Oregon Department of Transportation

Traffic Control Plans Design Manual

Delivery & Operations Division | Traffic Roadway Section

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Traffic Control Plans Design Manual

Engineering & Technical Services Branch
Traffic-Roadway Section

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Preface

The purpose of this manual is to provide an introduction to the standards, practices, devices and technologies that serve as the foundation for the temporary traffic control discipline. This manual provides an organized collection of traffic control plan design standards, guidelines, policies, and procedures to be used in the development of a temporary Traffic Control Plan (TCP).

This ***TCP Design Manual*** is intended for TCP designers, engineers or technical staff, members of City or County Public Works offices and private consulting engineering firms responsible for developing temporary traffic control plans and highway construction staging plans. However, concepts and guidance within this manual may also be applied to highway maintenance operations, utility and permit services, or other temporary activities within public highway rights of way.

Professionals conducting work outside of ODOT for other agencies should exercise caution in applying standards and practices within this manual as differences in design policy may exist between ODOT and those established by other agencies.

This technical manual is intended to provide greater detail in the design of temporary traffic control plans and supersedes other existing ODOT design policies that make reference to temporary traffic control design standards. This manual should be considered as the primary technical design policy for ODOT in the design of temporary traffic control plans.

This manual discusses Traffic Control Plans Design beginning with general information – including ODOT's Guiding Principle – and progressing to specific TCP design elements such as Traffic Control Devices, Traffic Control Measures, standard drawings, estimating, specifications and special provisions, etc.

This manual is updated annually. To expedite updates, this manual is available on-line. The on-line version is considered an official document. As an on-line document, it will not be published and distributed as a traditional publication, and there is no user list for update notifications.

It is the user's responsibility to verify they are using the most current version of the manual as their reference. Updated information will be detailed on the Work Zone Traffic Control Website.

The Traffic Work Zone Unit maintains the ***Traffic Control Plans Design Manual.*** Send comments or questions on this document to workzonestandards@odot.state.or.us or to:

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Table of Contents

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Chapter 1: General Standards and Practices

1.1 Key Topics Covered in this Chapter

- Safety – TCP Primary Function.
- TCP Structure and Form.
- TCP Design Elements.
- TCP designer Resources and Websites.

1.2 Work Zone Guiding Principle

Working with the Work Zone Safety Executive Steering Committee, the agency has developed and is implementing the following ***Work Zone Guiding Principle:***

Mission

ODOT's mission is to provide a safe, efficient transportation system that supports economic opportunity and livable communities.

Goal

Our work zone safety goal is zero fatalities and injuries, including ODOT employees, contractors, public safety professionals and the traveling public while efficiently moving people and goods.

Guiding Principle

The best work zone design and management plan will maintain safety and mobility, a balance that shall be analyzed continuously throughout the lifecycle of the facility.

Directive/Strategy

To accomplish this goal, project design teams shall consider the full range of options including, but not limited to, separation of the traveling public from workers and work areas, speed reductions, law enforcement, enhanced traffic control devices and signage, and overall roadway and work zone design.

Effective communication with travelers is essential to establish reasonable expectations and minimize unsafe driver behavior. While there is no single solution that is appropriate for all roadway designs and work zones, whenever practicable workers should be separated from traffic.

Resources

Mobility Advisory Committee (MAC)

ODOT's Mobility Advisory Committee is a resource that can provide necessary balanced guidance. Work through your mobility coordinator and the mobility committee to reach resolution. Bring issues forward early in the scoping and design stage to avoid surprises and keep everyone in the problem solving mode.

Work Zone Decision Tree Form

The *Work Zone Decision Tree* will help us identify separation options available per work zone. Impacts to safety, mobility, scope, schedule, budget, delay, driver convenience, and "other" impacts shall be identified when assessing separation options. To help guide us through our decision making, the Decision Tree is intended to provide new tools and approaches.

1.2.1 Guiding Principles and Decision Tree Application

The ***Guiding Principle*** emphasizes ODOT highway work zones are to be managed through the life of a project – from initial scoping, during project development, and throughout construction. Safety for workers and public traffic must be an integral part of the traffic control plan design. That level of safety must be managed throughout the life of the project. Traffic mobility must also be designed into each project and managed through the life of the contract.

The expectation for design teams is to apply the ***Guiding Principle*** and the ***Work Zone Decision Tree*** at key milestones throughout the course of the project – starting with Project Scoping.

Transportation Management Plan

As part of the commitment to safety and project integrity, ODOT makes the Transportation Management Plan (TMP) a **REQUIRED** portion of all ODOT highway construction contracts within public rights of way. ODOT is looking to increase the level of project planning, coordination and decision-making documentation for maintenance operations within future updates to the ***Oregon Temporary Traffic Control Handbook (OTTCH)***. ***See Section 1.4***, below, for more information about the TMP, its development and minimum required contents.

1.3 Safety – A Primary Function

1.3.1 Safety in TCP Design

Safety is primary in TCP Design**. *Chapter 6*** of the ***MUTCD*** repeatedly emphasizes safety management. ODOT's perspective regarding the function of a TCP coincides with the fundamental principles, guidance and standards within the ***MUTCD***. If designed with these ideas in mind, the TCP will minimize inconveniences to traffic during construction, minimize the number and severity of traffic crashes, and optimize safety and efficiency for highway workers.

The principal function of a Traffic Control Plan (TCP) is to:

> *"Provide for the reasonably **safe** and effective movement of road users through or around Temporary Traffic Control zones (work zones) while reasonably protecting road users, workers, responders to traffic incidents, and equipment."*

The goal of a TCP is to route road users through or around a work zone efficiently by:

- Using signs and pavement markings well in advance of the work zone, and adequately spaced throughout the work zone;
- Using devices that highlight or emphasize the appropriate path;
- Avoiding frequent or abrupt changes in roadway geometry; and,
- Avoiding work zone environments resulting in unanticipated, abrupt changes in speed.

ODOT, in accordance with the ***MUTCD***, works to emphasize the purpose and function of a Traffic Control Plan and develop consistent, safe and effective TCP designs.

MUTCD Definition of a "Traffic Control Plan" – Chapter 6A

From ***Chapter 6*** of the ***MUTCD***, the following excerpts discuss the definition and function of a temporary traffic control plan.

At the Planning level:

> *"When the normal function of the roadway is suspended, TTC (temporary traffic control) planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities."*

For worker safety:

> *"Of equal importance to the public traveling through the TTC zone is the safety of workers performing the many varied tasks within the work space. TTC zones present*

constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers and incident management responders on or near the roadway. At the same time, the TTC zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway."

The overall picture:

"Consideration for road user safety, worker and responder safety, and the efficiency of road user flow is an integral element of every TTC zone, from planning through completion. A concurrent objective of the TTC is the efficient construction and maintenance of the highway and the efficient resolution of traffic incidents."

The Traffic Control Plan

When conducting road work or working within the public right of way in Oregon, a traffic control plan is required. For ODOT highway construction contracts, the traffic control plan must include, as a *minimum*:

- ***Standard Specifications for Construction*** and ***Boilerplate Special Provisions.***
- A list of anticipated Pay Items.
- A list of applicable ***ODOT Standard Drawings*** and ***Standard Details***.

Project-specific traffic control plan sheets are recommended or required when projects include:

- Complex Scopes of Work – including multiple shifts in traffic, or where describing the activities in project-specific Special Provisions would be impractical.
- Full or partial facility closures – including motor vehicle, bicycle and pedestrian facilities where a detour is included to reroute roadway users.
- Pedestrian-specific construction staging or Temporary Pedestrian Accessible Routes.
- Challenging site locations or conditions.

Where additional details are needed to add clarity to improve the constructability of the project, development of project-specific plan sheets is encouraged. Include diagrams and engineered drawings to help convey the intended use and placement of traffic control measures and devices. The development of site-specific drawings may not be required for all projects or work activities; but, drawings should be considered for activities or locations where the additional detail would enhance the overall safety for the work area and increase the ease in which the plan is implemented in the field.

Typical Applications from Chapter 6 of the ***MUTCD***, *Typical Application Diagrams* from Chapter 5 of the ***Oregon Temporary Traffic Control Handbook (OTTCH)***, and ***ODOT Traffic Control Standard Drawings (TM800 Series)*** are intended to provide generic, non-project-specific temporary traffic control layouts for a variety of work zone conditions and roadway environments.

1.3.2 Engineering Judgement

From the ***MUTCD***, ***Chapter 1***, FHWA provides the following definition for "Engineering Judgment":

> *The evaluation of available pertinent information and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. *Documentation of engineering judgment is not required.*

A TCP designer should use engineering judgment when adding details to the TCP to improve clarity and efficiency; and, avoid excessive delays, added costs, and improve safety.

> ***** While being founded on baseline principals or thresholds, some additions or modifications to the TCP may be based largely on an engineer's individual experiences and not be previously documented. If invoking engineering judgment to make additions to the TCP, the engineer's decision process and final recommendation or solution should be well-documented including relevant assumptions. See *Transportation Management Plans* in ***Section 1.4***,

1.4 TCP Design Standards

1.4.1 Manual on Uniform Traffic Control Devices (MUTCD)

ODOT uses the guidance of the Federal Highway Administration (FHWA) ***MUTCD*** in the design of temporary traffic control plans. Mandates within the ***Oregon Administrative Rules (OAR)*** and ***the Oregon Revised Statutes (ORS)*** require the use of the ***MUTCD*** as the reference for the specifications of uniform standards for traffic control devices for use upon highways within this state. ***MUTCD Section 6A.01*** states:

> *"The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents."*

MUTCD Section 6B.01 states:

> *"A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied."*

Together, the MUTCD and the applicable OAR and ORS form the basis for requiring that a temporary traffic control plan including a temporary pedestrian accessible route plan be prepared for all construction or maintenance work within Oregon State highway right of way. The traffic control plans shall be stamped by a registered professional engineer.

1.4.2 OAR and ORS

The following ***Oregon Administrative Rules (OAR)*** and ***Oregon Revised Statutes (ORS)*** pertain to work zone and construction area traffic control:

> **OAR 734-020-0005** adopts the ***MUTCD*** as the reference for the specifications of uniform standards for traffic control devices for use upon highways within this state.
> **OAR 734-020-0410** requires the state traffic engineer's approval of all traffic signals, temporary, portable, or permanent.
> **ORS 811.230, .231, .232**, and **.233** cover double fines and yielding to highway workers.
> **ORS 163.165** expands the assault in the third degree to include intentionally, knowingly, or recklessly causing physical injury to a highway worker or a flagger. A TCP designer should be familiar with these and other OAR and ORS that pertain to work zone and construction area activities.

ORS 672.020 In order to safeguard life, health and property, no person shall practice or offer to practice engineering in this state unless the person is registered and has a valid certificate to practice engineering.

1.4.3 Additional Standards and References

A number of additional resources are available and are regularly used in developing a traffic control plan. The following references should be used to help maintain consistency and uniformity in the design and implementation of a temporary traffic control plan.

- ***FHWA Standard Highway Signs (SHS)*** manual and ***SHS Supplement*** – Includes sign designs for regulatory, warning, guidance and service signing regularly used in TCPs.
- ***FHWA Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide*** – Includes overview of requirements and guidance within 1990 ADA, the Proposed Right of Way Accessibility Guidelines (PROWAG), and MUTCD regarding accommodation, protection and mobility of ADA and pedestrians within a work zone.
- ***AASHTO Roadside Design Guide*** – Includes concepts and general discussions about “clear zone”, longitudinal barrier systems, impact attenuators and other safety hardware devices.
- ***2010 Americans with Disabilities Act (ADA) and ADA Title II*** – ADA Standards are issued by the (US) Department of Justice (DOJ) and the Department of Transportation (DOT), and apply to facilities covered by the ADA in new construction and alterations.
- ***2011 Proposed Rights of Way Accessibility Guidelines (PROWAG)*** – While not formally adopted into Federal Law, under Chapter R1, Section R101, the following should be noted:

  > *“Compliance with this document is mandatory when required by regulations issued by federal agencies that include accessibility standards for the design, construction, and alteration of pedestrian facilities in the public right-of-way.”*

- ***ODOT Sign Policy & Guidelines*** – Includes designs and functions for regulatory, warning, guidance and service signs specific to Oregon – modifying or supplementing ***MUTCD*** and ***SHS***.
- ***ODOT Temporary Traffic Control Handbook for Operations of Three Days or Less (OTTCH)*** – While not intended for long-duration roadwork activities, the ***OTTCH*** is based on the fundamental principles and standards within the MUTCD as well as Oregon-specific traffic control measures. The OTTCH is intended for work zone activities lasting less than three consecutive days – including mobile operations – for both freeways and non-freeway facilities.
- ***ODOT Portable Changeable Message Sign (PCMS) Handbook*** – Includes useful information regarding the function, application and proper operation of this valuable traffic control device.

- ***ODOT Highway Design Manual (HDM)*** – While primarily used for the design of permanent roadway facilities, the HDM includes valuable information in the design of temporary roadway alignments and other features.
- ***ODOT Transportation Management Plan (TMP) Project-Level Guidance Manual*** – Includes information useful in developing the TMP, and documenting project design and work zone safety enhancement decisions.

1.5 Transportation Management Plan (TMP)

FHWA "Final Rule on Work Zone Safety and Mobility" – 23 CFR 630 Subpart J

Published on September 9, 2004, the Federal Highway Administration released updates to the work zone safety regulations under 23 CFR 630 Subpart J – referred to now as the, "Final Rule on Work Zone Safety and Mobility." The complete Rule is available on the FHWA web site under the, "Resources" web page of the "Work Zone" section. Search for, "Work Zone Safety and Mobility" or, "23 CFR 630 Subpart J"

The Rule updates and broadens the former regulation at 23 CFR 630 Subpart J to address more of the current issues affecting work zone safety and mobility. The changes to the regulation encourage the broader consideration of the safety and mobility impacts of work zones across project development and the implementation of strategies that help manage these impacts during project delivery.

The updated rule applies to all State and local governments that receive Federal-aid highway funding. All of these agencies were required to comply with the provisions of the rule no later than October 12, 2007.

A key requirement in the Rule is the development and inclusion of a Transportation Management Plan (TMP) as part of the project development and contract administration processes.

As part of the commitment to safety and project integrity, ODOT makes the TMP a required portion of all ODOT highway construction contracts within State highway right of way. ODOT maintenance operations and permitted work are encouraged to use a TMP, but it is not a requirement.

1.5.1 Transportation Management Plan Document

The TMP should be considered as the "project diary" used by the agency to document and track critical design and implementation decisions made over the course of project development and throughout the implementation of the TCP. TMP development should begin as early as the Project Scoping phase.

The Transportation Management Plan (TMP), and the amount of detail within it, is relative to a project's scope of work. The more complex the project, the more details and information should be included in the TMP.

The ***ODOT Transportation Management Plan Template*** is available on ODOT's Work Zone Traffic Control website.

The template should be used to develop the TMP for all ODOT highway construction project.

ODOT TMP Minimum Requirements

For any ODOT project – identified as a "Significant project" or not - at a minimum, TMPs must include the following:

- Project Description
- Existing Traffic & Roadway Conditions
- Proposed Work Zone Strategies
- Potential Work Zone Impacts
- Alternative Work Zone Strategies
- Referenced Work Zone Documents
- Construction Monitoring
- TMP Evaluation

Because the TMP is considered a "living document", it will continue to grow and evolve throughout the life of the project development process. Therefore, as the project design evolves, the TMP should be regularly updated with new information that could affect the final design or the implementation of the Traffic Control Plan during constructions.

The documented information within the TMP – including decisions included on the ***Work Zone Decision Tree*** form, stakeholder partnership agreements, traffic control measures, and staging options – can be recalled, as needed, once construction has begun. If a proposal is made to modify the TCP, staging or construction schedule, TMP contents can be used to support documented design decisions, protect the integrity of the TCP, project schedule, and stakeholder agreements. TMP contents are ultimately used to minimize traffic delays and provide a safe, efficient work zone for road users and construction workers.

Upon completion of the design – during the "Plans, Specs & Estimate" (PS&E) phase - the TMP should be distributed to Project Team members (including Consultant staff) and the agency's resident engineer or coordinator.

ODOT intends to include the TMP in the bidding documents. A copy of the completed TMP will be included in the Bid Documents, and a copy distributed to the ODOT resident engineer.

Additional information regarding the TMP can be found in the ***Transportation Management Plan Guidance Manual*** available on the ODOT's Work Zone Traffic Control website.

1.6 Traffic control plan structure

1.6.1 Work Zone Limits & Components

Work Zone Limits

Because Oregon enforces the doubling of traffic fines in highway construction work zones, it is important to clearly identify the beginning and end of a work zone for the travelling public, contractors and law enforcement agencies.

The ***MUTCD***, Part 6, Section 6C.02; the ***Standard Specifications for Construction***, Section 00225.01; and, the ***Oregon Vehicle Code*** (ORS 811.230) define the limits of a work zone as follows:

> *"…from the first warning sign or high-intensity rotating, flashing, or strobe lights on a vehicle to the 'END ROAD WORK' sign or the last (traffic control) device."*

It is the intention of ODOT and this Design manual to clarify, "***first warning sign***" as meaning the initial, "ROAD WORK AHEAD" (W20-1) or similar advance warning sign (e.g. "BRIDGE WORK AHEAD", "SHOULDER WORK AHEAD", "UTILITY WORK AHEAD").

For the purposes of discussion and enforcement, the "*first*" or initial warning sign does not include the following:

- The standard, "ROAD WORK NEXT XX MILES" sign.
- The standard, "INTERMITTENT ROAD WORK NEXT XX MILES" sign.
- Messages displayed on electronic signs – e.g. PCMS or VMS.

Work Zone Components

A work zone is composed of four distinct areas (see *Figure 1-1*):

- Advance Warning Area.
- Transition Area.
- Activity Area.
- Termination Area.

Advance Warning Area

Where road users first recognize a work zone is approaching. This area includes the installation of advance warning signs.

Transition Area

Where road users are directed out of the normal travel path through signing and the placement of traffic control (channelizing) devices on the roadway. The Transition Area requires road users to maneuver in some manner before reaching the work area. Transitions often occur as a lane or shoulder/bike lane closure, lane shift, or a new (temporary) alignment via crossover or on-site diversion. Some Transition Areas may also include shifts in bicycle and/or pedestrian facilities into or adjacent to motor vehicle pathways.

Proper merging and shifting taper lengths; and, inclusion of appropriate channelizing or barrier systems will provide a satisfactory degree of safety and predictability for road users within the Transition Area.

Statistically, the Transition Area is responsible for the majority of work zone traffic crashes. Extra attention should be given to the design and implementation of this portion of the work zone.

Activity Area

Where work is conducted. The Activity Area also includes the leading longitudinal Buffer Space before the work space. Two types of buffer spaces are used to separate road users, including bicycles and pedestrians, from the work area. A longitudinal buffer space provides a recovery area for errant vehicles prior to reaching the work area. A lateral buffer space, or “shy distance” is often developed between the edge of the traffic lane and the edge of the work space.

To function properly, buffer spaces must not include any work equipment, materials or personnel.

Termination Area

Where road users leave the work zone, return to their existing path of travel and resume normal flow. Contractor equipment and workers should not be present in the downstream Buffer Space. Contractor haul vehicles may pass through the Termination Buffer Space as they leave the work site and accelerate to merge with public traffic.

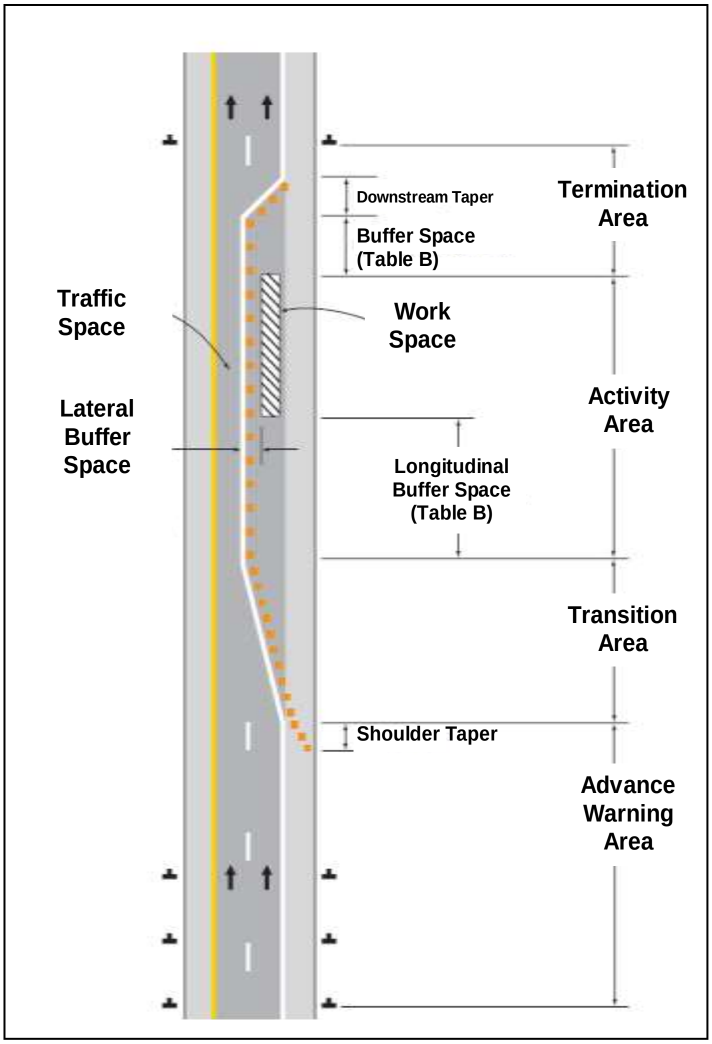

Figure 1-1: Work Zone Components

Other Work Zone Components

Additional elements are frequently used in the development of a traffic control plan, but are often more project-specific, including:

Tapers

Tapers are created using a series of channelizing devices to move traffic from one path of travel to another. There are five common types of tapers. The three primary tapers include the Merging (or Lane Closure), Shifting, and Shoulder Closure taper (Figure 1-2).

The appropriate length for tapers begins by determining the length, “L” – found on the Minimum Lengths Table on ***ODOT Standard Drawing TM800***. Once “L” is known, taper lengths are calculated:

Merging Taper
Used to merge two traffic lanes into one lane. The length of a Merging Taper is equal to "L". Being based on the pre-construction posted speed, the taper allows drivers to merge safely. For freeways, the Merging Taper length "L" is fixed at 1000 feet.

Shifting Taper
Used to shift traffic laterally. A Shifting Taper length is equal to 1/2 "L". Shifting Tapers may be longer – up to "L", but should not be less than 1/2 "L" as the taper angle can be too abrupt for drivers and can lead to panicked maneuvers and loss of control of their vehicle.

Shoulder (Closure) Taper
Used to close the shoulder of a roadway. The length of a shoulder closure taper is equal to 1/3 "L".

One-Lane, Two-Way Traffic (Flagger) Taper
Set up between the activity area and a flagger station, the Flagger and the taper are used to guide traffic into the two-way, one-lane portion of the roadway within the work area. The length of a One-lane, Two-way taper ranges from 50 – 100 feet.

Downstream (Termination) Taper
Provides a visual cue to traffic that they have passed the work area and are to returning to the original roadway configuration. The length of a Downstream Taper ranges from 50 – 100 feet.

Successive or Multiple Tapers should be separated by a reasonable distance to allow drivers to accomplish one maneuver at a time and readjust their speed. A number of ODOT Standard Drawings suggest distances varying from 2x"A" to 2x"L" between the two tapers.

Detours and Diversions

At times, it may be necessary to more aggressively separate traffic from the work area. In this case, there are two common traffic control measures available:

Detour
Is used when closing a roadway and traffic is moved from the existing facility to an alternate existing facility – often outside the project limits.

On-site Diversion
Is used to move traffic out of its original alignment and onto another part of the existing roadway; or, onto a temporary surface constructed within the project right-of-way or easement (Figure 1-2). Traffic is diverted around the work area often using a combination of signing, channelizing devices, barrier, and pavement markings.
On-site Diversions can be configured to accommodate all existing traffic lanes, a reduced number of lanes; or, a single, reversible lane controlled by a temporary traffic signal or flagging operations.

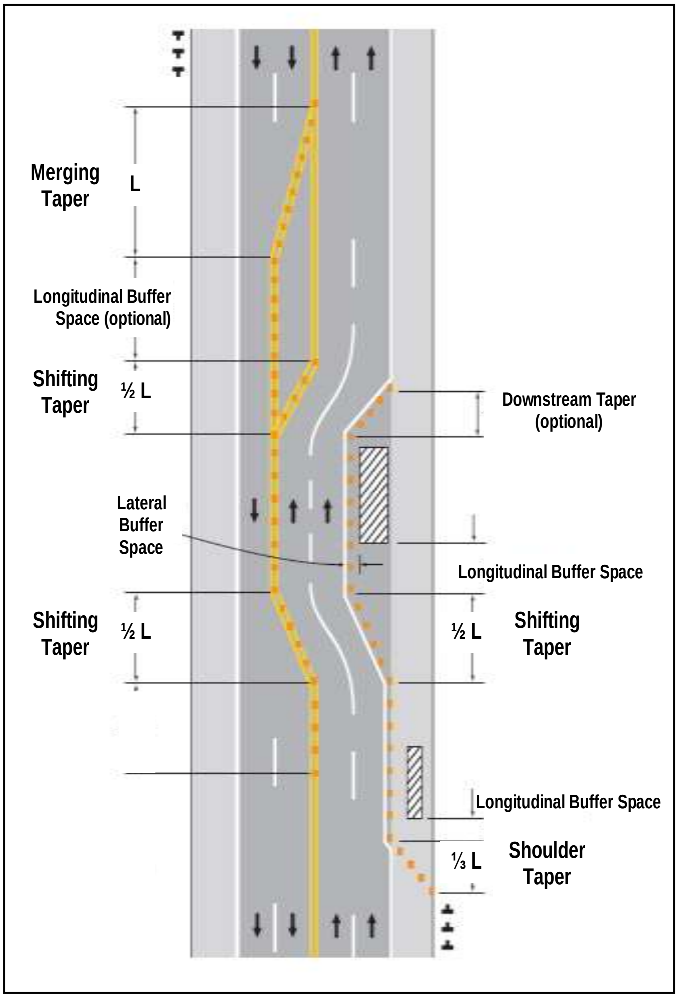

Figure 1-2: On-Site Diversion

1.6.2 Traffic Control Plan Design Form

A Traffic Control Plan can take one of two basic forms – a **Written TCP** or, a **TCP with Plan Sheets**.

Written TCP

Includes project-specific Special Provisions and applicable ODOT Standard Drawings. Written TCPs are common for projects with the following attributes:

- Construction details and instructions can be conveyed solely using specification language and Standard Drawings.
- Project duration is shorter – typically less than a few months.
- Scope of work is simple and may only include a few work activities (e.g. preservation work, or a shoulder widening project).

TCP with Plan Sheets

Should be developed for projects with the following attributes:

- All work activities cannot easily be described solely using project-specific Special Provisions or Standard Drawings.
- Scope of work is complex and requires multiple, site-specific Stages; and, is typically much longer – several months to a year or more.
- Construction features or activities are challenging and labor-intensive (e.g. bridge replacement, culvert installation, full roadway rebuilds, roadway realignments, signalized intersection/ramp terminal reconstructions).
- A detour route is included as part of the project.

TCPs with Plan Sheets add necessary project-specific details and instructions for Contractors not addressed through Standard Drawings or Specifications. Project-specific plan sheets can provide additional detail for:

- Bridge replacements or culvert installations.
- Interchange modifications and ramp terminal reconstructions.
- Full-depth roadway rebuilds or realignments.
- Full roadway closures with detour routes.
- Intersection rebuilds or new signal installations with mitigations for pedestrian accessibility impacts.

1.6.3 Standard Specifications & Special Provisions

The ***ODOT/APWA Standard Specifications for Construction***, ***Boilerplate Special Provisions***, and applicable Standard Drawings are part of every TCP and are the primary elements that explain how work is to be completed.

Chapter 4 – Specifications and Standard Drawings explains in greater detail the format, function, writing and editing of Specifications and project-specific Special Provisions. It also discusses Standard Drawing content and function. The following are meant as brief introductions to these valuable tools in developing a safe, efficient, and effective temporary traffic control plan.

Standard Specifications

The collection of ***Standard Specifications for Construction***, commonly referred to as the "Standard Specs," is available in hard copy form and on-line on the ODOT web site under the Specifications Unit located within the traffic-roadway section. The current version of the ***Standard Specifications for Construction*** is the 2021 edition – to be used for projects letting for contract beginning December 1, 2020. Projects with a bid date prior to December 1, 2020, will still be using the ***2018 Standard Specifications.***

The Standard Specifications and Boilerplate Special Provisions apply to all ODOT highway construction contracts. However, Designers are reminded that the Standard Specifications for Construction are also applicable to local Public Works agencies (e.g. Cities and Counties).

Boilerplate Special Provision

The Specifications Unit website includes links to documents known as the Boilerplate Special Provisions. *Boilerplate Special Provisions* have been developed to accomplish the following:

- Provide additional project-specific instructions for the Contractor.
- Identify important and relevant details on Standard Drawings or on project-specific plan sheets.
- Supplement the contents of the ***Standard Specifications for Construction***.
- Update language that has changed or become obsolete in the ***Standard Specifications for Construction***, since its publication.

When the ***2021 Standard Specifications for Construction*** was updated, ***Section 00220*** and ***Section 00225*** were broken down into respective Boilerplate Special Provision ***Sections 00220, 00221, 00222, 00223, 00224, 00225, 00226, 00227, 00228, and 00229***.

As the ***2021 Standard Specifications for Construction*** and ***Boilerplate Special Provisions*** are used and incorporated into more and more projects, the need for additional Special Provision language will likely arise. Contact the work zone Traffic Control Unit to discuss the need for additional Boilerplate language.

Boilerplates are available on the Specification Unit website for downloading, editing and publishing within contract bid document packages.

Custom Project – Specific Special Provisions

Custom Special Provisions are drafted from scratch and include language to address the needs of one specific project – language not otherwise available in the **Standard Specifications** or **Boilerplate Special Provisions**. Custom Special Provisions are not very common often because language within the Standard Specifications or Boilerplate Special Provisions can be modified to suit the specific need.

1.6.4 Standard Drawings

Oregon Standard Drawings are engineered products developed by ODOT for use on public roadways in Oregon. The ***Standard Drawings*** used for temporary traffic control in work zones are included under the **TM800 – Temporary Traffic Control** drawing series. The TM800 Series drawings are available on the ODOT engineering web site under the "***Standard Drawings and Details***" link. See **Chapter 4** for additional Standard Drawing information.

1.6.5 Project – Specific Construction Staging Plan Sheets

Complex projects, and those that include more complex design features, make it impractical to rely solely on Standard Drawings and Special Provision language to relay vital and necessary construction staging information to the Contractor to help ensure road user safety, mobility, and accessibility.

Under these circumstances, developing project-specific construction staging plan sheets - commonly referred to as "Plan sheets" – significantly enhances the success and effectiveness of the TCP.

Plan sheets are used to describe how the existing roadway area is to be divided between live traffic and the active construction area. Plan sheets also identify the types, quantities and locations for the variety of temporary traffic control devices often included in the TCP. See **Chapter 5** for additional temporary traffic control plan sheet information.

1.7 Traffic Control Plan Design

1.7.1 Design Considerations

Chapter 3 – Traffic Control Measures provides greater detail regarding the wide variety of issues, factors, considerations, and details a designer must process before and during the design of the TCP.

Information in this Chapter can be used to focus a Designer's attention on the broader questions – *What*, *Where*, *When*, *How* and *Why* – to help them develop a safe, effective, efficient, and biddable temporary traffic control plan.

The following should be considered as the most critical components in optimizing the design for a temporary traffic control plan:

Site Investigation

Take the opportunity to learn as much as practical about the exiting features and operations of the project site. Site investigations are invaluable to the designer to get firsthand knowledge of the project site and create accurate traffic control plans. Site investigations should be completed for all projects.

Scope of Work

Understanding the goal of the project, the finished products and any constructability issues associated with completing the project on-time and on-budget.
Chapter 3 includes a number of specific Scope of Work examples and questions the designer should be asking as they start developing their TCP.

Once the designer has a confident understanding of both the project site and the scope of work, the designer can begin looking at the various opportunities for safely managing road users through or around the work zone; and, optimizing the safety and efficiency for the workers.

Work Zone Decision Tree Form

For each project, Designers should begin with the Work Zone Decision Tree form (734-5042) as part of their design documentation process and safety enhancement opportunity analyses identified in the ODOT TMP Guidance Document. The ***Work Zone Decision Tree*** form offers Designers a systematic process for analyzing the variety of traffic control measures available for each project. The form can be used to help evaluate each option under various conditions, and determine the feasibility of each option. The designer can document decisions made regarding the selection or rejection of each option, and reasons supporting those decisions, on the form. See **Chapter 3** for additional ***Work Zone Decision Tree*** form information; and, **Appendix C** for a copy of the current form.

Both the ***ODOT TMP Project-Level Guidance Manual*** and the ***Work Zone Decision Tree*** form are available on the ODOT Work Zone Traffic Control Unit website.

1.7.2 Traffic Control Measures

In developing a TCP, there are several tools and strategies the designer may employ to optimize the safety and effectiveness of the work zone for all road users and highway workers. Commonly referred to as ***Traffic Control Measures*** (TCM), they can vary from a single traffic control device to the deployment of a complex array or sequence of devices.

TCM Examples

Paving Operations: Temporary traffic delineation may be accomplished using tubular markers, conical markers, plastic drums, temporary flexible pavement markers, even temporary paint – depending on the facility type and timing between temporary delineation and placement of permanent markings.

Bridge Replacements: A limited-duration full road closure with a detour may be used instead of staged bridge construction with 24-hour flagging or a temporary traffic signal to better manage traffic capacities and worker safety.

On-Site Diversions: A single-lane temporary roadway diversion with a temporary signal at each end; or, a two-lane, free-flow diversion may each be investigated as a viable TCM for a culvert or bridge replacement project.

See **Chapter 3** for additional Traffic Control Measure information and details – including additional examples of effective TCM used to develop safe and effective TCPs.

1.7.3 Primary Design Policies

The design of a temporary traffic control plan requires engineering experience and judgment when determining the use or application of a given safety measure or construction strategy. Design standards and practices must also be applied to ensure consistency, and optimize safety and mobility within the work zone. This manual identifies these standards to emphasize the need for regular and consistent use in TCP design.

The following Design Policies are used to produce safe, consistent and efficient work zones for all road users and construction contractors. See **Chapter 3** for design policy application details and examples.

Guiding Principles and Work Zone Decision Tree Form

The goal and objectives of the *ODOT Guiding Principle* is to be applied throughout the life of the project's development and construction. The *Work Zone Decision Tree* form is to be used for each project, and addressed at each of the project's key milestones to identify and document safety enhancement opportunities.

Design Speed

The pre-construction posted speed is used as the *Design Speed* for many TCP design values, including:

- Temporary alignment designs (e.g. on-site diversions, crossovers).
- Temporary sign and device spacing.
- Taper lengths for lane closures and shifts, and shoulder closures.
- Impact attenuator selection.

Sign and Device Spacing

The following values are used for spacing of channelizing traffic control devices (TCD) including plastic drums, conical and tubular markers:

- 10 feet – For intersection or access radii.
- 20 feet – For speeds < 40 mph (Recommend 10 ft. spacing for speeds < 30 mph).
- 40 feet – For speeds > 45 mph (Including freeways).

For temporary signing, spacing is speed-dependent as well. Spacing dimensions, "A", "B", and "C", as shown in the MUTCD and on Oregon Standard Drawings, are defined in Oregon as:

Table 1-1: Temporary Sign Spacing Dimensions

Speed (mph)	A (ft.)	B (ft.)	C (ft.)
20 – 30	100	100	100
35 – 40	350	350	350
45 – 55	500	500	500
60 – 70[1]	700	700	700
Freeway	1000	1500	2640

For additional device spacing information, see the, "Traffic Control Devices Spacing Table" shown on **TM800** in the ***Temporary Traffic Control Standard Drawings***.

Freight Mobility

Minimum horizontal roadway widths and vertical height constraints for work zones are critical to statewide freight mobility. See *Chapter 3* for horizontal widths and vertical height design details.

[1] Please note that this row of temporary sign spacing values is intended for non-freeway facilities only.

Bicycle and Pedestrian Accommodation

In developing a comprehensive TCP, the design must incorporate safety, mobility and accessibility needs for all road users – bicyclists, pedestrians and ADA road users – through the selected features, alignments, guidance, surfaces and safety appurtenances.

To optimize TCP designs, ODOT uses this manual, current Standard Drawings and guidance from FHWA sources – including the FHWA ***Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide*** – available in **Appendix E** and on the ODOT Work Zone Traffic Control Unit.

Incident Response

The TCP design should consider and include measures and mitigations available for allowing for the passage of emergency vehicles at all times. The TMP can identify and provide for the incorporation of design elements to aid incident management, including turn around for emergency vehicles, emergency access points, incident investigation sites, and signing to help motorists report the location of incident within the project.

1.8 Work Zone Intelligent Transportation Systems

1.8.1 Smart Work Zone Systems

Advances in technology have made it possible to monitor traffic conditions and construction operations, and relay that information to road users in real time. Oregon and other agencies across the U.S. are using this technology in permanent locations to monitor traffic and alert motorists of changing roadway conditions ahead. This same technology, however, can also be used within the work zone environment as a temporary feature.

ODOT currently uses permanent Intelligent Transportation Systems (ITS) to report real-time roadway conditions on major state highways (visit trip check). ODOT uses permanently installed communication equipment such as Variable Message Signs (VMS) to alert the traveling public of potential congestion, delays, emergency situations and Amber Alerts.

ODOT is adapting these permanent technologies for use in its temporary highway construction work zones. Using Portable Changeable Message Signs (PCMS), portable traffic sensors and other system components, ODOT aims to provide real-time alerts, travel time data, and detailed work zone information to approaching motorists. ODOT has defined these new temporary work zone systems as, "Smart Work Zone Systems" (SWZS).

Oregon has recently demonstrated these systems on a handful of select projects. ODOT has included a number of the successfully tested systems on its Qualified Products List (QPL) and is encouraging their inclusion into many of ODOT's future highway construction contracts.

SWZS used in Oregon work zones will be designed to measure fluctuating traffic volumes and speeds within the work zone. Using predetermined thresholds, the SWZS can then relay applicable warnings or other project-specific information to approaching motorists.

Through the use of the SWZS, ODOT hopes to improve overall work zone safety by reducing crashes and injuries, by minimizing traffic delay, and improving response time should there be a work zone.

1.9 Traffic Control Devices (TCD)

1.9.1 Using TCD to Create a Safe Work Zone

Traffic Control Devices are used to regulate, warn, and guide traffic safely through a work zone. When there is consistent, uniform usage of TCD, work zone safety is increased. A safe, efficient and uniform work zone performs two vital functions:

- Reduces the frequency of crashes.
- Reduces the severity of crashes.

1.9.2 TCD Principles

Properly selecting and implementing TCD for a given work zone is paramount in providing road users with information needed to safely navigate a work zone. Using the following five principles in selecting and setting up traffic control devices in a work zone, drivers will pass through the work zone with few surprises, maximizing work zone safety for all. Traffic Control Devices must:

- Fulfill a need.
- Command attention.
- Convey a clear and simple meaning.
- Command respect from the road user.
- Give adequate response time.

See **Chapter 2** for additional TCD discussion, usage guidance and details.

1.9.3 TCD Crash Testing

All traffic control devices used in a work zone on the National Highway System (NHS) are required by the FHWA to be successfully crash tested – or deemed, "crashworthy". If an errant vehicle strikes a TCD, it is crucial that the vehicle and its occupants are as protected as practical from impact with the device. A device being, "crashworthy" means the device has successfully completed standard material and crash testing, and met standard minimum evaluation criteria.

Upon successful crash testing and submittal of results to FHWA, the device may also receive a letter from FHWA stating the device's "Eligibility for Federal Aid Reimbursement". The purpose of this document is to outline the hardware eligibility review process when a request is submitted under the AASHTO Manual for Assessing Safety Hardware (MASH) criteria, which is recommended for crash testing of new devices, and for consideration of modified devices under MASH or NCHRP Report 350. It describes the information that should be submitted when requesting a review for Federal-aid reimbursement eligibility, as well as providing links to the appropriate sites where further detailed information may be found.

ODOT must have both the proof of successful crash testing and the FHWA letter of "Eligibility for Federal Aid Reimbursement" before the device can be considered for inclusion onto the ODOT QPL or used on an Oregon State Highway. Standard crash testing procedures and evaluation criteria can be found within the following resources:

- National Cooperative Highway Research Program (NCHRP Report 350) for devices tested prior to January 1, 2010.
- Manual for Assessing Safety Hardware (MASH) for new or modified devices tested after January 1, 2010.
- Eligibility for Federal Aid Reimbursement Process.
- FHWA Work Zone Device Crash Testing – Self-Certifying Process (**See Appendix A**).

A list of devices that have met MASH and NCHRP Report 350 requirements can be found on the FHWA web site in the **Safety** section under the **Road Hardware** page.

1.9.4 TCD Crash Testing Categories

Under the NCHRP Report 350 and MASH standards for crash testing, work zone devices have been classified into four categories, each having its own testing requirements:

Category 1

Low-mass devices. Devices typically self-certified for crashworthiness.

Category 2

Devices with higher mass. Frequently crash tested. Examples include signs/supports, and small portable (balloon) lighting.

Category 3

Much higher mass and requires correct installation and protection. Mandatory crash-testing. Examples include concrete barrier.

Category 4

Devices posing the greatest risk to motorists – Examples include trailer-mounted devices (PCMS, portable signals, Arrow boards, large portable light plants). FHWA crash-testing pending.

See **Chapter 2** for more information regarding TCD Categories and crash testing discussions.

1.9.5 The Qualified Product List (QPL)

All temporary traffic control devices used within Oregon State Highway right of way must be listed on the ODOT Qualified Product List. The QPL is a comprehensive listing of all products found to be acceptable by ODOT for use with specific categories in roadway construction and maintenance.

All TCD moved onto the QPL can be considered as, "crashworthy". Therefore, a device chosen from the QPL requires no further proof of crashworthiness.

It should also be noted that the FHWA requirement for Category 4 device crash testing is pending. ODOT has a long, successful record in using these devices within public right-of-way. Further, current ODOT standards and best practices call for additional delineation for these devices when in use, and have specific requirements for removing the devices from the roadway when not in use.

An exception to the use of a device *not* on the QPL would be for devices currently being used as an experimental feature – where the device is temporarily included on the unpublished "Conditional Use List" – and has not yet completed the formal QPL review process. The TCP Unit in Salem conducts a cursory review of such products and, using engineering judgment and reviewing product documentation, makes a determination if the device would be eligible for trial as an experimental feature.

If, during a review of the product submittal, the TCP Unit sees deficiencies or product functionality that indicate a strong possibility for product failure or harm to public traffic or workers, the device will be "Rejected" – and not allowed on the Conditional Use List of the QPL. If the performance or safety of a product on the Conditional Use or Qualified Products List is raised by other staff within ODOT, the product's status and continued use will be suspended until such time as the TCP Unit can investigate the issue and work with the manufacturer to correct the concern.

1.10 Mobility

1.10.1 Mobility Procedures Manual

The Mobility Procedures Manual describes a set of standards and processes that meets Agency goals for traffic mobility and safety. With respect to work zones, it can best be thought of as a working tool for ODOT planning, project development, construction, and maintenance offices.

The Mobility Procedures Manual discusses delay thresholds for construction travel delay for Oregon's highest level of importance facilities and its main highway freight corridors. Within the manual, a "corridor delay threshold" is defined as the maximum *additional* amount of delay created by all construction and maintenance projects on a given corridor**.** The total corridor delay is the additional delay caused by all active construction projects on the corridor *plus* the normal delay experienced during peak travel periods.

Delay can be minimized and Contractor efficiency maximized by conducting a Work Zone traffic analysis as part of the project development phase of the TCP. The analysis is used to determine the best times in a given day for a contractor to close a lane(s) to conduct work and to minimize public traffic delay. The results of the analysis help form the, "Lane Restrictions" – incorporated into ODOT highway construction contracts – notifying Contractors when they can and cannot conduct work on a highway within a lane(s) closure.

See the ***Mobility Procedures Manual*** for additional information regarding work zone mobility impacts and over-dimensional freight accommodation strategies.

1.10.2 Coordinating Travel Delay Estimates

Since the total travel delay resulting from combined construction and maintenance projects on a corridor should be below the "corridor delay threshold," coordination of all corridor activities is essential. Each ODOT region employs a mobility liaison who is responsible for this coordination. ODOT region mobility liaisons and additional mobility information are listed in **Chapter 3**, under **Section 3.3 – TCP Design Policies**.

1.11 Designer Resources and Web Links

1.11.1 TCP Designer Web links

There are multiple ODOT, federal, and non-government websites available that include valuable temporary traffic control information. Because website locations are highly dynamic, a web link to a list of useful TCP-related websites is available on the ODOT Work Zone Traffic Control website.

1.11.2 Traffic Control Plan Checklist

Appendix D contains a *Traffic Control Plan Checklist* that can be used by Designers as a comprehensive list of temporary traffic control items and measures that might be used within a project. Designers should compare this Checklist with the ***Work Zone Decision Tree*** form found in **Appendix C** to confirm all reasonable positive separation and work zone safety enhancement opportunities have been explored and documented.

Chapter 2: Temporary Traffic Control Devices

2.1 Key Topics Covered in This Chapter

- Purpose and Principals of Traffic Control Devices (TCD).
- Crashworthy Devices.
- TCD Categories.
- Detailed Descriptions of TCD.

2.2 Purpose and Principals of TCD

The primarily purpose of Traffic Control Devices (TCD) is to provide for the safe movement of traffic through or around the work zone. Safety for roadway users and workers within the work zone is enhanced through uniform usage of TCD. Temporary traffic control devices are used to:

- Regulate.
- Warn.
- Guide.

When temporary traffic control devices are installed consistently within the work zone, driver expectancy and compliance can be optimized. The consistent and proper application of TCD in the work zone performs two vital functions in a successful work zone:

- Reduce the frequency of crashes.
- Reduce the severity of crashes.

Individuals assigned the responsibility of assuring safe and effective work zones are knowledgeable in the general principles behind temporary traffic control devices.

TCD used in work zones should exhibit the following characteristics. These characteristics are considered key principles for temporary traffic control devices:

1. Fulfill a need;
2. Command attention;
3. Convey a clear & simple meaning;
4. Command respect from road user; and,
5. Give adequate response time.

It is imperative TCD are consistent and correctly applied within work zones to provide the road user necessary information to negotiate the work zone safely.

Inappropriate TCD are devices not needed for the current conditions within the work zone, and should be turned away from traffic, covered, or removed from the roadway. Legibility and visibility of the devices should be maintained through the life of the project. Damaged, dirty or improperly functioning devices must be repaired or replaced in a timely manner to maintain their effectiveness.

2.3 Crashworthy Devices

The Federal Highway Administration (FHWA) policy requires all TCD used in a work zone on the National Highway System (NHS) be crashworthy. FHWA adopted the testing guidelines established by the AASHTO ***Manual for Assessing Safety Hardware (MASH)***.

The Manual for ***Assessing Safety Hardware (MASH)*** is an update to and supersedes NCHRP Report 350, ***Recommended Procedures for the Safety Performance Evaluation of Highway Features***, for the purposes of evaluating new highway safety hardware. An implementation plan for MASH, adopted jointly by AASHTO and FWHA, states that all highway safety hardware accepted prior to the adoption of MASH (January 1, 2010), using criteria contained in ***NCHRP Report 350***, may remain in place and may continue to be manufactured and installed on the NHS.

Highway safety hardware accepted using ***NCHRP Report 350*** criteria is not required to be *retested* using ***MASH*** criteria. If a Report 350 approved device is updated or modified, affecting its structural characteristics or its performance (e.g. changes in materials, physical shape, size, weight, etc.), the device may require retesting under the ***MASH*** criteria. All new temporary work zone devices manufactured after December 31, 2019 must be successfully crash tested using ***MASH*** (2015 Edition).

New highway safety hardware not previously evaluated must utilize ***MASH*** for testing and evaluation. New ***MASH*** testing procedures include changes to design vehicles, variety in barrier design, safety performance, levels of roadway utilization, and criteria for impact severity. It provides a broad range of testing to establish a uniform basis for the application of roadside TCD to the level of use of the particular roadway.

All TCD used on Oregon State Highway construction projects must be listed on the ODOT ***Qualified Products List (QPL)***. ODOT ensures each device meets the established crashworthy guidelines before a device is used on the NHS. Signal poles are exempt. Each device is reviewed according to the ODOT Product Review Guidelines before the device is deemed Qualified and placed on the QPL. Occasionally, a device is categorized as "Conditional" and placed on the Conditional Use List. The Conditional Use List is used for products that meet established crashworthy guidelines, but when ODOT wants to evaluate the product controlled conditions before moving them onto the Qualified List. A designer or contractor may use devices on the Conditional Use List, but the resident engineer or contractor may have to conduct a field evaluation.

"Crashworthy" means a device has met the established testing and evaluation criteria of MASH (or Report 350 for older or existing devices) and has received a "Letter of Federal-Aid Reimbursement Eligibility" from the FHWA.

Work zone traffic control devices have been classified into four categories by the FHWA, each having its own testing requirements.

- **Category 1**: Low-mass devices with a known performance history. Vendors may self-certify the crashworthiness of these devices. Category 1 devices include tubular markers, conical markers, and plastic drums.
- **Category 2**: Devices with a higher mass and can pose a greater risk to the public if struck. Because of their higher mass, Category 2 devices typically require crash testing (e.g. Barricades, sign supports, and most temporary signing).
- **Category 3:** Category 3 devices pose a more significant risk to the public if not adequately protected or installed correctly. Category 3 devices require more complex crash testing. Examples include impact attenuators, concrete barrier, and guard rail systems, etc.
- **Category 4:** These devices pose the greatest risk to motorists as temporary TCD. Category 4 devices are usually trailer-mounted and should be shielded from traffic, when practical. At a minimum, if used on the roadside and not placed behind a barrier system, these devices should be heavily delineated using other Category 1 and 2 retro-reflective devices. Currently, Category 4 devices do not require crash testing, as FHWA is in the process of developing specific crash testing standards for them. Examples of Category 4 devices include sequential arrow boards, PCMS, portable traffic signals, and automated flagger assistance devices (AFAD).

Crashworthy Test Levels

In general, devices used on State Highways should be tested to the appropriate speeds used on the Highway. It is recommended to use Test Level 3 (TL-3) or higher devices for all highways, regardless of the posted speeds. Test Levels are defined in the AASHTO Roadside Design Guide, NCHRP Report 350, and MASH.

- **Test Level 1 (TL-1)** devices can be used on highways with speeds of 35 mph or less.
- **Test Level 2 (TL-2)** devices can be used on highways with speeds of 45 mph or less.
- **Test Level 3 (TL-3)** devices are used on highways with speeds greater than 45 mph.

Lights are *NOT* to be added to any channelization device (drums, barricades, etc.) on State Highways. To eliminate the need for large, potentially hazardous batteries, ODOT does not include supplemental warning light devices on its portable channelization devices.

2.3.1 American Traffic Safety Services Association (ATSSA)

The ***ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features*** is a set of guidelines users should refer to in evaluating the condition of TCDs in the field. The ATSSA Guidelines are included in the ODOT/APWA Standard Specifications, and on ODOT highway construction projects, the contractor is contractually obligated to use devices that meet these guidelines. Current specification requirements call for the use of new or “Acceptable” TCD for all installations. In the field, TCD not meeting the “Acceptable” criteria as described in the ATSSA Guidelines, should be replaced with devices that meet the guidelines.

2.4 Category 1 Devices

Table 2-1: Category 1

Self-Certified Crashworthy	Examples of Devices Included
• Lightweight devices < 100 lbs. • No potential for device to penetrate vehicle windshield or cabin. • No significant effect on control or trajectory of an impacted vehicle.	• Tubular and Conical Markers. • Plastic Drums. • Temporary Delineators. • Pavement Markers.

2.4.1 Tubular and Conical Markers

The most commonly used temporary traffic control devices for delineating the roadway and channelizing traffic through the work zone are tubular markers and cones. Tubular markers are typically a two-part device with a separate rubber base weighing between 12 and 18 pounds. Cones are often one or two-piece devices. Two-piece cones have a rubber base similar to tubular markers.

Tubular markers are effectively used to override existing pavement markings for shorter-duration applications (daily shift work or stationary work in place less than three days). For longer operations, the existing pavement markings are removed and temporary pavement markings are applied. While **Section 6F.77** of the 2009 MUTCD calls for the maintenance of pavement markings for all "*long-term stationary work zones*", ODOT recognizes that this is not always practical or cost-effective. Section 6F of the MUTCD also states:

> *Warning signs, channelizing devices and delineation shall be used to indicate required road user paths in TTC zones where it is not possible to provide a clear path by pavement markings.*

For most pavement preservation projects, or other projects constructed in short time segments, removing exiting markings and applying temporary markings is not practical. Therefore, under the allowances suggested in Chapter 6F of the MUTCD, exercise judgment in selecting either temporary pavement markings or channelization devices to provide guidance for drivers in the work zone.

Tubular Marker Types

- **Standard Tubular Markers**
  Orange plastic with silver-white reflective bands. Rubber base used as ballast.
- **Surface Mounted Tubular Markers**
  Similar to a standard tubular marker, but installed with an adhesive base to restrict movement of the device.

- **'Blue' Tubular Markers**
  Blue plastic with blue reflective bands. Used to delineate selective business accesses within a work zone.

When applied on an ODOT construction project, standard spacing for tubular markers and cones is speed-dependent and are spaced at either 20 or 40 feet apart. At speeds of 45 mph or greater, the 40 ft. spacing is used. For low-speed conditions (≤ 25 mph) or around intersection and access radii, a spacing of 10 feet is recommended.

Figure 2-1: Tubular and Conical Markers

2.4.2 Temporary Plastic Drums

Temporary Plastic Drums are the largest, most visible of the "soft," (deformable) channelization devices. Like tubular markers and cones, plastic drums are used to delineate travel lanes, identify work areas, construct lane closure tapers, and delineate PCMS and temporary traffic signal installations. Due to their larger size and higher target value, plastic drums are effective in creating a visual separation between the work area and live travel lanes. Because of this advantage, plastic drums are used extensively on Oregon high-speed divided highways and are required on Oregon freeways for some functions.

Alternating bands of orange and silver-white retro-reflective sheeting are used on plastic drums. This "encapsulated lens, wide-angle, retro-reflective" sheeting provides excellent visibility for the drums in the daytime or nighttime and in a variety of inclement weather conditions.

Due to their proximity to traffic, drums can have the tendency to shift slightly out of place at the passing of larger vehicles or during high wind conditions. To compensate, drums include a rubber ring (weighing at least 10 lbs.) installed around the base to add ballast to the drum without impeding its crashworthiness. However, a second ring can be added to the drum base to resist further movement. No other means of ballast are allowed to anchor drums.

Figure 2-2: Plastic Drum

2.4.3 Temporary Delineators

Temporary delineators are used to supplement normal pavement edge delineation (tubular markers, striping, etc.) to indicate the roadway alignment. The mounting height of the reflector should be approximately four feet above the edge of the roadway surface. Temporary Delineators should be used on temporary roadway alignments as required by the MUTCD **Chapter 3F**.

"Type W-1" (white) delineators are installed along both sides of a two-way roadway, and along the right side of a one-way roadway. The left side of a one-way roadway will be delineated with "Type Y-1" (yellow) delineators.

Traffic delineator spacing and installation details are shown on ***Standard Drawings*** **TM570**, **TM571**, **TM575**, and **TM576**.

Figure 2-3: Delineators

2.4.4 Temporary Pavement Marking and Markers

Temporary markings are used for long term stationary work zones greater than three days. Use channelization devices for short term stationary work zones and mobile work zones. Temporary markings are also used to enhance and delineate runs of temporary concrete barrier and temporary on-site diversions. The decision to use a certain temporary pavement marking or marker should follow the guidance in the MUTCD, ODOT Traffic Line Manual, and ODOT Pavement Marking Design Guidelines. Both the traffic work zone designer and the resident engineer play an important role in the installation of temporary pavement marking and markers. During project development the designer needs to show placement of the markings and markers in the plans. Meanwhile, the resident engineer has the latitude to direct the contractor to install additional markings and markers when not shown by the designer in the plans if deemed necessary.

Temporary Striping

The most common type of temporary pavement markings is temporary striping (paint). Temporary striping is a fast, economical, and effective means of providing required markings, and can be easily paved over.

Temporary and permanent striping must be accounted for during all aspects of construction staging. Determine the best placement for temporary striping while also considering the placement of permanent striping at the completion of the project. Staging may incorporate a combination of permanent and temporary striping.

Temporary striping must meet the same layout requirements for permanent striping. See the ODOT Traffic Line Manual for additional striping details.

Consider the duration of the project when calculating quantities for Temporary Striping If the project is expected to last through multiple seasons – particularly over the winter, a second or even third application of striping may be needed. Inclement weather, sanding treatments, snowplows, and studded tire wear can have a significant impact on the durability and visibility of Temporary Striping.

It is essential to consider roadway delineation as part of a temporary Traffic Control Plan. Pavement markings are critical in providing clear and positive guidance for drivers as they pass through a work zone.

Figure 2-4: Temporary Striping for Exit Ramp

Stripe Removal

Stripe removal is an important aspect to consider during plans development. According to the Standard Specifications, stripe removal may be accomplished by sandblasting, hydro-blasting, steel shot blasting, or grinding. Grinding of striping is *not* permitted on final permanent wearing surfaces. Grinding may be permitted on existing wearing surfaces if the project includes paving over the existing surface at some point in the project after the temporary markings are no longer needed on the existing surface.

If temporary striping is used, removal of conflicting existing pavement markings and reflectors is required. Include adequate quantities of “Stripe Removal” in the TCP to account for existing marking removal.

If durable materials (e.g. thermoplastics) are to be used for permanent striping, ensure that the placement of temporary striping will not adversely affect placement of the durable materials. It may be necessary to identify in the Special Provisions (or on plan sheets) to off-set temporary markings so as to avoid the application of the durable markings in their permanent location.

Temporary Striping on Stage Surfaces

Often, the total depth of the new pavement is too thick to complete the entire section in one lift. Lifts of pavement are placed one at a time. Drivers may be required to drive on an intermediate lift until the final lift (finish lift, or wearing surface) can be placed. Traffic may be shifted onto a temporary diversion (a temporary surface adjacent to the existing roadway) to allow for construction of the new pavement without having traffic in the active work area.

The interim driving surface will require temporary pavement markings until the next lift can be placed and markings can be applied.

Occasionally, temporary striping is needed on the final lift to allow completion of other road work before permanent striping is applied and traffic is shifted to its final position. When temporary striping is needed on the final lift, to minimize damage to the pavement surface, Standard Specifications – **Section 00225.42** – instruct the contractor to do the following:

- Place temporary tape or simulate lines using pavement markers.
- When durable striping will be used for permanent markings, apply a reduced application of temporary striping (paint) immediately adjacent to the location for the permanent striping. The paint will be allowed to wear off without having to grind off the paint.

As a designer, be aware of the planned material for the permanent markings and make any necessary adjustments to the TCP.

Temporary Pavement Legend, Crosswalks, and Stop Bars

Pavement Legends (e.g. Right Turn or Left Turn Arrows, "ONLY", "RR XING") are applied to the pavement prior to an intersection or decision point and are used to inform the driver of the direction that they are allowed to take in a particular lane or to warn them of an approaching condition. Existing and temporary pavement legends, crosswalks, and stop bars should be maintained during construction. Pavement legend examples include Right-Turn or Left-Turn arrows in dedicated turn lanes, "SCHOOL XING", "ONLY" or "RR XING" legend, where applicable. Bicycle legends may be included in designated bicycle lanes or along shoulders.

Temporary pavement markings (striping and tape) are also used for crosswalks and stop bars in areas where work obscures existing markings or markings are relocated due to staged construction. Do not use temporary pavement markers to represent crosswalks or stop bars.

To calculate the quantity of striping needed for a crosswalk, use the following process:

1. Measure the length of the crosswalk.
2. Multiply the distance by two (to account for the two parallel bars).
3. Multiply this quantity by three (each 12-inch bar is made of three 4-inch temporary stripes).

Use the same process for each stop bar, excluding Step 2) above.

Quantities and payment for temporary crosswalks and stop bars is made by the "square foot".

Quantities and payment for pavement legends are made by "each".

Striping Quantities for Multiple Season Projects

Some construction projects extend through the winter months and must "winter over." Winters in Oregon can be very harsh on pavement markings, especially in work zones. Consider additional striping quantities when the project is expected to extend into or beyond the winter months, to account for additional applications.

If the project runs for multiple seasons, adjust temporary striping quantities to account for multiple application(s) of temporary striping. The ADT and geographical location of the highway segment can affect the quantities for temporary striping.

Durable Striping

Durable striping (e.g. methyl methacrylate, thermoplastics or other polymer-based products) is used exclusively for permanent striping. When staging traffic from their original lanes to a temporary alignment this striping may conflict with the temporary alignment.

In this case, decide which of the following techniques is the safer, more practical and cost-effective method for protecting and guiding traffic:

- Removing the existing durable markings and replacing them later.
- Covering durable markings with temporary, non-reflective, removable tape ("blackout" tape).
- Place channelization devices (cones, tubular markers, drums) to create new lanes for the shifted traffic.

A strategy for dealing with durable markings should be based on factors such as duration needed for the temporary markings, quantity of durables in conflict, location of the project, age of the existing durable markings, traffic volumes, and complexity of the temporary traffic shift.

Discuss the decision with the region construction office and other stakeholders to avoid unnecessary removal of the durable striping.

Temporary Tape

Temporary Tape may be used in lieu of temporary striping when consideration is needed for damage to the roadway surface, temporary tape can be an excellent alternative material. Temporary tape is commonly applied to concrete roadways, bridge decks or other finished-grade surfaces that are not being overlaid as part of the project.

Three classifications of temporary tape exist:

- Removable;
- Non-Removable; and,
- Removable, Non-Reflective ("Blackout").

Temporary Removable Tape

Provides an effective, short-term (3-6 months) alternative to striping with the added benefit of leaving behind minimal traces or damage to the pavement surface.

Temporary Removable Tape is typically used in lieu of temporary striping or pavement markers on concrete pavements, including bridge decks.

Similar to temporary striping, temporary removable tape is useful in a number of applications:

- Skip and solid lines during staging.
- Used on existing or new bridge decks to avoid damage.
- Temporary crosswalks or pavement arrows.
- Used as an option for finish lift AC paving.

Temporary Non-Removable Tape

Provides an equally effective alternative to striping; however, due to its adhesive nature, is better suited to a pavement surface that is to be removed or overlaid later in the contract.

Temporary Non-Removable Tape is used for several unique applications:

- To secure pavement markers for Emulsified Asphalt Concrete (EAC or Cold In-place Recycled (CIR preservation projects.
- Used as temporary markings prior to an AC overlay.

Temporary Removable, Non-Reflective Tape

Commonly referred to as "Blackout" tape, it is typically used to temporarily cover durable markings. When a facility has existing durable markings, consider using removable, non-reflective tape as an alternative to grinding off the existing markings. This is desirable when the existing pavement surface is not being affected and a final wearing course is not being applied as part of the scope of work.

Chapter 6F of the ***MUTCD*** does not allow existing striping to be painted over with black paint or bituminous material. The standard accepted practices for long-term projects are to remove all inappropriate striping, or to cover existing striping with temporary removable, non-reflective tape. The intent is to mask the existing durable striping. When staging is completed, the "blackout" tape is removed and the existing durable striping is retained.

While non-reflective tape is more expensive than temporary striping, the removal and replacement of durable markings is significantly more expensive. In addition, coordinating the reinstallation of durable markings is difficult due to limited availability of durable marking contractors.

Pavement Markers

Pavement Markers are used to simulate or supplement temporary striping. The raised reflective surfaces of the markers make them effective devices especially at nighttime or during wet weather.

Pavement markers are available in three different forms:

- Reflective Pavement Markers (commonly known as, "buttons;
- Flexible Overlay Pavement Markers (commonly known as, "tabs" or "stick-n-stomps"); and,
- Flexible Oiling Pavement Markers (with a disposable plastic cover protecting the reflector.

Temporary Reflective Pavement Markers

The markers are either mono-directional or bi-directional, meaning they have reflectors on one side or on both sides.

Mono-directional markers are typically used to simulate skip lines in multi-lane sections or to supplement a painted line. See the ODOT Temporary Traffic Control Standard Drawings for examples of pavement marker use.

Bi-directional markers are used to delineate the centerline of a two-lane roadway, or the double-yellow markings in the median or turn-lane of a multi-lane, non-freeway section.

Reflective markers can be installed on either AC or concrete surfaces; however, if installed on AC surfaces, a bituminous adhesive should be used. If installed on a PCC surface, an epoxy adhesive should be used.

When specifying temporary pavement markers to be used on new or existing open graded AC pavements, the adhesive has a tendency to penetrate into the pavement. Remove marker without damaging the pavement surface.

Field personnel should use caution in the quantity of adhesive used to install pavement markers. Too much adhesive can make removal of the marker difficult, as well as leave large quantities of unsightly adhesive on the roadway surface.

Figure 2-5: Reflective Pavement Marker

Flexible Overlay Pavement Markers

These are used primarily during pavement preservation projects (HMAC overlays, EAC, CIR etc.) to simulate the existing striping. These types of preservation projects obliterate centerline striping, thus requiring temporary pavement markings until permanent striping can be replaced.

The quantity of flexible markers and the method by which they are installed will depend on both the type of work being done and the ADT of highway section. There is no difference in the pay item, whether an oiling cover is provided or not. The markers are measured and paid for as “each”.

Flexible Oiling Pavement Markers

These are used primarily during preservation projects such as Emulsified Asphalt Surface Treatments (EAST), commonly referred to as, "chip seals". Flexible markers are used to simulate the existing striping that is covered by the paving process. The markers are identical to the Overlay marker, except it has a plastic cover to protect the reflective face. The cover is removed after the oil is spread onto the roadway.

The quantity of flexible markers and the method by which they are installed will depend on both the type of work being done, the duration the devices will be needed, and the ADT of the highway section.

Flexible pavement markers are prone to fail prematurely when used on freeways. Therefore, temporary reflective pavement markers are the preferred option on freeways.

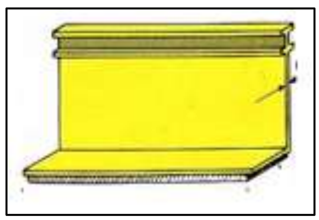

Figure 2-6: Flexible Pavement Marker

2.5 Category 2 Devices

Table 2-2: Category 2

FHWA Crashworthy	Examples of Devices Included
Device is not expected to produce significant vehicular velocity change, but may otherwise be hazardous.	• Barricades – Type I, Type II, and Type III. • Pedestrian Channelizing Devices (PCD). • Sign Stands – Portable, TSS, and Posts. • Tripod mounted devices.

2.5.1 Type I, II, and III Barricades

Type I and II barricades are typically used on pedestrian facilities and multi-use paths for delineating closures and as pedestrian signing supports.

Type III barricades are regularly used for the following:

- Delineating portable changeable message signs (PCMS), sequential arrow boards, or a temporary portable traffic signal trailers.
- Placed at regular intervals in a closed lane to remind drivers the lane is closed to traffic.
- Placed in the roadway in advance of and at the point of road closures.

The most common Type III barricades can be specified in 4-ft or 8-ft widths, depending on the application and the space available for placement. See the ***ODOT Temporary Traffic Control Standard Drawings*** for additional details.

Placement

In the ODOT Standard Drawings and on TCP sheets, barricade labels include a designation as to where on the roadway the barricade is to be placed. The designations, "**R**", "**L**", "**LR**" and "**C**" represent "Right", "Left", "Left-Right", and "Closure", respectively.

- Type "R" barricades are placed on the right side of traffic and traffic is expected to pass the barricade on the left when facing the barricade.
- Type "L" barricades are placed on the left side of traffic and traffic is expected to pass the barricade on the right when facing the barricade.
- Type "LR" barricades are typically placed in the center of a multi-lane roadway section and traffic is expected to pass on either side of the barricade.
- Type "C" barricades are used at roadway closure points.

When shown on TCP plan sheets, include the proper designation for each barricade:

- For an 8-ft Type III barricade on the *right side* of the road, use the **8' B(III)R** designation. The stripes on the panels will point down and to the left.
- For an 8-ft Type III barricade on the *left side* of the road, use the **8' B(III)L** designation.

The stripes on the panels will point down and to the right.

- For placing *two* 8-ft Type III barricades for a road closure, use the **2 – 8′ B(III)C** designation. The stripes on the panels will slope down and toward the center of the barricade.
- If a narrower barricade is needed due to width restrictions, replace the **8′** with **4′**

Figure 2-7: Barricades

Signs and Lights on Barricades

The ***MUTCD***, **Section 6F.03**, allows the installation of temporary signs on Type III barricades, if barricade/sign combination has been crash tested and found to be crashworthy. Installing temporary signs on barricades is not an ODOT standard practice, but may be an approved practice of other public agencies - Cities or Counties. Check with the applicable Road Authority before selecting or identifying temporary sign supports in the TCP.

Temporary signs that must be installed in the roadway for durations exceeding three consecutive days should be installed on a Temporary Sign Support (TSS). The use of the TSS allows the temporary sign to be installed 7 feet above the pavement surface for added visibility. Sign Post Reflectors mounted to the posts of the TSS have replaced the Type III barricade traditionally placed in front of the TSS. See the “Sign Supports” section, below, for more details.

All barricades used on State Highways must be selected from the QPL and conform to ODOT Temporary Traffic Control Standard Drawings. See the Standard Drawings for examples of the Barricades placed in various work zones.

ODOT requires barricades to have retro-reflective sheeting on one side of the barricade panels only – the panels facing incoming traffic. Sheeting on both sides of the barricade is not allowed for barricades used on State Highways.

Adding flashing warning lights on barricades is not an ODOT standard practice. Other agencies may choose to include them on barricades. However, the combination of the light and barricade must be deemed crashworthy and comply with all applicable DEQ requirements for the power supplies.

2.5.2 Pedestrian Channelizing Devices

Considered a channelizing device, the Pedestrian Channelizing Device (PCD) differs from traditional channelizing devices such as cones and drums in that the PCD is an interconnected system of devices. Similar to a run of temporary concrete barrier, the PCD is meant to function as a system of individual components linked together into a contiguous system. The PCD is considered a Category 2 device because of its intention to be connected together.

Because of their intended function in guiding pedestrians through a work zone, PCD are required to be ADA-compliant and meet ADA and PROWAG specifications for users in wheelchairs, those needing walking assistance, and for visually impaired pedestrians. The MUTCD includes a number of physical requirements for the design of the PCD. ODOT has incorporated these criteria into its Product Review Guidelines for companies submitting potential products under the "PCD" category.

Pedestrian Channelizing Devices are not intended to function as a re-directive barrier. PCD products are typically made of light-weight, low-density, polyethylene (LDPE) plastic formed into either hollow or solid panel-style segments that can be moved by hand. Systems can be supported and ballasted using any combination of metal, plastic or recycled rubber legs or bases, and ballasted using 20-lb sandbags or by filling some designs with small amounts of water or sand.

PCD listed on the ODOT QPL are orange and white colored, and are 32" tall – designed to be ADA compliant. Pedestrian channelizing devices interlock to form a rigid, stable, continuous guidance system through or around a work site. PCD are typically used for:

- Sidewalk or pedestrian pathway closures.
- Temporary pedestrian pathways.
- Construction activities or hazards adjacent to pedestrian facilities.

The Pedestrian Channelization Device bid item is paid for "per foot" by the total length of the installed system. Examples of some of the Pedestrian Channelizing Devices currently on the ODOT Qualified Products List (QPL) are shown in **Figure 2-8**.

Chapter 3 includes additional information regarding the selection and application of PCD within a temporary traffic control plan.

Figure 2-8: Pedestrian Channelizing Devices

2.5.3 Bicycle Channelizing Devices

The Bicycle Channelizing Device (BCD), similar to the Pedestrian Channelizing Device, is intended to be linked together to define a path for bicyclists. A BCD is primarily intended to separate bicycles from active work areas. BCD are not intended to separate bicycle traffic from motor vehicle traffic, as bicycle traffic may need to enter into or cross vehicular traffic to execute a turn or other movement. See **Chapter 3** for additional information regarding bicycle accommodations in work zones.

BCD provide continuous delineation and guidance for bicycles – intended to prevent bicyclists from weaving between drums or cones traditionally used to delineate the edge of a work area. Due to their barrier-like structure, BCD should be more effective in keeping bicycles out of the work space, and guiding them along desired pathways. While some BCD can be ballasted with water or sand, they are not intended to redirect traffic. BCD segments are capable of supporting delineator posts, or a breakaway sign support with a temporary sign up to 12 inches x 18 inches.

BCD are considered Category 2 devices due to their size and weight and because they are connected together as a system. A BCD does not need to be ADA-compliant, although the designer must consider pedestrian presence within the same space, and include applicable pedestrian accommodations within the design.

2.5.4 Temporary Signs

Designers should exhaust the following resources when determining the design or selection of temporary signs – including the legend, configuration, sizing, color, usage and placement:

- ODOT "Sign Policy & Guidelines for State Highway Signs."
- FHWA "Standard Highway Signs (SHS)" manual.
- FHWA "Manual on Uniform Traffic Control Devices (MUTCD)."

Temporary signs are used to convey regulatory, guidance, and warning messages. Appropriate signing must be visible and legible during construction activities, and updated, covered or removed, as activities change. Temporary signs can be moved about within the work zone, as needed; or, installed in fixed locations for the duration of the project. When the design of a sign is not provided in the documents listed above, a separate design will be needed and must be included in the contract plans.

2.5.5 Sign Sheeting

In designing a TCP, the use of temporary signs is expected. However, a wide variety of temporary signs and sign designs may be used within a traffic control plan and it is important to convey that specific information to the users of the TCP.

Within the ***2021 Standard Specifications for Construction*** and the ***MUTCD***, there are sign numbers that are used to describe temporary signs. For example, a "STOP" sign, a "DO NOT PASS" sign, or a "ROAD WORK AHEAD" sign will all be a different color and require different sheeting to build the sign correctly. Use the sign number to determine the sign legend, shape, color, and size.

Other standard highway signs are available for use during temporary traffic control. Examples include Regulatory, Guide, and Service signs, whose designs and sheeting will resemble a permanent sign.

One exception is that a yellow warning sign design used as a temporary sign, is specified in the ***2021 Standard Specifications for Construction*** as requiring orange sheeting when used temporarily for a work zone.

Roll-up signs are allowed to be used for signs in work zones. Roll-up sign sheeting must comply with current retro-reflectivity standards.

2.5.6 Sign Flags and Sign Flag Boards

Sign Flags (flexible fabric) and Sign Flag Boards (rigid plywood) can be used to draw a driver's attention to a temporary sign. Sign flag boards can be used to enhance the visibility of a temporary sign that may otherwise go unnoticed. For example, a temporary Speed Zone sign (see photo) looks like a permanent sign, but would be displaying a lower speed. It is important for drivers to notice this reduction, and using the flag boards can help achieve this. Critical detour signing or other regulatory signs (Temporary STOP signs, etc.) can also benefit from the added target value. Use sign flag boards sparingly, particularly for temporary signs that are already made using fluorescent orange sheeting.

Figure 2-9: Sign Flag Boards on a Speed Limit Sign

2.5.7 ROAD WORK XX MPH and LOOSE GRAVEL XX MPH Signs

Definition

The "ROAD WORK XX MPH" sign provides an advisory travel speed through the work zone based on the work activity and the roadway conditions. The "XX" number on the sign should be a safe, reasonable speed for drivers given the current work zone conditions or configuration.

The "LOOSE GRAVEL XX MPH" sign is used specifically for Emulsified Asphalt Surface Treatment ("Chip Seal") pavement preservation projects or other projects where the roadway surface is temporarily covered by or made up of an unpaved surface.

Application

Typical values for "XX" are 10 – 20 mph below the pre-construction posted speed. However, the reduced speed on these signs does NOT allow a designer to use a reduced Design Speed, nor is the displayed speed on this sign a regulatory speed. The displayed speed is only advisory.

The "XX" portion of the sign may be placed directly on the sign or added as a Velcro placard. The "XX" portion of the sign shall have a fluorescent orange background with black, non-reflective legend.

DO NOT use white sheeting and black legend for the "XX MPH" placard on these signs.

Avoid the overuse of these signs, as it can accelerate the loss of their effectiveness. Use sound engineering judgment when including these signs in the TCP.

Responsibility

In determining the appropriate speed for the "XX" placard on the signs, seek assistance from ODOT region traffic staff or the ODOT traffic-roadway section.

A 10 mph reduction below the pre-construction posted speed is most commonly used for the value of "XX". Larger reductions are heavily dependent upon the type of work being conducted and other traffic control measures in place on the project. If conditions or configurations within the work zone change, the speed on the "XX" placard can be adjusted to suit those changed conditions.

If values greater than 20 mph below the posted speed are needed, the traffic control plan should be revisited and additional measures implemented to enhance safe traffic speeds through the work zone.

As examples, a 40 mph "XX" placard may be used in a 55 mph work zone due to a temporary curvilinear alignment or a narrowed roadway. Or, a LOOSE GRAVEL XX MPH sign may display a 35 mph placard on a 55 mph roadway during a chip seal operation to minimize the likelihood of flying gravel.

Figure 2-10: Loose Gravel Sign

2.5.8 Specialty Signs

There are a number of ODOT specific "Specialty Signs" that are frequently included in a TCP. These signs are used to provide additional information to the traveling public as a courtesy. See **Chapter 6** of the ***ODOT Sign Policy ODOT & Guidelines*** for additional sign information.

Project Identification Sign (CG20-8)

The Project Identification sign is used to identify an ODOT highway construction project. From the ODOT Special Provisions in Section 00222, the Project ID sign should be included in the TCP if any one of the following criterion are met:

- Project duration is one year or more.
- Project is on an Interstate freeway.
- Engineer's estimate is $5 million or more.
- Other high-profile projects as determined by the ODOT Region.

Figure 2-11: Project Identification Sign

Project ID signs should be installed in advance of all other work zone signing, including the initial "ROAD WORK AHEAD" sign. For ODOT construction projects, the engineer (ODOT resident engineer typically determines the sign legend once the contract is awarded. The "ODOT" rider is typically included with the Project ID sign, but may be deleted for Local Agency projects where the sign is posted on a non-State roadway.

Business Access Sign (CG20-11)

The "BUSINESS ACCESS" sign is used to identify a private business access which may be obscured or otherwise impacted by construction. In combination with the "Business Access" sign, blue tubular markers are used to improve the visibility and delineation for the business access while under construction.

Figure 2-12: Business Access sign

2.5.9 Sign Support

Wood Sign Posts

Wood posts are the most common type of support for temporary signs. Details for the installation of Temporary Signs on wood posts can be found in the ODOT Standard Drawings for ***Temporary Traffic Control*** (TM800s) and for Signs, ***Illumination and Signal Support Structures*** (TM600s).

Perforated steel Square Tube posts (PSST)

PSST sign posts are an alternative to wood posts for the installation of Temporary Signs. PSST sign post materials are listed on the QPL. Proper size and gauge of the PSST posts are available

on ODOT Standard Drawing TM681 – Perforated Steel Square Tube (PSST) Sign Support Installation. Additional PSST installation details are found on ***ODOT Standard Drawing TM689*** – Temporary PSST Vane Anchor Installation, including the depth of the post footing and vane anchor size.

Metal posts are a popular alternative to wood due to cost, ease of installation and the ability to reuse the posts at the conclusion of the project.

Figure 2-13: Sign mounted on PSST

Temporary Sign Support (TSS)

A TSS is a crash-worthy wooden or metal sign support that can be used in lieu of in-ground wood or metal post installations. A TSS can be positioned and repositioned multiple times during a project to maximize the effectiveness of a temporary sign.

A TSS is useful when:

- A sign must be placed in the roadway, on a shoulder, paved island or other rigid surface.
- Roadside ground is too hard or soft for an in-ground installation.
- A sign is expected to move several times over the life of the project.
- A sign is in place for a short duration (i.e. less than one week).
- The location of in-ground signs would conflict with underground utilities.

See the ***ODOT Temporary Traffic Control Standard Drawings*** for TSS fabrication details. Contractors must build a TSS as shown in the Drawings for it to be crashworthy.

A TSS is crashworthy from all four directions. However, a TSS should NEVER be tipped over. A TSS has not been crash-tested in this orientation. Single-post and Double-post designs are shown on Figure 2-14 for wood supports. Single-post and Double-post designs are shown on the *Standard Drawings* for both wood and metal supports.

When not in use, the sign on the TSS should be covered; or, the TSS can be turned away from traffic or removed from the roadway completely.

All TSS must be delineated by placing retroreflective sheeting on the front and both the left and right sides of the TSS posts. The sheeting should be orange unless a STOP or DO NOT ENTER sign is installed on the TSS, in which case the sheeting should be red. The use of barricades to delineate TSS is no longer necessary. For additional details, see ***ODOT Standard Drawing TM821 & TM822 – Temporary Sign Supports***.

Figure 2-14: Temporary Sign Supports

The maximum total sign area allowed on a double-post TSS is 20 ft^2 (e.g. a 48-inch x 60-inch "SPEED LIMIT XX" sign). For the single-post TSS, the maximum total sign area is 12 ft^2 (e.g. a 36-inch x 48-inch "SPEED LIMIT XX" sign). Due to calculated dead load and wind load limitations, larger signs should not be installed on a TSS. A structural support (bridge, sign bridge, luminaire post, etc.), steel breakaway support (e.g. TBB), or equivalent, should be used for signs larger than the maximum sizes allowed on the TSS.

Portable Sign Support

The Portable Sign Support (PSS) is used to mount a roll-up sign for short-term or intermittent work. According to the ***MUTCD***, roll-up signs on Portable Sign Supports may be in place for a maximum of 72 consecutive hours.

However, ODOT construction contracts limit the use of roll-up signs to *48 consecutive hours* to avoid having signs left in place over a weekend.

Roll-up signs are most useful for operations that occur on a daily basis – installed in the morning, and then taken down in the evening at the end of the work shift. It should be noted that when the sign is taken down at the end of a shift the "48 consecutive hour" clock starts over. This practice may be repeated for the duration of the project as long as the sign is not left in place for more than 48 consecutive hours. If the sign is needed longer, it should be installed on a TSS or in-ground post. All signs should be turned, covered or removed when their messages are not applicable or appropriate to the work environment. Portable sign supports may be used for any sign type; regulatory, warning, guide, etc.

Figure 2-15: Portable Sign Support

Concrete Barrier Sign Support

Barrier sign supports are used to install temporary signs on concrete barrier where space for a TSS or post-mounted sign is not available. See the ***ODOT Temporary Traffic Control Standard Drawings*** for design details for this support.

Figure 2-16: Concrete Barrier Sign Support

The barrier sign support can be used on either standard 32-in barrier or the taller 42-in "Tall F" barrier. The maximum total sign area allowed on the current barrier sign support is 12 ft^2 (e.g. a 36-inch x 48-inch "SPEED LIMIT XX" sign).

If installing the initial "ROAD WORK AHEAD" sign on a barrier sign support in the median, DO NOT include any additional signing or surfaces on this sign support, including:

- **Sign Flag Boards.**
- **Advisory Speed placards.**
- **"FINES DOUBLE" riders.**
- **"ON ROADWAY" riders, etc.**

If the above riders or sign accessories are needed, they may be added to the TSS or post-mounted "ROAD WORK AHEAD" sign on the right shoulder.

Existing Sign Supports

Temporary signs may be added to or replace existing signs installed on existing highway sign supports and structures with prior approval from the applicable Road Authority or Utility. ODOT approval includes working with the ODOT sign & structures engineers, or equivalent.

2.6 Category 3 Devices

Table 2-3: Category 3

FHWA Crashworthy	Examples of Devices Included
Devices or hardware expected to cause significant velocity change or other harmful reactions to impacting vehicles.	• Temporary Impact Attenuators • Temporary Pre-cast Concrete Barrier • Temporary Guardrail, Connections, Transitions, and End Terminals • Temporary Bridge Rail • Breakaway Sign Supports

2.6.1 Temporary Concrete Barrier

Standard "F"-shape temporary concrete barrier (32-inch) is one of the most common temporary traffic control devices used in longer-term construction work zones. It provides traffic with positive separation from the work area and effective protection for construction workers.

Several factors should be considered when determining the need or quantity of temporary concrete barrier in the traffic control staging plan.

Temporary Concrete Barrier is primarily used to:

- Provide positive separation between the work area and live traffic.
- Provide a well-protected work area for construction personnel.
- Protect opposing traffic streams from cross-over crashes.
- Protect road users from deep excavations or hazards adjacent to the traveled way.
- Contain or redirect errant vehicles away from roadside obstructions or active work areas.

Fabrication and Placement

Standard "F" barrier must meet the fabrication specifications shown on ***ODOT Standard Drawing RD500*** and in ***Section 00820*** of the ***Standard Specifications for Construction***.

For temporary concrete barrier to perform as designed, and to remain crashworthy, it must be placed according to the following:

- On a flat, pavement surface of either asphalt concrete (AC) or Portland cement concrete (PCC).
- A 5.5-foot wide, unobstructed surface behind any unsecured concrete barrier for deflection, if impacted.
- Secured concrete barrier must maintain a 1.5-ft clear space behind the back face of the barrier.

- Barrier used as shoulder barrier must maintain 2-ft (if unsecured) or 1-ft (if secured) of pavement surface behind barrier as shown on RD503.
- Each barrier segment must be pinned to the adjacent segment.

If a 5.5-ft clearance cannot be provided when placing barrier adjacent to obstructions or hazards (e.g. bridge falsework, abutments, sheet piling, retaining walls, deep excavations), then the barrier must be secured to the pavement surface and include a 1.5-ft clearance from the obstruction/hazard. Visit *Section 3.4.25 – Barrier Placement* for additional information on not meeting minimum deflections.

See ODOT Standard Drawing TM830 for Barrier Securing details. For temporary barrier placed on concrete bridge decks, see the ***ODOT Bridge Design Manual (BDM)***, ***Section 1.13.1.10***, and ***Standard Details DET3295*** and ***DET3296*** for placement and anchoring information.

Blunt End Protection

Where the barrier run terminates, include details or instructions to the contractor to protect the exposed blunt ends of the concrete barrier using one of the following measures:

- Temporary Impact Attenuator - Sand barrel array, or compatible Narrow-site System.
- Truck-Mounted impact Attenuator (TMA) – Typically limited to three days or less.
- Temporary connection between the barrier run and other railing system (e.g. guardrail, bridge rail, or other concrete barrier) – See ODOT Standard Details for connections.
- Overlapped Ends with adjacent barrier run (see ODOT Standard Detail).
- Burying the blunt end into a roadside cut or fill slope.

Tall “F” Concrete Barrier (42-inch)

With its 42-inch height, Tall “F” barrier is primarily installed in medians and on the shoulders of Interstate freeways and the State Highway Freight System. Tall “F” barrier is typically used at locations with high truck volumes (DHV > 250); or, at locations with geometry that could result in a serious crash if a heavy vehicle penetrated the barrier (e.g. alignments with curve radii < 28^0 [205 ft.]).

Tall “F” barrier must meet the specifications shown on ***ODOT Standard Drawing RD545***. The same placement requirements for Standard “F” barrier apply to Tall “F” barrier.

Tall “F” barrier provides effective protection against median crossover crashes – particularly from large trucks. In Test Level 3 (TL-3) and 4 (TL-4) testing, Tall “F” barrier performed very well, seeing deflections of approximately 32 inches per NCHRP Report 350.

In the TCP, Tall “F” barrier may be used as temporary barrier. However, when used as temporary barrier, Tall “F” barrier is often left on the project and used as permanent barrier.

Due to the limited availability and greater difficulty with moving this type of barrier, it is impractical to specify Tall "F" barrier to be used ***exclusively*** as temporary barrier.

For securing "Tall F" barrier to the roadway, see ***ODOT Standard Drawing TM830*** and ***RD516***.

2.6.2 Temporary Steel Barrier

Temporary steel barrier provides traffic with positive separation from the work area and effective protection for construction workers. Steel barrier is highly portable, and is much easier to move from one location to another due to its lighter weight per foot.

Deflections of steel barrier due to impacts vary based on the barrier product and their individual installation and anchoring requirements. Deflection distances must be taken into account if steel barrier is being considered as a positive protection measure within a TCP.

Several factors should be considered when determining the need or quantity of temporary steel barrier in the traffic control staging plan.

Temporary Steel Barrier is primarily used to:

- Provide positive separation between the work area and live traffic.
- Provide positive separation between motor vehicle traffic and pedestrians where a temporary pedestrian pathway must share a portion of the roadway used by motor vehicles.
- Provide a protected work space for construction personnel and equipment.
- Protect adjacent, opposing directions of traffic from cross-over crashes.
- Protect traffic from deep excavations or hazards adjacent to the traveled way.
- Contain or redirect errant vehicles away from roadside obstructions or active work areas.

Placement

For temporary steel barrier to perform as designed, and to remain crashworthy, it must be placed according to the following:

- Placed on a flat, pavement surface of asphalt concrete (AC) or Portland cement concrete (PCC).
- Wide, unobstructed surface behind steel barrier to allow for deflection. Width depends on steel barrier manufacturer, and method which the barrier is secured to the pavement surface.
- A 5.5-foot wide, unobstructed surface behind any "minimal deflection" installation of steel barrier to allow for any deflection.
- Each barrier piece must be connected to the adjacent segment, per manufacturer instructions.

For temporary steel barrier on any bridge decks, see the ***ODOT Bridge Design Manual (BDM), Section 1.13.1.10***, and ***Standard Details DET3295*** and ***DET3296*** for placement information. Contact ODOT Bridge personnel to gain approval to place and anchor any barrier to an ODOT bridge.

Blunt End Protection

Where the barrier run terminates, include details or instructions to the contractor to protect the exposed blunt ends of the steel barrier using one of the following measures:

- Temporary Impact Attenuator - Sand barrel array, or compatible Narrow-site System.
- Truck-Mounted impact Attenuator (TMA) – Typically limited to three days or less.
- A temporary connection between the barrier run and other railing system (e.g. guardrail, bridge rail, or other concrete barrier) – See ODOT Standard Details for connections.
- Overlapped Ends with adjacent barrier run (see ***ODOT Standard Detail***).

2.6.3 Temporary Glare Shields

Temporary glare shields are installed along the top of concrete barrier between opposing traffic lanes. Glare shields are used to prevent opposing headlight glare from impairing driver visibility. Glare shields are typically installed where traffic maneuvers through a curvilinear alignment (e.g. freeway crossover) resulting in headlight beams aiming more directly into the path of oncoming vehicles. Space glare shields along the top of concrete barrier in accordance to Table 2-4.

Table 2-4: Glare Shield Spacing

Curve Radius (ft.)	Blade per Section	Spacing (ft.)
Tangent Sections	5	± 2′-6″
∞ to 1500	6	± 2′-1″
1500 to 750	7	± 1′-10″
750 to 500	8	± 1′-7″
500 to 350	9	± 1′-5″
350 to 275	10	± 1′-3″

Figure 2-17: Glare Shield

2.6.4 Temporary Glare Screens

Temporary Glare Screens are installed along the top of concrete barrier between a traffic lane and the work zone. Glare Screens are used to discourage “gawking” or “rubber-necking” by passing traffic – often resulting in erratic vehicle paths or unanticipated speed changes within the work area.

Do not mount Glare Screens on concrete barrier located between opposing traffic lanes. Use Glare Shields in these locations.

Temporary Glare Screens are measured and paid for, “per foot”. When Temporary Glare Screens are moved from one location of actual use to another, the “Moving Temporary Glare Screens” pay item is also measured and paid for, “per foot”.

2.6.5 Reflective Barrier Panels

Reflective Barrier Panels are large pieces of retroreflective sheeting in fluorescent orange or silver-white attached to the traffic side of temporary barrier or guardrail to enhance the visibility and conspicuity of the barrier system (see photo, right).

Barrier panels are typically installed in curvilinear sections of a barrier run. However, installing the panels on the beginning and ending curves of a temporary barrier run are most beneficial in assisting drivers through the unfamiliar alignment. Reflective barrier panels are measured and paid for as “per each”.

Figure 2-18: Reflective Barrier Panels

2.6.6 Temporary Impact Attenuators

Temporary impact attenuators (or, "crash cushions") are crashworthy devices that mitigate the effects of errant vehicles striking fixed objects. Temporary impact attenuators, when struck, absorb the energy of the vehicle and dissipate it within the system in various ways – by breaking apart (drum arrays), rapidly collapsing and decelerating (TMAs, gating narrow-site systems), or deflecting slightly and redirecting the errant vehicle (non-gating narrow-site systems). Work zone impact attenuators are listed on the ***ODOT QPL*** under "Impact Attenuator, Temporary" and can be separated into the following types:

Sand Barrel Drum Array

An array of sand-filled plastic drums (modules). See ODOT Temporary Traffic Control Standard Drawings for additional details.

Narrow-Site Systems

An attenuator style used specifically to protect blunt ends of concrete barrier, bridge rail, columns or other fixed objects within the clear zone with a narrow width (~2-ft). Most narrow-site systems are approximately two-feet wide, making them valuable and practical for protecting traffic where a full-size drum array attenuator will not physically fit. When attaching a narrow-site system to Tall "F" barrier, use a Tall "F" Concrete Barrier Transition to Standard Concrete Barrier (See ***ODOT Standard Drawing RD 560***) and attach the narrow site system to the Standard Concrete Barrier end. Narrow site systems are not designed to attach to Tall "F" Concrete Barrier and can create a snagging hazard.

Truck Mounted Attenuator (TMA)

A TMA is a mobile impact attenuator attached to a construction vehicle, and is typically used to protect fixed objects, isolated work areas, or other exposed hazards. Because of its portability, a TMA can be used to protect moving work areas or short-duration activities (AC or PCC pavement repairs). 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. See Chapter 3 for additional TMA placement guidance and details.

See ***Section 6F.86*** of the ***MUTCD*** for additional information regarding temporary impact attenuators.

2.6.7 Temporary Barrier, Guardrail Connections, and Guardrail Terminals

Use temporary connections to connect different barrier systems together. Temporary connections may be used as alternatives to impact attenuators, overlapped or buried ends, or other treatments. Several devices are available to connect temporary concrete barrier to other systems including existing barrier, bridge rail and guard rail sections.

Barrier-To-Guardrail Connectors

Some barrier installations may need to be connected to guardrail or other railing system. This requires a secure connection between the two runs to prevent errant vehicles from snagging the joint between the two systems. See ***ODOT Standard Drawing RD530*** for examples of barrier-to-barrier connections.

Temporary Connectors are paid for under the "Temporary Protection & Direction of Traffic" (TP&DT) lump sum pay item. Connectors are measured as "per each".

Bridge Rail Connectors

Frequently, bridge rail is terminated by attaching the rail to a run of guardrail to protect the hazard. See ***ODOT Standard Drawings BR203*** for an example of this type of connection. This connection detail may be used for temporary or permanent applications.

Guardrail Terminals

Guardrail is terminated by using energy absorbing or non-energy absorbing guardrail terminals. Follow the guidance in ***ODOT Highway Design Manual Chapter 4.6.10*** and ***4.6.11*** and ***Standard Drawings 420, 425, 430***, and ***435*** to choose guardrail terminals.

2.6.8 Other Barrier Systems

For work zone activities that are in place for a limited time (< 1 day), there are two additional traffic control devices used for protecting the work area and public traffic.

Movable ("Zipper") Concrete Barrier

Movable Barrier is typically used for staging projects requiring multiple and frequent moves of the concrete barrier.

Movable Barrier is a specially-shaped barrier made of multiple, smaller, interlocked segments. The system is moved using a special transfer machine designed to pick-up, move, and put down the barrier in a single pass. The barrier and machine are included in the contract as a single pay item.

Figure 2-19: Concrete "Zipper" Barrier

Product-specific impact attenuators are used for the Movable Barrier, attach to the end of the barrier run and are moved by the machine in the same manner as the barrier. Movable Concrete Barrier has a slightly higher deflection when struck by an errant vehicle (~ 5-ft, mid-run with unsecured ends). Avoid specifying this barrier system less than 5-feet from a work area or other obstruction. Do not specify moveable barrier as being "secured" to the roadway.

Mobile Barrier System

A mobile barrier system is advantageous and effective in providing positive protection between workers and traffic for small work areas (< 100 ft.). For example, bridge joint repairs, pavement patching, manhole adjustments, and overhead sign work would be well-suited for the use of a mobile barrier system.

Due to its ease in portability, mobile barrier systems can optimize safety and efficiency for projects on high-speed roadways that include multiple small work areas. Installing, moving and removing traditional temporary concrete barrier would not be practical for these types of projects.

When using a mobile barrier system, include a PCMS and a truck mounted attenuator as an additional bid items.

Figure 2-20: Mobile Concrete Barrier

2.7 Category 4 Devices

Table 2-5: Category 4

FHWA Crashworthy or Protected	Examples of Devices Included
• Portable, primarily trailer-mounted • Need to be shielded or, at a minimum, delineated • FHWA continues to monitor in-service crash performance • MASH encourages the design and testing of crashworthy versions • Good placement practices	• Sequential Arrows ('Arrow Boards') • Portable Changeable Message Signs (PCMS) • Automated Flagger Assistance Devices (AFAD) and Portable Traffic Signals • Portable Light Plants (Not flagger station lighting)

2.7.1 Temporary Electrical Signs

Sequential Arrow Signs

Sequential Arrows (arrow boards) are large truck or trailer-mounted lighted signs used to indicate the direction traffic needs to merge as part of a lane closure. Several approved sequential arrows are listed on the ***ODOT QPL***.

Sequential arrows shall ONLY be used to indicate a lane closure. Do not use a sequential arrow sign to indicate a traffic shift. Do not use a sequential arrow to indicate a "Keep Left" or "Keep Right" condition.

Sequential arrows are measured and paid for as "per each". See ***Section 6F.61*** of the ***MUTCD*** for additional information.

Radar Speed Trailers

Radar speed trailers are trailer-mounted lighted signs used to indicate the speed of vehicles traveling toward the trailer. The trailers are intended to reduce traffic speeds approaching, and as they travel through, a work zone. Radar Speed Trailers are currently available on the ODOT QPL.

Radar speed trailers should be setup to allow traffic travelling toward the trailer to clearly see the display panel, similar to a PCMS. The display panel should be programmed to flash the measured speed of the approaching vehicle alternating with a "SLOW DOWN" message when the vehicle's speed exceeds the speed limit threshold programmed into the Radar Speed Trailer.

Current Standard Specification language for the Radar Speed Trailer includes instructions for determining the speed limit threshold. See the Specification "00222.45(c) – Radar Speed Trailer" for more details.

The display panel should be programmed to go blank when the measured approach speed of a vehicle exceeds 30 mph above the posted speed limit. This is to discourage drivers from trying to see how high of a speed they can get to display on the panel.

Currently, radar speed trailers are required for paving operations on freeways and expressways as per ODOT Standard Drawing TM880, but may be used elsewhere as designers see fit. Radar speed trailers should not be used at the same location for long periods of time as the effectiveness of the trailers fades over time. Radar speed trailers are measured and paid for as "per each". See ***Section 2L*** and ***6F.60*** of the ***MUTCD*** for additional information.

Portable Changeable Message Signs (PCMS)

PCMS are large lighted signs used to display programmable, dynamic messages that reflect work zone conditions to be encountered by approaching traffic. PCMS can be mounted on either a trailer or work vehicle. Trailer-mounted PCMS can display three lines of text. Depending on the size of the unit, a vehicle-mounted PCMS can display either two or three lines of information. Several approved PCMS are included on the ***ODOT QPL***.

Installation and delineation details for a PCMS can be found in the ***ODOT Temporary Traffic Control Standard Drawings***.

ODOT has published a quick reference field guide "***Oregon Portable Changeable Message Sign Handbook"***, which provides guidance for the operation of portable changeable message signs (PCMS), including proper messages, application and placement of the devices.

Messages displayed on a PCMS should be complete, independent thoughts. Avoid displaying a message that relies on the second message to complete the thought. In practice, one message (*panel*) should be used to describe a situation or condition. The second panel should be used to convey supplemental information, an additional warning or direction for drivers.

Standard practice for a PCMS dictates that a maximum of two alternating panels are to be displayed on a single PCMS. However, under limited circumstances, it may be necessary to use an additional panel to address a specific segment of drivers or complex thought (e.g., oversize vehicles, or a complex detour). In no case should there be more than three panels on a single PCMS. If more than three panels are needed, an additional PCMS should be installed in sequence. If a second PCMS is installed, do not install any temporary signing between the two PCMS to maintain the integrity of the complex PCMS message sequence.

Due to limitations in the number of characters, abbreviations may be required. Abbreviations should follow the guidance in the ***MUTCD*** on ***Tables 1A-1, 1A-2,*** and ***1A-3***. Messages may include distance information expressed in feet or miles. Each panel is limited to three lines with eight characters per line (including spaces). Additional PCMS information can be found in ***Section 6F.60*** of the ***MUTCD***.

A PCMS may be used to display arrows and chevrons to simulate a sequential arrow board. Do not combine arrows/chevrons with text on the same panel. Arrows and chevrons used on a PCMS must comply with the graphical guidance given in the MUTCD. Animation, other graphics, logos, web sites, etc., shall not be displayed on a PCMS. When including suggested messages on a TCP sheet, use the following format:

TRAFFIC SHIFT 1 MILE	LANES SHIFT LEFT

PORTABLE CHANGEABLE MESSAGE SIGN
(Suggested Message, Locate As Directed)

Figure 2-21: Format for suggested PCMS

2.7.2 Temporary Traffic Signals

A temporary traffic signals is typically used to control the flow of traffic through a one-lane, two-way work area. Signals are often used in lieu of flaggers due to the duration of the two-way, one-lane operation.

The use of a temporary signal is limited to applications where a number of criteria are examined and can be met, as follows:

- ADT is typically below 3500.
- Analysis shows delays of less than 20 minutes.
- Adequate sight distance can be provided between STOP bars at each end of the work area.
- Cost comparison made between the signal and flagging show the signal being more economical.
- Other environmental conditions that would favor the signal over human flagger control.

Public roadways between the limits of the temporary signal must be considered. The intersecting roadway can either be incorporated into the operation of the signal with the addition of another signal head or the roadway can be closed and a detour route determined.

Private accesses (driveways, businesses) within the signalized area should not be allowed. Attempts should be made to provide a reasonable alternative access. However, depending on volumes, right-of-way constraints, economic impacts and political climates, it may be necessary to incorporate the private access into the signal as described above.

Figure 2-22: Temporary Traffic Signal (Span Wire)

Other road users, including pedestrians and bicyclists, should be considered when designing a temporary signal. If a significant number of other road users can reasonably be expected, then the project and the temporary signal needs to accommodate them. Bike lanes, bike detection, separate bike/pedestrian facilities are some of the options available to designers.

Temporary Signals can be used for the following work zone conditions:

- One-lane, two-way configurations.
- During the installation of a new permanent signal.
- To control traffic through an intersection being reconfigured.
- For the reconstruction of an interchange ramp terminal.

Temporary traffic signals are often selected over flagging when construction staging will require the one-lane, two-way traffic operations for several weeks or more. In lieu of two flaggers (24-hours/day) and two Advance flaggers (8-hours/day) during peak times, temporary signals are preferred for:

- Two-lane bridge replacements.
- Rock fall or side slope excavation projects.

Use of a temporary traffic signal becomes more cost-effective where one-lane, two-way traffic staging lasts approximately 28 consecutive days or more.

The design of the temporary signal may be prepared by an ODOT region signal designer, a consulting engineer, or by qualified staff within the individual agency.

Approval for the installation of a temporary signal on a State highway is granted by the state traffic engineer. Similar to a permanent signal, a plan showing the locations of all portable traffic signal equipment, as well as any other traffic control devices to be used in conjunction with the portable traffic signal must be submitted for approval. The process and required approval for temporary signals is similar to permanent signals and is available in ***Section 304*** of the ***ODOT Traffic Manual***. Approval for temporary signals on city or county roadways is granted by the responsible traffic engineer within these individual agencies.

2.7.3 Portable Traffic Signals

Portable traffic signals are temporary traffic signals mounted on a trailer. Portable traffic signals are subject to all of the same requirements for temporary traffic signals, including state traffic engineer review and approval.

Portable traffic signals should be considered when a temporary signal is needed for a limited duration, ideally less than one month. Portable traffic signals are also ideal when electricity is not readily available. Most portable traffic signals are powered by batteries, recharged by generators or solar panels.

Figure 2-23: Portable Traffic Signal

Portable traffic signals should not be used at locations where there is more than one travel lane in each direction. However, they may be permissible on divided four-lane roadways, two lanes in each direction, if a separate set of signal heads is provided for each additional travel lane. Portable traffic signals typically should be used at locations where the posted construction speed is less than 35 mph; however, for limited applications, speeds up to 55 mph may be applicable. When not in use, signal indications and all related traffic control devices should be either removed or covered.

Portable traffic signals are no longer limited to two phase operations. Newer signal technologies are allowing multiple phases and wireless connectivity. Under proper conditions, a portable signal can be used at intersections for limited durations. At most intersections, a temporary traffic signal (span wire) is usually a better option. The selected portable traffic signals must be listed on the ***ODOT QPL***. Refer to the ***ODOT Traffic Control Plan Standard Drawings*** for additional guidance as to the layout and additional TCD needed for the signal.

The process and required approval for portable signals is similar to permanent signals and is available in ***Section 304*** of the ***ODOT Traffic Manual.***

2.7.4 Flagger Station Lighting

Flagger Station Lighting shall be reasonably glare-free. Flagger Station Lighting must come from the ODOT QPL. Flagger station lighting illuminates the Flagger during nighttime operations, while minimizing the glare experienced by approaching drivers.

Flagger Station Lighting mounted on a trailer does not currently require proof of crashworthiness. Flagger Station Lighting devices mounted on a sign stand, tripod, or other type of portable pole, is considered as a Category 2 device, and proof of crashworthiness is required for inclusion on the ***QPL*** and use in an ODOT highway construction contract. Non-crashworthy stand-alone devices purchased prior to January 1, 2014 may still be used through the end of their useful life. The stand-alone flagger station lighting is preferred over the trailer mounted lighting because it is crashworthy, is more portable and mobile than the trailer, and easily transported.

2.7.5 Automated Flagger Assistance Devices (AFADs)

The AFAD is an automated device used as an option to control two-way traffic through a one-lane work zone operation; and, is intended to replace the presence of a Flagger standing on the roadway surface adjacent to live traffic.

The AFAD is a trailer-mounted device that includes a remotely controlled gate arm that can be raised or lowered across a single travel lane to control the flow of traffic. There are two styles of AFAD allowed by the ***MUTCD***.

The “Red-Yellow Lens” AFAD uses 12” red and flashing yellow signal lights installed on the trailer to control traffic movement. – The steady “red” light alerts drivers of a STOP condition, and the flashing “yellow” light directs drivers to proceed with caution through the work area.

The other style is a “STOP/SLOW” AFAD that uses a large rotating Stop/Slow paddle mounted in the center of the top of the trailer – similar to that of a Flagger’s Stop/Slow sign. The “STOP/SLOW” AFAD is no longer allowed for use on ODOT project as it does not convey a clear message to drivers.

AFADs listed on the ***QPL*** are allowed to be used in highway work zones.

Designers are asked to consider the use of an AFAD at each end of an active work area where traffic is being controlled through a two-way, one-lane configuration before selecting Flaggers as the intended traffic control measure. The AFAD should be considered for use if the following criteria or conditions can be met within the construction staging plan and physical project site characteristics. If these conditions cannot be met, Flaggers (and Pilot Cars) should replace the AFADs as the selected traffic control measure:

1. AFADs should be limited to projects on highway segments with hourly passenger car equivalent (PCE) volumes and lane closure lengths that fall within values shown in Table 2-6 below:

Table 2-6: Free-Flow Thresholds for AFAD & Flagging Operations

PCE (Hourly PCE shown are for both directions, total)	Length of One-Lane Section
≤ 550	1 - 2 miles
750	1/2 - 1 mile
900	Up to 1/2 mile
> 900	Not Recommended

2. Line of sight between the AFAD units must be maintained. When line of sight cannot be maintained, use of pilot car is required.
3. If AFAD units are more than 1/4 mile apart, use of a Pilot Car is required.
4. AFAD trailers are to be placed on the roadway shoulder. If the AFAD encroaches into the traffic lane, the AFAD gate arm shall not extend into the opposing lane. If freight mobility width requirements cannot be met due to the lane encroachment of the AFAD trailers, Flaggers will be considered as substitute for the AFAD.
5. AFAD Operations.
   - Flagger Station Lighting is required for AFAD use at night.
   - All other applicable requirements shown on ***ODOT Standard Detail DET4700*** and ***DET4705*** must be met.

For side roads within an active work zone, use of flaggers instead of AFADs is recommended due to limited shoulder widths. A "WAIT FOR PILOT CAR" sign can be used for low volume side roads as described in **Section 3.4.15.**

Designers are encouraged to explore other application and operational conditions. ODOT has adopted these conditions based on recently published standards and guidance in the ***2009 MUTCD***. ***Standard Detail DET4700*** and Special Provision language are available to address the use and placement of AFADs within a highway work zone. Review these resources for additional design standards and practices. See ***Sections 6E.04*** and ***6E.05*** of the ***MUTCD*** for more information regarding AFADs.

AFAD use on State Highways differs from the 2009 MUTCD. ODOT disallows the use of AFADs under the following configurations:

- **A single AFAD trailer at one end of the work zone operated by a Flagger who is simultaneously flagging traffic at the other end of the work area; and,**
- **One AFAD Operator controlling two AFAD trailers.**

2.7.6 Temporary Rectangular Rapid Flashing Beacon (RRFB)

The Rectangular Rapid Flashing Beacon or RRFB is a pedestrian activated flashing warning beacon used to supplement pedestrian or school crossing signs at uncontrolled crosswalks. The Federal Highway Administration (FHWA) issued Interim Approval for the optional use of RRFBs on all Oregon roads on April 5, 2018 under Interim Approval IA-21. RRFBs are generally associated with reduced pedestrian crash risk and improved motorist yielding behavior. The effectiveness of RRFBs depends on a number of factors including the number of lanes crossed, approach speed, the presence of a refuge island, visibility of the beacons, presence of advance stop bars on multi-lane approaches, and road user understanding of the device.

The use of temporary RRFB to enhance a temporary midblock crossing in work zones, should be considered where:

1. More than one travel lane in each direction
2. 8,000 Average Daily Traffic (ADT) volume (6000 ADT if high percentage of pedestrians who are young, elderly, or have mobility challenges), and
3. The posted speed is 40 mph or less.

For pre-construction speeds greater than 40 mph, consider a temporary speed zone reduction

The placement and visibility of the temporary RRFB to approaching vehicles (measured in advance of and to the stop line) shall be a minimum sight distance as shown in Table 2-7. If the approaching traffic does not have continuous view of the RRFB for at least the minimum sight distance, an advance warning sign shall be installed for the approach.

Table 2-7: Minimum Sight Distance for RRFB

Pre-Construction Posted Speed	Minimum Sight Distance
20 mph	175 feet
25 mph	215 feet
30 mph	325 feet
35 mph	390 feet
40 mph	460 feet
45 mph	540 feet
50 mph	625 feet
55 mph	715 feet

To signify the temporary nature of the midblock crossing, the pedestrian crossing sign (W11-2) should be black on orange installed on a wood post as shown in Figure 2-24.

The state traffic-roadway engineer's approval is required for installation of temporary RRFB on State Highways. An engineering study is required for the installation of any RRFB. Visit ***Section 310.3*** of the ***Traffic Manual*** for more information on the standards, process and required approval for RRFBs.

Figure 2-24: Temporary RRFB

2.8 Specialty TCD Bid Items

2.8.1 Overheight Vehicle Warning System (OVWS)

The OVWS is a warning system used to alert over-height vehicles of an upcoming restricted vertical clearance. The device relies on microwave and infrared technologies to signal a vehicle whose physical height exceeds that of the posted height restriction. The OVWS provides both an audible and visual warning. The PCMS displays instructions as to an alternate route around the restriction.

The OVWS are most effective on high-volume facilities with a significant percentage of truck traffic. Interstate freight routes are prime facilities.

Typically, the request to use this device comes from members of the Project Development Team who are familiar with the construction limitations and the available roadway facilities around the project site. Use OVWS from the ***QPL***.

2.8.2 Protective Netting

Protective netting refers to the material used to protect traffic passing below a bridge under construction. When construction occurs over travel lanes, or when there is the danger of construction equipment, tools, material, or debris falling onto pedestrians or traffic, use protective netting.

Protective netting may also be called for on projects where an overhead work area crosses an active stream, creek, river or other body of water.

Construction activities using protective netting may include:

- Overpass construction (e.g. deck preparation, rail work, protective fencing, painting, etc.).
- Sign bridge construction.
- Bridge falsework.
- Bridge maintenance.
- Tunnel repair/construction.

Contact the ODOT Bridge Section to determine design details, measurement/payment, and necessary specifications for protective netting.

2.8.3 Falsework Illumination

Falsework Illumination refers to a temporary lighting system attached to the falsework of a structure under construction, where the falsework is located adjacent to live travel lanes and/or extends over the travel lanes. Falsework Illumination typically consists of a long string of amber-yellow lights framing the falsework portal that traffic passes through. Falsework

Illumination is paid for as part of the "Temporary Protection & Direction of Traffic" (TP&DT) lump sum pay item.

2.8.4 Pole Base Covers

Pole base covers protect pedestrians from open footing excavations created as part of the installation of a utility pole. Pole base covers are typically comprised of utility grade plywood sheeting.

Pole Base Covers are paid for as part of the "Temporary Protection & Direction of Traffic" (TP&DT) lump sum pay item.

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.

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* 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**

- 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 *Section 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.

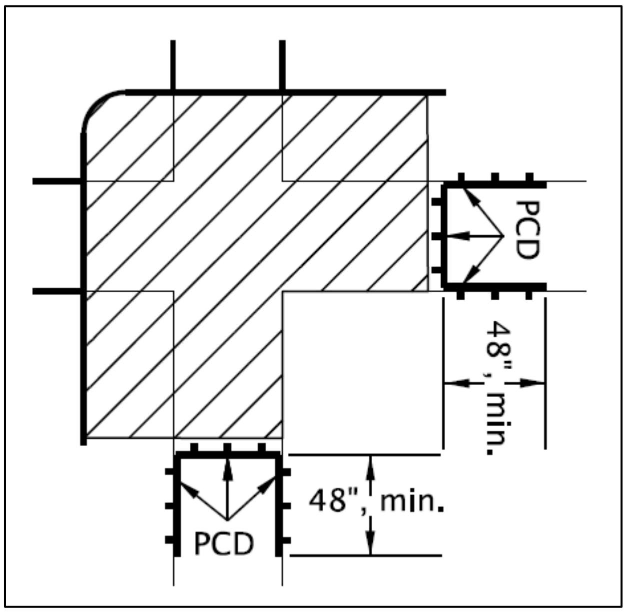


Figure 3-4: PCD Closure Detail

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.

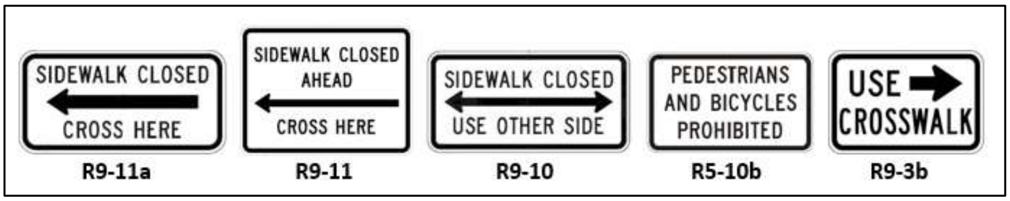


Figure 3-7: Examples of TPAR Regulatory Signs

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.

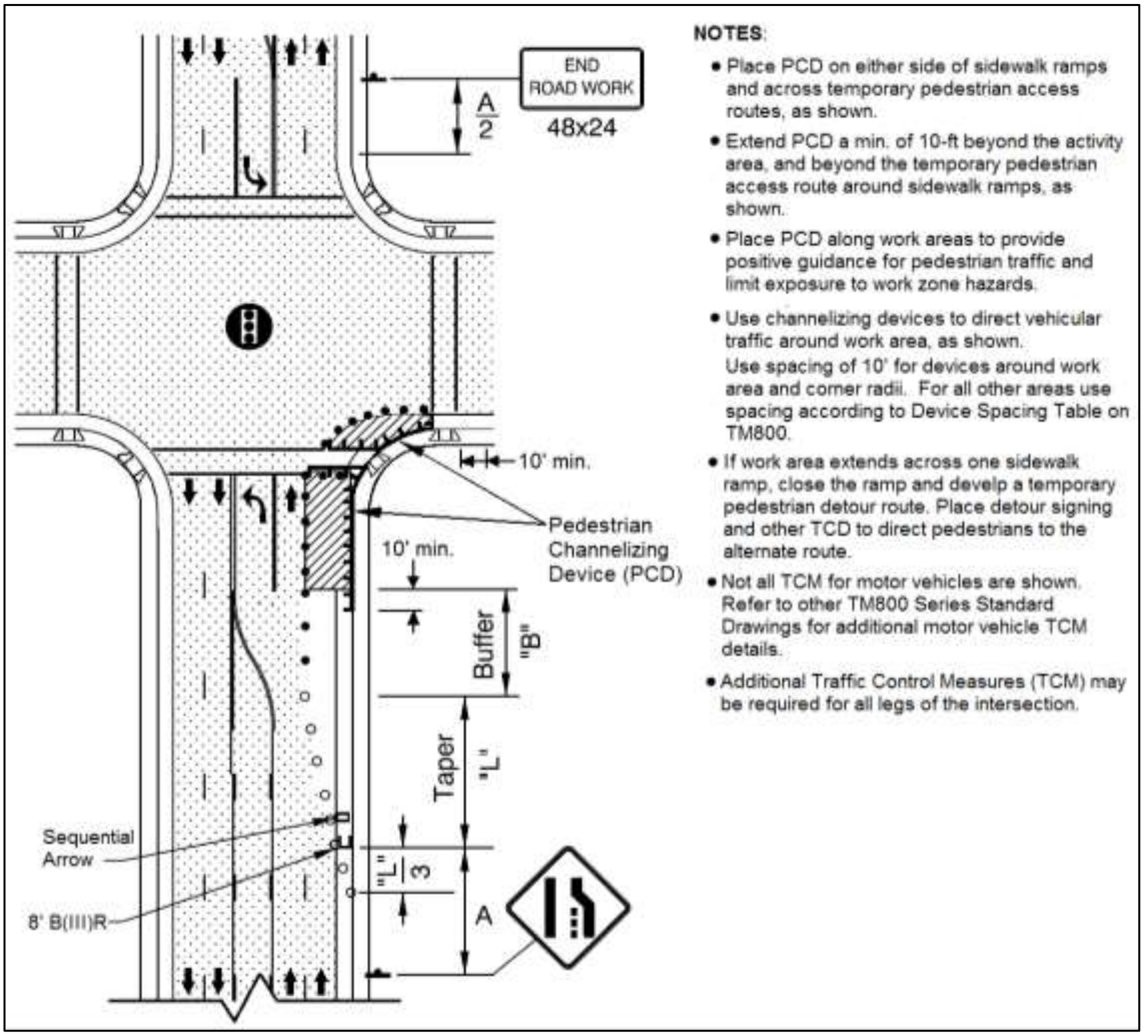


Figure 3-10: TPAR at Existing Signalized, Marked Crosswalk

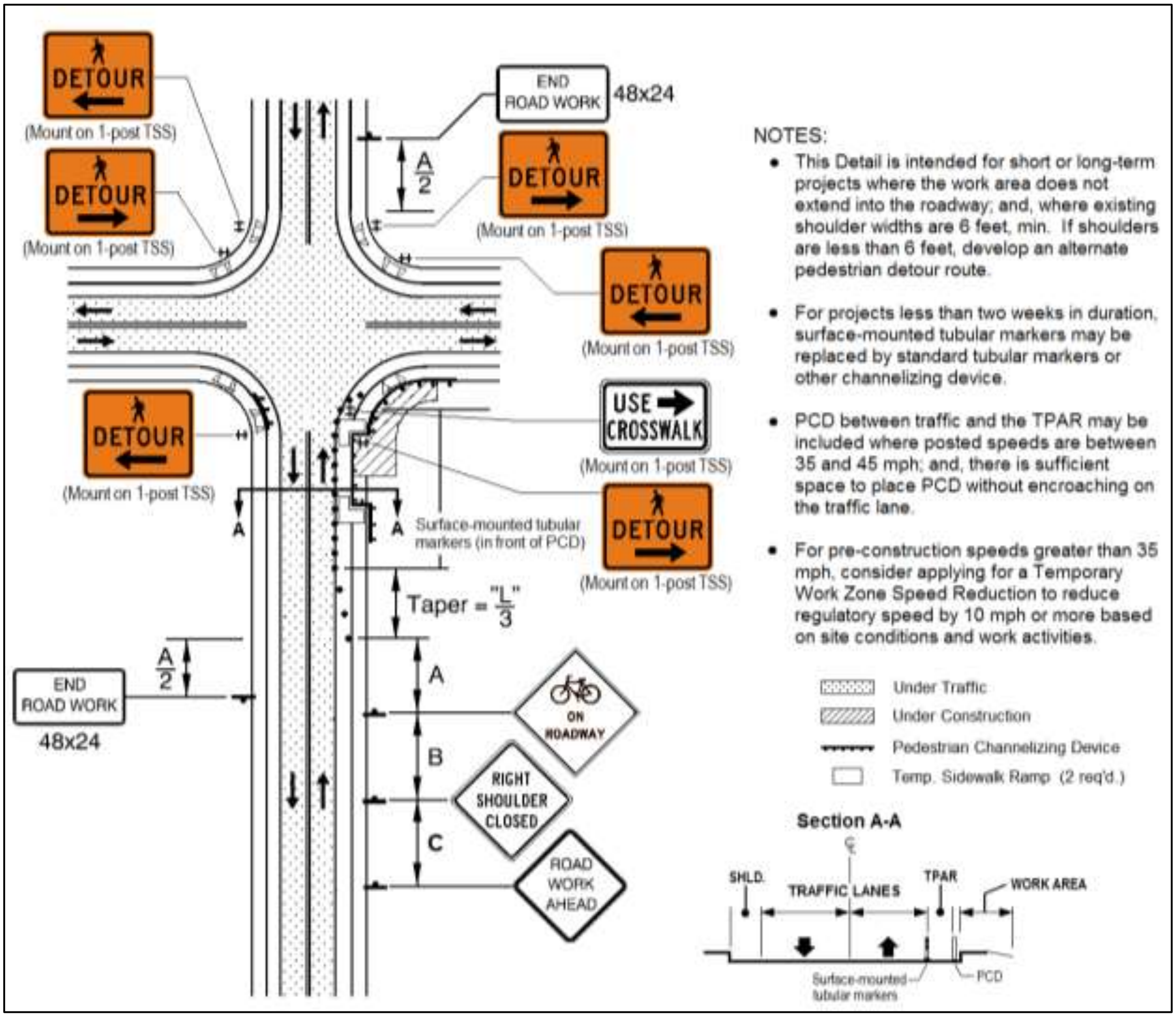


Figure 3-11: TPAR On-Site Diversion onto Shoulder or Bicycle Lane

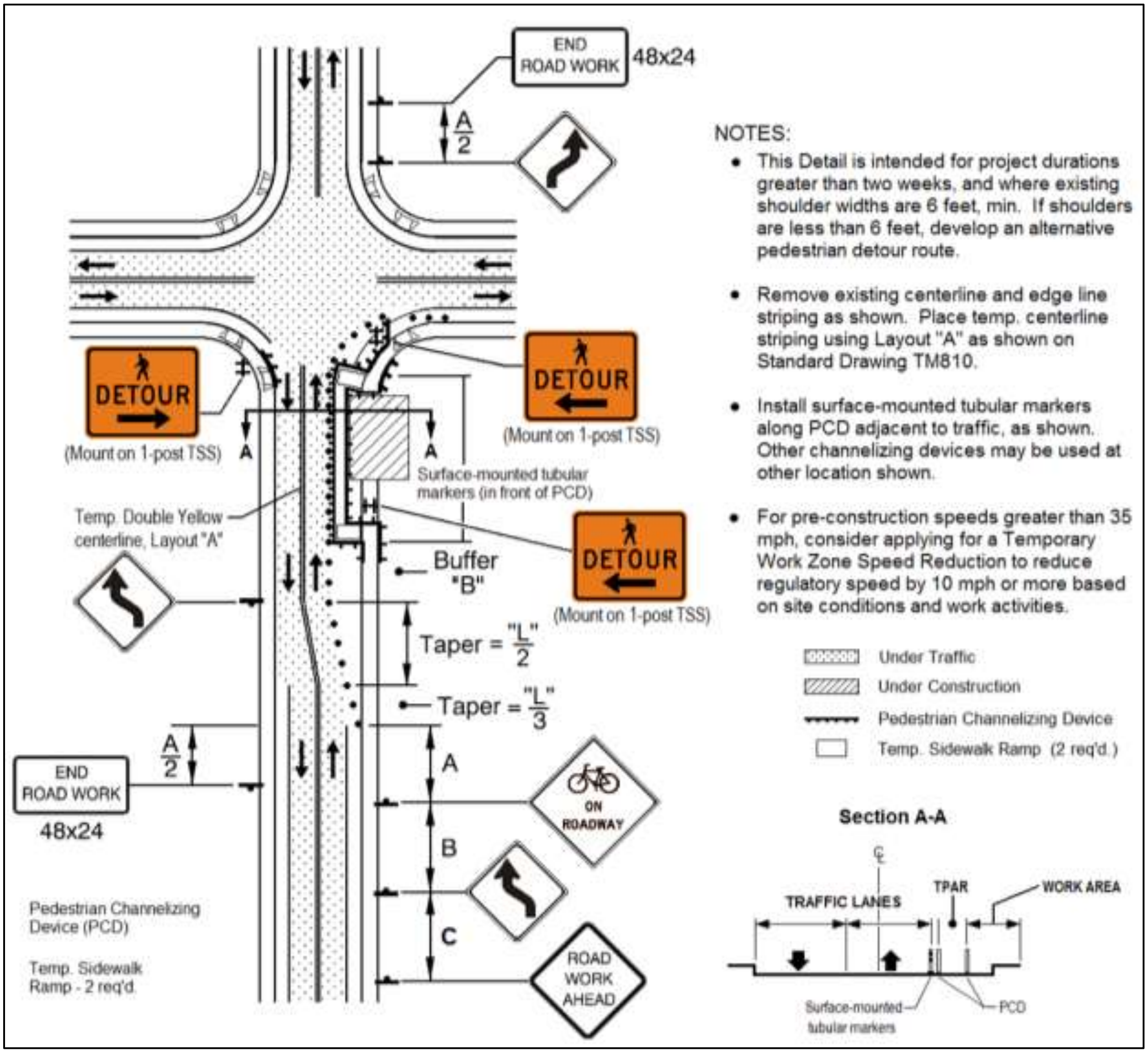


Figure 3-12: TPAR – On-Site Diversion with Partial Traffic Lane Encroachment

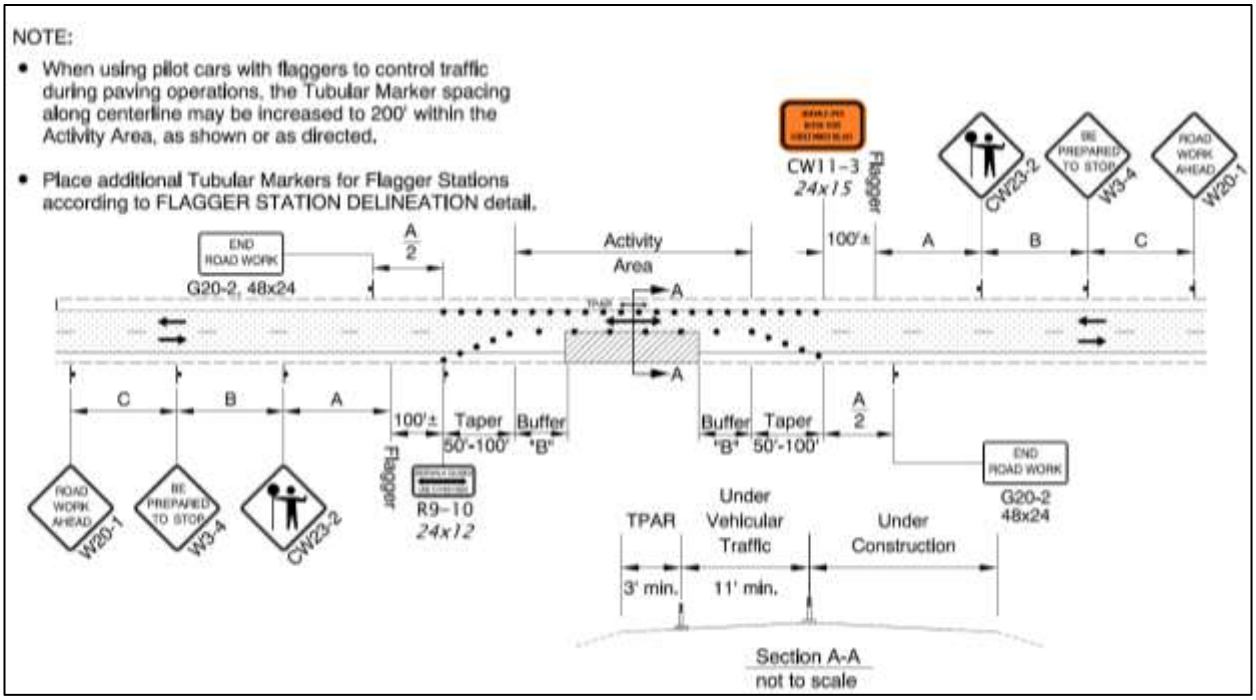


Figure 3-13: TPAR – 2-Lane, 2-Way Roadway – One Lane Closure

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.

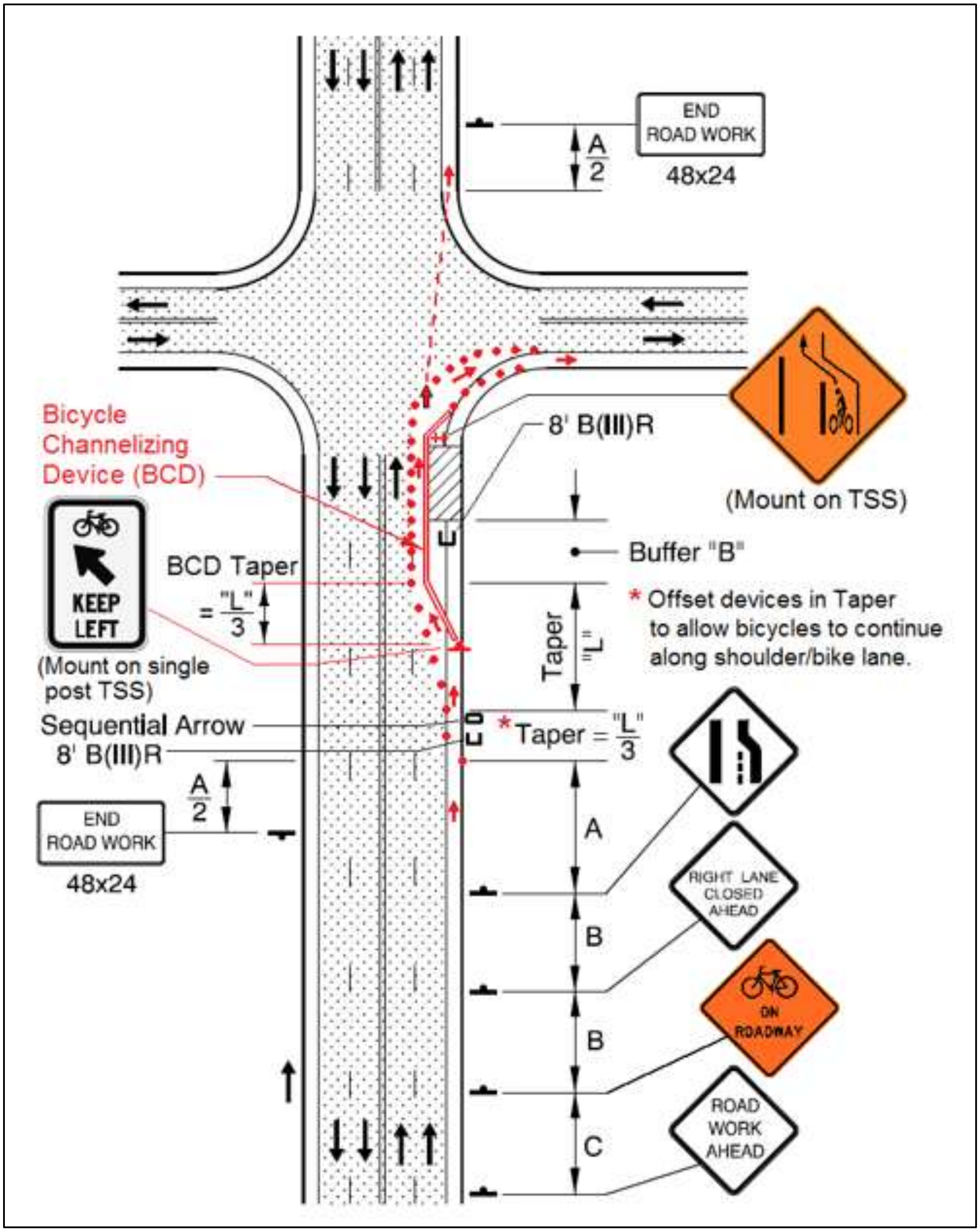


Figure 3-18: Suggested BCD Usage

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).

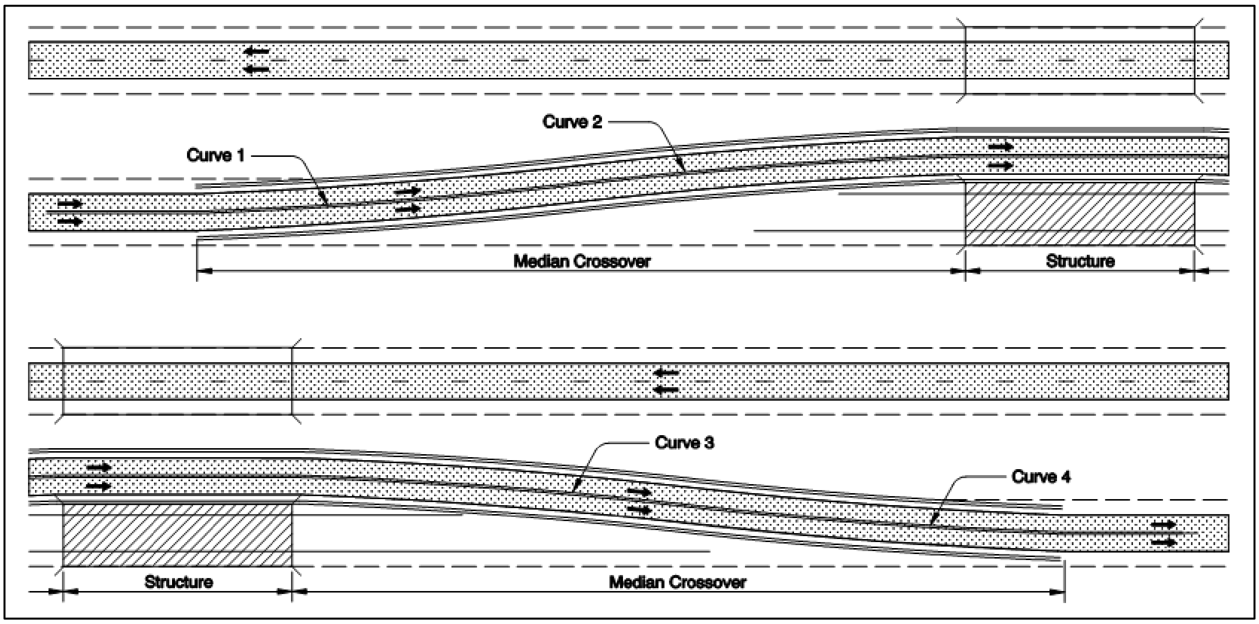


Figure 3-19: Temporary Alignment for On-Site Diversion

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).

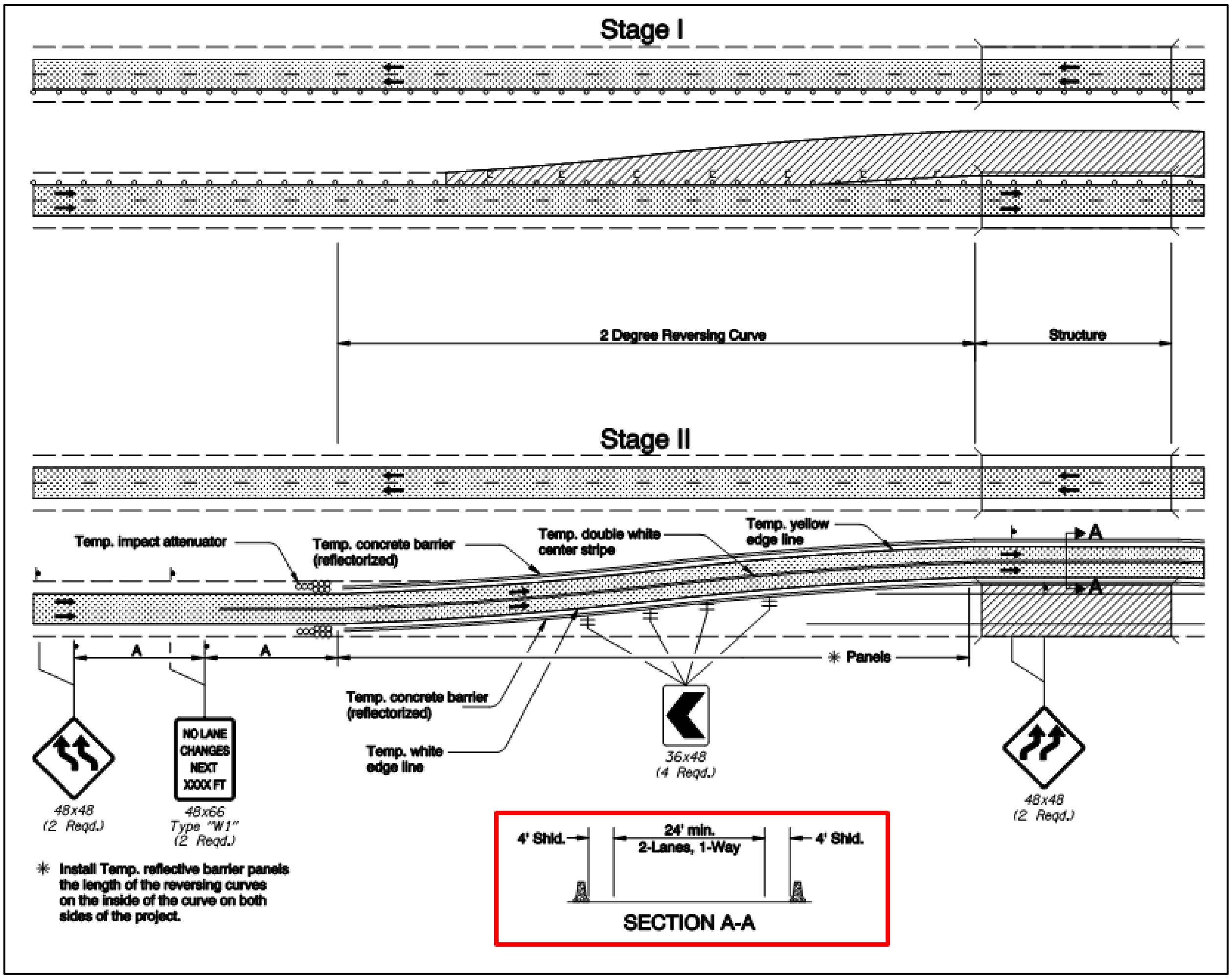


Figure 3-20: TCP Staging of On-Site Diversion

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

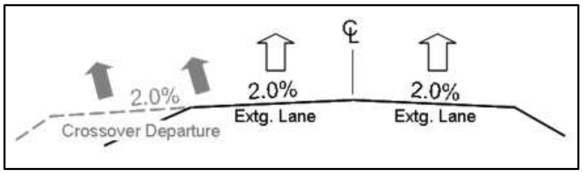


Figure 3-21: Example 1

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

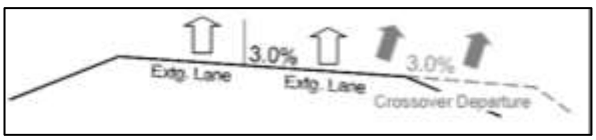


Figure 3-22: Example 2

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

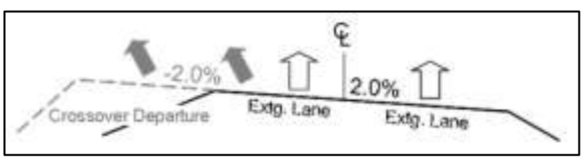


Figure 3-23: Example 3

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

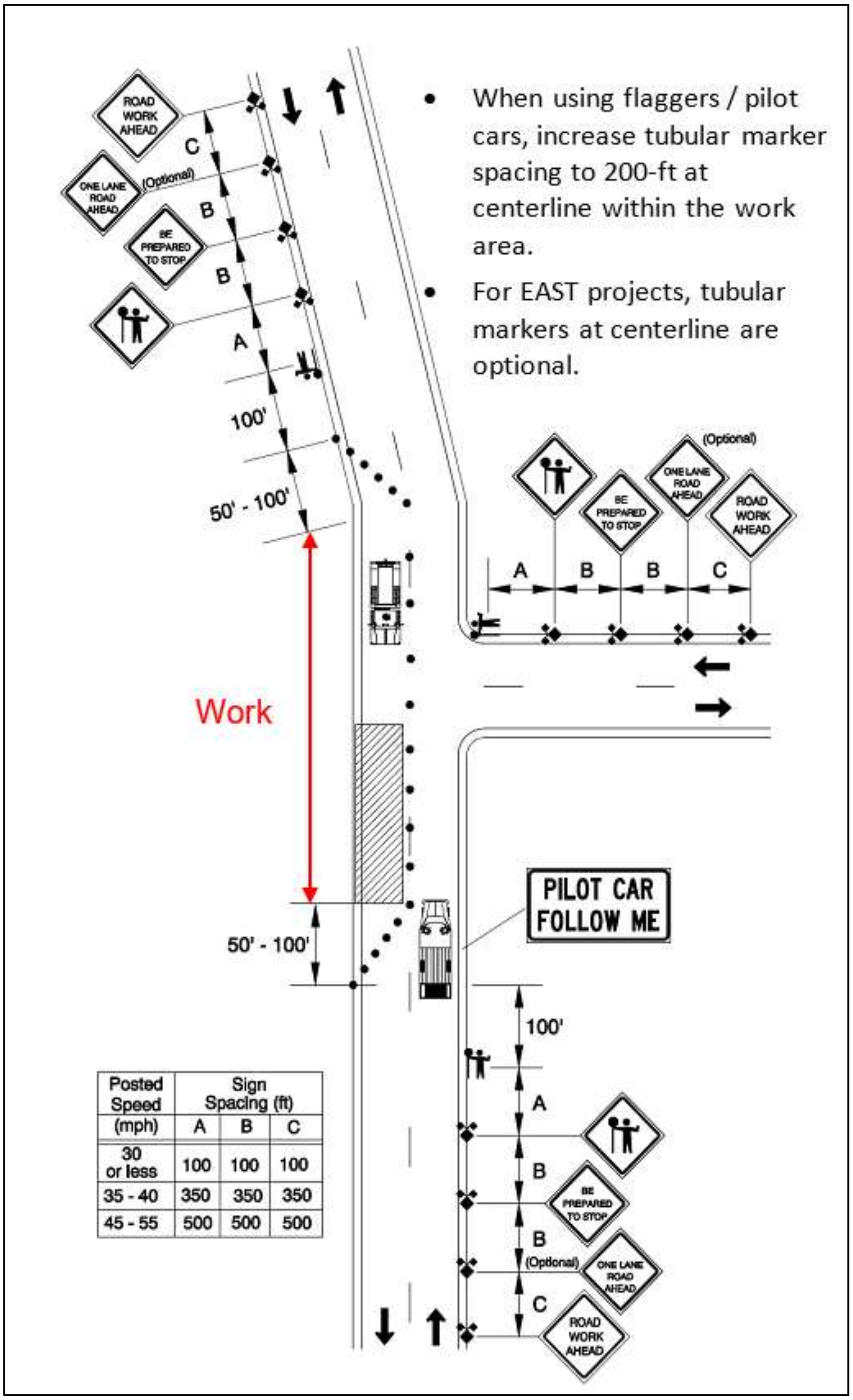
The WAIT FOR PILOT CAR (CR4-20) sign was developed to be used on very low-volume, dead end side roads within an active work zone to replace the need for a Flagger. In addition to low volumes (< 100 ADT), the side road must meet the following additional criteria:

- 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).

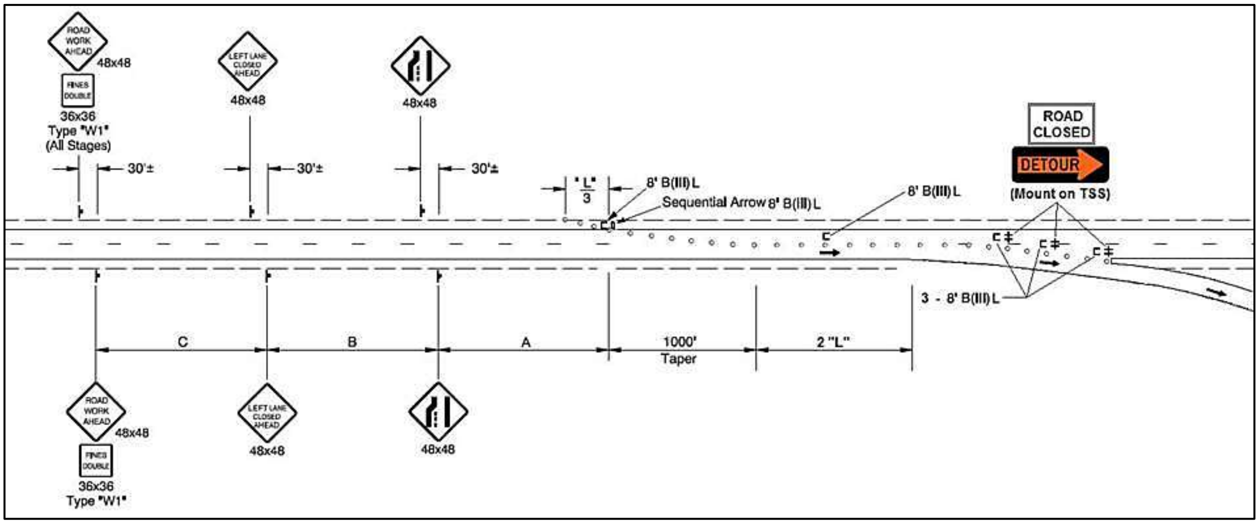


Figure 3-28: Freeway Closure

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

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

$D_{blockade\ min}$ = 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.

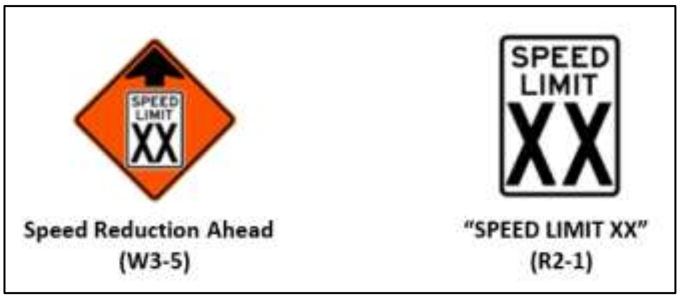


Figure 3-29: Speed Reduction Signs

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.

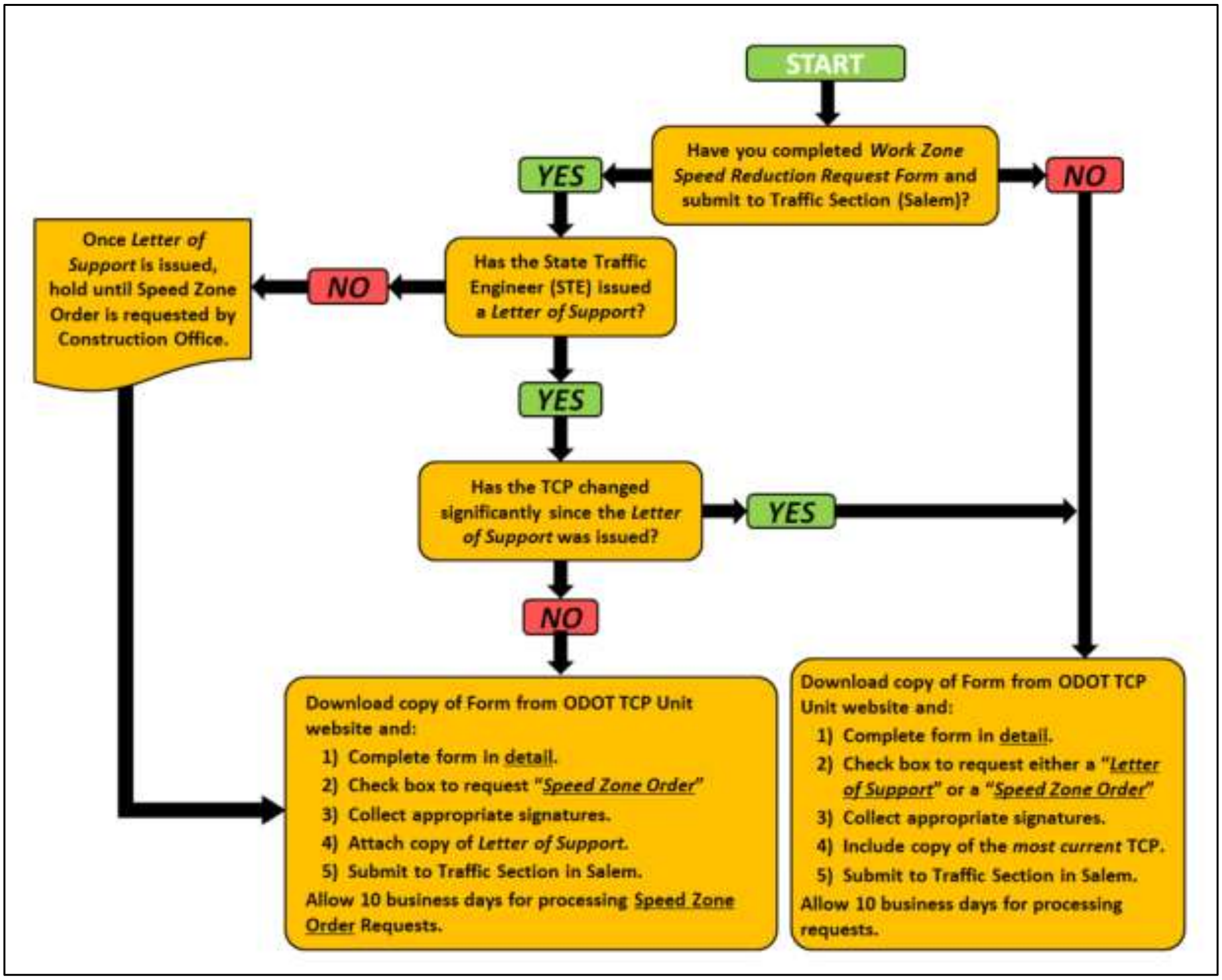


Figure 3-30: Work Zone Speed Reduction Process

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."; or
        - "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

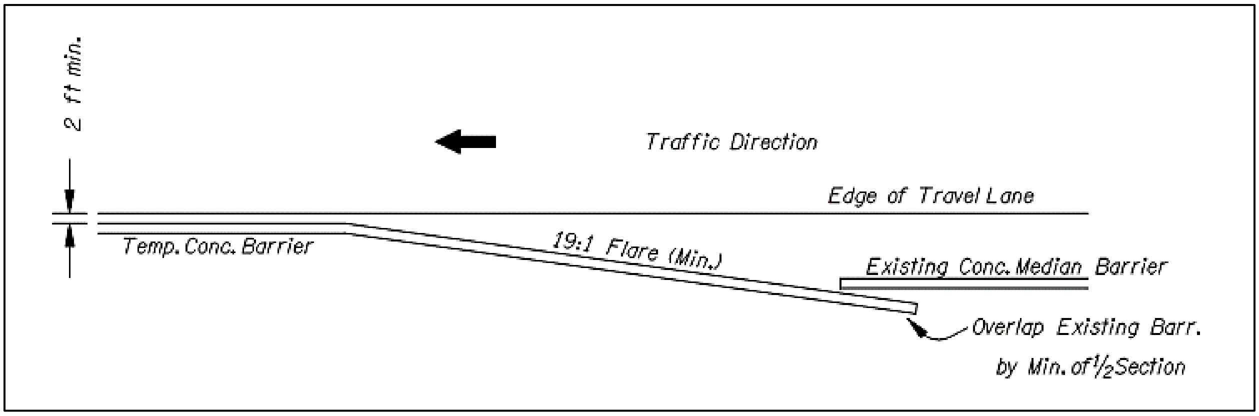


Figure 3-35: Typical Overlap of Temporary Concrete Barrier

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.

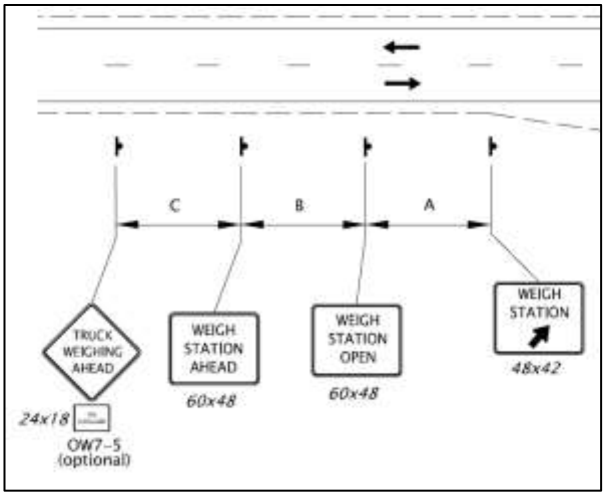


Figure 3-36: Advance Signing for Enforcement Areas

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.

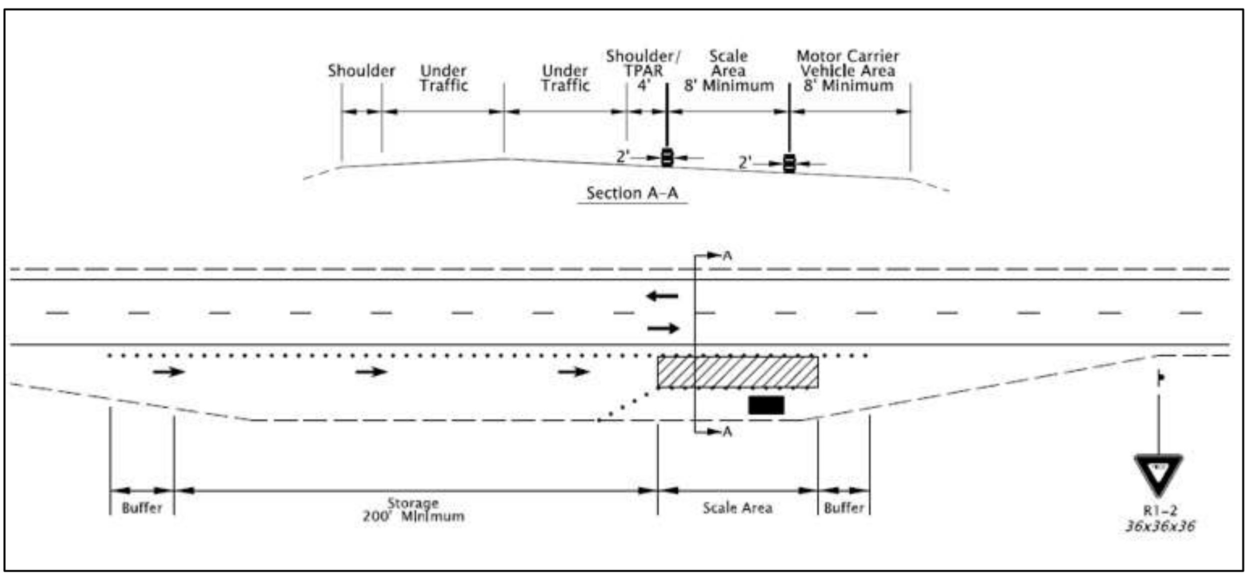


Figure 3-37: Temporary Weigh Stations and Chain up Areas Layout

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*.

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[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.

Chapter 4: Specifications & Standard Drawings

4.1 Key Topics Covered in this Chapter

- Purpose of Specifications and Standard Drawings.
- Structure and Components of Specifications and Standard Drawings.
- Information on Selected Specifications and Standards Drawings.

4.2 Standard Specifications

Highway construction specifications are a standard set of instructions, procedures and requirements directed at contractors and used to execute and manage a legal binding construction contract. The Specifications include descriptions for the scope of work, types of materials, equipment requirements, construction methods; and, measurement and payment methods for each work-related pay item.

4.2.1 General Overview

The ***Oregon Standard Specifications for Construction*** are applicable to all highway construction projects within the State of Oregon. The 2021 edition of the ***Oregon Standard Specifications for Construction*** has been published, distributed, and is in effect for all projects with a bid let date after December 1, 2020.

The 2018 Standard Specifications book is still available and is still valid for current construction projects that bid before December 1, 2020.

Visit the ODOT Specifications Unit website for current information on the 2018 and 2021 Standard Specifications.

Structure and Components - Division Format

The Standard Specifications are divided into 13 Parts according to function – e.g. Roadwork, Bridges, and Water Supply Systems. Each Part is divided into Sections and Subsections. Sections are divided into ten different Subsections. Sections include only those Subsections applicable to the subject matter within the Section.

The Standard Specifications applicable to Temporary Traffic Control Plans are found in Part 00200 through 00229 as follows:

- 00220 – Accommodation for Public Traffic
- 00221 – Common Provisions for Work Zone Traffic Control
- 00222 – Temporary Traffic Control Signs
- 00223 – Work Zone Traffic Control Labor and Vehicles
- 00224 – Temporary Traffic Channelizing Devices
- 00225 – Temporary Work Zone Traffic Control
- 00226 – Temporary Roadside Barriers and Impact Attenuators
- 00227 – Temporary Traffic Signals and Illumination
- 00228 – Temporary Pedestrians and Bicyclist Routing
- 00229 – Smart Work Zone Systems

The following table describes the ten different Subsections within each Section. Names and descriptions of the Subsection names remain consistent throughout the Standard Specifications, and Special Provisions. Subsections are identified as follows:

Table 4-1: Specification and Special Provisions Subsections

Subsection Name	Number	Description
Description	.01 – .09	Includes the intended function (Scope) of the Subsection, Definitions, and other General Requirements
Material	.10 – .19	Provides details for materials used on the project site – type, sources, physical properties, functions, etc.
Equipment	.20 – .29	Details for equipment, labor or additional items needed to accomplish the work
Labor	.30 – .39	Unique labor or qualification requirements
Construction	.40 – .49	Sequence of construction operations, needed processes, pay item project site limitations, and end product requirements
Temporary	.50 – .59	Unique temporary measures needed to accomplish the work. Not meant to supplement work zone traffic control measures
Maintenance	.60 – .69	Any required maintenance, repair or avoidance measures
Finishing & Cleaning Up	.70 – .79	Other related work required before the overall work and completion of the project is accepted
Measurement	.80 – .89	Units of measure and means by which pay items and work are calculated, totaled and recorded for payment
Payment	.90 – .99	Details, limitations, exclusions regarding payment for work or individual pay items based on the units of measure from the Measurement subsection

4.2.2 Standard Specifications – Section 00220

00220.00 – Accommodation for Public Traffic

Focuses primarily on instructions and requirements for contractors to maintain facilities for all road users for the life of the project. TCP Designers should be familiar with this Section – paying particular attention to the following subsections:

00220.02 – Public Safety and Mobility

"*Allow emergency vehicles immediate passage at all times*" – The TCP should consider and include measures and mitigations available to the Contractor for allowing for the passage of emergency vehicles at all times. The "at all times" clause may be accomplished, for example, through the use of a detour. However, Designers should work with Emergency Response and law enforcement agencies to ensure the detour route is viable, and does not compromise adequate response time or preclude access to sites cut off by the detour.

"*Do not stop or hold vehicles…for more than 20 minutes*" – TCP and traffic control measures should avoid conditions where the contractor could create delays to stopped traffic for periods greater than 20 minutes. Despite current Mobility policies, during specific work operations (e.g. flagging two-way one-lane traffic), this allowance is still given to contractors. In rare cases, to more-aggressively limit traffic delays, the 20-minute duration has been reduced to as little as 10 minutes. Modification to this Standard Specification language should be carefully considered and discussed with region traffic engineers, the resident engineer and the Traffic Control Plans engineer.

"Do not block driveways for more than two hours…" – In developing TCP staging plans, Designers should anticipate potential disruptions of traffic flow across "driveways" due to construction activities – particularly business accesses. If necessary, additional measures may be needed (e.g. "Business Access" unique spec) to mitigate the affected accesses; or, changes to the TCP may be needed to minimize adverse impacts to the accesses.

"Do not perform work that restricts…both sides of the travelled way at the same time" – The intent of this language is to allow vehicles travelling in one direction along a roadway segment to have the ability to exit the roadway in at least one direction (e.g. left or right). In addition, it provides drivers with an "escape route" in one direction – away from the work area – in the case of sudden traffic incident. In rare cases, there may be exceptions to this language. For example, if work is taking place on a one-lane elevated roadway or bridge where the work type might require activity to be done on both sides simultaneously (e.g. painting).

"Do not use steel plating…greater than 35 mph" – Carefully consider construction staging that may result in the need to use steel plating on a high-speed road ($\geq$ 45 mph). If unavoidable, Designers should explore what other options or strategies could be used to avoid steel plating:

- Can the hazard be placed behind or protected with concrete barrier?
- Could traffic be detoured?
- Could the work be accelerated or incentivized to be completed in a single shift?
- Could flagging be used to control traffic speeds over the plating?

Ultimately, public traffic should not be left to control their speed under this situation.

00220.03 – Work Zone Notifications

"Over-Dimensional Vehicle Restrictions" – If, during the development of the TCP, there is concern over impacts, or over any restrictions to over-dimensional vehicles (including within a detour), TCP Designers should discuss the specific TCP details with ODOT's Commerce and Compliance Division (CCD). Times and dates for these impacts are difficult to determine during project development, however, notifying CCD *early*, and updating them *often*, allows CCD more time to communicate with the trucking industry and make adjustments to their schedules.

"Notify the CCD…at least 35 calendar days before…" – Primarily a specification intended for contractors. But, TCP Designers can use this language to refine staging plans – particularly with on-going conversations with construction resident engineers to assist with reasonable construction schedules and other factors that may influence the TCP.

Closures – Lanes, Roads, Interchange Ramps, and Bicycle and Pedestrian Facilities – Intended for contractors, Designers can refer to this language to more closely examine the staging plans and TCP for details and measures the contractor will need to mitigate any of the closures applicable under this subsection.

00220.40(e) – Lane Restrictions

"…Keep all traffic lanes and pedestrian facilities open during: a. Holidays" – Intended to direct the contractor to not close the lanes when heavy traffic and congestions is anticipated during the following holidays:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

4.2.3 Standard Specification – Sections 00221 through 00229

Section 00221 – Common Provisions for Work Zone Traffic Control

Focuses on providing temporary traffic control measures and furnishing, installing, moving operating, maintaining, inspecting and removing traffic control devices throughout the project area. Designers should be familiar with this subsection, paying particular attention to the following subsections:

00221.03 – Traffic Safety and Operations

"Do not use an open Traffic Lane on a freeway or multi-lane facility as an acceleration or deceleration lane for construction vehicles" – Designers should review their staging plan and determine if this situation can be avoided. If not, Designers should be looking for alternatives including temporary accesses, or allowable lane closure times for contractor vehicle acceleration/deceleration.

"Do not use a flagger to allow construction vehicles to access an open traffic lane on a freeway or a multilane facility" – ODOT does not encourage or support the placement of a Flagger on a freeway or multi-lane facility acting in this capacity. During operations where multiple material delivery trucks are tasked with decelerating enough to safely enter into a closed lane to deliver construction materials (aggregate, asphalt, etc.), former practice would place a Flagger upstream of the access point to slow approaching traffic. Past experiences identified a number of issues:

- Flagger locations were far enough upstream that inbound traffic speeds were at or above the posted speed. When displayed, interpretation of the Flagger's "SLOW" paddle message by approaching traffic widely varied. Dramatic speed differentials resulted in an increase of near-misses and likely rear-end crashes.
- Placing the Flagger in a location that may not meet driver expectancy, and is usually of limited visibility (especially for nighttime operations), seemed to endanger the safety for the Flagger.
- Other effective mitigations have been developed and employed since this practice has been discontinued:
    - "CONSTRUCTION VEHICLE DO NOT FOLLOW" (CW23-14) signs on the back of each material hauling vehicle.
    - Temporary Speed Zone Reductions reducing the legal posted speed prior to the work area.
    - Speed Radar Trailers to reinforce the reduced posted speed.
    - Increased spacing between temporary channelizing devices (from 40' to 80') to allow material delivery vehicles to navigate into the closed lane at slightly higher speeds.

"When paving operations create an abrupt edge…" – TCP Designers can use this language to identify and determine the Standard Drawings, the TCD (e.g. temporary signing), and TCD quantities needed for the TCP.

"…When extended traffic queues develop…" – TCP Designers should work closely with the traffic analyst to determine the effectiveness of the staging plan and traffic control measure(s) proposed for the TCP – paying particular attention to analysis results for potential traffic queuing.

If regular queuing can be anticipated, Designers should include a reasonable quantity of Flagger Hours based on the duration of the flagging operations and the amount of time during the shift (or 24-hour day) where extended queues will occur and need to be mitigated.

TCP Designers should be very familiar with the traffic control measures and devices described in the following subsections. For consistency in safety, application, inspection, measurement and payment of these devices, agencies should refer to and enforce the language in these subsections (00220 through 00229) when using these devices in their work zones.

00221.60 – Temporary Traffic Control Devices

"Evaluate the condition of TCD using the…ATSSA…'Quality Guidelines for Work Zone Traffic Control Devices'" – Designers should familiarize themselves with this handbook as it provides a field-level guide regarding agency expectations for device quality, maintenance and replacement during a construction project.

Section 00222 – Temporary Signs

Includes important information regarding signs, supports and other accessories. Designers should also be aware of the cross reference to ***Sections 00940 (Signs)*** and ***02910 (Sign Materials)*** as they contain valuable information regarding temporary sign design and fabrication that is frequently referred to in a TCP.

"Ensure that all temporary signs are properly used and consistent with the work zone" – This attempts to get contractors to obscure temporary signs that are not applicable to the current work zone conditions, or otherwise provide erroneous information to public traffic. TCP Designers should be familiar with their staging plan and the need for all temporary signs in each Stage of the project.

Designers may consider identifying specific signs in the TCP that should be covered or removed during a given Stage when the sign is not needed. This gives the agency more power to enforce this Section and makes the need/inappropriateness of the sign clearer.

If a temporary sign is needed for only one Stage of the project, ensure all other plan sheets do not display that sign. Contractually, contractors are paid for signs "shown in the plans". If a sign is repeated on a subsequent Stage, yet not actually needed during that Stage, contractors may still claim payment for the sign, as they may have bid the project in that manner. If a sign is needed for the duration of the project, under the first incident of the sign in the plans, "(All Stages)" may be included as a note beneath the sign. On subsequent plan sheets, only a *reference* back to the initial sign is used (see Figure 4-1).

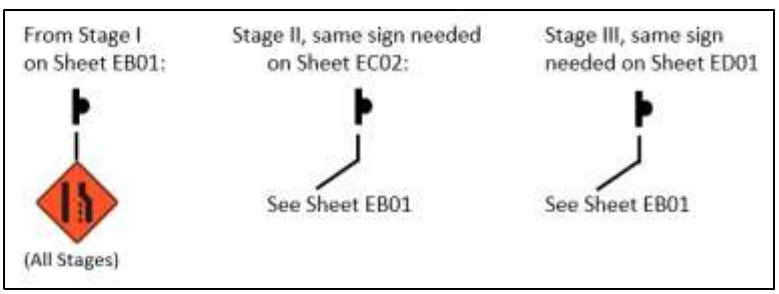


Figure 4-1: Sign Reference Example

Section 00223 – Work Zone Traffic Control Labor and Vehicles

This section includes providing flaggers, traffic control supervisors (TCS), and furnishing, operating and maintaining associated traffic control devices such as pilot cars, AFADs, flagger station lighting …etc.

The TCS included in this section is a challenging TCP pay item due to its intended application and the development of pay item quantities for it. TCS duties are listed in this Section. Expectations for how and when a TCS is to report to the job site during non-working on-call hours is also explained.

Consider the role of the TCS as that of the temporary traffic control "quarterback" – whose key responsibilities are centered on actions beginning as, "Notify…", "oversee…", "coordinate…", "review…", "inspect…", "prepare…", "provide…", "attend…", etc. The TCS can be considered the TCP supervisor for the project – but often hired by the prime contractor and included in the TCP as a pay item.

If the TCS pay item quantity is *zero*, Special Provision language is added to the contract to identify a modified list of traffic control oversight "duties" the contractor is responsible for replaces the list identified under Section 00223.31 in the Standard Specifications. The modified list of duties is paid for under the Temporary Protection and Direction of Traffic (TP&DT) pay item identified in Section 00221.90(b).

00223.41 – Flagger Station Lighting

For projects that include nighttime flagging, include an appropriate number of Flagger Station Lights in the TCP. Remember to include additional units if flagging is anticipated for extended queuing.

Section 00228 – Temporary Pedestrian and Bicyclist Routing

This section consists of furnishing, installing, maintaining, and removing temporary devices for accommodating pedestrians and bicycles through the work zone.

00228.10 – Pedestrian Channelizing Devices (PCD)

The PCD is used to separate, guide and protect pedestrians through or around work areas that have disrupted existing pedestrian facilities. In cooperation with ***Section 00221***, PCD from the ***ODOT Qualified Product List*** are ADA-compatible and, when used properly, provide safe channelization for all pedestrians – particularly visually-impaired pedestrians and those requiring wheelchairs for mobility. Designers should include PCD quantities for projects where existing pedestrian facilities have been altered or disturbed by construction activities and a temporary alternate facility or route is necessary. See **Chapter 3** for additional details regarding PCD application.

4.3 Special Provisions

Special Provisions commonly referred to as, "Boilerplates", and labelled as such on the ODOT Specifications Unit website. Special Provisions supplement the Standard Specifications, and serve to correct, add language to, or delete language from them. The "Boilerplate" Special Provisions also include more project-specific instructions and requirements that are used regularly in a project – but not on *every* project.

All ODOT highway construction projects require special provisions.

As the ***Standard Specifications for Construction*** book is updated, much of the corrective language in the boilerplates is incorporated into the new edition. The project-specific and conditional Special Provision language remains in the boilerplates.

Special Provisions can be found on the ODOT Specifications Unit website, under the Highway Section, Engineering Services pages.

The Specifications Unit website also includes a link to the, ***Specification and Writing Style Manual***. This manual is critical in understanding the proper writing techniques used in writing specifications for ODOT highway construction contracts. Three key principles to remember in writing specifications for ODOT construction contracts are:

- Write specifications as instructions to the contractor.
- It is implied instructions are to the contractor. Thus, "…the contractor…" can be omitted from most specifications.
- Write using the imperative mood, whenever practical.

The following provides an example of the imperative mood and preferred writing style. Instead of:

The contractor shall install temporary markers 10' feet apart along both sides of driveways within the work area.

The specification would use the imperative mood, remove "the contractor" as the subject, and be written as:

Install temporary markers 10' apart both sides of driveways within the work area.

4.3.1 Specification and Special Provision Writing

Before adding, deleting, or otherwise modifying Standard Specifications or Special Provisions, Designers should know the current requirements for making these edits. From the ODOT Specifications Unit website, see the Specification Manual. In general, if project-specific changes are made to Special Provision "Boilerplates" for ***Sections 00220*** through ***00229***, they should be forwarded electronically to the state work zone traffic engineer in Salem, for concurrence.

In addition, if changes are made to the Measurements (***00220.80s, 00221.80s, 00222.80s … and 0229.80s***) or Payments (***00220.90s, 00221.90s, 00222.90s… and 0229.90s***) subsections, these changes must also be sent to the state **s**pecifications engineer for concurrence.

Any edits to the ***00100 Section*** of the Standard Specifications regarding legal or contractual requirements must be reviewed by the ***Department of Justice (DOJ)***. The state specifications engineer will coordinate with DOJ the review of any changes.

When a change to a published Standard Specification or Special Provision is needed or proposed, the ODOT Specifications Unit asks that a Specification Change Request Form be completed and submitted to them for processing.

Project-Specific Special Provisions

TCP Designers typically only modify the Special Provision "Boilerplates" when developing the project-specific Special Provisions for the traffic control plan. The designer will edit the "Boilerplate" documents to meet the needs of their individual project.

In starting a new project, TCP Designers first need to download a current copy of the "boilerplates" for ***Sections 00220*** through ***00229*** from the Specifications Unit website.

Always download a new version of the Section 00220 through 00229 boilerplates before starting a new project. Special Provisions are updated and changed often. As a rule of thumb, if several (2-3) months lapse between the initial development of your project specifications and before the Special Provisions are to be sent out for final approval/concurrence, download a new version of the boilerplates to ensure no updates have been made that might conflict with other portions of the TCP.

While editing your project-specific Special Provisions, ensure "Track Changes" is ***on*** in Microsoft Word to record the changes made. In editing the Special Provisions, do the following:

- Delete portions that do not directly apply to the project – particularly to portions referring to pay items that have a *zero* quantity.
- Carefully read the, "Instructional Notes" in ***(parentheses and in colored, bold, italicized font)***. Follow applicable instructions, and then delete Instructional Notes before providing the final draft.
- Fill-in all blanks with the appropriate information

Before submitting the final hard copy version, Designers should "Accept All Changes in Document".

4.3.2 Section 00220 “Boilerplate” Special Provision

From the 2021 Section 00220 boilerplate, TCP Designers should note the following subsections:

Section 00220.02 – Public Safety and Mobility

The bullet that begins, “When performing trench excavation…”, complements the Standard Specification addressing the use of steel plating on roadways with a posted speed greater than 35 mph. This special provision language provides additional instructions and expectations to contractors in the case where the posted speed is over 35 mph. The measures included in the language can aid the TCP designer in developing their TCP – including considering necessary pay items, pay item quantities, and modifications to staging plans to potentially avoid the situation.

Section 00220.40(e) – Lane Restrictions

In most highway construction projects, traffic lanes may need to be closed for various lengths of time to complete the work. Within ODOT, conducting site-specific Work Zone Traffic Analysis (WZTA) will result in times and days when one or more traffic lanes can be closed. WZTA and the proper determination of when lanes can and cannot be closed is critical in preserving safety within the influence area of the work zone, managing congestion and worker exposure, minimizing travel delay; and, maintaining driver expectancy for a given facility type. WZTA can also be used to optimize construction costs and scheduling efficiencies through effective staging strategies.

Subsection ***00220.40(e-1) Closed Lanes***, if modified as a result of WZTA, will include project-specific times when the contractor may close one or more traffic lanes.

Work zone standards unit and state specification engineer MUST approve special provision 220.40(e) on ALL projects, including projects where no modifications are made.

Section 00220.40(f) – Limited Duration Road Closure

Used for a wide variety of road or facility closures, Designers may edit the language to use the subsection for interchange ramp closures, intersecting side streets, accesses, etc. In editing this subsection, Designers should include sufficient detail to clearly indicate the facility being closed, the allowable length of the closure, any additional TCM needed to safely conduct the closure, additional TCD needed to properly sign the detour, etc.

Sections 00220.41 through 00220.45

The subsections include additional language focusing specifically on Bridge Work. Designers can use this language to provide additional details in the TCP that will aid contractors in conducting the work safely, efficiently and cost-effectively. Useful language includes:

- Instructions to begin bridge work only after all equipment, labor and materials are on hand to complete work efficiently and quickly.
- References to the TCP – indicating the need for adequate TCD and signing for proper road closures and detours.
- Load restrictions for existing bridges under construction or being used for staging.

4.3.3 Sections 00221 through 00229 "Boilerplate" Special provision

A considerable amount of project-specific language in contained in these subsection that a TCP designer can use to generate TCP pay items and quantities. From the 2021 Sections 00221 through 00229 boilerplate, TCD Designers should note the following Subsections

Section 00222 – Temporary Traffic Control Signing

This section includes a several work zone conditions signing application to guide and warn motorist including:

- Standard project signs – e.g. "ROAD WORK NEXT XX MILES", "ROAD WORK AHEAD", "FINES DOUBLE", Project Identification signing, and "END ROAD WORK" signs.
- Horizontal and vertical clearance signs.
- Detour and Road Closure signing.
- Paving operations signing.

Section 00229 – Smart Work Zone Systems

This sections covers the designing, furnishing, installing, moving, operating, maintaining, inspecting, and removing temporary Smart Work Zone Systems including:

- Construction access systems.
- Queue detection systems.
- Traffic information systems.

4.4 Hierarchy of Documents

A wide variety of documents are used to assemble a TCP and develop a construction contract. Designers should make every effort to avoid contradictions and conflicts within those contract documents. The ***Oregon Standard Specifications for Construction*** lists a hierarchy for the documents included in a construction contract. This list is identified as the, "Order of Precedence" under ***Subsection 00150.10 (a)***. The hierarchy for the contract documents within your project is as following:

- Contract Change Orders;
- Special Provisions;
- Stamped Agency-prepared drawings specifically applicable to the Project and bearing the Project title;
- Reviewed and accepted, stamped Working Drawings;
- 3D Engineering Models and supplemental Agency-prepared line, grade and Cross Section data applicable to the Project;
- Standard Drawings;
- Approved unstamped Working Drawings and 3D Construction Models;
- Standard Specifications, and;
- All other Contract Documents not listed above.

Notes on a drawing take precedence over drawing details

4.5 Standard Drawings

General information, typical applications, and common layouts for temporary traffic control devices are shown in the ***ODOT Temporary Traffic Control Standard Drawings*** – currently under the TM800 Series. The TM800 series drawings show traffic control layouts for many common work zones, including 2-Lane, 2-Way Roadways, Freeway Sections, Bridge Constructions, and Signalized Intersections.

The Standard Drawings can be found on the ODOT website by using the following link sequence:

1. "Technical Services"
2. "Sections"
3. "Traffic-Roadway Section"
4. "Roadway Engineering"
5. "Visit the Standard Drawings Page"

Or, by searching the internet for, "***ODOT Standard Drawings***".

The drawings show general information and common practices. They can be used to convey, instruct, or provide layout information for a variety of common, non-site specific work zone activities.

Standard Drawings should *NOT* be used to:

- **Substitute for complex, multi-stage traffic control plans. Project-specific plan sheets should be developed for more elaborate staging plans.**
- **Create excerpts by cutting small details from the drawings and copied into other documents or portions of a TCP. Standard Drawings are an engineered product sealed by the TCP engineer. Changes or deviations from Standard Drawings should be developed as separate details within a TCP and sealed by the responsible engineer (e.g. "Engineer of Record").**

Designers should select the Standard Drawing(s) most applicable to project activities and that contain other details that will be needed at some time during the project.

Standard Drawings selected for the project must coincide with language included in the Special Provisions written for the project. Designers should also ensure that if Special Provisions refer to a specific detail on a Standard Drawing, the temporary traffic control measures and devices shown in that detail have an associated pay item quantity (unless otherwise addressed in the special provisions).

If a construction project is not complicated and does not require extensive construction staging, it may be possible to adequately convey construction information to the contractor using only the appropriate Standard Drawings, Standard Specifications and project-specific Special Provisions. Project-specific staging plan sheets may not be needed.

Each of the current TCP Standard Drawings has been organized to include similar details making it easier to locate specific information. The set of TCP drawings have been divided into subsets, with each subset being reserved for the following categories:

- TM800 – Standard TCP Details.
- TM810s – Category I Devices (*using FHWA Crashworthy designations*).
- TM820s – Category II Devices.
- TM830s – Category III Devices.
- TM840s – Urban settings (Speeds < 45 mph).
- TM850s – High-speed roadways (Speeds 45 mph or higher).
- TM860s – Freeways applications (Speeds 55 mph or higher).
- TM870s – Special applications.
- TM880 – Freeway speed control measures for paving operations.

A brief description of the contents and function for each Drawing is included below:

TM800 – Tables, Abrupt Edge, and PCMS Details

The tables on this drawing are referred to often on other TCP Standard Drawings. The most commonly used tables include:

- Concrete Barrier Flare Rate.
- Taper Rates & Buffer Lengths.
- Traffic Control Device Spacing Table.

This drawing also includes details for the application of:

- Abrupt Edge treatments and Signing.
- Portable Changeable Message Sign (PCMS) Installations.
- Flagger Station Lighting delineation.
- General Notes for All TCP Temporary Traffic Control drawings

TM810 – Temporary Reflective Pavement Markers

Includes details for a variety of patterns using temporary reflective pavement markers to either simulate or supplement other pavement markings.

TM820 – Temporary Barricades

Includes fabrication and notation details for Type I, II and III temporary barricades.

TM821 – Temporary Sign Supports

Includes a detail describing sign post reflective sheeting placement, as well as details for the construction of the Double Post TSS and Single Post TSS sign supports.

TM822 – Temporary Sign Supports

Includes a detail describing proper temporary sign placement, as well as details for the construction of the Concrete Barrier sign support.

TM830 – Temporary Concrete Barrier and Longitudinal Shoulder Rumble Strip Details

Includes details for pinning temporary concrete barrier to asphalt concrete (AC) and Portland cement concrete (PCC) pavement surfaces. Also includes a detail for the removal of existing longitudinal shoulder rumble strips.

TM831 – Temporary Impact Attenuators

Displays configurations for temporary (sand barrel array) impact attenuators based on the pre-construction posted (design) speed. Includes installation details for a standard installation as well as a “zero-offset” installation.

TM832 – Temporary Impact Attenuators

Displays configurations for temporary (sand barrel array) impact attenuators used to protect the blunt end of a double run of concrete barrier. Configurations are based on the pre-construction posted (design) speed.

TM833 – Temporary Impact Attenuators

Displays configurations for typical impact attenuator typical installations for drum arrays.

TM840 – Closure Details

Includes details for establishing a variety of closures including highway, street and sidewalk closures. Also includes a detail for the fabrication of a “trailblazer” detour sign cluster.

TM841 – Intersection Work Zone Details

Includes details for conducting a variety of lane closures under various work area locations and roadway configurations:

- 2-lane, 2-way streets for one-lane closures and shoulder closures.
- 4-lane, 2-way streets for right-side, near-side and far-side closures.
- 2-lane, 1-way streets for right-lane closures.

TM842 – Signalized Intersection Details

Includes details for establishing and protecting work areas in the vicinity of signalized intersections on two or three-lane roadways.

TM843 – Multi-lane Signalized Intersection Details

Includes details for establishing and protecting work areas in the vicinity of signalized intersections on four or five-lane roadways.

TM844 – Temporary Pedestrian Accessible Routing

Includes details for routing pedestrians through and around work areas.

TM845 – Temporary Sidewalk Ramps

Includes details for the construction of temporary sidewalk ramps in work areas.

TM850 – 2 Lane, 2-Way Roadways

Includes details for sign placement, lane closures and flagging operations on two-lane, two-way roadways.

TM851 – Non-Freeway Multi-lane Sections

Includes details for lane closures and establishing work zones on multi-lane, non-freeway roadways.

TM852 – Non-Freeway Multi-lane Sections

Includes additional details for lane closures, shifts and establishing work zones on multi-lane, non-freeway roadways.

TM853 – Non-Freeway Multi-lane Sections

Includes additional details for lane closures, shifts and establishing work zones on 3-lane, 2-way multi-lane, and non-freeway roadways.

TM854 – 2 Lane, 2-Way Roadways

Includes details for sign placement, lane closures and AFAD operations on two-lane, two-way roadways.

TM855 – 2 Lane, 2-Way Roadways

Includes details for sign placement, lane closures and operations on two-lane, two-way roadways where an AFAD cannot be utilized due to constraints.

TM860 – Freeway Sections

Includes details for conducting basic lane and partial ramp closures on a freeway section.

TM861 – Freeway Sections

Includes details for establishing a single-lane closure for pavement preservation work on a freeway section.

TM862 – Freeway Section

Includes details for establishing a two-lane closure for pavement preservation work on a multi-lane freeway section.

TM870 – Bridge Construction

Includes details for establishing a two-way, one-lane operation using either flaggers or a temporary traffic signal during the construction of a new bridge.

TM871 - Blasting Zones

Includes details for protecting traffic from a blasting zone on either two-lane or divided highways.

TM880 – Freeway or Divided Highway Speed Reduction (Paving Operations)

Includes details for speed reductions related to paving work on a freeway/divided highway.

Other Relevant Drawings

Other Standard Drawings that could be included in the contract based on the scope of work and contents of the TCP include:

- RD410 – Guardrail Parts (Thrie Beam).
- RD420 – Energy Absorbing Terminal.
- RD425 – Non Energy-Absorbing Terminal 3' or 4' Flare.
- RD503 – Precast Concrete Barrier Pin and Loop Assembly.
- RD510 – Concrete Barrier Terminal.
- RD530 – Guardrail Transition to Concrete Barrier.
- RD535 – Concrete Barrier (Modified) Around Median Obstacle.
- RD545 – Precast Tall (42") Concrete Barrier.
- RD560 – Cast-in-Place Tall Barrier Transition to Standard Concrete Barrier.
- BR233 – Thrie-Beam Rail and Transition.
- BR236 – Trailing End Bridge Connection Concrete Bridge Rail to Guardrail.
- TM204 – Flag Board Mounting Detail.
- TM211 – Signing Details US and Interstate Route Shields.
- TM212 – Signing Details Oregon Route Signs.
- TM570 – Traffic Delineators.
- TM575 – Traffic Delineator Installation for Freeways.
- TM576 – Traffic Delineator Installation for Non-Freeways.
- TM670 – Wood Post Sign Supports.
- TM671 – 3 Second Gust Wind Speed Map.
- TM677 – Sign Mounts.
- TM681, TM687, TM688 – Perforated Steel Square Tube Sign Support Installation and Foundation.

4.6 Standard Details

Standard Details may be used to provide additional information for a specific task, material or construction procedure not already described for the contractor in either the Special Provisions or on a Standard Drawing. Standard Details are intended to be copied into the Traffic Control Plan sheets at the beginning of the plan set (see the ODOT Contract Plans Manual for details). Standard Details may also, in some circumstances, be used to supplement Special Provision language and traffic control plan sheets.

In the Special Provisions, include the reference to the specific Standard Detail by calling out the traffic control plan sheet number where the detail has been inserted – e.g. "See Rumble Strip Detail on Sheet EA02." This helps ensure the contractor sees the Detail and uses it to complete the specific work activity.

A number of Traffic Control Plan Standard Details are available on the ODOT "Traffic Series Detail" link under the "DET4700 – 4799 – Temporary Traffic Control" website. The following are the Temporary Traffic Control Details:

- DET 4703 – Portable Traffic Signal
- DET 4710 – Temporary Transverse Rumble Strips.
- DET 4720 – Diversions and Cross Overs.
- DET 4730 – Single Lane Roundabout Flagging Operations.
- DET 4732 – Multilane Roundabout Partial Closure.
- DET 4734 – Multilane Roundabout Flagging Operations.
- DET 4740 – Rolling Slowdown Method.
- DET 4750 – 3 Lane 2-way Roadways.
- DET 4760 – Temporary Glare Screen.
- DET 4770 – Smart Work Zone System Dynamic Late-Lane Merge.
- DET 4772 – Work Zone Presence Lighting.
- DET 4773 – Mobile Barrier with Speed Reduction.
- DET 4774 – Mobile Barrier System.
- DET 4780 – Temporary Curb Ramps.
- DET 4781 – TPAR Table.
- DET 4782 – TPAR Sidewalk Closure, Two Corners per Intersection.
- DET 4783 – TPAR Sidewalk Diversion within Roadway Partial Corner Closure.
- DET 4784 – TPAR Sidewalk Diversion within Roadway Full Corner Closure.
- DET 4785 – TPAR Sidewalk Diversion with Additional Right of Way Partial Corner Closure.
- DET 4786 - TPAR Sidewalk Diversion with Additional Right of Way Full Corner Closure.
- DET 4787 – Temporary Midblock Crossing.

Chapter 5: Traffic Control Plans Design

5.1 Key Topics Covered in this Chapter

- Traffic Control Plans (TCP).
- Plan Sheet Function & Sequence.
- Plan Sheet Development.
- Typical Applications.
- Temporary Signs Design
- Drafting Standards.

5.2 Traffic Control Plans (TCP)

While this chapter is primarily written with the ODOT project development and plans production processes in mind, there is information in the following Sections that may be of value to members of other agencies responsible for the design and implementation of temporary traffic control plans.

A Traffic Control Plan (TCP) consists of written instructions, and often engineered drawings, that a contractor uses to construct a highway project, while guiding and protecting traffic passing through or around a work zone.

The primary function of a TCP is to provide for the safe and efficient movement of road users through or around work zones while protecting on-site workers, incident responders, and equipment, while providing for the efficient construction and maintenance of the highway. The needs and control of all road users (i.e. public traffic, bicyclists, and pedestrians) through a work zone are an essential part of highway construction.

Therefore, the four primary functions of a TCP are to provide:

1. Efficient Traffic Flow;
2. Enhanced Safety;
3. Minimized Inconvenience; and,
4. Adequate Mobility for All Road Users.

Planning for the TCP should be started as early in the Project Development process as possible – especially for larger, "significant" and more complex projects. Consider a variety of staging options for the TCP – including those options where separation between workers and public traffic can be maximized. Regularly communicate with Project Team members and utilize all available resources when optimizing the TCP – particularly resident engineer's staff to address constructability issues.

5.2.1 Traffic Control Plans Form

Traffic Control Plans can be separated into two distinct categories – A "Written" plan, or a TCP that incorporates project-specific Plan Sheets.

A designer should consider the following project characteristics in determining the type of traffic control plan to develop and what level of complexity should go into that plan.

"Written" TCP

A "Written" TCP includes, as a minimum, the current ***Standard Specifications for Construction***, the appropriate ***Standard Drawings***; and, the most current version of the ***Special Provision*** ("boilerplates" – downloaded from the Specifications Unit website. See **Chapter 4**).

In compiling and editing the ***Special Provision***, the designer will include only the appropriate language from the following sources:

- Special Provision "boilerplates"
- Any additional necessary references to other Special Provision sections
- Any necessary Unique Special Provision

A "Written" plan, by definition, does not include project-specific traffic control plan sheets. Examples of a "Written" TCP include pavement preservation projects or other projects with:

- Few stages
- No detours or temporary roadways
- A short list of Pay Items
- A shorter duration (< 6 months ±)
- Scope of work easily conveyed through Special Provisions and Standard Drawings

TCP with Plan Sheets

The second form of Traffic Control Plan includes project-specific *plan sheets* in addition to the information included in a "Written" TCP. The plan sheets are used as a graphical representation of the construction staging plan. The sheets provide additional information or instructions to the contractor showing how to break up (or "*stage*") the construction of the project while still providing safe, efficient passage for live traffic.

Traffic Control Plans with Plan Sheets are common for projects with:

- Multiple stages/phases.
- Detour routes and/or temporary roadways (e.g. on-site diversions).
- An extensive list of Pay Items with medium to large quantities.
- Medium to long durations (several months to years).
- Complex Scope *not* easily conveyed through Special Provision or Standard Drawings.

5.3 Plan Sheet Function & Sequence

TCP plan sheets are customized for each project based on the scope of work and the complexity of the project. If the project can be built without the need for involved stages, detours or other complexities, plan sheets may not be needed. Designers are responsible for determining if the development of project-specific plan sheets will help clarify the intentions of the TCP and construction staging sequence, however, construction office staff should be brought into this decision-making process. They may have a unique perspective on past experiences with a particular project type or the benefits associated with having additional details for a give activity.

Plan sheets are typically added when additional information would significantly aid in bidding on and building the project. Plan sheets are used when communicating detailed information solely through ***Standard Drawings*** and ***Special Provision*** language is inadequate.

TCP Designers are strongly encouraged to consider developing project-specific plan sheets for those situations that are obvious and for those that are less-obvious. Plans sheets for pedestrian accommodation portions of a project are particularly encouraged.

"Written" TCP

A "Written" TCP, as the name would imply, does not typically include plan sheets. A "written" TCP will include project-specific specification language and cross-reference ***Standard Drawings*** for the basic traffic control device layouts to be used for construction. Any additional project-specific details are typically included in the project special provisions and within the itemized cost estimate.

TCP with Plan Sheets

For more complex projects, plan sheets are necessary to develop a safe, efficient and comprehensive staging plan. The staging plan is valuable for showing one interpretation for the construction sequence and how the roadway is divided amongst road users and the construction work space. Several staging plans may be needed depending on types of work involved in the project.

Plan Sheets are needed when the following components are included as part of the project TCP:

- Detours.
- Staging – Where locations for traffic and the work area are shifted around within the project limits more than once over the life of the project.
- Bridge replacements using one or two-lane on-site diversions.
- Full-depth pavement reconstruction.
- Construction of temporary roadways to support live traffic.
- Modifying existing traffic flow patterns to accommodate temporary traffic flow (e.g. one-way street converted to a two-way street).

- Interchange modifications, upgrades or construction of new elements.
- Significant horizontal or vertical roadway alignment changes.
- Complex activities at intersections or other locations with multiple accesses or conflicts.
- Pedestrian/Bicycle Accommodation – Specific plan sheets should be used for the majority of pedestrian/bicycle accommodation.

When developing a TCP, Designers should evaluate the following key design elements:

- **Strengths and Opportunities** – Chances available to the designer to accelerate or simplify construction, to separate workers from public traffic; and, to minimize traffic delays. Taking advantage of the staging plan, local transportation services and infrastructure; and, other features of the existing project site and surrounding environment.
- **Weaknesses and Threats** – Significant hurdles – even "fatal flaws" – within the existing site or proposed project. Issues or constraints that will have a notable impact on the TCP design and constructability of the project. Site restrictions that might create additional challenges for the TCP designer, project team, construction management staff and contractor as the project is developed and eventually constructed.

Designers will be confronted by a broad range of factors and considerations as they develop their TCP. Understanding the scope of work and having multiple technical resources available will aid in developing a safe and effective TCP.

The following are some specific factors that can influence the development of a Traffic Control Plan:

- **Traffic Data** – Existing volumes, facility capacity, 85^{th} percentile speeds, truck percentages, crash history and problem areas within the project limits.
- **Roadway Characteristics** – Horizontal and vertical alignments, number of lanes, lane and shoulder widths, pavement types and condition, sight distances, surrounding terrain, and local environs (e.g. urban, rural, commercial, residential, etc.).
- **Traffic Control & Safety Appurtenances** – Signs, structures, traffic signals, roadside barriers, pavement markings, lighting, and other traffic control devices.
- **Construction Details** – Materials used for finish product, excavation quantities and locations, project durations, available right of way and work area separation from traffic, and number of accesses adjacent to work areas.

Traffic control plans are developed in response to and in cooperation with the contents of the Roadway plan sheets. The staging of the project coincides with the finished products being built – with the exception of temporary work that may be needed prior to permanent features or subsequent Stages to allow for the accommodation of traffic and presence of construction activities in close proximity with one another. For ODOT projects, TCP sheets are typically arranged as follows:

1. **Detail Sheets** – Include additional information for specialized construction activities, customized temporary signs, or other unique devices or products.

2. **Detour Sheets** – Display designated route(s) for traffic to circumvent the work zone using existing alternate routes. Includes details for points of closure, detour-specific signing, devices and other detour route conditions, restrictions or information.
3. **Plan Sheets** – Construction staging drawings identifying the portions of the work area used by live traffic and those available to the contractor for construction. Includes details for the location, type and quantity of traffic control devices required to guide and protect traffic through the work zone.

See **Figures 5.1** through **5.4**, below, for different kinds of TCP plan sheet examples. Visit the ODOT E-Plans website for examples of current and past project TCP plans.

The use of a certain traffic control measure in one project does not constitute a TCP "standard," nor does it warrant its use in subsequent projects.

Stage vs. Phase

A Stage includes the construction required to complete the work on one portion of the roadway while traffic uses the remaining portion. Subsequent Stages moves traffic to the newly constructed portion, and allows work to take place on the portion vacated by traffic. Multiple Stages and Phases are developed, as needed, for more complex projects. Plan sheets should be developed and labeled for each Stage. Stages will show the traffic control needed to protect the work area and guide, regulate, and warn traffic moving through the project.

A Phase is a smaller, more distinct portion of a Stage. Typically, during Phase construction, mainline traffic alignments do not change, rather traffic is shifted within the space for traffic, while work on associated segments is completed. Plan sheets should be developed and labeled for each Phase within each Stage.

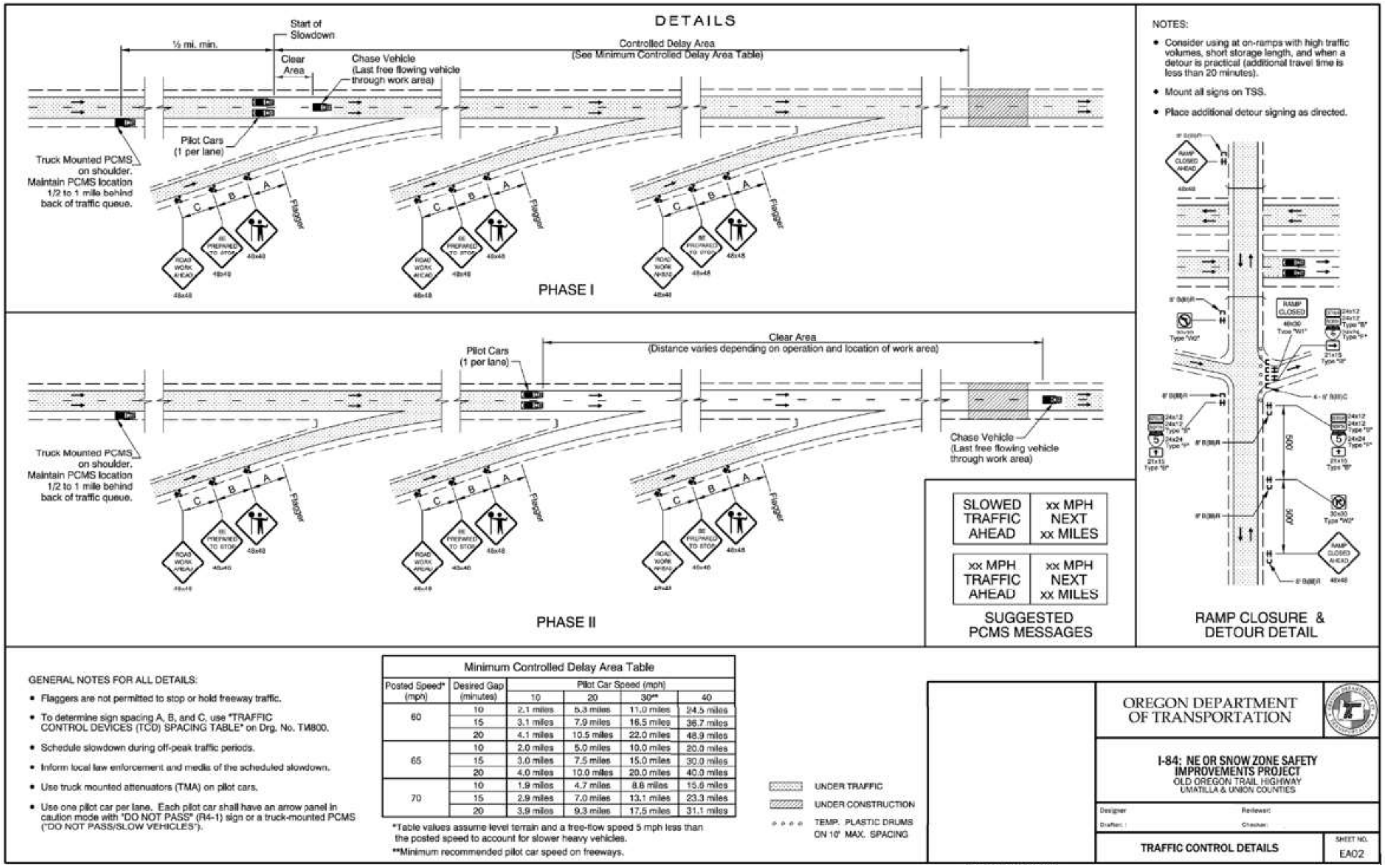
Plan Sheet Numbering

TCP sheet numbering should follow the guidance shown in the ODOT CAD Manual. The TCP sheet numbering series consists of two components. The first component is a two letter character and the second is a sequential two or three digit number. The first letter character in the TCP sheet is a fixed *"E"* followed by a second letter beginning with *"A"* to represent subgrouping of sheets (i.e., details, detours, TPARs, and Staging). Further series of subgrouping can be accomplished with the sequential two digit such as EA01, EA02, EA03, etc.

A Traffic Control Plan set could have the following order and numbering: EA01, EA02, EB01, EB02, EC01, and EC02. Please note that subgrouping may not be required for non-complex projects. The traffic control drawing order and sheet numbering sheet summary is provided in Table 5.1

Table 5-1: Drawing Order and Sheet Numbering

Format	Sheet No.	Sheet Title	Includes
EA##	EA01	Traffic Control Details	General details for work zone
EA##	EA02	Traffic Control Details	*(As needed)*
EB##	EB01	Traffic Control Detour Plans	Detour signing if required
EB##	EB02	Traffic Control Detour Plans	*(As needed)*
EC##	EC01	Traffic Control Plan	Temporary pedestrian Access Route
EC##	EC02	Traffic Control Plan	*(As needed)*
ED##	ED01	Traffic Control Plan	Construction staging sheets
ED##	ED02	Traffic Control Plan	*(As needed)*
EE##	EE01	Traffic Control Plan	Construction staging sheets
EE##	EE02	Traffic Control Plan	*(As needed)*



Minimum Controlled Delay Area Table

Posted Speed* (mph)	Desired Gap (minutes)	Pilot Car Speed (mph) 10	20	30**	40
60	10	2.1 miles	5.3 miles	11.0 miles	24.5 miles
	15	3.1 miles	7.9 miles	16.5 miles	36.7 miles
	20	4.1 miles	10.5 miles	22.0 miles	48.9 miles
65	10	2.0 miles	5.0 miles	10.0 miles	20.0 miles
	15	3.0 miles	7.5 miles	15.0 miles	30.0 miles
	20	4.0 miles	10.0 miles	20.0 miles	40.0 miles
70	10	1.9 miles	4.7 miles	8.8 miles	15.6 miles
	15	2.9 miles	7.0 miles	13.1 miles	23.3 miles
	20	3.9 miles	9.3 miles	17.5 miles	31.1 miles

Figure 5-1: Detail Sheet

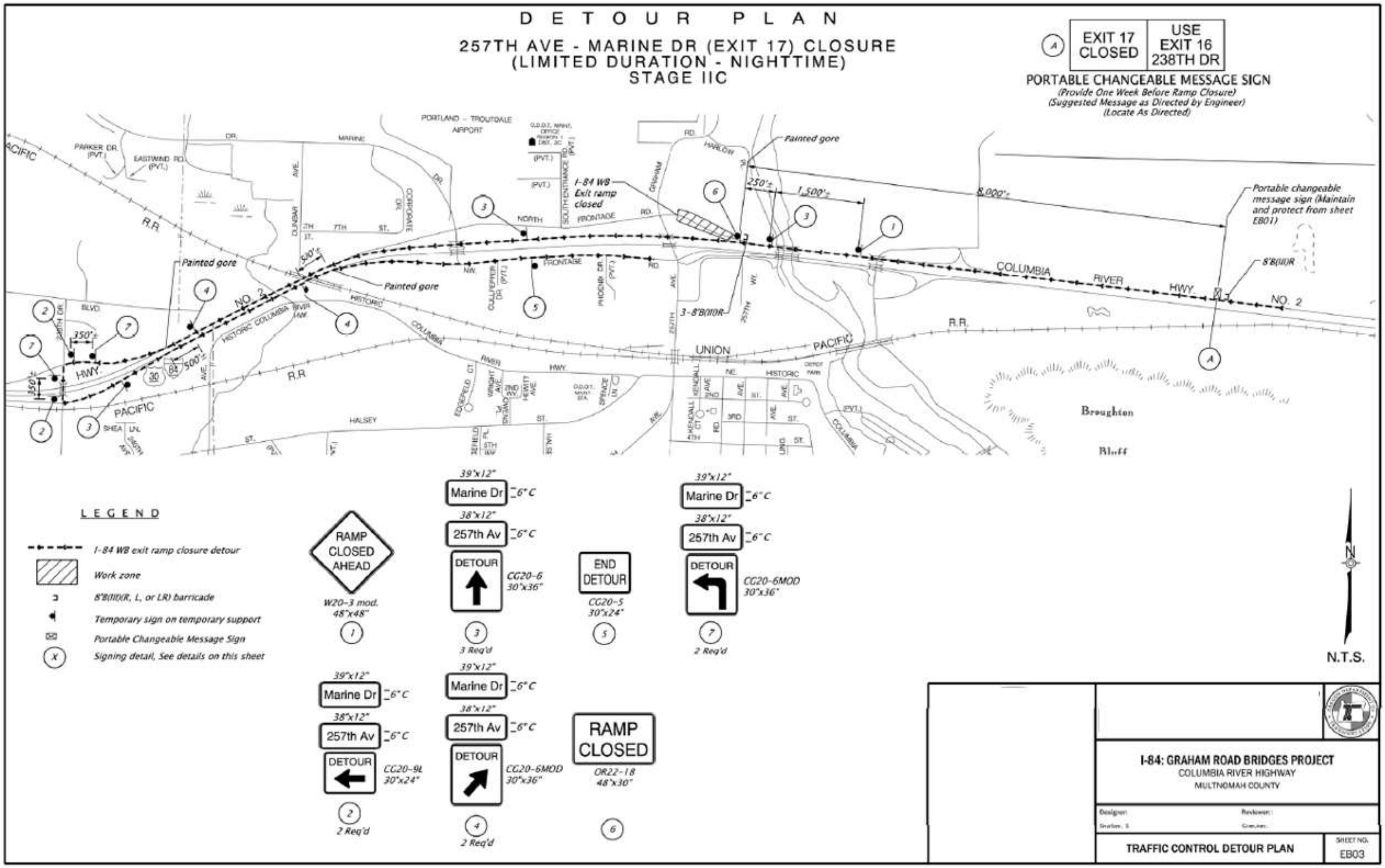


Figure 5-2: Detour Sheet

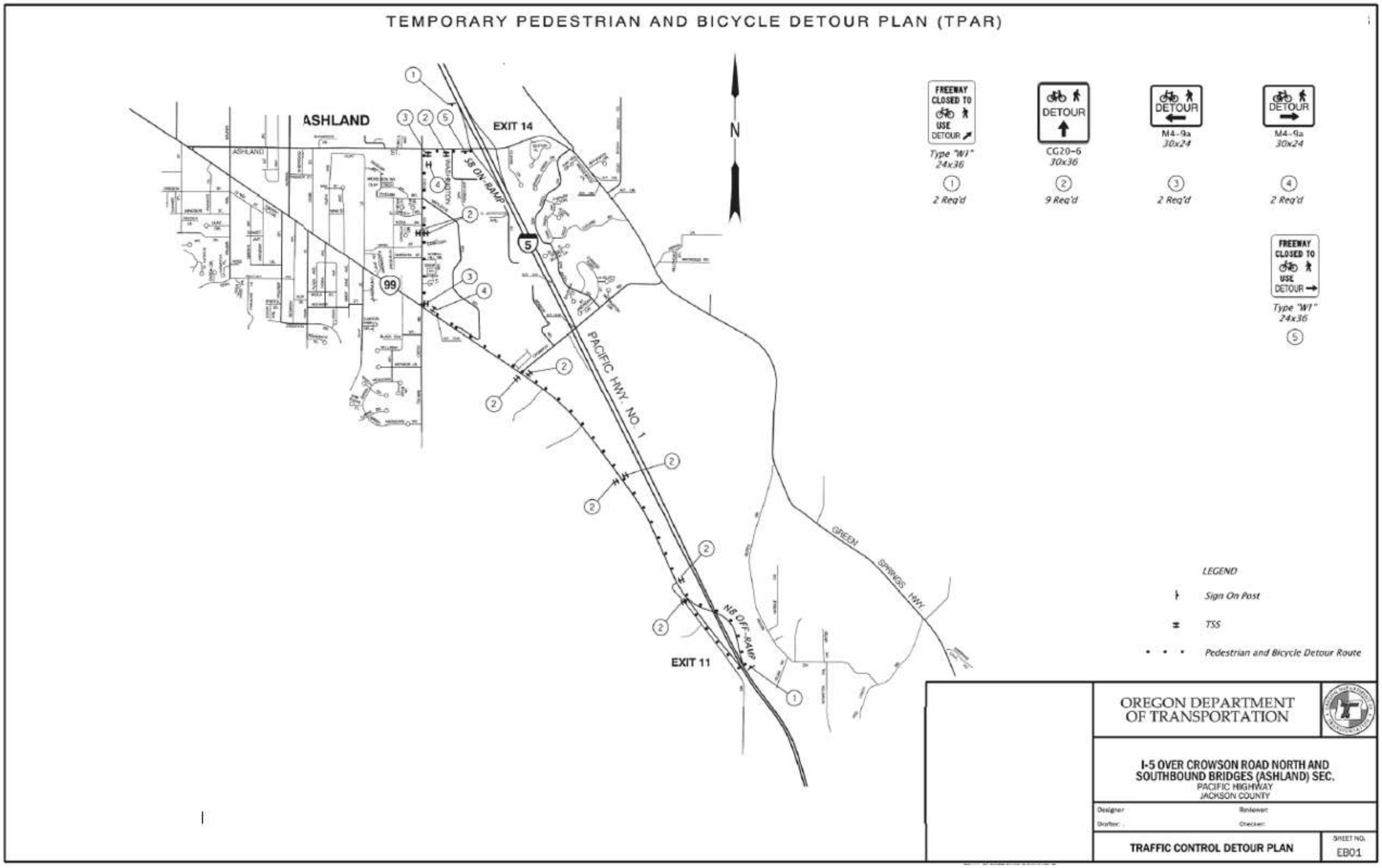


Figure 5-3: TPAR Sheet

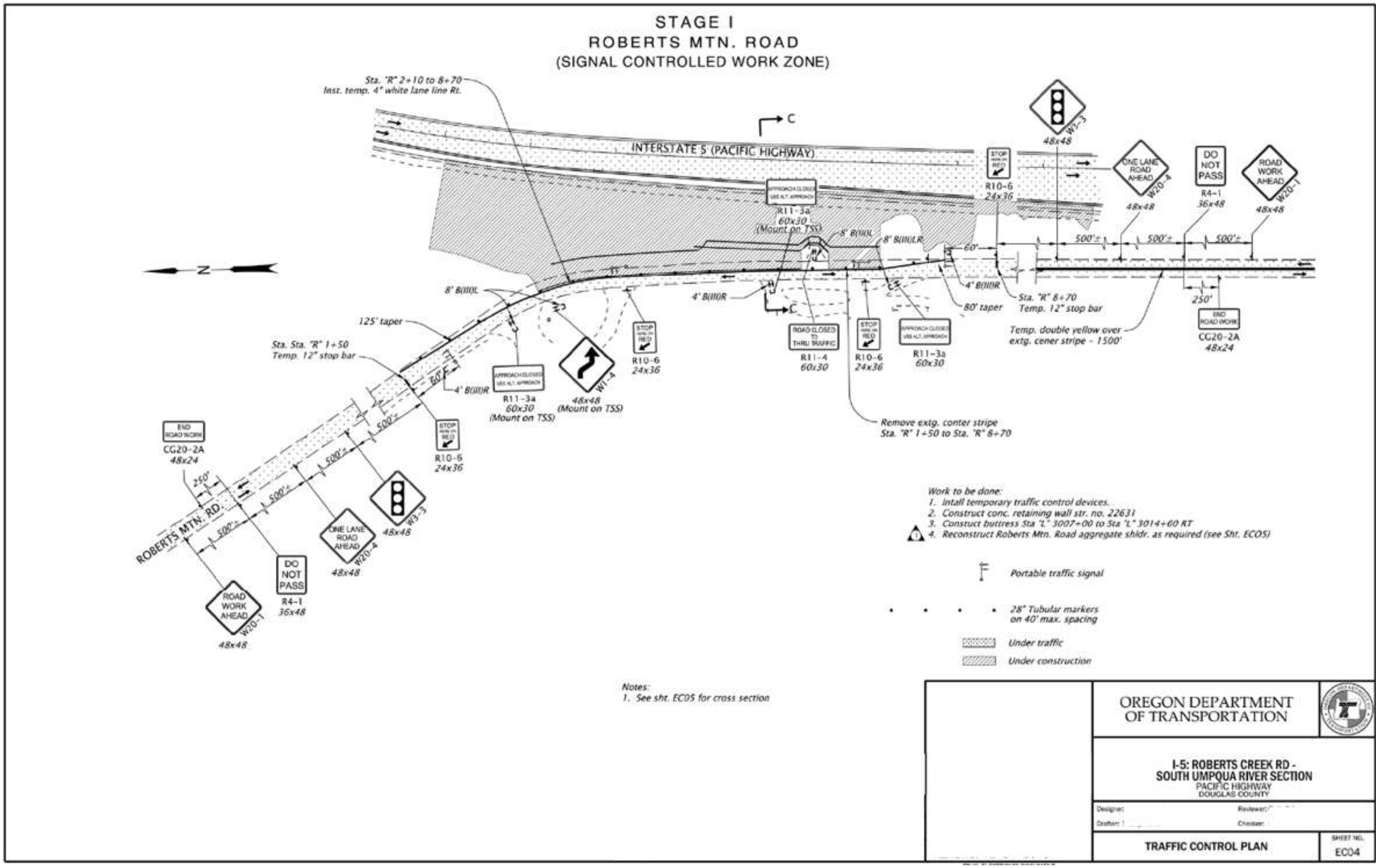


Figure 5-4: Staging Plan Sheet

5.4 Plan Sheet Development

In its contract plan development process, ODOT uses the following terminology for the differing layers of design that make up a complete project design.

Base Sheets

The Base Sheets (or Base Map) act as the starting point for the development of the TCP – helping to provide early suggestions as to the number of Stages and Phases needed for the project. The base map is derived from the existing Roadway plan sheets.

The following features are represented on the Base Sheets:

- Engineered alignments and centerlines.
- Existing edges of pavement.
- Engineering Station labels.
- Existing roadway appurtenances.

For ODOT contract plans development, the typical scale for the traffic control plans is 1″=200′ – half the scale of the Roadway plans (1″=100′). The TCP designer can choose to change the scale of the plans to best show the details. Depending on the different types of traffic control plans included, several different scales may be used to show details. The general TCP plans may be at 1″=200′ and the pedestrian TCP plans may be shown at 1″=50′.

Cross Sections

Cross sections are a representation of the typical sections associated to a particular stage at a given station, but with the distinction of showing multiple phases of construction on a single diagram (e.g. Final grade, Existing ground, Top of Stage, etc.). Typical Sections, developed by the roadway designer, are a graphical representation of the work within the project limits at a specific engineering Station. Typical Sections provide a detailed illustration of the construction components being built, removed, moved or otherwise incorporated into the project at a specific location during a particular time in the contract and should be used by the TCP designer to aid in the TCP design.

Once the location for a representative Section has been selected, the Section should be shown for every Stage throughout the plans. The Cross Section will illustrate how the entire roadway will be constructed by showing each Stage at that location.

To differentiate the various Stages in time on each Cross Section, a unique line style is used for each surfacing components as shown in Figure 5-5.

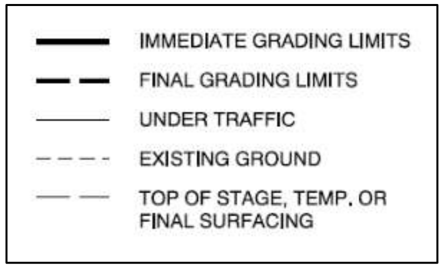


Figure 5-5: Surface Components

Dimensions on the Cross Section will show the width available for traffic. The TCD separating the work area from the “Under Traffic” area should also be shown. The “Under Traffic” area is determined by evaluating the scope of construction, TCD, and staging requirements during each stage.

The cross section should be scaled at 4 to 5 times the size of the plan scale to provide adequate detail – preferably between 1”=40’ and 1”=50’. The cross section can be placed on the same plan sheet where the Station exists, or on a separate sheet, where space allows. A separate plan sheet may be preferred when multiple sections are taken from a single plan sheet.

Through comprehensive evaluation, it can be determined if the available lane width during a Stage/Phase is adequate. When the available lane width is less than adequate, staging or construction alternatives are considered – including constructing temporary roadway widening. In some cases, it may be advantageous to build temporary surfacing – despite the fact that the surfacing may be “throw away”. Other alternatives include compensating for the narrower width by limiting the duration of the work, utilizing different traffic control measures, rearranging Stages, or developing a broader mitigation strategy.

See Figure 5-6 for example Cross Sections for “Stage I” and “Stage II”. Note the multiple line styles shown – representing existing and future surfaces – simultaneously on a single diagram.

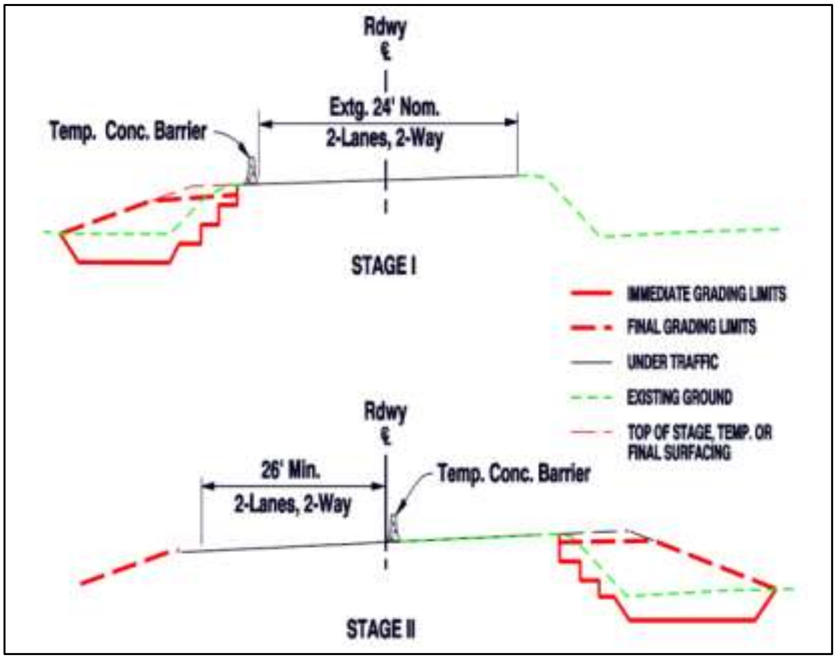


Figure 5-6: Cross Section Example

Plan Sheets

Using the earlier base sheet and cross section information, the TCP incorporates the desired staging and phasing into the design. Designers should graphically identify the work area – typically accomplished by filling in the area with a stippling hatching pattern. Areas "under traffic" can be left unchanged. Other areas, such as "Construct under Traffic" should use a distinct alternate hatching pattern. Example patterns are shown in Figure 5-7.

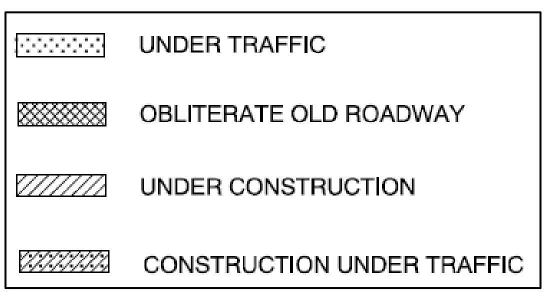


Figure 5-7: TCP Stippling Hatching Patterns

Complete the plan by including the required TCD within each Stage and Phase.

5.5 Typical Applications

Include the appropriate ***Standard Drawings*** to provide additional guidance and details for the more straight-forward or common work activities. To determine which Standard Drawings to include, Designers should carefully evaluate the following:

- Scope of work.
- Duration of the project.
- Existing roadway characteristics – Type, widths, location, features, geometry.
- Proximity of work to live traffic.
- Traffic volumes.
- Pre-construction posted speed.

Refer to **Chapter 4 – Specifications** for detailed discussions regarding ***Standard Drawings*** and ***Standard Details***.

Chapter 6 of the ***MUTCD*** also contains a number of common traffic control layouts for standard work zone operations. Refer to Section 6H – Typical Applications for a variety of more common layouts for activities ranging from mobile operations to long-term stationary work on freeways. Designers can use the Typical Applications to develop more detailed, project-specific TCPs, as needed.

5.6 Temporary Sign Design

Temporary Signs

Use the following resources when determining the text, configuration, sizing, color, usage and placement for Temporary Signs:

- ODOT "*Sign Policy & Guidelines for State Highway Signs*"
- FHWA "*Standard Highway Signs*"
- FHWA ***"Manual on Uniform Traffic Control Devices (MUTCD)"***

GuideSIGN™

For the design of highway signs, ODOT utilizes a software program called ***GuideSIGN***™. The program runs within the ***MicroStation***™ drafting software environment. It is also available in ***AutoCAD***™ and there is a ***Windows® version***.

The program includes a variety of features for creating many panel styles derived from ***MUTCD*** sign standards. Designers should become familiar with the features of the software by completing an on-line tutorial or taking a training class. ***GuidSign***™ can be a powerful tool in designing permanent and temporary signs for your project. However, its complexity may warrant a grief amount of training before beginning your designs.

Once in the software, Designers can manipulate a variety of sign panel categories to create needed signs. Example categories include:

- Panel (Regulatory, Guide, Service, Exits).
- Borders (Thickness, radius, offset).
- Margins (Border, Text, Symbols, etc.).
- Spacing (Letters, Words, Symbols, Shields, etc.).
- Text (Font style, Height, Orientation).
- Symbols (Arrows, Logos, Shields, etc.).

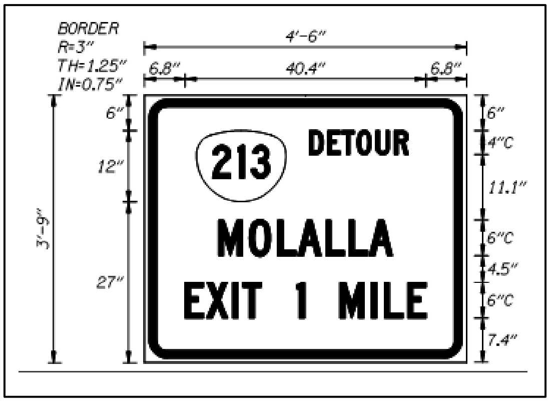


Figure 5-8: GuideSIGN™ Example

Sign Design

When using ***GuidSign™*** (or other applicable software) to design temporary signs, details shown in Table 5.2, below, should be used.

Table 5-2: Sign Design Attributes

SIGN SIZE (in x in)	BORDER RADIUS (in)	BORDER THICKNESS (in)	BORDER INSET (in)
≤ 24 x 24	1-1/2	5/8	3/8
30 x 30	1-7/8	3/4	1/2
36 x 36	2-1/4	7/8	5/8
48 x 48	3	1-1/4	3/4
60 x 72	3	1-1/4	3/4
72 x 120	1/8 x Min. Dimension	1-3/4	1-1/4
> 72 x 120	1/8 x Min. Dimension	2-1/2	2

In ***GuidSign™***, various text fonts, height, and spacing are selected for letters, numbers, and fractions. Others objects – arrows and symbols – can be selected from the menus. GuidSign™ also includes a feature for placing Exit Panels within a sign design. There are editing functions for modifying the sign and moving and aligning objects and text. Once the sign is prepared, panel dimensions can be added. A reporting function can be used to prepare a detailed sign panel report as shown in Figure 5-9. Sign contractors and sign shop can then use the report to manufacture the sign.

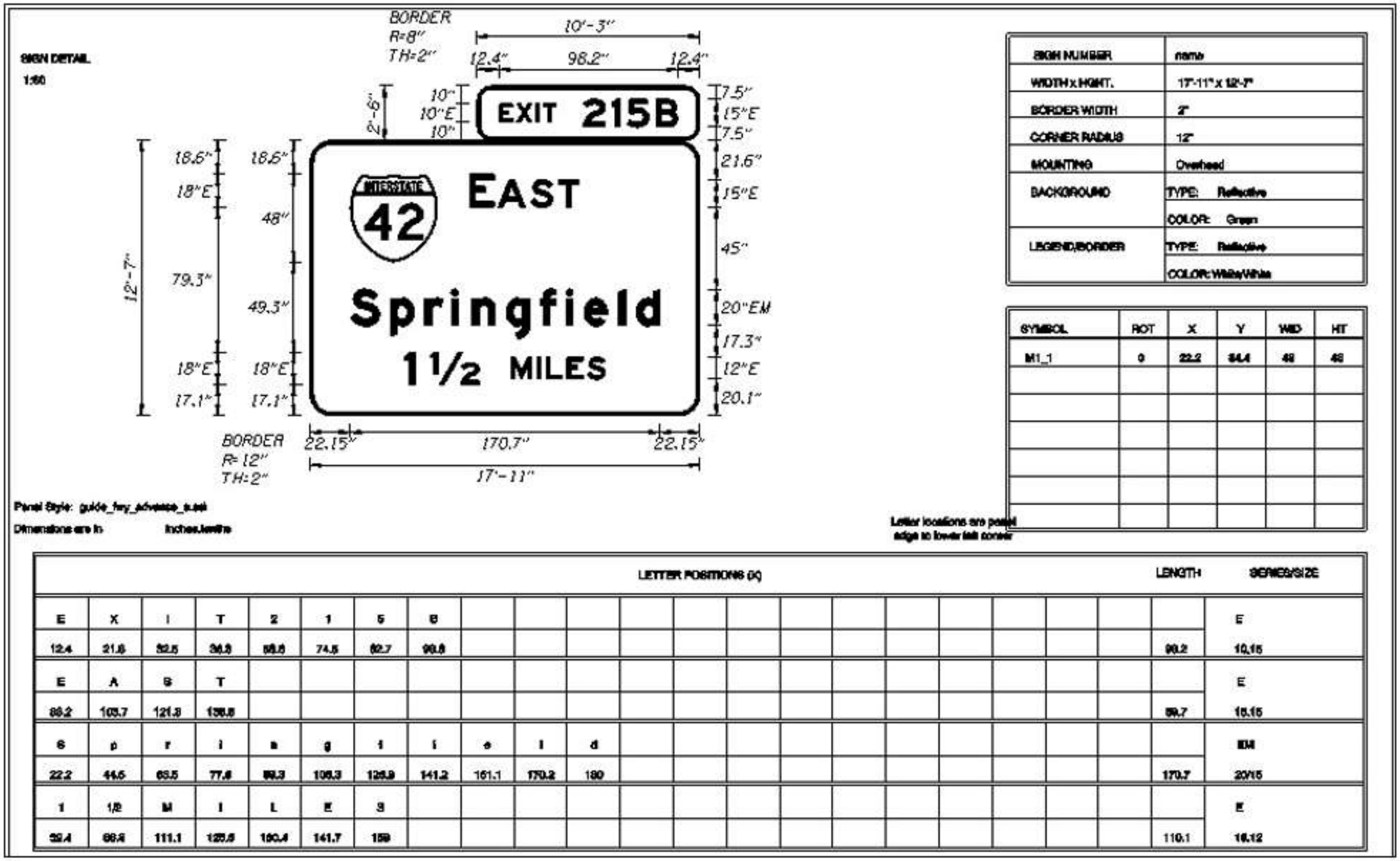


Figure 5-9: Sign Panel Report Example

5.7 Drafting Standards

ODOT provides a number of resources for the development of highway construction contract plans. The tools are available on the ODOT website under the Drafting and Contract Plans Program page. Users can search the internet for "***ODOT Drafting and Contract Plans Program***" to find the home page. The most commonly used resource is the ODOT CAD Manual and the ***ODOT CAD Workspace***.

ODOT CAD Manual

The ***ODOT CAD Manual*** presents the policies, procedures, methods, and standards for developing and preparing final Contract Plans. It also provides the standards used in the preparation of these plans using Computer Aided Design (CAD) in ***MicroStation***™. Department staff, consultants, and outside agency personnel should use the ***ODOT CAD Manual*** to prepare contract plans.

ODOT staff and consulting engineer staff working on ODOT projects must perform road design services and contract plan production using ***MicroStation***™ and ***InRoads***™ and provide all deliverables in a form suitable to these programs.

Consultant engineering staff working on federal aid projects for local governments is encouraged to follow the direction in this guide as closely as possible. Other CAD formats may be required as a part of a contract with a local government.

ODOT CAD Workspace

The CAD Workspace is a FTP (File Transfer Protocol) website that maintains several files useful for developing ODOT construction contract plans. Under the ODOT Workspace, Designers can download, install and update the following tools:

Cell Libraries

The TCP cell library – "TCPE.cel" – can be used to quickly place TCP related signs, devices, and symbols on traffic control plan sheets.

TCP Cache

The TCP Cache is another useful resource in developing traffic control plan. Once the ***MicroStation***™ compatible cache file is attached – "<year>TCP.cache.dgn" – the elements within the file can easily be copied into the plans. Although not listed under the ODOT Workspace, contact the Traffic Control Plans Unit for a copy of the TCP cache file.

Chapter 6: Traffic Control Cost Estimating

6.1 Key Topics Covered in this Chapter

- TCP Cost Estimator.
- Traffic Control Plan Pay Items.
- Quantity Calculations.
- Temporary Protection and Direction of Traffic.
- TCD Cost Estimate.

6.2 TCP Cost Estimator

ODOT has developed an Excel-based spreadsheet to help organize and manage traffic control devices, quantities, and costs. The use of the spreadsheet is not mandatory and should be considered as yet another tool available to Designers in developing their temporary traffic control plans.

The ***TCP Cost Estimator*** is available on the ODOT Traffic Control Plans Unit website. The file is updated on a regular basis, so download a new copy from the TCP Unit website before beginning your estimate.

Designers should be aware that the estimator does have some limitations. For very complex staging plans, it may be necessary to run through the process more than once to calculate quantities for a particular pay item.

In generating quantities, many of the calculations are rounded up to the nearest whole unit or the nearest factor of five. Some quantities include a percentage for the anticipated replacement of damaged devices. Some devices, however, require the TCP designer to manually enter a percentage for replacement devices.

Read all Notes and Comments ('mouse-over') within the estimator before completing an estimate. All of the adjustments mentioned above are based on historical observations and the dynamic and widely variable nature of this discipline.

The first worksheet of the Cost Estimator is titled, "INSTRUCTIONS – Read First". Read this before using the Cost Estimator for the first time. If you have any questions or find errors within the Cost Estimator, please contact the Traffic Control Plans Unit.

6.3 Traffic Control Plan Pay Items

A number of traffic control devices are used to assemble a traffic control plan. TCP Designers will quickly become familiar with the more frequently-used devices. This chapter hopes to introduce the extensive list of TCD, as well as information and practices available in calculating quantities for these devices.

The TCP Cost Estimator includes the temporary traffic control devices currently being used by ODOT (and most city and county agencies) within its highway construction contracts. Designers should become familiar with the technical *pay item name* for each item and their unit of measure. A sample of the bid pay item list is shown in Table 6-1. For the complete list of TCP pay items visit the Standard Specification Website.

Table 6-1: TCP Pay Item Sample

Item Number	Item Description
0221-0100000A	Temporary Protection and Direction of Traffic
0221-0101000A	Temporary Work Zone Traffic Control, Complete
0222-0102000J	Temporary Signs
0222-0162000E	Sequential Arrow Signs
0222-0164000E	Portable Changeable Message Signs
0222-0167300E	Portable Changeable Message Signs, Roller Mounted
0222-0167500E	Radar Speed Trailer
0223-0168000T	Flaggers
0223-0169000E	Traffic Control Supervisor
0223-0168100E	Flagger Station Lighting
0223-0172000T	Pilot Cars
0223-0174000T	Pedestrian Transport Vehicles
0223-0200000E	Automated Flagger Assistance Device
0223-0170000E	Rail Road Flagger Services
0223-0175000T	Tow Truck
0224-0142000E	Surface mounted tubular markers
0224-0143000E	Replace Surface Mounted Tubular Markers
0224-0145000E	Temporary Plastic Drums

6.4 Quantity Calculations

In developing the cost estimate for a Traffic Control Plan, there are two important tasks to focus on:

- A complete list of TCP pay items (and accompanying Special Provisions).
- Adequate quantities for those pay items.

Having both the right type of TCD and sufficient quantities, helps avoid the need for inconvenient and often costly Contract Change Orders (CCO). Therefore, carefully compare the contents of their Special Provisions and plan sheets (if applicable), as well as the list of appropriate Standard Drawings, to the list of pay items in the TCP Cost Estimator. And, in confirming the complete list of devices, ensure that an adequate quantity has been provided in the TCP – including a small percentage as a contingency or to account for damage by traffic, vandalism, etc.

Temporary Signs

One of the more important pay items is the quantity for Temporary Signs. Since every project will include some amount of temporary work zone signing, forgetting the pay item is not likely. However, not generating a proper quantity is very easy to do. Below is an excerpt from the list of Temporary Signs that are included on the "SIGNS" workbook within the Estimator.

SIGN NAME / LEGEND	SIGN NUMBER	Width in.	Height in.	Size ft²	Quantity
KEEPING OREGON ON THE MOVE (Rider) "Keeping Oregon on the Move"	With CG20-8 or CG20-8s	96	12	8	
YOUR TAX DOLLARS AT WORK (Project Identification sign)	CG20-8	96	48	32	
YOUR TAX DOLLARS AT WORK (Urban ID sign w/ "ODOT" Rider)	CG20-8	48	66	22	
ROAD WORK AHEAD	W20-1	48	48	16	
ROAD WORK AHEAD - *(Smaller)*	W20-1	36	36	9	
BRIDGE WORK AHEAD	CW21-10	48	48	16	
BRIDGE WORK AHEAD - *(Smaller)*	CW21-10	36	36	9	
SHOULDER WORK	W21-5	48	48	16	
SHOULDER WORK *(Smaller)*	W21-5	36	36	9	
ON RAMP (Rider)	W13-4	36	36	9	
NEXT XX MILES (Rider)	W7-3a	24	18	3	
ROAD WORK NEXT XX MILES	CG20-1	60	24	10	
ROAD WORK XX MPH *(New sign!)*	CW20-1a	48	48	16	
INTERMITTENT ROAD WORK NEXT XX MILES	CG20-13	60	36	15	

Figure 6-1: Sign Estimation Worksheet

It is important to remember the following when calculating Temporary Sign quantities:

- In multi-lane sections, a *pair* of signs – one on each side of the roadway, are needed for each direction.
- Sign supports and sign covers, installation, moving, reinstalling and removing are all included in the square-ft. cost of the signs.
- Route Shields are measured separately – even if installed on the face of another temporary sign.
- Examine Stages and Phases of the TCP carefully. Signs may be reusable from one Stage to the next and thus, a new sign is not needed – it can simply be moved to the new location needed for the next Stage. Make references on subsequent plan sheets back to earlier sheets where the same sign is used in the same location. For example:
    - **Sheet EB01**: Shows a "ROAD WORK AHEAD" sign at Sta. 125+00
    - **Sheet EB05**: A leader pointing to a post-mounted sign symbol at Sta. 125+00 says, "*See Sheet EB01*"
- The "SIGNS" worksheet includes blank lines for project-specific "custom" signs (e.g. "BAKER RD. DETOUR NEXT RIGHT").
- An additional 5% is automatically added to Temporary Sign quantities at the end bottom

By providing a thorough list of temporary work zone signs from the ***MUTCD***, the FHWA ***Standard Highway Signs (SHS)*** manual, and the ***ODOT Sign Policy & Guidelines***, the designer can use the Estimator like a checklist to capture a quantity for each individual sign needed for the project. The Estimator generates the total square footage quantity of temporary signs and adds a small percentage to account for damage, vandalism, oversights, etc.

Accompanying TCD

When a given TCD is normally accompanied by an additional device(s), the Cost Estimator automatically includes those devices. For example, per ***Standard Drawing TM800***, for each Portable Changeable Message Sign (PCMS) placed on the roadway, six Plastic Drums and one Type III Barricade are installed in advance of it. Thus, for each PCMS entered into the "PCMS-ARROWS-RADAR" worksheet (*Figure 6.1*), the Estimator automatically adds six Plastic Drums and one Type III Barricade and inserts them into the "ESTIMATE SUMMARY worksheet. See Figure 6-2 and 6-3 for this illustration. Additional devices are also added for Portable Traffic Signals, AFADs, and for Smart Work Zone Systems (SWZS).

PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)			
Each PCMS adds: 1 Type III Barricade and 6 Plastic Drums to the "Estimate Summary"			
Stage/Phase or Operation	NEW PCMS	MOVE PCMS	Comments
EX: North end of Project (for duration)			
For Duration of Project	2		
TOTAL:	2		

Figure 6-2: PCMS Estimator Worksheet

TRAFFIC CONTROL PLANS - PAY ITEM ESTIMATE SUMMARY					
Project:			County:		
Preparer:		Date:		KEY #	
Phone:		Email:			
Pay Item #	PAY ITEM	Unit	Quantity	Unit Cost	TOTAL
0225-0100000A	Temporary Protection & Direction of Traffic	LS	All	—	$ -
0225-0102000J	Temporary Signs	ft^2	0	$ 14.50	$ -
0225-0104000E	Temporary Barricades, Type II	Each	0	$ 47.00	$ -
02	Temporary Barricades, Type III	Each	2	$ 108.00	$ 216.00
0225-0140000F	Temporary Glare Shields	ft	0	$ 10.00	$ -
0225-0141000F	Moving Temporary Glare Shields	ft	0	$ 3.50	$ -
0225-0141100E	Temporary Reflective Barrier Panels	Each	0	$ 12.50	$ -
0225-0142000E	Surface Mounted Tubular Markers	Each	0	$ 34.00	$ -
0225-0143000E	Replace Surface-Mount Tubular Markers	Each	0	$ 34.00	$ -
0	Temporary Plastic Drums	Each	12	$ 40.00	$ 480.00
0225-0147000E	Temporary Delineators	Each	0	$ 30.00	$ -
0225-0141150F	Pedestrian Channelization Devices	ft	0	$ 26.00	$ -
0225-0158000A	Temporary Traffic Signal Installation **	Lump Sum	0	$ -	$ -
0225-0158000E	Portable Temporary Traffic Signal **	Each		$ -	$ -
0225-0162000E	Sequential Arrow Sign (project duration)	Each	0	$ 2,400.00	$ -
0225-0164000E	Portable Changeable Message Sign (PCMS)	Each	2	$ 5,500.00	$ 11,000.00
0225-0172000T	Pilot Cars	Hour		$ 60.00	$ -
				GRAND TOTAL:	$11,696.00

Figure 6-3: Estimate Summary Worksheet

6.5 Temporary Protection & Direction of Traffic (TP&DT), Lump Sum Item

The TP&DT Lump Sum item – often misconstrued as being synonymous with the entire Traffic Control Plan (TCP) – is actually a single pay item comprised of several individual Traffic Control items that do not otherwise have their own pay item category, including monies that might be used by the contractor to pay for labor costs related to the installation, maintenance, cleaning and removal of various TCD as called for in the Specifications. It can be considered as a "miscellaneous" item.

Figure 6-4 is an excerpt from the ***TCP Cost Estimator*** listing some of the items that would be accounted for under the Temporary Protection & Direction of Traffic lump sum item.

ITEM	Unit	Quantity	Unit Cost	TOTALS
Tubular & Conical Markers (Use Worksheet Below)	Each	0		$0.00
Tubular& Conical Marker MOVES (Use Worksheet Below)	Each	0		$0.00
Temp. Concrete Barrier To & From Stockpile (Includes Std. & Tall Barrier)	ft	0		$0.00
Remove Temp. Barrier from Project (Includes Std. & Tall Barrier)	ft	0		$0.00
Move Concrete ("Zipper") Barrier Laterally	Each	0		$0.00
Move "Zipper" Machine To/From Storage (Min)	Lump Sum	0		$0.00
Guard Rail, Anchor Type 1	Each	0		$0.00
Guard Rail, Anchor Type 1 Modify	Each	0		$0.00
Guard Rail, Transition 2-Sides	Each	0		$0.00
Pole Base Excavation Covers	Each	0		$0.00
Work Zone Delineation Fence (Orange, plastic)	ft	0		$0.00
Temporary Chain Link Fence	ft	0		$0.00
Falsework Illumination	ft	0		$0.00
Incidental Flagging Hours	Hour	0		$0.00
Blue Tubular Markers	Each	0		$0.00

Estimated TP& DT:	Construction Budget:	x 1.0% =	$0
	COMPARED TO ...		
Calculated TP&DT (from items above. Use $5000 Min.):			$0
	** TP&DT =		

** Typically, use the larger of the two amounts. However, staging complexity and project duration can affect TP&DT amounts. Therefore, if the difference is greater than 100%, consider using the average of the two amounts.
See Section 00225.90(a-2) for other items included in the TP&DT lump sum Pay Item.

Figure 6-4: TP&DT Estimate Worksheet

6.6 TCP Cost Estimate

Costs for temporary traffic control pay items fluctuate each year. Costs are adjusted annually following the release of the updated average annual pay item price report generated by the ODOT Highway Division's Estimating Unit. Designers working on ODOT construction projects should not make additional modifications to the pay item costs in the Cost Estimator – including regional adjustments. These and other cost adjustments are made during the final stages of project development before the project is released for advertisement.

The last worksheet in the TCP Cost Estimator is called the "ESTIMATE SUMMARY" and summarizes all of the quantities and costs generated for traffic control devices.

Once all preceding worksheets are complete, Designers should remember to complete the cells in yellow on the "ESTIMATE SUMMARY", where applicable to your project.

Before completing the Cost Estimate, revisit the entire workbook looking for any errors, oversights or omissions. In addition, the following items are worth noting:

"CHANNELIZATION" Worksheet

Check for an appropriate percentage of replacement for Plastic Drums and Surface-Mounted Tubular Markers, as appropriate.

"BARRIER-GUARDRAIL" Worksheet

You may prefer to calculate quantities for Barrier and Barrier Moves by hand in lieu of using this worksheet.

"BARRIER Accessories" Worksheet

Quantities for the three new "Repair Temporary Impact Attenuator" pay items should be discussed with construction office staff.

"ESTIMATE SUMMARY" Worksheet

- **Temporary Traffic Signal Installation and Portable Temporary Traffic Signal**
  Based on the staging plan, designs for signal installations should come from a traffic signal designer. Approval to add a signal, even a temporary one, must come from the state traffic engineer.
- **Flaggers and Pilot Cars**
  Quantities should be calculated very carefully. Flagger hours are likely to be dependent on the scope of work and construction schedule. Designers should communicate with construction management staff who, having reviewed the scope of work and the staging plans, should be able to recommend or confirm quantities for these pay items.
- **Flagger Station Lighting**
  Used to light each anticipated Flagger station. Seek guidance from construction staff to refine quantities, as needed.

- **Traffic Control Supervisor (TCS)**
  See **Chapter 3** for additional warrants and assistance in determining TCS quantities. Consult with construction staff and the Standard Specifications to provide additional guidance regarding TCS quantities.
- **Tow Trucks**
  A rare pay item, but useful on projects with limited widths and where continuous flow of traffic in a single lane is critical. MUST include Special Provision language. Consult with construction offices for use.

When submitting a TCP estimate, the "ESTIMATE SUMMARY" worksheet is typically the only worksheet needed. If sending electronically, the whole Excel file may be sent. Keep a copy of the entire workbook in both electronic and hardcopy formats for your Project File.

All state and local agency Federal-aid project payments for work zone traffic control devices shall be measured per unit basis (Method "A"). Use of Lump Sum Basis (Method "B") should be rare and reserved for only those small projects where traffic control requirements are not complex and the number, type and location of traffic control devices can be easily and readily identified from the project plans. Incidental Basis (Method "C") shall not be used on Federal-aid projects.

Appendix A: Acronym List

Table A-1: Acronym List

Abbreviation	Definition
3R / 3-R	Resurfacing, Restoration, and Rehabilitation
4R / 3-R	Resurfacing, Restoration, Rehabilitation, and Reconstruction
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AEE	Association of Engineering Employees
AGC	Association of General Contractors of America
ASAP	As Soon As Possible
ASCE	American Society of Civil Engineers
ATE	Associate Transportation Engineer
ATR	Automatic Traffic Recorders
ATS	Advanced Transportation Systems (subcommittee of AASHTO)
ATSSA	American Traffic Safety Service Association
BLM	Bureau of Land Management
BMP	Beginning Mile Point
BMP	Best Management Practice
BMS	Bridge Management System (ISTEA)
BNRR	Burlington Northern Railroad
CAC	Citizens Advisory Committee
CAD / CADD	Computer Aided Drafting and Design
CalTrans	California Department of Transportation
CAT	Countermeasure Analysis Tool
CBD	Commercial Business District
CCA(A)	Clean Air Act (Amendment)
CFS	Cubic Feet per Second
CMS	Changeable Message Sign(s) (see VMS – preferred)
CMS	Congestion Management System (ISTEA)
CP	Cathodic Protection

Abbreviation	Definition
CPM	Critical Path Method (method of scheduling)
CTWLTL	Continuous Two-Way Left Turn Lane, "Twiddle"
DBA	Doing Business As
DEQ	Department of Environmental Quality
DHV	Design Hourly Volume
Dia.	Diameter
DLCD	Division of Land Conservation and Development
DM	District Manager
DMS	Dynamic Message Sign (see VMS)
DMV	Driver and Motor Vehicle Services
DUII	Driving Under the Influence of Intoxicants
E&C	Engineering and Contingencies
EA	Environmental Assessment
EA	Expenditure Account
EAC / HMAC	Emulsified Asphalt Concrete / Hot Mix Asphalt Concrete
EB	Eastbound
ECL	East City Limits
EIS	Environmental Impact Statement
EMP	Ending Mile Point
EMS	Emergency Medical Services
EP	Edge of Pavement
EPA	Environmental Protection Agency
ES	Edge of Shoulder
FAA	Federal Aviation Administration
FAQ	Frequently Asked Questions
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
GIS	Geographic Information System
GPS	Global Positioning System
HCM	Highway Capacity Manual
HEP	Hazard Elimination Program
HOV	High Occupancy Vehicle

Abbreviation	Definition
I/D	Incentives / Disincentives
ID	Inside Diameter
IGA	Inter-Governmental Agreement
ISTEA	Intermodal Surface Transportation and Efficiency Act
ITE	Institute of Transportation Engineers (formerly Traffic)
ITIS	Integrated Transportation Information System
ITS	Intelligent Transportation System
kg	Kilogram
km	Kilometer
km/h	Kilometers per Hour
LCDC	Land Conservation and Development Commission (Oregon)
LL	Live Load
LMC	Latex Modified Concrete
LOS	Level of Service
m	Meter
CCD	Oregon Commerce and Compliance Division
MHz	Megahertz (millions of cycles per second)
mm	Millimeter
MP	Milepoint, Milepost
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
NB	Northbound
NCHRP	National Cooperative Highway Research Program
NCL	North City Limits
NEPA	National Environmental Protection Act
NHS	National Highway System
NHTSA	National Highway Traffic Safety Administration
NIMBY	Not in My Backyard
NTS	Not to Scale
OAR	Oregon Administrative Rules
OD	Outside Diameter
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation

Abbreviation	Definition
OHP	Oregon Highway Plan
ORS	Oregon Revised Statutes
OSHA	Occupational Safety and Health Administration (U.S.)
OSP	Oregon State Police
OSU	Oregon State University
OTC	Oregon Transportation Commission
OTIA	Oregon Transportation Investment Act
OTP	Oregon Transportation Plan
OVWS	Overheight Vehicle Warning System
Oxing	Overcrossing
PCC	Portland Cement Concrete
PCE	Passenger Car Equivalents
PCMS	Portable Changeable Message Sign
PDT	Project Development/Design Team (also PT for Project Team)
PE	Preliminary Engineering
PE	Professional Engineer (registered)
PIN	Personal Identification Number
PM	Project Manager
PMC	Polymer-modified Concrete
PS&E	Plans, Specs, and Estimates
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
PT / PDT	Project Team / Project Development Team
PUC	Public Utility Commission
PVMS	Portable Variable Message Sign
QA	Quality Assurance
QPL	Qualified Products List
R&D	Research and Development
R/W	Right of Way
RAME	Region Access Management Engineer
RATS Team	Region and Technical Services Team
RDWY	Roadway
REA	Revised Environmental Assessment

Abbreviation	Definition
Rev.	Revised, Revision Date
RFP	Request for Proposal
RIG	Resource Issues Group
RFQ	Request for Qualifications
ROD	Record of Decision
RR	Railroad
RTP	Regional Transportation Plan
RWIS	Roadside Weather Information Sign
SB	Southbound
SCL	South City Limits
SF	Square Feet, ft^2
SH, Shld	Shoulder
SHPO	State Historic Preservation Office
SI	Le Systeme International d'Unites (Metric System)
SOV	Single Occupant Vehicle
SPIS	Safety Priority Index System
SPRR	Southern Pacific Railroad
SRCM	Soils and Rock Classification Manual (ODOT)
SSD	Stopping Sight Distance
STA	Special Transportation Area
STE	State Traffic Engineer
STIP	Statewide Transportation Improvement Plan
STIP-SIP	Statewide Transportation Improvement Program – Safety Investment Program
STR	Section, Township, and Range (surveying)
SU	Single Unit Truck
T&E	Threatened and Endangered
TAC	Technical Advisory Committee
TAG	Technical Advisory Group
TCD	Traffic Control Devices
TCM	Traffic Control Measures
TCP	Traffic Control Plan
TCPE	Traffic Control Plans Engineer
TCS	Traffic Control Supervisor

Abbreviation	Definition
TDB	Transportation Development Branch
TDM	Transportation Demand Management
TE	Transportation Engineer
TEA-21	Transportation Equity Act for the 21st Century
TEOS	Traffic Engineering and Operations Section
TGM	Transportation Growth Management
Thk	Thick, Thickness
TIP	Transportation Improvement Plan
TIS	Transportation Impact Study
TMA	Truck Mounted Impact Attenuator
TMP	Traffic Management Plan
TP & DT	Temporary Protection & Direction of Traffic
TPAR	Temporary Accessible Route
TPARP	Temporary Accessible Route Plan
TPAU	Transportation Planning Analysis Unit
TRB	Transportation Research Board
TS&L	Type, Size, and Location
TSP	Transportation System Plan
TSRM	Technical Services Resource Manager
TSS	Temporary Sign Support
TSSU	Traffic Systems Services Unit
TTC	Temporary Traffic Control
TTI	Texas Transportation Institute
TVT	ODOT's Transportation Volume Tables
TWLTL	Two-Way Left-Turn Lane
U of O	University of Oregon
UBA	Urban Business Area
UGB	Urban Growth Boundary
UP	University of Portland
UPRR	Union Pacific Railroad
USDOT	United States Department of Transportation
V/C	Volume to Capacity Ratio
VE	Value Engineering

Abbreviation	Definition
VMS	Variable Message Sign
VMT	Vehicle Miles of Travel (Vehicle Miles Traveled)
w/	With
w/o	Without
WB	Westbound
WCL	West City Limits
WIM	Weigh in Motion
WS	Wearing Surface
WSDOT	Washington State Department of Transportation
Wt.	Weight
WYSIWYG	What-You-See-Is-What-You-Get, “Wizzy Wig”
Xing	Crossing

Appendix B: Glossary of Terms

Table B-1: Glossary of Terms

Term	Definition
3-R Project	A project involving resurfacing, restoration, or rehabilitation of an existing highway.
4-R Project	A project involving reconstruction of an existing highway.
AASHTO	American Association of State Highway and Transportation Officials.
Abutment	Supports at the end of the bridge used to retain the approach embankment and carry the vertical and horizontal loads from the superstructure. Current terminology is bent or end bent.
Access Control	The condition where the legal right of owners or occupants of abutting land to access a highway is fully or partially controlled by the Department of Transportation.
Access Management	Measures regulating physical connections to streets, roads, and highways from public roads and private driveways.
ADT (Average Daily Traffic)	The average number of vehicles passing a certain point each day on a highway, road, or street.
Advance Plans	90% complete plans including special provisions normally sent at 15 weeks.
Advance Review	Complete review prior to final approval. All of PS&E must be provided and nearly complete.
Advertisement	The period of time between the written public announcement inviting proposals for projects and the opening of the proposals (bid or letting date).
Aggregate	Rock of specified quality and gradation.
Aggregate, Coarse	Aggregates predominantly retained on the No. 4 sieve for Portland cement concrete and those predominantly retained on the ¼” for asphalt concrete.
Aggregate, Dense Graded	A well-graded aggregate so proportioned as to contain a relatively small percentage of voids.
Aggregate, Fine	Those aggregates which entirely pass the 3/8” sieve.
Aggregate, Open Graded	A well-graded aggregate containing little or no fines, with a relatively large percentage of voids.
Aggregate, Well-Graded	An aggregate possessing proportionate distribution of successive particle sizes.

Term	Definition
Air-Entraining Agent	A substance used in concrete to increase the amount of entrained air in the mixture. Entrained air is present in the form of minute bubbles and improves the workability and frost resistance.
Alignment	Geometric arrangement of a roadway (curvature, etc.).
Allowable Headwater	The maximum elevation to which water may be ponded upstream of a culvert or structure as specified by law or design.
Alternative Modes	Modes such as rail, transit, carpool, walking, and bicycle which provide transportation alternatives to the use of the single-occupancy automobiles.
Approach	[OAR 734-020-0420(1)] All lanes of traffic moving toward an intersection or mid-block location from one direction.
Approach Road	A roadway or driveway connection between the outside edge of the shoulder or curb line and the right-of-way line of the highway, intended to provide vehicular access to and from said highway and the adjoining property.
Apron	The paved area between wingwalls at the end of a culvert.
Asphalt	Asphalt cement.
At-Grade Crossing	A crossing of two highways or a highway and a railroad at the same level.
Asphalt Concrete	A mixture of asphalt cement, graded aggregate, mineral filler, and additives, as required.
Average Daily Traffic (ADT)	Average Daily Traffic (ADT) – The average 24-hour volume of traffic, being the total during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year.
Award	Written notification to the bidder that the bidder has been awarded a contract.
Axle Load	The load borne by one axle of a traffic vehicle.
Backfill	Material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.
Backwater	The water upstream from an obstruction in which the free surface is an elevation above the normal water surface profile.
Ball-bank Indicator	A curved level which is used to determine the safe speed around a curve, as indicated by trial speed runs. The indicator measures the centrifugal force on the vehicle. The ball-bank indicator is designed to show the combined effect of the vehicle body roll angle, the centrifugal force, and the superelevation angle of the roadway.
Base Course	The layer of specified material of designed thickness placed on a subbase or a subgrade to support a surface course.

Term	Definition
Bedrock	The solid rock underlying soils or other superficial formation.
Bench Mark	A relatively permanent material object bearing a marked point whose elevation above or below an adopted datum is known.
Bench Repair	Repairs made to signal control equipment by the Traffic Systems Services Unit (TSSU).
Best Management Practices	Techniques which reflect current thinking on a specific subject.
Bid Schedule	The list of bid items, their units of measurement, and estimated quantities bound in the proposal booklet. (When a contract is awarded, the Bid Schedule becomes the Schedule of Contract Prices.)
Bidder	Any qualified individual or legal entity submitting a proposal in response to an advertisement.
Biennium	For the State of Oregon, a two-year period, always odd numbered years, starting July 1 and ending two years later on June 30.
Bleeding (Concrete)	The movement of mixing water to the surface of freshly placed concrete.
Borrow	Material lying outside of planned or required roadbed excavation used to complete project earthwork.
Box Culvert	A culvert of rectangular or square cross-section.
Breakaway	A design feature that allows a device such as a sign support to yield or separate upon impact. The release mechanism may be a slip plane, plastic hinges, fracture elements, or a combination of these.
Bridge End Panel	A reinforced concrete slab placed on the approach embankment adjacent to, and usually resting upon, the abutment back wall; the function of the approach slab is to carry wheel loads on the approaches directly to the abutment, thereby eliminating any approach roadway misalignment due to approach embankment settlement.
Bridge Railing	A longitudinal barrier whose primary function is to prevent an errant vehicle from going over the side of the bridge structure.
Bushings	A lining used to reduce friction and/or insulate mating surfaces usually on steel hanger plate bearings.
Buttress	A rock fill placed at the toe of a landslide in order to resist further slide movement. The slide toe is excavated to below the zone of sliding before placing rock fill.
Capacity	The maximum number of vehicles (vehicle capacity) or passengers (person capacity) that can pass over a given section of roadway or transit line in one or both directions during a given period of time under prevailing roadway and traffic conditions.
Cast-in-Place	The act of placing and curing concrete within formwork to construct a concrete element in its final position.

Term	Definition
Catch Basin	A receptacle, commonly box shaped and fitted with a grilled inlet and a pipe outlet drain, designed to collect the rain water and floating debris from the roadway surface and retain the solid material so that it may be periodically removed.
Cathodic Protection	A means of preventing metal from corroding; this is done by making the metal a cathode through the use of impressed direct current and by attaching a sacrificial anode.
Centerline	A defined alignment from which specific information is identified.
Change Order	A written order issued by the Engineer to the contractor modifying work required by the contract and establishing the basis of payment for the modified work.
City Street	A public road which is owned and operated by a city government intended for use of the general public for vehicles or vehicular traffic.
Clear Zone	Roadside border area starting at the edge of the traveled way that is available for safe use by errant vehicles. Establishing a minimum width clear zone implies that rigid objects and certain other hazards with clearances less than the minimum width should be removed and relocated outside the minimum clear zone or remodeled to make breakaway, shielded, or safely traversable.
Cobbles	Particles of rock, rounded or not, that will pass a 12” square opening and be retained on a 3” sieve.
Cofferdam	A barrier built in the water so as to form an enclosure from which the water is pumped to permit free access to the area within.
Cohesionless Soil	A soil that, when unconfined, has little or no strength when air-dried and that has little or no cohesion when submerged.
Cohesive Soil	A soil that, when unconfined, has considerable strength when air-dried and that has significant cohesion when submerged. Clay is a cohesive soil.
Commercial Vehicle	A vehicle that is used for the transportation of persons for compensation or profit, or designated or used primarily for the transportation of property.
Compaction	The process of densifying a layer of soil or rock material by using static or vibratory rollers made specifically for this purpose.
Concept Plans	Plans to determine the basic features of a project including alignments, typical sections, slopes, preliminary drainage, and TS&L bridge plans.
Concrete Overlay	1.5” to 2” of concrete placed on top of the deck, used to extend the life of the deck and provide a good riding surface.
Continuous Two-Way Left-Turn Lane	A traversable median that is designed to accommodate left-turn egress movements from opposite directions; Abbreviated as “TWLTL and often pronounced, “Twiddle”

Term	Definition
Contract	The written agreement between the Division and the contractor describing the work to be done and defining the obligations of the Division and the contractor.
Contract Plans	Detailed drawings and diagrams usually made to scale showing the structure or arrangement, worked out beforehand, to accomplish the construction of a project and/or object(s).
Contract Time	The number of calendar days shown in the proposal which is allowed for completion of the work.
Contractor	The individual or legal entity that has entered into a contract with ODOT.
Coordinates	Linear or angular dimensions designating the position of a point in relation to a given reference frame. It normally refers to the State Plane Coordinate System.
Core	A cylindrical sample of concrete removed from a bridge component for the purpose of destructive testing.
County Road	A public road which is owned and operated by a county government intended for use by the general public for vehicles or vehicular traffic.
Course	A specified surfacing material placed in one or more lifts to a specified thickness.
Crash Cushion	An impact attenuator device that prevents an errant vehicle from impacting fixed object hazards by gradually decelerating the vehicle to a safe stop or by redirecting the vehicle away from the hazard.
Crash Tests	Vehicular impact tests by which the structural and safety performance of roadside barriers and other highway appurtenances may be determined. Three evaluation criteria are considered, namely (1) structural adequacy, (2) impact severity, and (3) vehicular post-impact trajectory.
Creep	Time dependent inelastic deformation under elastic loading of concrete or steel resulting solely from the presence of stress.
Cross Section	The exact image formed by a plane cutting through an object, usually at right angles to a central axis or alignment.
Crossover	A technique used to shift live traffic from one side of a divided roadway either into the median or onto the remaining half of the highway not under construction. Also called an “on-site diversion”, it may also cross traffic out onto a temporary roadway running parallel to the work area.
Crosswalk	Any portion of a roadway at an intersection or elsewhere that is distinctly indicated for pedestrian crossing by lines or other markings on the surface of the roadway that conform in design to the standards established for crosswalks.
Crown Section	Roadway section with the height of the center of the roadway surface above its gutters.

Term	Definition
Culvert	A pipe, a reinforced concrete box, or a series of pipes or boxes that provide an opening under the ground for passage of water or other uses.
Curb	A vertical or sloping member along the edge of a pavement or shoulder forming part of a gutter, strengthening or protecting the edge, and clearly defining the edge of vehicle operators.
Curing	The preparation of a material by chemical or physical processing for keeping or use; treating concrete by covering its surface with some material to prevent the rapid evaporation of water.
Delamination	Subsurface separation of concrete into layers.
Deliverables	Engineering work to be submitted.
Demand	The number of users desiring service on the highway system.
Design Speed	A speed determined by traffic volumes, the geographic characteristics of the area, geometric layout of the existing facility, number of traffic lanes, and the posted speed for use in designing a project. Within the TCP discipline, Design Speed equates to the Pre-construction Posted Speed of the roadway facility.
Design Volume or Design Hourly Volume	A volume determined for use in design representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume. ODOT uses the 30th highest hour as its design hour.
Deviation	A departure from an access management standard.
DLCD	Department of Land Conservation and Development.
“Doghouse” (signal head)	A five indication, traffic control signal display used for control of P/P left turn lanes consisting of a single, circular red indication centered at the top with circular and arrow indications for yellow and for green in the middle and lower portion of the display, respectively.
E&C	*Engineering & Contingencies* are ODOT’s costs to administer the construction contract. In addition, Contingencies are unforeseen costs due to design changes, construction, extra work price agreements or types of problems caused by weather, accidents, etc. by the contract pay item.
Environmental Classes	Class I Environmental Impact Statement: Projects that normally involve significant changes in traffic capacities and patterns. These projects generally involve major right-of-way acquisitions. Both draft and final Environmental Impact Statements are required. Class II Categorical Exclusions: Projects that normally involve the improvement of payment conditions on traffic safety but little, if any, change in traffic capacities or patterns. Right-of-way requirements must be minor. These projects are categorically excluded from further environmental documentation, unless permit requirements indicate otherwise.

Term	Definition
	Class III Environmental Assessment: Projects that do not clearly fall within Class I or Class II. These projects require assessments to determine their environmental significance.
Erosion Control Designer	The person assigned to specify the proper methods for control of the flow of particulates and sedimentation for a given project.
Expansion Joint	A joint in concrete that allows expansion due to temperature changes, thereby preventing damage to the surface.
Expressway	Highways that provide for safe and efficient high speed and high volume traffic movements.
Extra Work	Work not included in any of the contract items as awarded but determined by the Engineer necessary to complete the project according to the intent of the contract. This may be paid on a negotiated price, force account, or established price basis.
Failsafe System	Failsafe system is hard wired to the signal controller and operates independently of any other signal function. The default state of a failsafe system is flashing mode.
Falsework	A temporary construction on which permanent work is wholly or partially supported until it becomes self-supporting. For cast-in-place concrete or steel construction, it is a structural system to support the vertical and horizontal loads from forms, reinforcing steel, plastic concrete, structural steel, and placement operations.
FHWA	Federal Highway Administration.
Final Review	The last in the review process; PS&E must be complete.
Fiscal Year	For the State of Oregon, July 1 through June 30 of the next year.
Flood Plain	An area that would be inundated by a flood.
Forms	A structural system constructed of wood or metal used to contain the horizontal pressures exerted by plastic concrete and retain it in its desired shape until it is hardened.
Freeway	A fully access controlled throughway.
Freeway Median	The space between inside shoulders of the separated one-way roadways of a divided highway.
Functionally Obsolete Bridges	Those bridges which have deck geometry, load carrying capacity, clearance, or approach roadway alignment which no longer meets the usual criteria for the system of which they are a part as defined by the Federal Highway Administration.
Geotextiles	Sheets of woven or non-woven synthetic polymers or nylon used for drainage and soil stabilization.
Glare Shield	A device used to shield a driver’s eye from the headlights of an oncoming vehicle.

Term	Definition
Grade Separation	A crossing of two highways or a highway and a railroad at different levels.
Green Concrete	Concrete that has set but not appreciably hardened.
Grout	A mixture of cementitious material and water having a sufficient water content to render it a free-flowing mass, used for filling (grouting) the joints in masonry, for fixing anchor bolts, and for filling post-tensioning ducts.
High Speed	When the posted speed on a roadway is $\geq$ 45 mph.
Highway	(ORS 801.305) Every public way, road, street, thoroughfare and place, including bridges, viaducts and other structures within the boundaries of this state, open, used or intended for use of the general public for vehicles or vehicular traffic as a matter of right.
Highway Capacity Manual (HCM)	The Highway Capacity Manual is the standard “Bible” for most traffic analysis; however, the HCM does not provide procedures that are appropriate for work zone analysis.
HOV Lanes	High-Occupancy Vehicle lanes, special road lanes which can only be used by vehicles with more than one occupant.
Hydration	The process by which cement combines with water to form a hard binding substance.
Hydrodemolition	Process to abrade or remove a surface, such as concrete, by streams of water ejected from a nozzle at high velocity.
Incidental Work	Work necessary for fulfillment of the contract but which is not listed as a pay item in the contract and for which no separate or additional payment will be made.
Intermodal connectors	Short lengths of roads that connect intermodal facilities to the state highway system.
International System of Units (SI)	The modernized metric system.
Intersection	The area of the roadway created when two or more roadways join together at any angle.
ISTEA	Intermodal Surface Transportation Efficiency Act, passed by Congress in 1991.
ITS	Intelligent Transportation System.
Key Number	Number assigned to a project by Program Section to identify it in the Project Control System (PCS). All structures in a project have the same key number; bridges are numbered separately.
Lane Closure Restrictions	ODOT often limits the hours that work zone traffic lanes and roads may be closed in an effort to reduce motorist delay, inconvenience and crash potential.

Term	Definition
Leveling	A course of construction to restore horizontal and vertical uniformity to existing pavements, normally continuous throughout the project limits.
Lift	The nominal compacted thickness of material placed by equipment in a single pass.
Live Load	Force of the applied moving load of vehicles and/or pedestrians.
LOS	Level of Service – a range of operating conditions defined for each type of facility and related to the amounts of traffic that can be accommodated at each level.
Low Speed	When the posted speed on a roadway is $\leq$ 40 mph.
Low Volume Road	Any roadway with an AADT < 400 vehicles.
Mandatory Source	A material source provided by ODOT from which the contractor shall obtain materials.
Manual Classification of Traffic Counts	Federal Government directed vehicle classification that breaks the class of vehicles into 16 types. Traffic counts with vehicles broken down into their 16 types are necessary for most ODOT project work.
Manual Traffic Counts	Performed by ODOT personnel and available from ODOT Traffic Data Section in the Transportation Development Branch. Traffic counts used for analysis should be close to the work area and on the same type of highway designation and should also have been taken in the last three years.
Material	Any natural or man-made substance or item specified for use in the construction of the project.
Median	A continuous divisional island which separates opposing traffic and may be used to separate left turn traffic from through traffic in the same direction as well. Medians may be designated by pavement markings, curbs, guideposts, pavement edge or other devices.
Median Pedestrian Island	A non-traversable median section designed to provide an area where pedestrians can take refuge while crossing the traffic stream approaching from the left, and then the traffic stream approaching from the right.
Micro Silica (Silica Fume) (MC)	Very fine non-crystalline silica used as an admixture in concrete to improve the strength, permeability, and abrasion resistance.
Mode of Transportation	A means of moving people and/or goods.
Modular Expansion Joints	Multiple, watertight joint assemblies for bridges requiring expansion movements greater than 4”.
MPO	Metropolitan Planning Organization – a planning body in an urbanized area of over 50,000 population which has responsibility for developing transportation plans for that area.

Term	Definition
Mylars	Drawings on Mylar. The final “legal” drawing used for signatures and printing contract plans.
NHS	National Highway System – a system of Statewide and Interstate Highways and intermodal connectors meeting federal criteria (approximately 155,000 miles total), designated by Congress in the National Highway System Designation Act of 1995.
Non-traversable Median	A median which, by its design, physically discourages or prevents vehicles from crossing it except at designated openings which are designed for turning or crossing movements and are designed to impede traffic from crossing the median. Examples include curbed medians or concrete barrier medians, also included are depressed grass or landscaped medians.
OAR	Oregon Administrative Rules – Rules written by a government agency intended to clarify the intent of an adopted law.
Occupancy	The amount of time motor vehicles are present in a detection zone expressed as a percent of total time. This parameter is used to describe vehicle density, a measure of highway congestion. The number of passengers in a vehicle which, when used in conjunction with vehicular volume, provides information on the total number of persons accommodated on a transportation link or within a transportation corridor.
Operating Rating (Permit Loads)	The absolute maximum permissible stress level to which a structure may be subjected. It is that stress level that may not be exceeded by the heaviest loads allowed on the structure. Special permits for heavier than normal vehicles shall be issued only if such loads are distributed so as to not produce stress in excess of the operating stress.
OR Route	A route system established and regulated by the Oregon Transportation Commission to facilitate travel on main highways throughout the state.
ORS	Oregon Revised Statues – The laws that govern the State of Oregon.
OTC	Oregon Transportation Commission – ODOT’s governing body; the Commission has five members appointed by the Governor.
Outer Separation	The area between the traveled ways of a through traffic roadway and a frontage road or street.
Pavement	Asphalt concrete or Portland cement concrete placed for vehicular use on highway, road and street traveled ways, shoulders, auxiliary lanes, and parking areas.
Peak Hour	Hour of the day with the most traffic, usually during morning and evening commute times. Generally not the design hour.
Pedestrian	A person on foot, in a wheelchair, or walking a bicycle.

Term	Definition
Pile	A long, slender piece of wood, concrete, or metal to be driven, jetted, or cast-in-place into the earth or river bed to serve as a support or protection.
Plastic Deformation	Deformation of material beyond the elastic range.
Preliminary Plans	75% complete plans, normally sent at 20 weeks.
Preliminary Review	In the review process, plans should be approximately 75% complete.
Prestressed Concrete	Concrete in which there have been introduced internal stresses (normally pretensioned steel) of such magnitude and distribution that the stresses resulting from given external loadings are counteracted to a desired degree.
Pretensioned	Any method of prestressing in which the strands are tensioned before the concrete is placed.
Principal Arterial (Urban, Controlled Access)	A street or highway in an urban area which has been identified as unusually significant to the area in which it lays in terms of the nature and composition of travel it serves. The principal arterial system is divided into three groups: Interstate freeways, other freeways and expressways, and other principal arterials (with no control of access). Principal arterials should form a system serving major centers of activity, the highest traffic volume corridors, and the longest trip desires and should carry a high proportion of the total urban area travel on a minimum of mileage.
Resident Engineer	The engineer's representative who directly supervises the engineering and administration of a contract.
Proposal	A written offer by a bidder on forms furnished by the Division to do stated work at the prices quoted.
Plans Specifications and & Estimates (PS&E)	Plans, Specifications, and Estimates: Usually it refers to the time when the plans, specifications, and estimates on a project have been completed and referred to FHWA for approval. When the PS&E has been approved, the project goes to bidding.
Pumping	The ejection of mixtures of water, clay, and/or silt along or through transverse or longitudinal joints, crack or pavement edges, due to vertical movements of the roadway slab under traffic.
Queue	A line of vehicles waiting to be served by the highway system. The queue can be determined graphically, as shown in the WZ Traffic Analysis Guide, Chapter 2.
Raised Median	A non-traversable median where curbs are used to help delineate the boundary between the median and the adjacent traffic lane and to elevate the surface of the median above the surface of the adjacent traffic face.

Term	Definition
RAME	Region Access Management Engineer – An individual, who is a registered professional engineer and who, by training and experience, has comprehensive knowledge of ODOT's access management standards, policies, and procedures and has professional expertise in traffic engineering concepts which underlie access management principles.
Realignment	Rebuilding an existing roadway on a new alignment where the new centerline shifts outside the existing right-of-way and where the existing road surface is removed, maintained as an access road, or maintained as a connection between the realigned roadway and a road that intersects the original alignment.
Redline	Marked up drawing, typically in red pencil, with review comments or changes proposed.
Region Traffic Engineer/Manager	Registered Professional Engineer, or person working under direct supervision of a Registered Professional Engineer, responsible for traffic operations in the Region. Actual position titles may vary from region to region.
Right-of-Way	A general term denoting publicly-owned land, property or interest therein, usually in a strip acquired or devoted to transportation purposes. The entire width between the exterior right-of-way lines including the paved surface, shoulders, ditches, and other drainage facilities in the border area between the ditches or curbs and right-of-way line.
Riprap	A facing of stone used to prevent erosion. It is usually dumped into place, but is occasionally placed by hand.
Road Designer	The person assigned to specify the project requirements for the road portion of a given project.
Roadside Barrier	A longitudinal barrier used to shield roadside obstacles or non-traversable terrain features. It may occasionally be used to protect pedestrians from vehicle traffic.
Roadway	That portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the berm or shoulder. If a highway includes two or more separate roadways, the term "roadway" refers to any such roadway separately, but not to all such roadways collectively.
Rubble	Irregularly shaped pieces of varying size stone in the undressed condition obtained from a quarry.
Sand	Particles of rock that will pass a No. 4 sieve and be retained on a No. 200 sieve.
Scaffolding	Temporary elevated walkway or platform to support workmen, materials and tools.
Scarify	To loosen, break up, tear up, and partially pulverize the surface of soil or of a road.

Term	Definition
Scour	Erosion of a river bed area caused by water flow.
Screeding	The process of striking off excess material to bring the top surface to proper contour and elevation.
Seal	A concrete mass poured under water in a cofferdam that is designed to resist hydrostatic uplift. The seal facilitates construction of the footing in dry conditions.
Seasonal Adjustments	Adjusting the traffic count data so that it reflects the time of year during which construction will take place, if different from the traffic count date.
Seed File	A CAD file which has been set up with certain generic parameters. Typically they come with certain reference files attached.
Shoofly	Detour alignment of temporary roadway around a fixed object, such as a railroad track or bridge. Very similar to an on-site diversion, yet often less formal in its design and anticipated duration.
Shotcrete	Mortar or concrete pneumatically projected at high velocity onto a surface.
Shoulder(s)	[ORS 801.480] The portion of a highway, whether paved or unpaved, contiguous to the roadway that is primarily used by pedestrians, for the accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses, exclusive of auxiliary lanes, curbs, and gutters.
Shrinkage	Contraction of concrete due to drying and chemical changes, dependent on time.
Shy Distance (E-Distance)	The distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate hazard by the typical driver, to the extent that the vehicle's placement or speed will be changed. Often it is an extra 2′ added to the right shoulder where roadside barriers are used. The left shoulder is increased only when the shoulder is 10′ or more.
Sight Distance	The length of roadway ahead visible to the driver.
Silt	Soil, passing a No. 200 sieve that is non-plastic or exhibits very low plasticity.
Slope	The degree of inclination to the horizontal. Usually expressed as a: • ratio, such as 25:1, indicating 1 unit rise in 25 units of horizontal distance or run, i.e. run/rise ratio, • decimal fraction (0.04), • degree (2˚) or • percent (4%).
Slope Paving	Pavement placed on the slope in front of an abutment to prevent soil erosion.

Term	Definition
Special Event	Any planned activity that brings together a community or group of people for an expressed purpose including, but not limited to, parades, bicycle races, road runs and other activity that result in changes to traffic volumes on the state highway creating total or partial closure of state highways or state highway sections.
Special Provisions	The specifications for a project that augment and have authority over the standard and supplemental specifications. They are commonly referred to as “specials”.
Specifications	The body of directions, provisions, and requirements, together with written agreements and all documents of any description, made or to be made, pertaining to the method or manner of performing the work, the quantities, and the quality of materials to be furnished under the contract.
Standard Detail	A detail which can be copied from one project to another and can be modified to fit the project needs.
Standard Drawings	Detailed drawings for work or methods of construction that are selectively included in a project book.
Standard Specifications	Detailed specifications for project work, found in the Oregon Standard Specification Construction Book.
State Highway	The State Highway System as designated by the Oregon Transportation Commission, including the Interstate system.
State Highway Index Number	An Oregon Transportation Commission approved identifier assigned to a highway. Every state highway has a state highway index number, commonly referred to as a State Highway Number.
State Highway Name	An Oregon Transportation Commission approved name used in conjunction with a State Highway Index Number to identify a state highway.
State Highway System	Public roads owned and operated by the State of Oregon through the Oregon Department of Transportation.
State Plane Coordinates	The plane-rectangular coordinate system established by the United States Coast and Geodetic Survey. Plane coordinates are used to locate geographic position.
Station	A distance of 100 feet measured horizontally.
Stirrup	Vertical U-shaped or rectangular shaped bars placed in concrete beams to resist the shearing stresses in the beam.
Structures	Bridges, retaining walls, endwalls, cribbing, buildings, culverts, manholes, catch basins, drop inlets, sewers, service pipes, underdrains, foundation drains, and other like or similar features which may be encountered in the work.

Term	Definition
Subbase	A course of specified material of specified thickness between the subgrade and a base.
Subgrade	The top surface of completed earthwork on which subbase, base, surfacing, pavement, or a course of other material is to be placed.
Sufficiency Rating	A method of evaluating data by calculating four separate factors to obtain numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100% would represent an entirely sufficient bridge and 0% would represent an entirely insufficient or deficient bridge.
Superelevation	The difference in elevation between the inside and outside edges of a roadway in a horizontal curve; required to counteract the effects of centrifugal force.
Superstructure	Those parts of a structure above the substructure, including bearing devices.
TEA-21	The Transportation Equity Act for the 21st century.
Tining	Used on finished concrete deck or slab surfaces to provide friction and reduce hydroplaning. Grooves are placed in the plastic concrete or cut into the hardened concrete.
Traffic Control Device (TCD)	Any sign, signal, marking, or device placed, operated or erected for the purpose of guiding, directing, warning or regulating traffic. Any device that remotely controls another traffic control device by electrical, electronic, sound or light signal. Any sign that is held or erected by a highway maintenance or construction crew working in the highway.
Traffic Lane	That part of the traveled way marked for moving a single line of vehicles.
Traveled Way	That part of the roadway for moving vehicles, exclusive of shoulders and auxiliary lanes.
Traversable Median	A median that by its design does not physically discourage or prevent vehicles from entering upon or crossing it and are typically built to provide a separation between opposing traffic but do not impede traffic from crossing the median. Such medians include painted medians and continuous two-way left-turn lanes.
Typical Section	A cross-section established by the plans which represents in general the lines to which the contractor shall work in the execution of the contract.
UGB	Urban Growth Boundary – The area surrounding an incorporated city in which the city may legally expand its city limits.
US Route	A route system established by the US Congress to facilitate travel on main highway throughout the nation. This route system is regulated by an AASHTO committee.

Term	Definition
Utility	A line, facility, or system for producing, transmitting, or distributing communications, power, electricity, heat, gas, oil, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity which directly or indirectly serves the public. The term utility shall also mean the utility company, district, or cooperative, including any wholly owned or controlled subsidiary.
V/C Ratio	Volume to Capacity Ratio – A measure of roadway congestion, calculated by dividing the number of vehicles passing through a section of highway during the peak hour by the capacity of the section. V/C is the mobility criteria for Oregon highways, as defined in the 1999 Oregon Highway Plan.
VMT	Vehicle Miles of Travel – Miles traveled per vehicle multiplied by the total number of vehicles.
Warning Lights	Portable, lens-directed, enclosed lights. The color of the light emitted shall be yellow. They may be used in either a steady-burn or flashing mode. Refer to MUTCD, Section 6F.72.
Warrants	The criteria by which the need for a safety treatment or improvement can be determined.
Water/Cement Ratio	The weight of water divided by the weight of cement in a concrete; ratio controls the strength of the concrete.
Wearing Surface	The top layer of a pavement designed to provide structural values and a surface resistant to traffic abrasion.
Weep Hole	A drain hole through a wall to prevent the building up of hydraulic pressure behind the wall.
Wet Signature	Final Mylar plots requiring the signature of the responsible professional and must be signed by hand. Electronic versions of professional stamps are acceptable, but signatures are not.
Work Zone (WZ)	An area of a highway with construction, maintenance or utility work activities. It extends from the first warning sign to the "End Road Work" sign or the last traffic control device.
WZ Traffic Analysis Request Form	The form requesting to have WZ Traffic Analysis performed for a project. Most commonly filled out by TCP Designers or Transportation Project Managers and sent to a WZ Traffic Analyst. A copy of the ODOT Request Form is included in Appendix C.

Appendix C: Forms

Print Form

Work Zone Decision Tree

Evaluate Separation Opportunities, WZ Concepts, WZ Devices

Project Name (Section) | Key No. | Contract No.

Highway | Project Leader / Project Manager | Agency Project Manager | Region

Phase: ☐ 1 – Scoping ☐ 2 – Project Initiation to DAP ☐ 3 – DAP to Final PS&E ☐ 4 – Construction

Contractor

Opportunities to Evaluate	Phase	Possible / Viable	Impacts	Stakeholders & Input	Status Recommendation (R) / Decision (D)
Road closure (full closure, directional closure)	1				
Crossover/on-site diversion	1				
Rigid barrier (concrete, steel, temporary guardrail)	1				
Daytime / nighttime evaluation	1				
Staged construction with temporary widening	1				
Standard lane closures with channelizing devices	1				
Law enforcement overtime	1				
Smart Work Zone System/Work Zone ITS	1				
Accelerated contracting strategies	1				
Accelerated construction strategies	1				
Automated Flagger Assistance Devices (AFAD)	1				
Temporary Transverse Rumble Strips (TTRS)	1				
Radar speed trailers	1				
Construction Speed Zone Reductions	1				
Increased lateral buffer space	1				
Public information campaigns	1				
Other:	1				
	2				
	3				
	4				

ADD ANOTHER ITEM

Figure C-1: Work Zone Decision Tree Form

OREGON DEPARTMENT OF TRANSPORTATION
Traffic-Roadway Section
Traffic Standards & Asset Management Unit MS#5
4040 Fairview Industrial Drive SE
Salem, Oregon 97302-1142

WORK ZONE SPEED REDUCTION REQUEST FORM

Reset Form | Save As | Print Form

Complete this form to request a speed reduction in a work zone on an Oregon State Highway. **The presence of one or more factors from Section 6 of this form may not necessarily result in a reduced speed.** Traffic Engineering staff will determine if a speed reduction is needed from a review of the construction scope of work and the traffic control plan. Some conditions may benefit better from temporary traffic control measures other than a speed reduction.

The request must be reviewed and signed by the Construction Project Manager, Traffic Control Plan Designer, and Region Traffic Manager before submitting to the Traffic-Roadway Section for a Letter of Support or Construction Speed Zone Order. With a State Traffic Engineer Letter of Support and no changes to the traffic control plan, only the Construction Project Manager review and signature is required before resubmitting the Form to the Traffic-Roadway Section for a Construction Speed Zone Order. For permit projects, only the District Manager review and signature is required before submittal.

Submit this form and a copy of the Traffic Control Plan to the ODOT Traffic-Roadway Section (Attn: Kathi McConnell) for review. Please allow 10 business days for review and response of the request.

For help and instructions, see the Form's Instructions and Definitions document. Work zone speed zone reductions are generally not warranted when:

- Activities are more than ten feet from the edge of the traveled way; or,
- Activities are an intermittent or mobile operation on the shoulder.

SECTION 1 - PROJECT INFORMATION

PROJECT NAME	CONTRACT, KEY, BUNDLE #	BID DATE	START WORK DATE

HIGHWAY [?]	PROJECT START MP	PROJECT END MP	COUNTY

REQUESTING A:			CONST. SPEED ZONE ORDER REQUESTS		REQUEST DATE
☐ State Traffic Engineer Letter of Support	☐ Construction Speed Zone Order	☐ Amend Existing Const. SZ Order	☐ Have STE Letter of Support	☐ No changes to Traffic Control Plan	

SECTION 2 - EXISTING CONDITIONS

EXISTING POSTED SPEED [?]	AADT (VEH/DAY) [?]	SPIS PERCENTILE [?]

Describe in detail any unique site conditions that may conflict with normal driver expectancy (e.g.: limited sight distance due to changes in horizontal/vertical alignments, etc.)

SECTION 3 - DESCRIPTION OF NEED

Describe in detail the scope of work, and condition or operation which would merit a construction speed reduction. Identify the portion(s) of the traffic control plan that impacts normal driver expectancy and would benefit from a speed reduction. If more than one condition or operation, describe in separate paragraphs.

SECTION 4 - LOCATION

Describe the operation's or condition's location. Include beginning and ending mileposts. Include the requested speed limit for each operation or condition. If other than mileposts, please describe using the Traffic Control Plan. If more than one condition or operation, describe in separate paragraphs.

Work Zone Speed Reduction Request Form
734-2874 (3/12)

Page 1 of 2

Oregon Department of Transportation
Traffic-Roadway Section

Figure C-2: Work Zone Speed Reduction Request Form (1/2)

WORK ZONE SPEED REDUCTION REQUEST FORM

PROJECT:
DATE:

HIGHWAY: , **MP - MP**
COUNTY:

SECTION 5 - TIMING

Describe when the operation or condition will be in place using stage/phase, specific activity, project milestone, or time of day, etc. If more than one condition or operation, describe in separate paragraphs.

SECTION 6 - FACTORS

Select the work type and factor(s) for the construction speed zone reduction and explain. Work type definitions and diagrams are located in the Form's Instructions and Definitions. ***The presence of one or more factors does not necessarily result in a reduced speed.*** *Some conditions may benefit better from temporary traffic control measures other than a speed reduction.*

GENERAL CONDITIONS

- ☐ Temporary horizontal curve is designed and includes an advisory speed >10 mph below pre-construction posted speed.
- ☐ Reduced safe speed for stopping sight distance.
- ☐ Condition conflicts with normal driver expectancy.

SHOULDER ACTIVITIES

- ☐ Uninterrupted traffic flow with workers present for extended periods, within 10 feet of the traveled way, unprotected by barrier.

LANE ENCROACHMENTS, CENTERLINE ENCROACHMENTS, OR LANE CLOSURES

- ☐ Uninterrupted traffic flow with workers present for extended periods, within 10 feet of the traveled way or in a closed lane, unprotected by barrier.
- ☐ Barrier within 2 feet of the traveled way.
- ☐ Pavement edge drop-off (>2 inches) within 2 feet of the traveled way.
- ☐ Lane width reduction resulting in a lane width of ≤11 feet on freeways, ≤10 feet on non-freeways.

TEMPORARY ON-SITE DIVERSION

- ☐ Temporary on-site diversion lane widths ≤11 feet.
- ☐ Advisory speed for temporary on-site diversion's horizontal curvature >10 mph below the pre-construction posted speed.

SECTION 7 - SIGNATURES

The request must be reviewed and signed by the Construction Project Manager, Traffic Control Plan Designer, and Region Traffic Manager before submitting to the Traffic-Roadway Section for a Letter of Support or Construction Speed Zone Order. With a State Traffic Engineer Letter of Support and no changes to the traffic control plan, only the Construction Project Manager review and signature is required before resubmitting the Form to the Traffic-Roadway Section for a Construction Speed Zone Order. For permit projects, only the District Manager review and signature is required before submittal.

REQUESTED BY	EMAIL	PHONE
CONSTRUCTION PROJECT MANAGER*	SIGNATURE	DATE
	X	
TRAFFIC CONTROL PLANS DESIGNER**	SIGNATURE	DATE
	X	
REGION TRAFFIC MANAGER**	SIGNATURE	DATE
	X	

*For permit work: District Manager
**Not needed for permit work

Work Zone Speed Reduction Request Form
734-2874 (3/12)

Page 2 of 2

Oregon Department of Transportation
Traffic-Roadway Section

Figure C-3: Work Zone Speed Reduction Form (2/2)

OREGON DEPARTMENT OF TRANSPORTATION
Traffic-Roadway Section
Traffic Standards & Asset Management Unit MS#5
4040 Fairview Industrial Drive SE
Salem, Oregon 97302-1142

TEMPORARY TRANSVERSE RUMBLE STRIP REQUEST FORM

TRAFFIC CONTROL PLANS UNIT USE ONLY	
Received By:	Date Received:
Assigned To:	Date Completed:

Complete this form to request Temporary Transverse Rumble Strips (TTRS) in a work zone on an Oregon State Highway. The State Traffic Engineer must approve all TTRS applications on State Highways. Traffic Engineering staff will determine if using TTRS is acceptable from a review of the construction scope of work and the traffic control plan.

The request must be reviewed and signed by the Construction Project Manager and Traffic Control Plan Designer before submitting to the Traffic-Roadway Section for a State Traffic Engineer Approval Letter. For permit projects, only the District Manager review and signature is required before submittal.

Submit this form and a copy of the Traffic Control Plan to the ODOT Traffic-Roadway Section (Attn: Scott McCanna) for review. Please allow 15 business days for review and response of the request.

TTRS are meant to attract the driver's attention to highly unusual conditions, such as conditions requiring a stop when one is not expected. Some conditions may benefit better from temporary traffic control measures other than TTRS. Studies have shown that TTRS are generally not effective as speed control devices. Generally, TTRS should not be placed:

- On sharp horizontal or vertical curves;
- Through pedestrian crossings;
- On bicycle routes; or
- On roadways used by bicyclists unless a minimum clear path of 4 feet is provided:
  - at each edge of the roadway, or
  - on each paved shoulder as described in AASHTO's "Guide to the Development of Bicycle Facilities."

SECTION 1 - PROJECT INFORMATION

PROJECT NAME	CONTRACT KEY NUMBER		START WORK DATE	REQUEST DATE
HIGHWAY [?]	PROJECT START MP	PROJECT END MP	COUNTY	

SECTION 2 - EXISTING CONDITIONS

POSTED SPEED [?]	AADT (VEH/DAY) [?]	
Describe in detail any unique site conditions that may conflict with normal driver expectancy (e.g.: a required stop or abrupt alignment change when one is not expected, etc.)		

SECTION 3 - DESCRIPTION OF NEED

Describe in detail the scope of work, and condition or operation which would benefit from transverse rumble strips. If more than one condition or operation, describe in separate paragraphs. Answer this question: why are TTRS needed?

SECTION 4 - LOCATION

Describe the operation's or condition's location. Include beginning and ending milepoints. If other than milepoints, describe using the Traffic Control Plan. If more than one condition or operation, describe in separate paragraphs. Answer this question: where are TTRS needed?

Temporary Transverse Rumble Strip Request Form
734-2886 (8/12)

Page 1 of 2

Oregon Department of Transportation
Traffic-Roadway Section

Figure C-4: Temporary Transverse Rumble Strip Form (1/2)

TEMPORARY TRANSVERSE RUMBLE STRIP REQUEST FORM

PROJECT: HIGHWAY: , MP - MP

DATE: COUNTY:

SECTION 5 - TIMING

Describe when the operation or condition will be in place using stage/phase, specific activity, project milestone, or time of day, etc. If more than one condition or operation, describe in separate paragraphs. Answer this question: when are TTRS needed?

SECTION 7 - SIGNATURES

The request must be reviewed and signed by the Construction Project Manager and Traffic Control Plan Designer before submitting to the Traffic-Roadway Section for a State Traffic Engineer Approval Letter. For permit projects, only the District Manager review and signature is required before submittal.

REQUESTED BY	EMAIL	PHONE
TRAFFIC CONTROL PLANS DESIGNER*	SIGNATURE	DATE
	X	
CONSTRUCTION PROJECT MANAGER**	SIGNATURE	DATE
	X	

*Not needed for permit work

**For permit work: District Manager

Temporary Transverse Rumble Strip Request Form
734-2686 (6/12)

Page 2 of 2

Oregon Department of Transportation
Traffic-Roadway Section

Figure C-5: Temporary Transverse Rumble Strip Form (2/2)

Traffic Analysis Work Request Form

Key No: __________ Prefix: ________________ County: _________________

Project Name: ____

Hwy. Name: __________________________________ Hwy. No.: __________

Beginning MP: __________ End MP: __________

Requested by: __________________________________ Phone: ________________

Section: ____

Request Date: __________ Due Date: __________ Date Out: __________

Job Field Options

- ☐ Project Analysis
- ☐ Interchange Analysis
- ☐ Signal Analysis
- ☐ Storage Analysis
- ☐ Cost Analysis
- ☐ Detour Analysis
- ☐ Work Zone

Projected Work Required

- ☐ Two Way - One Lane
- ☐ Daily Lane Closures
- ☐ Extended Lane Closures
- ☐ Limited Total Closures/Blasting
- ☐ Full Closures/Detour
- ☐ Chip Seal
- ☐ Left Turn Storage
- ☐ Signals
- ☐ Slow Downs
- ☐ Extra Closure Lengths

Brief Project Summary:

Figure C-6: Example Traffic Analysis Form

Appendix D: Traffic Control Plans Checklist

Traffic Control Task/Item	Notes	
This list is an attempt to capture all of the items included in Traffic Control Plan Development and is by no means comprehensive.		
Transportation Management Plan	See the FHWA Publication Developing and Implementing TMP for Work Zones - Appendix A for TMP Checklist	☐
Project Description		
Project Background		☐
Project Type		☐
Project Area/Corridor		☐
Project Goals and Constraints		☐
Permit Requirements		☐
Proposed Construction Phasing/Staging		☐
General Schedule and Timeline		☐
Related Projects		☐
Existing Conditions		
Roadway Characteristics		☐
Pre-Construction Posted Speed		☐
Traffic Data (volumes, speed, capacity, etc)		☐
Traffic Operations		☐
Crash Data		☐
Community Input		☐
Project Conditions		
Roadway Characteristics		☐
Vertical/Horizontal Clearances		☐
Abrupt Edges		☐
Traffic Projections		☐
Mobility		☐
Delay		☐
Motor Carrier Notification and Coordination		☐
Traffic Operations		☐
Temporary or Portable Signals		☐
Haul Routes & Waste Sites		☐
Traffic Analysis		☐
Lane Allowances and Restrictions		☐
Local Events		☐
Holidays & Weekends		☐
Community Input		☐
Construction Approach/Phasing/Staging Strategy		☐
Utility Operations		☐
Alternative Contracting Methods		☐

Figure D-1: TCP Checklist (1/4)

Temporary Traffic Control Strategies		
Traffic Control Strategies		☐
Speed Zone Reduction (Temporary), STE Approval		☐
Traffic Signal (Temporary), STE Approval		☐
Shoulder Closure		☐
Lane Closure(s)		☐
Full Closure		☐
Detour		☐
Weight Restrictions		☐
Vertical/Horizontal Clearances		☐
Detour Signs/Striping - Both Directions		☐
Geometrics		☐
Local government/community notification and input		☐
Access - Business/Residential		☐
Non motorized user detours		☐
Emergency/Public Transit/School/Mail impacts		☐
Detour Agreement		☐
Crossover		☐
Rolling Slowdown		☐
Diversion		☐
Extended Traffic Queue's		☐
Night Work		☐
Flaggers/Pilot Cars		☐
Lane Shift		☐
Blasting Traffic Control - closure		☐
Traffic Control Devices		☐
Temporary Signs (see TCP Cost Estimator for list of signs)		☐
Temporary Striping		☐
Channelization Devices		☐
Rumble Strips, STE Approval		☐
Pavement Markers		☐
Barricades		☐
Barrier (Concrete & Guardrail		☐
Glare Shields		☐
Temporary Barrier Panels		☐
Impact Attenuators		☐
Sequential Arrow Signs		☐
Portable Changeable Message Signs		☐
Temporary Traffic Signals (Portable)		☐
Flagger Station Lighting		☐
Portable Traffic Management System		☐
Steel Plates in Roadway		☐

Figure D-2: TCP Checklist (2/4)

Traffic Control Bid Items(Check TCP Cost Estimator)	
TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	
TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	
TEMPORARY SIGNS	
TEMPORARY BARRICADES, TYPE II or III	
TEMPORARY GUARDRAIL, TYPE 2A, 3, or 4 REFLECTORIZED	
TEMPORARY GUARDRAIL TERMINALS, FLARED or NON-FLARED	
TEMPORARY GUARDRAIL TRANSITION	
TEMPORARY BRIDGE CONNECTIONS	
TEMPORARY CONCRETE BARRIER, REFLECTORIZED	
TEMPORARY CONCRETE BARRIER, TALL, REFLECTORIZED	
MOVING TEMPORARY CONCRETE BARRIER	
TEMPORARY IMPACT ATTENUATOR	
MOVING TEMPORARY IMPACT ATTENUATORS	
TEMPORARY IMPACT ATTENUATOR, TRUCK MOUNTED	
TEMPORARY GLARE SHIELDS	
MOVING TEMPORARY GLARE SHIELDS	
REFLECTIVE BARRIER PANELS	
PEDESTRIAN CHANNELIZING DEVICES	
REPAIR TEMPORARY IMPACT ATTENUATOR	
SURFACE MOUNTED TUBULAR MARKERS	
REPLACE SURFACE MOUNTED TUBULAR MARKERS	
TEMPORARY PLASTIC DRUMS	
TEMPORARY DELINEATORS	
TEMPORARY REFLECTIVE PAVEMENT MARKERS	
TEMPORARY FLEXIBLE PAVEMENT MARKERS	
TEMPORARY REMOVABLE TAPE	
TEMPORARY NON-REMOVABLE TAPE	
TEMPORARY NON-REFLECTIVE TAPE	
TEMPORARY STRIPING	
TEMPORARY PAVEMENT LEGENDS	
TEMPORARY PAVEMENT BARS	
TEMPORARY TRANSVERSE RUMBLE STRIPS	
STRIPE REMOVAL	
LEGEND REMOVAL	
TEMPORARY ILLUMINATION	
TEMPORARY TRAFFIC SIGNAL	
PORTABLE TRAFFIC SIGNAL	
SEQUENTIAL ARROW SIGNS	
PORTABLE CHANGEABLE MESSAGE SIGNS	
OVERHEIGHT VEHICLE WARNING SYSTEM	
PORTABLE TRAFFIC MANAGEMENT SYSTEM MOBILIZATION	
PORTABLE TRAFFIC MANAGEMENT SYSTEM	
FLAGGERS	
FLAGGER STATION LIGHTING	
AUTOMATED FLAGGER ASSISTANCE DEVICE	
TRAFFIC CONTROL SUPERVISOR	
PILOT CARS	

Figure D-3: TCP Checklist (3/4)

Public Information Strategies		
Public Awareness Strategies		☐
Business Access Delineation & Signing		☐
Pilot Car Local Residence/Business Notification		☐
Motorist Information Strategies		☐
Portable Traffic Management Systems		☐
Use of Permanent VMS		☐
Transportation Operations Strategies		
Demand Management Strategies		☐
Emergency Vehicles		☐
Corridor/Network Management Strategies		☐
Work Zone Safety Management Strategies		☐
Positive Protection for Workers		☐
Traffic/Incident Management and Enforcement Strategies		☐
Work Zone Enforcement		☐
Tow Truck		☐
Contract Deliverables		
Specifications		☐
Standard Specifications		☐
Boilerplate Special Provisions		☐
Unique Special Provisions		☐
Custom Special Provision		☐
Plans		☐
Standard Drawings		☐
Traffic Control Details		☐
Traffic Control Plans - Stage and Phase Plans		☐
Detour Plan		☐
Cross Sections		☐
Estimate		☐

Figure D-4: TCP Checklist (4/4)

Appendix E: Design Conversion Charts

Table E-1: Sizing Increments

English (Inches)	Metric (mm)
3	76
6	152

Table E-2: Sign Letter Heights

English (Inches)	Metric (mm)
4	102
5	127
6	152
8	203
10	254
10 2/3	271
12	305
13 1/3	339
15	381
16	406
18	457

Table Appendix E-3: Border and Radius Sizes

English (Inches)	Metric (mm)
½	13
1	25
1 ½	38
2	51
3	76
6	152
9	229
12	305

Table E-4: Arrow Sizes

English (Inches)	Metric (mm)
4 X 6	102 X 152
5 X 7	127 X 178
6 X 9	152 X 229
8 X 12	203 X 305
10 X 16	254 X 406
15 1/8 X 24 ¼	384 X 616
18 ¼ X 29 ¼	464 X 743
22 ¼ X 35 5/8	565 X 905

Appendix F: Work Zone Unit Member's Roles and Responsibilities

State Work Zone Engineer

- Manages the statewide temporary traffic control plan design program. Oversees functions and activities within the ODOT Traffic Control Plans Unit.
- Responsible for developing, updating, teaching and interpreting statewide design standards and practices used in the development of temporary traffic control plans for long and short-term highway construction projects and maintenance operations.
- Oversees the development of Standard Specifications, Special Provision language and Standard Drawings used in the development of temporary traffic control plans.
- Provides technical support to ODOT Region Design offices, consulting engineering firms, City and County agencies, private utility companies, and contractors in the development of traffic control plans, selecting appropriate traffic control measures, solving project-specific challenges, or crafting project-specific special provision contract language.
- Provides technical support for region construction personnel in exploring traffic control plan modifications; the interpretation of specification language; implementation of temporary traffic control measures; or, addressing work zone traffic operational issues.
- Provides technical support and responses to members of the public through inquiries made through ODOT's ***Ask ODOT*** website.
- Manages and publishes the ODOT "***Traffic Control Plans Design Manual***".
- Manages and publishes the "***Oregon Short Term Traffic Control Handbook for Operations of 3 Days or Less***".
- Coordinates and publishes the annual ODOT "***Work Zone Review Summary Report***".
- Manages and participates in the maintenance of Sections 00220 through 00229 of the ***Oregon Standard Specifications for Construction***.
- Leads quarterly meetings of the ***ODOT Statewide Work Zone Action Group (SWAG)*** of region TCP designers. Meetings are used to maintain statewide work zone and traffic control design consistency and application of statewide standards and practices; and, to exchange discipline information and current developments/technologies.

Traffic Work Zone Standards Engineer

- Responsible for development, maintenance, interpretation of temporary traffic control plans design practices and standards, standard specifications, special provisions, standard drawings, and cost estimate data.
- Researches, develops and recommend new/modified statewide standards, specifications, and procedures related to temporary traffic control plan design. Reviews and recommends exceptions to statewide design standards, specifications and design procedures.
- Provides technical assistance to region traffic control plans designers, City and County Public Works agencies and consulting firms in the design of Traffic Control Plans.
- Participates as a member of the ***Qualified Products List Committee***. Provides input to the committee regarding the testing, application, approval or disapproval of temporary traffic control devices and products submitted by vendors.
- Provides technical support to ODOT region design offices, consulting engineering firms, City and County agencies, private utility companies, and contractors in the development of traffic control plans, selecting appropriate traffic control measures, solving project-specific challenges, or crafting project-specific special provision contract language.
- Provides technical support for region construction personnel in exploring traffic control plan modifications; the interpretation of specification language; implementation of temporary traffic control measures; or, addressing work zone traffic operational issues.
- Assists the work zone engineer in leading quarterly meetings of the ***ODOT Statewide Work Zone Action Group (SWAG)*** of region TCP designers.

Traffic Work Zone Analyst

- Manages the statewide work zone Traffic Analysis discipline as part of the Traffic Control Plans Unit. Responsible for the development, maintenance, and use of ODOT's ***work zone Traffic Analysis tool***; and, publication of the ***ODOT work zone Traffic Analysis Manual***.
- Manages the curriculum for, and delivers ODOT's two-day "***work zone Traffic Analysis***" class.
- Researches, develops and recommends new/modified statewide standards, specifications, and procedures related to work zone traffic analysis. Reviews and recommends exceptions to traffic analysis and operation-related design standards, specifications and procedures.
- Provides technical support to ODOT region design offices, consulting engineering firms, City and County agencies, private utility companies, and contractors in the development of traffic control plans, selecting appropriate traffic control measures, solving project-specific challenges, or crafting project-specific special provision contract language.
- Provides technical support for region construction personnel in exploring traffic control plan modifications; the interpretation of specification language; implementation of temporary traffic control measures; or, addressing work zone traffic operational issues.
- Assists the work zone engineer in leading quarterly meetings of the ***ODOT Statewide Work Zone Action Group (SWAG)*** of region TCP designers.

ODOT provides a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive.

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