Chapter 3: Traffic Control Measures

3.1 Key Topics Covered in This Chapter

- The concept of a Traffic Control Measure (TCM).
- An Array of Design Considerations used to develop TCP for all road users.
- The variety of TCP Design Standards, Practices and Policies.
- Specifications directly related to TCP Design.

3.2 General Principles

A Traffic Control Measure (TCM) is best described as a work zone traffic control strategy within a particular staged construction activity using one or more temporary traffic control devices to optimize work site safety and the movement of all public traffic through our around the work zone.

The type and number of TCM selected and implemented in a work zone are often proportional to the scope and complexity of the work. TCM will range from one or more simple devices, to extremely complex systems of devices, technologies and human resources depending on a number of factors related to a given work zone. For example, TCM used for short-duration utility operations may use only a few temporary signs. A larger, year-long construction project, however, might incorporate multiple traffic control measures including flaggers, barrier systems, and numerous other temporary traffic control devices.

Examples of commonly used TCM include:

- PCMS – For road condition information
- Flagging for 2-way, 1-lane work areas
- Temporary Portable Traffic Signals
- Sidewalk Closure with Pedestrian Detour
- “BCD” separating bikes from work areas
- Lane Closures – For needed work space
- Temporary Median Crossovers
- Advance Flaggers for Extended Queues
- Temporary Concrete or Steel Barrier
- Smart Work Zone Systems (see “*SWZS*”)
- Limited Duration Full Road Closure with Detour
- On-Site Diversions
- Rolling Slowdown Method

3.3 Design Considerations

The unique nature of each work zone presents Designers with a broad range of design challenges. This chapter focuses on common considerations the designer should explore in putting together a TCP and the traffic control measures best suited for their project.

Designers should gain a thorough understanding of each project. As project development begins, Designers should carefully investigate each facet of the project – looking for details, conditions, restrictions, opportunities and other factors that must be addressed to optimize the design of the TCP and overall safety for the project.

Guiding Principle and "Work Zone Decision Tree" Form

To aid in evaluating and documenting the variety of traffic control measures and staging alternatives, Designers should use the ***Work Zone Decision Tree*** form. See APPENDIX F and the ODOT Work Zone Traffic Control Unit website for a link to a fillable PDF of the DECISION TREE form. See **Chapter 1** for additional details regarding the ***ODOT Guiding Principle*** and the ***Work Zone Decision Tree***.

From the earliest stages of project development (e.g. Scoping), Designers should begin documenting their decision-making processes while evaluating applicable traffic control measures and devices best suited for the project.

The ***Work Zone Decision Tree*** form is a tool Designers can use to help them document the many evaluations and decisions made over the course of the TCP design, as well as, provide a critical component within the ***Transportation Management Plan (TMP)*** during project construction and implementation of the TCP.

As the project design evolves – changes in scope, new site restrictions, modified staging strategies, stakeholder feedback, budgetary shortfalls, constructability issues, etc. may require the designer to update the TMP with the new information. In these cases, the designer should revisit the ***Work Zone Decision Tree*** and look for any necessary changes to the preferred TCM or TCP enhancements. Both the TMP and the ***Work Zone Decision Tree*** should to be updated at key milestones during project development to capture new information; and, to reassess and ensure the selected traffic control measures and devices are providing optimal protection for public road users and highway workers.

Designers should complete the form with sufficient detail so as to provide a clear record of what TCM and TCD were evaluated, which were advanced, which were discarded, including the reasons for each; and, the final decision(s) made that have resulted in the design of the TCP.

Design Considerations

A designer must explore and address the wide variety of considerations that will result in the development of a safe, effective, efficient and buildable traffic control plan. Many of the following considerations can impact the format and content of the TCP, but also affect construction staging, constructability, project duration and overall cost:

- Scope of Work.
- Project complexity.
- Staging sequence and durations.
- Facility Type, geometry, cross section.
- Existing road side features, facilities.
- Existing traffic speeds and operations.
- Traffic characteristics and behaviors.
- Location, topography, climate features.
- Positive protection options or opportunities to mitigate worker exposure to traffic.
- Construction Schedule and constraints.
- Environmental constraints.
- Alternative/Accelerated contracting options.
- Interagency/Stakeholder impacts.

3.3.1 Sites Investigation

One of the first tasks for a designer should be to visit the project site and examine the surroundings, conditions, traffic operations, adjacent facilities and overall character of the site.

During site visits, the designer should consider collecting the following:

- Pictures and video throughout the project limits.
- Posted speed(s) and physical limits for each speed zone.
- Available right-of-way widths.
- Geometry/alignments, Sight distances, Lane count and configurations.
- Facility type: Urban/rural, freeway/non-freeway, arterial, freight route.
- Roadside inventory: Existing signs, utilities, landscaping, transit stops and other roadside features that may affect construction staging.
- Existing pedestrian/ADA and bicycle facilities.

If existing pedestrian and bicycle traffic features (e.g. sidewalks, bicycle lanes) are not present, document how these road users are travelling along the roadway – along a paved shoulder, along an unpaved pathway adjacent to the road, a local off-system route, etc.

- Historic structures, designated preservation/archeological sites.
- Notes on traffic movement, driver/bicycle/pedestrian behaviors, and other general operational observations.
- Inventory of local businesses, accesses, and any significant traffic generators and destinations for pedestrians and motor vehicles.

- Waterways or other environmentally sensitive features.

Collecting recent traffic counts for the main roadway and connecting highways, is also very helpful. Knowing traffic volume percentages for each vehicle classification – particularly heavy trucks – is beneficial in selecting appropriate measures and locating them properly within the project site.

Other design resources include the ***ODOT Video Log***, ***Google Maps***, ***Google Earth***, and aerial photography. However, as these resources may not be current, their accuracy, reliability and value should be limited to conceptual design purposes. Construction plans and any, "digital terrain models" (DTMs) for any recently-completed projects on, overlapping, or adjacent to your current project may provide more current "existing" features.

Since design takes place long after the project has been scoped and site conditions are prone to changes over time, designers should visit work zones sites during planning and construction. This is especially important to capture current conditions on the ground.

Driver Expectancy

Considerations should also be made for the concept of, "*Driver Expectancy*" in the design of the TCP. Different facility types yield different types of drivers and behaviors. Drivers will *expect* certain levels of operation, performance, visual recognition, and advance warning for different types of roadways.

Freeway drivers expect faster speeds, wider lanes, longer sight distances, and more advance signing. Urban arterial drivers might expect narrower lanes, lower speeds, bus stops, pedestrian and bicycle traffic, on-street parking and multiple accesses.

On commuter routes, drivers can frequently exhibit, "inattention blindness" – looking at the road ahead, but not really 'seeing' the details due to subconscious focus on other issues (work, family, schedules, etc.) – and driving the route on "auto-pilot". This condition may warrant additional efforts by the designer to get drivers' attention as they enter and drive through the work area.

Work zones on each facility type will warrant different traffic control measures and devices. For example:

- Temporary concrete barrier is used more frequently on freeways, and is used to separate traffic from workers and/or roadside hazards, or between opposing traffic flows.
- Freeways will not use flagging operations to stop or control the flow of traffic.
- Two-lane, two-way highways are more likely to use cones, tubular markers or plastic drums to separate traffic from the work space.
- Flaggers and/or Pilot cars are commonly used in one-lane, two-way work zones to safely control vehicle movement.

The overriding premise is that the work zone is temporarily changing the roadway environment, and mitigations and strategies must be employed to alert ***all*** drivers of these changes. It is the duty of the designer to develop a traffic control plan that changes driver behavior, provides adequate advance warning and guidance; and, conforms to normal driver expectations while they are travelling through the work zone.

Project Location and Sites Topography

The physical features of a roadway facility play an important part in the development of a traffic control plan. From selecting staging strategies to the type of devices or pavement markings used, the location and terrain of your facility can be highly influential.

Be aware of the variety of environments across the state that will affect the design of the TCP. Desert climates with higher temperatures and remote locations can affect the performance of certain TCD and make the expedient delivery of additional or replacement devices difficult. Marine (coastal) environments, with their tendency toward inclement weather (fog, rain), can present unique challenges in selecting and placing traffic control devices. Mountainous regions can generate problems for larger, heavier vehicles and may require additional mitigation strategies within the TCP. Populated urban centers and environmental features such as rivers, lakes, rock formations, wildlife habitats, historical monuments and archeological/preservation sites can create their own unique construction or staging complexities.

Designers should work with staff within their agency to learn about site-specific factors or features that may influence the TCM included in the design of the TCP.

Access Management

Designers should look for potential impacts to private or public accesses within the project limits that may occur at any time during the project. Consider what traffic control measures may be necessary to limit or mitigate those impacts.

Within the ***ODOT/APWA Standard Specifications for Construction*** (see ***Section 00220***), some access types can be closed for short durations. From the results of traffic analysis (e.g. ***ODOT's Work Zone Traffic Analysis***) and in working with Project Development Teams and affected stakeholders, some accesses may be closed for longer durations (See ODOT Boilerplate Special Provision for ***Section 00220.40***). Nevertheless, the designer must include mitigations for these impacts within the TCP. By using language in the project Special Provisions and through the inclusion of detailed plan sheets, a designer can provide specific instructions to the Contractor for addressing these access closures or modifications.

3.3.2 Project Scope

In tandem with understanding the details of the project site, the designer must clearly understand all facets of the project – what work is being done, anticipated duration for the project, when the project is expected to begin/finish, and most beneficially – a construction schedule.

Knowing what work is being done and how the project is to be built will help the designer develop a traffic control plan that will optimize safety, mobility and constructability.

Take into account all of the work activities being done for your project. Pay particular attention to aspects of the work that involve complex construction or use highly specialized materials or equipment. Work with the resident engineer to learn what you can about any challenging portions of the project.

Designers should also be looking for opportunities to provide positive protection to separate workers from traffic – or for staging options that might enhance the ability to provide positive protection. The more details you know about your project, the more potential strategies you can develop, and the more applicable and effective your traffic control measures will be. Again, use the ***Work Zone Decision Tree*** to document TCM evaluations and design decisions – including positive protection opportunities and other TCM used to optimize public traffic and worker safety.

In reviewing the Scope of Work, the designer should gather answers to a number of scope-related questions to maximize the design and strengthen the integrity of the TCP. Below, are some example lists of questions for a given scope of work.

Bridge Repair or Bridge Replacement

- Building a new bridge, or repairing an existing bridge?
    - If new, is the bridge being built in a different location, or same location?
    - Are there plans for demolition and removal of the existing bridge?
- How is the existing bridge configured?
    - Would the structural configuration allow the bridge to be partitioned to allow for staging traffic on a portion of the bridge?
- Are there in-water work limitations?
- Can traffic capacity on the bridge be reduced during construction?
- Can the road be closed (long or short-term), and traffic detoured?
    - Are practical alternate routes available as detours?
- Is the construction schedule being accelerated? If not, can it be?
    - Is the project critical enough to warrant incentives for early completion?
- Are there geometric, topographical or other environmental constraints?

Similar to bridge projects, answers to several questions should be collected for projects involving pavement reconstruction or preservation, as well as "Modernization" projects that construct or rebuild larger highway segments or facilities:

Pavement Preservation

- What is the roadway type – freeway, high-speed, urban, mountainous, etc.?
- What is the extent of the work – overlay, grinding, and full-depth reconstruction?
- What type of material is being used to repair/replace the existing pavement?
- Can multiple lanes be closed to accelerate the work?
- Can the road be closed completely (long or short-term)?
- How extensive is the access control within the project limits?
- Should the project be accelerated?

New Road Construction or Modernization

- Are geometric changes being made to the alignment?
- Is capacity being added to the new facility – widening, etc.?
- Is the control of traffic being changed - adding, removing a traffic signal(s)?
- Are local public services (transit, mail, schools, police/fire) being affected?

Level of Complexity

The complexity of a TCP is often proportionate to the scope of work. The complexity of the TCP, however, may be applied to the entire project, or to an isolated aspect of the project that would benefit from a higher level of detail. Ultimately, a TCP should include sufficient detail and information allowing field staff or a Contractor to adequately protect pubic traffic and workers; and, complete the scope of work in a reasonable time at a reasonable expense.

A "*simple*" project may benefit from added complexity within the staging plan and TCP. For example, adding one or more plan sheets may clarify a unique construction feature or process that would otherwise be difficult to convey through Special Provision language or a Standard Drawing. The added time to generate plan sheets during project development, may result in decreased time and costs during construction of the project.

3.3.3 Project Duration

Many traffic control measures depend on the duration of the project – translating as the duration traffic may be exposed to a potential hazard. Managing this risk, as well as the construction schedule – in whole or in part – has a key role in the final content and configuration of the TCP.

Work zone hazards present for short durations (3 days or less), are often mitigated using measures that may differ from those used to address more complex conditions that are in place for much longer. For example, using portable signing and an increased spacing of channelizing devices for the purpose of minimizing worker direct exposure to live traffic might be used for operations of one day or less. Longer, stationary projects may include post-mounted signs, PCMS, temporary traffic signals, concrete barrier and other features to establish the presence of a work zone that could be in place for days, weeks or years.

Project Duration, with a broad array of additional factors, must be considered in selecting the appropriate traffic control measures for long-term construction projects, or short-duration work activities, including:

- Facility type and Location (urban, rural).
- Traffic volumes.
- Posted speeds, running speeds.
- Crash history, Known safety issues (e.g. ODOT "SPIS" site information).
- Worker exposure to live traffic, Positive protection options.
- Availability and practicality of a full road closure with a detour.

These factors in mind, the anticipated duration of a project can affect the selection of appropriate traffic control measures:

- 24-hour Flagging operations vs. a Temporary Traffic Signal.
- Temporary concrete barrier vs. channelizing devices (cones, tubular markers, drums).
- Temporary pavement markings vs. channelizing devices.
- On-site Diversion vs. Full Road Closure with detour vs. In-place staging plan.
- Static, rigid, post-mounted temporary signs vs. Roll-up signs on portable sign supports.

Device Quantities

For projects with durations greater than one year, quantities for many of the TCP pay items should be adjusted to account for replacement. Over time, pavement markings, channelizing devices, impact attenuator repairs, etc. become worn, faded, dirty, damaged, or vandalized. With increased exposure to traffic, devices are more likely to be struck and may require repair or replacement. For projects with long durations, small increases in the TCD quantities should be made for devices susceptible to these conditions.

For a project that "***winters over***" – the project extending or shut down through the winter – inclement weather, low temperatures, and traction devices can all be very hard on devices left on the project site. Pavement markings and channelizing devices may need to be replaced, repaired, or at least freshened up.

As such, a designer should consider adding a small percentage to pay item quantities for those devices left exposed to live traffic over the winter months:

- Channelizing devices: Consider +10-20% depending on proximity to live traffic.
- Pavement markings (paint stripe): Consider a second application for temporary stripes.
- Pavement markers (reflective, flexible): Consider replacement amount for high traffic areas.
- Temporary signs: Not typically adjusted for winter shutdowns.

3.3.4 Project Schedules

Be aware of projects with "accelerated" construction schedules, or projects with time-critical components that must be completed within a specific timeframe. Examples include projects with detours, bridges on critical highways or freight routes; or, routes with high traffic volumes and a high level of importance to the region or local infrastructure.

Projects with an aggressive completion schedule, or time-critical components, may include unique construction materials or equipment that might require additional TCM and project-specific specifications to accommodate the construction schedule. Communicate regularly with the resident engineer's office and Project Development teams, watching for atypical construction strategies that would trigger the need for special traffic control measures within the TCP.

Within ODOT, shorter-duration projects can occasionally have bid dates adjusted to accommodate other projects or anticipated workloads. Smaller projects may also be combined with larger projects for various reasons – cost, funding opportunities, seasonal timing, politics, etc.

Occasionally, an "Emergency" project will need immediate attention. Abide by fundamental design protocols, as much as practical, in the development of the traffic control plan. Do not use a project's "emergency" status to default to sub-standard practices or poor engineering judgment resulting in an unsafe project. A safe, effective TCP can be developed – even for the most emergent project. Use human and material resources wisely to aid in the expedited development of the TCP.

3.3.5 Communication and Interaction

Maintain frequent communication with the Transportation Project Manager and other members of your Project Development Team regarding relevant details that may affect the TCP. The Transportation Project Manager should also be able to update Designers with stakeholder inquiries or comments; or, agreements made between the agency and stakeholder groups.

As the design progresses, interact regularly with the designated resident engineer or a representative from their office. Resident engineers are an extremely valuable resource in developing a buildable staging plan. Resident engineers can provide insight into construction techniques, anticipated durations for a variety of work activities, quantities needed for various traffic control devices, and other guidance that may not be readily apparent to the designer.

Communicate regularly with appropriate technical discipline representatives within your agency – Bridge, Roadway, Environmental, and Right-of-way Sections, etc. Technical groups often provide important data Designers may use to simplify or streamline the TCP by eliminating impractical or unfeasible staging concepts.

Constructability Review

Consider conducting a Constructability Review as an effective tool to refine or correct your preliminary traffic control plan. The Constructability Review is a method used to collect valuable, practical feedback from potential Contractors regarding the constructability of your draft TCP.

Typically, a short list of Contractors is invited to review a set of the Concept or Preliminary Plans for a given project. Contractors are asked to provide comments, suggestions or recommendations as to whether the current plans are feasible or if there is a safer, more efficient or cost-effective way to construct the project. Constructability Reviews are not difficult to conduct and they frequently yield invaluable feedback for the Project Development Team and the designer.

3.4 TCP Design Policies & Practices

This section discusses a number of the more significant policies and practices relating to the design and implementation of a traffic control plan. For additional information, or questions regarding the interpretation or application of these policies, please contact the ODOT Traffic Control Plans Unit in Salem, or visit the ODOT Work Zone Traffic Control Unit website.

3.4.1 Positive Protection

The FHWA defines 'Positive Protection Devices' as devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in the ***National Cooperative Highway Research Program (NCHRP) Report 350***. The determination of when to use positive protection can be based on either a project-specific engineering study or the application of ODOT guidelines and tools included in this section and are based on engineering judgment.

Project-specific engineering studies and agency guidelines typically consider expected work zone conditions along with the function and advantages/limitations of various measures and devices that may be included in the TCP.

The ***AASHTO Roadside Design Guide (RDG)*** states, "…the design and selection of work zone safety features should be based on expected operating speeds and proximity of vehicles to workers and pedestrians."

Work Zone Decision Tree

In the early development of the TCP, Designers should use ***the Work Zone Decision Tree*** form to evaluate different opportunities for positive protection, and document decisions made regarding the selection of traffic control measures and devices needed to best provide the desired level of positive protection.

Designers should look for opportunities to separate workers from live traffic – first examining options such as detours or on-site diversions to essentially remove worker/traffic conflicts. Subsequent options may include the use of temporary concrete, steel or other rigid barrier systems. As the project scope or work site environments dictate, positive protection options such as additional clear zone, or limiting worker exposure to live traffic should be considered.

Positive Protection Devices

Numerous products and devices can be used to provide different degrees of positive protection in a work zone. **Chapter 2** discussed the features and some applications for these types of devices. Devices more commonly used in Oregon for positive protection, and their additional considerations, are included below:

Portable Concrete Barrier

For long-duration activities, where work space is limited and either worker/traffic exposures or road user/work area hazard exposures are present on a regular basis.

Adequate space is required for barrier deflection, or the barrier needs to be pinned to the pavement surface. Adequate space is needed for equipment to install/move/remove the barrier. Barrier must be placed on rigid pavement surface (AC, PCC) to remain crashworthy. Adequate Contractor ingress/egress points will be needed either at barrier ends, or mid-run. All exposed ends must be treated with some manner of impact attenuation or protection.

Steel Barrier

While not widely used in Oregon and currently on the ODOT's Conditional Use List, steel barrier is gaining ground in its consideration as an effective positive protection device. Steel barrier has several advantages over concrete barrier, including:

- Low transportation costs.
- High length/hour installation rates.
- Durability.
- Ease of on-site portability.
- Low weight/foot dead load for bridge applications.

Steel barrier can be as effective as concrete barrier in providing a safe and effective positive protection device with minimal deflection, when properly secured to the pavement surface.

Figure 3-1: Steel Barrier in Transportation

To minimize the deflection of steel barrier, it must be secured to the pavement per manufacturer installation instructions. "Unsecured" steel barrier, however, can deflect between 6-13 feet when impacted by a full-size pickup truck at an angle of 25^0, at a speed of 100 km/h (62.1 mph) [per MASH crash testing].

Moveable Concrete ("Zipper") Barrier

Moveable barrier is most effective for projects where lane configurations must change regularly – e.g. reversing peak traffic flows, multiple longitudinal work areas (e.g. micro-silica deck pours, bridge deck joint replacements) – and other locations where barrier is warranted, but the shorter duration of the activity makes placement of standard concrete barrier challenging and risky.

ODOT owns a barrier moving machine and approximately 3.5 miles of the specialized barrier. A great deal of advance coordination, communication and project planning is needed to successfully include the system in a highway construction contract.

Truck Mounted Impact Attenuators (TMA)

The TMA can be used in a wide array of work zone applications including, mobile operations, short duration and stationary activities for less than three days. Where other types of barrier systems may not be practical due to the short work duration, or a localized work space, the TMA is effective in providing adequate positive protection for workers under these conditions.

A TMA should be placed in advance of the object or workers being protected, as shown in Table 3-1, below, or as approved by the resident engineer (engineer). A TMA is ***NOT*** intended for long-term protection in a single location, and should be limited to a single location for three consecutive days or less.

TMAs require an adequate roll-ahead distance to keep the workers or work space in front of it safe in the event the TMA is struck. Intrusion into the work space in front of the TMA should also be considered for high-speed work areas where the TMA spacing may be greater.

Table 3-1: TMA Placement for Stationary Operations

		TMA Support Vehicle Weight	
Stationary Operations[1] (Barrier Vehicle)		**9,900 – 22,000 lb. (TL-2 rated TMA)**	**> 22,000 lb. (TL-3 rated TMA)**
Posted Speed[2] (mph)	≤ 45	100	75
	50 – 55	*	100
	> 55	*	150

* TL-2 rated TMA is not suitable for these speeds. Use TL-3 rated TMA.

[1] Distances shown are between front of the TMA support vehicle and beginning of the area or equipment being shielded by the TMA.

[2] Posted speed refers to the pre-construction posted speed of the facility.

Table 3-2: TMA Placement for Mobile Operations

Mobile Operations[1] (Shadow Vehicles)		TMA Support Vehicle Weight 9,900 – 22,000 lb. (TL-2 rated TMA)	TMA Support Vehicle Weight > 22,000 lb. (TL-3 rated TMA)
Posted Speed[2] (mph)	≤45	100	100
	50 – 55	*	150
	>55	*	175

Positive Protection Considerations

Effective as of December 4, 2008, the FHWA published the Temporary Traffic Control Devices Rule ***(23 CFR 630, Subpart K***) that provides additional information and emphasizes the need to appropriately consider and manage worker and road user safety as part of the project development process. The Rule provides guidance on key factors to consider in reducing worker exposure and risk from motorized traffic. It also requires highway agencies to consider positive protection where such devices offer the highest benefits to worker safety, such as situations where workers may be at increased risk of serious injury from exposure to traffic.

Designers should carefully consider the following factors in determining positive protection options, along with the examples of situations where positive protection devices may be required:

Project Scope and Duration

The ***MUTCD*** defines "long term" projects as those longer than three days. However, common practice tells us projects in place longer than two weeks benefit most from the use of barrier – offsetting the time, energy and exposure of equipment and workers in placing and removing the barrier devices.

Anticipated Traffic Speeds

Risk of serious injury to workers increases exponentially as traffic speeds increase in a work zone. For Oregon, a high-speed work zone is one where posted speeds are 45 mph and higher. Consideration should also be made for the 85th percentile speeds for a given highway section. For projects where free flow traffic conditions exist, or where limited sight distances can be expected, consideration of these average traffic speeds will be especially critical.

* TL-2 rated TMA is not suitable for these speeds. Use TL-3 rated TMA.

[1] Distances shown for mobile operations are appropriate for support vehicle speed up to 15.5 mph.

[2] Posted speed refers to the pre-construction posted speed of the facility.

Anticipated Traffic Volumes

Much like higher traffic speeds, risk of injury to workers increases as the volume of traffic increases. However, high-speed traffic and high traffic volumes may occur separately. As volumes increase – pushing volume/capacity ratios close to 1.0 – congestion will help to regulate traffic speeds and likely slow traffic down. The risk to workers can come from the presence of a much higher number of vehicles, impatient drivers, limited sight distances, sudden braking and varying driver responses, etc. Urban areas are subject to these conditions – particularly urban freeways where the expectation is for consistent free-flow conditions.

Vehicle Mix

A traffic stream with a higher percentage of large trucks can raise the warrants for positive protection measures – particularly where intrusion into the work area by a larger, heavier vehicle would have far more significant consequences to the work activity.

Type of Work Activity

Depending on the physical activity itself, the amount of exposure to workers can warrant more significant positive protection measures. Activities placing workers immediately adjacent to live traffic for extended periods of time can provide some of the greatest benefits in using positive protection. Shadow vehicles with truck-mounted impact attenuators can help shield workers in situations where work spaces are small and move frequently along a highway section.

Traffic Worker Offsets and Exposure Durations

Similar to the Type of Work mentioned above, the lateral placement of workers with respect to live traffic streams should be a consideration for the use of positive protection. When a lateral “Buffer Space” or adequate clear zone (see **Clear Zones in the Work Zone** in this Section, below) cannot be provided, positive protection can provide the greatest benefit to protecting workers from live traffic intrusions.

Limited Escape Routes

Projects with limited or no available escape routes for workers present the greatest threat to workers in cases of an errant vehicle in a work zone. Work in tunnels, on bridges and other confined spaces best represent this condition.

Time of Day

One of many Project Team considerations focuses on when to conduct the work given in the Project Scope – whether the work is done in the summer or year-round, on weekdays or weekends, during the daytime or at night. Often, the determination is based on when traffic volumes are low enough to allow lane closures or other decreases in traffic capacity that would minimize delay and optimize mobility through the work zone. Nonetheless, considerations should also be made for conducting work at night – where visibility and conspicuity are diminished, drivers tend to be more tired or drowsy; and inclement weather can further reduce visibility for road users and workers. If working at night, along with supplemental lighting, positive protection measures should be considered. For additional information, see the ***NCHRP Report 476 – Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction***. Also see the ATSSA Nighttime Lighting Guidelines for Work Zones.

Additional guidance on day versus night work is included in Section 3.4.3.

Road User Roadway Departures

Considerations for the use of positive protection should be made for work zones where conditions increase the risk of exposure to roadside hazards for road users. Hazards such as vertical drop-offs, side slopes greater than 4:1, structures and structural falsework, construction materials and larger equipment can present additional risks to road users for serious injury.

The ***AASHTO Roadside Design Guide (RDG)*** suggests vertical drop-offs greater than three inches as a warrant for positive protection. In examining this warrant, the other considerations listed in this Section should also be weighed in determining the need for the positive protection, as well as the method used to provide that protection.

Potential Hazard from Positive Protection Device Itself

According to the ***AASHTO Roadside Design Guide, Chapter 9***, deciding to implement a positive protection device to protect a work zone hazard should be weighed against the potential for the device to be a greater hazard than the hazard being protected.

For example, one should ask if a vehicle driving over a given drop-off would result in a more severe crash than if the vehicle struck a positive protection device.

Another example would be to consider the scenario where a positive protection device is placed such that the "buffer space" or clear zone is decreased, and then asking if an errant vehicle would be better off striking the device rather than having the normal amount of open space (and reaction time) to possibly correct their speed and/or trajectory.

Work Zone Geometrics or Restrictions

Consider temporary changes to either roadway geometry or the physical size (e.g. width, height) of the path vehicles must travel in as they pass through or around the work zone. Severe curves, abrupt changes or shifts in roadway alignment, narrow lanes or shoulders, restricted sight distances, or other changes that strain normal driver expectancies can significantly increase risk for both workers and road users in the work zone. If dramatic geometry changes are unavoidable, effective safety mitigations may include additional advance notification of the conditions (e.g. PCMS) and the placement of positive protection devices.

Contractor Accesses

For longer term projects where the Contractor may have accesses to the work site from the main highway, considerations should be made for accesses midway through a run of concrete or steel barrier. In addition to the accesses being well delineated – and perhaps signed using a Smart Work Zone System (SWZS) – any exposed ends of the barrier system must be protected with an appropriate impact attenuator.

Roadway Classification

While positive protection, when warranted, is suitable for all roadway types, high-speed facilities with a higher level of importance and greater dependence on mobility and access management, should be more heavily considered. For example, in Oregon, freeways would warrant placement of concrete barrier to divide opposing directions of traffic when one direction of traffic is moved onto a crossover or staged to share the existing pavement with the opposing traffic stream.

Impacts to Project Cost and Duration

While often not a *primary* reason for selecting between two different traffic control measures, cost is a legitimate factor and must be considered as part of the overall decision-making process for providing positive protection.

While at first glance, concrete or steel barrier may appear to be the best solution, if many miles of barrier are needed, it may become cost-prohibitive within the scope of the project. Other positive protection measures may require additional effort, greater degrees of coordination, or additional political backing; but, the trade-off may be a substantial reduction in project cost and almost negligible reductions in safety.

As examples:

- Current right-of-way widths and low traffic volumes might allow for the construction of a single-lane on-site diversion instead of using large quantities of barrier.
- A limited full road closure is paired with a local, parallel detour route – minimizing out-of-direction travel while still supporting freight mobility needs.
- A one-direction detour is used for opposing traffic, allowing for a full-width crossover for the affected direction of traffic that would have been adjacent to the work area. Keep in mind, in some instances construction of a temporary facility may take longer than employing the "traditional" measure, but if the temporary facility can ensure a much safer and more efficient environment for both the Contractor and for road users, the additional time (and perhaps added cost) may be justified.

As project scopes are investigated, factors weighed, and opportunities explored, Project Development Teams should also consider seeking additional support from upper level managers within the agency (e.g. ODOT Area and Region Managers) when a particular measure or staging concept is the preferred means, yet presents some potentially significant increased costs for the project.

Positive Protection Devices Support Tool

From the ATSSA Guidelines on the Use of Positive Protection in Temporary Traffic Control Zones, the "*Decision Support Tool for Selecting Various Positive Protection Devices"* table gives Designers guidance on the variety of devices available and an equally variable set of conditions where applicability, benefits, costs and other factors can be compared, evaluated and used to select the protection device best for their project.

Table 3-3: Positive Protection Device Selection Decision Support

Positive Protection Device	Most Appropriate Projects and Locations for Use	Relative Costs and Benefits	Other Considerations
Portable Concrete Barriers	Longer duration stationary projects; areas with limited room for barrier deflection such as bridges and tunnels; drop-off conditions; worker exposure concerns	Substantial installation and removal costs; provide greater benefit on stationary activities compared with those that move such as pavement resurfacing	Require space for placement equipment; contractor access to work area; protection for exposed barrier ends
Ballast Filled Barriers	Low-speed urban projects; projects with limited space for concrete barrier placement equipment; areas with room for larger deflection, if needed (some water filled barriers are designed to minimize deflection)	Potentially lower installation and removal costs as they can be placed and removed by hand when unfilled	May be filled with water or sand; consider ballast material transport options, handling, and disposal, along with potential temperature issues (mitigated with environmentally sensitive anti-freeze)
Steel Barriers	Short-duration projects such as pavement rehabilitation and maintenance; areas with room for larger deflection (if anchored, deflection can be minimized). May also be used on long-term projects	Lower transport costs due to their lightweight, stackable design, quick installation	Lateral displacement is generally 6 to 8 feet (depending on impacting vehicle); may be anchored to minimize deflection
Moveable Concrete Barriers	Longer duration projects; projects where the traffic control configuration is changed frequently (where lanes are	Substantial cost and effort to install; provide benefit on projects where lane	Reconfiguration of the barrier can be accomplished quickly and safely; may be used

Positive Protection Device	Most Appropriate Projects and Locations for Use	Relative Costs and Benefits	Other Considerations
	opened and/or closed on a daily or nightly basis)	configuration changes often	to optimize directional capacity
Shadow Vehicles with TMAs	Mobile, short-duration, and short-term stationary projects such as striping, signal maintenance, vegetation control, pavement patching and repairs, and joint and crack sealing; locations where other barriers may be impractical due to the mobility of the operation	Costs include those for truck, attenuator, and driver – undamaged attenuator may be reused on other projects to spread costs	Adequate roll ahead distance is required to protect workers; consider the potential for motorists to access area between shadow vehicles and workers
Vehicle Arresting Systems	Longer term projects where the installation is used over an extended period, such as nightly closure of a roadway over an extended period; used to close an entire area and stop errant vehicles from intruding	Fixed end anchors require substantial effort to install; temporary anchors provide a lower cost solution for short-term applications	Requires adequate buffer space to allow vehicle to slow to a stop; consider work vehicle access to the closed area

3.4.2 TCP Design Exception Process

While there is no formal Design Exception process for most of the components of Temporary Traffic Control Plan design, designers shall document assumptions, thought processes and design decisions when they differ from normal practices or current design standards. Include a summary statement of the design exception(s) in the Transportation Management Plan (TMP).

Many of the design standards contained within the temporary traffic control discipline originate from the ***MUTCD***. Reductions of these standards should be avoided. However, it is understood that in the field of temporary traffic control, with confined or otherwise challenging work areas, some latitude must be granted. In most cases, where the documented standard cannot be met, despite due diligence, the solution may lie in the designer optimizing the design feature given the available resources.

For example, if the design for a temporary on-site diversion requires a curve radius using a design speed well below the pre-construction posted speed, the designer should thoroughly document the decision to do so. Designers should contact the "Engineer of Record" to discuss the design and reasons for any substandard components. Communicate design decisions of this nature with your supervisor and with the resident engineer. Designers should contact the work zone engineer in Salem to discuss design options and possible mitigations.

For Designers, if modifications to critical temporary State Highway roadway design elements (roadway alignments, pavement designs, etc.) are needed that do not meet published minimum standards from this manual, the ***Highway Design Manual (HDM)*** or other applicable policies, filing an exception through the formal Roadway Design Exception process is an option or else document decisions in the TMP. If a temporary roadway feature is going to be left between a different unfunded phase of a project, then the Roadway design exception process applies. For design exceptions related to temporary pedestrian accessible routes, see **Section 3.4.5** for additional guidance.

3.4.3 Lane Restrictions

Work Zone Traffic Analysis (WZTA)

All construction projects affecting traffic flow on state highways require a traffic analysis to determine when the existing lanes will exceed their capacity. The traffic analysis is used to identify how many lanes are needed to support projected construction year volumes during specific times of day or night, days of the week, or months of the year, while accounting for multiple work zone factors that can create delays or congestion.

For ODOT projects, the project-specific traffic analysis should be conducted by an analyst trained to use ODOT's Work Zone Traffic Analysis (WZTA) tool, or other comparable traffic analysis tool. The ***Work Zone Traffic Analysis Manual*** outlines the analysis procedure that is utilized to determine the allowable lane restrictions for a specific project. The principles, thresholds and guidance as discussed in the ***Work Zone Traffic Analysis Manual*** should be followed. Contact the ODOT region traffic analyst to determine the appropriate traffic analysis method.

Within ODOT, the region traffic analyst will complete the analysis and return a recommendation to the TCP designer identifying the number of lanes and times of day when lanes can be closed without creating unbearable delays and extended queues that take too long to dissipate. The project team, in coordination with the resident engineer, can then use this information or modify it to fit the project needs to give the contractor enough time to work efficiently.

For example, when the lane restriction recommendation shows a 6-hour work window, the project team, including resident engineer, may decide to add additional working hours to allow the work to be completed efficiently. Depending on the analysis, these hours are chosen when closures will result in the least overall impacts to traffic; this is often in the evening hours when volumes are dropping and any queues developed will dissipate with decreasing volumes as opposed to the morning when volumes are generally increasing. Mitigation strategies should also be considered for planned queuing and delays.

The lane restrictions are then added to the ***Special Provisions*** subsection ***00220.40(e) – Lane Restrictions***. Current lane restriction specification language can be found in ***Section 00220.40*** of the ***ODOT/APWA Standard Specifications*** and the ***Section 00220-00229 Special Provision*** "boilerplate." Both references are available on the Specifications Unit Website.

As the Work Zone Analysis indicates, the design team should allow lane closures at all times feasible, only restricting lane closures for specific volume or design reasons, so the contractor may have the widest window to develop their work plan based on available resources and work type.

For instance, including a short daytime work hour window (+/- 2 hours) on an ADA ramp project when possible could improve efficiencies. The short work hour window during the day may be utilized for material delivery and other miscellaneous work.

ODOT is required to comply with the ***FHWA 630 Rule for Work Zone Safety and Mobility***, and has agreements with the Mobility Advisory Committee (MAC) regarding mobility issues. It has established the ***Project Delivery Leadership Team Operational Notice (PD-16)*** for managing communication and issues impacting highway mobility.

When the lane restrictions for a project are extended to accommodate a more productive work window that results in extended delays to traffic, coordination with the Mobility Advisory Committee (MAC) is necessary. The MAC can provide the project delivery team a mobility exception, as necessary. ODOT's Region Mobility Liaisons can assist in the coordination efforts between the project delivery team and the MAC. Table 3-12 lists the contact information for the Region Mobility Liaisons.

Table 3-4: ODOT Region Mobility Liaison Contacts

Mobility Liaison	Region	Address	Phone	Email
Debbie Martisak	Region 1	123 NW Flanders St, Portland OR 97209	503.731.4554	Deborah.A.MARTISAK@odot.state.or.us
Keith Blair Mike Doane	Region 2	455 Airport Rd SE, Bldg A, Salem OR 97301	503.986.2656 503.986.2996	Keith.P.BLAIR@odot.state.or.us Michael.D.DOANE@odot.state.or.us
Sarah Thompson	Region 3	3500 NW Stewart Parkway, Roseburg OR 97470	541.957.3687	Sarah.L.THOMPSON@odot.state.or.us
Teresa Gibson	Region 4	63055 N Hwy. 97, Bldg K, Bend OR 97708	541.388.6242	Teresa.GIBSON@odot.state.or.us
Jeff Wise	Region 5	31327 SE 3rd St, Pendleton, OR 97801	541.963.1902	Jeff.WISE@odot.state.or.us

Daytime vs Nighttime Work

Improving safety in highway work zones remains a shared goal among every state and local agency. Because daytime and nighttime work both have their own safety risks, each project must be carefully analyzed and designed to develop the best construction strategy, targeted for the particular location, work type, schedule and budget.

State highways that have high traffic volumes are difficult to perform roadwork during the day without causing adverse disruption to traffic flow and freight movement. As a result, the majority of roadwork taking place on high traffic volume highways is scheduled for off-peak and nighttime hours. Working during nighttime hours is associated with reduced traffic congestion, which leads to lower crash frequencies as identified in several studies. Congestion during a work activity remains a major reason for increased rear-end crashes. Ultimately, lower volumes results in reduced vehicular exposure at work zones.

Nevertheless, lower volumes can allow drivers to travel at higher speeds through the work zone due to the greater maneuverability than what is typically experienced during the day. It is well recognized in the crash data that impaired and drowsy drivers are greater concentrated during nighttime than daytime hours. Visibility is much more reduced for drivers and workers at night than during the day. Certainly, the frequent extended nighttime work leads to workers' fatigue and higher risk of worksite injuries.

Given that each project is unique, the types of risks will vary from one project to another. Therefore, the decision on whether the work should be performed at night versus day should be investigated for each project.

At a minimum, the traffic work zone designer and the project delivery team during project development should evaluate the following work zone safety strategies:

- Reducing the duration and number of work zones
- Use of directional closures (median crossovers)
- Use of full roadway closures (detours)
- Use of public outreach campaigns to reduce congestion through work zones
- Providing law enforcement overtime
- Limiting work zone intrusions on long-term, high-volume projects
- Improving work zone visibility at night with lighting or other devices
- Dividing a project by sections or phasing, as required by geometry or work type, to allow for both day and night work in one contract

- For example: when working on a highway with low traffic volumes that allows for daytime work but a horizontal clearance restricts over-sized trucks during daytime at a bridge section of the project, an accommodation could be made by staging for nighttime work on that isolated bridge segment while the remainder of the project could take place during daytime. Allowing for both day and night work in one contract improves productivity and in turns reduces frequency of disruption to traffic flow.

A strategy should not be eliminated solely because it may not meet the ODOT Highway Mobility Standards as outlined in the ***Project Delivery Leadership Team Operational Notice (PD-16)***. The project team should engage the Mobility Advisory Committee (MAC) for a mobility exception if needed.

Special Events

The TCP designer and the transportation project manager (TPM) should work together to determine if there are local events which could seriously affect traffic flows through the work zone, and if special lane restrictions need to be imposed during the event.

The TCP designer should contact the local Chamber of Commerce to collect a list of special events that may affect traffic flow through the work zone. Conversations with the Chamber of Commerce will provide additional information including; anticipated number of participants, start and end times for the activities and the general location for the event(s). Additional lane restrictions for any relevant special events may need to be included in the Special Provisions under ***Section 00220.40(e)***.

During construction, lane restrictions may need to be modified to accommodate the work and/or traffic. The resident engineer is responsible for overseeing the contract, including any changes to lane restrictions. Coordinate the change in lane restrictions with the TCP Engineer of Record, for review and concurrence.

3.4.4 Abrupt Edges

Abrupt edges result from a variety of highway construction activities:

- Paving operations.
- Cold Plane Pavement Removal (“grinding”).
- Excavation or trenching (longitudinal).
- Removal of existing concrete barrier (keyed-in or grout pad).

Abrupt edges must be mitigated within the TCP. Depending on the nature of the abrupt edge, a number of methods are available to protect traffic.

Paving Operations

Longitudinal and transverse paving joints produce abrupt edges. Depending on the depth of the pavement surface(s) being applied, the Contractor is required to employ various traffic control measures to protect traffic as outlined in ***the ODOT/APWA Standard Specifications*, *Subsections 00745.61*** *Longitudinal Joints* and ***00745.62*** *Transverse Joints*.

For longitudinal joints, when the nominal thickness of HMAC being paved is greater than 2 inches, then the Contractor has to schedule the work so that at the end of each day there are no drop-offs. When the nominal thickness of HMAC being paved is less than 2 inches, then the Contractor can only leave a longitudinal joint the length of HMAC paved in one shift. If neither requirement is met, the Contractor must protect the joint with a wedge of HMAC.

These specifications are important because they will affect staging plan assembly and the quantity of temporary traffic control devices needed.

The Special Provision "(00220) Abrupt Edge (Paving)" includes additional information regarding mitigations for abrupt edges. Be sure to include the appropriate language when your project includes paving operations that may create longitudinal abrupt edges.

Several ***ODOT Traffic Control Plan Standard Drawings*** contain instructions, requirements, and practices to be used to protect abrupt edges created by paving operations, and are shown in specific details within those drawings:

- 2-Lane, 2-Way Roadways drawing – "2-Lane, 2-Way Roadway Overlay Area."
- Multi-Lane, Two-Way, Non-Freeways drawing – "Typical Abrupt Edge Delineation."
- Two-Lane Freeway Projects detail – "Divided Freeway One Lane Closure Preservation Work Area."
- Multi-lane Freeway Projects drawing – "Divided Freeway Two Lane Preservation Work Area."

Cold Plane Pavement Removal ("Grinding")

Depending on the depth of the pavement surface being removed, the Contractor is required to employ various traffic control measures to protect traffic as outlined in ***Standard Specification Section 00620.40 Pavement Removal***. The way pavement is removed may have an impact on the duration of the contract. The method should be accounted for to help determine time based pay item quantities – i.e. Flaggers.

Excavations or Trenching

If an abrupt edge results from trenching or excavation (pavement reconstruction, longitudinal trenching, etc.), there are requirements for the Contractor as well. Be sure to include the appropriate language from the Special Provision "00220 – Abrupt Edge (Excavation)".

Abrupt edges resulting from curb ramps construction are not subject to the above requirements.

3.4.5 Pedestrian Accessibility Design

Work zones can affect pedestrians in a variety of ways – particularly related to mobility and accessibility – making designs for pedestrian accommodation in work zones challenging. ODOT's commitment to pedestrian transportation through and around highway work zones includes considerations for providing safe, efficient and accessible facilities for pedestrians.

This obligation applies to all work zones included in any of the following:

- All projects on or along the State Highway System, regardless of funding source.
- All projects funded by the Federal-aid highway program.
- All projects that are contracted through ODOT, including project off the State Highway System.
- All projects delivered by ODOT work forces off the State Highway System.

The ODOT Maintenance and Operations Branch will lead the development of practices and procedures for maintenance force work and for work conducted by third parties issued permits to work within State Highway rights of way.

Definitions

For the purpose of this Section and throughout this design policy, the following definitions are to be used:

Pedestrian

"*Pedestrians*" will refer to all road users afoot, in wheelchairs, walkers, crutches and other mobility aides; visually impaired pedestrians, and all others identified under the *Americans with Disabilities Act* (ADA).

Accessibility

"*Accessible*" will refer to the ability of existing pedestrian traffic to continue to traverse a particular highway section during construction. Construction staging or work activities may not introduce any new barriers to pedestrian traffic mobility.

Temporary Pedestrian Accessible Route (TPAR)

A *TPAR* is an area within a work zone, marked by signing, delineation and TCD, for the use of pedestrians to navigate through or around the work area. The TPAR is included as part of the traffic control plan.

Temporary Pedestrian Accessible Route Plan (TPARP)

A *TPAR Plan* is a written and drawn plan within the TCP that identifies requirements for providing safe, effective and accessible routes for pedestrians through or around the work zone including TPAR details, advance public notification; and, construction and maintenance responsibilities.

Pedestrian Accommodation Principles

The principles discussed in the *standards* in the ***MUTCD*, *Sections 6C, 6D, 6F*** and ***6G***; current ***ODOT/APWA Standard Specifications***; and, ***ODOT Standard Drawings*** address minimal requirements needed to accommodate pedestrians in work zones.

Pedestrian accommodation requirements are described in the ***Public Right-of-Way Accessibility Guidelines (PROWAG), Section R205***:

> *"When a pedestrian circulation path is temporarily closed by construction, alterations, maintenance operations, or other conditions, an alternate pedestrian access route complying with sections 6D.01, 6D.02, and 6G.05 of the MUTCD shall be provided. Where provided, pedestrian barricades and channelizing devices shall comply with sections 6F.63, 6F.68, and 6F.71 of the MUTCD"*

In accommodating pedestrians, the following principles must be applied, addressed and incorporated into the TCP:

- Do not lead pedestrians into conflicts with public traffic, construction vehicles, equipment, or operations; or, hazardous materials.
- Where practical, when directing pedestrians across a roadway, use existing intersection corners and crosswalks – marked or unmarked. For route continuity and to meet pedestrian expectancy, application of temporary mid-block crossings should be limited to sections where existing crossings are more than 1000 feet apart. An existing marked mid-block crossing may be used to shorten pedestrian routes.
- Provide a convenient, contiguous pathway that equals or exceeds the existing level of pedestrian accessibility.
- Minimize out-of-direction travel for pedestrians.
- If closing a pedestrian route, sign the closure in a minimum of ***two*** locations.
    - In advance of the closure point at the nearest alternate crossing or diversion point.
    - At the closure point itself.
- Closure signing may be different at each location and requires careful attention to detail to provide proper instructions and directions. See the ***MUTCD***, ***ODOT Standard Drawings*** and the ***ODOT Sign Policy & Guidelines*** for additional signing information.
- Avoid having a pedestrian route double-back on itself. Pedestrians are not likely to walk one block beyond the closure to the next crossing, and then one block back on the other

side of the road. They will likely cross before the work zone impact (if visible), or mid-block – which may be unsafe or leave the pedestrian within the work area.

- As part of the impact analysis, confirm if visually impaired pedestrians can be expected in the work zone by a number of means, including:
- Personal investigations and/or collecting manual counts.
- Contact local agency/organization sources.

Contact the Oregon Commission for the Blind **– (888) 202-5463, ocb.mail@state.or.us , or [www.oregon.gov/blind website](http://www.oregon.gov/blind)**

- Work closely with the ***ODOT Region Public Information Officer (PIO)*** to ensure frequent public outreach is conducted regarding impacts to pedestrian facilities during the project.

Temporary Pedestrian Accessible Route (TPAR)

When accommodating pedestrians in highway work zones, developing a pedestrian-specific temporary traffic control plan is required. A TPAR that matches or exceeds the existing level of accessibility **shall** be provided as part of the temporary traffic control plan when existing pedestrian facilities are impacted by construction or construction staging. The temporary traffic control plans shall be stamped by a registered professional engineer. To a reasonable and prudent degree, the TPAR must meet applicable ODOT and ***MUTCD*** standards.

While the finished *permanent* features of a construction project must be ADA-compliant, upgrading the level of accessibility of existing facilities to meet **all** ADA standards is not going to be practical or even physically possible for most projects. Therefore, TPAR designs must be explored and developed to maintain pedestrian accessibility through or around active work areas within these projects. When a section of highway includes non-ADA compliant pedestrian features (e.g. substandard sidewalks, curb ramps, surfaces, etc.), accessibility is already being limited. TPARs must not create new barriers to pedestrian accessibility.

- If sidewalks do not exist within project limits; and, pedestrians are using paved shoulders or other roadway surfaces, the TPAR design must provide a pathway that matches or exceeds the existing level of accessibility.
- Where site-specific conditions are not adequately addressed through specification language or Standard Drawings, include additional design details through project-specific special provision language and engineered plan sheets.

TPARs provide pedestrians with useable, traversable, clearly-defined routes through or around the work zone. Key components of the TPAR include:

- A level of accessibility equal to or better than the existing pedestrian facility.

An "existing pedestrian facility" may not necessarily include a sidewalk. Pedestrians may be using the roadway shoulder or some other pathway.

- Accessible Features – Curb ramps, landing pads, traversable surfaces, manageable grades and cross slopes, etc.
- Detectable Warning Features – Textured pavements (e.g. "truncated domes"), detectible edges, curbs around fountains or pools, hazardous vehicular pathway warnings (e.g. bollards), audible indicators, etc.
- Route and route features meeting applicable ODOT and ***MUTCD*** Standards including:
    - Curb ramps with a maximum finished running slope of 8.33%.
    - Constructed temporary sidewalks, paths and curb ramps with a maximum finished cross slope of 2%.
    - 60 inch continuous sidewalk widths; or, 48 inch widths with 60 inch x 60 inch level landings (max. 2% slope) every 200 feet.
    - Continuous and detectable surfaces with vertical drops or edges less than 1/4 inch.

See ***ODOT Roadway Standard Drawings*** related to *Curbs, Islands, Sidewalks and Driveways* (***RD900 series***) and ***Standard Details (DET4780s)*** for details specific to curb ramps, sidewalk grades and cross-slopes, sidewalk closures etc.

- TPAR design coordination with local agencies, as necessary, where the TPAR incorporates local facilities. Ensure pedestrian access and TCD placement on local agency facilities are approved prior to releasing the project for advertisement.

Special Pedestrian Design Environment

Much like the preparation done for the design of the vehicular TCP, Designers should first investigate, inventory and document the existing facilities or pathways being used by pedestrian traffic. In particular, document features related to the existing level of accessibility, including:

- Surfaces used by pedestrian traffic, and surface quality.
- Pathway widths and pinch points.
- Continuity of the route.
- Access to the route (e.g. stairs, ramps, curbs, accesses from private property, etc.).
- Estimated grades and cross slopes.

Be aware of roadway features and environments that may alter 'common', 'typical,' or 'default' TPAR designs. Each traffic control measure or work zone condition must accommodate pedestrians, or identify an alternative means to do so.

Temporary and Portable Signals

Traffic signals present unique challenges for TPAR design. Consider the following as part of the development of the TPAR:

- Signal design may require pre-emptive push buttons and associated signal timing. If during construction staging, ADA users cannot reach existing push buttons, consider the following mitigations:
    1) Call out construction of temporary stand-alone push buttons, where needed.
    2) Place Flagger at affected corner(s). Use Flagger to activate button, as needed.
    3) Place signal in "Pedestrian Recall" mode to remove need to activate the push button.
- If a crosswalk is closed at a signalized intersection, each applicable Pedestrian Crossing Signal Head should be covered, the existing push buttons disabled, and the crossing itself should be signed and include detectable barricades.

Closure of Sidewalks, Multi-Use Paths and Paved Shoulders

Provide equal or better levels of accessibility to temporary facilities to allow safe, efficient travel through or around the work zone.

Two-way, one-lane traffic control measures often provide minimal operational widths for motor vehicles. Default designs often omit standard shoulder widths that could otherwise be used by pedestrians.

Freeway Closure to Pedestrians

When providing a detour route that utilizes an adjacent facility off the freeway system, consider displaying the detour route on printed flyers located in a waterproof container under the closure sign or provide a sign displaying a schematic diagram of the detour route as shown in Figure 3-2.

Figure 3-2: TPAR Schematic Diagram

Urban/Suburban Intersections

Scope of work often includes work on all four corners of an intersection. In some urban/suburban environments, viable detours, or the location for adequate temporary facilities, may be limited. Consider the use of construction easements within the intersection area to provide the additional space needed to include a temporary pedestrian facility adjacent to the work area – one that would minimize out-of-direction travel and encourage pedestrian use.

Unlike a permanent crosswalk closure, a temporary crosswalk closure does not require an approval of the state traffic-roadway engineer.

Temporary Uncontrolled Crossings

The temporary uncontrolled crosswalks fall under two categories. The first is at existing crossing locations and the second is at non-existing crossing locations. Please refer to ***Traffic Manual – Section 310.0*** for more information on crosswalk locations.

For **existing crossing locations**, an approval is not needed for temporary marking the uncontrolled crosswalk provided that the crossing is temporary enhanced to meet or exceed the existing condition of the closed crosswalk under construction. The following is a list of enhancements that should be considered:- "PEDESTRIAN CROSSING" signs (W11-2)

- Temporary refuge island using channelizing devices for roadways with 3 or more lanes
- Temporary curb extension using channelizing devices for roadways with street parking or wide shoulders (greater than 6ft)
- Temporary speed zone reduction where speeds greater than 40 mph
- Temporary RRFB

Marking an uncontrolled crosswalk at a **non-existing crossing location** such as but not limited to midblock crossing requires both an engineering study and Region Traffic Engineers approval. All uncontrolled marked crosswalk at non-existing crossing location shall be enhanced with at least some of the following options:

- "PEDESTRIAN CROSSING" signs (W11-2).
- Advance stop lines and "STOP HERE FOR PEDESTRIANS" signs (R1-5b).
- Temporary refuge island using channelizing devices for roadways with 3 or more lanes.
- Temporary curb extension using channelizing devices for roadways with street parking or wide shoulders (greater than 6ft).
- Temporary speed zone reduction where speeds greater than 40 mph.
- Temporary RRFB.

The use of temporary RRFB is strongly encouraged for use at temporary uncontrolled marked crosswalks when the following traffic conditions exist:

- **More than one travel lane in each direction.**
- **8,000 ADT (6000 ADT if high percentage of pedestrians).**
- **Posted speed is 40 mph or less.**

Refer to S*ection 2.7.6* for more information on temporary RRFB in work zones.

Temporary Midblock Crossing

When it is not practical to direct pedestrians to cross at corner or an existing crosswalk due to long out of direction travel greater than 1000 feet, consider providing a temporary midblock crossing. Marking of temporary midblock crosswalks can be accomplished with temporary tape or simulated lines using flexible pavement markers. The use of flexible pavement markers should be limited to situations where it desirable to signify the temporary nature of the crosswalk and preferably used on low-volume, low-speed roadways. If flexible pavement markers are utilized, provide adequate gap for vehicle wheel path.

Existing Bicycle and Pedestrian Facilities

Designers should collect information and details specific to the existing facilities for these road users – including widths, grades, surface conditions, pavement markings, signing, and the overall level of accessibility to these facilities.

Pedestrian Traffic Generators

Schools, shopping malls, theatres, arenas and similar pedestrian volume generators will result in sudden, large volumes of pedestrians in a concentrated area or section of the work zone. Carefully consider the location and length of needed temporary pathways to safely and effectively guide pedestrians through or around work zones in these areas.

Physical Restrictions

Where it is impractical to provide a safe, effective TPAR due to space limitations or other physical constraints, alternative measures should be considered for accommodating pedestrians, including strategies such as:

- Detour routes using adjacent existing facilities that minimize out-of-direction travel.
- Partnerships with local transit providers (e.g. Tri-Met, Cherriots, LTD) to provide discounted or complimentary passes.
- Shuttle services provided by private transportation vendors.

In special circumstances where a temporary pedestrian accessible route is unavailable and the use of adjacent facility would result in a significant out-of-direction travel, providing a pedestrian transport vehicle should be considered. Designate an area for pedestrians to wait for the transport vehicle. The pedestrian transport vehicle shall have the capacity of safely loading, unloading, and transporting through the work zone at least two ADA passengers in powered chair and a maximum of 10 able-bodied pedestrians.

Temporary Handicap Parking

When a permanent handicap parking space is removed due to a work zone activity, provide an alternate temporary handicap parking space. Select a location that is level, close to an entrance and near a curb ramp. If an existing curb ramp is not available, place a temporary curb ramp to allow access to sidewalk. The parking space shall be clearly signed and marked, so it is easily identified. The marking may be omitted if work is lasting less than 3 days.

TPAR Plan Sheet Details

TCPs must provide enough detail to Contractors to build the project, and to safely accommodate bicycle and pedestrian traffic within the work zone.

Develop pedestrian-specific plan sheets as part of the TCP to clearly indicate pedestrian pathways; surface designs; TCD types, locations and quantities; and, other ADA-specific details. For intersection work, the work should be divided up into separate Stages or Phases to maximize pedestrian accessibility and minimize out-of-direction travel. Only **one corner** per block should be impacted by construction at a time. This allows for up to **two corners** per intersection to be closed at the same time while maintaining pedestrian access, thereby increasing construction efficiencies. ODOT ***Standard Detail DET4782*** shows the TPAR for a two corner per intersection closure.

Draft pedestrian-specific plan sheets at a scale of 1"=50' to improve clarity and help ensure proper implementation.

Plan sheets should include details for:

- TPAR cross sections
- Temporary curb ramps
- Closure points
- Detour routes
- TPAR route direction arrows
- Surfacing design details
- ADA-specific accommodations

The TCP should include bid items and quantities necessary to implement the details shown in the TPAR Plan, including:

- Temporary Surfacing – AC, cement-treated base (CTB), plywood with surface friction treatments.
- Temporary Curb Ramp materials – e.g. AC, lean concrete, drainage pipe, truncated domes, QPL products.
- Channelizing Devices – Pedestrian Channelizing Devices (PCD), Bicycle Channelizing Devices (BCD), other QPL or ADA-compliant devices, where applicable.

TPAR Design Exception

In cases where it is technically or fiscally infeasible to provide an equal or better level of pedestrian accessibility through the TPAR design, document, in writing, constraints that preclude this compliance. This documentation may be considered as a TPAR "Design Exception".

It is recommended to include a "Memo to File" in the project file. The memo should include supporting correspondence, maps, and any diagrams or plan sheets that can be used to support the decision to design any portion of the TPAR with a level of accessibility less than the existing pedestrian facility. Use the ***Work Zone Decision Tree*** form to identify and document any TPAR design concepts that were evaluated as part of the design process. Include a summary statement of the TPAR design exception(s) in the Transportation Management Plan (TMP).

Where the TPAR design might deviate significantly from the existing pedestrian pathway, the designer should consider a peer review and discuss the exceptions with their lead engineer or manager. If the TPAR is being designed by a staff member, and separately sealed by an "Engineer of Record", the engineer should be given a summary of the design exceptions as part of their plan review.

If the TPAR design includes exceptions, incorporate additional temporary measures into the TPAR Plan as enhancements including, but not limited to, pedestrian-specific signing (warning or regulatory) alerting pedestrians of any accessibility restrictions, and estimated durations of those impacts.

Exception Examples

1. An existing 4-block section of sidewalk is 48 inches wide, but the surface is traversable. The adjacent neighborhood streets have no sidewalks and are divided into 1000-ft long blocks. Work involves the installation of a drainage inlet. Staging will narrow a 20-ft long section of sidewalk from 48 inches to 36 inches.
    - If detours or other alternate routes are impractical, document the exception to narrow the existing sidewalk. Include an anticipated duration of the impact.
    - Document any mitigations included in the TPAR for the narrowed section.
2. An existing 10-ft section of paved highway shoulder must be excavated to complete a cross pipe installation. The asphalt will be removed and replaced with a densely compacted 1/2"-minus aggregate, and left in place for three consecutive days. The compacted aggregate will be rolled smooth and made traversable.
    - If detours or other alternate routes are impractical, document the exception to have pedestrians cross the short compacted gravel section for three days.
    - Document added mitigations for the temporary surfacing, including additional signing and special provision language directing the Contractor to specifically monitor, maintain and repair (as needed) the aggregate section at the end of each work shift.

Pedestrian Channelization – TCM Selection & Placement

Providing a well-delineated, ADA-compliant pathway is critical in safely and effectively guiding pedestrians through or around the work zone.

A suitable system for separating and guiding pedestrians through or around construction work areas can be determined by evaluating several site conditions and project-related factors. Suggestions are based on posted speeds and anticipated pedestrian traffic volumes. Use the following additional factors in determining final device selection:

Pre-construction Posted Speed

Higher motor vehicle traffic speeds may warrant more substantial mitigations for pedestrian traffic, particularly if TPARs remain on-site.

Pedestrian Traffic Volumes

Volumes will have an impact on TPAR design and complexity.

Project Duration

Longer projects can warrant placement and cost of more substantial pedestrian control measures.

Facility Type & Traffic Volumes

Divided highways, arterials and other high-volume facilities often attract transit services and higher pedestrian volumes; and thus more likely warranting ADA-compliant devices for pedestrian management.

Alternate Pedestrian Routes

On-site alternate pedestrian routes can often be preferred due to shorter lengths, consistent terrain, and accessibility. However, where staging impacts on-site routes, local detour routes may be available and can help decrease risks related to exposure to work activities. Both route options must provide for the protection of pedestrians, be properly signed, and accommodate all ADA users.

"Outside The Box" Alternatives

Occasionally, neither on-site pedestrian routes, nor local detours are viable. In these cases, more creative means of pedestrian transport should be considered and weighed against traditional TCM. Partnerships with public transit, taxi and shuttle services may provide acceptable levels of pedestrian mobility.

Available ROW Widths

As with constructability issues, some locations will not have adequate width to provide safe, effective, ADA-compliant pedestrian facilities. Alternative measures should again be explored.

In contrast, where pedestrian facilities *could* be accommodated in proximity to the work area, consider including additional width as part of a construction easement – if widened, the additional width could be used for placement of temporary pedestrian facilities.

Benefit/Cost Ratios: Device Quantities vs. Other Measures

While not a primary consideration, costs between measures must be compared and weighed in combination with other issues discussed above. **Table 3-5**, below, may be used to help determine a practical traffic control measure for pedestrian separation and guidance.

Table 3-5: TPAR Traffic Control Measure Selection Guide

	Pre-construction posted speed (mph)	Using shoulder or making no /minimal changes to pedestrian pathway alignment[1]		Using closed/partial lane or making major changes to pedestrian pathway alignment[2]	
		Between Traffic & TPAR	Between TPAR & Work Area	Between Traffic & TPAR	Between TPAR & Work Area
Urban[3]	≤40	If off sidewalk: surface-mounted tubular markers at 5-10 ft. spacing; PCD or similar.	PCD, or other barrier system[1]. Consider adding escort for long, elaborate TPARs.	Surface-mounted tubular markers at 5-10 ft. spacing; PCD or similar.	PCD, or other barrier system[4]. Consider adding escort for long, elaborate TPARs
	≥45	If off sidewalk: rigid barrier system (e.g. steel, concrete), with protected ends.	PCD, or other barrier system[1]. Consider adding escort for long, elaborate TPARs	Rigid barrier system (e.g. steel or concrete), with protected ends.	PCD, or other barrier system[1]. Consider adding escort for long, elaborate TPARs
Rural[5]	≤40	Existing/temporary pavement markings; tubular markers at 10-20 ft. spacing.	PCD, or tubular markers at 5-10 ft. spacing. Consider substituting for Contractor escort for very long TPARs.	Surface-mounted tubular markers at 5-10 ft. spacing; PCD or similar.	PCD, or other barrier system[1]. Consider substituting for Contractor escort for very long TPARs.
	≥45	Existing/temporary pavement markings; tubular markers at 10-20 ft. spacing.	PCD, or tubular markers at 5-10 ft. spacing. Consider substituting for Contractor escort for very long TPARs.	Rigid barrier system (e.g. steel or concrete), with protected ends.	PCD, or other barrier system[1]. Consider substituting for Contractor escort for very long TPARs.

[1] **Minimal Change**: Shifting alignment by one or two feet, without encroaching onto separate portion of roadway (e.g. traffic lane).

[2] **Major Change:** Examples might include shifting from sidewalk to a full/partial traffic lane; or multi-use path onto a shoulder. Provide traffic lane closures, lane shifts and shoulder closures according to ODOT Standard Drawings. Use Buffer Space "B" between the end of the lane closure taper and start of the TPAR shift where it moves pedestrian into the roadway or traffic lane.

[3] **Urban:** Higher traffic volumes; multiple pedestrian facilities/crossings; high anticipated pedestrian presence/usage; large pedestrian traffic generators.

[4] **Other Barrier System:** Refers to temporary concrete or steel barrier; or other continuous system that includes a handrail and detectable edge; and, will restrict pedestrian access from work area. All barrier systems must include crashworthy end treatments when exposed to vehicle traffic.

[5] **Rural:** Low traffic volumes; few to no specific pedestrian facilities, low to very-low anticipated pedestrian presence/usage.

Before finalizing the pedestrian TCM choice, Designers should also consider using local detour routes, where practical, to remove pedestrian traffic from the work zone, altogether.

If detour routes and the TCM listed below are impractical, or technically infeasible, the following measures can also be considered:

- On-site shuttle services – for known high pedestrian volumes
- On-call shuttle services – for low pedestrian volumes
- A taxi fare voucher systems – for all pedestrian volume situations

Designers should also consider the practicality/feasibility for temporary bus stops developed and coordinated through the local transit authority.

Where an off-roadway TPAR is developed, and the alignment differs dramatically from the original facility (e.g. non-parallel, non-linear, etc.) or bisects an active work area, PCD should be placed on *both* sides of the temporary pathway. See **Table 3-5**, above, for additional scenarios and PCD selection details.

Final selection of the channelization between pedestrians and either traffic or the work space should be based on engineering judgment, site conditions, work activity and duration; and, TCP staging details.

Contact the ODOT work zone traffic control unit for additional assistance with project-specific PCD applications.

Device Placement

PCD placement depends on a number of factors including the location of pedestrians with respect to the hazard(s) – e.g. motor vehicle traffic, construction activities, surface conditions, pedestrian destinations, etc.

Between Pedestrians and Vehicular Traffic

When the project impacts the existing pedestrian facility; pedestrians may be forced to share the same roadway surface as motor vehicles (e.g. a closed lane or shoulder).

Figure 3-3: PCD between Pedestrians and Vehicles

Closure Points

PCD are an effective means for keeping pedestrians from venturing beyond the intended point of closure – especially critical where closure points are immediately adjacent to an active work area, or a location that could result in significant pedestrian injury or death. At the sidewalk closure point, the channelizing pedestrian device needs to extend the length of the sidewalk in a "U" shape facing away from the closure as illustrated in Figure 3-4. In severe cases, chain link fencing and other similar strategies may be warranted. See ODOT Standard Drawing TM844 for examples of Closure Points and the appropriate signing and devices used at those locations.

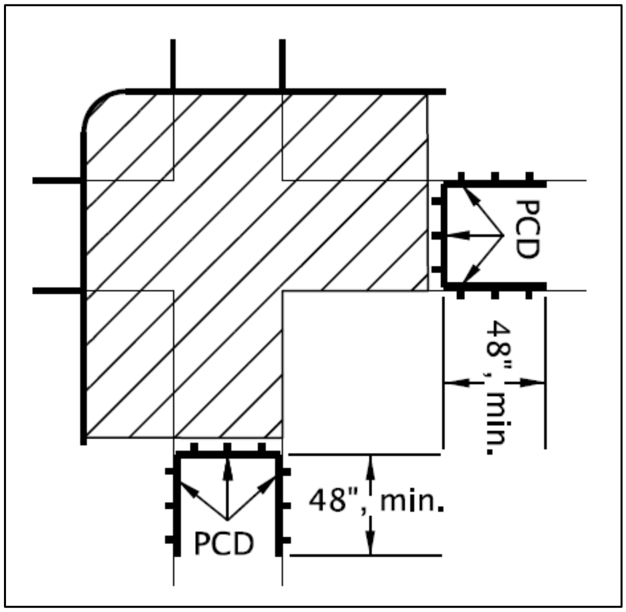


Figure 3-4: PCD Closure Detail

Detour

The preferred solution is to develop a reasonable-length detour route using existing local facilities and the neighborhood street network.

Barrier

However, if a detour route is not available, nor practical; a rigid barrier system (concrete, steel, plastic (water solution-filled)) may be used to separate motor vehicles from pedestrians.

Temporary Easement

If a detour route through a local neighborhood is not practical due to length or infrastructure condition, an on-site detour should be considered. The on-site route may channelize pedestrians through a parking lot or other property. Development of this type of route would require a temporary construction easement and a formal agreement made between ODOT and the affected property owner. PCD should be used on both sides of this type of TPAR design.

Pedestrians and the Work Area

Use PCD between pedestrians and the active construction work area when the following conditions apply:

- Pedestrian traffic must pass along-side the work area. The “work area” may include active or inactive work, storage of equipment and materials; or, empty space for Contractor access or staging purposes.
- If work area hazards are present on both sides of the pedestrian pathway, PCD should be placed on both sides of the pathway. See photo below.
- Exceptions are described in Table 3-4, above.

Figure 3-5: PCD between Pedestrians and Work Area

Covered Pathways

Where work activities take place above the pedestrian pathway, or falling debris is a concern, the TCP should include directions to Contractors to provide a canopied or covered pedestrian walkway in those areas. Covered walkways should be well-lit for nighttime use.

Figure 3-6: Covered Pathway

Pathway Lighting

Pedestrian facilities should be adequately lit for nighttime use, and in some cases for security purposes. Existing lighting may be used, but supplemental lighting may be needed for temporary covered pedestrian pathways.

Temporary Pedestrian Signing

Providing adequate, complete and consistent signing for temporary pedestrian pathways is equally critical in helping ensure effective pedestrian accommodation in a work zone.

Several standard signs are available for use in signing sidewalk closures, instructions for alternate crossing points and/or alternate pedestrian routes. Designers should use the following resources in developing their pedestrian traffic control plan details:

- ***FHWA Standard Highway Signs and Supplement***.
- ***MUTCD –*** *Chapters 2 – Signs*, and *6 – Temporary Traffic Control.*
- ***ODOT Sign Policy & Guidelines***.

In signing a temporary pedestrian facility, Designers should focus on four important components:

Advance Notification

Required signing for ODOT projects or local agency projects receiving ODOT funding. Advance notification signing is placed to notify pedestrians of sidewalk closures under three conditions:

- **Full-time closures:** Displaying the start and end dates for the closure.
- **Daily closures:** Displaying the daily and hourly closure schedule for the sidewalk.

- **Intermittent closures:** Displays the duration pedestrians should expect temporary, intermittent, short-duration (~5 min. or less) closures of the sidewalk.

Positive Guidance & Continuity

An effective TPAR must be properly signed. Without clear, adequate, and continuous signing, pedestrians may choose their own route – a route that may lead to serious injury.

The use of standard signs, particularly regulatory signs, is strongly recommended. Standard regulatory signs provide an added degree of enforceability should a pedestrian choose to ignore the TPAR alignment and personal injury results. Regulatory signs are predominantly used at closure points and points where it has been determined safest for pedestrian travel.

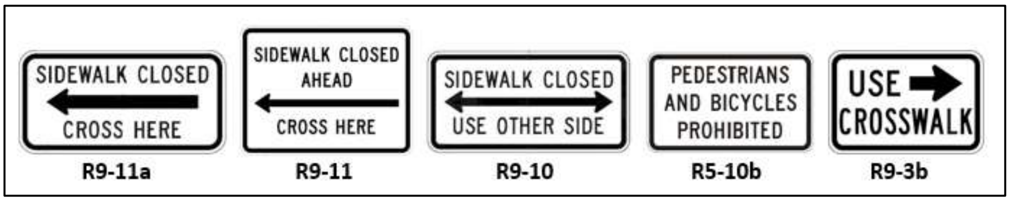


Figure 3-7: Examples of TPAR Regulatory Signs

A consistent use of warning signs should be used to alert pedestrians of changed conditions and provide positive guidance for any temporary detour routes. Detour routes must be signed completely in both directions, where applicable, and include "reminder" signs at reasonable intervals along longer TPARs.

Figure 3-8: Examples of TPAR Guidance Signs

Sign Supports & Mounting Heights

Like many temporary signs used for motor vehicle traffic, the sign support and mounting height of a pedestrian sign will depend on the sign location. Most temporary pedestrian signs will be installed on a single-post Temporary Sign Support (TSS), see ***ODOT Standard Drawing TM821***.

Where a TSS is placed along a sidewalk, buffer strip, roadway shoulder, or other location where pedestrian traffic may come into contact with the sign, the sign should be installed with the bottom of the sign 7 feet above the ground, per the ***MUTCD***.

Mount signs on PCDs at the sidewalk closure point or where PCD is used for sidewalk diversion as shown in Figure 3-9.

Figure 3-9: Sign Mounting on PCDs

Mounting temporary pedestrian signs on a Type II barricade should be limited for two primary reasons:

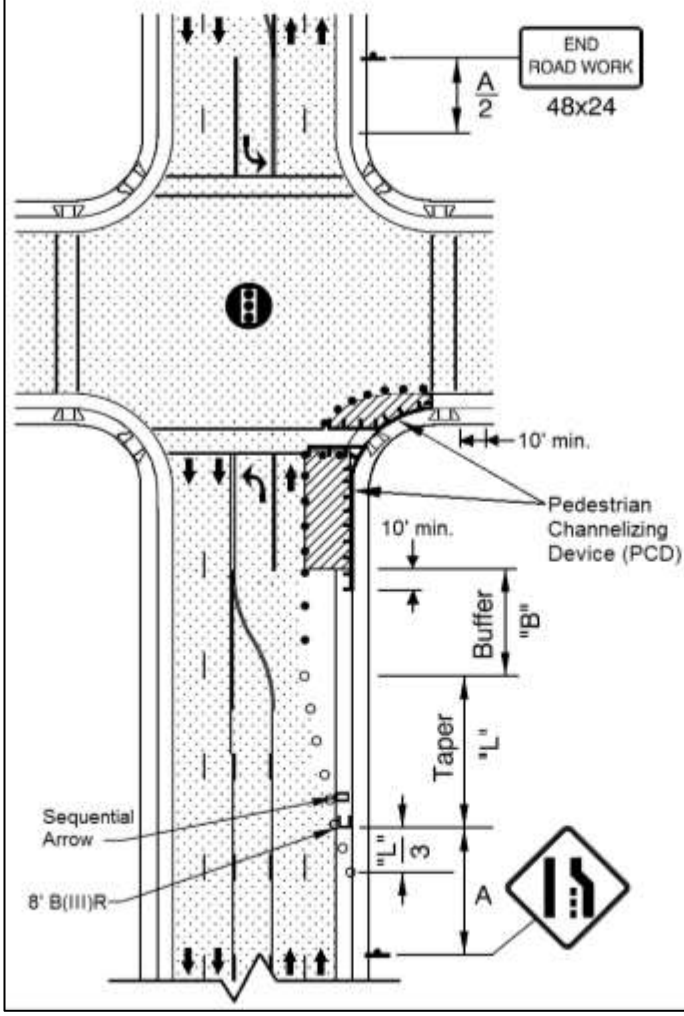
- The barricade can often create a pinch point or tripping hazard to pedestrians when placed on a sidewalk or other location so as to be legible by pedestrians
- The Type II barricade is a separate Pay Item, and often causes confusion during construction as to whether the barricade, acting as a sign support, should be incidental to the cost of the sign, or measured and paid for as a Type II barricade.

Refer to the ***MUTCD***, ***Chapter 6***; and, ***ODOT Standard Drawings TM821*** and ***TM844*** for additional details.

TPAR Details

Because every project site and TPAR design is different, there are too many permutations and scenarios to address in this single Manual. However, the following details have been developed based on some of the more common situations and mitigations being implemented to date.

Similar to ODOT Standard Drawings, while no one drawing may perfectly match your project's specific needs and conditions, Designers are welcome to use these details – or portions of them – to design their own project-specific TPARs. Contact the ODOT work zone Traffic Control Unit for further discussion and assistance in the design of temporary pedestrian accessible routes. Examples of TPAR details are provided in Figures 3-10 through 3-13.



NOTES:

- Place PCD on either side of sidewalk ramps and across temporary pedestrian access routes, as shown.
- Extend PCD a min. of 10-ft beyond the activity area, and beyond the temporary pedestrian access route around sidewalk ramps, as shown.
- Place PCD along work areas to provide positive guidance for pedestrian traffic and limit exposure to work zone hazards.
- Use channelizing devices to direct vehicular traffic around work area, as shown.
  Use spacing of 10' for devices around work area and corner radii. For all other areas use spacing according to Device Spacing Table on TM800.
- If work area extends across one sidewalk ramp, close the ramp and develp a temporary pedestrian detour route. Place detour signing and other TCD to direct pedestrians to the alternate route.
- Not all TCM for motor vehicles are shown. Refer to other TM800 Series Standard Drawings for additional motor vehicle TCM details.
- Additional Traffic Control Measures (TCM) may be required for all legs of the intersection.

Figure 3-10: TPAR at Existing Signalized, Marked Crosswalk

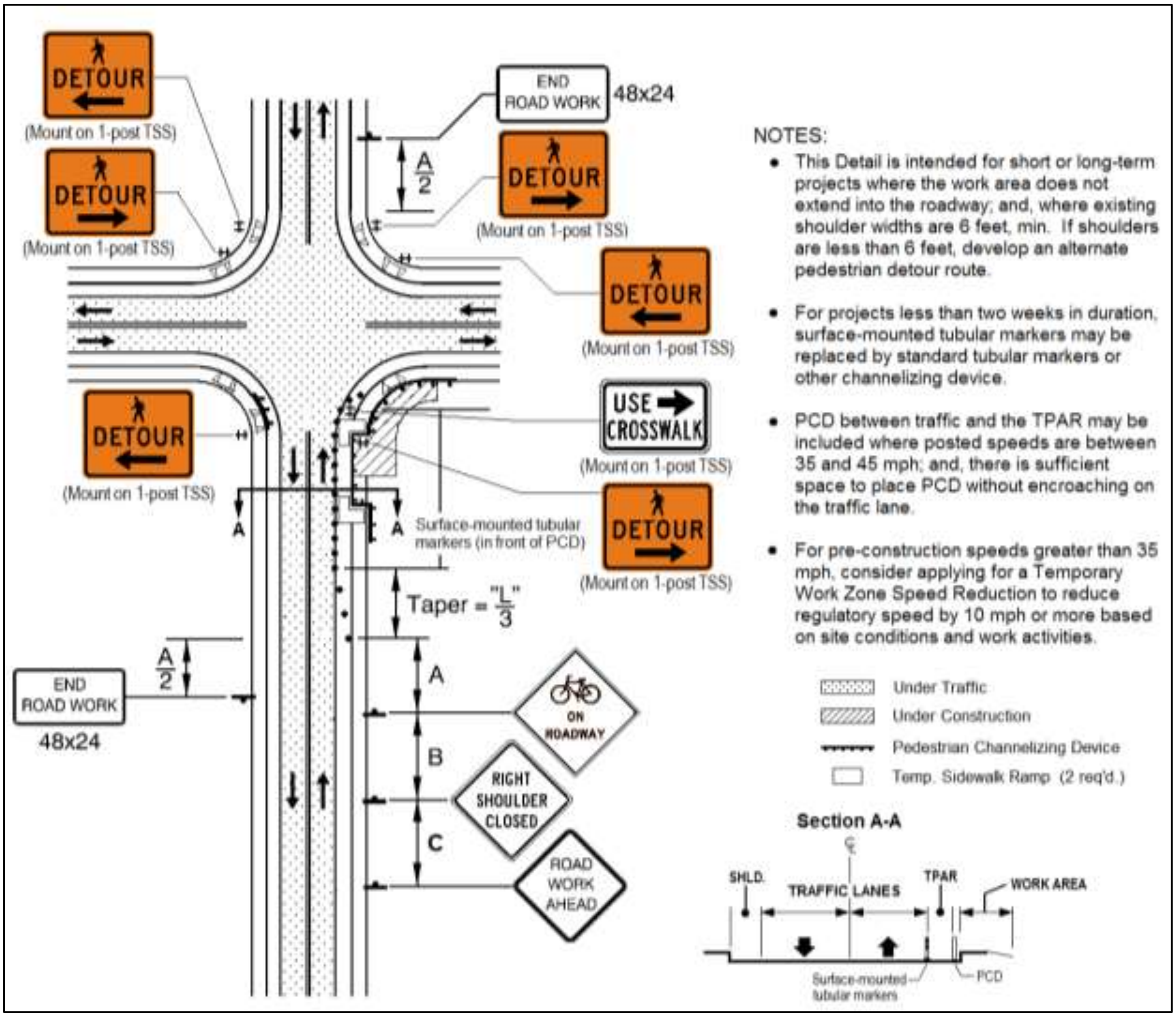


Figure 3-11: TPAR On-Site Diversion onto Shoulder or Bicycle Lane

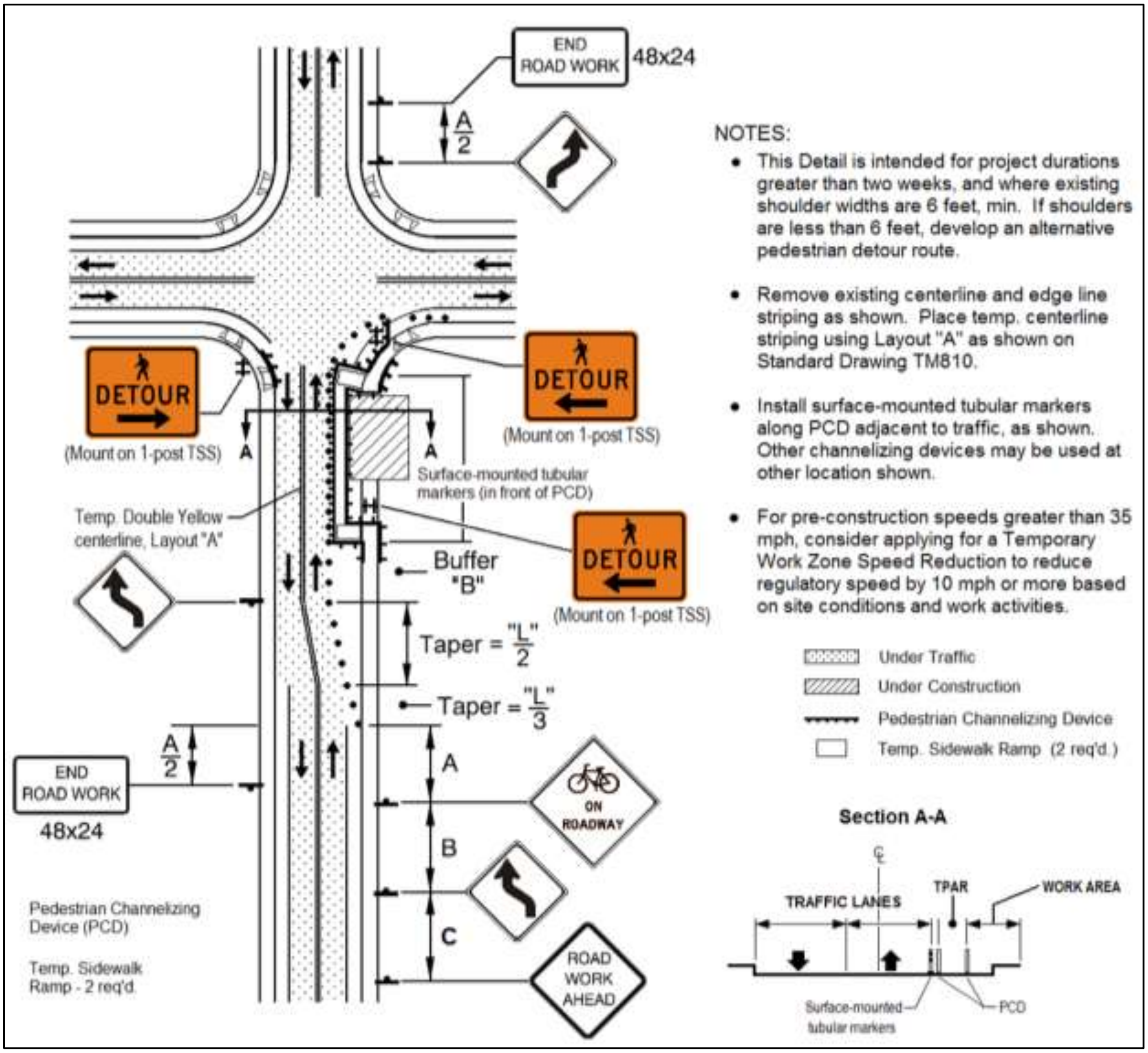


Figure 3-12: TPAR – On-Site Diversion with Partial Traffic Lane Encroachment

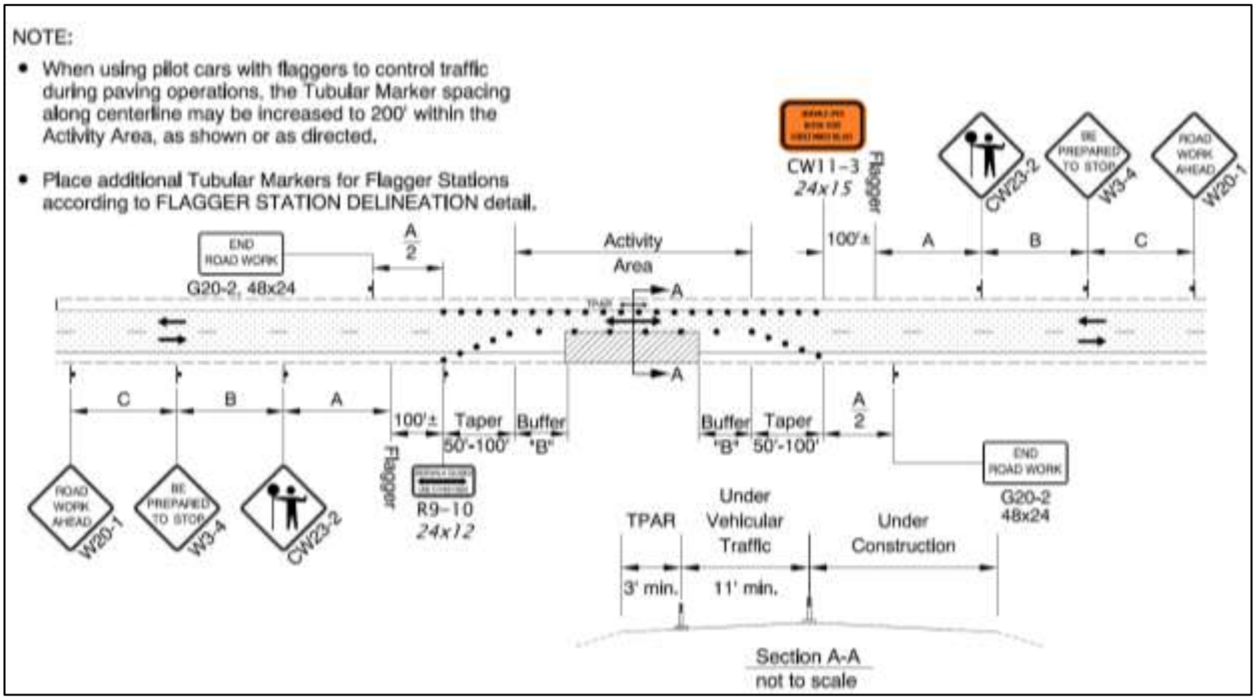


Figure 3-13: TPAR – 2-Lane, 2-Way Roadway – One Lane Closure

3.4.6 Bicycle Accommodation Design

When a highway construction work zone affects the safety, accessibility or movement of bicyclists, the TCP must provide traffic control measures to accommodate bicyclists through or around the work zone.

The principles discussed in the STANDARDS in the ***MUTCD***, ***Section 6C***; the ***ODOT/APWA Standard Specifications***, and the ***ODOT Standard Drawings*** also apply to accommodating bicycles in a work zone. For site-specific conditions or configurations not addressed by the aforementioned references, the designer may need to provide additional bicycle facility-specific details within the traffic control plan.

If the existing roadway, to be affected by the project, includes a marked bicycle lane or a wide shoulder used by bicycle traffic; or, the highway is a designated bicycling route, bicycling traffic should be provided with a convenient and accessible path that replicates, as nearly as practical, the most desirable characteristics of the existing bicycling route. This may include bicycle pushbuttons, separated bike lanes, and bike detours.

Bicycle Accommodation Issues

- Do not lead bicyclists into conflicts with public traffic, construction vehicles, equipment, operations, or hazardous materials.

- Provide a convenient, contiguous and traversable path with an equal or better degree of accessibility than the existing bicycling route.
- Providing a separate roadway space (e.g. shoulder, bike lane) for bicycles is preferred. Use channelizing devices to separate bicycles from traffic if delineating a temporary pathway/alignment.
- Where roadway width is not available, explore detour routes for bicycles. Develop a thorough signing plan for the detour. Include regulatory bicycle exclusion signs to keep bicycles out of the work area and encourage use of the detour route.
- Coordinate with local agencies, as necessary, if alternate bicycling routes would utilize their facilities. Ensure bicycle traffic and TCD placement on their facilities are approved prior to your project being released for advertisement.
- For pre-construction posted speeds of 35 mph or lower, where neither roadway width, nor alternate routes are available, a "shared roadway" condition could be provided. Designers should apply for a 10 mph temporary Speed Zone Reduction for the section where bicycles will be on the roadway. Include "Bicycles ON ROADWAY" signs for additional mitigation.

Special Bicycle Design Environments

Designers should be aware of the following design environments as they begin their designs for bicycle accommodation. Each traffic control measure or work zone condition should accommodate bicycles, or identify an alternative means to do so:

- **Closure of Shoulders, Sidewalks, Bike Lanes or Multi-Use Paths**: Provide temporary facilities or pathways that allow for safe, efficient bicycle travel through or around the work zone. Please note that two-way, one-lane work zones often leave minimal operational widths for vehicles and may omit a standard shoulder normally used by bicyclists. Be prepared to consider alternative routes, shared roadway conditions or other strategies under these circumstances.
- **Urban/Suburban Intersections**: Scope of work often includes work on all four corners of an intersection and can sometimes intrude into the shoulder/bike lane. In some urban/suburban environments, viable detours or space for adequate temporary facilities may be limited.

If speeds are low enough (e.g. ≤ 35 mph), or measures can be deployed to ensure a reduced speed through the work zone, use of a shared roadway condition may be one of a few remaining measures for accommodating bicyclists.

- **Existing Bicycle Facilities:** Designers should collect information and details specific to the existing facilities for cyclists – including widths, grades, surface conditions, pavement markings, signing, and access to these facilities.

- **Construction Details and Staging Considerations**: TCPs must provide enough detail to Contractors to build the project, and to safely accommodate bicycle traffic within the work zone.

Bicycle-specific details may be included on separate plan sheets, depending on the level of complexity at each location where special bicycle channelization is needed. For simpler mitigations, details may be included on the same sheets used for managing motor vehicle traffic.

Develop bicycle-specific plan sheets, as needed, as part of the TCP to clearly indicate bicycle traffic routes; surfacing designs; bicycle-specific signing; bicycle channelizing device (BCD) locations and quantities, and other details.

Bicycle-specific plan sheets may be drafted at a larger scale (e.g. 1″= 100′ or 1″= 50′) to improve clarity for the TCP design. Nonetheless, the TCP should include bid items and quantities necessary to implement the details shown in the plans, including:

- Bicycle channelizing devices (BCD).
- Bicycle-specific temporary signs.
- Cross sections at critical locations or "pinch points" where precise placement of TCD is vital.
- Temporary surfacing material (see Section 00230 – Temporary Detours of the Standard Specifications).

"Outside the Box" Alternatives

Occasionally, neither on-site roadway widths, nor local detours are available. In these cases, more creative means of transporting bicycles should be considered and weighed against traditional measures. Partnerships with public transit or private shuttle services have been used in the past to maintain acceptable levels of bicycle mobility. Consider temporary bus/shuttle stops, information kiosks, "hotline" phone numbers, etc., to provide an effective transportation means for cyclists.

Temporary Signing

Bicycle–specific signing should be used in cases where the following conditions exist during the construction of your project:

- A significant number of bicycles can be expected. Local agencies, Chambers of Commerce, and other resources may be helpful in determining likelihood of bicycle presence.
- When an existing bicycle facility (e.g. bike lane, multi-use path) is impacted by construction and cyclists must share a traffic lane, or the shoulder width is narrowed to 3-feet or less.

"BICYCLES ON ROADWAY" (CW11-1) Sign

Include for the conditions described above, and for locations and situations such as:

- Shoulders, bike lanes or sidewalks are closed or removed as part of construction activities.
- Rural Areas: Consider cyclist touring routes, larger cycling events (e.g. Cycle Oregon). These locations may not be readily recognizable as a cycling route.
- Designated Bicycle Routes and Scenic Bikeways: Several highways around Oregon carry a significant volume of cyclists year-round – e.g. Oregon Coast Highway (US 101), John Day Highway (US 26), OR99W, Santiam Highway (OR 22), etc. Visit the Oregon Parks and Recreation Department website for additional information.

See ***Chapter 6*** of the ***ODOT Sign Policy & Guidelines*** for additional sign details. The CW11-1 sign may be fabricated using rigid substrates (plywood, sheet aluminum), or roll-up sheeting.

Figure 3-14: CW11-1 Sign

"BICYCLES KEEP LEFT (RIGHT)" (CR4-22) Sign

Include the sign at the leading end of a BCD taper to indicate to cyclists on which side of the BCD they should ride. The sign may also be used at locations where it is desirable to keep bicyclists from crossing into the active work area. The sign should be installed on a single-post Temporary Sign Support.

Figure 3-15: CR4-22 Sign

Temporary signing can also be helpful in identifying the location, or beginning and ending points of a temporary bicycle pathway. While standard sign designs should be considered first, project-specific sign designs may be necessary.

Other temporary bicycle signing examples:

Figure 3-16: Other Bicycle Signs

Boilerplate Special Provision – Section 00222

From the current ***2021 Boilerplate Special Provision*** for ***Section 00222***, include the applicable language regarding the use of the "BICYCLES ON ROADWAY" sign. The Boilerplate can be found on the ODOT Specifications Unit website. The Boilerplate language includes several different applications depending on the location of the project.

Channelizing Devices

When construction staging creates a situation where a shoulder of 5-feet or more can be maintained between a traffic lane and the work area, Designers should show enough detail on TCP plan sheets to clearly convey the proper location of channelizing devices that will retain enough of the shoulder width to accommodate bicycle traffic. In these cases, the devices should be shown immediately adjacent to the work area (e.g. longitudinal saw cut, excavation, pavement overlay edge, etc.), or as far from the edge of the traffic lane to optimize the width of the shoulder for bicycle traffic. See the photos below.

Figure 3-17: Shoulder Width Accommodation for Bicycles

Include cross-section details at multiple locations to emphasize the proper placement of devices with respect to the bicycle travel space. Designers should include additional notes or details to clarify the intent of how bicycles are to be accommodated in the work zone.

As the level of detail for bicycle and pedestrian accommodation is often higher and more site-specific than it is for motor vehicles, the benefits of including bicycle-specific details on the TCP sheets may be more apparent.

Bicycle Channelizing Device (BCD)

To help agencies and Contractors better manage work zone safety and liability, and provide a safer travel space for bicycle traffic, the Bicycle Channelizing Device (BCD) can be included in the TCP and placed between bicycle traffic and the active work area.

The intent of the BCD is to guide bicyclists along a designated path, and encourage them to stay on the roadway and out of the active work area. BCD will typically be placed on the right, between the active work area and the roadway space identified for bicycle traffic.

Where a temporary bicycle pathway alignment may differ from the motor vehicle alignment, BCD placement along the edge of the active work area should be considered. An additional alignment of individual channelizing devices (cones, drums, etc.) may be placed on the opposite side of the temporary bicycle pathway to facilitate bicycles entering and exiting the temporary bicycle pathway. See Figure 3-18, next page, for suggested BCD placement details.

BCD Supplemental Signing

To reinforce compliance and enforceability in having bicycles stay out of the work area, regulatory signing has been developed that can be posted at the beginning and regular intervals along a BCD alignment. See the ***ODOT Sign Policy & Guidelines***, ***Chapter 6***, for sign design details.

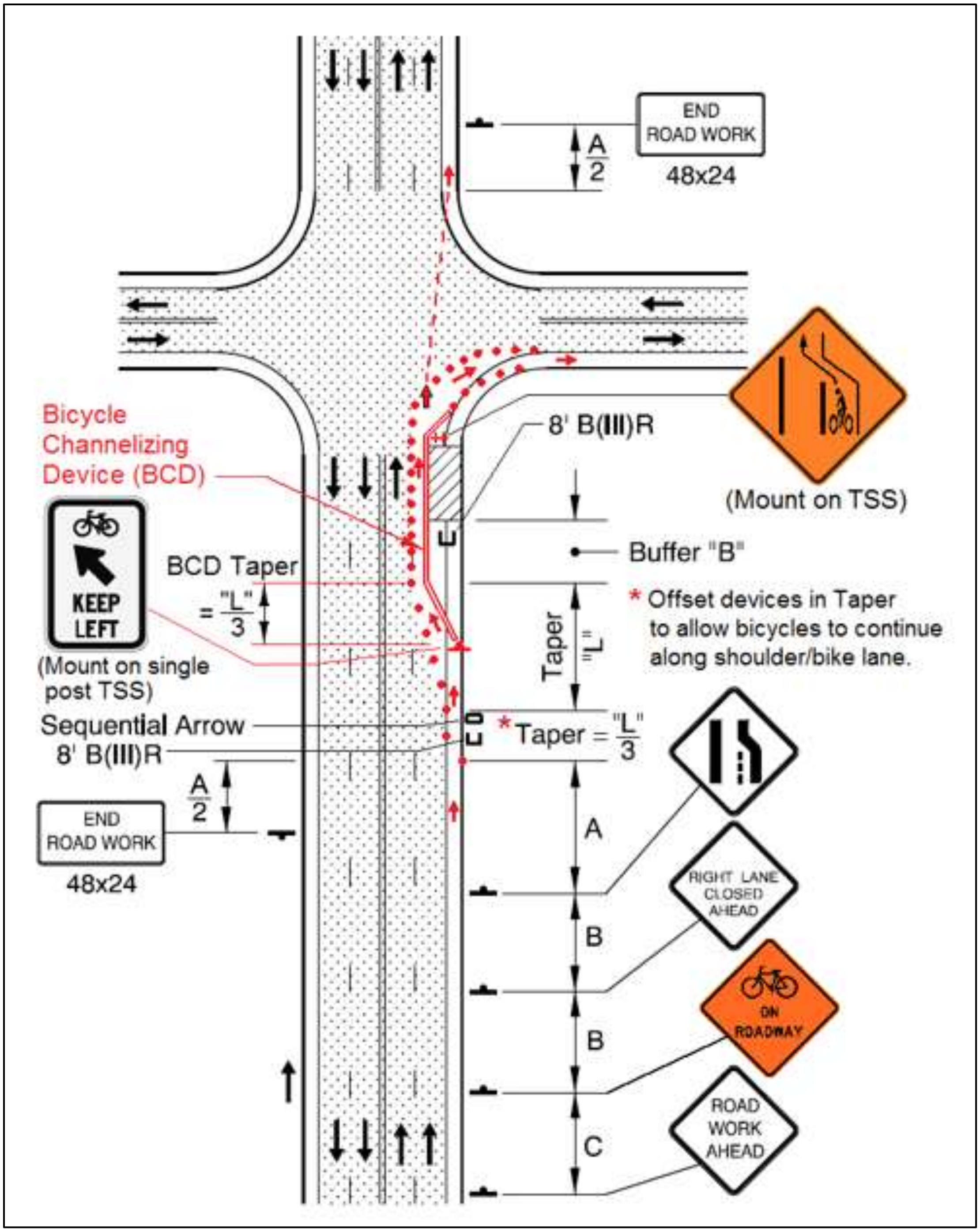


Figure 3-18: Suggested BCD Usage

3.4.7 Clear Zones in the Work Zone

The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways. Due to the nature of a work zone, horizontal clearance is often limited. Further, driver awareness is often heightened. As a result, lateral clear zone requirements are generally less. Work zone clear zones do not override the permanent clear zone – meaning existing roadside features should not be removed to meet work zone clear zone requirements. Engineering judgment is regularly used to determine tolerable clear zone widths in work zones. Depending on site restrictions, only an operational clearance may be needed – often as little as two feet.

As Designers consider staging needs and opportunities for positive separation between workers and traffic, maximizing lateral clear zones should be explored, and included, when feasible.

ODOT provides suggested minimum clear zone distances (see *Table 3-6*). However, clear zone distances should be maximized, where possible. When clear zone distances are critical to a project, distances should be identified within the project documents – e.g. shown in cross sections on the plans, or clearly described in the project Special Provisions.

When determining clear zones, account for traffic speeds, volumes, roadway geometry, available right of way, and work duration. Document specific clear zone widths in the project file.

Stored Construction Equipment & Material

From the ***ODOT/APWA Standard Specifications for Construction – Section 00220.02*** – stockpiled materials and inactive construction equipment and vehicles not behind barrier should be stored a minimum of 30 feet from the traveled way for all projects. The work zone clear zone concept applies to exposed hazards in the work zone – exposed barrier ends, stored equipment, drop-offs, fixed objects, etc. For practicality purposes, the work zone clear zone concept does not apply to construction vehicles and materials being used for active construction operations.

Drop Offs

Drop-offs or abrupt edges are inevitable during some construction activities. Protecting drop-offs with temporary concrete barrier or not within the clear zone depends on the depth of the drop, the proximity to live traffic, speeds, volumes, roadway geometry, and duration of the exposed hazard.

At a minimum, drop-offs within the clear zone should be delineated according to the ***Typical Abrupt Edge Delineation*** detail shown on ***ODOT Standard Drawing TM800***. Excavations within four feet of the traveled way shall be protected according to ***Standard Specification 00220.40(d)***. See the ***AASHTO Roadside Design Guide*** for additional information regarding concrete barrier warrants.

Table 3-6: Suggested Minimum Clear Zone Distance

Pre-Construction Posted Speed (mph)	Minimum Distance[1] (ft.)
35 or less	10
40	12
45 – 50	16
55	20
60 or greater	30

Construction Vehicles Contraflow

In developing the traffic control plan, project staging should consider construction vehicle access points to the highway, and circulation patterns within the work area and to/from the work site (e.g. delivering or hauling away construction materials). When implementing the TCP, Agency personnel should monitor Contractor operations if contraflow conditions exist on the project site.

Construction vehicles accessing the highway within a closed lane or shoulder should travel in the same direction as adjacent public traffic whenever possible to avoid confusing motorists – particularly at night or during inclement weather. Exceptions are made for compaction rollers, motor graders, bulldozers and other off-road type equipment that must move in both directions; and, during two-way, one-lane traffic control where traffic is alternating directions through the work area (e.g. flagging, temporary signals).

Construction vehicles traveling toward oncoming traffic in a closed lane on the driver's right side –violates driver expectancy and can cause confusion, potentially leading to a crash. When construction vehicles must move against oncoming traffic (e.g. picking up lane closure devices) construction vehicles should normally back up at a controlled speed to avoid confusing traffic and to avoid turning their vehicle around in the work area.

Construction vehicles often travel freely in the opposite direction of traffic when work is taking place:

- Within a wide median area
- On a separate roadway
- Behind concrete barrier or guardrail

Contraflow Mitigations

When it is not possible or practical for construction vehicles to travel in the same direction as adjacent traffic, construction vehicles may drive within a closed lane in the opposite direction of

[1] Clear zones distances shown are measured from edge of the nearest live traffic to the hazard or obstacle.

adjacent traffic if the following criteria are considered and are addressed in the TCP (via special provision language, plan sheet details, additional TCD pay items, etc.):

- Using a barrier system to separate the work area from live traffic.
- Limiting work to daytime hours to maximize visibility.
- Using overhead work area lighting at night to increase visibility and reduce driver confusion.

Contractors may propose construction vehicles turn off their headlights when driving toward oncoming traffic while within the work area. To legally operate the vehicles at night without headlights, "…the work area shall be illuminated to a minimum of 2 foot-candles per square foot." See OSHA 1926.600(7).

- Limiting the speed of construction vehicles to 20 mph or less (the slower the better)
- Maximizing the separation between live traffic and construction vehicles (e.g. 1 buffer lane)
- Using larger channelizing devices (e.g. Plastic drums) to separate work area from live traffic, and reducing channelizing device spacing
- Minimizing dust and flying debris (e.g. Temporary glare screens)
- Using Truck Crossing (W11-10) warning sign or a PCMS to warn traffic about construction vehicles in the work area.
- Temporarily reducing the legal posted speed of the highway. Use the Work Zone Speed Reduction Request Form and seek state traffic-roadway engineer approval before posting a reduced regulatory speed.
- Identifying safe and efficient locations where construction vehicles can turn around without accessing the highway.
- Identifying specific ingress and egress access points to the work area. Designers may incorporate a Smart Work Zone System (SWZS) designed for construction vehicle access. The SWZS can be included in the TCP at each critical ingress location to warn approaching traffic by displaying real-time warning messages of entering vehicles. See ***Chapter 2*** and ***Chapter 3*** for more information about Smart Work Zone Systems.

3.4.8 Crossover Design and "On-Site Diversions"

A crossover is a construction staging technique used to shift traffic from one side of a divided roadway onto a portion of roadway not under construction – typically sharing the remaining roadway with opposing traffic. A specific type of crossover, known as an "on-site diversion", moves traffic onto a temporary alignment constructed either in the median or adjacent to the original alignment. Crossovers are an effective method for completing construction of a roadway by replacing or repairing the roadway or a structure while maintaining traffic in both directions. A crossover also provides an effective means for providing long-term positive separation between workers and live traffic. In determining the feasibility of a crossover or an on-site diversion, record any design-related issues or decisions into the Work Zone Decision Tree (See Chapter 1 for more details).

In some cases, based on the results of proper work zone Traffic Analysis, the existing capacity of a facility may be reduced to minimize the amount of temporary roadway needed for the on-site diversion and for additional right of way.

Construction of an on-site diversion typically consists of a temporary roadway alignment (possibly construction of a temporary structure, as well). The limits of the on-site diversion extend from the initial reversing curve (Curve 1, see Figure 3-19 below) leaving the existing roadway to the final reversing curve tying the alignment back into the existing roadway (Curve 4).

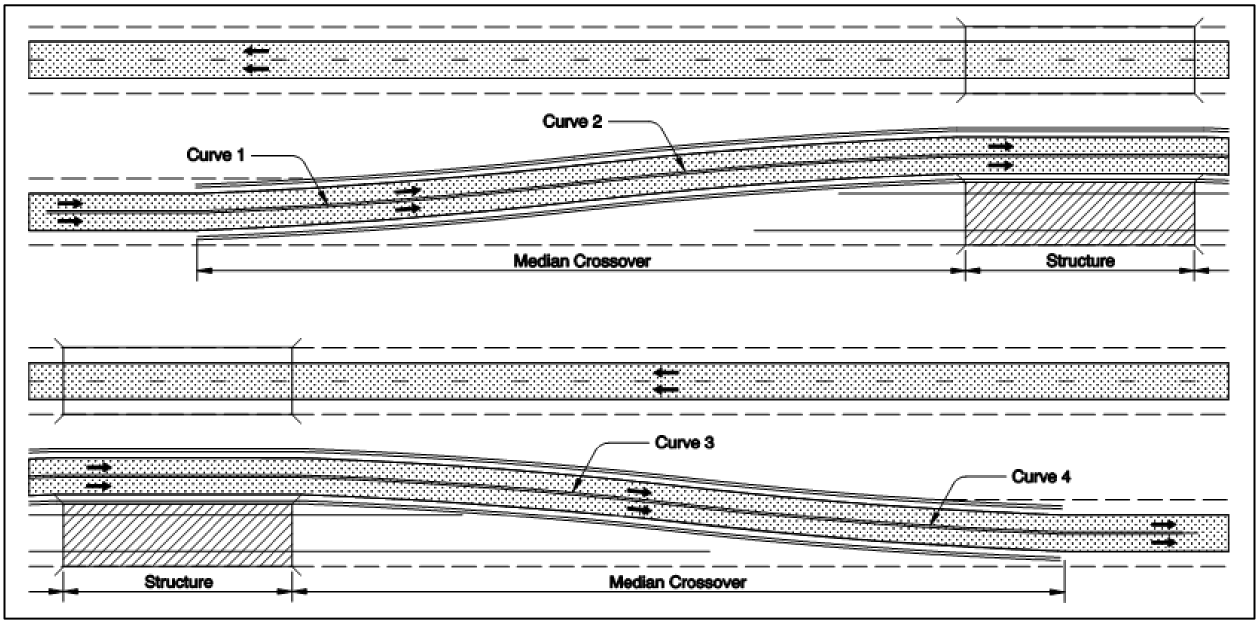


Figure 3-19: Temporary Alignment for On-Site Diversion

On-site diversions are typically used on freeways, but may be used on divided highways with limited at-grade accesses. Lane closures and traffic shifts are typically used on multi-lane non-freeways with two-way continuous left-turn medians, but diversions are an option for long-term stationary work.

An engineered alignment and cross-sections should be developed for the crossover. Temporary crossover alignments do not need to incorporate spirals, spiral segments or partial spirals. However, spiraled curves should be considered when the existing alignment is located on a curve. TCP Designers should provide at least one cross-section taken somewhere along the crossover alignment and show this on the TCP plan sheets (see Figure 3-20).

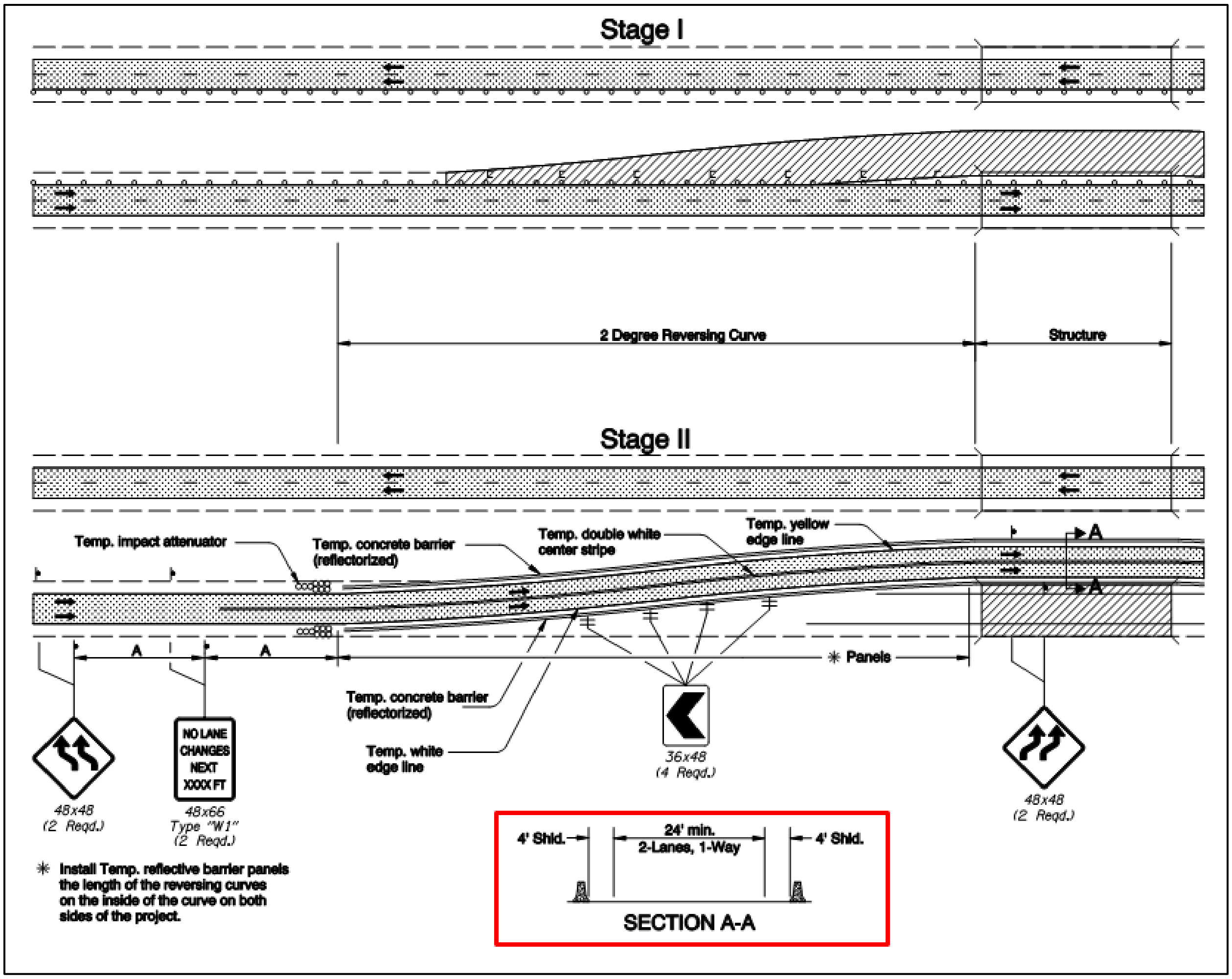


Figure 3-20: TCP Staging of On-Site Diversion

Crossover Design

In determining the radius of curvature for crossover alignments, the designer should begin with the ***ODOT Highway Design Manual - Comfort Speed Table (Table 200-13)***. For radii of Curves 1 and 4 (Figure 3-19), use the existing mainline superelevation rate in the lane adjacent to the crossover departure and return points. It is not practical to build temporary pavement on mainline to develop superelevation for the crossover departure and return curves. Therefore, designers should attempt to use curves based on the superelevation rate of mainline at these points.

Example 1

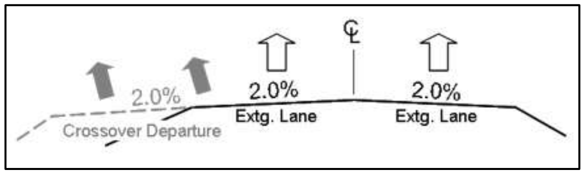


Figure 3-21: Example 1

Given: Pre-construction posted speed = 65 mph. Mainline super = normal 2.0% crown at centerline.

If crossover is built in the median, as shown, using ***HDM – Table 3.5***, the minimum radius for Curves 1 and 4 would be **2292 ft.** ($2^0$30′) = 66 mph Comfort Speed at 2.0% superelevation.

Example 2

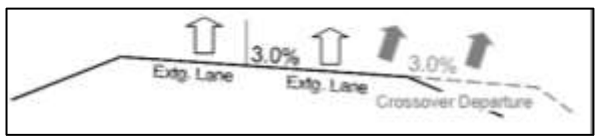


Figure 3-22: Example 2

Given: Pre-construction posted speed = 55 mph. Mainline super = 3.0%.

If crossover is built to the right, using ***HDM – Table 3.5***, the minimum radius for Curves 1 and 4 would be **1273 ft.** ($4^0$30′) = 55 mph Comfort Speed at 3.0% superelevation.

Example 3

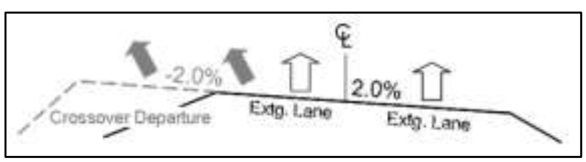


Figure 3-23: Example 3

Given: Pre-construction posted speed = 60 mph. Mainline super = 2.0%.

If crossover is built in the median, as shown, using ***HDM – Table 3.5***, the minimum radius for Curves 1 and 4 would be **2546 ft.** ($2^0$15′) = 61 mph Comfort Speed at -2.0%[1] superelevation.

[1] Because traffic is travelling counter to (across) the +2% superelevation, the effect is similar to a driver traversing a -2.0% adverse superelevation.

Crossover Design Consideration

- Where physical space within the work area allows, flatter curves may be used.
- For driver comfort and ease in negotiating the crossover, use the same or similar radii for all four curves in the diversion alignment. Be particularly aware of truck volumes using the alignment. Large trucks are sensitive to sharp reversing curves and adverse superelevation.
- If existing mainline superelevation rates exceed 5.0%, or radius of curvature exceeds 12^0, see the ***ODOT Highway Design Manual (HDM)***.
- Spirals, spiral segments or partial spirals may be necessary to transition from the existing mainline alignment to the temporary crossover alignment.
- If crossover departures and return points are in close proximity to existing entrance or exit ramps, show channelizing devices (typically plastic drums) on TCP plan sheets that mimic acceleration lanes and exit gore areas.
- Include minimum acceleration lane lengths and a terminal taper for entrance ramps.
- If Exit ramps are too close to the return point of a crossover, closing the Exit ramp and detouring traffic to the next exit is recommended.

The alternate Exit may be in advance of the closed Exit ramp. Provide thorough advance warning (e.g. PCMS) and detour signing in these cases. Include all necessary signing for ramp closures and detour routes for mainline *and* any impacted crossroads.

Crossover Width

- Use 4-ft minimum shoulder widths in multilane crossovers to accommodate large vehicle off-tracking. Use 2-ft minimum shoulder widths for single-lane crossover alignments.
- Use **Table 3-7** to provide horizontal widths between positive barriers (concrete or steel barrier, guardrail or other rigid system) through crossovers.

Table 3-7: Crossover Widths

Facility	Single Lane (ft.)	Two Lane (ft.)
Interstate/Multilane Route	19	28
Other 2-Lane NHS Route	16	28

If narrower crossover widths are needed on a State highway, contact the appropriate ODOT Region Mobility Liaison and Commerce and Compliance Division (CCD) to discuss design and mitigation options.

See the “Freight Mobility Daylight Width” and “Freight Mobility Nighttime Width” maps from the ODOT Commerce and Compliance Division (CCD) website for additional route and freight restriction information.

Other Crossover Design Considerations

- Consider filing for a temporary Speed Zone Reduction Order for crossovers. Approval of the reduction is not guaranteed. The approval will be based on site conditions during staging and the scope of work. See the Temporary Speed Zone Reduction section in this manual for additional information.
- Add appropriate Advisory Speed (W13-1) riders below advance Reverse Curve (W1-4), Two Lane Reverse Curve (W1-4b) and Three Lane Reverse Curve (W1-4c) symbol signs to indicate advisory speeds through the crossover curves.

Issuance of a Temporary Speed Zone Reduction does NOT warrant a reduction in the TCP Design Speed. See the “DESIGN SPEED” section below.

- Consider drainage issues for crossovers. Flat crossovers or crossovers using concrete barrier on both sides can generate areas of standing water resulting in the chance of vehicles hydroplaning. If using concrete barrier, the TCP should indicate barrier with “scuppers” to facilitate drainage of surface water.
- Disallowing lane changes through a crossover can be advantageous in controlling speeds and complex movements within the crossover. To preclude lane changes, on the plan sheets, include appropriate signing and identify a 4” double, solid white stripe along the centerline of multi-lane crossovers.
- Appropriate signage can include:
    - Use “NO LANE CHANGES NEXT XXXX FEET” (OR22-16), or “STAY IN LANE” (R4-9) signs with Type “XX FT” (W16-2aP) plaque for crossover distances less than 1500 feet.
    - Use “NO LANE CHANGES NEXT 1/X MILE” (OR22-17), or “STAY IN LANE” (R4-9) signs with Type “XX MILES” (W16-3aP) plaque for crossover distances of 1/4 mile or greater. Use distances in 1/4 mile increments.
    - Sign use should be consistent throughout the project, do not mix and match the “STAY IN LANE” and “NO LANE CHANGES” signs.
    - Start double solid white striping at the first regulatory sign (e.g. “NO LANE CHANGES…”), and stop the double solid white striping at the end of the specified distance.

3.4.9 Design Speed

The Pre-construction Posted Speed shall be used as the "Design Speed" for the following alignments and applications within the design of a temporary traffic control plan, unless otherwise indicated in this manual:

- Temporary roadway alignments, crossovers and on-site diversions.
- Spacing between signs and traffic control devices.
- Temporary impact attenuator selection.
- Taper lengths for lane shifts, lane and shoulder closures.
- Temporary sign letter heights.

The "Design Speed" of a temporary alignment should not be below the pre-construction posted speed unless site conditions demand a reduced design. Designers should consult with their "Engineer of Record" before reducing the design speed. ODOT designers should discuss reduced designs with their "Engineer of Record" and the resident engineer.

Through a signed Temporary Speed Zone Reduction Order, the regulatory posted speed through a work zone may be reduced (Typically 10 mph for a freeway. And, up to 20 mph (in two – 10 mph steps) for 2-lane non-freeway.

A Temporary Speed Zone Reduction will NOT result in a reduction in the Design Speed.

3.4.10 Detours

A traffic detour can be a very effective traffic control measure within a TCP. By closing the road to live traffic, positive protection for workers is maximized. Detours can also allow for improved finished products as Contractors can work in a single work space without the need to construct the project in multiple smaller pieces.

In determining the feasibility of a detour, record design-related issues or decisions in the ***Work Zone Decision Tree*** (See Chapter 1 for more details). Consider developing a detour for the project under the following conditions:

- The physical work area cannot support live traffic and construction activities concurrently.
- When the accelerated completion of a project is desired, having uninterrupted use of the entire work site can facilitate a time-critical schedule.
- Construction constraints (e.g. vehicle weight/size restrictions) require specific vehicle classes to be precluded from the work zone.

Effective detour designs must consider, address and incorporate the following:

- Detour routes must accommodate height, width, weight, length, off-tracking and other physical characteristics of the design vehicle (largest vehicle expected to use the detour).
- Signal timing adjustment or flagging operations to give priority to heavy freeway traffic.
- Appropriate and adequate detour signing for the entire route in both directions. Roundabout detour signs should use a curved stem arrow in accordance with the ***MUTCD***.
- For conditional or periodic detours, using multiple PCMS can provide real-time advance warnings or notifications. Include additional emphasis in the TCP – see ***2021 Standard Specifications, Section 00222.40(c)*** – for the Contractor to cover inappropriate signing and change PCMS messages as detour conditions change.
- Confirm agreements with local cities, businesses and residences regarding the proposed detour route(s) – including any mitigation strategies or limitations.
- Early coordination and approval with the ODOT Commerce and Compliance Division (CCD) as to the proposed detour route(s).

Designers should be prepared to respond to local agency requests to mitigate impacts the detour may have on their community. They may ask for additional signing, channelization, or other TCD to enhance guidance of vehicles through their area (e.g. "BUSINESS ACCESS" signs, blue tubular markers, other temporary guide, warning or service signs).

3.4.11 Device Spacing

The placement of temporary traffic control devices (signs, channelizing devices, pavement markings) is critical to allowing drivers to see, read, interpret and react to the devices.

Devices too closely spaced can be confusing and make it difficult to process the information. Devices too far apart – particularly channelizing devices – can confuse drivers as to where they are supposed to drive, and what hazards they should avoid.

Drivers may forget individual messages if signs are spaced too far apart. Proper spacing helps maintain the context and integrity of messages, warnings or guidance signs and devices provide.

Proper spacing for channelizing devices and temporary signing is provided in the ***ODOT Temporary Traffic Control Standard Drawings***. The, "*Traffic Control Devices (TCD) Spacing Table*" on ***Standard Drawing TM800*** shows standard spacing for both low-speed and high-speed work zone conditions.

Reduced Spacing

Channelizing device spacing around radii at intersections, business accesses, driveways or other locations where additional emphasis is desired, may be reduced to 10 feet. If done, include additional language in the Special Provisions, or show the reduced spacing on plan sheets. See ***ODOT Standard Drawing TM800*** for additional details.

Increased Spacing

Increases to device spacing can also be made based on construction needs for specific operations or work tasks. For example, during freeway paving operations – where traffic speeds are higher – allowing construction material delivery vehicles (e.g. AC or PCC dump trucks) to exit the traffic stream at higher speeds can help control excessive speed differentials and avoid surprising traffic with sudden slowing in the live traffic lane. Placing channelizing devices further apart can allow work vehicles to exit the live lane at higher speeds. ***TM880*** shows these devices spaced at 80 feet (normally 40 ft.) in the area where work vehicles would be exiting the live lane to deliver construction materials.

Special Provisions

Some device spacing is addressed in the ***Standard Specifications*** or Special Provision 'Boilerplate' and is reserved for specific types of work or devices. Spacing requirements described in the Special Provisions supersede spacing requirements shown on the Standard Drawing "TCD Spacing Table"[1].

3.4.12 "DO NOT PASS" Signing

Through interpretation of ***Chapters 2B*** and ***3B*** of the ***MUTCD*** , ODOT requires the installation of "DO NOT PASS" and "PASS WITH CARE" signs at the respective limits of existing 'No Passing' zones anytime work obliterates centerline pavement markings.

Additional requirements are included in the following Special Provisions used for pavement preservation projects on State highways:

- "00222 – MHMAC and HMAC Preservation Projects".
- "00222– CIR and EAC".
- "00222– Emulsified Asphalt Surface Treatment" (or, "chip seal" projects).

For long preservation projects with low volumes, primarily "chip seal" projects, see the ***Special Provision***, "***00222 – Combined No Passing Zones***", used to minimize the number of "DO NOT PASS" signs. This Special Provision is most applicable on projects meeting the following criteria:

- ADT < 1000.
- Project Length is > 10 miles.
- Unless engineering judgment determines the need for additional signs.

'No Passing' zones less than 1/4 mile apart can be combined into a single, continuous 'No Passing' zone. See the above Special Provision for sign placement details.

[1] See Section 00150.10(a) of the ***ODOT/APWA Standard Specifications for Construction*** for information regarding the Order of Precedence for TCP documents and drawings.

3.4.13 Flagging

Flaggers are used to control the flow of traffic in and around the work zone. Flaggers are used on a wide variety of roadway classifications including local, low-volume highways to high-volume, urban arterials. Flaggers should not be used on freeway projects. A flagger is useful for the following activities:

- Controlling traffic flow on two-way, one-lane sections of roadway.
- Stopping traffic to allow construction vehicles to enter or exit the roadway.
- Slowing traffic immediately adjacent to workers and active construction equipment.
- Directing traffic through an intersection under construction (If signalized, signal must be off while flagging).

Pay Item Quantities

Flaggers are included in the contract as the pay item, "Flagger Hours". "Flagger Hours" can be calculated based on the scope of work, and by discussing needed quantities with a resident engineer, ODOT Region Design staff, or the ODOT Cost Estimating Unit in Salem.

To determine flagger hours, first examine the construction schedule. Determine the activities that normally require flaggers. Approximate how long it will take to complete each of those activities – typically in terms of weeks, days or work shifts. Convert those durations all to 'hours'. Next, determine the number of flaggers required for each of those activities.

Multiplying out each activity with the number of flaggers needed:

$(D_1 \times F_1) + (D_2 \times F_2) + (D_3 \times F_3) + (D_n \times F_n) = \text{Total Flagger Hours}$

Where: D = Duration of the Activity (hours); F = Number of Flaggers needed for the Activity

It is important to have a reasonable construction schedule and to know production rates for differing activities. Construction production rates can be found in the Fuel Escalation Worksheet under "All items production schedule" tab. Flagging Hours should be as accurate as practical. Avoid over-estimating Flagger Hours, or adding arbitrary 'margins of error'.

Flagging Principles

While Flaggers are certified and their day-to-day performance is not the responsibility of the TCP designer, several basic Flagging principles can have a significant impact on the development of the Traffic Control Plan and Designers should be aware of them.

Flagging on Multi-lane Roadways

Flaggers are allowed to control only one lane of traffic at a time. A single flagger should not be controlling two approaching lanes in the same direction simultaneously.

In multilane sections, one approach lane must be closed before reaching the Flagging sign sequence.

Example: See the ***ODOT Temporary Traffic Control Standard Drawing for Blasting Zones**, **TM871***. The "4-LANE, 2-WAY ROADWAY" detail in this drawing shows a lane closure in advance of the Flagging sign sequence. This technique should be applied to any multilane facility approaching a flagging operation.

If a project requires flagging on a multi-lane roadway, include additional temporary signing and channelizing device quantities for the lane closure(s).

Flagging at Intersections

When flagging intersections, one flagger should be used for each leg of the intersection where total approach volumes exceed 400 ADT for the intersection.

Example: Four-leg intersection with ADT of 750 vehicles requires four flaggers.

See the "2-LANE, 2-WAY, ONE LANE CLOSURE" detail on ***ODOT Temporary Traffic Control Standard Drawing TM841*** for an example of a flagging operation in an intersection.

In the case of flagging a multilane approach, place the lane closure well in advance of the flagging operation to allow traffic to safely merge and then refocus their attention on the approaching flagging operation.

Flagging at Signalized Intersections

When flagging a signalized intersection, the signal must be turned off, unless flagged by uniformed police officer(s).

Refer to the ODOT Temporary Traffic Control Standard Drawings for details regarding work in signalized intersections.

When flagging in signalized intersections, lane shifts, closures and all appropriate traffic control devices and signing should be moved away from the intersection as far as practical to allow for the placement of required Flagger signing and the Flagger station.

Flagging at Un-signalized Intersections

When flagging a stop-controlled intersection, the existing "*STOP*" signs must be covered according to ***ORS 811.260*** and ***811.265***. Refer to the ODOT Temporary Traffic Control Standard Drawings for details regarding work in an un-signalized intersection.

Flagging on Freeways

ODOT highway construction contracts should not include or show Flaggers being used to control traffic on a freeway. It is not recommended to use Flaggers to slow traffic on a freeway due to the potential to create adverse differences in approach speeds into the work area, potentially increasing the risk of rear-end crashes.

For small, isolated work activities (e.g. PCC pavement or bridge joint repairs), an effective alternative is to include a Truck Mounted Attenuator (TMA) in the TCP that the Contractor may place (per manufacturer specifications) in advance of the work area.

Contractors may want to use a Flagger to "SLOW" approaching traffic during material delivery or hauling operations. This is at the discretion of the Contractor, but ODOT no longer considers this a safe practice. In addition to the reasons mentioned above, a Flagger can be substituted with a PCMS on a work vehicle displaying more informative messages, such as:

SLOWED	RIGHT (LEFT)	WORKERS	WORK
TRAFFIC	LANE	IN RIGHT (LEFT)	VEHICLES
1/2 MILE	SLOWED	LANE	AHEAD

Figure 3-24: Sample PCMS Messages

Side Roads within the Work Zone

For lengthy preservation (paving) projects, where two-way, one-lane traffic is controlled by Flaggers and Pilot Cars, include a Flagger and appropriate signing for each intersecting side road within the limits of the **active work area** – not the project limits. Because of the mobile nature of preservation projects, as the work progresses, Flaggers (and some signing) can be moved along with the activity.

Again, it is important for the designer to understand the productivity limits based on the scope of work. How far the Contractor can pave in a day (or work shift) will determine how many side roads will be impacted by the work activity and how many Flaggers are needed in the TCP.

Additional Flaggers may be required at high-volume accesses (i.e. shopping or recreational centers, residential neighborhoods, campgrounds, or other high-volume generators). Advance Flaggers may also be needed depending on volumes, roadway geometries, etc.

Low-volume, dead-end roads or private accesses within the work area should be addressed on a project-by-project basis given the function of the road and services it feeds.

Individual private residences along the highway within the work area can be personally contacted and informed of the process for entering and exiting their property. Work closely with the resident engineer's office to determine the extent of parties affected by construction and determine if additional mitigations in the TCP are needed.

3.4.14 Flagging – Advance Flaggers for Extended Traffic Queues

When traffic volumes increase unexpectedly and traffic queues cannot readily dissipate ("residual queues") while traffic is under a two-lane, one-way operation (i.e. flagging), extended traffic queues will likely develop.

Take into consideration the likelihood of residual queuing in developing the traffic control plan and determining other TCM to include. Depending on the approach volumes and the potential for residual queues, adjustments may be necessary in the 'Lane Restriction' portion of the project ***Special Provisions - Section 00220.40(e)*** to further limit the hours the Contractor can close lanes and avoid this condition.

In anticipation of extended queuing, refer to the "EXTENDED TRAFFIC QUEUES FOR ADVANCE FLAGGING" detail in the ***ODOT Temporary Traffic Control Standard Drawings*** to determine quantities for the additional devices. The detail describes:

- Placement details for additional signing and devices.
- Conditions when additional devices and Advance Flagger are needed.

During construction, field personnel should implement this measure under the following conditions:

- Traffic queues extending beyond the initial advance warning sign (e.g. "ROAD WORK AHEAD").
- Sight distance from the back of the stopped queue to the next approaching vehicle is less than 675 feet.

In calculating quantities for, "Flagger H ours", consider including additional hours for Advance Flaggers. In the cost estimate, "Flagger" and "Advance Flagger" hours should be combined into the single "Flagger Hours" pay item.

3.4.15 Flagging – Flagger / Pilot Car Operations

Pilot Cars may be used in conjunction with flaggers in the TCP to guide platoons of vehicles through lengthy two-way, one-lane work areas. Pilot cars are an effective traffic control measure for a variety of work types – paving operations, longitudinal excavations, shoulder work, striping operations, night work, complex temporary alignments, etc.

Pilot Cars are typically included in the TCP when:

- Lane closures exceed 1/2 mi. and sight distance between Flagger Stations obscured by:
    - Roadway topography/ geometry – horizontal/ vertical curvature, foliage.
    - Geography – terrain limiting communication (radios, cell coverage, etc.).

- Workers immediately adjacent to high-speed traffic, not separated by barrier system.
- Multiple isolated activities occurring within a single, longer work area.
- Pilot car operations often limited to a maximum length based on:
    - Operating speed: 25-35 mph.
    - Holding traffic for 20 minutes, maximum at each end of work area.
    - Number of intersections and accesses, which can affect pilot car efficiency.

Pilot Cars are measured and paid for by the hour. Like Flagger hours, Pilot Car hours should be carefully calculated by the designer.

Figure 3-26 demonstrates the set-up for a Flagger/Pilot car operation. The "ONE LANE ROAD AHEAD" sign may be used to provide additional work zone information, but is optional.

"WAIT FOR PILOT CAR" Signing

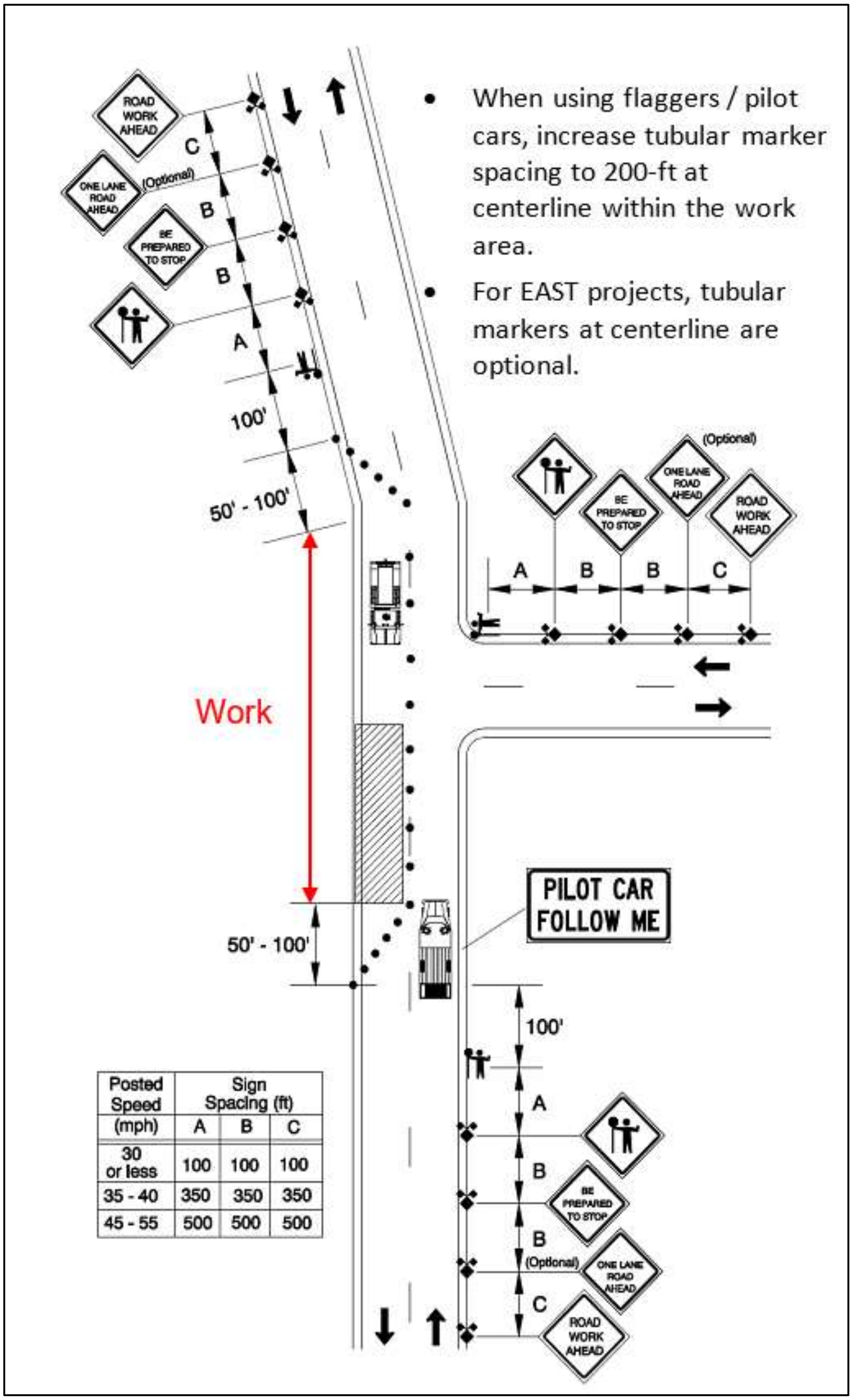
The WAIT FOR PILOT CAR (CR4-20) sign was developed to be used on very low-volume, dead end side roads within an active work zone to replace the need for a Flagger. In addition to low volumes (< 100 ADT), the side road must meet the following additional criteria:

- Access or side road traffic is being stopped for no more than 20 minutes (per Section 00220 of the ***Oregon Standard Specifications for Construction***, and Chapter 3 of the ***Oregon Temporary Traffic Control Handbook***).
- Access or side road is a dead-end facility or has no immediate alternate access, and:
- Does not access public service facilities (e.g. parks, rest stops, waysides, ranger stations, landfills, utility hubs, treatment plants, etc.).

Per the "00222 – Wait For Pilot Car" Special Provision, during construction, intersections using the "WAIT FOR PILOT CAR" sign are to be checked regularly each hour to ensure safe and effective traffic operations. If operational issues are observed at these or other locations using the "WAIT FOR PILOT CAR" sign, the sign shall be replaced by a Flagger.

Figure 3-25: CR4-20 & CR4-20a Signs

For private residential driveways, a smaller 12"x 12" "WAIT FOR PILOT CAR" (CR4-20a) sign may be installed and face the residence (not visible to public traffic). The intent of this sign is to avoid the need for a Flagger at each individual private driveway within the active work area. Complete details are included in ***Chapter 6*** of the ***ODOT Sign Policy and Guidelines***.



Posted Speed (mph)	Sign Spacing (ft) A	B	C
30 or less	100	100	100
35 - 40	350	350	350
45 - 55	500	500	500

Figure 3-26: Flagging Operation with Pilot Car

3.4.16 Freeway Closures (Short Term)

Occasionally, it may be necessary to temporarily close one or both directions of a freeway or access-controlled facility to complete work directly over the lanes of the highway. If a Rolling Slowdown (RSM)) cannot be used due to the 20-minute time limitation for that measure, a temporary, short-term closure may be necessary.

Due to the significant impact this traffic control measure has on traffic capacity and mobility, a directional or full closure may only be limited to times when the lowest volumes occur – typically in the late evening or very early morning hours.

Work zone traffic analysis can be used to determine the acceptable hours for the closure. Include this information in the project ***Special Provisions*** under ***Section 00220.40(g) – Road Closure***.

The directional or full closure requires additional temporary signing and channelizing, as well as a detour plan. The detour plan can utilize either:

- The existing ramps of the interchange under construction, or a combination of adjacent interchanges to bypass the work site.
- An alternate route if interchange configurations are not conducive as a detour route.

In either case, an extensive combination of traffic control measures must accompany the detour plan. For multilane facilities incorporate the following measures:

1. Include one or more PCMS in advance of the initial advance warning signage. Suggested PCMS messages include:

FREEWAY CLOSED X MILES	ALL TRAFFIC EXIT FWY	FREEWAY CLOSED 1 MILE	TRAFFIC MUST USE EXIT XXX	FOLLOW DETOUR EXIT XXX

Figure 3-27: Freeway Closure PCMS Messages

Use PCMS to alert drivers of the approaching closure and to provide advance notification of what actions must be taken and where traffic must go.

2. Close all but one traffic lane. If possible, leave the right lane open to better facilitate exiting traffic off the freeway.
3. Include all necessary signing, channelizing and Sequential Arrows needed to direct drivers into the open lane.

If closing more than one lane, include one Sequential Arrow for each lane being closed. See the ODOT Traffic Control Plan Standard Drawings for additional information relating to a multi-lane closure.

4. Include an adequate number of devices and signing at the point of the closure to clearly indicate the roadway is closed and to direct traffic to the exit ramp or detour starting point (see Figure 3-28, below).

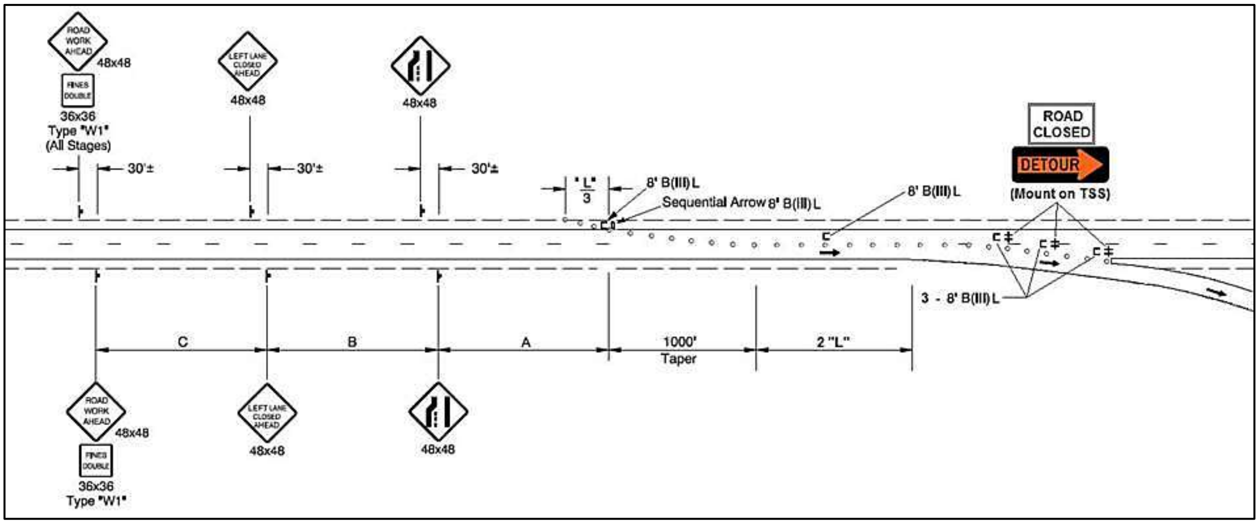


Figure 3-28: Freeway Closure

5. As shown in Figure 3-28, include a sufficient distance between one activity and the next for drivers. In this case, a distance of **2** “**L**” is shown between the end of the Lane Closure taper and the beginning of the exit ramp channelization.
6. If using interchange ramps for your detour, consider additional arrangements at ramp terminals to control traffic and give priority to exiting freeway traffic volumes - Traffic signal may need timing adjustment, Flaggers may be needed, lanes on the crossroad may need to be closed for flagging operations, etc.

Alternate routes must accommodate the Design Vehicle for the facility being closed – typically, a large, multiple-axle truck (e.g. WB-67).

If a non-State facility is used for the detour, ensure that an inter-governmental agreement (IGA), or other official agreement, is in place prior to specifying the local facility in the TCP. Work with your Transportation Project Manager to coordinate these arrangements.

3.4.17 Horizontal and Vertical Design Policy

The two key aspects in effective TCP design are providing sufficient horizontal roadway widths and adequate vertical clearances. As part of ODOT's focus on statewide mobility through highway work zones, the accommodation of oversized vehicles on the State highway system must be considered and addressed.

Designers are responsible for indicating and mitigating all temporary widths and heights restrictions in the TCP, as well as including all relevant Special Provision language directing the Contractor to implement these mitigations.

In the ODOT Mobility Procedures Manual, meeting the standards within ***Chapter 4 – Temporary Conditions*** and ***Chapter 5 – Notification Requirements***, are required on all ODOT contracts. Current specifications require **35 days** of advance notification for any height, width, weight, or other restrictions.

Horizontal and vertical clearance deviations from the minimums as shown in the ***Mobility Procedures Manual***, or the ***TCP Design Manual***, are subject to the Mobility Advisory Committees' approval through Commerce and Compliance Division (CCD). If reductions in any of the above dimensions are necessary:

- Contact the ODOT Region Mobility Liaison; and,
- Communicate these changes to the CCD in the ***Mobility Consideration Checklist***.

For any further information regarding the mobility process, contact your Region's Mobility Liaison.

Horizontal Design

Use the ***Mobility Procedures Manual*** and the below dimensions to develop the TCP. The following dimensions assume **all** vehicle classifications are allowed on the roadway. Over-dimensional vehicles are not being diverted to an alternate route.

The total horizontal dimensions shown in Tables 3-8 and 3-11 are **minimums**. Designers should make efforts to increase these dimensions, where practical. For consistency with CCD policies, dimensions shown are separated into Daylight and Nighttime hours. Daytime hours are defined as those times between, "1/2 hour before sunrise and 1/2 hour after sunset."

Table 3-8: Minimum Daylight Horizontal Design Widths

Facility	Single Lane (ft.)	Two Lanes (ft.)
Interstate/Multilane	19	28
Other Two Lane NHS Route	16	28

Table 3-9: Minimum Nighttime Horizontal Design Widths

Facility	Single Lane (ft.)	Two Lanes (ft.)
Interstate or Multilane	16	28
Other Two Lane NHS Route	14	28

The majority of projects will use the Daylight horizontal widths listed in Tables 3-9 and 3-10. As such, Tables 3-9 and 3-10, can help in dividing up horizontal widths further into traffic lane and shoulder widths.

Table 3-10: Daylight Single Lane and Shoulder Widths

Facility	Lane Width (ft.)	Shoulder Width (ft.)
Interstate or Multilane	12	3.5
Other Two Lane NHS Route	12	2

Table 3-11: Daylight Two Lanes and Shoulder Widths

Facility	Lane Width (ft.)	Shoulder Width (ft.)
Interstate or Multilane	12	2
Other Two Lane NHS Route	12	2

Consider the following in attempting to optimize safety, construction efficiency and traffic operations through the work zone:

- Depending on staging needs, but without falling below minimums shown in Table 3.7, lane and shoulder widths can be adjusted to favor construction requirements or traffic operations.

- **If reduced horizontal widths are granted by CCD, lane widths should be reduced first, followed by shoulder width reductions, as follows:**
    - **Interstate Recommended Min. Widths: Lanes = 11 ft.; Shoulders = 1 ft.**
    - **Non-Interstate Recommended Min. Widths: Lanes = 10 ft.; Shoulders = 1 ft.**
    - **Reduced widths should be analyzed for the off-tracking of the design vehicle. AutoTurn™ within MicroStation™, or other comparable modeling software, may be used for the analysis.**

- If a ***positive barrier*** (e.g. concrete barrier, guard rail, bridge rail, bridge abutments, or other rigid obstacle) exists on one side of the roadway only, the needed width for one or two lanes becomes dependent on pavement width availability, vehicle overhang and axle width. Discuss vehicle details with the CCD and adjust your design accordingly.

When a width restriction is anticipated as part of the TCP, Designers should ensure all applicable language from ***Sections 00220 – 00229*** of the ***ODOT Standard Specifications*** and ***Special Provisions*** is included. The language must accurately address the Contractor's responsibility to complete and submit the electronic Highway Restriction Notice (734-2357) form to CCD for any planned temporary horizontal restriction on a highway due to a work zone.

Vertical Design

For temporary vertical clearance, the following design standards apply:

- During TCP development, if any reduction in the existing vertical clearance is anticipated – installation of falsework, pavement overlays, etc. – CCD must be notified of the change(s) in height.
- If any changes to vertical clearance are required in the TCP following the Preconstruction Conference, the designer should work with CCD at least 35 days prior to the restriction.
- If 17 feet of clearance cannot be maintained during construction, include additional traffic control measures in the TCP to warn motorists of the restrictive condition. PCMS or additional signing can be used to display height restriction information and instructions.
- During TCP development, if the vertical clearance is expected to drop below 15 feet 6 inches, the designer will need to include the language from Section 00225.02 in the Special Provision "boilerplate". Be sure to include sufficient quantities for the temporary Low Clearance signs as called for in the subsection.
- To further supplement the standard traffic control measures for low vertical clearances, an Overheight Vehicle Warning System (OVWS) from the QPL may be included in the TCP. If an OVWS is used, the Special Provision language found on the Specifications web site needs to be included.

If a height restriction is anticipated as part of the TCP, Designers should include all applicable language from Sections ***00220 – 00229*** of the ***ODOT Standard Specifications*** and ***Special Provisions*** in the contract. The language must accurately address the Contractor's responsibility complete and submit the electronic ***Highway Restriction Notice*** form to CCD for any planned temporary vertical restriction on a highway due to a work zone.

3.4.18 Rumble Strips

Longitudinal Shoulder Rumble Strips

On many sections of Oregon freeways and highways, ODOT has installed longitudinal rumble strips along the shoulders and in the median. The rumble strips are a very effective measure in getting the attention of an errant or drowsy driver allowing them to return safely to their travel lane before leaving the roadway.

Unfortunately, staging or shifting traffic can send vehicles across the rumble strips creating an undesirable effect for drivers – even a potential safety concern.

Therefore, longitudinal rumble strips that conflict with the staging plan – forcing drivers to cross over the rumble strips - should be mitigated by calling for them to be ground (milled) out and paved back prior to shifting traffic.

Designers should include a reference to the ***ODOT Temporary Traffic Control Standard Drawing TM830*** that includes the "Existing Rumble Strip Removal" detail. Designers should also include the language from the ***ODOT Special Provision called, "00220 Longitudinal Rumble Strips"*** into the project Special Provisions.

Measurement and payment for grinding out and paving back longitudinal rumble strips should be covered under the "Cold Plane Pavement Removal" and "Asphalt Concrete Paving" pay items, respectively. These items are not currently measured or paid for under the TCP pay item list. If removal of shoulder rumble strips is necessary, communicate the quantity (feet) of rumble strips being removed to the appropriate member of the Project Development Team (e.g. roadway designer, etc.).

Temporary Transverse Rumble Strips (TTRS)

Transverse rumble strips consist of a series of narrow, transverse bands of a raised material or depressed road surface extending across the travel lanes that provide a tactile and audible warning for drivers. Through noise and vibration, the rumble strips alert drivers of unexpected changes in alignment, surfaces, traffic control and other conditions that may require them to slow or stop. See the ***MUTCD***, the ***ODOT Traffic Manual*** and ***ODOT Standard Detail DET4710*** for additional information. Temporary transverse rumble strips may introduce other concerns regarding the work zone. Drivers may try to avoid them because they look like debris, drivers may pull over because they think they hit something. The location and advanced warning of transverse rumble strips needs to be clear in the project plans.

If a designer wishes to include transverse rumble strips in the TCP, three key components are needed:

1. A completed Temporary Transverse Rumble Strip Request form must be completed and sent to the state work zone engineer's office for review. A recommendation will be sent

to the state traffic-roadway engineer (stre). If approved, a signed approval letter will be returned to the original submitter.

2. The ***ODOT Standard Detail DET4710*** and ***DET4715*** must be included in the TCP. Dimensions to the warning sign warning of the condition or the condition itself have to be included in the project specific plan sheet. Current guidance on the detail shows the rumble strips located 100' in front of the warning sign.
3. Language from the "***00225 Temporary Transverse Rumble Strips***" specification must be incorporated into the project Special Provisions. When a specific type of transverse rumble strip is needed, adjustments to the special provision language are needed to identify special restrictions or requirements.

STEP 1 (stre approval) is not required for the installation of portable transverse rumble strips for short term stationary construction, maintenance and utility operations. Short-term stationary work is daytime work that occupies a location for more than 1 hour within a single daylight period. The region traffic engineer approval is required for portable transverse rumble strips during intermediate-term work, including night work. All other installations (milled, raised, long-term) require stre approval as mention in STEP 1 above.

There are three types of temporary transverse rumble strips used for different applications:

Raised Transverse Rumble Strips

Made from pavement marking material (e.g. thermoplastics). Typically used for long durations on wearing courses only, as the removal of the rumble strips can damage the pavement. Raised rumble strips can also be made of temporary removable tape. The tape strips may be used on wearing surfaces as damage to the pavement is minimal for the removable tape.

Milled (Ground-in) Transverse Rumble Strips

Made by grinding strips into the pavement. Typically used for long durations on base courses when a wearing course has not been paved yet (or on wearing courses that are to be paved as part of the project). Milled rumble strips should not be used on wearing courses as they damage the pavement and would require additional efforts to remove and repave.

Portable Transverse Rumble Strips

Made of preformed plastic or rubber and simply placed on the road. Used on any pavement surface where the strips are needed for shorter durations. Not intended for extended stationary use, portable strips are intended for daily use and should be picked up at the end of each shift.

Temporary portable rumble strips are measured and paid for 'per foot'. The pay item should include all costs related to installation, maintenance, moving and removal.

3.4.19 Smart work zone System (SWZS)

For complex projects on high-volume, high-speed facilities, where the safe, smooth operation of traffic can be critical, the use of a SWZS can help optimize safety and efficiency for both the Contractor and public traffic. Also known as, "smart work zones", or "work zone ITS," these systems can help manage the flow of traffic, minimize congestion and ultimately reduce the number of crashes in a work zone.

SWZS can be used to measure and collect traffic volumes, speeds, headways, lane occupancies and monitor traffic flow conditions. The system processes the data and presents traffic with real-time travel information, or warns drivers of changing work zone traffic conditions. Drivers are alerted through the system's portable changeable message signs – displaying messages to slow or stop ahead; or, to follow a detour or use an alternate route.

A Special Provision is available for the SWZS – "***00229 – Smart Work Zone System***". Designer should be including this system in projects that would benefit from traffic flow information, queue detection, conflict monitoring alerts, or other safety and mobility benefits including:

- Traffic alerts of slowed or stopped traffic downstream – Displayed on PCMS for public traffic; Sent to email addresses/smart phones for PM and Contractor staff.
- Travel time estimates to reach the end of the work zone, nearest crossroad or other highway landmark.
- Alert traffic of construction vehicles entering or crossing the traffic stream.
- Display pre-programmed legal speed reductions during peak work activity.
- On-site web-based (PTZ) cameras streaming images to the project-specific website for traffic and construction monitoring by PM staff.
- Collect traffic volumes, speeds in multiple lanes and in multiple directions for traffic analysis during and post-project.

SWZS can be modified to fit all types and sizes of projects and be adapted to a wide array of functions. Costs depend on the complexity of the system used and the duration the system is in place. For additional information, contact the ODOT work zone Traffic Control Unit in Salem.

3.4.20 "ROAD WORK AHEAD" signing

The "ROAD WORK AHEAD" (W20-1) sign is installed in advance of the transition and work areas to mark the beginning of the work zone. While there are other signs and devices that may precede the ROAD WORK AHEAD sign (e.g. PCMS, "ROAD WORK NEXT XX MILES", Project ID sign), the ROAD WORK AHEAD sign should be the predominant sign in advance of any lane shifts, lane closures or other changes to the original roadway environment. As such, the ROAD WORK AHEAD sign should be kept as close to the work area as practical and as dictated by other work zone signing needed within the work zone.

As a project progresses and as the new roadway is completed – including surfacing and pavement markings – specification language or plan sheet instructions should direct the

Contractor to move and reinstall the ROAD WORK AHEAD sign to a location that minimizes its distance from the active work area. When the project is substantially completed, but there is still some work on the roadway, the permanent ROAD WORK AHEAD sign should be removed, and temporary ROAD WORK AHEAD signs should be used for advanced notification while work occurs. Removing the permanent ROAD WORK AHEAD while little to no work is occurring helps with the effectiveness of the ROAD WORK AHEAD sign.

The “ROAD WORK NEXT XX MILES” (CG20-1) sign may be installed for projects longer than three miles where work is continuous along the highway, or where individual work areas are closely spaced (< 3 miles ± apart). The sign may be installed in advance of the initial “ROAD WORK AHEAD” sign at each end of the project facing incoming traffic.

Multiple Work Areas

When a single project has multiple individual work areas along the same highway (e.g. concrete pavement repairs, bridge deck joint replacements), signing modifications may be needed.

When individual work areas are more than three miles (±) apart, Designers should include a separate “ROAD WORK AHEAD” sign in advance of each work area. Include a separate “END ROAD WORK” sign at the end of each work area. Law Enforcement agencies can then enforce the Double Fines law within those specific areas – where the conditions are most appropriate.

The “END ROAD WORK” (CG20-2A) sign is installed beyond the end of the work area to mark the end of the work zone. From the definition of a “highway work zone” under ORS 811.230, ODOT uses this configuration to define the limits of a “work zone” for the purposes of enforcing Oregon’s double fines law.

3.4.21 Rolling Slowdown Method (RSM)

If work takes place overhead, crossing live travel lanes in either or both directions of a highway, the “Rolling Slowdown Method” can be an effective traffic control measure for conducting the work safely, yet maintaining the movement of public traffic.

Purpose

Rolling Slowdowns are conducted for short-term work that requires working in or over live travel lanes on high-volume facilities (freeways, multi-lane arterials, etc.) for durations of less than 20 minutes. Rolling Slowdowns are used when a full highway closure and detour is impractical. Rolling slowdowns are useful for projects that might include:

- Installation of permanent, overhead Variable Message Signs (VMS).
- Replacement/repair of sign bridges and/or signs on them.
- Installation of bridge girders, decking or other components.
- Demolition and removal of structures.
- Cable or other utility crossings.

The Rolling Slowdown process creates a time gap (20 minute, max.) in live traffic to conduct overhead work while keeping the facility open and not stopping or diverting traffic. Rolling Slowdowns work best on access-controlled facilities.

Considerations

Rolling Slowdowns should be scheduled during off-peak traffic periods. Coordinate with State or local law enforcement agencies and the media prior to the scheduled Slowdown(s). Law enforcement agencies may be used to aid in the execution of the Rolling Slowdown as "pilot vehicles" (see below).

Designers should discuss practical time gap lengths needed with their resident engineer. Longer time gaps can result in an increased number of accesses (ramps) affected by the Slowdown. The more access closures needed, the more signing and devices needed in the TCP quantity estimate.

The designer should be very familiar with the scope of work, and thus, should know if a Rolling Slowdown is likely to be included in the TCP. A Rolling Slowdown is a traffic control measure that is not implemented "at the last minute". A great deal of coordination with a broad range of stakeholders is necessary.

Rolling Slowdowns can involve a number of pay items, including:

- Pilot Car Hours (Unless using law enforcement resources).
- Flagger Hours (at on-ramp terminals and other closure points).
- Flagger Station Lighting.
- Traffic Control Supervisor (TCS) – Recommended.
- Temporary signs (closure and detour signing at on-ramp terminals and along detour routes).
- Barricades.
- PCMS (one at each closure point, and at least one in each direction on mainline).
- Plastic Drums (at closure points).

Most devices may be reused for multiple Slowdowns, but quantities for Flaggers, TCS and Pilot Cars should be tabulated carefully. Variations in the number of Rolling Slowdowns and the number of closure points from one Slowdown to another can affect the quantities for Flagger and Pilot Car Hours.

Procedure

1. Place a Portable Changeable Message Sign (PCMS), truck-mounted, on mainline in advance (upstream) of the planned starting point for the Rolling Slowdown – i.e. approximately ½ to 1-mile in advance of the first on-ramp closure.
    a. Place one PCMS for each direction affected by the Slowdown. The PCMS should be mobile, preferably truck-mounted, and maintain approximately ½ to 1 mile advanced notice of the back of the traffic queue.

   b. Suggested messages for the PCMS: SLOWED TRAFFIC AHEAD / PREPARE TO SLOW.
2. Traffic Control vehicles (typically pilot cars, but may be marked police cars) will enter the highway and form a moving blockade by slowly decelerating traffic behind them to a predetermined fixed speed. One Traffic Control vehicle is needed for each lane of traffic. The queue should never stop completely.
3. A large gap will open between the free-flowing traffic in front of the Traffic Control vehicles and the slowed traffic behind. The gap in time between the slowly moving blockade and the work site (calculated beforehand – see Table 3-11) will give the Contractor time to complete the planned overhead work. A maximum time gap of 20 minutes is allowed for any singular Rolling Slowdown.

The distance needed for 20 minutes of clear highway may not be practical, given the number of access points and traffic volumes (even at off-peak times). However, the need for a full 20-minute time gap is uncommon.

4. A separate Traffic Control vehicle - the "Chase Vehicle" - shall follow the last free-flowing vehicle ahead of the blockade. When the Chase Vehicle passes the work site, the overhead work operation can begin.
5. All on-ramps to the highway between the rolling blockade and the work operation must be temporarily closed, using flaggers, until the "All clear" signal is given by the crew doing the work, or until the front of the rolling blockade passes a particular on-ramp closure. Place advance signing at the approach to each entry ramp.

The location where the Traffic Control vehicles begin the Slowdown and the speed at which the rolling blockade is allowed to travel shall be based on the Table 3-12, below:

Table 3-12: Rolling Slow Down - Minimum Distance from Work Area in Miles

Desired Gap (min)	Blockade Speed (mph)[1]			
	10	20	30	40
10	2.0	5.2	11.0	24.4
15	3.1	7.9	16.5	36.7
20	4.1	10.5	22.0	48.9

[1] Assumes a pre-slow down speed of 55 mph

Table 3-12 assumes a pre-blockade speed of 55 mph (from truck speed limits of 55 mph). The table does not take into account horizontal or vertical alignments, lane widths, number of lanes, or other variables that may slow traffic moving through the project. Wherever practical, Rolling Slowdowns should combine the highest Blockade speed with the shortest Desired Gap to conduct the work.

At a minimum, Rolling Slowdowns should maintain a minimum speed of 30 mph on freeways and 20 mph on all other roadways. Slower blockade speeds should only be considered in cases where the number of accesses on the roadway segment are very high (> 1 access per mile) and the number of closures may be cost-prohibitive or create excessive delays or congestion on adjacent facilities.

A detail sheet should be developed and incorporated into the Traffic Control Plan sheets depicting all sign, PCMS and devices being used, and their placement for each closure point. Include ***ODOT Standard Detail DET4740*** for Rolling Slowdown Method details.

Additional Information

From the 00220 Boilerplate Special Provision, Section 00220.40(g), the Contractor is required to have contingencies prepared for the following circumstances:

- Work operations are not completed by the time the Blockade reaches the work area. All work, except that necessary to clear the roadway, will cease immediately and the roadway shall be cleared and reopened as soon as practical.
- The work site, the Blockade, and Flaggers shall communicate by radio to adjust the speed of the Blockade, as necessary, to accommodate the closure time needed.
- The initial PCMS on mainline should be mobile and continuously move with the operation to provide pertinent data to the drivers approaching the back of the queue. Maintain the location of the PCMS about ½ to 1 mile behind the back of the queue. A PCMS located 10 miles behind the queue, trying to warn about the queue ahead, does not provide adequate warning.

Rolling Slowdowns Calculation

Equation 1: Rolling Slowdown Distance

$$\text{Min Blockade Distance}, D_{\text{blockade min}}\ (\text{miles}) = \frac{t_{gap}\, V_{FreeFlow}\, V_{Blockade}}{60\left(V_{FreeFlow} - V_{blockade}\right)}$$

$D_{\text{blockade min}}$ = the minimum distance upstream from the beginning of the work area where the blockade should begin (miles)

t_{Gap} = Desired Gap in Traffic (minutes)

$V_{blockade}$ = Blockade Speed (mph)

$V_{FreeFlow}$ = Free-Flow (pre-blockade) Speed (mph)

$V_{FreeFlow}$ = 55 mph for Freeways & Non-Freeways

3.4.22 Sign Placement

Temporary sign placement is a critical component in the design of a TCP. Temporary signing is the primary method for conveying work zone warnings, guidance and regulatory messages to drivers. Signs must be designed properly, contain a clear, concise message, and be placed to maximize their visibility. Proper sign placement allows drivers to read, interpret and react to the sign messages.

A designer should be very familiar with the ***TCD Spacing Table*** shown on the ***ODOT Standard Drawings TM800. MUTCD Section 6F*** provides additional information and guidance relating to the placement of temporary signs.

Address the following temporary signing items as you develop your TCP:

- First, conduct a field investigation and collect an inventory of existing signing – including specific sign locations – and any other roadside features that may conflict with temporary sign placement. See the **Facility Features** discussion earlier in Section 3.3.1.
- Use the inventory to place temporary signing within the TCP. Avoid locating temporary signing in the immediate vicinity of existing signing. Wherever practical, provide standard sign spacing between temporary and permanent signs.

Urban Areas

- Placement of temporary signing is more challenging with the presence of added roadside obstacles and facilities. Consider the following when specifying sign locations or showing them on TCP sheets:
  - Investigate the work site and collect data regarding available shoulder widths and the presence of sidewalks. Use this data to determine if widths will allow signs to be post-mounted or will require a Temporary Sign Support (TSS).

- Collect additional data identifying designated bicycle lanes, multi-use paths, landscape strips between roadway and sidewalk, and other facilities that may affect temporary sign placement.
- Be aware that the "shoulder" may also be a designated Bicycle Lane. Showing temporary signs in the "shoulder" (on the plans or in the Special Provisions) will force cyclists into live travel lanes, potentially creating an unsafe condition.

If multiple TSS will be placed on a shoulder frequently used by bicycles for extended periods, add a "Bicycles ON ROADWAY" (CW11-1) sign in advance of the TSS-mounted sign sequence. Repeat the "Bicycles ON ROADWAY" sign approximately every mile, as needed.

- Temporary signs may sometimes be installed on existing utility poles, but ONLY if prior arrangements have been made with the appropriate utility or local jurisdiction. Larger signs may exceed load limits for some utility structures. This should also be checked.

3.4.23 Speed Zone Reductions

Under some circumstances, it may be necessary or advantageous to implement a temporary speed reduction through a work zone.

The duration of the temporary speed zone reduction will vary based on the type and complexity of the work being done and how quickly the constraint or hazardous condition can be relieved or eliminated.

To obtain a temporary speed reduction in a work zone on a State Highway, an official Speed Zone Reduction Order must be approved and signed by the state traffic engineer. County and City agencies must go through their proper channels in obtaining similar approval.

For ODOT projects, the designer should download the "Work Zone Speed Reduction Request Form" - found in Appendix C or online under the traffic-roadway section web site. Look for links to the traffic-roadway "Publications" page. The Work Zone Speed Reduction Request Form includes instructions for how to fill out the form and the process to follow. A variety of circumstances can justify the warrant for a speed zone reduction, including:

- Reducing the number of lanes for traffic.
- Complex construction staging.
- Temporary alignments, crossovers or on-site diversions.
- Freeway nighttime paving operations on high-speed, multi-lane facility.
- Workers present for extended periods within 2-ft of travel lanes and not behind barrier.
- Lane widths (existing or due to construction) of less than 12 feet.
- Horizontal curves with a safe speed 10 mph or more less than the posted speed.
- Pavement edge drop-offs within two feet of the traveled way for more than ¼ mile.

Speed Reduction Process Information

The state traffic engineer has the authority to set a reduced speed in a work zone or other temporary condition on State Highways. The request must be reviewed and concurred with by the resident engineer, TCP designer, and region traffic unit manager before submitting to the work zone Traffic Control Unit for final review. For permit projects (e.g. Maintenance operations and Utility work), only the District Manager and region traffic engineer signatures are required before submittal to the TCP Unit. In submitting requests, include the completed Work Zone Speed Reduction Request Form and a copy of the traffic control plan (Advance Plans or "90% complete" recommended).

Requesting a Speed Zone Reduction is typically a 2-stage process:

1. During project development, request a, "Letter of Support" from the state traffic engineer.
2. After Contract award, request a ***Temporary Speed Zone Order***.

If a speed reduction is being considered, the following guidance can optimize the approval process:

- Include a copy of the current TCP in the submittal. Provide as much detail as practical.
- Add a quantity of Temporary Signs in the estimate to cover signs used for the Speed Zone reduction – Typically, two signs per direction being slowed. Multi-lane facilities would need four signs per direction.

DO NOT draw the specific Speed Zone signs on your plan sheets! 'Sign Outlines' or 'placeholders' may be included and labeled as, "Hold for Temp. Speed Zone Signing," or other notation.

- Following the Plans-in-Hand meeting, issuance of Final Plans, or after Award, a Speed Zone Order can be requested. The signed Order will establish the final placement and duration of the temporary speed zone signs.

A process flowchart to determine what needs to be submitted for traffic-roadway section for review is shown in Figure 3-30.

Letter of Support

Requesting a ***Letter of Support*** is typically done no sooner than after the completion of the Preliminary Plans for a project. Issuance of a Letter of Support depends largely on the amount of detail shown in the traffic control plan.

The Letter of Support is NOT a Speed Zone Order and cannot be used to include specific speed zone signs in the TCP or place signs on a project.

The purpose of the Letter of Support is to:

- Inform the traffic-roadway section, resident engineer, and region traffic Manager that a regulatory, work zone speed reduction is being considered for the project.
- Open a dialog between designers and traffic-roadway section on the use of a regulatory speed reduction, and related temporary traffic control measures.
- Enhance the consistency and quality of the design of work zone speed reductions.
- Provide a means to capture temporary speed zone signing quantities in the TCP estimate.
- Accelerate the processing of the Speed Zone Order request.

Designers need to plan ahead and allow 10 business days for ***Work Zone Speed Reduction*** requests to be processed and a ***Letter of Support*** to be issued.

Once a designer has received the Letter of Support, include the language from the ***Special Provision***, "***00222 – Temporary Speed Zone Reduction***" in the project Special Provisions.

Temporary Speed Zone Order

A Temporary Speed Zone Order is typically requested after the contract is awarded and both the Contractor and resident engineer (or District Manager for permit projects) have agreed on the project staging and traffic control. Allow 10 business days for the Speed Zone Order request to be processed and the Order to be issued.

If a ***Letter of Support*** has been issued by the state traffic engineer, and no (significant) changes have been made to the traffic control plan since the Letter of Support was issued, the resident engineer (or District Manager for permit projects) can submit a signed Order request to the traffic-roadway section. No additional information is required for processing the Order request.

work zone traffic unit staff will determine if a speed zone reduction is warranted based on the contents of the submitted Order request and current traffic control plans. Speed Zone Orders for a work zone are written specifically for the conditions present in the work zone. The presence of one or more conditions or factors from ***Section 6*** of the ***Speed Reduction Request Form*** may not necessarily result in the support of a speed reduction. Some conditions may be better mitigated with temporary traffic control measures other than a speed reduction.

A ***Speed Zone Order*** can be issued without a ***Letter of Support*** for projects already under contract. Similar materials and information should be submitted as part of the Speed Zone Order request if a ***Letter of Support*** has not previously been issued (see Figure 3-28).

Speed Zone Reduction Signing

The standard sign sequence for a temporary speed zone reduction should include the following signs in the following order:

1. A fluorescent orange version of the Speed Reduction (W3-5) sign.
2. A "SPEED LIMIT XX" (R2-1) sign.

The "SPEED XX" (OR2-1) sign is no longer in use as a result of the passage of Senate Bill 558 during the 2019 legislative session. The bill provided consistency for road users and law enforcement around safe speeds. The change in signs from "SPEED XX" to "SPEED LIMIT XX" is meant to signify that speed limit is the maximum safe speed.

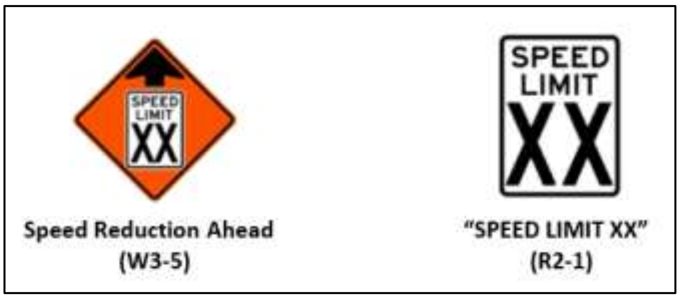


Figure 3-29: Speed Reduction Signs

The SPEED XX (OR2-1) sign is no longer in use as a result of the passage of Senate Bill 558 during the 2019 legislative session. The bill provided consistency for road users and law enforcement around safe speeds. The change in signs from SPEED XX to SPEED "LIMIT" XX is meant to signify that speed limit is the maximum safe speed.

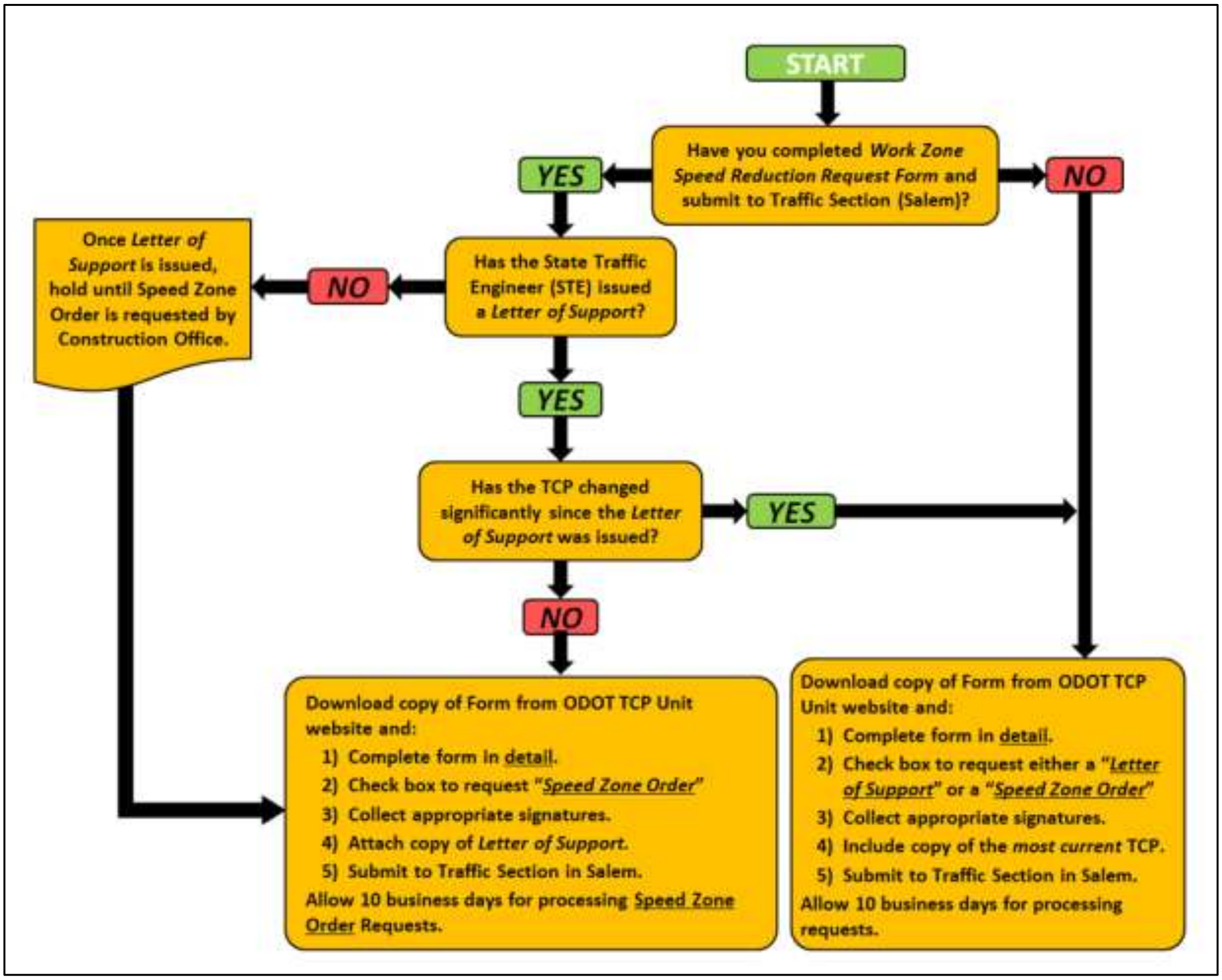


Figure 3-30: Work Zone Speed Reduction Process

Sign Placement

In most cases, sign placement for temporary speed zone signing is no different than for any other temporary signing. Nonetheless, the following guidelines can be used for locating temporary speed zone signing within a TCP:

- Two-lane, two-way roadways: Located on right side of roadway.
- Four-lane Divided or Access-controlled (freeway) roadways: Matching sequence located on right and left (median) side of the roadway, where practical. Supplemental (left-side) signs should not be placed in a center continuous two-way left turn lane.
- Roadways with three or more lanes per direction: Matching sequence located on right and left (median) side of the roadway, where practical.

A PCMS can be used to provide supplemental, advance notification of an approaching reduced speed zone. However, specific regulatory messages should be avoided on the PCMS to avoid confusing public traffic and law enforcement as to where the reduced speed zone begins.

MESSAGES to AVOID

SPEED LIMIT XX	SLOW SPEED XX	SPEED XX CAUTION

SUGGESTED MESSAGES

SPEED XX AHEAD X MILES	SLOW TO XX MPH AHEAD	REDUCED SPEED X MILES	SLOW TO XX FOR WORKERS

Figure 3-31: Sample of PCMS Messages

Speed Zone Reductions are written for a segment or length of roadway affected by some condition that warrants a reduction in speed to enhance safety for road users and workers. Speed Zone signing can placed in one or both directions of a roadway segment – depending on whether construction is making an impact on the original roadway environment and/or workers are present and adjacent to live traffic without the aid of positive protection.

Speed Zone Reduction signing locations will vary, but generally should be located after the Road Work Ahead sign and terminate before the End Road Work sign. The speed zone signs should not be placed between warning signs and the condition requiring the warning signs. The Speed Zone Order will include specific details regarding sign placement. Contact the work zone Traffic Control Unit for additional guidance.

Freeway Speed Zone Reduction

In an effort to help control speeds and optimize safety for high-speed work zones, new traffic control measures for select project types on Oregon freeways and divided highways have been developed. Projects on these facilities involving moving operations, where workers are immediately adjacent to live traffic, would qualify for a temporary speed zone reduction. The speed zone reductions are typically approved for 10 – 15 mph below the pre-construction posted speed limit.

In developing the TCP, include a "Work Zone Speed Reduction Request" for projects that include all of the following:

- Moving operations on Interstate freeways or multilane divided highways (e.g. paving, concrete rubblization, barrier replacement/installation).
- Pre-construction posted speed ≥ 45mph.
- Workers will be adjacent to live traffic and not behind concrete barrier, guardrail or other positive protection barrier system.
- Work is done at night. Consider requesting a speed zone reduction for daytime operations where the facility ADT > 10,000.

If the project meets all of the criteria listed above, include the ***Special Provision***, "***00222 – Speed Reduction Measures (Paving Operations)***", identify ***Standard Drawing TM880 - Freeway or Divided Highway Speed Reduction (Paving Operations)*** on the list of applicable drawings in ***Section 00221*** of the ***Special Provisions***, and include language and quantities for all of the associated bid items. The freeway/divided highway speed zone reduction request process is the same as the process used to request a temporary speed zone reduction for other project types and scopes of work:

- A "Letter of Support" may be obtained from the state traffic-roadway engineer (STRE) by completing and submitting a "Work Zone Speed Reduction Request" and a copy of the TCP. Having the "Letter of Support" will help expedite the processing of the Speed Zone Order Request once the project has been awarded.
- To obtain a Speed Zone Order, a "Work Zone Speed Reduction Request" MUST be completed and submitted with a copy of the TCP to the STRE for approval.

Additional Traffic Control Enhancements for Speed Zone Reductions

Where speed compliance is critical, additional enhancements to the TCP should be considered, including the following:

- Radar Speed Trailers.
- Dedicated PCMS with speed zone-specific messages.
- Sign Flag Boards for SPEED LIMIT XX signs.
- "Reminder" SPEED LIMIT XX signs posted on 1/2 mile intervals.
- Supplemental SPEED LIMIT XX sign lighting (e.g. amber flashers).

Speed Zone Reduction Alternatives

As an alternative to a formal Speed Zone Reduction Order, other signs may be added to the TCP to warn of conditions that warrant reduced speeds.

Example signs include:

- Reverse Curve (W1-4), or Two Lane Reverse Curve (W1-4b).
- Advisory Speed (W13-1) riders below advance warning signs.
- "LANE NARROWS" (CW23-5).
- Curve (W1-2a) with an advisory speed included on sign face.

Advisory Speed plaques shall only be used where an engineering study determines the need to advise drivers of an advisory speed for a condition. Advisory Speed plaques shall be in 5 mph increments.

The "ROAD WORK XX MPH" (CW20-1a) sign may be used as a general warning for a reduced speed condition. The speed displayed on the sign should be determined through engineering judgment and have ODOT approval.

Figure 3-32: Advisory Speed Zone Reduction Signs

Avoid creating a temporary situation that would require an Advisory Speed of more than 20 mph below the pre-construction posted speed for non-freeways, and more than 15 mph below the posted speed for freeways.

The "CONSTRUCTION SPEED XX" sign has been deleted from the ODOT Sign Policy. ***Do not*** use this sign in a Traffic Control Plan (see Figure 3-31).

Figure 3-33: Construction Speed Sign

Reducing the posted speed of a facility through a Temporary Speed Zone reduction DOES NOT constitute a reduction in the DESIGN SPEED for traffic control measures or the traffic control plan.

3.4.24 Temporary Alignments

Temporary roadways used by traffic during construction staging should be engineered alignments. Crossovers, on-site diversions, temporary ramps or other roadway elements should be designed and constructed based on an engineered alignment.

Designers should consider the following design elements in developing a temporary roadway:

- Spirals are not mandatory, but are recommended. It may be necessary to include a spiral, spiral segment or partial spiral in the design if the alignment departs from or returns to a curvilinear segment of roadway. Spiral elements will aide in proper superelevation and transitions.

- Minimum superelevation rates may be obtained from Table 3-5 of the HDM.
- See ***Section 3.4.8*** for freeway crossover design details.
- Radii for all non-freeway projects shall not be less than that needed to meet a design speed equivalent to the pre-construction posted speed.
- Match mainline shoulder widths, where practical. For freeway crossover shoulder widths, 4 feet is recommended. Use a minimum of 2 feet for temporary freeway alignments.
- Include appropriate pavement markings and channelizing devices.

Pavement design and materials needed to construct temporary alignments are not normally included in the Traffic Control Plan. Embankment, aggregate, and pavement material quantities should be included in the Roadway pay item schedule.

3.4.25 Temporary Concrete Barrier

Temporary concrete barrier is a commonly used traffic control measure and provides one of the most effective means for separating workers from public traffic within work zone. Several factors should be considered when determining the need for temporary concrete barrier.

Barrier Warrants

The need for temporary concrete barrier is not always obvious. Engineering judgement and experience can help a designer decide when to use barrier. As for guidance from a technical reference, the AASHTO Roadside Design Guide suggests the following as warrants for placing temporary concrete barrier:

- If setting and removing the concrete barrier to protect a hazard takes less time than the hazard is expected to be exposed to traffic.
- If the presence of the concrete barrier presents a lesser risk to safety than the hazard being protected.

Use the following as additional warrants for the inclusion of concrete barrier in your TCP:

- For freeway applications, if the existing means of separating opposing directions of traffic is altered or reduced through construction staging, temporary concrete barrier is warranted. For example:
    - Staging decreases a 30-ft wide landscaped median to a 20-ft median
        - Southbound traffic is moved into the median on a temporary crossover.
        - Existing concrete median barrier is being replaced.
    - Protecting structure falsework, a bridge column or abutment, or other structure work.
    - Separating traffic from deep excavations adjacent to the travelled way. Examples of factors that emphasize this warrant include:

        - Providing a 3:1 aggregate wedge is impractical due to the depth of the excavation.
        - Exposure to lengthy longitudinal excavations (For lower speeds, shorter lengths; or for higher speeds, longer lengths).
        - If a minimum 4-ft shoulder cannot be provided with the 3:1 aggregate wedge; or, the pavement surface replaced by the end of the shift.
    - Other work activities where severe damage or injury may result if left unprotected by a physical barrier.

While not all inclusive, this list of warrants or conditions presents the designer with an appropriate amount of latitude and an opportunity to use their engineering judgement in the final decision to use concrete barrier or not.

Barrier Placement

Due to the physical properties and nature of temporary barrier, it needs to remain crashworthy when placed in a work zone. Therefore, there are strict requirements for the placement of barrier. To remain crashworthy, temporary barrier must be:

- Set on a level asphalt concrete (AC) or Portland Cement Concrete (PCC) surface
- Installed with 5.5-ft of clearance behind it – measured from the back face of the barrier to the nearest obstacle. The 5.5-ft clearance shall be free of all permanent and temporary obstructions, including construction materials, parked vehicles, etc.
- Secured to a PCC or AC pavement surface when a 5.5-ft clearance cannot be provided. Refer to the ***ODOT Temporary Traffic Control Plan Standard Drawings*** for securing details.
    - Even when secured, a 1.5-ft minimum clearance must be provided behind the barrier.
    - Designers should identify type of barrier on plan sheets as:
        - "Temp. Barrier – XXX.XX ft."; <u>or</u>
        - "Min. Deflection Temp. Conc. Barrier, Reflectorized – XXX.XX ft."
        - Use Tables 00226-1 and 00226-2 in ***Special Provision 00226***.
- Anchored to a PCC bridge deck.
    - See the ***ODOT Bridge Design Manual (BDM)***, ***Section 1.13.1.10***, for specific barrier designs and installation details.
    - Check with the bridge designer.
    - Include Details DET3295 and DET3296 in the Plans.

In most cases, where the minimum clearance of barrier needed for deflection cannot be met, despite due diligence, the solution may lie in the designer optimizing the design feature given the available resources. The designer shall document assumptions and thought processes as described in *Section 3.4.2 – TCP Design Exception Process*.

When installing temporary concrete barrier:

- Protect all blunt ends exposed to live traffic with a temporary impact attenuator from the ***ODOT QPL***.
- Do not install on a gravel or dirt surface.
- Do not install barrier at an angle greater than 25^0 from parallel with the approaching traffic flow.
- Do not use barrier to close a roadway unless placed in a crashworthy manner with appropriate, crashworthy end treatments (see End Treatments, below).
- Do not install without pinning individual barrier sections together.

Channelizing devices should close a lane/shoulder when preceding a lane/shoulder closure utilizing barrier. Errant vehicles will be alerted to the closure by the channelizing devices, and will hopefully avoid striking the barrier.

Temporary concrete barrier may be moved into place and used as "Permanent" barrier at the completion of the project, as long as the barrier meets all of the requirements of ***Standard Specifications – Section 820***.

Reflective Barrier Panels

Reflective barrier panels are a very effective device, when used properly, in improving the delineation and visibility of temporary concrete barrier. Panels are installed on the face of the barrier and provide drivers with a highly reflective series of markers.

Because of their reflectivity, Barrier Panels are most effective on barrier in curved sections of a road where, by itself, barrier may otherwise be difficult to see at night or in inclement weather.

For calculating reflective barrier panel quantities, two panels are attached to each piece of barrier. Include a percentage of the total quantity for replacement (typically, 10-20%). Make small adjustments to the replacement percentage depending on factors such as the number of times barrier is moved, the width of the shoulders, traffic speeds and volumes, radius of curvature, and project duration.

Additional Reflective Barrier Panel information is included in ***Section 00226*** of the ***ODOT/APWA Standard Specifications for Construction***.

Figure 3-34: Reflective Barrier Panels

Highway Median Barrier Replacement Projects

An occasional component in freeway construction projects is the removal and replacement of obsolete permanent median barrier. In developing a traffic control plan for this type of activity, ODOT has found most Contractors use the following procedure to replace the barrier:

- Place an equal length of temporary concrete barrier alongside the existing barrier to be removed.
- Close the adjacent lane to provide sufficient room to work. Occasionally, the adjacent lane on both sides of the highway are closed.

Appropriate barrier connections or blunt end protection are required. Designers should include barrier connection details in the TCP, as needed (see **End Treatments**). Including at least two Truck-Mounted Impact Attenuators (TMA) is recommended.

Providing a perceived "clear zone" between opposing directions of travel by closing inside traffic lanes, in lieu of installing temporary concrete barrier, is not a standard practice.

Temporary Glare Screen

To minimize the potential for distracted drivers in the work zone, a new pay item has been developed and added to the ***ODOT QPL***. The Temporary Barrier Screen is a visual and protective system installed on top of temporary concrete barrier. The Glare Screen is made of low-density polyethylene (LDPE) plastic, is lightweight and extends approximately 24 inches above the top of the barrier. While purposefully designed as an anti-"gawk" screen, the screens can also be used to control some dust and debris from passing over the barrier and into live traffic lanes.

Systems made of plywood sheets and steel piping, or of chain link fencing materials are no longer allowed on ODOT construction projects. Glare screen products must come from the ***ODOT QPL*** or be otherwise approved by the resident engineer.

The ODOT Traffic work zone Unit continues to investigate additional barrier screen products for approval and addition to the ***ODOT QPL***.

End Treatments

The blunt end of a temporary concrete barrier run presents a serious hazard when exposed to traffic. When concrete barrier is placed on the project site, a number of methods are available for protecting the blunt ends:

Temporary Impact Attenuators

The most common device used for protecting blunt ends. Available in a wide variety of styles for various applications:

Barrel or Drum Array – A sand-filled array of plastic barrels. See the ***ODOT Temporary Traffic Control Plan Standard Drawings*** for additional details.

Narrow Site system – Approx. 2-ft in width. Used where space does not allow for the placement of the drum arrays. A tall concrete barrier transition to standard concrete barrier must be used when attaching narrow site systems to tall concrete barrier. See the ***ODOT QPL*** for additional details.

Truck-Mounted Attenuator (TMA) – Installed on a truck. A TMA is intended as a short-term, mobile protection device. Portability gives the TMA greater flexibility in placement. Use of a TMA to protect blunt ends should be limited to three consecutive days.

Temporary Connections

Several devices are available to connect runs of temporary concrete barrier with other barrier systems including existing barrier, bridge rail and guard rail sections. For examples, please see ***ODOT Standard Drawings RD530, DET110*** and others depending on the needed connection.

Overlapped Ends

If sections of barrier are being moved, installed or reinstalled frequently such that matching up the ends of the runs is impractical, blunt ends may be overlapped so as to “hide” the exposed end from approaching traffic. See the following Figure 3-35 for additional details

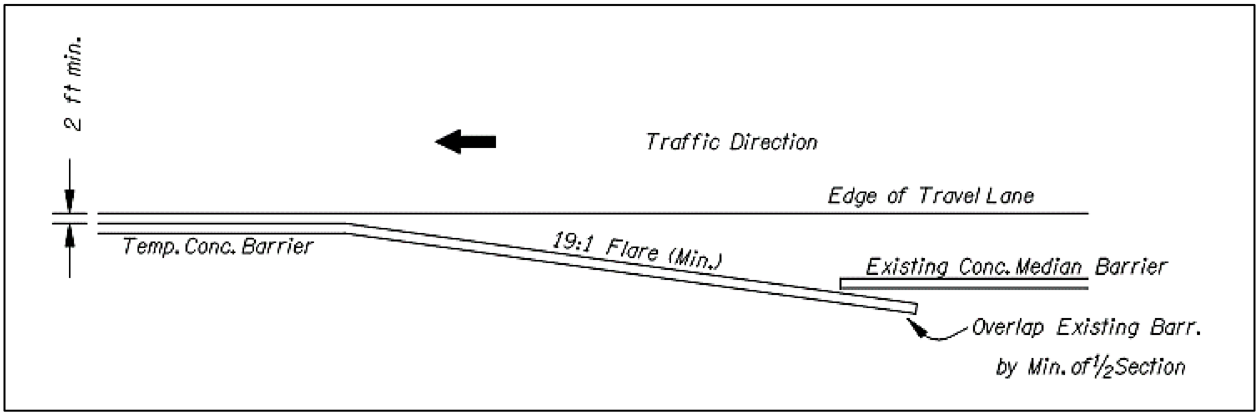


Figure 3-35: Typical Overlap of Temporary Concrete Barrier

Buried Ends in Fill/Back Slopes

When the work zone presents itself and other protection techniques listed here are impractical, the blunt end of the barrier may be buried in the roadside backfill or a cut slope. For examples of this type of application, see ***ODOT Standard Drawing RD526***.

Sloped End Terminals

This device is limited to facilities with a posted speed of **30 mph or less**. Sloped end terminals are primarily used in urban, low-speed settings or in a ramp terminal or other intersection where traffic is coming to a stop. See ***ODOT Drawing RD510*** for additional details.

Non-Recommended and Discontinued Protection Methods

ODOT **DOES NOT** recommend the following measure for "protecting" blunt ends:

- **Flaring the end of the barrier beyond the "clear zone."**
  Often, there is inadequate space available to provide the proper clear zone. In addition, the entire barrier flare must be installed on an AC or PCC surface to maintain the crashworthy properties of the barrier. Furthermore, the length of barrier needed (and any temporary surfacing) to provide the necessary clear zone can end up costing as much as a temporary impact attenuator.

The following measure for "protecting" blunt ends has been ***discontinued***:

- **Barrier Mounds**
  Following a letter issued by the Federal Highway Administration (FHWA) in February, 2003, the use of barrier mounds as a means of protecting the blunt end of a concrete barrier run is no longer allowed. **DO NOT** use mounded fill material at the end of a concrete barrier run to protect the blunt end – for either temporary or permanent applications. **DO NOT** include ***ODOT Standard Drawings RD525, RD565*** or ***DET152*** in your Traffic Control Plans.

Tall Concrete Barrier ("F" shape)

Tall "F" (42-inch) barrier was originally designed to replace the "single slope" concrete barrier. The Tall "F" barrier provides effective protection against median crossover crashes – particularly from large trucks. During Test Level 3 (TL-3) and 4 (TL-4) testing, the Tall "F" barrier performed very well, seeing deflections of approximately 32 inches.

The primary use for Tall "F" barrier is in the median of ODOT Interstate and Highway freight routes. As a secondary use, Tall "F" barrier may be used as shoulder barrier for these same routes.

In the TCP, Tall "F" barrier may be used as temporary barrier. Typically, however, the Tall "F" barrier is then moved into a final location and used as permanent barrier. Due to the limited availability and greater difficulty with moving this type of barrier, it is impractical for a designer to specify Tall "F" barrier to be used *exclusively* as temporary barrier.

Do not specify the use of Tall "F" barrier in your TCP as temporary bridge rail or in a situation where the Tall "F" barrier would need to be restrained on a PCC surface. The current ***Barrier Restraint Detail*** shown in the ***ODOT Traffic Control Plan Standard Drawings*** has not been approved for use with Tall "F" barrier.

For pinning "Tall F" barrier to the roadway, see ***ODOT Drawing RD516***.

3.4.26 Temporary Weigh Stations and Chain up Areas

The ODOT Commerce and Compliance Division ensures the safety of freight movement throughout Oregon by performing unannounced temporary inspections on the side of the highways. The temporary weigh stations and chain up areas serve as the spots to inspect mechanical safety of trucks, properly packaging of hazardous materials, properly securing of loads, maintaining legal weight limits as well as other Federal Motor Carrier Safety Regulations.

The region traffic work zone designer serve as a resource for temporary traffic control operations on state highways and in this case assisting with the layout of the temporary weight station and chain up areas for enforcements on state highways. At minimum, the temporary traffic control consists of advance signing as showing in Figure 3-36.

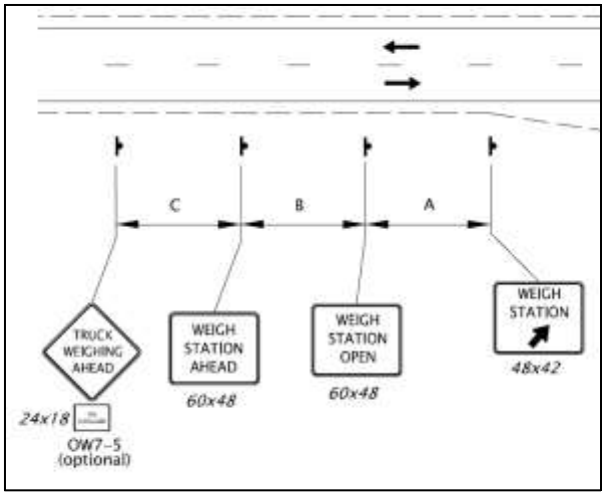


Figure 3-36: Advance Signing for Enforcement Areas

The layout of the enforcement areas consists of approximately 200 feet of storage length, followed by an inspection spot (scale area), followed by a merging taper adequate for entering back the highway. A minimum of 8 feet wide lane is needed for the storage and inspection area. Figure 3-37 summarizes the general layout of the temporary weight stations and chain up areas for enforcement.

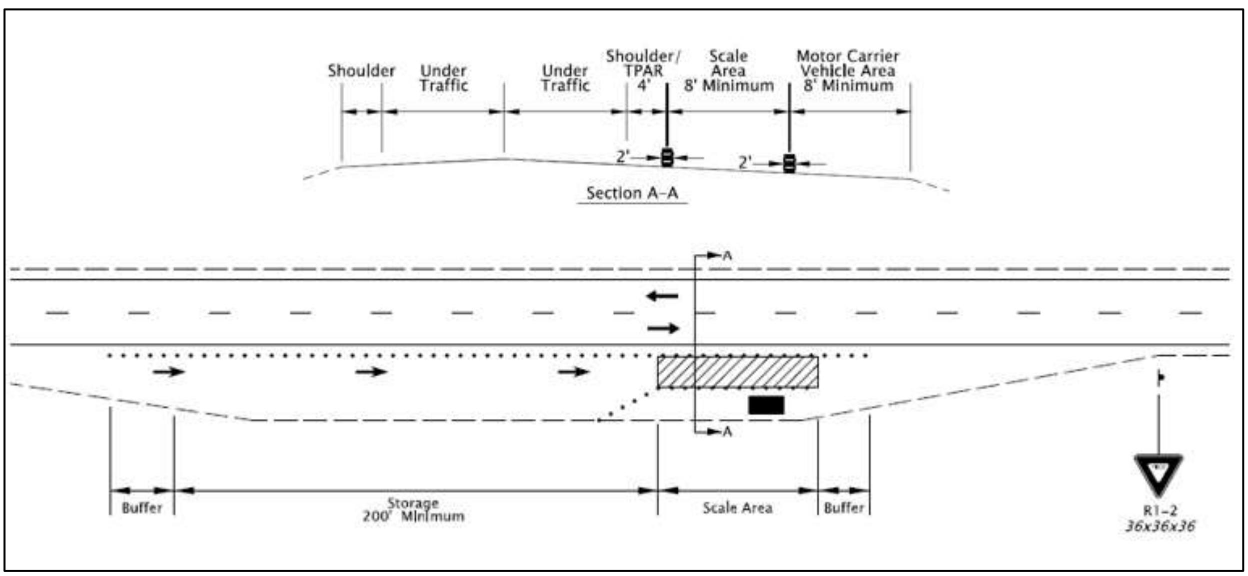


Figure 3-37: Temporary Weigh Stations and Chain up Areas Layout

The following is additional information necessary for temporary operations at temporary weigh stations and chain up areas:

- When the weigh station is full, close weigh station by changing the "WEIGH STATION OPEN" sign to "WEIGH STATION CLOSED" and place channelizing across the entrance at 40 feet spacing.
- Only weigh trucks in the direction of travel in which the temporary weigh station is located.
- To sort trucks, flaggers should bring trucks to a stop before having the truck enter the weigh station.
- Do not locate sign supports in location designated for bicycles or pedestrian traffic.
- When flagging at night, the flagger station shall be illuminated.
- When the weigh station is not in use, the signs associated with weigh station shall be moved or covered.
- The motor carrier vehicle shall activate an overhead amber light or strobe light that is visible from 360°.

Please contact the work zone traffic unit for further guidance on temporary weigh stations and chain up areas for enforcement as authorized by ORS 810.530.

3.4.27 Temporary Illumination

When removing existing illumination from the project, develop a temporary illumination plan to meet or exceed the existing illumination levels provided on the project. The temporary illumination shall be in place before the existing illumination is removed and remain in operation until new permanent illumination is installed and operational.

3.4.28 Work Zone Presence Lighting

Previous research has identified lighting condition in addition to speeding as one the high risk factors impacting work zone safety. The use of presence lighting is gaining popularity is some transportation agencies as a mitigation strategy to improve compliance with speed limits in work zones during nighttime operations. Work zone presence lighting system is a series of portable light unit that are powered by a generator or batteries. The series of lights are placed on the shoulder of freeways in advance of the lane closure to alert motorists of the upcoming work zone activity. The presence lighting aid in slowing motorist prior to the lane merge or lane shift. Each lighting unit can provide light output ranging from 14,000 to 60,000 lumens. The higher output units can spaced out further than the lower output units.

Work Zone Presence Lighting System may be used on freeways, or high-speed divided roadways where existing ambient lighting is non-existent or very limited. Use the system on projects to stimulate driver attention as traffic approaches the work zone. On freeways and divided roadways, include one system in each direction active work is taking place. Include ***Standard Detail - DET4772*** in the TCP when Work Zone Presence Lighting is used.

3.4.29 Law Enforcement

Work Zone Law Enforcement Process

Simply lowering the speed limit in work zones often does not translate to reduced drivers' speed. Several studies have shown that posting a reduced speed limit is not enough to get drivers to slow down voluntarily in work zones. According to FHWA:

> *Drivers reduce their speeds through the work zone only when they perceive a need to do so, based on conditions in the work zone or the perception of enforcement activities.*[1]

Drivers voluntary speed reductions due to work zone conditions (i.e., barrier near travel lane, temporary crossover, lane encroachment, and reduced speed limit sign) are often closer to 5 mph. However, the presence of law enforcement in the work zone yields a speed reduction as much as 15 mph. Therefore, law enforcement have a significant effect in achieving a continuous speed reduction through the work zone.

Traditionally, the ODOT Transportation Safety Division (TSD) has managed a Work Zone Law Enforcement (WZLE) federal grant program through federal funds from the STIP and coordination with Delivery and Operations Division (D&OD). Federal funds are used to pay for presence and enforcement activities; state highway funds are used to pay for WZLE presence only (this was never an option with TSD and will be an option as of July 1, 2021).

Effective July 1, 2021, D&OD will integrate work zone law enforcement services into project delivery. This change will allow project delivery teams to direct project charge for WZLE activities instead of vying for limited and prioritized WZLE grant funding. This transition will require Project Development Teams (PDTs) to identify, plan and budget for WZLE resource needs on projects. TSD's Region Transportation Safety Coordinators (rtscs) will continue to acquire an agreement with the LE agencies and provide liaison support throughout the lifecycle of the project. For more information on the WZLE process and workbook visit the Work Zone Law Enforcement webpage.

The work zone law enforcement process will be identified as early as scoping. During scoping, the traffic work zone control designer will use the *Work Zone Decision Tree* to identify the law enforcement needs. Once the need for law enforcement is identified for the project, the scoping team will incorporate it in the scoping notes and scoping Cost Estimation Tool (CET).

During project development at the Design Acceptance Phase (DAP) milestone, the designer will re-evaluate the need for law enforcement based on risk factors (see Table 3-13) and document the needs in the *Work Zone Decision Tree*.

[1] FHWA, *Guidelines on Managing Speeds in Work Zones*, Fall 2015.

Table 3-13: Law Enforcement Considerations

Risk Factor	Factor Description	Rank				
Average Daily Traffic (ADT)	Higher volumes of traffic increase the work zone risk for both public traffic and workers.	0	1	2	3	4
Crash History	Higher rates of accidents will increase work zone risk for public traffic and workers	0	1	2	3	4
Speed	Higher speeds increase risk to severity of accidents and ability for vehicles to navigate work zones.	0	1	2	3	4
Complexity of Work Zone	More complex work zones, with existing horizontal and vertical curves and TTC that requires drivers having navigate the work zone increase risk for public traffic and workers	0	1	2	3	4
Worker Risk	Workers exposed to live traffic has more risk than placing workers behind positive protection	0	1	2	3	4

Once the designer has determined that WZLE is needed on a project, the next step is to start estimating the hours of WZLE needed for the project in its entirety. The estimated WZLE hours will be based on the risk associated with the work zone. This can be determined by ranking each risk factor shown in Table 3-13 a value 0 to 4 as following:

- High Risk (60% coverage) = 4
- Medium – High Risk (45% coverage) = 3
- Low – Medium Risk (30% coverage) = 2
- Low Risk (15% coverage) = 1
- No Risk (0% coverage) = 0

Please note that this is not an exhaustive list of risk factors to take into consideration. The above provided method is the preferred method for identifying law enforcement needs, however the designers have the discretion to use additional risk factors or an alternative methods as necessary.

After a rank is assigned to each risk factor above, the total WZLE hours for a specific work zone activity (stage/phase) or for the entire project can be calculated as following:

$$WZLE\ Hours = \frac{Average\ Risk\ Factor}{4} \times 0.6 \times \frac{Work\ Hours\ (acitvity\ or\ project)}{Month} \times Duration\ (months) \times Number\ of\ Officers$$

Depending on the length of the project an additional officer could be added. For instance on a 15 mile long work zone two officers can be requested per shift. The new work zone law enforcement process with direct project charging allows for multiple officers in the work zone.

The Traffic Control Plans Cost Estimator provides a detailed approach to estimating the WZLE hours as described above.

Once the law enforcement jurisdiction, needs, and budget is identified, the designer will share this information with the transportation project manager (tpm) or resident engineer – consultant projects (re-cp) and the resident engineer for validation. The next step in the process is for the tpm or re-cp to notify rtsc of the WZLE needs. The tpm or re-cp or area manager (am) will then identify the funding source if it wasn't captured during scoping/STIP adoption.

Next step is for the rtsc to coordinate will law enforcement agency. The rtsc will first reach out to Oregon State Police (OSP) to see if they are able to resource law enforcement for the work zone. If OSP declines, rtsc will reach out to the identified local law enforcement agencies.

Increasing the law enforcement work hours to account for roundtrip traveling to a remote jobsite should be taken into consideration.

Once a law enforcement agency resources are assigned and a work order is executed, the law enforcement officer will be invited to the pre-construction meeting. At the pre-construction meeting, the work zone will be discussed and this will include the schedule, law enforcement placement …etc.

Work Zone Enforcement Plan (WZEP)

When law enforcement use is planned for a project, include a Work Zone Enforcement Plan (WZEP) in the Transportation Management Plan (TMP). Consider the need, extent, and type of police enforcement to be used. Manage the WZEP throughout the life of the project. Law enforcement personnel must be invited to pertinent project meetings, including the pre-construction meeting to discuss how law enforcement will be used and to coordinate locations within the project for enforcement.

During Design and Construction

Work with law enforcement during project design to designate locations within the project for placement of law enforcement. Provide positive protection to the greatest extent feasible while maintaining a visible presence of the law enforcement to motorists. Identify safe locations for increasing the safety of law enforcement in the project specific law enforcement plan, in order of preference, as follows:

1. Include longitudinal and lateral buffer spaces from live traffic.
2. Incorporate positive protection features of the existing highway and current construction project. Existing positive protections may include:
    a. Existing pullouts
    b. Existing guardrail, barriers, etc.

   c. Project related positive protection, including shadow vehicles and truck mounted attenuators
3. To greatest extent feasible provide law enforcement project specific positive protections, keeping in mind that a clear zone should be maintained for traffic.
4. Incorporate delineation to the greatest extent feasible for identified locations if the previous alternatives are not appropriate.

Additionally, the following should be considered as appropriate:

1. Asking Law Enforcement to turn lights on while providing presence.
2. Asking Law Enforcement to provide mobile enforcement.
3. Asking Law Enforcement to provide two officers for enforcement, one mobile and one stationary.

Consider speed management alternatives and supplements to enforcement. These may include the following:

1. Reduced Speed Limits
2. Speed Reader Trailers, Rumble Strips, Other Temporary Traffic Control Devices
3. Public Information Campaigns

3.5 Design-Related Specifications

Special Provision language is a key component in every TCP. The specifications in this section can present additional challenges for a designer – resulting in inconsistent applications – thus, additional clarification has been included here.

As is evident in several locations throughout this Design Manual, it is strongly recommended the designer be very familiar with the contents of the current ***ODOT/APWA Standard Specifications for Construction*** and ***Boilerplate Special Provisions*** from ***Sections 00220*** through ***00229***. Being familiar with other related and cross-referenced Sections is also encouraged. See **Chapter 4** for additional Specification information.

3.5.1 20-Minute Stop or Hold

In keeping with ODOT's commitment to mobility and minimizing delay to the traveling public, the following bulleted item is included in ***Section 00220 – Accommodations for Public Traffic, under Section 00220.02(a)*** in the ***ODOT/APWA Standard Specifications for Construction***:

- Do not stop or hold vehicles on a highway within the project site for more than 20 minutes.

Because of this strong commitment, this bulleted item should never be deleted through the project-specific Special Provisions.

It is rare, and often unnecessary, but changes to the amount of time ("20 minutes") made through the Special Provisions must be concurred with by the ODOT work zone engineer.

Requests to lengthen the amount of delay will not be granted as this creates undue delays in the work zone – leading to driver frustration and potential road rage situations.

Important Notes

- Carefully take into account the scope of work, project schedule and cumulative, long-term effects on traffic traveling through this project before considering any modifications to this Standard Specification.
- This language is primarily aimed at two-way, one-lane operations – typically, during flagging operations – but can also apply to flagging of side roads or private accesses within a work zone.
- This language does not apply to freeway operations, as stopping or holding traffic on Oregon freeways is not allowed for planned construction or maintenance activities.

- The *2008 Standard Specifications for Construction*, rewrote the original 2002 language and split it into two separate bulleted items for clarity. The second bullet addresses temporary driveway closures:
    - Do not block driveways for more than two hours, unless otherwise authorized in writing.

In addition, Liquidated Damages (see ***Section 00180.85***) cannot be applied to this portion of the Special Provisions. Under this situation, ODOT notifies the Contractor that they are in 'Breach of Contract,' and they must modify work practices to relieve the excess delay or they will be issued a "Suspend Work" order.

3.5.2 Contracting Provisions and Alternative Methods

Contracting provisions and alternative contracting methods can be used to accelerate the completion of a project. By reducing the overall project duration, traffic delays and inconveniences to public traffic. See examples of optional contracting provisions and alternative contracting methods below.

Optional Contract Provisions

ODOT uses optional contract special provisions requirements that 1) incentivize Contractors to find innovative ways to accelerate construction, minimize construction impacts, encourage innovation in work sequencing and maintaining specified contract times or limits; or 2) disincentivize Contractors from completing specified contract work after specified contract times or limits. The extra cost to ODOT is easily covered by savings derived from the reduced construction time and construction impacts.

Examples of effective optional contract provisions include:

- **Incentive/Disincentive (I/D)** – ODOT uses incentive/disincentive (I/D) contract special provisions to maintain construction completion dates, encourage innovation in work sequencing, and accelerate project delivery. ODOT pays the Contractor a contract specified incentive amount for completing specified contract work earlier than the time specified in the contract. Contractor pays ODOT, (not as a penalty) a contract specified disincentive amount, in-addition to liquidated damages for completing specified contract work later than the time specified in the contract. Refer to Operational Notice PD-17 for guidance and clarification on the use of I/D contract provisions.
- **Lane Closures Liquidated Damages** – ODOT uses lane closures liquidated damages contract special provisions to encourage Contractors to finish specified contract work within the contractual time limits by requiring the contractor to pay ODOT, not as a penalty, but as liquidated damages for any lane closure that goes beyond the contractual limits. Refer to ***ODOT Standard Specifications for Construction Boilerplate Special Provisions, SP00180.95(c).***

For information on whether your project is a good fit for use of optional contract special provisions contact Project Controls Office (PCO) Specifications Unit at ODOTSpecifications@odot.oregon.gov

Alternative Contracting Methods

Alternative contracting methods can be used for complex projects to accelerate the completion of a project or to enable contractor involvement in the design phase. Examples Alternative Contracting methods include:

- **Price + Methods or A+B; A+C+D** – These types of contracting methods are similar to Design-Bid-Build, but they have a few extra steps in the bidding phase to select the Contractor.
- **"A+B" Contracting Method** – where, "A" = Price; "B" = Contractor's proposed number of calendar days to construct the project.
- **"A+C+D" Contracting Method** – where, "A" = Price; "C" = Value of Contractor's pre-qualifications and "D" = Value of Contractor's approach.

Alternative contracting methods that get the contractor involved in the design phase:

- **"Construction Manager/General Contractor" Method** – Is an integrated contracting approach to planning, designing, and constructing a project. Owners, Designer(s), and Contractors work collaboratively to develop the project scope, optimize the design, improve quality, manage costs and share risks. This method allows for fast-tracking project completion, by enabling early work of construction packages to begin before all the design is complete resulting in shorter project time and reduce costs.
- **"Design-Build" Method** – A delivery method in which ODOT contracts with a single entity that provides design, construction and quality management services for a project. This method allows for fast-tracking project completion, parts of construction begin before all the design is complete resulting in shorter project time and reduce costs.

For information on whether your project work type is a preferred or viable option for an Alternative Contracting Method contact Alternative Delivery Services (ADS) at email: alternativecontracting@odot.oregon.gov. Additional information on Alternative Contracting Methods is available on ADS' website: https://www.oregon.gov/ODOT/Business/Pages/Alternative-Contracting.aspx

3.5.3 Business Accesses

This traffic control measure is used to help delineate business accesses disrupted by construction. Driveway approaches for private businesses are occasionally disturbed making them less visible to passing traffic, and particularly difficult to find at night or during inclement weather.

In an effort to partner with local businesses affected by construction, ODOT uses additional signing and special channelizing devices to clearly identify temporary business accesses.

ODOT uses the "BUSINESS ACCESS" (CG20-11) sign to identify the affected accesses. Refer to the ***ODOT Sign Policy & Guidelines***, ***Chapter 6***, for additional guidance on sign designs and placement.

Signing and Blue Tubular Markers in place

(CG20-11)

Figure 3-38: Business Access

The sign is to be installed on a single-post Temporary Sign Support (TSS). On plan sheets, Designers should add, "(Mount on Single-Post TSS)" under each sign.

DO NOT indicate the sign is to be mounted on a Type II barricade. Current ODOT temporary signs include the cost of the sign support. A Type II barricade is a separate pay item. A conflict arises when the sign is installed on the Type II barricade. ODOT expects the barricade cost to be included in the cost of the sign, while the Contractor expects to be paid for the barricade. Therefore, indicate the sign is to be installed on a single-post TSS.

ODOT/APWA Standard Specifications - Section 00220 incorporate the "BUSINESS ACCESS" sign into the TCP. Due to the specific purpose of the signing, this measure should limited to business accesses and not applied to private residential driveways or public streets.

3.5.4 Pavement Preservation Projects

Pavement preservation projects make up the largest part of the highway construction projects completed each year. While larger, complex modernization or bridge replacement projects get most of the attention, pavement preservation projects demand a surprising amount of attention to detail regarding the temporary traffic control. Preservation projects have the potential of creating much more delay to the traveling public due to the nature of the work and the traffic control measures used – e.g. flagging one-lane two-way traffic.

Pavement Preservation Project Types

ODOT includes Special Provision language for three distinct types of pavement preservation projects. Within the ***Sections 00220***, ***00222*** and ***00225 Boilerplate Special Provisions***, each pavement preservation type includes usage criteria described in "Instructional Notes", as well as specific language to be included in the Project Special Provisions based on the type included in the project.

Minor Hot Mix Asphalt Concrete (MHMAC) and HMAC preservation projects

Use this Specification language on Level 1, 2, or 3 MHMAC and HMAC Overlay (00744 or 00745) Preservation projects, provided the following criteria are met:

- Obtain Region Technical Center Manager's approval.
- Perform and/or document enough traffic analysis to confirm traffic volumes meet the following criteria:
    - ADT < 5,000 for roadways with posted speed > 45 mph.
    - ADT < 10,000 for roadways with posted speed ≤ 45 mph.

Emulsified Asphalt Surface Treatment (EAST) Preservation Project (a.k.a. "Chip Seals")

Use this Specification language on "Chip Seal" (Emulsified Asphalt Surface Treatment) (00710 or 00715) projects, provided the following criteria are met:

- Obtain state traffic engineer's approval.
- Compile Field Data Summary.
- ADT < 5,000 for roadways with posted speed > 45 mph.
- ADT < 10,000 for roadways with posted speed ≤ 45 mph.
- Federally funded projects require FHWA approval.

Cold In-place Recycle (CIR) or Emulsified Asphalt Concrete (EAC) Preservation Projects

Use this Specification language on "Cold in Place Recycle" (00720) or "Emulsified Asphalt Concrete" (00735) projects, provided the following criteria are met:

- Obtain state traffic engineer's approval.
- Compile Field Data Summary.
- ADT < 5,000 for roadways with posted speed > 45 mph.
- ADT < 10,000 for roadways with posted speed ≤ 45 mph.
- Federally funded projects require FHWA approval.

Boilerplate Special Provisions

In the context of this manual, *Boilerplates* are prepared documents that can be used in the same way a form letter or a document "template" might be used. Boilerplates can be thought of as generic 'fill-in-the-blanks' documents where the designer inserts additional project-specific information and deletes language that does not pertain to the Project.

Due to the dynamic nature of the temporary traffic control discipline, Boilerplates are also used to make corrections or additions to the ***ODOT/APWA Standard Specifications for Construction*** after the book is published.

When beginning any new ODOT/APWA highway construction project, the designer must download a **new copy** of the Boilerplate Special Provisions for ***Sections 00220*** through ***00229*** from the ODOT Specifications Unit web site.

Boilerplates are updated frequently, so the designer should always **download the current edition available on the ODOT Specifications web site before** every **project.**

If several months pass between the first time the Boilerplates were downloaded and the completion of a project, the designer should consider downloading another new copy of the boilerplates and updating their Project-specific Special Provisions for the project.

Signs and Striping

Because preservation projects frequently obliterate existing striping, No Passing and Passing Zones need to be identified using, "DO NOT PASS" (R4-1) and "PASS WITH CARE" (R4-2) signs. In addition, the "NO CENTER STRIPE" (W8-12) signs with "NEXT XX MILES" (W7-3a) riders must be used to alert drivers and supplement temporary pavement markings.

From the ***Section 00222 Boilerplate Special Provision***, instructions are included for the application and use of specific signs related to pavement markings within preservation projects.

The Boilerplate Special Provisions also include instructions and language for temporary pavement marking requirements for preservation projects. However, where markings are not sufficient in conveying regulatory Passing and No Passing Zone restrictions, the signs described above must be installed and remain posted until permanent markings can be placed.

Other project-specific requirements for striping, signing and temporary traffic control are included in each of the Boilerplate Special Provisions for preservation projects.

3.5.5 Steel Plating

On State Highways with a posted speed greater than 35 mph, Contractors are **NOT ALLOWED** to use steel plating to temporarily cover open trenching across the roadway or adjacent to the edge of the traveled way. Details of this specification language have been incorporated into the ***Standard Specifications for Construction*** under ***Sections 00220*** and ***00405***.

The language is intended to address the placement of steel plating anywhere in the travel lane and on the shoulder.

For higher-speed roadways (40 mph and greater), it has been determined unsafe to have traffic, especially large trucks, traverse the steel plating. Despite efforts to secure the plating to the roadway, the high impact loads to the plates eventually loosen the plate and create extremely severe hazards for drivers.

If steel plating is used on lower-speed roadways, the current ***Section 00220 Boilerplate Special Provision*** describes methods and materials to be used by the Contractor to safely use steel plating under live traffic.

Within the ***Section 00220 Boilerplate Special Provision***, various scenarios are included to address trenching, or the installation of piping or conduit transversely under the roadway. Conversations with the resident engineer will help determine the appropriate language to include in the Project-specific Special Provisions.

3.5.6 Traffic Control Supervisor (TCS)

The Traffic Control Supervisor (TCS) is a specially trained and certified employee working for the prime Contractor, or as a subcontractor. The TCS is responsible for coordinating the administration, proper installation, maintenance, layout and overall quality of the Traffic Control Plan, and the necessary temporary traffic control devices used on the project.

The TCS must carry a valid TCS Certificate. According to the specifications, the project superintendent shall not be assigned as the TCS on a construction project. For every day a TCS is to be on the project, the engineer must be notified 24-hours in advance.

TCS are currently measured and paid for on a "per Construction Work Shift" basis. The payment of one TCS "work shift" will be made regardless of length of the work shift. Payment will not be made until a **Traffic Control Inspection Report** (No. 734-2474) is completed for each day the TCS has finished a work shift.

Below are examples of some of the duties of the TCS from the current Specifications:

- Overseeing the installation, maintenance and removal of traffic control devices and markings.
- Coordinating personnel, mobile equipment and supplies used in traffic markings, sign installations and roadway channelization.
- Scheduling and insuring that all field assignments are satisfactorily completed according to prescribed traffic engineering plans.
- Supervising traffic control and maintenance crews.

See ***Section 00225*** of the ***Standard Specifications*** for additional information regarding TCS duties, measurement and payment details.

When Should A TCS Be Included In A Contract?

A TCS can be included on any project. However, it is recommended that a TCS be used when a project meets any of the following criteria:

- Multiple Stages involving repeated lane closures, traffic shifts or other significant disruptions to normal traffic operations.
- The placement and/or repeated relocation of multiple TCD, including significant signing changes – i.e. detours or alternate route signing.
- Projects with complex construction staging or complicated temporary alignments.
- Night paving operations.
- High mainline ADTs (> 10,000).
- Freeway work.
- High profile projects with substantial community or stakeholder involvement.

TCS Quantities

The current unit of measure for the TCS is the "Construction Work Shift". The use of and quantities for the TCS depend on a variety of conditions and factors, including:

- Scope and complexity of the work.
- Duration of the contract (1 month? 1 year? Longer?).
- Physical length of the project.
- Number of changes (Stages or Phases) to the traffic control layout:
- Lane closures or shifts.
- Work areas that progress along mainline on a regular basis.
- Opening/closing detour routes.
- Facility type (freeways and high-speed, multilane roadways warrant additional TCS).
- The amount of work done at night (traffic control quality more critical at night).
- Site location and roadway geometry.
- Seasonal weather conditions.

However, the general practice is to provide one TCS construction work shift for each anticipated day of active work. A designer should do their best in determining the construction schedule for the project, and determine a reasonable number of active work days. Winter shutdowns and other periods of work suspension should not be included in the TCS quantity estimate.

Additional TCS information is available in ***Section 00223*** of the ***Standard Specifications*** and Boilerplate Special Provisions.

Quantities Calculations – Examples

- Freeway paving project expected to last 4 weeks. Paving approximately 2 miles per night. Shifting traffic three times per shift. Long, straight, flat section of freeway.
    - TCS Quantity: 4 weeks @ 5 nights per week = 20 shifts.
      Consider adding small quantity for weather/mechanicals = 0 – 5 shifts.

      TOTAL = 20-25 Work Shifts.

- Bridge Replacement on two-lane, rural highway. ADT = 4500. Bridge replaced in three Stages. Two-way, one-lane traffic moved three times over 6-month-long project. Project starts in April. July and April likely to run two 8-hour shifts to meet completion date.
    - TCS Quantity: Three stages over 6 months = 6 x 23 days per month = 138 shifts.
      July – Second shift = 23 shifts.
      August – Second shift = 23 shifts.
      Two weekends (1 shift each Sat & Sun) July & August = 2 x 2 x 2 = 8 shifts.
      Contingency shifts = 5 shifts.

      TOTAL = 197 Work Shifts.

The TCP designer should have regular discussions with the resident engineer's office to confirm appropriate TCS quantities. Consider small adjustments (3%–10%) to TCS quantities as a contingency for changes in the staging plan or construction schedule.

However, like Flagger Hours, Designers should be prepared to justify their quantities for this pay item. Arbitrary or over-inflated quantities for this pay item should be avoided.

TCS Payment

Within Section 00223.88, the TCS item is *measured* per "construction work shift". Under Section 00223.98, the TCS is *paid* for at the contract unit price, per each for the item "Traffic Control Supervisor" – meaning each unit is a, "construction work shift."

Payment is made for each construction work shift that a TCS has been authorized to work on the project. Current language limits payment of a maximum of two TCS per single work shift. This is done to allow a TCS to be at each end of a very long project with active work areas many miles apart. It is also used to keep Contractors from abusing the pay item quantity.