considered when there are low traffic volumes and few intermediate access locations, or intermediate access locations are controlled by flaggers.

When requesting or reviewing lane closures, the following lane closure lengths should be considered for contractor efficiency based on the type of construction activity shown:

Figure C-1 Length of Lane Closure Based on Type of Construction Activity

Length of Lane Closure Based on Type of Construction Activity

Construction Activity	Length of Closure	
	Two Lane Conventional Highway (Miles)	Freeway & Multilane Highways (Miles)
Hot Mix Asphalt Paving 0.15' Thickness 0.25' Thickness	 2 1.5	 4 3
Concrete Slab Removal and Replacement	2	2
Seal Coats	2	3
Stripe Removal	2	3
Placing Traffic Stripe	2	3

For two-lane conventional highways where reversible traffic control will be used, the length of lane closure may be specified by a maximum 20-minute delay or maximum length of closure, such as 1 mile, determined based on roadway traffic volume and the allowable 20-minute delay for public traffic. Some construction activities may require more than the maximum allowable delay allowed by DD-60-R2, such as rock slide removal and blasting. Comply with the requirements in DD-60-R2 for longer delays for construction activities when necessary for safety and operational efficiency.

Topic 7 Full Closures

Construction in work zones with high traffic volumes has typically been done at night. Work restricted to night hours may extend over several months or years because of the inability to maximize actual working hours due to the continual setup and breakdown of equipment and materials. In the same manner, work in some areas has been restricted to weekend hours, heavily impacting commercial and tourist activities during the weekend.

Full closures are required for specific construction activities, such as falsework assembly and removal. Other construction activities can benefit from the use of full closures because full closures will expedite the work and allow contractors to be more efficient. Bridge deck polyester overlays, approach slab replacements, and concrete pavement slab replacements are construction activities that require multiple operations and cure times, so longer work windows will expedite the work. Multiple overnight lane closures

can be eliminated by allowing full closures on weekends. For detailed information on full closures, refer to Appendix 125 A, "Full Closure of Highway Guidelines."

Full closures should be considered for projects that meet the following criteria:

- Nighttime or weekend closures lead to significant delays.
- Materials or methods require day work conditions.
- Longer work windows are required to complete certain activities.
- Overall delay over an extended construction period could have significant impacts on the traveling public, as well as on commercial interests in the project area.
- Significant reduction in working days is possible (e.g., 50-75%).

  Use of a full closure can help to reduce the total number of working days. If the reduction accounts for 75% or more, a full closure would provide economic and safety benefits as well as increased work quality.

To implement a full closure, projects must have all of the following:

- Viable alternate routes or capacity.
- Adequate lead time available to provide information to the public and gain support for the work.
- Support from external partners.

Topic 8 Buffer Lanes

A buffer lane is a closed lane that separates a lane carrying traffic from the work area to enhance the safety of workers and allow errant vehicles to recover safely. Where two or more lanes are adjacent to a work area, including work on shoulders, close the lane adjacent to the work area following the lane requirement charts. Buffer lanes must be used in projects that meet the following criteria:

1. Work is on the traveled way within 6 feet of the adjacent traffic lane.
2. Work is off the traveled way but within 6 feet of the adjacent traffic lane, and the posted speed is 45 mph or greater.
3. Work is off the traveled way but within 3 feet of the edge of the traveled way, and the posted speed is less than 45 mph.

On multilane facilities with 3 or more lanes in the direction of travel or for shoulder work with 2 or more lanes in the direction of travel, provide lane requirement charts that allow adjacent lanes to be closed so that a buffer lane is provided between the work and the lane open to traffic to enhance worker safety.

The lane closure period for the buffer lane adjacent to the work area should be, whenever possible, the same closure time for the lane or shoulder where work is being

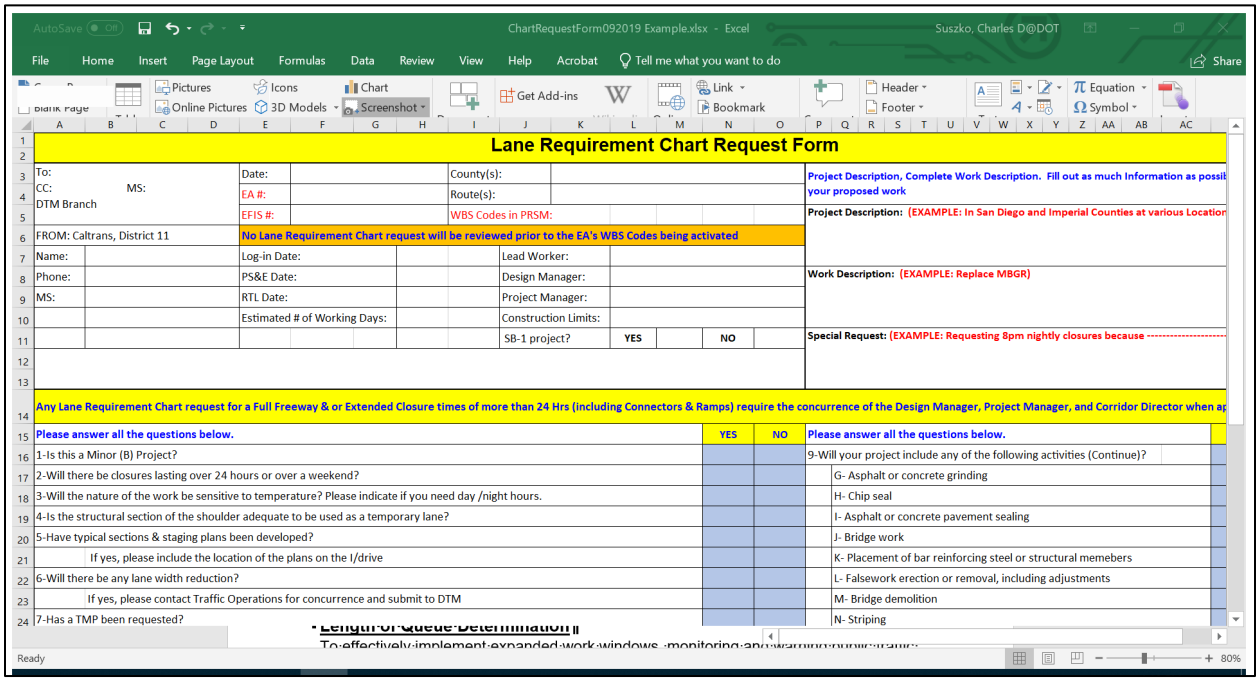
performed. With matching time periods for lane requirements for both lanes, or a shoulder and lane, the lane closure does not have to be reset to take the adjacent lane or be removed early to open a lane, thus reducing the exposure of the traffic control crew to a lane open to traffic. The requirement for a contractor to close the adjacent lane to provide a buffer lane is in Section 12-4.02C(3), "Closure Requirements and Charts," Subsection 12-4.02C(3)(a), "General," of the Standard Specifications.

Topic 9 Lane Closure Requests

Project engineers are responsible for providing traffic operations with lane closure requests that show the closure work window time and the length of closure requirements that allow contractors to complete the work efficiently. If necessary for the type of work activity, closure requests must also include the construction activities and locations that require full highway closures.

An example of a lane closure request form with project information and construction activity is shown in Figure C-4.

Figure C-2 Example Lane Requirement Chart Request Form



Lane Requirement Chart Request Form

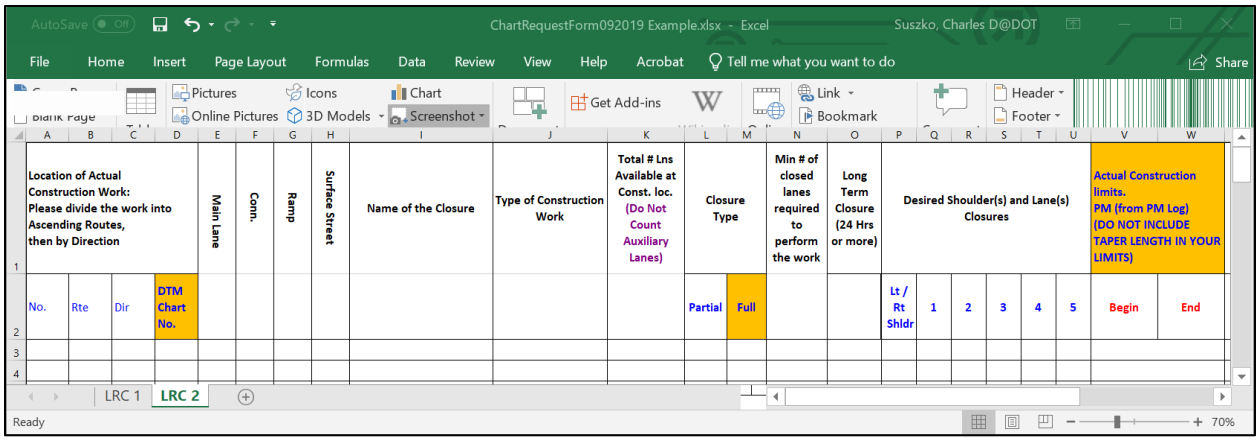
To:	Date:	County(s):	Project Description, Complete Work Description. Fill out as much Information as possib your proposed work
CC: MS: DTM Branch	EA #:	Route(s):	Project Description: (EXAMPLE: In San Diego and Imperial Counties at various Locatior
	EFIS #:	WBS Codes in PRSM:	
FROM: Caltrans, District 11	No Lane Requirement Chart request will be reviewed prior to the EA's WBS Codes being activated		Work Description: (EXAMPLE: Replace MBGR)
Name:	Log-in Date:	Lead Worker:	
Phone:	PS&E Date:	Design Manager:	Special Request: (EXAMPLE: Requesting 8pm nightly closures because ----------
MS:	RTL Date:	Project Manager:	
	Estimated # of Working Days:	Construction Limits:	
		SB-1 project? YES NO	

Any Lane Requirement Chart request for a Full Freeway & or Extended Closure times of more than 24 Hrs (including Connectors & Ramps) require the concurrence of the Design Manager, Project Manager, and Corridor Director when ap

Please answer all the questions below.	YES	NO	Please answer all the questions below.
1-Is this a Minor (B) Project?			9-Will your project include any of the following activities (Continue)?
2-Will there be closures lasting over 24 hours or over a weekend?			G- Asphalt or concrete grinding
3-Will the nature of the work be sensitive to temperature? Please indicate if you need day /night hours.			H- Chip seal
4-Is the structural section of the shoulder adequate to be used as a temporary lane?			I- Asphalt or concrete pavement sealing
5-Have typical sections & staging plans been developed?			J- Bridge work
If yes, please include the location of the plans on the I/drive			K- Placement of bar reinforcing steel or structural memebers
6-Will there be any lane width reduction?			L- Falsework erection or removal, including adjustments
If yes, please contact Traffic Operations for concurrence and submit to DTM			M- Bridge demolition
7-Has a TMP been requested?			N- Striping

Detailed information on lanes and shoulders to be closed is required:

Figure C-3 Example Lane and Shoulder Information



This information will be necessary for estimating the maximum queue length.

Topic 10 Length of Queue Determination

To effectively implement extended work windows, monitoring and warning the public about slowed or stopped traffic is essential. Advanced warning for public traffic must occur before the traffic reaches the end of a traffic queue. Advanced warning includes construction area signs, portable changeable message signs (PCMS), and advanced flaggers on conventional highways. To choose what type of monitoring and warning is required and to determine where to place PCMS boards to provide advanced warning, first determine the expected queue length based on the maximum allowable traffic delay of 20 minutes above the normal recurring delay to traffic.

Multilane Highway Queue Length Analysis

For multilane highways, the estimated length of queue needs to be determined so that appropriate end-of-queue monitoring and warning can be selected to be included in the project specifications, plans, and bid items.

For work zone traffic analysis, the concept of delay is defined as the average additional travel time that will be required to travel from one point to another as a result of construction activities. Existing delays resulting from current capacity, geometric deficiencies, and incidents are not included. To estimate delays, volume over the work zone capacity is used in combination with the jam density and the number of open lanes. This will generate a queue length in miles expected from the lane closure, as well as a time to clear the queue.

The free-flow threshold represents the traffic flow rate beyond which traffic can no longer operate under a free flow condition. The free-flow threshold is the point at which stable flow can no longer be sustained.

At traffic flow rates above the free-flow threshold, traffic begins to increase in density and decrease in speed and queueing begins to form upstream of the work zone. Traffic flow in this area becomes unstable as the influence of the work zone congestion begins to hinder traffic operations. This congested area will continue to expand if traffic volumes remain above the free-flow threshold. As queues continue to form, traffic operations will break down.

Work Zone With Traffic Control Vehicle Design Capacity

Several default values for work zone capacity have been developed through many years of work zone observations, experience, and engineering capacity studies. The work zone capacities are based on a standard lane width of 12 feet. Narrower lane width may result in reduced capacities. Other factors that could reduce capacity are steep grades, poor pavement conditions, and visually complex surrounding environments.

As noted within the Ohio Department of Transportation "Lane Closure Queue Analysis Tool," Work zone capacity data from Texas and California were previously examined in "Traffic Capacity Through Work Zones on Urban Freeways" by Dudek and Richards (1981) to show that the observed work zone capacity (or capacity rates) differ by the type of work and lane configuration. The lane configurations are described by [A, B], where A is the total number of lanes in one direction, and B is the number of lanes open in one direction during the lane closure. As shown in Figure C-6, the capacity tended to increase with the number of open lanes. Light work, such as median barrier or guardrail repair or installation had the highest observed capacity. Bridge repair work moderately lowered capacity, while paving operations had the highest effect on highway capacity.

Note: Districts have flexibility in the tools they use to analyze work zone capacity and are not limited to the Ohio Department of Transportation Lane Closure Queue Analysis Tool.

Figure C-4 Work Zone Observed Capacity

Work Zone Observed Capacity (VPH)					
Type of Work	Lane Configuration [A, B]				
	[3, 1] (VPH)	[2, 1] (VPH)	[5, 2] (VPH)	[3 or 4, 2] (VPH)	[4, 3] (VPH)
Median barrier/guardrail repair or installation		1500[2]		3200[2] 2940[1]	4800[2] 4570[1]
Pavement repair	1050[1]	1400[2]		3000[2] 2900[1]	4500[2]
Resurfacing, asphalt removal	1050[1]	1200[2] 1300[1]	2750[1]	2600[2] 2900[1]	4000[2]
Striping, slide removal		1200[2]		2600[2]	4000[2]
Pavement markers		1100[2]		2400[2]	3600[2]
Bridge repair	1350[1]	1350[1]		2200[2]	3400[2]
[1] Average capacities observed in Texas (Dudek and Richards, 1981) [2] Capacity rates observed in California (Kermode and Myra, 1970)					

Baseline work zone vehicle per hour capacities are for a highway with two or more lanes in one direction; at least one lane is closed, and the other lane is carrying the traffic with continuous flow. The work zone capacity is based on the assumption that there are no interruptions, such as signals, stop signs, or flaggers. Work zone capacities are in passenger car equivalents (PCEs) per hour, per lane for one or more lanes closed.

Figure C-5 Multilane Highways and Freeway Lane Closure Work Zone Capacity Values

Multilane Highways and Freeway Lane Closure Work Zone Capacity Values	
Roadway Type	**Work Zone Capacity**
Multilane Highways	1,400 PCE per Open Lane
Freeways	1,500 PCE per Open Lane
Special Conditions Multilane Highways and Freeways	1,200 PCE per Open Lane

The work zone capacity values for the free flow are based on decades of experience observing work zones and are provided as a starting point for analysis. Unique project circumstances and engineering judgment should always be taken into account when determining if the baseline work zone capacity value is appropriate.

The work zone capacity baseline should be adjusted for steep grades, poor pavement conditions, and visually complex surrounding environments. The work zone capacity baseline should also be adjusted when highways with 3 or more lanes are reduced to one lane, which requires truck traffic and passenger cars to use the same lane. Steep grades are more than 3% in urban areas and 5% for rural highways. Construction operations with intensive work cause significant rubbernecking when the construction activity is taking place next to live traffic, which affects work zone capacity. For these types of conditions, through many years of work zone observations and experience, the

work zone capacity of 1200 PCEs/hr/lane is recommended to be used in the queue length analysis.

Work zone capacity analysis should consider the use of alternative routes, which allow for vehicle diversion when available.

The percentage of truck traffic also affects work zone capacity and should be considered by converting the percentage of trucks into equivalent passenger cars when truck volumes are significant. Truck traffic volume percentage above 5% should be considered significant and equivalent passenger cars should be used for trucks. Based on the 2016 *Highway Capacity Manual,* the work zone capacity analysis factor adjustment for equivalent passenger cars per truck is based on the percentage of truck traffic and type of terrain, as shown in Figure C-8.

Figure C-6 Truck Traffic and Type of Terrain

Truck Percentage	Equivalent Passenger Cars per Truck Factor	
	Type of Terrain	
	Level	Rolling
≤ 5%	1.0	1.0
> 5%	2.0	3.0

Truck volumes can be found on the Traffic Census Program web page.