Chapter 1010

1010.01 General

Addressing work zone impacts to all road users is an important component in the design of a project and needs to be given adequate consideration early in the design process. Most work zones create some level of traffic impacts and require additional safety features; therefore, identify and address all work areas and operations needed for construction during the project design. Planners, designers, construction engineers, maintenance personnel, and others all play a role in developing a comprehensive work zone design. Consider including Rail, Freight, and Ports, Commercial Vehicle Services, Public Transportation, and Active Transportation Divisions for help coordinating with freight and transit industries and other road users.

This chapter provides the designer with guidance to develop comprehensive work zone strategies and plans to address a project’s safety and mobility benefits/improvements for all modes, as well as constructability. A systematic process for addressing work zone impacts is required by federal regulations and state policy.

1010.02 Work Zone Safety and Mobility

WSDOT policy per Executive Order E 1001, directs all WSDOT employees to make the safety of workers and the traveling public our highest priority during roadway design, construction, maintenance, and related activities. Designers should be familiar with this executive order as it is intended to support systematic consideration and management of work zone safety and mobility impacts across all stages of project development.

1010.03 Transportation Management Plans and Significant Projects

1010.03(1) Transportation Management Plan (TMP)

A transportation management plan is a set of strategies such as Transportation Systems Management and Operations (TSMO) strategies (such as dynamic lane merge, dynamic speed control, or Smart Work Zone Systems) for managing the corridor-wide work zone impacts of a project. A TMP is required for all projects and is the key element in addressing known work zone safety and mobility impacts. The TMP development begins in the scoping phase of a project by assessing impacts known at the time and then selecting mitigating strategies and design solutions to manage those impacts. It is very important to continue the development of the TMP throughout the project development process.

Not all work zone impacts have to be addressed with traffic control plans only. Many work zone impacts can be reduced or eliminated through project design elements like alignment choice, materials selection, structure types, overbuilding, and phased construction. Work zone impacts related to work duration may be resolved or reduced through innovative bidding and contract administration.
A TMP may recommend temporary modification to design elements outside the ranges discussed in the Design Manual.

For example, a work zone may temporarily reduce design speed and/or lane and shoulder widths. These temporary design elements are documented in the TMP and in the project’s work zone traffic control plans and contract provisions. They do not require a Design Analysis.

The three major components of a TMP are described below.

**1010.03(1)(a) Temporary Traffic Control**

Temporary Traffic Control (TTC) components are those strategies for directing traffic through the work zone and minimizing the duration of the impacts. These components are to be included in the Plans, Specifications, and Estimates (PS&E) as Traffic Control Plans (TCPs) and contract provisions. The TTC components may include but are not limited to the following strategies:

- TTC strategies such as lane closures or shifts, one-lane two-way operations (flagging and or pilot car), staged construction, or full road closures and detours.
- Traffic Control Devices such as temporary signing, channelizing devices (cones, drums), changeable message signs, arrow boards, temporary signals, and temporary pavement markings.
- Corridor Project Coordination, Contracting Strategies, and Innovative Construction Strategies such as A+B bidding, incentives/disincentives, and precast members or rapid cure materials.

**1010.03(1)(b) Transportation Systems Management and Operations (TSMO)**

The TSMO components are those strategies for improving traffic flow and safety through the work zone. Some of these strategies may be included in the PS&E, but could also be WSDOT-managed elements outside the contract. The TSMO components may include but are not limited to the following strategies:

- Transportation demand management strategies such as Transit service improvements, transit incentives, and park & ride promotion.
- Corridor/Network Management (traffic operations) Strategies such as Signal timing/coordination improvements, temporary signals, bus pullouts, reversible lanes, and truck/heavy-vehicle restrictions.
- Work Zone Safety Management Strategies such as using positive protective devices, speed limit reductions, automated flagger assistance devices, radar speed display signs.
- Traffic/Incident Management and Enforcement Strategies such as Traffic Management Centers (TMCs) and Intelligent Transportation Systems (ITS), Washington State Patrol, tow service, WSDOT Incident Response Team vehicle(s), traffic screens, and emergency pullouts in long work zones with narrowed shoulders.
- Smart Work Zone Systems and simpler version, Queue Warning Systems are dedicated specialized smart systems to provide more rapid information to drivers and to optimize the safety and efficiency of traffic through the work zone.

**1010.03(1)(c) Public Information**

The Public Information (PI) components are those strategies for raising awareness of the upcoming project impacts or current restrictions. Public awareness strategies may be developed and implemented by WSDOT through the region or Headquarters (HQ) Communications offices and implemented before and during construction.

For more information on TSMO, see [Home | TSMO | WSDOT (tsmowa.org)](http://tsmowa.org)
Motorist information strategies may be WSDOT-managed elements with state equipment outside the contract or identified on plans in the PS&E. The PI components may include, but are not limited to, the following strategies:

- Public Awareness Strategies such as Brochures or mailers, press releases, paid advertisements, and project website (consider providing information in other languages if appropriate).
- Motorist Information Strategies such as Highway advisory radio (HAR), changeable message signs, and transportation management center (TMC).

It is very important to continue the development of the TMP throughout the project development process. Not all work zone impacts have to be addressed with traffic control plans only. Many work zone impacts can be reduced or eliminated through project design elements like alignment choice, materials selection, structure types, overbuilding, and phased construction. Work zone impacts related to work duration may be resolved or reduced through innovative bidding and contract administration.

The TMP Checklist in Exhibit 1010-2 will help identify and organize TMP components. Include the completed checklist in the Project File. For significant projects, develop this checklist and the supporting plans, data, impacts assessment, strategies, capacity/delay analysis and endorsements into a formal TMP document to be included in the Project File. For TMP examples, see:

http://ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/sample TMPs.htm

### 1010.03(2) Projects TMP Requirements for Significant & Non-Significant Projects

Transportation Management Plan components for design-bid-build and design-build projects are as follows:

<table>
<thead>
<tr>
<th>Non-Significant Projects</th>
<th>Significant Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary Traffic Control Plans</td>
<td>Temporary Traffic Control Plans</td>
</tr>
<tr>
<td>Request for Proposal Section 2.22</td>
<td>Request for Proposal Section 2.22</td>
</tr>
<tr>
<td>TMP Document Not Required + Temporary Modification to Design Element Explanations</td>
<td>TMP Document Required</td>
</tr>
</tbody>
</table>

1. Temporary Traffic Control Strategies
2. Transportation Systems Management & Operation (TSMO) Strategies
3. Public Information Strategies
4. Agreements with Other Agencies & Stakeholders
5. Temporary Modification to Design Element Explanations
6. TMP Roles & Responsibilities, Contact Information

Significant projects, as defined in 23 CFR Part 630 J, are defined as:

1. A project that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on state policy and/or engineering judgement.
2. All Interstate system projects within the boundaries of a designated Transportation Management Area that occupy a location for more than three days with either intermittent or continuous lane closures shall be considered as significant projects unless FHWA grants an exception request based on the State’s ability to show the project does not cause sustained work zone impacts.
For Significant Projects: A TMP Document is required per federal law (23 CFR Part 630 J) in addition to the temporary traffic control plan and contract provisions. The TMP Document’s size and scale depends on the project’s complexity and extent of adverse road user impacts but should be expanded to include agreements with other agencies/stakeholders, WSDOT commitments, and project contact information as appropriate. The TMP Checklist in Exhibit 1010-2 will help identify and organize TMP components.

In addition, Significant Projects may require a Value Engineering (VE) study (see Chapter 310) and a Cost Risk Assessment (CRA) or Cost Estimate Validation Process (CEVP) that could help define strategies or identify risks: Cost risk assessment | WSDOT (wa.gov)

For additional TMP Document information, see:

- WSDOT TMP Document examples, under the Tools, templates & links tab.
- FHWA-provided TMP Document examples
- FHWA Developing and Implementing Transportation Management Plans for Work Zones

For Non-Significant projects, temporary traffic control plans and contract provisions included in the PS&E will be considered the TMP; however, consider TSMO and Public Information components to address the work zone impacts.

1010.04 Developing TMP Strategies

1010.04(1) Key Considerations

The following list is intended to alert the designer to design, construction, and operational considerations that need to be addressed as part of a TMP. Addressing these items is required per WSDOT’s work zone policy and federal regulations, and they are key to the successful development of a project’s TMP.

- Determine work zone impacts through an impact assessment process. Account for all needed work areas, operations and possible staging areas.
- Minimize, mitigate, and manage work zone impacts.
- Integrate project constructability, work efficiency, and cost containment into the work zone safety strategy.
- Integrate work zone impacts strategies early, during planning, programming, and design to help develop an accurate scoping estimate.
- Hold a Work Zone Design Strategy Conference early in the design process. (Include bridge, construction, traffic, maintenance, freight, transit, local agency, and law enforcement personnel.)
- Utilize the Work Zone TMP Checklist/TMP document (required for significant projects).
- Emphasize public and worker safety and assess work zone mobility through a capacity analysis.
- Address Washington State traffic and safety regulations as provided for by state law.
- Use the legally adopted Manual on Uniform Traffic Control Devices (MUTCD), with Washington State modifications as the minimum standard.
- Provide an appropriate level of traffic control plans (TCPs).
- Consider work zone ITS elements.
- Use established design criteria in work zone roadway and roadside design.
- Accommodate pedestrian access (including ADA requirements) and maintenance of existing transit stops and bicycle traffic.
- Consider maintenance issues and needs through the duration of the project.
- Consider school, hospital, emergency services, and postal delivery, impacts.
• Consider economic impacts (business access) due to traffic delay or restricted access.
• Consider freight mobility; total roadway widths to less than 16 feet should be avoided if possible. Truck routes can be found here: [https://geo.wa.gov/datasets/WSDOT::wsdot-freight-data-truck-freight-economic-corridors/about](https://geo.wa.gov/datasets/WSDOT::wsdot-freight-data-truck-freight-economic-corridors/about)
• Address traffic impacts extending beyond the project limits and impacting other roads.
• Identify seasonal or special event impacts that affect recreation or business due to work zone impacts.
• Consider risk management and tort liability exposure.
• Approach the work zone design from the road user’s perspective.
• Incorporate worker safety needs (positive protection) in your work zone designs.
• Address work vehicle ingress and egress to each work area.
• Use of law enforcement.
• Attend work zone training.

### 1010.04(2) Impacts Assessment

One of the most important tasks in developing a TMP is assessing the mobility impacts and safety performance. Careful consideration is needed when assessing the scope of the TMP. A designer needs to possess a clear understanding of how project features will be constructed, including work methods, equipment, materials, and duration, to complete the work. Involve the construction PE when making decisions on assessing and addressing impacts.

A complete and accurate impacts assessment will allow for the development of an effective TMP that should only need minor modifications to address construction considerations. The Traffic Manual provides information on how to determine expected work zone congestion along with mobility management strategies.

An early and ongoing impacts assessment allows time to:

• Develop TTC, TSMO, and PI (see Section 1010.03(1)) strategies to address identified impacts as needed to effectively manage the project.
• Resolve potential work zone impacts within the design features of the project. Decisions that consider work zone impacts during bridge type selection, materials selection, advertisement dates, and others have the potential to resolve or minimize work zone impacts.
• Consider innovative mitigation strategies that may involve many stakeholders.

Some impacts may be difficult to completely solve and may ultimately need a management decision to determine the level of mitigation or impact that is acceptable. These types of impacts need to be clearly addressed in the TMP with documentation supporting and explaining the decision.

The following are some examples of impacts that need to be managed during the design of a project:

1. Bridge construction sequence or falsework opening plans need to match the TTC staging or channelization plans. Coordination with the HQ Bridge and Structures Office is essential as the bridge design schedule may differ than the project schedule. Maintain the legal height of 16 feet 6 inches as the minimum falsework opening whenever possible; if this height cannot be maintained, then consider overheight vehicle impacts, possible additional signing needs, and temporary bypass routes. Reduction in shoulder widths due to barrier or bridge staging may affect active transportation access and mobility and are to be addressed in TTC plans. Refer to Chapter 720 for additional requirements and approvals. Coordination with the Permits Office may be needed.
2. If existing signal and illumination systems are not able to be maintained during the construction phases, plans for temporary systems or connections need to be included in the project.
3. Temporary relocation of existing signing (including overhead signing) may be required and should be detailed in the plans.

4. Permanent traffic loop installation (such as advance loops, turn pockets, and stop bars, and ITS loops) and pavement marking installations (crosswalks, arrows, and so on) may require specific TTC plans.

5. Maintenance of pavement markings. The type of temporary markings to be used based on work duration, pavement surface and reducing the potential for a “ghost stripe” on the final pavement surface need to be considered.

6. Lane shifts onto existing shoulders:
   - The depth of the existing shoulder pavement must be adequate to carry traffic and rumble stripes need to be removed.
   - Any existing catch basins or junction boxes located in the shoulder need to be addressed.
   - The existing clear zone needs to be reevaluated when the edge of traveled way is temporarily shifted.
   - Shifting of more than one lane in a direction is only allowed with temporary pavement markings. Shifting lanes by using channelizing devices is not allowed due to the high probability that devices used to separate the traffic will be displaced.
   - Signal head alignment may need to be adjusted when lanes are shifted approaching an intersection.

7. Roundabout construction at an existing intersection requires site-specific staging plans. Roundabouts require consideration of unique construction characteristics and each roundabout has very site-specific design features.

1010.04(3) Work Duration

The duration of work is a major factor in determining a strategy and the amount and types of devices to use in traffic control work zones. A project may have work operations with durations that meet several or all of the following conditions:

1010.04(3)(a) Long-Term Stationary Work Zone

This is work that occupies a location continuously for more than three days. Construction signs should be post-mounted and larger; more stable channelizing devices should be used for increased visibility. Temporary barriers, pavement markings, illumination, and other considerations may be required for long-term stationary work. Staged construction or temporary alignment/channelization plans are required with this type of work.

1010.04(3)(b) Intermediate-Term Stationary Work Zone

This is work that occupies a location for up to three days. Signs may still be post-mounted if in place continuously. Temporary pavement markings, in addition to channelization devices, may be required for lane shifts. Barrier and temporary illumination would normally not be used in this work zone duration.

1010.04(3)(c) Short-Term Stationary Work Zone

This is work that occupies a location for more than one hour within a single day. At these locations, all devices are placed and removed during the single period.

1010.04(3)(d) Short-Duration Work Zone

This is work that occupies a location for up to one hour. Because the work time is short, the impact to motorists is usually not significant. Simplified traffic control set-ups are allowed, to reduce worker exposure to traffic.
The time it may take to set up a full complement of signs and devices could approach or exceed the amount of time required to perform the work. Short-duration work zones usually apply to maintenance work and are not used on construction projects. (See Work Zone Traffic Control Guidelines for more information.)

1010.04(3)(e) Mobile Work Zone
This is work that moves intermittently or continuously. These operations often involve frequent stops for activities such as sweeping, paint striping, litter cleanup, pothole patching, or utility operations, and they are similar to short-duration work zones. Truck-mounted attenuators, warning signs, flashing vehicle lights, flags, and channelizing devices are used, and they move along with the work. When the operation moves along the road at low speeds without stopping, the advance warning devices are often attached to mobile units and move with the operation.

Pavement milling and paving activities are similar to mobile operations in that they can progress along a roadway several miles in a day. These operations, however, are not considered mobile work zones, and work zone traffic control consistent with construction operations is required.

1010.04(4) Transportation Management Plan Strategies
With a completed impacts assessment, strategy development can begin. There are often several strategies to address a work zone impact, and engineering judgment will be needed in selecting the best option. Constructability, along with addressing safety and mobility, is the goal. Selecting a strategy is often a compromise and involves many engineering and non-engineering factors. Work closely with bridge, construction, maintenance, and transportation operations office personnel when selecting and developing strategies for the Transportation Management Plan (TMP) and PS&E.

Do not assume that strategies chosen for past projects will adequately address the impacts for similar current projects. There may be similarities with the type of work, but each project is unique and is to be approached in that manner. Always look for other options or innovative approaches; many projects have unique features that can be turned to an advantage if carefully considered. Even a basic paving project on a rural two-lane highway may have opportunities for detours, shifting traffic, or other strategies.

The Traffic Manual contains comprehensive information regarding work zone traffic analysis to determine expected delay and queuing.

For a list of work zone analysis tools, see: http://ops.fhwa.dot.gov/wz/traffic_analysis/index.htm#tools

1010.04(5) Temporary Traffic Control Strategies

1010.04(5)(a) Lane Closure
When one or more traffic lanes are closed, a capacity analysis is necessary to determine the extent of congestion that may result. Night work or peak hour work restrictions may be required if the analysis shows adverse traffic impacts. On highways with speeds over 40 MPH, traffic safety drums and truck-mounted attenuators should be used in lane closures and the drums should not encroach on the open lanes. Additional lanes should be closed if encroachment is necessary. Consider closing additional lanes to increase the lateral buffer space for worker safety.
1010.04(5)(b) Shoulder Closure
A shoulder closure is used for work areas off the traveled way. On high-volume freeways or expressways, they should not be allowed during peak traffic hours. Channelization devices should not encroach on the open lanes of roadways with speeds of 45 mph and above.

1010.04(5)(c) Alternating One-Lane Two-Way Traffic
This strategy involves using one lane for both directions of traffic. Flaggers are used to alternate the traffic movements and pilot cars can increase capacity by guiding motorists through the work zone more effectively, especially for work zones exceeding 800 feet between flaggers.

If flaggers are used at an intersection, a flagger is required for each leg of the intersection. Only law enforcement personnel are allowed to flag from the center of an intersection. Close lanes and turn pockets so only one lane of traffic approaches a flagger station. When a signal is present, it shall be turned off or set to red flash mode when flagging.

Law enforcement personnel may be considered for some flagging operations and can be very effective where additional driver compliance is desired. The Traffic Manual contains information on the use of law enforcement personnel at work zones.

Do not include alternating traffic with flaggers as a traffic control strategy until all other reasonable means of traffic control have been considered. Flagging stations need to be illuminated at night. Flaggers need escape routes in case of errant vehicles. Provide a method of alerting them to vehicles approaching from behind. Two-way radios or cellular phones are required to allow flaggers to communicate with one another. The flagger’s location, escape route, protection, signing, and any other safety-related considerations all need to be incorporated into the traffic control plan for the flagging operation. Flaggers are not to be used on freeways or expressways. Using flaggers solely to instruct motorists to proceed slowly is an unacceptable practice.

Removing flaggers from the roadway during alternating traffic operations can be done with portable temporary traffic control signals or automated flagging assistance devices (AFAD).

Refer to WAC 296-155-305 for flagging requirements.

1010.04(5)(d) Temporary Alignment and Channelization
Temporary alignments and/or channelization may be an option for long-duration work zones or staged traffic control. The following are guiding principles for the design of temporary alignment and channelization plans:

- Use site-specific base data to develop site-specific traffic control plans.
- Use permanent geometric design criteria.
- Provide beginning and ending station ties and curve data.
- Include lane and shoulder widths.
- Provide temporary roadway sections.
- To avoid confusion, do not show unnecessary details on the plan.
- Do not use straight line tapers through curves; use circular alignment.
- Consider existing crown points, lane/shoulder cross slope breaks, and super-elevation transitions that may affect a driver’s ability to maintain control of a vehicle.
- If the project has multiple stages, from one stage to the next, show newly constructed features as existing elements.
Consider the time needed for removal of existing markings and placement of the new markings and possibly placement of barriers and attenuators. In urban areas where work hours for lane closures are limited, special consideration may be necessary to allow time to implement the plan, or an interim stage may be necessary.

- Use shoulder closure signing and channelizing devices to close a shoulder prior to a temporary impact attenuator and run of temporary concrete barrier.
- Existing signing may need to be covered or revised, and additional construction warning signs may be needed for the new alignment.
- Temporary pavement marking types and colors should be specified. Long-duration temporary markings should be installed per the Standard Plans for permanent markings.
- For better guidance through shifting or taper areas, consider solid lane lines. Return to broken lane lines between shift areas.
- Provide a list of the approved temporary impact attenuators that may be used for the plan if applicable.
- The plans are to provide all the layout information for all the temporary features just as a permanent pavement marking plan would.

**i Staged Construction**

Staged construction requires combining multiple work operations into a logical order to provide large protected work areas and separate traffic spaces for long durations, which maximizes work operations and minimizes daily impacts to traffic. Design temporary alignment and channelization plans to place traffic in these semi-permanent locations. Permanent geometric design criteria are to be used when developing these plans. Design strategies such as overbuilding for future stages or the use of temporary structures are often part of staged construction on significant impact projects. Develop detailed capacity analysis and traffic modeling for each stage.

**ii Lane Shift/Reduced Lane Width**

Traffic lanes may be shifted and/or width reduced in order to accommodate a long-duration work area when it is not practicable, for capacity reasons, to reduce the number of available lanes. Shifting lanes of traffic requires the removal of existing conflicting pavement markings and the installation of temporary markings. Use advanced warning signs to show the changed alignment and use of solid lane lines through the shift areas when L/2 shifts are used and consider solid lane lines for more gradual shifting tapers.

Utilizing the existing shoulder may be necessary to accommodate the shifting movement. First, determine the structural capacity of the shoulder to ensure its ability to carry the proposed traffic. Remove and inlay existing shoulder rumble strips prior to routing traffic onto the shoulder.

**iii Traffic Split or Island Work Zone**

This strategy separates lanes of traffic traveling in one direction around a work area. On higher-speed roadways, temporary barriers are provided to prevent vehicles from entering the work area. Some drivers have difficulty understanding the "lane split" configuration resulting in braking or unnecessary late lane changes. Braking and erratic lane changes decrease the traffic capacity through the work zone, which results in an unstable traffic flow approaching the lane split. This strategy should be avoided in urban areas due to frequency of exit ramps. Evaluate other strategies to keep traffic on one side of the work area to avoid a traffic split if possible.
Consider the following guidance for traffic split operations:

- **If used, limit the duration the traffic split can be in place.** Consider incentives and disincentives to encourage the contractor to be as efficient as possible. A higher level of traffic impacts may be acceptable if offset with fewer impacted days.

- **Advance warning signs advising drivers of the approaching roadway condition are required.** Consider the use of Portable Changeable Message Signs (PCMS), portable Highway Advisory Radio (HAR), and other dynamic devices. Overhead signing and in-lane pavement markings also may be necessary to give additional driver notice of the traffic split.

Consider how the operation will impact truck traffic. If the truck volumes are high, additional consideration may be prudent to control in which lane the trucks drive. If the operation controls the lane used by trucks, it eliminates much of the potential for truck/car conflicts and truck lane changes through the work zone. For questions concerning truck operations, contact the HQ Freight Systems Division.

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- **Consider how the operation will impact truck traffic.** If the truck volumes are high, additional consideration may be prudent to control in which lane the trucks drive. If the operation controls the lane used by trucks, it eliminates much of the potential for truck/car conflicts and truck lane changes through the work zone. For questions concerning truck operations, contact the HQ Freight Systems Division.

- To discourage lane changing, consider the use of solid lane line markings to delineate traffic approaching the split or island. Refer to the MUTCD for additional details.

- **Consider the use of STAY IN LANE (black on white) signs, or set up a "no pass" zone approaching the lane split and coordinate with the Washington State Patrol (WSP).**

- Supplement the existing roadway lighting with additional temporary lighting to improve the visibility of the island work area (see exhibit in Chapter 1040).

- Coordinate with the region Transportation Operations Office for signing and pavement marking details when designing island work zones.

- Work area ingress and egress should be through and adjacent lane closure.
iv Temporary Bypass

This strategy involves total closure of one or both directions of travel on the roadway. Traffic is routed to a temporary bypass usually constructed within the highway right of way. An example of this is the replacement of an existing bridge by building an adjacent temporary structure and shifting traffic onto the temporary structure. A temporary channelization plan will show pavement markings, barrier and attenuators, sign and device placement.

v Median Crossover

This strategy involves placing both directions of traffic on one side of a multilane divided highway. The number of lanes is usually reduced in both directions and one direction is routed across the median. The design for elements of temporary crossovers needs to follow the same guidance as permanent design for alignment, barriers, delineation, and illumination.

- The goal is to design crossovers for operating speeds not less than 10 mph below the posted speed limit unless site conditions require a lower design speed.
- Median paving may be required to create crossover locations (consider drainage for the added pavement).
- Use temporary barrier on freeways to separate the two directions of traffic and evaluate the need for a glare screen.
- Provide temporary illumination at the crossover locations (see Exhibit 1040-25 in Chapter 1040)
- Straight line crossover tapers work best for highways with narrow paved medians.
- Temporary pavement markings, removal of conflicting existing markings, and construction signs are also required.
- Channelizing devices should be used to supplement temporary markings at the crossover locations.
- Provide a clear roadside recovery area adjacent to the crossover and avoid placing crossover detours near structures.
- For traffic that is crossed over (going against the normal traffic flow direction) existing bridge rail ends, barriers, guardrails or other objects may require temporary barrier/impact attenuators for protection.

1010.04(5)(e) Total Closures and Detours

Total closures may be for the project duration or for a critical work operation because of major constructability considerations or safety performance. The main requirement for total closures is the availability of a detour route and if the route can accommodate the increased traffic volumes and truck turning movements. Local roads may have lower geometric criteria than state facilities. Placing additional and new types of traffic on a local road may influence safety performance, especially when drivers are accustomed to the geometrics associated with state highways. Pavement integrity and rehabilitation may need to be addressed when traffic is detoured to specific local roadways.

For the traveling public, closing the road for a short time might be less of an inconvenience than driving through a work zone for an extended period of time (see the Traffic Manual and RCW 47.48). Advance notification of the closure is required, and a signed detour route may be required.
Consider the following road closure elements:

- Communication with all stakeholders, including road users, adjoining property owners, local agencies, transit agencies, the freight industry, emergency services, schools, and others, is required when considering a total closure strategy. This helps determine the level of support for a closure and development of an acceptable closure. Include Rail, Freight, and Ports; Commercial Vehicle Services; and Public Transportation Divisions to help coordinate.
- Analyze a closure strategy and compare it to other strategies, such as staged work zones, to determine which is overall more beneficial. This information helps stakeholders understand the impacts if a closure is not selected.
- A closure decision (other than short-term, minor-impact closures) will require stakeholder acceptance and management approval once impacts and benefits have been analyzed.
- Closures that reopen to a new, completed roadway or other noticeable improvements are generally more accepted by the public.
- Route-to-route connections and other strategic access points may have to be maintained or a reasonable alternative provided.
- Material selection, production rates, and work operation efficiencies have a direct tie to the feasibility of the closure strategy. A strong emphasis has been placed on this area and several successful strategies have been implemented, such as weekend-long closures or extended-duration single-shift closures. These strategies use specific materials such as quick-curing concrete, accelerated work schedules, prefabricated structure components, on-site mix plants, and so on, and are based on actual production rates. The WSDOT Materials Laboratory and the HQ Construction Office are good resources for more information on constructability as a component of an effective work zone strategy.
- Interstate or interstate ramp closures (including interstate closures with interchange ramps as detours) lasting more than 7 days require FHWA 60-day advance notice. (See the Stewardship and Oversight Agreement for closure notification requirements.)
- Short-duration closures of ramps or intersecting streets during off-peak hours do not require extensive approval if advance notice is provided and reasonable alternate routes are available.
- Detailed, project-specific traffic control plans, traffic operation plans, and public information plans are required.
- Depending on the duration of the closure/detour and the anticipated amount and type of traffic that will use the route, consider upgrades to the route such as signal timing, intersection turning radius for large vehicle, structural pavement enhancements, or shoulder widening.
- An approved detour agreement with the appropriate local agency is required for detour routes using local roadways and are to be completed prior to project advertisement.

Document road closure decisions and agreements in the Project File.

Roadway closures, detours, and alternate routes must be analyzed by for disproportionate impacts to EJ and LEP communities. If an EJ or LEP community is identified along a proposed route and will be disproportionately impacted, appropriate mitigation must be coordinated between WSDOT Communications and the Contractor. When additional changes are made to the route, it should be evaluated to determine if the detour adds congestion, noise or creates safety issues for adjacent residences and businesses and/or adds considerably longer distance to access residences/businesses that may affect low income and minority population. WSDOT will work with local agencies and conduct public outreach as necessary, to ensure that the proposed route will not have a disproportionately high and adverse effect on EJ or LEP populations. A Communications Plan must include appropriate accommodations for identified populations and businesses.
1010.04(5)(f) Intermittent Closure

This involves stopping all traffic for a short time to allow the work to proceed. Traffic volumes will determine the allowed duration of the closures. Typically, the closure would be limited to a ten-minute maximum and would occur in the lowest traffic volume hours. Equipment crossing and material delivery are where this type of closure may work well. Traffic is reduced to a single lane on a multilane highway, and a flagger or law enforcement is used to stop traffic.

1010.04(5)(g) Rolling Slowdown

Rolling slowdowns are commonly practiced by the Washington State Patrol (WSP) and they are a legitimate form of traffic control for contractors or utility and highway maintenance crews for very specific short-duration closures (to move large equipment across the highway, to pull power lines across the roadway, to switch traffic onto a new alignment, and so on). They are not to be used for routine work that can be addressed by lane closures or other formal traffic control strategies. Traffic control vehicles, during off-peak hours, form a moving blockade, which reduces traffic speeds and creates a large gap (or clear area) in traffic, allowing very short-term work to be accomplished without completely stopping the traffic.

Consider other forms of traffic control as the primary choice before the rolling slowdown. A project-specific traffic control plan (TCP) are to be developed for this operation. The TCP or contract provisions should list the work operations in which a rolling slowdown is allowed. The gap required for the work and the location where the rolling slowdown begins needs to be addressed on the TCP. Use of the WSP is encouraged whenever possible. Refer to the Traffic Manual Chapter 5 for additional information on rolling slowdown operations. A typical traffic control plan is available at: Design - Work Zone Typical Traffic Control Plans | WSDOT (wa.gov)

1010.04(5)(h) Pedestrian and Bike Detour Route

When existing pedestrian access routes and bike routes are disrupted due to construction activities, address detour routes with a traffic control plan. Plans are to provide enough detail and be specific enough to address the conflicts, mobility, and accessibility. Also, consider the impacts to transit stops for pedestrians. See Chapter 1510 for pedestrian work zone design requirements.

1010.04(5)(i) Project Delivery Methods

To reduce construction times and minimize impacts to the traveling public, consider alternative delivery techniques to accomplish this. For more information, see: Project delivery methods | WSDOT (wa.gov)

1010.04(5)(j) Innovative Design/Construction Methods

- Overbuild beyond normal project needs to maintain additional traffic or facilitate staged construction.
- Replace bridges using new alignments so they can be built with minimal impacts.
- Bring adjacent lifts of hot mix asphalt (HMA) to match the latest lifts (lag up) and require a tapered wedge joint to eliminate drop-off and abrupt lane edges.
- Require permanent pavement markings at intervals during multi-season projects to limit the duration temporary markings are needed and to support pavement marking visibility during winter shut-down.
1010.04(6) Transportation Systems Management and Operations (TSMO) Strategies

The following are operational strategies to consider based on project specific needs:

1010.04(6)(a) Transportation Demand Management
- Provide transit service improvements and possible incentives to help reduce demand.
- For long-term freeway projects, consider ramp metering.
- Provide a shuttle service for pedestrians and bicyclists.
- Provide local road improvements (signals modifications, widening, and so on) to improve capacity for use as alternate routes.
- Provide traffic screens to reduce driver distraction.

1010.04(6)(b) Corridor/Network Management
- Provide a temporary express lane with no access through the project.
- Consider signal timing or coordination modifications.
- Provide emergency pullouts for disabled vehicles on projects with long stretches of narrow shoulders and no other access points.
- Use heavy-vehicle restrictions and provide alternate routes or lane use restrictions.

1010.04(6)(c) Work Zone Safety Management
- Provide temporary access road approaches for work zone access.
- Use positive protective devices (barrier) for long-term work zones to improve the environment for workers and road users.
- Install intrusion alarms or vehicle arresting devices.
- Use speed limit reductions when temporary conditions create a need for motorist slow-downs. Refer to the Traffic Manual for additional information, guidance, and approval requirements for speed limit reductions in work zones.
- Use advanced queue warning systems depending on the extent of expected work zone congestion on high-speed roadways. Refer to the Traffic Manual for additional information and guidance for Smart Work Zone Systems and other simpler truck-mounted PCMS versions.

1010.04(6)(d) Traffic/Incident Management and Enforcement
- Provide law enforcement patrols to reduce speeding and aggressive drivers.
- Provide incident response patrol during construction to reduce delays due to crashes in the work zone.
- Provide a dedicated tow service to clear incidents.

1010.04(6)(e) Smart Work Zone System (SWZS)
- Deploy roadway monitoring technology such as queue length detection, mobile surveillance, and over-dimension vehicle detection.
- Deploy dynamic traffic control technology such as temporary ramp metering, variable speed control, and dynamic lane merge.
- Deploy driver information systems such as portable changeable message signs (PCMS), travel time and congestion information, and integration with third-party trip planning applications.

See Section 1010.09(5) for more information on SWZS and potential integration with TMCs and broader ITS operations.
1010.04(7) Public Information Strategies

The following are strategies to consider based on project specific needs:

1010.04(7)(a) Public Awareness

One PI strategy is a public awareness campaign using the media, project websites, public meetings, e-mail updates, and mailed brochures. This gives regular road users advance notice of impacts they can expect and time to plan for alternate routes or other options to avoid project impacts. Involve the region or HQ Communications Office in developing and implementing these strategies. Coordinate transit travel information and restrictions with the Public Transportation Division. www.wsdot.wa.gov/Pub Tran/

Coordinate freight travel information and restrictions with the Rail, Freight, and Ports Division.
https://geo.wa.gov/datasets/WSDOT::wsdot-freight-data-truck-freight-economic-corridors/about

1010.04(7)(b) Driver Information

In addition to work zone signs, provide driver information using highway advisory radio (HAR) and changeable message signs (existing or portable). Include a Smart Work Zone System to provide drivers with real time information on queuing and delays. Involve the region TMC in the development and implementation of these strategies. Additional information on smart work zone systems can be found on the Work Zone Safety web page: https://wsdot.wa.gov/engineering-standards/design-topics/traffic-work-zone-traffic-control-wztc

The Freight Alert system should be used to communicate information with freight industry on work zones. Each region has the capability to send alerts with this system.
https://geo.wa.gov/datasets/WSDOT::wsdot-freight-data-truck-freight-economic-corridors/about

Work zone strategy development is a fluid process and may be ongoing as project information and design features are developed during the design process. There may be many factors involved with strategy development, and it is necessary to be well organized to make sure all the relative factors are identified and evaluated.

1010.04(7)(c) Pedestrian and Bicycle Information

Include pedestrian and bicycle access information and alternate routes in the public awareness plans. Pedestrian and bicyclist information signing, including alternate route maps specifically for these road users, could be considered.

1010.05 Work Zone Capacity Analysis

Work zone congestion and delay is a significant consideration for many highway projects. At high-volume locations with existing capacity problems, even shoulder closures will increase congestion.

All work zone traffic restrictions need to be analyzed to determine the level of impacts. Short-term lane closures may only require work hour restrictions to address delays; long-term temporary channelization, realignments, lane shifts, and more will require a detailed capacity analysis to determine the level of impact. See Chapter 5 in the Traffic Manual for additional information. Transportation System Management and Operation (e.g. Transportation Demand Management and public information strategies may be required to address delays). Traffic capacity mitigation measures are important since many projects cannot effectively design out all the work zone impacts. Include a Work Zone & Traffic Analysis in the TMP.

Work zone mobility impacts can have the following effects:
• **Crashes:** Most work zone crashes are congestion-related, usually in the form of rear-end crashes due to traffic queues. Traffic queues extending beyond the advance warning signs may increase potential for crashes.

• **Driver Frustration:** Drivers expect to travel to their destinations in a timely manner. If delays are excessive, driver frustration can lead to aggressive or inappropriate driving actions.

• **Constructability:** Constructing a project efficiently relies on the ability to pursue work operations while maintaining traffic flow. Delays in material delivery, work hour restrictions, and constant installation and removal of traffic control devices all detract from constructability.

• **Local Road Impacts:** Projects that reduce capacity can sometimes cause traffic to divert to local roadways, which may impact the surrounding local roadway system and community.

• **Public Credibility:** Unanticipated work zone congestion and delay can create poor credibility for WSDOT with drivers and the surrounding community without sufficient public outreach in advance.

• **Restricted Access:** Severe congestion can effectively gridlock a road system, preventing access to important route connections, businesses, schools, hospitals, and so on.

• **User Cost Impacts:** Traffic delays have an economic impact on road users and the surrounding community. Calculated user costs are part of a work zone capacity analysis and may be used to determine liquidated damages specifications.

While maintaining the optimum carrying capacity of an existing facility during construction may not be possible, but efforts should be made to maintain existing traffic mobility through and/or around the work zone. Maintaining mobility does not rule out innovative strategies such as roadway closures. Planned closures can accelerate work operations, reducing overall impacts to road users. These types of traffic control strategies are to include transportation demand management and public information plans to notify road users and mitigate and manage the impacts as much as possible.

A work zone capacity analysis helps determine whether a work zone strategy is feasible. Mitigation measures that provide the right combination of good public information, advance signing and notification, alternate routes, detours, and work hour restrictions, as well as innovations such as strategic closures, accelerated construction schedules, or parallel roadway system capacity improvements, can be very effective in managing mobility impacts.

Many projects will have several potential work zone strategies, while other projects may only have one obvious work zone strategy. It is possible that a significant mobility impact strategy may be the only option.

There is no policy on the acceptable level of work-zone-created congestion and delay allowed on a project. In conjunction with the region traffic engineers, the designer uses engineering judgement along with knowledge of the projects traffic conditions, alternate routes, and more to determine an acceptable level of congestion and delays. This level of impact anticipated by the work zone strategy are to be in concurrence with region management.

The traffic analysis process helps shape the TMP as the work zone strategies are evaluated and refined into traffic control plans and specifications. Maintain work zone traffic analysis documents in the Project File.

Current volume data in the project vicinity is required for accurate traffic analysis results. Seasonal adjustment factors may be needed depending on the data was collected and when the proposed traffic restrictions may be in place. Assess existing data as early as possible to determine whether additional data collection may be required. The region Transportation Operations Office and the HQ Transportation Data & GIS Office can assist with collecting traffic volume data. Coordination with local agencies may be needed to obtain data on affected local roads.
Refer to Chapter 5 in the Traffic Manual for comprehensive work zone mobility management, work zone capacity information, and work zone queue and delay estimation calculations. The following resources are also available to assist with the actual analysis and mitigation strategy development upon request:

- HQ Transportation Operations Office
- HQ Transportation Data & GIS Office
- Region Traffic Office
- Region Public Information Office

1010.06 Work Zone Design

Part 6 of the MUTCD mostly addresses short-duration temporary traffic control standards. Some long-duration work zones may require temporary alignments and channelization, including barrier and attenuator use, temporary illumination and signals, and temporary pedestrian and bicycle routes. Use Design Manual guidance for permanent features.

1010.06(1) Lane Widths

Maintain existing lane widths during work zone operations whenever practicable.

For projects that require lane shifts or lane width reductions due to work area limits and staging, consider the following before determining the work zone lane configurations to be implemented:

- Overall roadway width available
- Posted speed limit
- Traffic volumes through the project limits
- Number of lanes
- Existing lane and shoulder widths
- Crown points and shoulder slope breaks
- Treat lane lines and construction joints to provide a smooth flow
- Length and duration of lane width reduction (if in place)
- Roadway geometry (cross slope, vertical and horizontal curves)
- Vertical clearances
- Transit and freight vehicles, including over-sized vehicles

Work zone geometric transitions should be minimized or avoided if possible. When necessary, such transitions should be made as smoothly as the space available allows. Maintain approach lane width, if possible, throughout the connection. Design lane width reductions prior to any lane shifts within the transition area. Do not reduce curve radii and lane widths simultaneously.

When determining lane widths, the objective is to use lane geometrics that will be clear to the driver and keep the vehicle in the intended lane. In order to maintain the minimum lane widths, temporary widening may be needed.
1010.06(2) Buffer Space

Buffer spaces separate road users from the work space or other areas off limits to travel. Buffer spaces also might provide some recovery space for an errant vehicle.

- A lateral buffer provides space between the vehicles and adjacent work space, traffic control device, or a condition such as an abrupt lane edge or drop-off. As a minimum, a 2-foot lateral buffer space is recommended. Positive Protective Devices may be required if workers are within one lane width of traffic. When temporary barriers are used, place a temporary edge line 2-foot laterally from the barrier.
- When feasible, a longitudinal buffer space is used immediately downstream of a closed or shifted traffic lane or shoulder. This space provides a recovery area for errant vehicles as they approach the work space.

Devices used to separate the road user from the work space should not encroach into adjacent lanes. If encroachment is necessary, it is recommended to close the adjacent lane to maintain the lateral buffer space.

To achieve the minimum lateral buffer, there may be instances where pavement widening or a revision to a stage may be necessary. In the case of short-term lane closure operations, the adjacent lane may need to be closed or traffic may need to be temporarily shifted onto a shoulder to maintain a lateral buffer space. During the design of the traffic control plan, the lateral buffer needs to be identified on the plan so that additional width is available; use temporary roadway cross sections to show the space in relation to the traffic and work area.

1010.06(3) Work Zone Clear Zone

The contractor’s operations present opportunities for errant vehicles to impact the clear area adjacent to the traveled way. The work zone clear zone(s) (WZCZ) in a project are determined by the posted speeds of the roadways in the project using Exhibit 1010-2. The WZCZ applies only to roadside objects introduced by the contractor’s operations (vehicles, equipment, and materials). It is not intended to resolve existing objects in the Design Clear Zone or clear zone values established at the completion of the project.

During nonworking hours, vehicles, equipment, or materials shall not be within the WZCZ unless they are protected by permanent guardrail or temporary concrete barrier. The use of temporary concrete barrier shall be permitted only if the engineer approves the installation and location.

During actual hours of work, unless protected as described above, only equipment and materials absolutely necessary to construction shall be within the WZCZ, and only construction vehicles absolutely necessary to construction shall be allowed within the WZCZ or allowed to stop or park on the shoulder of the roadway.

Exhibit 1010-1 Minimum Work Zone Clear Zone Distance

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Distance From Traveled Way (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 mph or less</td>
<td>10</td>
</tr>
<tr>
<td>40 mph</td>
<td>15</td>
</tr>
<tr>
<td>45 to 50 mph</td>
<td>20</td>
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<tr>
<td>55 to 60</td>
<td>30</td>
</tr>
<tr>
<td>65 mph or greater</td>
<td>35</td>
</tr>
</tbody>
</table>
1010.06(4) Abrupt Lane Edges and Drop-offs

Minimize, mitigate, or eliminate abrupt lane edges and drop-offs whenever practicable. When unavoidable, traffic control plans should provide a protection method. Consider temporary barriers for long duration drop off protection and contract provisions limiting the duration of edges from daily paving operations consistent with Standard Specification section 1-07.23(1).

When a temporary concrete barrier is used to protect a drop-off, provide a lateral offset from the drop-off to the back side of the barrier with an offset distance equal-to or greater than the distance listed in DM Exhibit 1610-3. Provide an edge line on the traffic side of the temporary barrier at least 2-feet from the face of the barrier. Provide a barrier end treatment; such as an impact attenuator, or end terminal, when the barrier end is located inside the Design Clear Zone.

Open trenches within the traveled way or auxiliary lane shall have a steel-plate cover placed and anchored over them. A wedge of suitable material, if required, shall be placed for a smooth transition between the pavement and the steel plate. Warning signs shall be used to alert motorists of the presence of the steel plates.

Abrupt lane edges, and drop-offs and steel plates require additional warning and considerations for motorcyclists, bicyclists, and pedestrians, including pedestrians with disabilities.

Signing to warn the motorcycle rider, bicyclists and pedestrians, including pedestrians with disabilities of these conditions is required. (See RCW 47.36.200 and WAC 468-95-305.) See Design Manual Chapter 1510 for work zone pedestrian accommodation guidance.

See Standard Specifications section 1-07.23(1) for the contract requirements for drop off protection and address project specific protection if necessary.

1010.06(5) Vertical Clearance

In accordance with Chapter 720, the minimum vertical clearance over new highways is 16.5 feet. For locations where this minimum cannot be met, follow the reduced clearance criteria discussed in Chapter 720 and include it in the traffic control plans. Maintain legal height on temporary falsework for bridge construction projects. If legal height on temporary falsework cannot be provided, consider over-height vehicle impacts and possible additional signing needs and coordination with permit offices. Widening of existing structures can prove challenging when the existing height is at or less than legal height, so extra care is required in the consideration of over-height vehicles when temporary falsework is necessary. Coordination with the HQ Bridge and Structures Office is essential to ensure traffic needs have been accommodated. Vertical clearance requirements associated with local road networks may be different than what is shown in Chapter 720. Coordinate with the local agency.

1010.06(6) Reduced Speeds in Work Zones

Drivers tend to reduce their speed only if they perceive a need to do so. Reduced speed limits should only be used to address an altered geometry when not able to meet design standards for the existing speed, when the roadway will be narrowed with the minimum lateral clearance to barriers, when roadway conditions warrant a reduction like BST operations, and when there will be workers on foot within a lane width of high-volume traffic traveling at 45 mph and faster without positive protection devices in place.

Speed limit reductions are categorized as follows:

- Continuous Regulatory Speed Limit Reduction: A speed reduction in place 24 hours a day for the duration of the project, stage, or roadway condition.
• Variable Regulatory Speed Limit Reduction: A speed reduction in place only during active work hours (Class B construction signs may be used). This is the preferred option when positive protection devices are not used.
• Advisory Speed Reduction: In combination with a warning sign, an advisory speed plaque may be used to indicate a recommended safe speed through a work zone or work zone condition. Refer to the MUTCD for additional guidance.

Refer to the Traffic Manual for additional information, guidance and approval requirements for speed limit reductions in work zones. Include approval documents in the Project File.

1010.06(7) Accommodation for Pedestrians and Bicyclists

Many public highways and streets accommodate pedestrians and bicyclists, predominately in urban areas. During construction, access must be maintained through or around the work zones. When existing pedestrian routes are closed, design and construct the alternate routes to be detectable and to meet or exceed the existing level of accessibility.

When existing accessible routes are closed, temporary pedestrian facilities within the work zone are required to meet ADA accessibility criteria to the maximum extent feasible. Covered walkways are to be provided where there is a potential for falling objects.

In work areas where the speeds are low (25 mph), or the ADT is 2,000 or less, bicyclists can use the same route as motorized vehicles. For work zones on higher-speed facilities, bicyclists will need a minimum 4-foot shoulder or detour route to provide passage through or around a work zone.

It may be possible to make other provisions to transport pedestrians and bicyclists through a work zone or with a walking escort around the active work area. Roadway surfaces that are reasonably smooth provide for greater accessibility for those walking, biking and rolling. Conditions such as loose gravel, uneven surfaces, milled pavement, or asphalt tack coats restrict access and may increase the potential for falling or tripping. It is recognized that construction may create these temporary conditions and to the extent feasible should be avoided or signs should indicate the conditions.

Information can be gathered on considerations for bicyclists by contacting local bike clubs and local agencies. Coordination with local bike clubs increases the likelihood that their members are notified of work zone impacts, and it helps maintain good public relations. (See Chapter 1510 for more pedestrian and bicyclist design requirements and MUTCD Chapter 6D for pedestrian work zone design requirements.)

1010.06(8) Warning Signs for Motorcyclists

The roadway surface condition requires additional warning signs to alert the motorcyclist of work zone conditions. Per RCW 47.36.200 paragraph 2, “(2) If the construction, repair, or maintenance work includes or uses grooved pavement, abrupt lane edges, steel plates, or gravel or earth surfaces, the construction, repair, or maintenance zone must be posted with signs stating the condition, as required by current law, and in addition, must warn motorcyclists of the potential hazard only if the hazard or condition exists on a paved public highway, county road, street, bridge, or other thoroughfare commonly traveled. For the purposes of this subsection, the department shall adopt by rule a uniform sign or signs for this purpose, including at least the following language, "MOTORCYCLES USE EXTREME CAUTION."
1010.06(9) Oversized Vehicles

The region Maintenance offices and the HQ Commercial Vehicle Services Office issue permits to allow vehicles that exceed the legal width, height, or weight limits to use certain routes. If a proposed work zone will reduce roadway width or vertical clearance, or have weight restrictions, adequate warning signs and notification to the HQ Commercial Vehicle Services Office and the appropriate region Maintenance Office is required as a minimum. When the total width of a roadway is to be reduced to less than 16 feet for more than three days, communication with these offices and any other stakeholders is required; include documentation in the Project File. The contract documents shall include provisions requiring the contractor to provide a 30-calendar-day notice prior to placing the restriction.

In the permit notification, identify the type of restriction (height, weight, or width) and specify the maximum size that can be accommodated. On some projects, it may be necessary to designate a detour route for oversized vehicles. Oversized vehicles can sometimes be unexpected in work zones, even though warning and restriction or prohibition signs may be in place. Some oversized loads can overhang the temporary barrier or channelization devices and encroach on areas where workers are present. Assess the exposure of those within the work zone. Routes with high volumes of oversized loads or routes that are already strategic oversized load routes may not be able to rely only on warning or prohibition signs. Protective features or active early warning devices may be needed.

Consider bridge height restrictions, signage of conditions or other bridge strike mitigation measures in cases where an oversized load has the potential to cause significant damage to structures or expose workers to injury. The structure design, staging, and falsework openings may need to be reconsidered to accommodate oversized loads passing through these structures without striking them.

1010.07 Temporary Traffic Control Devices

FHWA regulations require that temporary traffic control devices be compliant with the 2016 edition of the Manual for Assessing Safety Hardware (MASH) crash test requirements. In some cases, either the 2009 MASH or the National Cooperative Highway Research Program (NCHRP) Report 350 compliant devices may be used. See Standard Specification 1-10.2(3) for more information.

1010.07(1) Channelizing Devices

Channelizing devices alert and guide road users through the work zone. They are used to channelize traffic away from the work space, pavement drop-offs, or opposing directions of traffic. Traffic Safety Drums are the preferred devices on freeways and expressways as they are highly visible and are less likely to be displaced by traffic wind. 36-inch and 28-inch cones are also used on WSDOT projects. They are a good choice for flagging operations. 42-inch Tall channelization devices are cone-type devices and should be used in place of tubular markers to separate opposing traffic.

Tubular markers are not a recommended device unless they are being used to separate traffic on low-volume low-speed roadways. Longitudinal channelizing devices are interconnected devices that provide channelization with no gaps. These devices look like a temporary barrier, but are not approved as a positive protective device. Barricades are a channelization device mostly used to supplement other channelization devices in traffic control operations involving road, ramp, or sidewalk closures.
1010.07(2) Construction Signs

Construction signs are used to regulate, warn or guide road users through a work zone. Class A construction signs are signs that remain in service throughout the construction or during a major phase of the work. They are mounted on posts, existing fixed structures, or substantial supports of a semi-permanent nature. Class A signs will be designated as such on the traffic control plan. Class B construction signs are those signs that are placed and removed daily or are used continuously in one location for durations extending up to 7 calendar days and are mounted on portable or temporary crashworthy mountings with a minimum mounting height of 1 foot. Temporary sign supports with 5- to 7-foot mounting heights may be useful when temporary signs are mounted behind channelizing device or in urban areas with roadside parking that may obstruct sign visibility. Construction signs need to be placed such that they do not obstruct active transportation facilities.

See Chapter 1020 and the Standard Plans for signing details. Sign messages, color, configuration, and usage are shown in the MUTCD and the Sign Fabrication Manual. Existing signs may need to be covered, removed, or modified during construction.

1010.07(3) Warning Lights

Warning lights are either flashing or steady burn and can be mounted on channelizing devices, barriers, and signs. Secure crashworthy mounting of warning lights is required.

- **Type A**: Low-intensity flashing warning light used on a sign or barricade to warn road users during nighttime hours that they are approaching a work zone.
- **Type B**: High-intensity flashing warning light used on a sign or barricade to warn road users during both daytime and nighttime hours.
- **Type C and Type D 360 degree**: Steady-burn warning lights designed to operate 24 hours a day to delineate the edge of the roadway.

1010.07(4) Arrow Board (Sequential Arrow Sign)

An arrow board is a sign with a matrix electronic display elements capable of either flashing or sequential displays. They are usually trailer mounted with solar power and batteries to energize the electronic displays. An arrow board with merge displays are required for lane closures on multilane roadways. When closing more than one lane, use an arrow board for each lane reduction. Place the arrow board at the beginning of the transition taper and out of the traveled way. The caution display (four corner lights) is only used for shoulder work. Arrow boards are not used on two-lane two-way roadways. These devices are not crashworthy and should be removed when not in use or placed behind barrier or guardrail.

1010.07(5) Portable Changeable Message Signs (PCMS)

PCMS have electronic displays that can be modified and programmed with specific messages and may be used to supplement other warning signs. These signs are usually trailer mounted with solar power and batteries to energize the electronic displays. A two-second display of two messages is the recommended method to provide time to motorists to read the sign’s message twice. These devices are not crashworthy and should be removed when not in use, or placed behind barrier or guardrail. PCMS are best used to provide notice of unexpected situations like the potential for traffic delays or queuing and to provide a notice of future closures or restrictions. They should not be used in place of required signs.
1010.07(6) Portable Temporary Traffic Control Signals

These versatile trailer-mounted portable signals are battery powered, with the ability to be connected to AC power. They can operate on fixed timing or be traffic actuated. They are typically used on two-lane two-way highways to alternate traffic in a single lane for extended durations. Portable signals work best when the length between signals are 1,500 feet maximum and no accesses lie between the temporary signals. Temporary stop bars, and lighting at the stop bars is required for signal use. For assistance on using these devices, contact the region Transportation Operations Office.

1010.07(7) Portable Highway Advisory Radio

Highway Advisory Radio (HAR) can be used to broadcast AM radio messages about work zone traffic and travel-related information. The system may be a permanently located transmitter or a portable trailer-mounted system that can be moved from location to location as necessary. Contact the region Transportation Operations Office for specific guidance and advice on the use of these systems.

1010.07(8) Automated Flagger Assistance Device

An Automated Flagger Assistance Device (AFAD) is a flagging machine that is operated remotely by a flagger located off the roadway and away from traffic. This device is recommended on 45 MPH routes to support flagger safety especially on highways with reduced sight distance or limited escape routes. A traffic control plan is required for use of the AFAD and a flagger is required to operate each device. If used, a Red/Yellow lens AFAD is required, see the MUTCD for additional guidance on temporary traffic control zone devices.

1010.07(9) Radar Speed Display Sign

RSDS are a work zone speed management device that display motorist’s speed in real time along with a regulatory speed limit sign or advisory speed sign mounted above the speed display.

RSDS work best when a single lane of traffic remains open but may be used when multiple lanes are open. When multiple lanes are open in heavy traffic volume conditions, it may be unclear which vehicle’s speed is actually displayed.

RSDS are not an automated speed enforcement speed, but a passive feedback system to drivers. Modest speed reductions of 3 to 6 mph have been recorded when used within an active work zone.

1010.08 Positive Protection Devices

Channelizing devices will not provide worker and road user protection in some work zones. Positive protection devices such as temporary barriers, impact attenuators, transportable attenuators, and protective vehicles shall be considered per federal law (23 CFR Part 630 K).

Unless Region Traffic Operations decides otherwise, situations when positive protection devices are required include:

- To separate opposing traffic traveling 45 mph and faster normally separated by a median or existing median barrier.
- Where existing traffic barriers or bridge railings are to be removed.
- For drop-off protection during widening or excavations (see Standard Specification 1-07.23(1)).
- When temporary slopes change clear zone requirements.
- For bridge falsework protection.
- When equipment or materials are to remain in the work zone clear zone.
• When newly constructed features in the clear zone will not have permanent protection until later in the project.
• Where temporary signs or light standards are not crashworthy.

To separate workers from motorized traffic when work zone offers no means of escape for the worker, such as tunnels, bridges, and retaining walls, or for long-duration worker exposure within one lane-width of high-volume traffic with speeds of 45 mph and faster.

**1010.08(1) Temporary Barriers**

Providing temporary barrier protection may become the key component of the work zone strategy. Barrier use usually requires long-term stationary work zones with pavement marking revisions, and will increase the traffic control costs of a project. The safety benefit versus the cost of using barrier requires careful consideration, and cost should not be the only or primary factor determining the use of barrier. (See Chapter 1610 for guidance on barriers.)

**1010.08(1)(a) Concrete Barriers**

Concrete barriers are the safety-shape barriers (Type F, Type 2) shown in the Standard Plans. Safety-shape barriers can be unanchored or anchored. See Chapter 1610 for more detailed information on these barriers and their deflection characteristics.

**1010.08(1)(b) Movable Barrier Systems**

Movable barriers are specially designed segmental barriers that can be moved laterally one lane width or more as a unit with specialized equipment. This allows strategies with frequent or daily relocation of a barrier. The ends of the barrier must be located out of the clear zone or fitted with an impact attenuator. Storage sites at both ends of the barrier will be needed for the barrier-moving machine. WSDOT owns this type of barrier and equipment and it may be available for project use. Pay items are included in the PS&E to deliver the barrier and equipment from and back to the WSDOT storage location and for operation and maintenance during the project.

**1010.08(1)(c) Portable Steel Barriers**

Portable steel barriers have a lightweight stackable design. They have options for gate-type openings and relocation without heavy equipment. Steel barriers can be unanchored or anchored per the manufacturer’s specifications. The lateral displacement of unanchored steel barriers from vehicle impacts typically ranges from 5 to 8 feet depending on manufacturer.

The lateral displacement of anchored steel barriers from vehicle impacts typically ranges from 1 to 3 feet depending on manufacturer and anchor pinning arrangement. Steel barriers are proprietary items. See manufacturer website for more information.

**1010.08(2) Impact Attenuators**

Within the Design Clear Zone, the approach ends of temporary barriers shall be fitted with impact attenuators. The information in Chapter 1620 provides all the necessary impact attenuator performance and selection information. In addition to the guidance in Chapter 1620, consider the characteristics of the work zone when selecting an attenuator. Selection should consider site specific conditions and the dynamic nature of work zones throughout the project.
Contract plans showing temporary impact attenuator placement need to include a list of the approved attenuators that a contractor may use for that installation. See the Attenuator Selection Template at: www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/Impact_attenuator_selection_template.xlsx

1010.08(3) Transportable Attenuators

A transportable attenuator (TA) is a positive protection device attached to the rear of a large truck or as a trailer that can be positioned to provide protection for a work area just in front of the device after a proper roll ahead distance is provided in case of an impact. A TA should be used for active work areas when speeds are 45 mph and greater and other positive protection devices are not in place.

1010.09 Other Traffic Control Devices or Features

1010.09(1) Delineation

Temporary pavement markings will be required when permanent pavement markings are obliterated due to construction operations or temporary reconfigurations needed for long-term work zone strategies. Temporary pavement markings can be made using paint, preformed tape, or raised pavement markers. Complex projects will most likely require both long- and short-duration temporary markings. All temporary pavement markings are to be retroreflective and match permanent pavement marking colors. All conflicting pavement markings are to be completely removed. Temporary pavement markings are installed in accordance with the Standard Plans and Standard Specifications.

Short-duration temporary pavement markings are made with materials intended to last only until permanent markings can be installed on paving and BST projects, or for short durations between construction stages. Short-duration broken line patterns typically consist of a 4-foot line with a 36-foot gap for paint and tape markings but may be increased to a 10-foot line with a 30-foot gap when specified in the Contract. Short-duration broken line patterns consist of a grouping of three raised pavement markings at 3-foot spacing with a 34-foot gap.

Flexible raised pavement markers are required for bituminous surface treatments but typically are not allowed on other pavement types. Temporary edge lines are installed only when specified in the plans. When specified, temporary edge lines are either solid lines or raised pavement markers at 5-foot spacing.

Long-duration temporary pavement markings layouts will match permanent pavement marking standards and should be used on projects spanning multiple seasons and/or wintering over. To enhance wet-weather visibility, long-duration temporary pavement markings should be supplemented with reflective Type 2 Raised Pavement Markers. Long-duration markings need to be detailed in the contract plans for installation and material type. Pre-formed tapes should be used on the final pavement surface to avoid leaving scars when removed.

Lateral clearance markers are used at the angle points of barriers where they encroach on or otherwise restrict the adjacent shoulder. Barrier delineation is necessary where the barrier is less than 4 feet from the edge of traveled way.

Guideposts may be considered to aid nighttime driving through temporary alignments or diversions. (See Chapter 1030 for delineation requirements.)

1010.09(2) Screening

Screening devices can be used to reduce motorists’ distraction due to construction activities adjacent to the traveled way. Consider screening when a highway operates near capacity during most of the day.
Screening should be positioned behind traffic barriers to prevent impacts by errant vehicles and should be anchored or braced to resist overturning when buffeted by wind. Commercially available screening or contractor-built screening can be used, provided the device meets crashworthy criteria if exposed to traffic and is approved by the Engineer prior to installation.

Glare screening may be required on concrete barriers separating two-way traffic to reduce headlight glare from oncoming traffic. Woven wire and vertical blade-type screens are commonly used in this installation. This screening also reduces the potential for motorist confusion at nighttime by shielding construction equipment and the headlights of other vehicles on adjacent roadways. Make sure that motorists’ sight distance is not impaired by these glare screens. Contact the HQ Design Office and refer to AASHTO’s Roadside Design Guide for additional information on screening.

1010.09(3) Illumination

Illumination might be justified if construction activities take place on the roadway at night for an extended period of time. Illumination might also be justified for long-term construction projects at the following locations:

- Road closures with detours or diversions.
- Median crossovers on freeways.
- Complex or temporary alignment or channelization.
- Haul road crossings (if operational at night).
- Temporary traffic signals.
- Temporary ramp connections.
- Projects with lane shifts and restricted geometrics.
- Projects with existing illumination that needs to be removed as part of the construction process.

Illumination is required when:

- Traffic flow is split around or near an obstruction.
- Flaggers are necessary for nighttime construction activities (supplemental lighting of the flagger stations by use of portable light plants or other approved methods). Refer to Standard Specification 1-10.3(1)A.

For information on light levels and other electrical design requirements, see Chapter 1040.

1010.09(4) Signals

A permanent signal system can be modified for a temporary configuration such as temporary pole locations during intersection construction, span wire systems, and adjustment of signal heads and alternative detection systems to accommodate a construction stage (see Chapter 1330).

1010.09(5) Smart Work Zone Systems (SWZS)

A Smart Work Zone System (SWZS) uses real time information to optimize the safety and efficiency of traffic through the work zone and should be considered on long term closures with recurring work zone queuing exceeding 3 miles.

SWZS can provide information such as queue detection for “slowed or stopped traffic ahead” messaging before motorists see brake lights, merging instructions (zipper merging where motorists are instructed to use all open lanes up to the merge point and take turns merging) to reduce the queue lengths, or travel time information so drivers can choose alternate routes. A SWZS may be limited to the highway approaching the work area or a more complex highway network system to manage regional impacts from the projects mobility impacts.
Portable equipment used in a SWZS may include portable changeable message signs, portable roadside traffic sensors and cameras that communicate wirelessly through a web-based central management platform. Predetermined messages will be displayed on the changeable message signs approaching a work area based on traffic data from the portable sensors also placed approaching the work area. A SWZS technician will install, program, and monitor the system.

A simplified version of a SWZS, A Queue Warning System (QWS) should be considered for daily, nightly, or weekend long closures for warning of non-recurring work zone queuing up to 3 miles.

As a minimum, A PCMS should be positioned in advance of a lane closure with messages about queuing when they are present and relocated as needed by a traffic control supervisor.

Refer to the Traffic Manual for additional information and guidance on work zone queuing mitigation.

1010.10 Traffic Control Plan Development and PS&E

WSDOT projects need to include plans and payment items for controlling traffic based on a strategy that is consistent with the project construction elements, even though there may be more than one workable strategy. A constructible and biddable method of temporary traffic control is the goal. The contractor has the option of adopting the contract plans or proposing an alternative method.

1010.10(1) Traffic Control Plans

“Typical” traffic control plans are generic in nature and are not intended to address all site conditions. They are intended for use at multiple work locations and roadways with little or no field modifications necessary. Typical plans may be all that are needed for basic paving projects. Some typical plans are located at: Design - Work Zone Typical Traffic Control Plans | WSDOT (wa.gov)

“Project-specific” traffic control plans are typical-type plans that have been modified to fit a specific project or roadway condition. Dimension lines for signs and device placement provide the distances based on the project highway speed limit, and spacing charts have been removed; the lane and roadway configuration may also be modified to match the project conditions.

“Site-specific” traffic control plans are drawn for a specific location. Scaled base data drawn plans will be the most accurate as device placement and layout considerations can be resolved by the designer. These types of plans should be used for temporary alignment and channelization for long-duration traffic control. Making a “project-specific” plan applicable for a site-specific location is another option if the device layout will match the site-specific location since the plan is usually not to scale.

The following plans, in addition to the TCP types above addressing the TTC strategies, may be included in the PS&E.

1010.10(1)(a) Construction Sign Plan

Show Class A Construction Signs that will remain in place for the duration of the project located by either station or milepost. Verify the locations to avoid conflicts with existing signing or other roadway features. These locations may still be subject to movement in the field to fit specific conditions. For simple projects these sign are often shown on the vicinity map sheet.

1010.10(1)(b) Construction Sign Specification Sheet

Provide a Class A Construction Sign Specifications sheet on complex or staged projects. Include location, post information, and notes for Standard Plans or other specific sign information and sign details.
1010.10(1)(c) Quantity Tabulation Sheets

Quantity Tabulation sheets are recommended for barrier and attenuator items and temporary pavement markings on projects with large quantities of these items or for staged construction projects.

1010.10(1)(d) Traffic Control Plan Index

An Index sheet is a useful tool for projects that contain a large quantity of traffic control plans and multiple work operations at various locations throughout the project. The Index sheet provides the contractor a quick referencing tool indicating the applicable traffic control plan for the specific work operation.

1010.10(1)(e) Construction Sequence Plans

Sequence plans are placed early in the plan set and are intended to show the proposed construction stages and the work required for each stage. They should refer to the corresponding TCPs for the traffic control details of each stage.

1010.10(1)(f) Temporary Signal Plan

The temporary signal plan will follow conventions used to develop permanent signals (as described in Chapter 1330), but will be designed to accommodate temporary needs and work operations in order to prevent conflicts with construction operations. If channelization has been temporarily revised then opposing left-turn clearances should be maintained as described in Chapter 1310, or signal timing should be adjusted to accommodate the revision. Some existing systems can be maintained using temporary span wires for signal heads and video, microwave actuation, or timed control.

1010.10(1)(g) Temporary Illumination Plan

Full lighting is normally provided through traffic control areas where power is available. The temporary illumination plan will follow conventions used to develop permanent illumination (as described in Chapter 1040), but will be designed to accommodate temporary needs and work operations so that there will be no conflicts with construction operations.

1010.10(2) Contract Specifications

Work hour restrictions for lane closure operations are to be specifically identified for each project where traffic impacts are expected and liquidated damages need to be applied to the contract. Refer to the Plans Preparation Manual for additional information on writing traffic control specifications.

1010.10(3) Cost Estimating

Temporary traffic control devices and traffic control labor can be difficult to estimate. There is no way of knowing how many operations a contractor may implement at the same time. The best method is to follow the working day estimate schedule and the TCPs that will be used for each operation. Temporary signs and devices will be used on many plans, but the estimated quantity reflects the most used at any one time. A lump sum item can be used to pay for temporary traffic control when an assessment of the cost risk associated with that approach indicates that the traffic control operation is sufficiently well defined. Criteria to use in the assessment include the number and complexity of planned intersection, interchange, mainline, transit, bicycle, pedestrian, and other high impact closures; rolling slowdowns; multiple work shifts; and roadway detours. A template for assessing risk is available at the design support webpage www.wsdot.wa.gov/design/support/.
1010.11 Training and Resources

Temporary traffic control-related training is an important component in an effective work zone safety and mobility program. Federal regulations require that those involved in the development, design, implementation, operation, inspection, and enforcement be trained at a level consistent with their responsibilities.

1010.11(1) Training Courses

The following work zone related courses are available through the Learning Center and the State Work Zone Engineer can assist with the availability and scheduling of classes:

- **Work Zone Design:** Taught by the HQ Transportation Operations Office, with a focus on work zone safety and mobility through transportation management plan and temporary traffic control PS&E development.

- **Traffic Control Supervisor Certification:** This is the same course that the standard specifications 1-10.2 require for Contractor’s personnel overseeing the implementation of the contract traffic control plans. Certain WSDOT employees with similar responsibility’s should attend this 3-Day course for TCS certification.

- **Traffic Control Supervisor (TCS) Recertification:** This 1-day course is for WSDOT employees those wanting to renew a current TCS certification.

- **Flagger Certification:** This 1-day course, taught by Region Safety Offices, is for employees who may have flagging duties or want to become a certified Traffic Control Supervisor. The safety offices can assist with class scheduling.

- Traffic analysis, traffic engineering, pedestrian facilities design and other courses may also be available and apply to work zone safety and mobility.

The American Traffic Safety Services Association (ATSSA) offers free or low-cost training through an FHWA work zone safety grant.

1010.11(2) Resources

It is the responsibility of the designer to address all anticipated work zone traffic control impacts because the level of safety and mobility will be directly affected by the effectiveness of the transportation management plan (TMP). The following resources are available to assist the designer with various aspects of the work zone design effort.

1010.11(2)(a) Region Work Zone Resources

Each region has individuals and offices with various resources that provide work zone guidance and direction beyond what may be available at the project Design Office level. They include:

- Region Transportation Operations Office
- Region Construction and Design Offices

1010.11(2)(b) Headquarters Work Zone Resources

The following Headquarters staff are available to answer questions and provide information:

- State Work Zone Engineer (email: HQworkzone@wsdot.wa.gov)
- WSDOT Work Zone web page
- TSMO Subcommittee on Work Zones
- State Assistant Traffic Design Engineer
1010.11(2)(c) FHWA Work Zone Resources
The FHWA Washington Division Office and Headquarters (HQ) Office may be able to provide some additional information through the WSDOT HQ Transportation Operations Office.
The FHWA also has a work zone web page: http://ops.fhwa.dot.gov/wz/

1010.12 Documentation
Refer to Chapter 300 for design documentation requirements.

1010.13 References

1010.13(1) Federal/State Laws and Codes
See Chapter 1510 for Americans with Disabilities Act policy and references.
“Final Rule on Work Zone Safety and Mobility,” Federal Highway Administration (FHWA), Published on September 9, 2004
http://ops.fhwa.dot.gov/wz/resources/final_rule.htm
Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC “Manual on uniform traffic control devices for streets and highways” (MUTCD)

1010.13(2) Design Guidance
A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO
Executive Order E 1001, Work Zone Safety and Mobility
wwwi.wsdot.wa.gov/publications/policies/fulltext/1001.pdf
Executive Order E 1060, Speed Limit Reductions in Work Zones
wwwi.wsdot.wa.gov/publications/policies/fulltext/1060.pdf
Executive Order E 1033, WSDOT Employee Safety
wwwi.wsdot.wa.gov/publications/policies/fulltext/1033.pdf
Plans Preparation Manual, M 22-31, WSDOT
Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-10, WSDOT
Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT
Traffic Manual, M 51-02, WSDOT
Work Zone Traffic Control Guidelines, M 54-44, WSDOT

1010.13(3) Supporting Information
Construction Manual, M 41-01, WSDOT
Environmental Manual, M 31-11, WSDOT
Highway Capacity Manual, 2010, TRB
Chapter 1010

*ITE Temporary Traffic Control Device Handbook*, 2001


*Manual for Assessing Safety Hardware*, AASHTO, 2009

Manual for Assessing Safety Hardware, AASHTO, 2016


Work Zone Safety Web Page, WSDOT [https://wsdot.wa.gov/engineering-standards/design-topics/traffic-work-zone-traffic-control-wztc](https://wsdot.wa.gov/engineering-standards/design-topics/traffic-work-zone-traffic-control-wztc)

WSDOT Project Management website: Project management guide | WSDOT (wa.gov)

**Exhibit 1010-2 Transportation Management Plan Components Checklist**

Use the following checklist to develop a formal TMP document on significant projects.

1. Introductory Material
   a. Cover page
   b. Licensed Engineer stamp page (if necessary)
   c. Table of contents
   d. List of figures
   e. List of tables
   f. List of abbreviations and symbols
   g. Terminology

2. Executive Summary

3. TMP Roles and Responsibilities
   a. TMP manager
   b. Stakeholders/review committee
   c. Approval contact(s)
   d. TMP implementation task leaders (public information liaison, incident management coordinator)
   e. TMP monitors
   f. Emergency contacts

4. Project Description
   a. Project background
   b. Project type
   c. Project area/corridor
   d. Project goals and constraints
   e. Proposed construction phasing/staging
   f. General schedule and timeline
   g. Adjacent projects
5. Existing and Future Conditions
   a. Data collection and modeling approach
   b. Existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural)
   c. Existing and historical traffic data (volumes, speed, capacity, volume-to-capacity ratio, percent trucks, queue length, peak traffic hours)
   d. Existing traffic operations (signal timing, traffic controls)
   e. Incident and crash data
   f. Local community and business concerns/issues
   g. Traffic growth rates (for future construction dates)
   h. Traffic predictions during construction (volume, delay, queue)

6. Work Zone Impacts Assessment Report
   a. Qualitative summary of anticipated work zone impacts
   b. Impacts assessment of alternative project design and management strategies (in conjunction with each other)
      i. Construction approach/phasing/staging strategies
      ii. Work zone impacts management strategies
   c. Traffic analysis results (if applicable)
      i. Traffic analysis strategies
      ii. Measures of effectiveness
      iii. Analysis tool selection methodology and justification
      iv. Analysis results
   d. Traffic (volume, capacity, delay, queue, noise, design vehicle)
   e. Safety
   f. Adequacy of detour routes
   g. Business/community impact
      i. Emergency services
      ii. Utility and delivery services (i.e. trash collection, postal, etc.)
   h. Seasonal impacts
   i. Cost-effectiveness/evaluation of alternatives
   j. Selected alternative
      i. Construction approach/phasing/staging strategy
      ii. Work zone impacts management strategies

7. Selected Work Zone Impacts Management Strategies
   a. Temporary Traffic Control (TTC) strategies
      i. Control strategies
      ii. Traffic control devices
      iii. Corridor Project coordination, contracting, and innovative construction strategies
   b. Public Information (PI)
      i. Public awareness strategies
      ii. Motorist information strategies
Chapter 1010 Work Zone Safety and Mobility

- c. Transportation Systems Management and Operations (TSMO)
  - I. Demand management strategies
  - II. Corridor/network management strategies
  - III. Work zone safety management strategies
  - IV. Traffic/incident management and enforcement strategies

8. TMP Monitoring
   - a. Monitoring requirements
   - b. Evaluation report of successes and failures of TMP

9. Contingency Plans
   - a. Trigger points
   - b. Decision tree
   - c. Contractor's contingency plan
   - d. Standby equipment or personnel

10. TMP Implementation Costs
    - a. Itemized costs
    - b. Cost responsibilities/sharing opportunities
    - c. Funding source(s)

11. Special Considerations (as needed)
12. Attachments (as needed)