Washington State

TRAFFIC CONTROL SUPERVISOR (TCS)

Training Course

3-Day TCS Certification
1-Day TCS Recertification

Developed by Washington Department of Transportation
By Authorization of the
Washington State Traffic Control Oversight Committee

January 2025

Washington State Department of Transportation

Foreword

For Washington State Traffic Control Supervisors:

Concern for the safety of workers and all road users within work zones for construction and maintenance activities have prompted federal, state, and local transportation organizations to seek improvement in workers' understanding of proper traffic control signage and setup. Training and certification of persons setting up and removing traffic control devices is becoming more prevalent among all jurisdictions.

The foundation of this three-day certification course for Traffic Control Supervisors has been developed by Washington State Department of Transportation (WSDOT) from the following sources:

1. Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD), particularly Part 6 as modified by WSDOT
2. WSDOT policies, standards, and guidelines related to temporary traffic control and safety of workers and traveling public during highway construction and maintenance operations
3. Work zone-related state laws and regulations per the Revised Code of Washington (RCW) and Washington Administrative Code (WAC)

This course book in addition to Part 6 of the MUTCD will be provided to each student and are allowed to be used as references during the certification exam at the end of the course. By achieving a score of 80% or better on the exam, you will be issued a Washington State Traffic Control Supervisor certification card valid for four years from the date of your examination.

This training program is designed to meet the Traffic Control Supervisor certification requirements per *WSDOT Standard Specifications for Road, Bridge and Municipal Construction* for Contractors.

For additional information regarding TCS requirements, contact WashingtonTCOC@wa.gov.

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Chapter 1 : Introduction

1.1 Navigating Hyperlinks

The electronic version of this course book (PDF) contains several hyperlinks in underlined, blue text which is activated by left-clicking on it. Table of Contents contains hyperlinks as well, even though the text is not blue or highlighted. External hyperlinks open a webpage in a separate browser.

For ease of use, there are several internal hyperlinks will take the user to other sections of the Coursebook. To return to the original location, press "Alt + Left Arrow" at the same time.

1.2 "Find" Feature

This coursebook is also searchable.

Either press "Ctrl + F" at the same time or go into the Edit menu and select Find.

A "Find" icon will pop up. Then search for desired keyword, such as "PCMS". Then click "Next" to continue going through the coursebook wherever the keyword shows up.

1.3 Summary

The responsibility and complexity of providing safe and efficient temporary traffic control through highway work areas is tremendous. The difficulty of performing these operations correctly is a concern to highway officials at the federal, state and local levels.

This chapter covers "Washington State Traffic Control Supervisor" certification requirements, course scope, and course objectives.

1.4 Traffic Control Supervisor Certification & Recertification Requirements

For **first-time** Traffic Control Supervisor certification, you must meet the following requirements:

- ☐ 2000+ hours of traffic control experience verified by 2 letters of recommendation signed by current/previous employers or persons familiar with applicant's traffic control experience.
- ☐ Current flagging card from Washington, Oregon, Idaho, or Montana
- ☐ Attend the 3-day Washington TCS certification training course
- ☐ Pass the open book, 50-question exam (80% or better score) within the allotted 2-hour time limit

To **renew an existing** Traffic Control Supervisor certification, you must meet the following requirements:

- ☐ Current Washington TCS card or one expired 6 months or less
- ☐ Current flagging card from Washington, Oregon, Idaho, or Montana
- ☐ Attend the 1-day Washington TCS recertification training course
- ☐ Pass the open book, 25-question exam (80% or better score) within the allotted 1-hour time limit

The Traffic Control Supervisor certifications are valid for 4 years from the issue date.

Reminder: Washington Flagger certifications are only valid for 3 years. If the flagger certification is invalid, that makes the TCS certification invalid as well.

Reminder: A Washington TCS card is required for WSDOT projects; other state TCS cards not accepted.

1.5 Course Scope

This course provides comprehensive training for interpreting, installing, maintaining, and evaluating temporary traffic control for work zones while emphasizing safety issues of road users and highway workers as appropriate. Special importance is placed on the duties and responsibilities of the Traffic Control Supervisor and Traffic Control Manager.

The principles presented in the course apply to the following:

- All roads open to public travel: streets, roads, highways, and freeways (all jurisdictions)
- Urban, suburban, and rural work zones
- Work zones of various duration and complexity, including daytime and nighttime
- Construction, maintenance, utility work, emergency incident response operations, and special events TTC zones.

Traffic control procedures and devices presented as acceptable current practices are based on Part 6 of the MUTCD, which provides minimum national standards and guidelines; but also include recommendations based on successful practices by the Washington Department of Transportation (WSDOT) and several other highway agencies that exceed the minimum MUTCD requirements.

1.6 Course Objectives

The course is designed to provide fundamental principles and practices for work zones enabling students to provide safe and efficient operation of temporary traffic control. Of critical importance is the need to employ consistent temporary traffic control recognized by road users throughout the country, adhere to recognized standards, and to meet all legal requirements. The course stresses successful, effective practices while discouraging poor practices in work zones.

Course objectives include:

1. Gain an understanding on temporary traffic control principles, standards, guidelines, devices, and plans
2. Selection of appropriate traffic control plan(s) for a specific work operation and location.
3. Make minor traffic control plan modifications as appropriate to address site specific features.
4. Accommodation of all road users including bicyclists, pedestrians, and pedestrians with disabilities.

Chapter 2 : Traffic Control Regulations & Resources

2.1 Summary

This chapter covers regulatory requirements that apply to temporary traffic control in work zones in addition to various manuals and guides providing useful work zone related information. Additional resources and manuals will be introduced throughout this course manual in other chapters.

2.2 National Regulations for Work Zones

There are two key pieces of federal regulation related to work zones that are controlled by the Federal Highway Administration (FHWA):

- **23 CFR Part 630 J "Work Zone Safety and Mobility" (Updated December 2024)**
  - MUTCD sets forth basic principles, prescribes standards, and provides guidance for traffic control on all public roads.
  - All personnel involved in work zones shall be trained to a level appropriate to the job decisions that the individual is required to make and be retrained periodically.
  - As a multi-disciplinary team, States shall perform work zone programmatic reviews on 5-year cycles to continually improve work zone safety and mobility.
  - Temporary traffic control plans (TCPs) & Contract Provisions are required for all projects; significant projects shall also have formal Traffic Management Plan (TMP) Documents.
  - Positive protection devices (transportable attenuators, 2+ weeks: temporary barrier, etc.) required on 45+ mph roadways when workers have no means of escape from errant vehicles.
  - Traffic control bid items for payment, if necessary.

- **23 CFR Part 630 K "Temporary Traffic Control Devices" (Updated December 2024)**
  - Maintain the quality and adequacy of all temporary traffic control devices.
  - To the extent practical, manage work zone exposure and reduce the risks of crashes resulting in fatalities or injuries to workers and road users by considering:
    - *Positive protection devices* (transportable attenuators) required on 45+ mph roadways when workers have no means of escape from errant vehicles (bridges, tunnels). Consider on high volume 45+ mph roadways, 2+ week project durations, and work operations within one lane of open travel lanes.
    - *Exposure control measures*, while providing adequate consideration for mobility impacts, such as:
      - Full road closures, ramp closures, or median crossovers/bypasses/diversions.
      - Performing work at night or during off-peak periods.
      - Using accelerated construction techniques (extended closures).
    - *Other traffic control measures*, such as:
      - Sequential arrow signs on lane closure tapers.
      - Reduced channelizing device spacing.
      - Longitudinal and lateral buffer spaces.
      - Work zone speed management (Speed Safety Cameras & Law enforcement).
      - Enhance flagger stations with AFADs
      - Pace or pilot vehicles.
      - High quality work zone pavement markings.

2.3 Manual on Uniform Traffic Control Devices (MUTCD)

In Washington, 2009 MUTCD is currently adopted and modified per WAC 468-95-010. The 11th Edition of MUTCD anticipated to be adopted in Washington mid-2025 when WACs are updated by the legislature. This 2025 TCS coursebook will reference the 2009 MUTCD.

The MUTCD applies to all highways open to public travel. Traffic control devices covered by the MUTCD includes signs, signals, markings, and devices placed on, over or adjacent to a street or highway by authority of a public body or official having jurisdiction to regulate, warn, or guide traffic.

The MUTCD contains 10 parts. Part 6 of the Revised 2009 MUTCD sets forth basic principles and prescribes standards for temporary traffic control.

In MUTCD and 23 CFR 655, the following terms are used to identify the level of compliance required:

- **Standard: "Shall" conditions are mandatory statements**
- *Guidance: "Should" conditions are recommended statements*
- Option: "May" conditions are permissive statements
- Support: Descriptive and/or general information

Important: In general, Standard statements shall not be modified or compromised.

Important: Employers are required to evaluate and consider Guidance statements and implement them when engineering judgement or study indicates they are appropriate per WISHA Regional Directive 27.20 for traffic control and flagging.

Employers can be cited by Labor & Industries for failure to implement Guidance statements if they do not explain **how it was evaluated** and **why it was not implemented**. Simply stating "Guidance is not mandatory" is not sufficient.

Two commonly used terms are defined by the MUTCD, but paraphrased below for simplicity:

- **Engineering Judgment**: **Informal evaluation** of pertinent information by applying appropriate principles, practices, MUTCD Standards, and MUTCD Guidance to determine applicability, design, operation, or installation of traffic control devices.

  With Engineer concurrence, Traffic Control Supervisor can make engineering judgements.

  Per WAC 468-95-017, engineering judgement should be exercised in the selection and application of traffic control devices, including their placement.

  Documentation of engineering judgment is not required by MUTCD [but is good practice]. Documentation can consist of a simple explanation completed in a paragraph or bullet list.

- **Engineering Study**: **Comprehensive, formal evaluation via formal report** of pertinent information by applying appropriate principles, practices, and MUTCD Standards, MUTCD Guidance to determine applicability, design, operation, or installation of traffic control devices.

  Engineering Study shall be performed by an engineer or an individual working under the supervision of an engineer through the application of procedures and criteria established by the engineer.

  An engineering study shall be documented.

2.4 Washington State Modifications to the MUTCD (WAC 468-95)

Per Washington law (RCW 47.36.030), the Washington State Department of Transportation (WSDOT) shall adopt uniform standards for traffic control devices installed along state highways. The law also requires that traffic control devices along county roads fully conform to these adopted standards, and those along city streets conform to the extent practicable.

To fulfill this responsibility, WSDOT has adopted the MUTCD per WAC 468-95-010 with several modifications affecting temporary traffic control per WAC 468-95. Modifications affecting temporary traffic control are discussed later in Chapter 14.

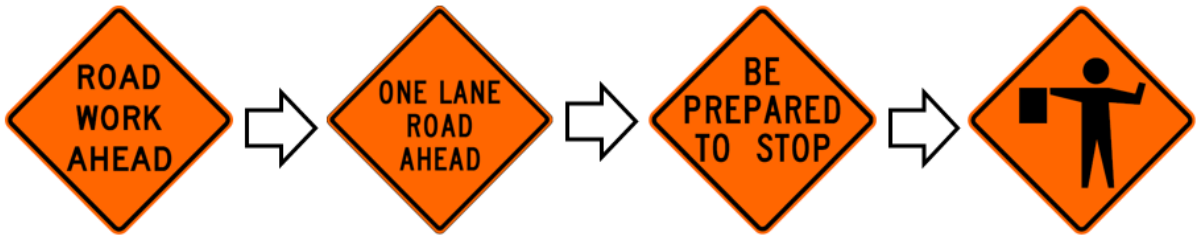
These modifications alter Part 6 of the MUTCD in significant ways:

- Temporary sign spacing (WAC 468-95-300)
- Maximum channelizing device spacing (WAC 468-95-301)
- Flagging at signalized intersection requirements (WAC 468-95-3015)
- Single flagger at center of intersection prohibited (WAC 468-95-302)
- Motorcycle Use Extreme Caution sign requirements (WAC 468-95-305)
- Motorcycle Use Extreme Caution supplemental plaques (WAC 468-95-306)
- Abrupt Lane Edge warning sign (WAC 468-95-307)
- Temporary pavement marking duration extension & layout (WAC 468-95-310)

2.5 Flagging Requirements for Washington (WAC 296-155-305)

Washington State Department of Labor & Industries (L&I) has enhanced flagging requirements per WAC 296-155-305, summarized as:

- Roads 45+ mph: 4 sign advance warning signs required instead of 3



W20-1 W20-4 W20-7B (OPTIONAL IF 40 MPH OR LESS) W20-7A

- 2+ day flagging operations must have site-specific traffic control plan
- Flagger orientation for new projects or existing projects that change significantly is required
- Washington, Oregon, Idaho, or Montana flagging cards accepted
- Enhanced high-visibility garment requirements (see Section 7.6 for details)
- Flagger stations illuminated at night, except in emergencies
- Flaggers cannot be assigned other duties while flagging or use devices that distract them (includes cellphones, headphones, or radios; however, two-way radios OK)

See Chapter 7 for additional flagger requirements.

2.6 Work Zone Information Sheet

This Work Zone Info Sheet provides a comprehensive set of work zone information including distance tables (in feet and mileposts), work zone speed limit policy, work zone sign size, WSDOT Manual and state law links, and arrow board information.

This double-sided 8½" x 14" (which can also be printed out on a 11" x 17") can serve as a useful resource for designers, inspectors, traffic control supervisors, and many others.

2.7 Typical Traffic Control Plan Library

WSDOT's Work Zone Typical Traffic Control Plans (TCPs) provides several generic plans may be modified with good engineering judgement but also serve as a guide.

Traffic control plans with work zone speed limit reductions must be approved and all traffic control plans must be accepted by the Agency with jurisdiction (WSDOT, City, and/or County). See Sections 5-18, 5-19 and Section 5-25 in Chapter 5 of the WSDOT Traffic Manual for more details.

2.8 Standard Specifications for Road, Bridge, and Municipal Construction (M41-10)

The Standard Specifications outline and clarify Contractor obligations for **construction projects** on all WSDOT projects and local agency projects receiving FHWA federal funding. These specifications include contractual requirements along with measurement and payment information.

Standard Specifications are updated yearly in September and available electronically. The Contract Provisions states which year's Standard Specification is in effect for that specific project.

In 2026 Standard Specifications (published September 2025), temporary traffic control content (1-07.8, 1-07.23, & 1-10) will be moved into Section 2-04. Statewide RFP template update expected in 2027.

In 2025 and earlier Standard Specifications, Section 1-10 covers temporary traffic control with detailed description of the duties and responsibilities of the Traffic Control Manager, Traffic Control Supervisor (TCS), and all other traffic control labor; traffic control plans, procedures, and devices including crashworthiness and quality standards; and traffic control measurement and payment.

Chapter 15 provides work zone-related Standard Specification sections, included in this coursebook:

- **1-10 Temporary Traffic Control**
- **9-35 Temporary Traffic Control Materials**
- **1-07.23 Public Convenience and Safety**
- **1-07.8 High-Visibility Apparel**
- **8-21 Covering Conflicting Signs (Long-term temporary sign covering)**

Important contract administration sections in Standard Specifications, not included in this coursebook:

- 1-04.2 "Hierarchy of Contract Documents" [Simplified]
- 1-04.4 "Changes to Contract–Engineer's Authority" [Simplified]
- 1-05 Control of Work–Authority of Engineer vs Inspector/Assistant [Simplified]

Other work zone-related sections in the Standard Specification, not included in this coursebook:

- 5-04 Hot Mix Asphalt – Joints
- 6-10 Temporary Concrete Barrier
- 8-09 Raised Pavement Markers [Simplified]
- 8-17 Temporary Impact Attenuator [Simplified]
- 8-22 Permanent & Long-Term Temporary Pavement Marking [Simplified]
- 8-23 Temporary Pavement Markings [Simplified]
- 9-34 Pavement Marking Materials [Simplified]

2.9 Work Zone Traffic Control Guidelines for Maintenance Operations (WSDOT, M54-44)

The WSDOT M54-44 Manual provides interpretive guidance and typical traffic control plans to assist WSDOT maintenance personnel, utility contractors, and developers for temporary traffic control of **3 days or less**. This Manual does not change the intent of Part 6 of the MUTCD. Traffic control devices and distances shown reflect desired minimums for WSDOT use.

Typical traffic control plans provided in the M54-44 Manual are not intended for Construction projects, but the mobile closure plans may be used as guidance until Typical Traffic Control Plans developed.

2.10 Traffic Manual (M51-02)

Chapter 5 "Work Zone Traffic Control" in the WSDOT Traffic Manual provides instruction, guidance, and policy for work zone traffic control operations for the following work zone (WZ) topics:

- Federal and state laws
- Mobility management (aka: congestion management strategies)
- WZ traffic analysis (capacity, queue-delay analysis)
- Traffic incident management
- Safety management
- WZ Speed Limit & Advisory Speed policy & approval requirements
- Washington State Patrol Enforcement & Assistance
- Uniformed Police Officer Assistance
- Rolling Slowdowns & Traffic Holds
- Traffic Control Plan Acceptance & Review Protocol

2.11 Design Manual (M51-02)

The Design Manual provides policy, procedures, and methods for design. The following chapters are related to work zones:

- **1010 "Work Zone Safety & Mobility"**
  - Transportation Management Plan
  - Work Zone Design
  - Traffic Control Devices & Strategies Overview
  - Plans, Specifications, & Estimate

- **1610 "Traffic Barriers"**
  - Deflection Distances ("design slide distance when impacted")
  - Barrier Flare Rates ("how fast can a barrier taper over to traffic")
  - Length of Needed ("how far barrier needs to extend upstream past an object")
  - Concrete Barrier Single-Slope Terminal (for 25 mph or less), see 1610.06(3)

- **1620 "Impact Attenuator Systems"**
  - List of approved attenuators (work zones = temporary OK)

2.12 General Special Provisions

Contract Provisions may include General Special Provisions (Division 1, Section 1-10 for most traffic control GSPs) for items such as work zone safety contingency bid item, AFADs, temporary rumble strips, radar speed display sign, connected sequential arrow signs, smart work zones systems, queue warning systems, contractor-provided road zipper system, mobile barrier system, etc.

2.13 Web Sites

AASHTO (American Association of State Highway & Transportation Officials)
http://transportation.org

ANSI (American National Standards Institute)
https://ansi.org/

ATSSA (American Traffic Safety Services Association)
http://atssa.com

DOSH (Labor and Industries)
http://lni.wa.gov

FHWA (Federal Highway Administration)
http://fhwa.dot.gov/

The National Work Zone Safety Clearinghouse
http://workzonesafety.org/

ITE (Institute of Transportation Engineers)
http://ite.org

Manual of Traffic Signs
http://trafficsign.us/index.html

MUTCD
http://mutcd.fhwa.dot.gov

NHTSA (National Highway Traffic Safety Administration)
http://nhtsa.dot.gov/http://mutcd.fhwa.dot.gov/

WSDOT: Home Page
http://wsdot.wa.gov/

WSDOT: Engineering Publications (WSDOT Manuals)
https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals

WSDOT: Commercial Vehicle Services (Oversized & Superloads Freight Permit & Restrictions)
https://wsdot.wa.gov/travel/commercial-vehicles

WSDOT: Typical Traffic Control Plan Library
https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/plan-sheet-library/work-zone-typical-traffic-control-plans-tcp

WSDOT: Work Zone Safety
https://wsdot.wa.gov/travel/traffic-safety-methods/work-zone-safety

Washington State Laws (RCWs & WACs)
https://apps.leg.wa.gov/rcw/
https://apps.leg.wa.gov/wac/

Oregon Department of Transportation
http://oregon.gov/ODOT/

Idaho Transportation Department
http://itd.idaho.gov/

Montana Department of Transportation
https://mdt.mt.gov/

2.14 Definitions

Important terms used in this course are defined here to clarify the meaning intended.

- **Delineation** – highlighting the presence of an object, typically with channelizing devices.
- **Freeway** – a divided highway with full control of access.
- **Highway** – a general term for denoting a public way used for purposes of travel by vehicular traffic, including the entire area within the right-of-way.
- **Major Street** – a street normally carrying a higher volume of vehicular traffic.
- **Median** – the area between two roadways of a divided highway measured from the edge of one traveled way to the edge of the other traveled way. The median excludes turn lanes. The median width might be different between intersections, interchanges, and at opposite approaches of the same intersection.
- **Minor Street –** the street normally carrying the lower volume of vehicular traffic.
- **Roadway** – that portion of the highway improved, designed, or ordinarily used for vehicular travel and parking lanes, but exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm, or shoulder is used by persons riding bicycles or other human powered vehicles. In the event a highway includes two or more separate roadways, the term roadway as used herein shall refer to any such roadway separately, but not to all such roadways collectively.
- **Rural Highway** – a type of roadway normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians.
- **Tangent** - the straight away area between the work area and the lane of traffic that runs from the transition taper to the downstream taper.
- **Traffic Control Plan (TCP) -** A traffic control plan describes the temporary traffic control measures to be used facilitating road users through a temporary traffic control zone and plays a vital role in guiding road users when work disrupts normal traffic flow. A TCP will detail the types of devices required and placement location information for each device in the zone. Plans may range from, very detailed designed solely for a specific project or location, to a typical application or a standard drawing approved by a highway agency. The degree of detail in a TCP will depend on the project complexity and the anticipated interference of work activities with traffic movement.
- **Traveled Way –** The part of the roadway made for vehicle travel excluding shoulders and auxiliary lanes. Within temporary work zones, this distance may be from edge of device to edge of device (or face of opposite barrier) when a single open lane is available.
- **Typical Application (TA)** – The MUTCD has typical applications of temporary traffic control zones to assist in developing TCP's. Selecting the most appropriate typical application requires knowledge and understanding of the following factors; duration of the work, location of work, and the roadway type. In addition, typical applications often need to be modified based on site and traffic conditions and to comply with State specific modifications or standards.
- **Urban Street** – a type of street normally characterized by relatively low speeds, wide ranges of traffic volumes, narrower lanes, frequent intersections and driveways, significant pedestrian traffic, and more businesses and houses.

2.15 Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AFAD	Automated Flagger Assistance Device
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials International
ATSSA	American Traffic Safety Services Association
DOJ	Department of Justice
DOSH	Department of Occupational Safety and Health
FHWA	Federal Highway Administration
HOV	High Occupancy Vehicle
ITE	Institute of Transportation Engineers
L&I	Department of Labor and Industries
MUTCD	Manual on Uniform Traffic Control Devices
MASH	Manual for Assessing Safety Hardware
NCHRP	National Cooperative Highway Research Project
NHI	National Highway Institute
ODOT	Oregon Department of Transportation
OSHA	Occupational Safety and Health Administration
PCMS	Portable Changeable Message Sign
PROWAG	Public Rights of Way Accessibility Guidelines
PV	Protective Vehicle
QPL	Qualified Products List
QWS	Queue Warning System
RCW	Revised Code of Washington
RSDS	Radar Speed Display Sign
SWZS	Smart Work Zone System
TCOC	Traffic Control Oversight Committee
TCP	Traffic Control Plan
TCS	Traffic Control Supervisor
TA	Transportable Attenuator
TTC	Temporary Traffic Control
TMP	Transportation Management Plan
VMS	Variable Message Sign (Permanent)
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Administration
WSDOT	Washington State Department of Transportation
WSP	Washington State Patrol
WZTC	Work Zone Traffic Control

Chapter 3 : Traffic Control Management & Traffic Control Supervisor Responsibilities

3.1 Summary

This chapter will familiarize the participants with the duties and responsibilities of each member of the traffic control management team.

3.2 Traffic Control Management

This section applies to all WSDOT and Local Agency (city & county) Federal-aid construction projects.

The Contractor has the responsibility for managing and providing safe traffic control measures appropriate for the type of work and consistent with the requirements of contract plans and specifications. Traffic control will be inspected by Agencies for adequacy and conformance with applicable standards and contract documents.

Standard Specifications 1-05.1 gives the Contracting Agency's Engineer full authority to enforce Contract requirements and utilize alternative resources (including a reduction in payment of any costs) in the event the Contractor fails to respond promptly to Contract requirements or orders from the Engineer. If necessary, the Engineer may suspend all or part of the Work at the Contractor's risk.

The Contractor must assign personnel as the Traffic Control Manager and Traffic Control Supervisor in accordance per Standard Specifications 1-10.2.

3.2(1) Traffic Control Manager

The Contractor must be formally assign this position to the Prime Contractor's field supervisor(s), typically, the Superintendent. TCM may not be subcontractor per Standard Specifications 1-10.2(1).

TCMs are not required to possess a current TCS and flagger certification.

TCM Responsibilities, per Standard Specifications 1-10.2(1)A, are summarized:

- Be available to the Agency via telephone 24/7
- Oversee Traffic Control Supervisor and provide accepted traffic control plans, MUTCD, PROWAG, and applicable Standard Specifications
- **Coordinate** traffic control operations, including those of Subcontractors
- Coordinate traffic control closures with appropriate police, medical emergency, fire control, and other local agencies
- Oversee the convenience, safety, and orderly movement of all road users
- Review the Traffic Control Supervisor's daily traffic control daily
- Be aware of field traffic control operations
- Being present on-site a sufficient amount of time to satisfy responsibilities
- Have on site: MUTCD, PROWAG, *Quality Guidelines for Temporary Work Zone Traffic Control Devices*, current set of traffic control plans, Contract Provisions, and Standard Specifications.

3.2(2) Traffic Control Supervisor

The Contractor must designate both a primary and alternate Traffic Control Supervisor, who will take over the primary TCS's duties in the event of that person's inability to perform. The TCS shall be responsible for the safe implementation of traffic control plans.

The TCS shall process the following certifications, per Standard Specifications 1-10.2(1):

- Current TCS card (Washington state only)—valid for 4 years
- Current flagging card (Washington, Oregon, Idaho, or Montana)—valid for 3 years

For some projects, WSDOT Contract Provisions require the primary TCS to have 500+ hours of experience providing traffic control as a TCS or traffic control laborer on 55+ mph multilane highways: Provision

Mandatory TCS Responsibilities, per Standard Specifications 1-10.2(1)B, are summarized:

- Be on site within 45 minutes & available via phone 24/7 to expeditiously correct any traffic control deficiency after notification from Engineer
- Be present on site whenever flagging or traffic control labor is utilized
- Have a current set of traffic control plans, Contract Provisions, MUTCD, PROWAG, and *Quality Guidelines for Temporary Work Zone Traffic Control Devices*
- Inspect traffic control devices hourly during working hours & once during nonworking hours (opposite daylight or darkness of working hours); inspect nighttime lighting once a shift; and inspect Class A signs once a week
- Prepare a daily traffic control diary (WSDOT Form 421-040A & 421-040B) for each day that traffic control is performed. After TCM reviews, TCS to submit daily traffic control dairy to Engineer no later than end of next working day
- Making minor revisions to the traffic control plan (original intent of TCP must be maintained and concurrence of both Contractor & the Engineer received)
- Attend traffic control coordination meetings or activities
- Ensure needed devices and equipment is available and works
- Ensure pedestrian access routes maintained, detectable, and are accessible

Performing Flagger and Other Traffic Control Labor is now considered incidental to Traffic Control Supervisor responsibilities, which are paid as lump sum, and is no longer be compensated by "Flagger" and "Other Traffic Control Labor" hourly bid items.

TCSs may also serve as a Queue Warning System Technician, provided they are trained and authorized by the Vendor, concurrently while performing required TCS duties.

However, TCSs are prohibited from also serving as a Smart Work Zone System Technician due to the complexity of the system, instead TCS will collaborate with the SWZS Technician and set up, maintain, and remove the SWZS devices as needed.

3.3 Specifications

See WSDOT, Standard Specification Section 1-10.2:

- 1-10.2(1) General
- 1-10.2(1)A Traffic Control Management
- 1-10.2(1)B Traffic Control Supervisor

Chapter 4 : Fundamental Principles of Traffic Control

4.1 Summary

This chapter covers the fundamental work zone principles that will guide participants in the completion of their responsibilities as Traffic Control Supervisors when implementing temporary traffic control.

4.2 Purpose of Temporary Traffic Control

The primary function is to reasonably protect road users and workers while providing orderly movement.

To accomplish this, temporary traffic control must:

- **Warn** motorists and pedestrians of hazards
- **Advise** motorists and pedestrians of the proper travel path through the area
- **Delineate** the path traffic should follow
- **Separate and protect** motorists, pedestrians, and workers

4.3 Fundamental Principles & Work Zone Impact Triangle

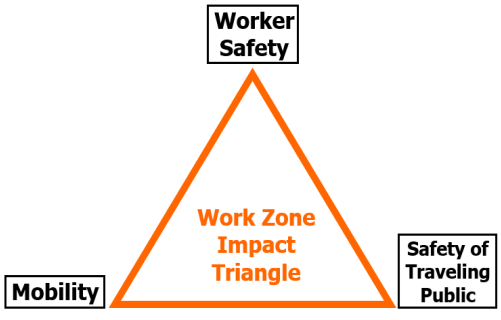
Each work zone is unique and ranges in duration and complexity; therefore, a "one-size fits all" approach does not work. In work zones, there are problems and tradeoffs (not problems and solutions). Understanding fundamental principles and the "work zone impact triangle" serves as a guiding philosophy for developing and implementing good temporary traffic control:

Fundamental Principles:

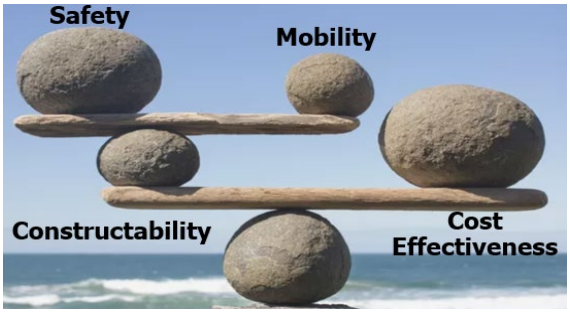
1) Keep it simple (one thing at a time when feasible)
2) Maintain consistency & expectancy
3) Clearly guide road users
4) Maintain mobility by managing congestion & delays
5) Routinely inspect traffic control
6) Give attention to roadside safety (work zone clear zone)

Work Zone Impact Triangle: Prioritizing one component sacrifices the other two

- Road closures prioritize worker safety but sacrifices mobility and can create public safety concerns due to queuing
  - Mitigation: Advanced closure notification to public with queue warning systems. Use effectively with large work crews.
- Mobile shoulder closures prioritize mobility but sacrifices workers and safety of traveling public.
  - Mitigation: Use transportable attenuators shadowing work vehicles and advance warning vehicles with message boards



It's A Balancing Act: The balance between safety, mobility, constructability, and cost effectiveness and the tradeoffs associated with prioritizing one over the others must be reached for every project on a case-by-case basis.



4.4 Duration of Work

The work duration will have a significant impact on the level of temporary traffic control needed. The longer the duration, the more extensive the work zone design and temporary traffic control setup because it will be in place for weeks or months. Long-term work zones often include Class A Construction Signs, temporary pavement markings, temporary barriers and impact attenuators, and nighttime illumination along with other temporary traffic control devices.

Shorter duration work zones intended to be in place a few hours or a few days and typically utilize Class B construction signs, channelizing devices, and protective vehicles but rarely involve temporary pavement markings, barriers with impact attenuators, or temporary illumination.

Short duration or mobile closures may be using traffic control vehicles equipped with truck-mounted PCMSs with minimal channelizing devices and temporary signs. This simplified traffic control setup minimizes worker traffic exposure because the time needed to set up a full complement of signs and devices could far exceed the time required to perform the work.

There are five categories of work zone durations per MUTCD Section 6G.02 and one additional one included in WSDOT's M54-44 Manual.

4.4(1) Long-Term Stationary Work Zone

Work that occupies a location for more than 3 days

Typically used for staged traffic configurations that creates large, protected work areas for long durations to maximize productivity and minimize overall traffic impacts). Temporary barrier is often added when in place for 2 weeks or longer.

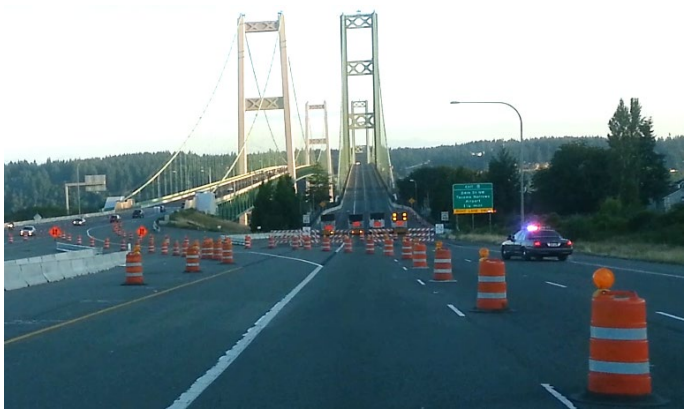
Work zone design strives towards permanent design standards when feasible but narrowed lanes and reduced shoulders are common.

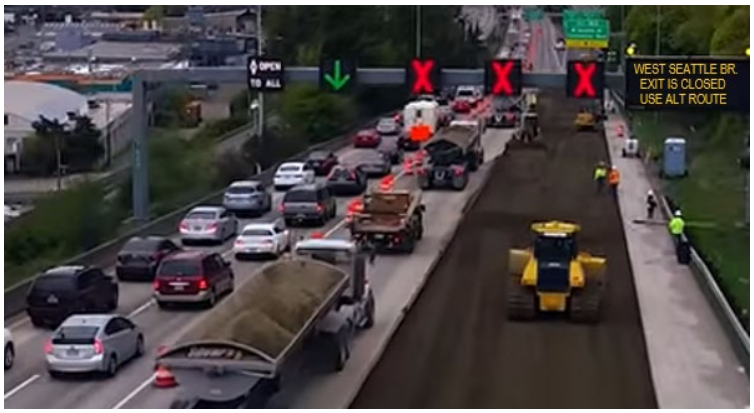
4.4(2) Intermediate-Term Stationary Work Zone

Work that occupies a location for more than 1 daylight period up to 3 days or more than an hour at night.

These work zones utilize **enhanced temporary traffic control** and includes weekend-duration closures (Friday night - Monday morning). These work zones often exceed MUTCD requirements because traffic control is in place during nights and for longer durations, but not designed to permanent standards.

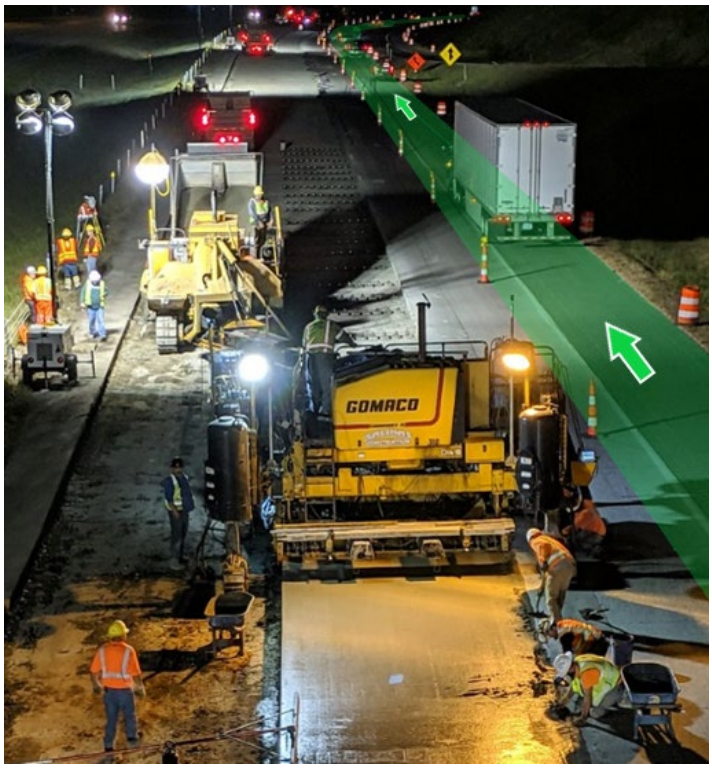
Class B constructions signs, channelizing devices, arrow boards, and PCMSs are typically used to denote closures, but additional devices such as radar speed display signs may be used.

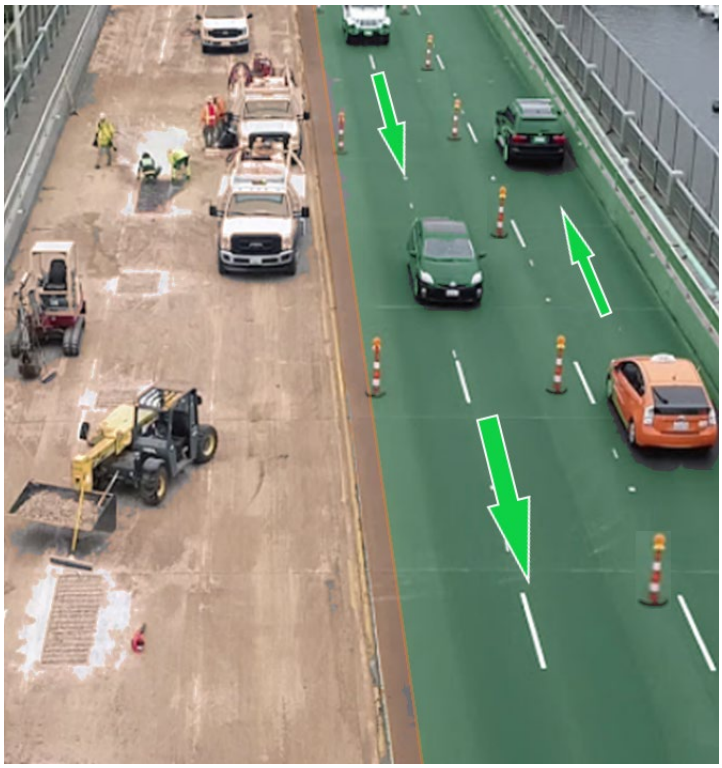




Existing pavement markings are typically used to guide motorists, with the channelizing devices denoting closures (as well as guiding road users), like shown above. When a single open lane is shifted onto the shoulder (left photo below), then add 28" cones at edge of paved shoulder at night.

When separating opposing directions of travel, typically reduce channelization spacing by half unless left turns are permitted (right photo below). Existing guardrail/barrier may be used in lieu of channelizing devices.





The two photos below show a 2-lane median crossover at Tacoma Narrows Bridge in Tacoma, where 2 lanes each direction was maintained on one bridge while the other was closed for a weekend.

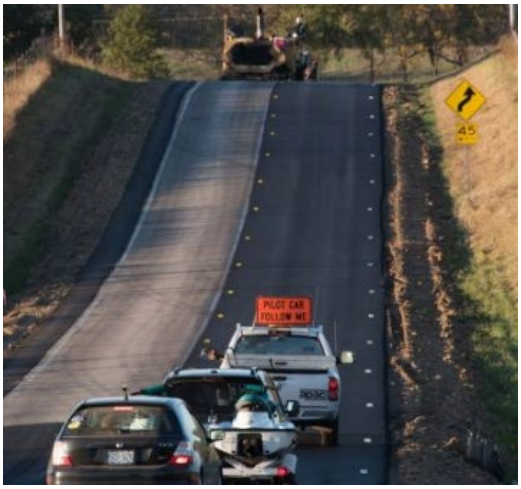
When 2+ temporary lanes in the **same** direction of travel are shifted laterally for weekend-durations, conflicting pavement markings should be removed at the shifts with temporary lane line separating the two lanes (solid lane line used at the median crossover below but broken white lane lines "skips" are OK). Edge lines for these intermediate-duration closures are optional; using channelizing devices instead OK.

4.4(3) Short-Term Stationary Work Zone

Work that occupies a location for more than 1 hour within single daylight period

These are the "typical" daytime work zones utilizing temporary traffic control with all the devices installed and removed during that same day. These work zones are designed to meet and exceed MUTCD requirements, depending on WSDOT Region or Local Agency standard practices.

Class B constructions signs, channelizing devices and arrow boards are typically used to denote closures, but may be supplemented with PCMSs and other devices.



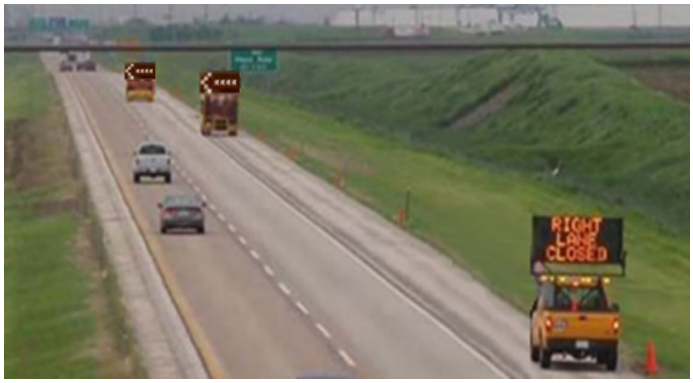
4.4(4) Short Duration Work Zone

Work that occupies a location for up to 1 hour

These work zones usually apply to maintenance work and are not used for construction projects; see the M54-44 Manual for more information.

Because the work time is short, simpler traffic control setups are sometimes used to reduce worker exposure; otherwise, the time required to set up traffic control would exceed the amount of time required to perform work. These work zones are designed to meet MUTCD requirements.

Temporary signs, truck-mounted PCMSs, and truck-mounted arrow boards are typically used with minimal channelizing devices.



4.4(5) Very Short Duration Work Zone

Work that occupies a location for a few seconds or minutes

A WSDOT-specific work duration in the M54-44 Manual, these work zones usually apply to maintenance work, surveying, or incident response and are not used for construction projects. Work may include:

- Removing lost cargo/debris from roadway
- Taking a survey "shot"
- Providing motorist assistance
- Preforming quick maintenance/repair

4.4(6) Mobile

These work zones are ones moving intermittently or continuously with workers mostly in vehicle serves lends itself to mobile closures instead of stationary closures, where workers are on foot for significant periods of time.

Mobile lane closures are used mainly for maintenance work operations; however, it is sometimes used in construction projects for pavement marking installation when specifically allowed in Contract Plans.

Mobile closures utilize shadow vehicles with either vehicle-mounted temporary signs or truck-mounted PCMSs that often double as arrow boards to inform approaching motorists of the closure along with protective vehicles protecting work crews. Typically, transportable attenuators are used as the protective vehicle when blocking lanes. Rarely are channelizing devices used.

Typically, encroachment on open lanes is not allowed on high-speed (45+ mph) roadways; however, for pavement marking operations, lane encroachment of up to 1-foot is allowed for marking application equipment per the M54-44 Manual.

Stationary vs. mobile operations is explained below:

Stationary Closures

- **Workers mostly on foot**
- Multiple work locations within 1-2 miles
- Catch basin cleaning
- Highway lighting repair

Mobile Closures

- **Workers mostly in vehicles**; briefly on foot
- Work location moves nearly continuously over for several miles
- Pavement marking installation
- Sweeping operations

(Continued)

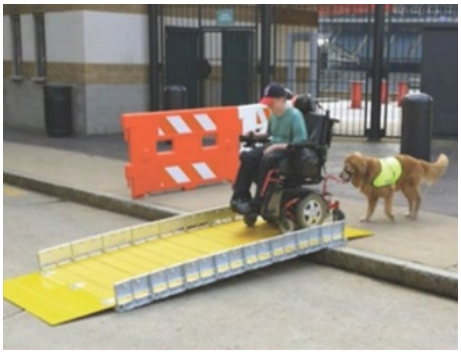
4.5 Road Users

WSDOT and Local Agencies in Washington are focusing on becoming more multimodal, moving away from the motorist-focused vision of the past.

Properly addressing work zone impacts to all road users will become increasingly important in the successful design, construction, maintenance, and operation of a fully functional transportation system.

Road users include, but are not limited to:

- Pedestrians, including those with disabilities whom are blind and in wheelchairs


- Bicyclists, Motorists, & Motorcyclists



- Commercial Vehicles ("semi-trucks"), including Oversized/Superload permitted vehicles



- Transit operator and users


4.5(1) Expectancy & Reaction

Based on similar situations in the past, people expect certain things to appear and operate in a certain manner. When reinforced over a period of time, these expectancies develop into a workable set of expectations allowing people to anticipate and plan a course of action almost subconsciously.

Driver reaction time is effected by expectancy and complexity:

- **Expectancies met**: Reaction time is reduced and performance tends to be error-free
- **Expectancies violated & situation complex**: Longer reaction time, poor performance & errors

When a situation is very complex, motorists may temporarily freeze and be unable to make any speed or path choice at all. In extreme circumstances, motorists will just stop within the lane or respond erratically.

A key practice of effective temporary traffic control is:

In similar situations, use similar treatments, to get a similar desired response.

Properly designed temporary traffic control with advanced warning signs, gradual channelization tapers and other features that are developed based on traffic speed will help provide road users the necessary information to safely negotiate the work zone.

Utilize the following traffic control following strategies to minimize road user difficulties:

- Sufficient advance warning to avoid surprising road users
- Avoid placing a lane closure taper within horizontal curves or adjacent to an on-ramp merges (know there will be times when it is just necessary to do so)
- Avoid placing traffic control features in "busy" areas already competing with motorists' attention
- Keep things simple

4.5(2) Credibility

Credibility means the message conveyed by the traffic control device must be accurate and relevant to the situation. When consistently credible, road user compliance to signage will increase. On the other hand, when irrelevant signs remain in place than road users will quickly adapt to disregard them.

To increase the credibility, adhere to the following:

- Maintain controls as if every driver were approaching the work zone for the first time
- Do not inform road users of hazards that do not exist
- Turn, cover or remove signs that are not applicable (**MUTCD Standard**)

Few things lose credibility quicker than leaving up flagger signage when flagging operations are not occurring, like shown below, because motorists will soon disregard it. Later, when the flagger is actually present and stopping traffic, motorists are caught off guard by the stopped traffic which increases the risk of rear-end collisions and makes it more difficult for flaggers to get motorists to stop.

The traffic control below fails because it does not clearly delineate and guide road users through the roundabout under construction. The left lane should have been closed along with signage at the roundabout. These poor setups cause motorists to lose respect for other work zones as well.

4.6 Commercial Vehicle Considerations

Washington is the second most trade-dependent state in the nation. About 70% of that freight is moved via commercial vehicles ("semi-trucks"). T-1 and T-2 corridors shown in the FGTS Truck Freight corridor state map have significant commercial vehicle volumes and need special consideration in work zones.

The operating and braking characteristics of commercial vehicles are completely different from passenger vehicles and poorly understood by many motorists. It is critical Traffic Control Supervisors have a good understanding of commercial vehicle for the safety of not only their work crew, but the traveling public.

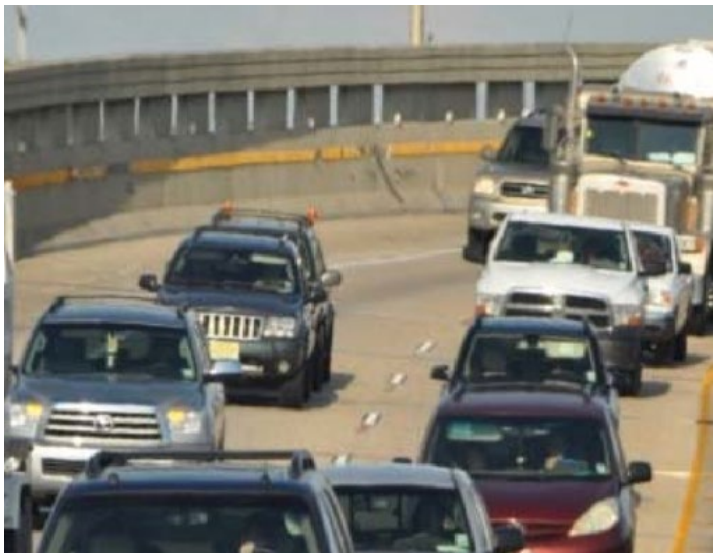
This is a major contributor to rear-end collisions approaching congested work zones with traffic queuing.

4.6(1) Severity of Commercial Vehicle Collisions

Laws of physics state a large object in motion tends to stay in motion. The momentum of semi-trucks (105,000 pounds legal in WA) is nothing short of spectacular and must be respected.

It is important to remember temporary and permanent concrete barriers do not stop commercial vehicles; their momentum is simply too great even at 50 mph.

What does it take to stop semi-trucks? The "Tall-Wall" is concrete barrier permanently attached to concrete pavement and also includes a heavily reinforced beam at the top. Temporary applications are not practical. It is 7'-6" tall and weighs 1000 pounds/linear foot and designed for semi-tankers traveling 50 mph (not normal freeway speeds of 65 mph).

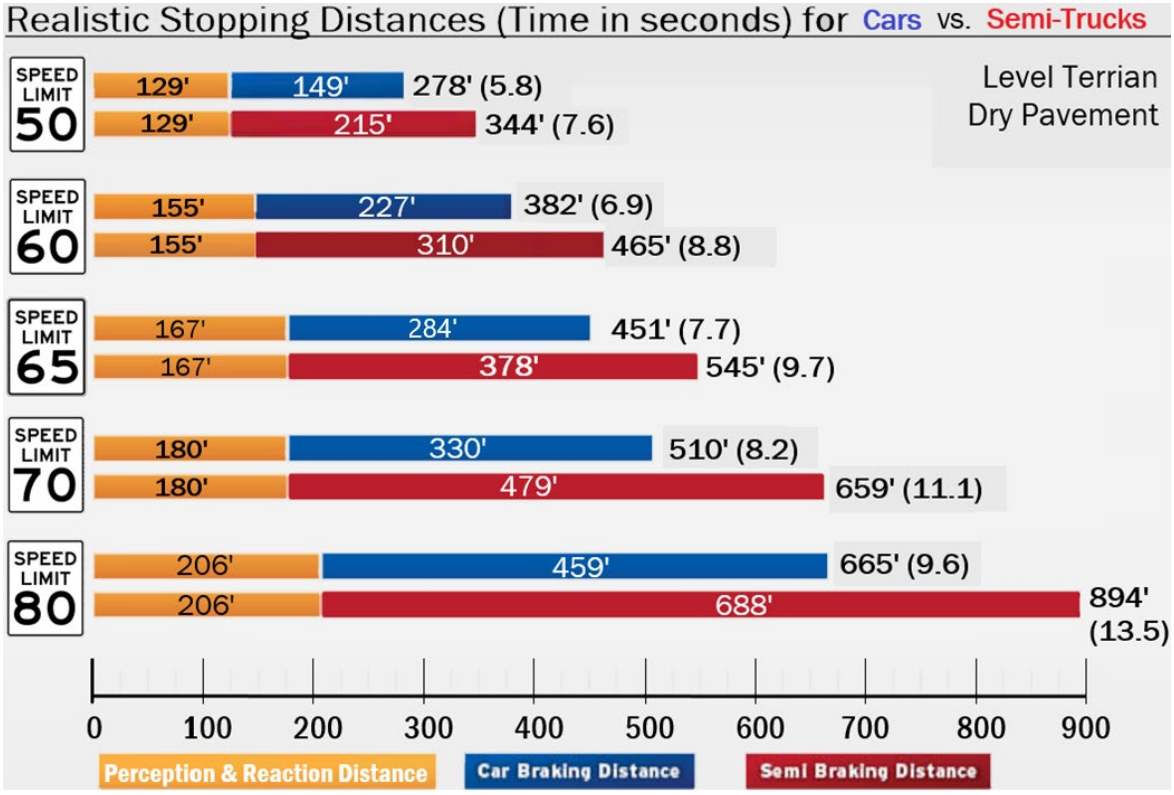


Positive protection via barriers is limited to passenger vehicles and pickup trucks, and that is not likely to change anytime soon due to physics.

4.6(2) Increased Stopping Distances

It is common knowledge that stopping distance for commercial vehicles is greater than passenger cars; however, this differential has been drastically reduced due to recent braking innovations for large vehicles as required by the National Highway Traffic Safety Administration final ruling by 2013.

Stopping distances shown below are for **level roadways in dry conditions**. Reaction time is 1.75 seconds (design will use 2.5), car deceleration rates range from 15 to 18 ft/s^2 for passenger cars, and 10 to 12.5 ft/s^2 for semi-trucks which are typical of most good drivers.



4.6(3) Effects of Steep Downgrades

On downgrades of 5% or greater, semi-trucks must use proper gear selection and the "jake-brake" (when permitted) prior to entering the downgrade. Enter the downgrade too fast and rely on braking alone, the brakes will quickly overheat and ease to even work, eventually they can catch fire. It is important to understand semi-trucks cannot downshift on steep grades (unlike your passenger car), truckers must be in the lower gear at the top of the grade to "hold back the momentum".

An expert truck-driver trainer explains the effects of steep downgrades for mountain driving in British Columbia in this video.

These two videos show truckers losing control on steep downgrades:

1. Siskiyou downgrade in Oregon
2. Downgrade in British Columbia

By understanding how difficult it is for semi-truckers to just maintain speed along downgrade, you can appropriate it is nearly impossible for truckers to stop on steep downgrades.

From a traffic control standpoint, be extremely careful placing flagging stations on steep downgrades and avoid doing so if it is possible. If necessary, consider adding a PCMS just prior to the downgrade informing truckers of stopped traffic along the downgrade like the following:

PCMS		
1	2	3
TRUCKERS EXTREME CAUTION	5% GRADE 30 MPH CURVE	1.5 MILES AHEAD
1.5 SEC	1.5 SEC	1.5 SEC

FIELD LOCATE JUST PRIOR TO BEGINNING OF DOWNGRADES 5% OR GREATER FOR TEMPORARY ROADWAY ALIGNMENTS WITH HORIZONTAL CURVES DESIGNED 15 MPH OR MORE BELOW THE EXISTING SPEED LIMIT.

PCMS		
1	2	3
ONE LANE ROAD W/ FLAGGERS	3 MILES AHEAD	EXPECT STOPPED TRAFFIC
1.5 SEC	1.5 SEC	1.5 SEC

FIELD LOCATE JUST PRIOR TO BEGINNING OF DOWNGRADES 5% OR GREATER FOR LANE CLOSURES WITH ALTERNATING TRAFFIC WITH EXPECTED QUEUES ALONG OR IMMEDIATELY FOLLOWING DOWNGRADES.

In addition, apply this strategy when temporary realignments result in horizontal curves designed for 15 mph or more below the existing speed limit along steep downgrades as well, modify the PCMS message as appropriate. For more discussion on 2-message versus 3-message PCMSs, see Section 5.5.

This simple additional PCMS can not only save the life of your flagger, but also motorists stopped at the back of the traffic queue.

4.6(4) Oversized Loads & Superload Freight

Commercial vehicles include larger Oversized and Superload freight far more impactful to work zones.

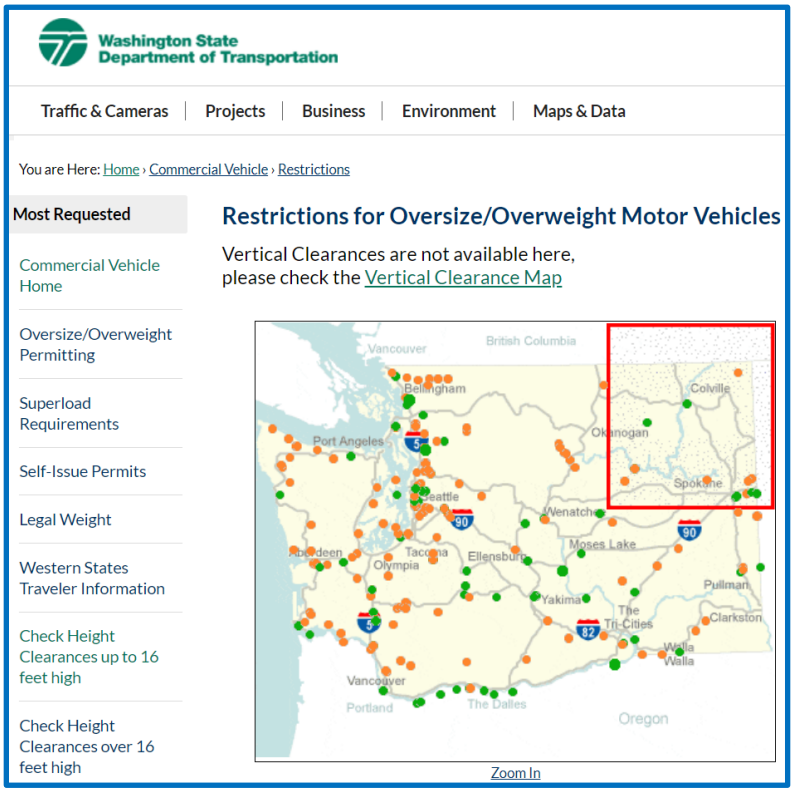
Oversize Freight

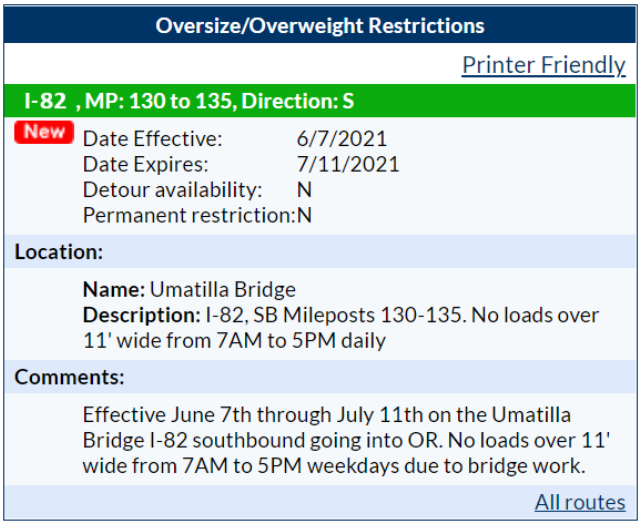
Superload Freight

Large Truck Freight Category	Width (feet)	Length (feet)	Height (feet)	Weight (pounds)
Oversize	8.5 to 16	Varies to 125	14 to 16	105,500 to 200,000
Superload	> 16	> 125	> 16	> 200,000

Commercial vehicles frequently travel major roadways throughout Washington; see FGTS Truck Freight corridor map (T-1 and T-2 corridors are the most critical to commercial vehicles and include Interstates).

When work zones reduce the travel way to less than 16 feet wide or reduce existing vertical clearances to less than 16'-6", then WSDOT Commercial Vehicle Services needs to be contacted at least 7 calendar days in advance to post the oversize/overweight restriction online and/or updating the height clearances. A 30+ day advance notification for restrictions in place for more than 3 days on T-1, T-2, & T-3 corridors. This coordination is performed through WSDOT Construction offices by the Traffic Control Manager.





See Section 5-15 in Chapter 5 of the WSDOT Traffic Manual for details.

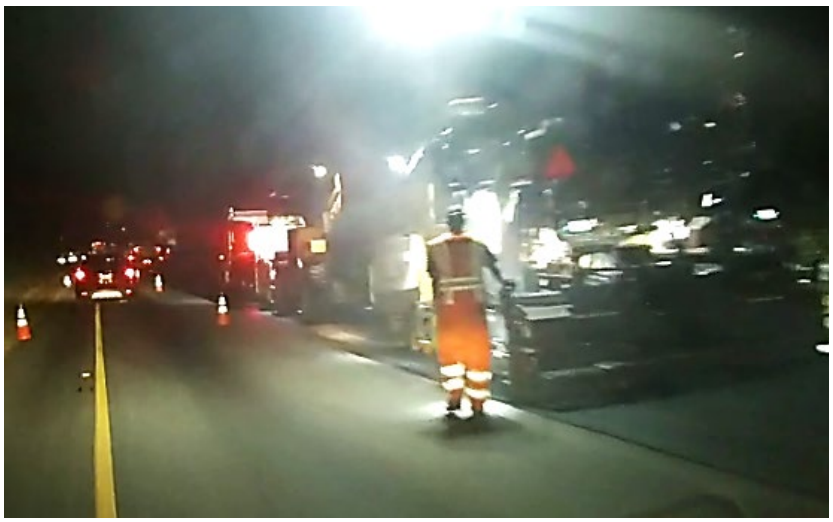
4.6(5) Reduced Travel Way Width

It is the Oversized freight that causes most traffic control issues because they are self-permitting and do not have to obtain permission to travel through work zones. Use W5-1 or W5-4 warning signs in advance when reducing the travel width to **less than 16 feet on freeways & major highways**. Oversize freight blocks a roadway for several hours, like on I-90 at Vantage shown below:

W5-1

W5-4

Some construction operations require the roadway or ramp to be temporarily narrowed to less than 16 feet between channelizing devices/barrier and significantly impacts oversized commercial vehicles.



In addition to posting width restriction thru WSDOT Commercial Vehicle Services, it is very beneficial to use a PCMS in located advance to inform motorists of the narrow roadway:

PCMS		
1	2	3
ROADWAY NARROWS 12' WIDE	SHOULDER DRIVING AHEAD	SLOW TRAFFIC AHEAD
1.5 SEC	1.5 SEC	1.5 SEC

FIELD LOCATE 1.5 +/- MILES PRIOR TO FIRST LANE CLOSURE TAPER.

REMOVE PHASE 3 WHEN TRAFFIC QUEUES NO LONGER PRESENT. INCREASE DISPLAY TO 2.0 SEC.

LOCATE PCMS PER WSDOT STANDARD SPEC. 1-10.3(3)C.

PCMS	
1	2
RIGHT LANE CLOSED	ROADWAY NARROWS 14' WIDE
2.0 SEC	2.0 SEC

FIELD LOCATE 1.5 +/- MILES PRIOR TO FIRST LANE CLOSURE TAPER.

LOCATE PCMS PER WSDOT STANDARD SPEC. 1-10.3(3)C.

4.6(6) Reduced Vertical Clearances

Per Traffic Manual, vertical clearances within the traveled way **15’-3” or less shall be signed** on all roads. On Interstates and major trucking routes, desirable to maintain at least 16’-6” vertical clearance when possible but recommended to sign vertical clearance reductions of less than 16’-6”.

For detailed information for vertical clearance signage requirements and placement information, see Section 2-8.9 in Chapter 2 of the WSDOT Traffic Manual.

Posted vertical clearances are typically 3 inches less than actual (so 15’-9” actual would be posted 15’-6”). As a generalization, the vertical clearance signage is typically as follows:

- W12-2 sign installed in advance of the location of low clearance
- If the vertical clearance is the same across the traveled way, W12-301 is used
- When vertical clearance varies across the traveled way, W12-302 are used

W12-2

W12-301

W12-302R

W12-302L

An example of W12-302 signs used for falsework at an existing bridge under construction:

The consequences of oversized fright hitting 15’-3” overpass at freeway speed is clearly shown below:

4.7 Work Zone Queue Mitigation Strategies

Five were killed in a Kansas City work zone when a semi-truck slammed into queued traffic. At 65 mph, it takes nearly 10 seconds and 550 feet for fully loaded, 80,000-pound semi-trucks to stop. This is a major contributor to rear-end collisions approaching congested work zones with traffic queuing. It is critical for large truck drivers to anticipate queued traffic and get slowed down in advance.

Large trucks account for nearly 60% of fatal rear-end work zone crashes.

Nearly 90% of work zone fatalities occur on freeways & 45+ mph roadways.

Work zone queue mitigation has reduced these high-speed rear-end collisions by 45%, a significant safety benefit, according to this FHWA-sponsored report. Thus, WSDOT implements work zone queue mitigation strategies on freeways & 45+ mph roadways when significant queuing is anticipated.

4.7(1) Use PCMSs in Advance of Queues

Ideally positioned ½ mile in advance of queues (typically placed 1.5± miles prior to lane closure), using a PCMS inform motorists of slow traffic is very effective when the message is relevant.

PCMS	
1	2
RIGHT LANE CLOSURE	1.5 MILES AHEAD
2.0 SEC	2.0 SEC

↔

PCMS	
1	2
WATCH FOR SLOW TRAFFIC	NEXT # MILES
2.0 SEC	2.0 SEC

USE IF TRAFFIC BACKUPS EXPECTED, BUT NOT VERIFIED.

↔

PCMS	
1	2
SLOW TRAFFIC AHEAD	NEXT # MILES
2.0 SEC	2.0 SEC

ONLY USED IF TCS VERIFIES HOURLY THAT TRAFFIC BACKUPS ARE PRESENT.

PCMSs may be changed based on the actual traffic conditions, particularly for queue warning. When traffic is free-flow, a message about the lane closure and distance ahead may be used. Alternatively,

"WATCH FOR SLOW TRAFFIC" if traffic queues may or may not be present but are expected (such as overnight or lane closures remaining during nonworking hours).

"SLOW TRAFFIC AHEAD" should only be displayed when traffic queues are present and verified. Otherwise, motorists will start to disregard the message including when it's the most relevant and important.

4.7(2) Truck-Mounted PCMS

Using a truck-mounted PCMS driven up the paved shoulder (8+ foot shoulder should be present) is particularly useful during freeway rolling slowdowns

Keep this vehicle ½± mile in advance of back of traffic queue by moving up and down the paved shoulder in a safe manner until queues have dissipated.

For mobile closures, strategically inform approaching motorists of the work operations ahead as a shadow vehicle in advance of vehicles blocking shoulders and/or lanes.

4.7(3) Queue Warning System

Queue warning system (QWS) is a simpler version of a Smart Work Zone System that provides queue warning motorists in real-time using a couple traffic speed sensors, either trailer-mounted or embedded in traffic drums, that automatically update PCMS messages displayed wireless communication as programmed by a Technician, which can be Contractor or subcontractor personnel (including the TCS) if trained and authorized by the Vendor. Contract specifications provide more details if QWS is used.

QWS is typically used for intermittent 3-mile queues that grow and dissipate in work zones with lane closures moving on a daily or nightly basis. The 3-mile QWS consists of two PCMSs and two traffic sensors and are easily installed and removed by the traffic control personnel.

For larger queues, 6-mile QWS versions are available.

When queues dissipate (traffic becomes free flow), the QWS PCMS messages are automatically programmed to display traditional lane closure and/or work zone speed limit information.

The benefit of this Queue Warning System it mitigates work zone queue safety concerns allowing for extended lane closure hours, that otherwise may not have been provided by the Agency otherwise.

4.7(4) Smart Work Zone System

Smart Work Zone Systems (SWZS) provide travel delay and "zipper merge" instruction to motorists in addition to queue warning. SWZS has multiple traffic sensors and PCMSs that functions in real time like Queue Warning Systems but also include portable travel time readers to determine travel time delays.

This complex system is independently programmed and operated by an independent Technician, who coordinates and collaborates with the TCS. Because of the complexity of the Smart Work Zone System, the Traffic Control Supervisor is prohibited from also being a SWZS Technician (unlike with the Queue Warning System). Contract specifications provide more details if SWZS is used.

SWZS consists of three components:

- Traffic queue warning
- Zipper merge/lane usage instructions
- Travel delay through work zone

This more complex system is meant for regular, reoccurring 6 to 9-mile work zone queuing where lane closure locations remain in place for long-term (1+ week or months). See SWZS video.

Zipper Merge:

Zipper merge encourages motorists to use all open lanes up to the merge taper, where a vehicle from each lane takes their turn moving into the remaining open lane. This can increase capacity by discouraging motorists from "fighting" with each other approaching the closure taper (cutting off "cheater" that roll down to the end of the open lane before merging.

When motorists utilize all open lanes up to a merge point, the length of the queue is reduced by avoiding empty lanes, as shown below:

All Open Lanes Utilized = Minimizes Queues

Travel Delay:

By displaying current travel delays in real time at a location prior to major alternative routes or bypasses around the work zone, we can significantly increase traffic diversion. More traffic that goes around the work zone, less traffic the work zone must serve and results in less queuing and delays.

Delay is either display in minutes (left photo below), or time to a landmark (right photo below):

Typical Traffic Control Plans:

Plans Smart Work Zone Systems on 2-lane and 3-lane freeways are included in the Work Zone Typical Traffic Control Plans (TC160s & TC170s). Separate plans are provided for queues up to 6 miles and 9 miles but can be modified for more lanes if needed.

4.8 Work Zone Collisions & Safety Improvements

The objective of temporary traffic control is to safely guide road users while protecting workers, studying crashes provides valuable opportunities to observe trends and improve work zone safety.

This video by Wisconsin County Highway Association conveys well the dangers faced in work zones.

National work zone statistics (ARTBA, 2022 & FHWA, 2018):

- 96% of fatalities occur to road users (4% to workers)
- 90% all fatal crashes occur on freeways & 45+ mph highways
- 34% of fatalities involve large trucks
- 12% of fatalities involve pedestrians & bicyclists

Washington work zone statistics (ARTBA, 2022):

- 5 fatalities occurred to road users (national average = 19 per state)
    - 1 fatality involved large trucks
- 0 worker fatalities (in last 10 years, 1 flagger killed getting out of passenger side of drum truck by a driver 3+ times over legal alcohol limit, Article)
- 0 fatalities involving pedestrians or bicyclists

WSDOT's Gray Notebook contains quarterly updates of WSDOT's multimodal systems and programs, including fatality and serious injury statistics.

Washington work zone crash statistics is available at WSDOT Work Zone Safety webpage.

National work zone crash statistics is available at: FHWA Work Zone Facts and Statistics

Work zone may contribute to increased crash rates by:

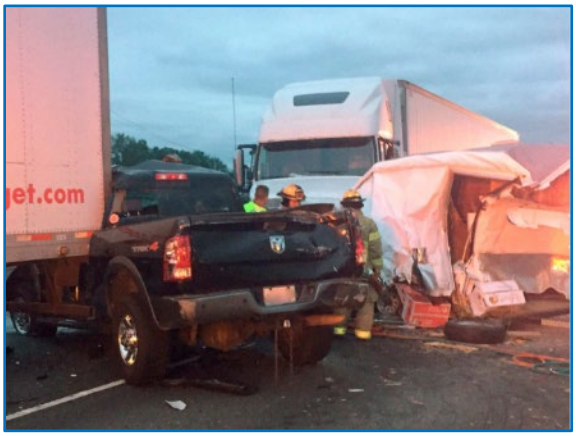
- Confronting road users with unexpected situations (freeway lane splits with short gores)

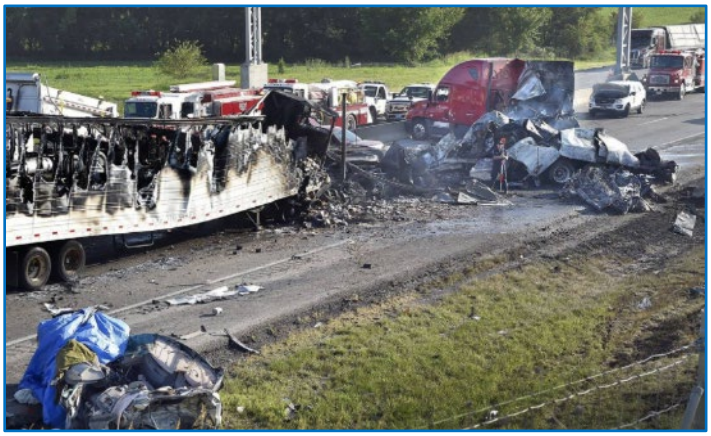
- Creating obstructions within the work zone clear zone adjacent to traffic resulting in collisions

- Distracting motorists from focusing on the driving task (very active work zones)

- Exposing workers to traffic

- End-of-queue collisions resulting from extended work zone queuing



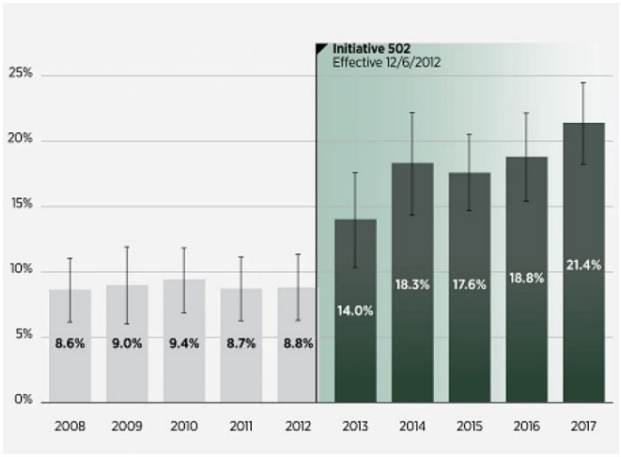


- **Legalization of marijuana in Washington** (Initiative 502 was effective 12/6/2012)

  According to a AAA study, the percentage of drivers in fatal crashes testing positive for THC more than doubled since recreational marijuana was legalized in Washington.

  Colorado shows similar rate increases as well and the trend has continued.

  Insurance Institute for Highway Safety article found crashes have increased up to 6% in states with legalized recreational marijuana versus boarder states where cannabis is still illegal.



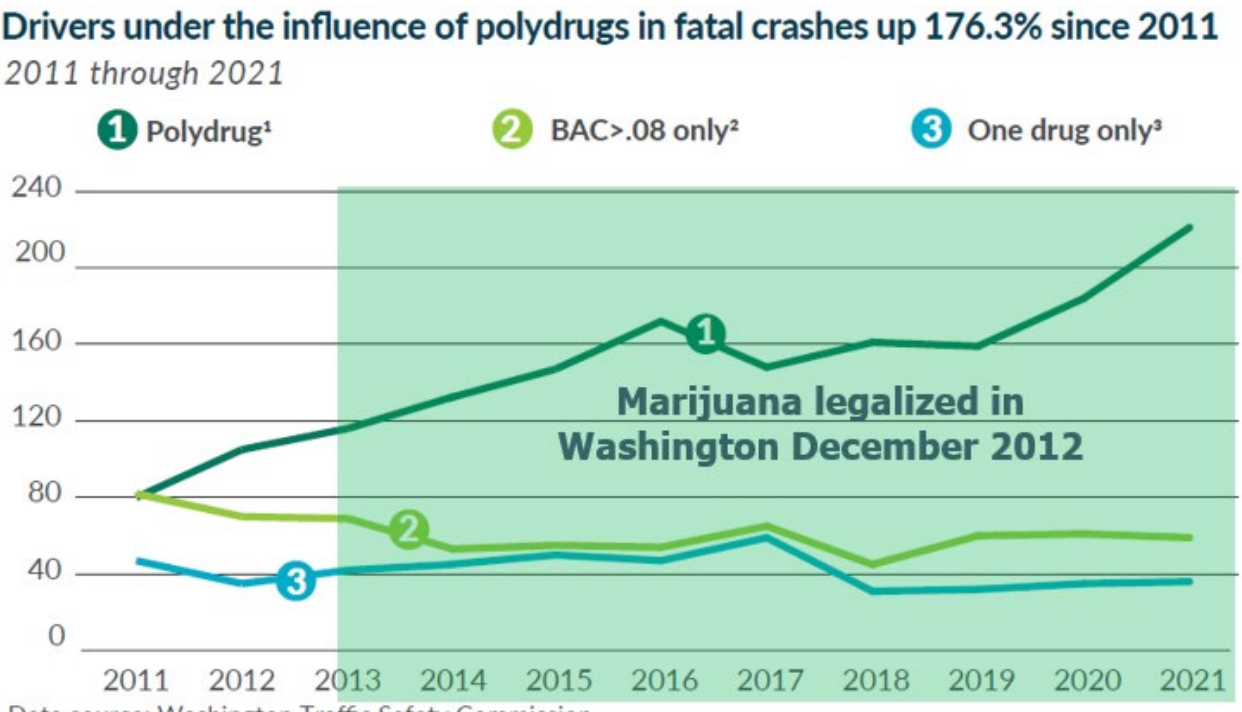
The percentage of drivers involved in fatal crashes in Washington state who tested positive for THC has doubled since the state legalized marijuana for recreational use, AAA says. (Graphic courtesy of the AAA Foundation for Traffic Safety.)

- **Increases in poly-drug fatalities**

  The Washington Traffic Safety Commission has extensive data regarding fatalities. In 2023, nearly 50% of fatalities involved impaired drivers. Washington had 810 fatalities in 2023 (averaged 597 fatalities during 2012-2017) with nearly 300 fatalities caused by poly-drug drivers. The number of alcohol or drug-positive impaired drivers contributing to fatal crashes is sobering. News Article.

  Data in graph to below updated thru 2021 with the poly-drug fatal crash trend ever increasing.

  Washington is a Target Zero state.



Data source: Washington Traffic Safety Commission

Notes: **1** Polydrug (Drug positive for two or more drugs or any alcohol and drugs).
2 Blood Alcohol Content greater than 0.08. **3** One drug only (tested positive for one drug or Blood Alcohol Content less than 0.08).

4.8(1) Managing Speed and Safety in Work Zones

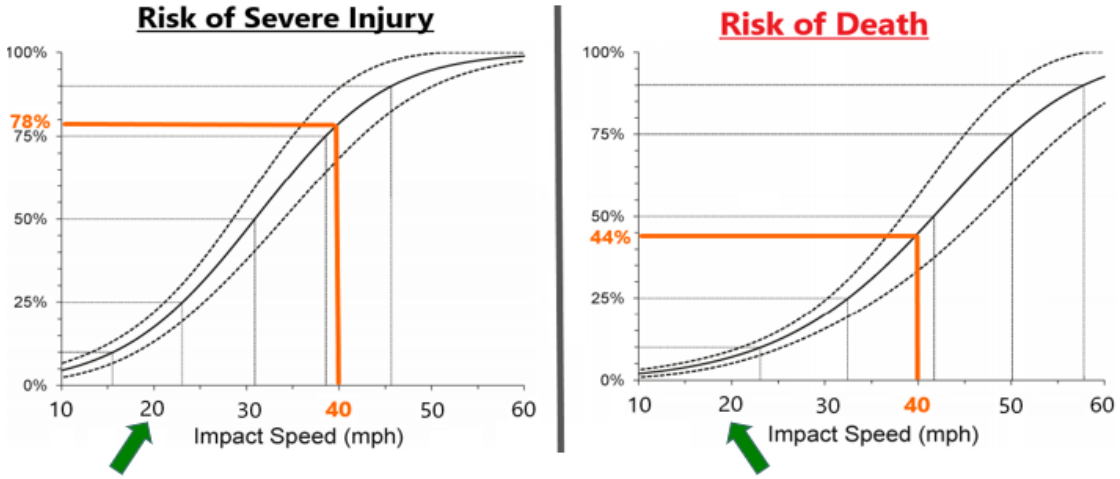
Recall national statistics state 90% all fatal crashes occur on freeways & 45+ mph highways. Of those 96% of fatalities occur to road users (4% to workers) nationally, so these roads are our focus.

It is a common misunderstanding that lowering work zone speed limits always improves safety for road users and workers; in fact, it can make crashes more frequent…

"Can't we just use 45 mph work zone speed limits to keep us safe?"

If motorists always drove the speed limit with minimal speed variance (difference in speed), safety would be increased by lowering speed limits. In reality, this just does not happen.

Even at 40 mph, a worker struck by a vehicle will be seriously injured 78% and killed 44% of the time according to an AAA study for pedestrian-vehicle impacts. "Slowing down traffic" is not very effective until speeds are ~ 20 mph, which are used in school zones.



Since we are not going to get traffic to travel 20-30 mph on freeways and 45+ mph roadways, we need to use other safety countermeasures than lowering speed limits.

"Can lowering the speed limit make crashes more likely?"

To the surprise of many, yes. NCHRP Synthesis 482 (2015) "*Work Zone Speed Management*" states speed reduction techniques can increase speed variance. Greater the speed variance (more interactions between vehicles) = reduced safety. It's common sense.

Interstate 5 in Tacoma was reduced to 50 mph (24/7) from April 2019 thru late 2021, after remaining 60 mph since start of construction in 2001. Per KIRO 7 article, after the speed limit was reduced to 50 mph **collisions increased 33%** from 2019 thru July 2021.

Using excessively low speed limits introduces the "speeding game"—some drivers always drive the limit, others "add 5-7 mph", and others completely disregard it and drive whatever they want. This increases speed variance, which increases interactions.

In short, motorists drive what speed they feel comfortable on a given roadway; lowering the speed limit alone does not slow down motorists without a change in the roadway configuration.

Even without speed limit reductions, NCHRP 482 found motorists slow down about 5 mph in work zones anyway. With a 15-mph speed limit reduction, speeds only drop another 2-3 mph but speed variance nearly doubles, which offsets any safety benefit from the reduction.

A 1997 FHWA Report "*Effect of Raising and Lowering Speed Limits…"* studied over 200 sites where speed limits were lowered and raised up to 20 mph. Significant conclusions:

- Majority of motorists don't just automatically drive 5-10 mph over speed limits (87)
- Changing the speed limit alone, without additional enforcement, education, and other engineering measures has only a minor effect (Page 87)

"What can we do to improve work zone safety?"

1) **Assign realistic speed limits in active work zones and warning signs + advisory speeds for restricted features to explain why motorists to slow down.**

2) **Impose double work zone fines, use radar speed display signs, actively enforce traffic laws:**

Work Zone Speeding DOUBLE FINE Breakdown		
Violation	**Speed Limit Up to 40**	**45+ Speed Limit**
1-5 mph Over	$250	$210
6-10 mph Over	$272	$250
11-15 mph Over	$332	$312
16-20 mph Over	$414	$374
21-25 mph Over	$518	$436
26-30 mph Over	$620	$518
31-35 mph Over	$722	$620
35+ / 36-40 mph Over	$846	$722
40+ mph Over		$846

- I20-301 sign provides notice to motorists but is not required for officers to issue double citations in work zones; however, it is recommended by WSP
- Reckless driving (typically speeding 20+ mph in work zone but at officer's discretion) imposes a 30-day license suspension + ~ $1,000
- Reckless endangerment of workers = 60-day license suspension + ~ $5,000 fine

3) Utilize speed safety cameras systems (SSCS) in work zones with workers present

The House and Senate unanimously voted to pass SB 5272 and was signed into law by the Governor in April 2023. A SSCS vendor has been selected and will be managed through WSDOT Headquarters – Transportation Operations. **Implementation is expected to begin February 2025 starting with 1 camera system and increasing to 15 cameras by 2027.**

WSDOT and Washington State Patrol are detailing how this program will be implemented including criteria for when and where to deploy SSCS, performance metrics and reporting requirements, speeding thresholds for violations, define fine structures (1 warning followed by $248 fines for subsequent violations), adjudication processes with Office of Administrative Hearings, and enhancing the framework for ongoing equity considerations.

In advance, SSCS vendor will coordinate with the Contractor to determine a reasonable notice of anticipated date/times SSCS vendor will be on-site, anticipated traffic control and anticipated work operations, location of signage and vendor equipment, and contact information.

SSCS vendor field personnel will need to enter work zones to install/remove signage and devices, document (via video typically) the traffic control setup to confirm workers are present.

About 20 other states have speed safety camera system for automated speed enforcement in work zones and it has proven very effective.

- Illinois: Average free-flow speeds reduced to 45-52 mph with a 55 mph limit (ITE).
- Maryland: 80% reduction in speeding violations + 50% drop in fatalities within 3 years of implementation, hitting a 10-year low (FHWA).
- In Pennsylvania, 11+ mph speed reduced 62% & work zone fatalities dropped 25% (PennDOT).

4.9 Work Zone Clear Zone

A clear zone is a roadside border area starting at the edge of the traveled way ("edge line") that is available for errant drivers to stop or regain control of a vehicle to reduce the risk of a serious crash. This area may include a paved shoulder, a recoverable and/or non-recoverable slope that is free of obstructions to the extent practical. See Standard Specification 1-07.23(3).

Work zone clear zones (WZCZ) distances are dependent on the posted speed limit:

Minimum Work Zone Clear Zone

Regulatory Posted Speed	Distance From Traveled Way (Feet)
35 mph or less	10
40 mph	15
45 to 50 mph	20
55 to 60 mph	30
65 mph or greater	35

Work zone clear zone does not apply when objects are behind guardrail/barrier (keep them 3+ feet away from unpinned/unanchored temporary barrier)

Work zone clear zones (WZCZ) applies during working and nonworking hours to temporary Contractor roadside objects such as vehicles, equipment, and materials:

During work hours (unless behind guardrail/barrier):

- Only **essential** construction work vehicles, equipment, and materials are allowed within WZCZ
- Personal vehicles are prohibited within WZCZ

During non-work hours (unless behind guardrail/barrier):

- All construction work vehicles, equipment, and materials must be removed from WZCZ
- Personal vehicles are prohibited within WZCZ

Important: Trailer-mounted devices must be removed from the work zone clear zone when not in use as soon as practically possible. These devices include:

- PCMSs
- Arrow boards (sequential arrow sign)
- Portable temporary traffic signals
- Automated Flagger Assistance Devices (AFADs)
- Radar speed display signs (RSDSs)
- Nighttime illumination

Do not parking transportable attenuators adjacent to travel lanes with the attenuator "up" like to the right

Make sure the attenuator is "down" or remove the attenuator from the WZCZ.

Devices placed near the upstream terminal ends or Permanent attenuators like the speed display sign shown to the right are not protected by the guardrail or barrier.

The radar speed display sign should have been moved ~100' farther beside the guardrail to be in a protected area.

As a rough rule of thumb, for every 20 feet past the attenuator, an additional 1 foot of work area is protected since vehicles veer off at a skew.

Design clear zone applies to roadside features (bridges, temporary wooden timber poles). See Design Manual Chapter 1600 for more information.

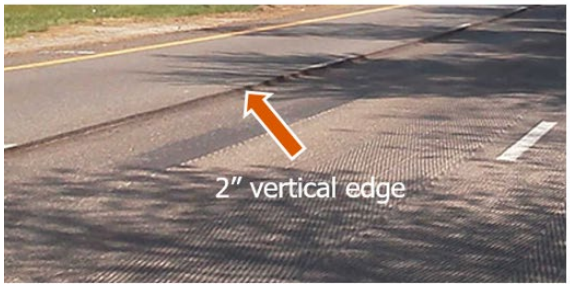
4.10 Drop-Off Protection

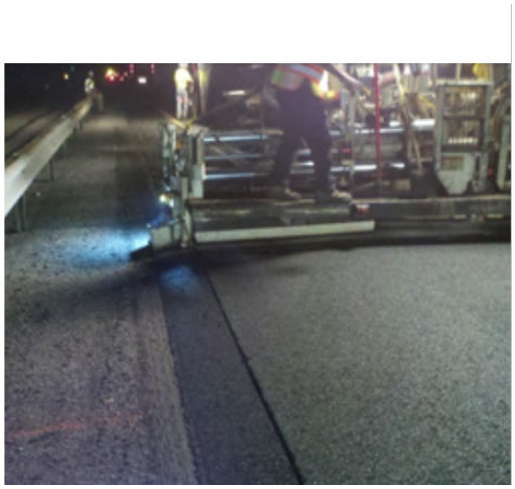
Per Standard Specifications 1-07.23(1), Contractors shall conduct all operations to minimize any drop-offs (abrupt changes in roadway elevation) left exposed to traffic during nonworking hours.

For additional information regarding special motorcycle signage requirements, see Section 5.4(9).

Drop-offs up to 0.2':

May within travel way if protected by warning signs, but Contractor shall minimize drop-off exposed during nonworking hours.





- Vertical edges should be located at the lane line or edge line

Drop-offs Over 0.21': Must be protected further + appropriate warning signs

1) 36" or taller channelizing devices with edge line @ 3'+ feet from drop-off
2) Temporary barrier + attenuator/sloped terminal
3) Steel plate with anchors
4) 4H:1V or flatter edge of compacted stable material

4.11 Sight Distance Considerations

4.11(1) Decision Sight Distance

Simply the distance needed by motorists to recognize and avoid unexpected hazards or changes in the roadway and based on the vehicle's speed but can also be thought of in terms of time.

Providing motorists with **8+ seconds of "sight time" through work zones is optimal**. Position flagging stations or lane closure tapers on straight section of roadway is far safer than within curves.

4.11(2) Stopping Sight Distance

Add the braking distance to decision sight distance, you get design stopping sight distance. This distance is typically based on the posted speed limit and level grade.

Steep downgrades can increase these stopping distances as much as 25%; upgrades decrease them.

Speed (mph)	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
Stopping Sight Distance (feet)	115	155	200	250	305	360	425	495	570	645	730	820
Time (seconds)	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.1	6.4	6.8	7.1	7.4

As discussed previously, this design stopping distance significantly exceeds realistic stopping distances for semi-trucks and cars as it is based on very conservative, almost unrealistic assumptions.

As discussed later, the longitudinal buffer space distances are the same as stopping sight distance.

LONGITUDINAL BUFFER SPACE = B												
SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
LENGTH (feet)	115	155	200	250	305	360	425	495	570	645	730	820
Buffer space may be adjusted (±) based on field conditions.												

4.11(3) Signs of Insufficient Sight Distance

More of a concern on high-speed roadways, multiple skid marks are a telltale sign to examine traffic operations through a work zone in detail. In the photo below, all the skid marks are in the left lane, which is adjacent to the barrier with glare screen. Is queuing occurring in this area? If so, are motorists coming up stopped vehicles unexpectedly and slamming on their brakes? Once the cause of the issue is determined, then potential mitigations can be developed and implemented.

Chapter 5 : Temporary Traffic Control Devices

5.1 Summary

This chapter covers the selection and proper use of temporary traffic control devices in a manner to promote and enhance work zone safety and efficiency by providing for the orderly movement of all road users on all streets and highways. Often, traffic control devices are the only means of communications with road users.

Temporary traffic control devices range from signs, channelizing devices, pavement markings, barriers & impact attenuators, signals, lighting units, delineators, rumble strips, and screens.

5.2 Principles of Traffic Control Devices

To be effective, all traffic control devices should meet the following five basic requirements:

- Fulfill a need
- Command attention
- Convey a clear simple meaning
- Command respect of road users
- Give adequate time for proper response

5.3 Conformance to Established Standards

The MUTCD and the Washington State Modifications to the MUTCD set the standard for temporary traffic control devices.

Per Standard Specifications 1-10.2(3), temporary traffic control device quality is determined using the *Quality Guidelines for Temporary Traffic Control Devices* and crashworthy requirements apply to traffic control devices (trailer-mounted devices still exempt).

5.3(1) Quality Guidelines for Temp. Traffic Control Devices

Per Standard Specifications 1-10.2(3), the condition of signs and traffic control devices shall be acceptable or marginal as defined in the *Quality Guidelines for Temporary Traffic Control Devices and Features*, published by the American Traffic Safety Services Association.

- Purchase link

There are three levels of device quality:

- Acceptable (most devices @ start of project)
- Marginal
- Unacceptable

Any traffic device determined unacceptable by the Engineer's visual inspection shall be removed from the project and replaced within **12 hours** of notification. The Engineer's decision is final.

Photos on the next page depict the three device quality conditions.

Acceptable Devices:

Marginal Devices:

Unacceptable Devices:

5.3(2) Crashworthy Requirements

Crashworthy means a roadside device has been successfully crash tested in laboratory conditions using crash test scenarios and standards established by The American Association of State Highway Transportation Officials (AASHTO) Manual for Assessing Safety Hardware, 2016 Edition (**MASH-16**).

MASH-16 has superseded National Cooperative Highway Research Project Report 350 (NCHRP-350) for crashworthy device testing standards. Serviceable NCHRP-350 approved devices may still be used per the Standard Specifications.

There are six levels of crashworthiness for both MASH-16 and NCHRP-350:

TL-3 work zone devices can be used on any roadway, including 70+ mph rural Interstates. TL-2 devices are limited to roadways 40 mph or less. No work zone devices are crashworthy for single-unit "box trucks" (TL-4) or semi tractor-trailer (TL-5) or semi tractor-tankers (TL-6).

"Why are devices tested at 62 mph but used on 70+ mph roadways?"

Crashworthiness is based on "worse practical conditions" instead of the worse-case. Per MASH-2016 Manual, crash testing impact speed and angle combinations represent the 93rd percentile of real-world crashes and work zone devices are only tested up to TL-3 (permanent cast-in-place longitudinal barriers are the only feature meeting TL-6 currently).

To determine if a device has pasted crash testing, FHWA provides hardware eligibility letters:

- MASH-16 Approved Hardware Eligibility Letters
- NCHRP 350 Approved Hardware Eligibility Letters

Per Standard Specifications 1-10.2(3), most work zone devices need to be crashworthy in accordance to MASH-16, but NCHRP-350 devices are allowed when:

1. When MASH-16 complaint devices do not exist and only NCHRP-350 devices are available
2. If the device was manufactured in 2019 or earlier and is still within its normal service life (acceptable or marginal per *ATSSA's Quality Guidelines for Temporary Traffic Control Devices*)
3. Small, lightweight channelizing devices (including traffic safety drums) without warning lights
4. Trailer-mounted devices are not required to be crashworthy currently

The trailer-mounted devices include:

- PCMSs
- Arrow boards
- Portable temporary traffic signals
- Automated Flagger Assistance Devices (AFADs)
- Radar speed display signs (RSDSs)
- Nighttime illumination


Manufacturers have not been able to make trailer-mounted devices crashworthy. Due to their importance the Federal Highway Administration (FHWA) still allows their use in work zones provided appropriate precautions are taken per FHWA WZ-45 Memo:

- Delineate transversely with channelizing devices or,
- Shield (place behind barrier or guardrail) when positioned [within the work zone clear zone]
- Operate in as safe a manner as practical so they do not pose an undue hazard to motorists
- When not used, remove from work zone clear zone

Examples of proper delineation (left photo) or shielding (right photo) are shown below:

Examples below of non-crashworthy devices that shall not be used unless behind barriers as they may result in significant damage/injury upon collision. These are often contractor manufactured sign stands made with common construction materials like wood, angle iron, or more creative designs.



Non-crashworthy devices may be placed behind guardrail or barrier (keep 3' away from barrier).

5.3(3) Sign Stability

Per Standard Specifications 1-10.3(3)A, when it is necessary to add weight (ballast) for stability, sand bags or other similar ballast may be used, but **the top of the ballast shall not be more than 4 inches above the Roadway surface** and shall not interfere with the breakaway features of the device.

Acceptable examples include sandbags not more than 4" above the roadway, base weights from traffic drums. However, hanging a sandbag on the top of a tripod-mounted sign would be unacceptable:

5.3(4) Avoid Turning Signs Perpendicular to Traffic

Avoid turning signs so they face perpendicular to traffic, basically turning them into a blade, especially for 5-foot or 7-foot mounted signs as they can go through the vehicle's windshield upon impact:

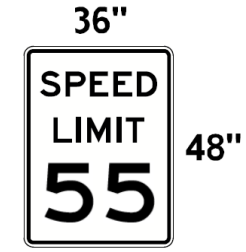
A better alternative is to simply flip the sign over on the stand (the plain aluminum side faces towards traffic) for short intervals or remove the entire sign assembly from the work zone clear zone.

5.4 Construction Signs

The fundamental purpose is to warn, advise, or guide road users traveling through a work zone. See MUTCD Sections 6F.02 thru 6F.69 and either WSDOT Standard Specifications 1-10.3(3)C and 9-35.2 for Construction or M54-44 Manual Section 1-6.3 for Maintenance.

There are three types of signs:

1. **Regulatory Signs (R-series):** Enforceable signage (typically white on black background) require prior approval from the Agency and are used in work zones informing drivers of applicable laws and traffic regulations.



R2-1 (B/W)

R3-704 (B/W)

R11-201 (B/W)

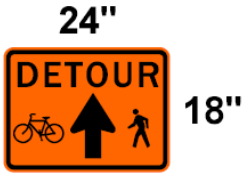
2. **Warning Signs (W-series):** Signage providing road users notification notice of general or specific conditions, particularly when a potential hazard is not obvious. These signs should not be overused, or they will lose their attention-getting value. Warning signs should be placed far enough in advance to provide road user adequate time to comprehend and take needed action.

W3-5

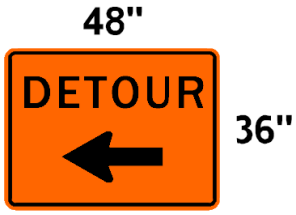
W24-1BL

W20-501R

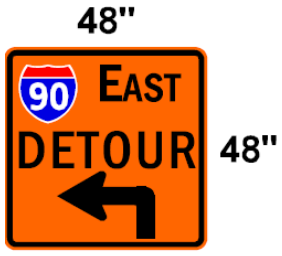
3. **Guide/Informational Signs (E, G, I, M-series):** Show destinations, designations, directions, distance, services, points of interest, and other geographical or cultural information.



M4-9A



M4-9L



M4-9 MOD

I20-301 (B/W)

R11-1501 (B/W)

E5-1 (W/G)

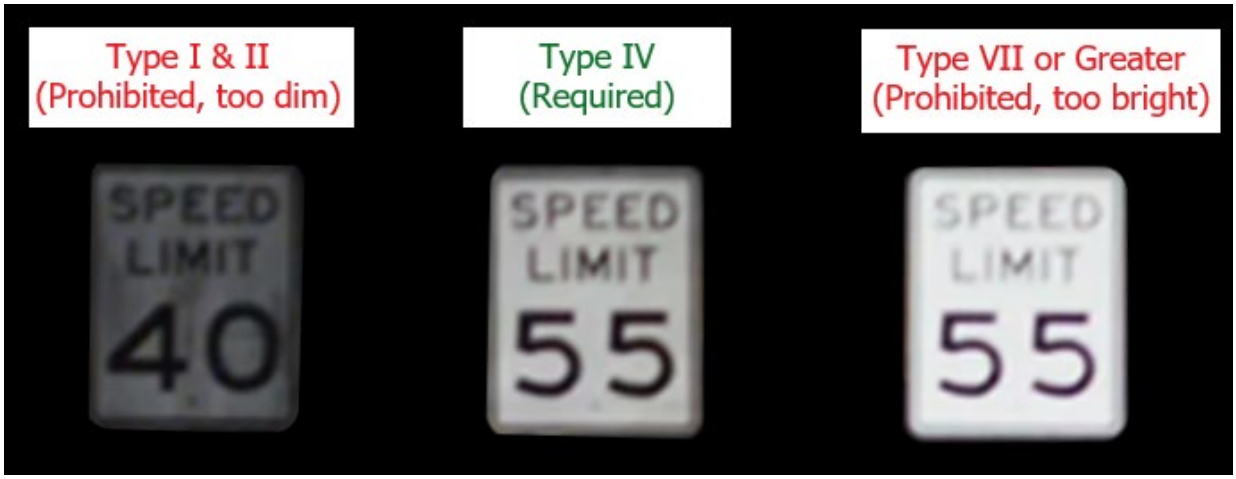
5.4(1) Sign Material

Per Standard Specifications 9-35.2, Construction projects are required to use only rigid aluminum signs (left photo below). Roll-up fabric signs is only allowed for Maintenance, utility, or developer projects with durations 3 days or less per the M54-44 Manual (right photo below). Plywood signs are prohibited.

5.4(2) Sign Reflectivity for Nighttime Visibility

Per Standard Specifications 9-35.2, construction signs shall have reflective sheeting which allows them to be visible at night to motorists via headlights. Reflectivity is graded as Type I thru XI (Type 1 thru 11). Higher the Type, brighter the sheeting at night.

Types are known in trade names as Engineering Grade (Type 1 & 2) to High Intensity Prismatic (Type 3 & 4) to Super Intensity (Type 8) to Very High Intensity (Type 9 thru 11).



For example, regulatory speed limit signs are now required to have Type IV (Type 4) reflective sheeting per Standard Specifications 9-35.2 (old contracts using 2022 or older Standard Specifications still allow Type II or III). The photo above shows the different Types at night. Lower reflective Type (left) is too dim; higher Type (right) is too bright and "washes out" the text. So, there is a fine balance between having a sign bright enough but not too bright (middle).

Per Standard Specifications 9-35.2, reflective sheeting requirements for construction signs:

Warning Signs

Retroreflective Sheeting

~~Type I, II (Engineering Grade)~~

Type VIII (Super High-Intensity)

Type IX & XI (Very High Intensity)

Note: Former WSDOT Type X still OK.

Warning Sign Color

Black on Fluorescent Orange

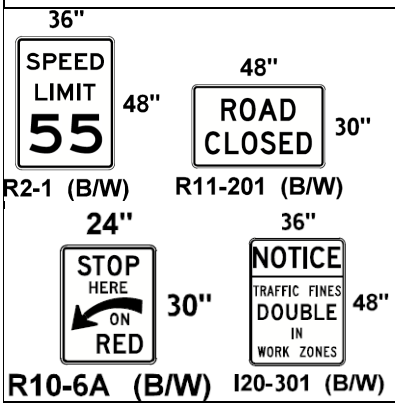
~~Black on Yellow~~

Material

0.08 (1/12″) to 0.125 (1/8″) Aluminum

~~Fabric Roll-ups~~
~~Plywood~~
~~Fiberglass Reinforced Plastic~~

Regulatory Signs (Black on White)



Retroreflective Sheeting

~~Type I, II (Engineering Grade)~~

Type IV (High-Intensity Prismatic)

Note: Existing signs with Type II (rural only) & Type III (urban & rural areas) can still be used thru 2026.

Regulatory Color

Black on White

Material

0.08 (1/12″) to 0.125 (1/8″) Aluminum

~~Fabric Roll-ups~~
~~Plywood~~
~~Fiberglass Reinforced Plastic~~

Regulatory Signs (Red Background)

Retroreflective Sheeting

~~Type I, II (Engineering Grade)~~

Type III (High-Intensity)

Type IV (High-Intensity Prismatic)

Note: Existing signs with Type II (rural only) & Type III (urban & rural areas) can still be used thru 2026.

Regulatory Color

White on Red

Material

0.08 (1/12″) to 0.125 (1/8″) Aluminum

~~Fabric Roll-ups~~
~~Plywood~~
~~Fiberglass Reinforced Plastic~~

Construction Signage – Other Non-Orange Signs

Retroreflective Sheeting

~~Type I (Engineering Grade)~~

Type IV (High-Intensity Prismatic)

Note: Existing "EXIT" signs with Type II green background & Type III/IV letters, boarders, symbols can still be used thru 2026.

Note: Other existing signs with Type II (rural only) & Type III (urban & rural) can still be used thru 2026.

Regulatory Color

Black on White

Material

0.08 (1/12″) to 0.125 (1/8″) Aluminum

~~Fabric Roll-ups~~
~~Plywood~~
~~Fiberglass Reinforced Plastic~~

5.4(3) Sign Storage

It is preferred to store signs indoors when feasible; however, proper outdoor storage techniques can extend the useable life of signs. Signs are very expensive at well over $100 each.

To prevent premature sign failure, signs should be stored as follows:

- Store signs vertically on edge
- Provide gaps between signs (for good air flow)
- Avoid sign face contact with treated wood
- Remove all packaging materials

The traffic control vehicle below has been designed to organize and properly storage several traffic control devices, including cones and signs. The signs fit into several "slots" to help with organization.

Back at the shop, a larger sign storage area is created using wooden shelving. Because most traffic control signs are 48" tall, a storage facility with 9-foot ceilings can support two rows of signs. Note the laminated label used to help sort the top and bottom row of signs grouped together.

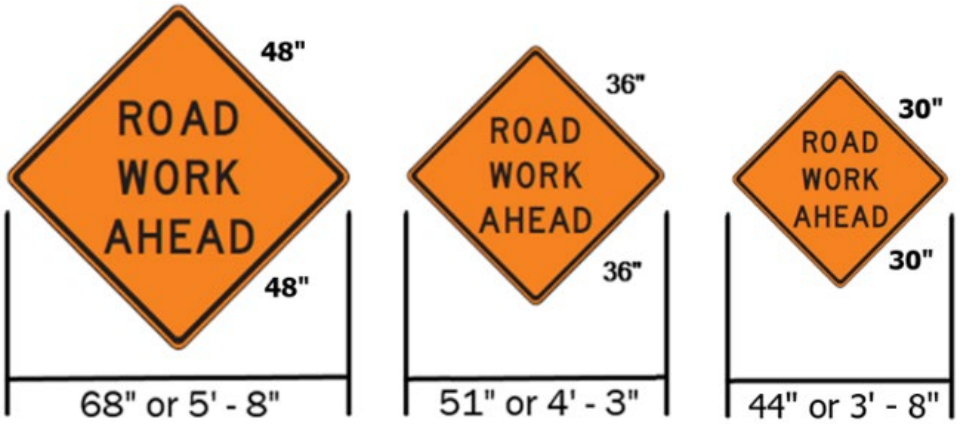
5.4(4) Work Zone Sign Sizes

Traffic control plans will state needed sign sizes, but WSDOT typically uses larger signs than required in the MUTCD. For typical diamond-shaped warning sign sizes, see the table below:

Typical Minimum Diamond-Shape Sign Sizes		
Roadway	**WSDOT**	**MUTCD (Table 6F-1, Page 578-580)**
Freeway (Mainline & Ramps)	48" x 48"	48" x 48"
Roadways 45+ mph	48" x 48"	36" x 36"
Roadways 40 mph or Less	**36" x 36" MIN** 30"x30" OK (≤ 30 mph)	36" x 36" (35-40 mph) 30" x 30" (≤ 30 mph)

When 36"x36" MIN is stated on Plans, either a 36"x36" or 48"x48" sign may be used.

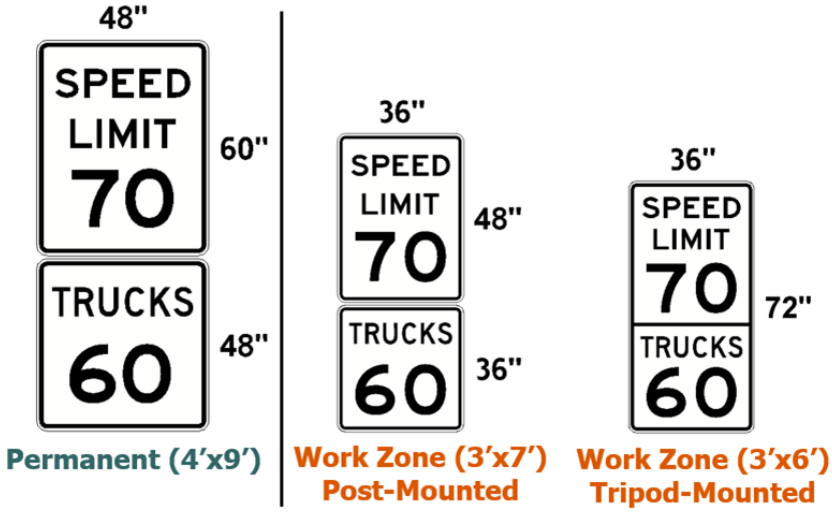
WSDOT's recent trend of only using 48"x48" warning signs everywhere is being relaxed because it can be very difficult to place large signs in tight areas because of their width, as shown below:



Work zone signs, because of their temporary nature, are often smaller than permanent signs. However, large signs than shown in Plans may be used with Contractor and Engineer concurrence.

- See MUTCD Table 6F-1 (Page 578-580) for size information for work zone signs.
- Note, permanent sign sizes are listed in MUTCD Table 2B-1.

Work zone speed limit signs are smaller than permanent signs. See below:



R2-1 Sign Size
MUTCD Table 6F-1 (Page 578)

Guidance:

Freeways: 36" x 48"
Multilane Hwy: 36" x 48"
45+ mph Hwy: 30" x 36"
Hwy 40- mph: 24" x 30"

5.4(5) Work Zone Sign Information

Typical Sign Sequence:

The number of actual warning signs range significantly, but three warning signs are the most common. In Washington, the generic "AHEAD" is used in lieu of distances (1000 FEET, ½ MILE, 1 MILE).

- **1st Sign**: Generic sign informing road users of the work zone ahead

W20-1

W21-7

W21-6

  - W20-1 typically used, but W21-7 for utility work and W21-6 for survey crews OK

- **2nd Sign**: Provides more detailed information about the closure or work operation

W21-5

W20-5R

W20-3

- **3rd Sign**: Advises a course of action or closure

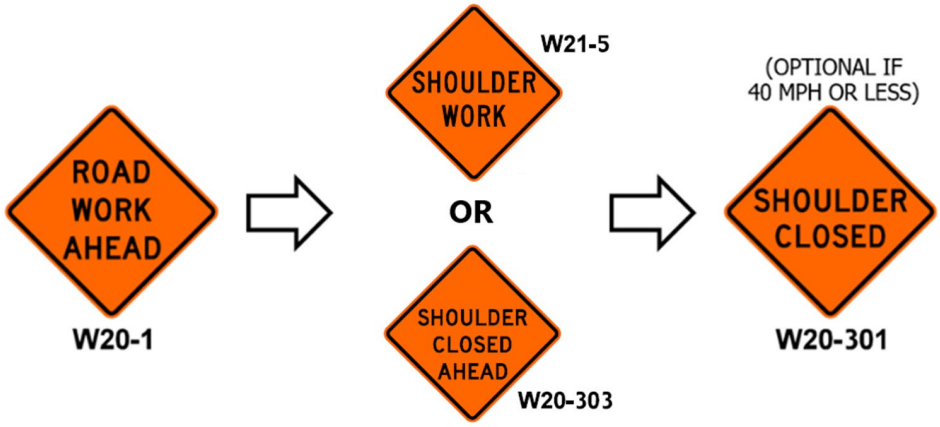
W20-301


W4-2R

R11-4 (B/W)

Typical Shoulder Closure Signage:

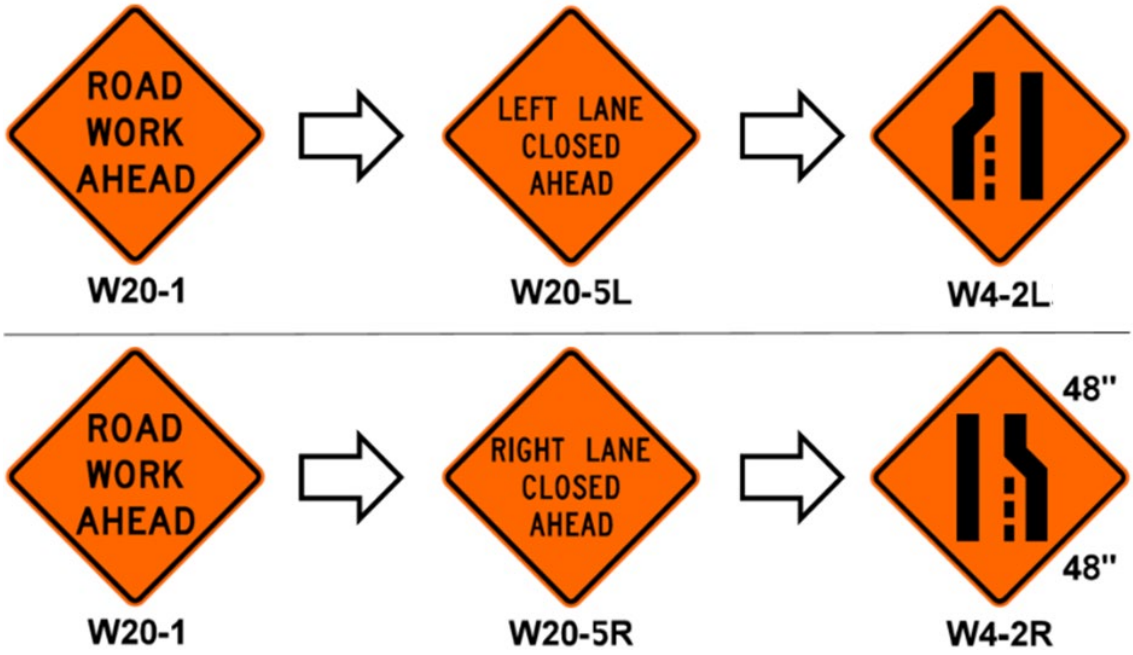
For shoulder closures, 3 signs typically used. For roadways 40mph or less, can be reduced to 2 signs.



Alternatively, shoulder-specific signage is useful on 45+ mph multilane roadways and freeways:

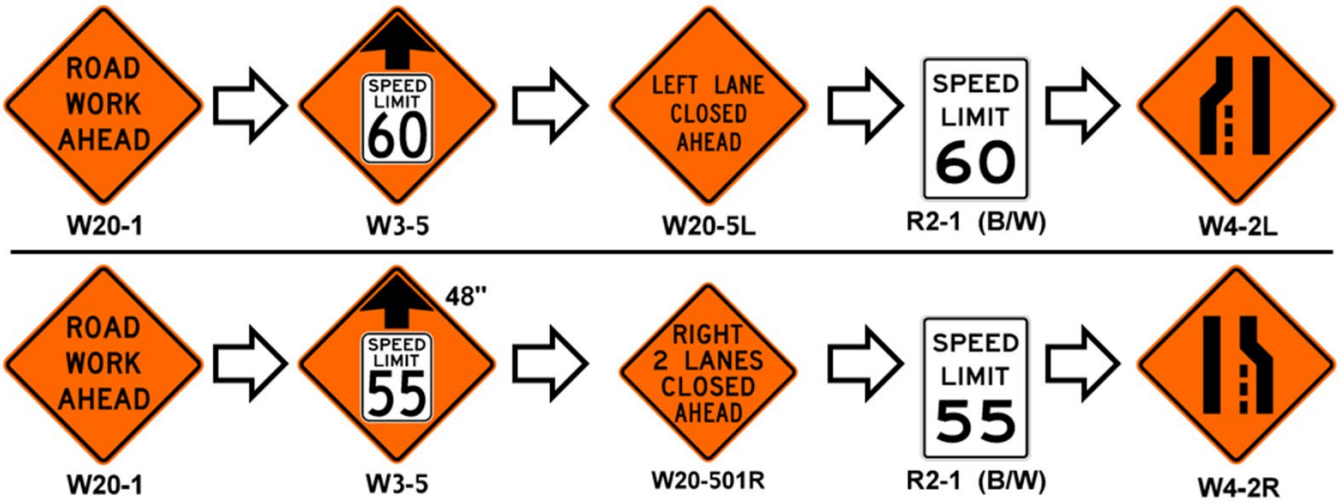
Typical Single Lane Closure Signage

The sign series below show typical signage for single left and single right lane closures:



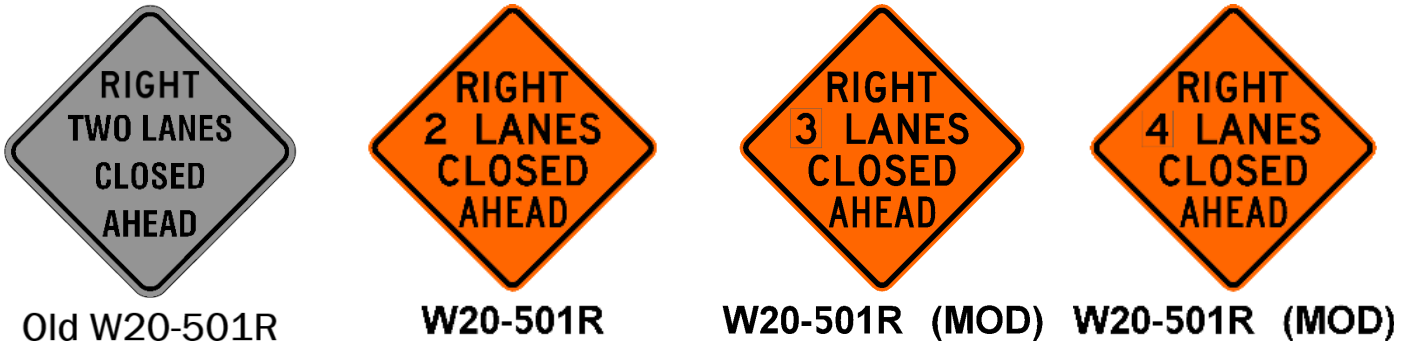
Typical Lane Closure(s) with Temporary Reduced Speed Limit Signage

The sign series show a single left lane closure with a 60 mph speed limit reduction sequence followed by a double right lane closure with a 55 mph reduction (actual lane closures and speed limit may vary):



Note: The W3-5 and R2-1 signs may be placed after the lane closure if shown on traffic control plans.

The updated W20-501 sign can be modified with a "3" for triple lane closures, "4" for quadruples, and so on by using a small plaque going over the "2" using clear recloseable fasteners or a similar method.



5.4(5) Work Zone Speed Limit Signage

Reduced regulatory work zone speed limits must be approved thru WSDOT Region Traffic or Local Agencies prior implementation in work zones. For policy information, see Chapter 16.

Work zone speed limit signs are always black on white with a 1-foot minimum mounting height. Temporary Class B signs are tripod or barrier mounted (left 3 picture); while long-term Class A signs are either barrier-mounted or installed on wooden posts.

Black on orange speed limit signs are prohibited by the MUTCD. Unlike other states, Washington does not typically use the "WORK ZONE" plaque above the speed limit sign because it is difficult to mount on temporary signage and research has shown it to be ineffective at reducing speeds.

5.4(6) Work Zone Speed Limit Reduction Signage

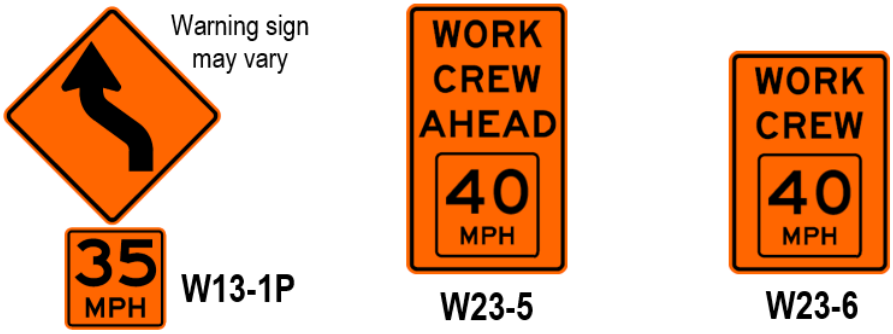
A work zone speed limit reduction sign (W3-5, with orange background) is used for 10+ mph reductions providing motorists a sufficient distance to safely slowdown by just letting up on the gas pedal without having to apply brakes (except for downgrades). Do not use yellow background signage in work zones.

5.4(7) Work Zone Advisory Speed Signage

Work zone advisory speeds must be approved thru WSDOT Region Traffic or Local Agencies prior implementation in work zones. For policy information, see Chapter 16.

Work zone advisory speed signs are always black on orange and shall not be used in conjunction with any sign other than a warning sign per MUTCD 6F.52. In short, this means it is prohibited to mount an advisory sign below a speed limit sign.

Advisory speeds as supplemental plaques (the 35 MPH sign below on left) are mostly posted on wood posts; trying to mount supplemental plaques to tripod-mounted signs is difficult.

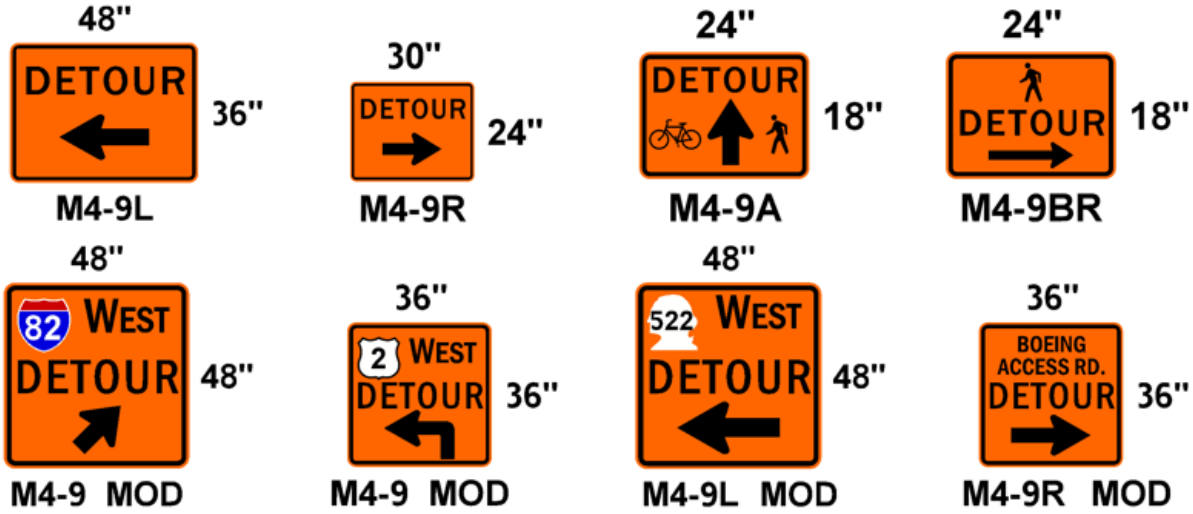


5.4(8) Detour & Alternate Route Signage

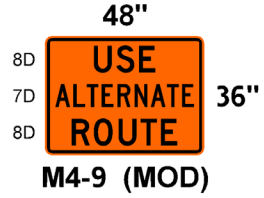
Detour routes are typically used to guide motorists, pedestrians, and bicyclists around closures. The Contract's detour route and signage will be shown in the Detour Plans, which are separate from TCPs.

There are generic and route-specific detour signs. The route-specific signs include the roadway information being detoured for clarity.

Freeways and high-speed multilane roadways typically use 48"x36" or 48"x48 detour signs. Single lane or lower speed roadways typically use smaller 30"x24" or 36"x36" detour signs. Pedestrian/bike detour signs are typically 24"x18".



In lieu of detour routes, "use alternate route" signage may be used only where WSDOT or Local Agency has determined a formal detour route is not necessary.



5.4(9) Standard, Modified, and Custom Signs

Most signs in work zones will be standard signs; however, Contract Plans may specify modified versions of standard signs or customized signs. See details below.

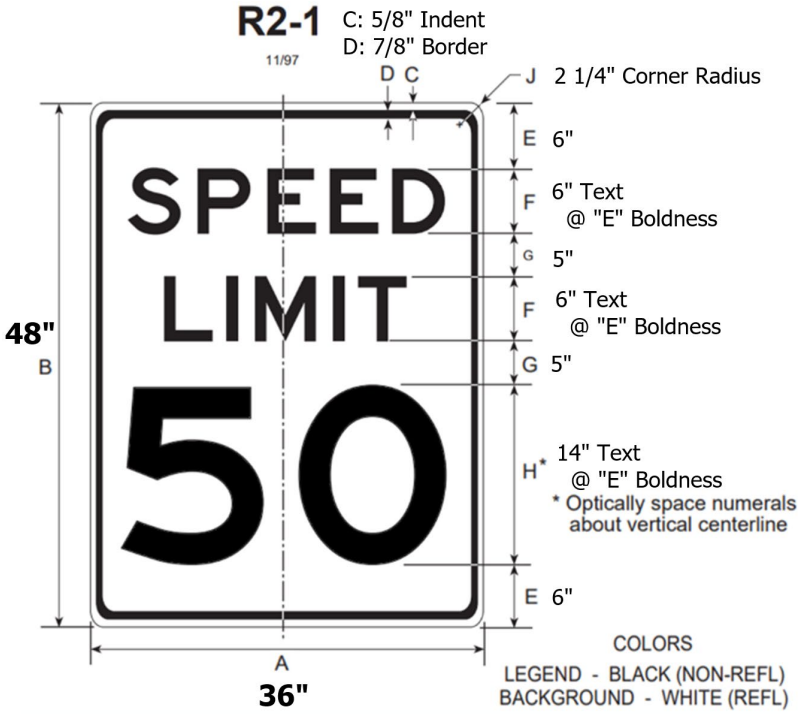
Standard Signs

Standard signs are used for the most common signage, such as speed limit signs.

The WSDOT Sign Fabrication Manual assists sign fabricators by providing standard sign layouts for official highway signs of different sizes, both permanent and temporary and is based on federal standards from the MUTCD and the Federal Standard Highway Signs Book.

Sign layouts are self-explanatory except for text and number sizes. The text is typically listed in a format of #C, #D, or #E. The # is the height of the text in inches. Typical boldness level ranges from C thru E (even though B thru F exists); C is less bold than D which is less bold than E.

The sign layout from the Sign Fabrication Manual for the R2-1 Speed Limit sign is explained on the right:

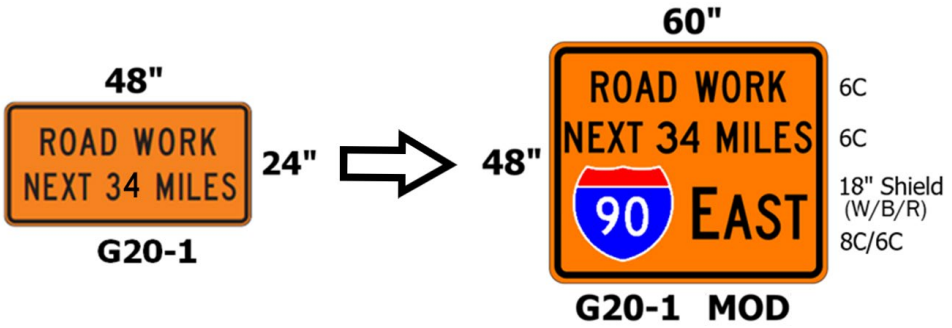


DIMENSIONS (INCHES)								
A	B	C	D	E	F	G	H	J
36	48	5/8	7/8	6	6E	5	14E	2 1/4

Modified Standard Signs

Standard signs may be modified in some manner and its layout is included in Contract Plans so the sign can be fabricated.

The standard G20-1 sign has been modified to include an interstate shield and direction.

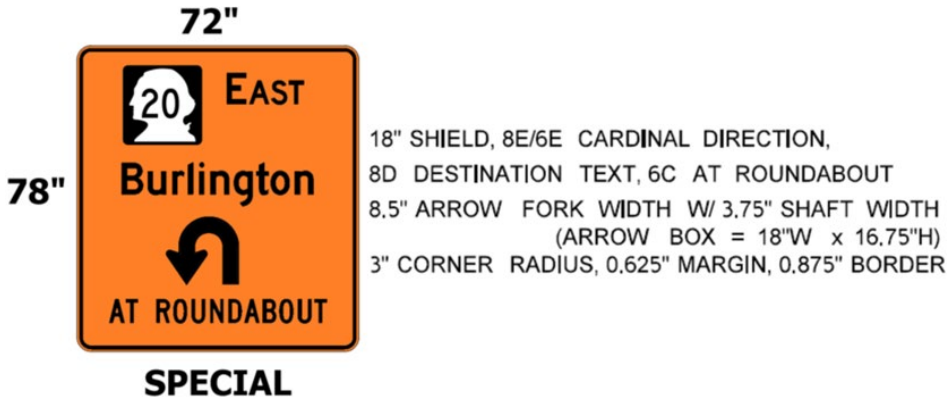


Sign size, text size and boldness, and shield size information is provided so the sign can be fabricated.

Custom Signs

Contract Plans may create customized signage far beyond just a modification of a standard sign for unique situations where unique situations need to be highlighted.

Sign size, text size and boldness, and shield size information will be provided along with any arrow size information for fabrication.



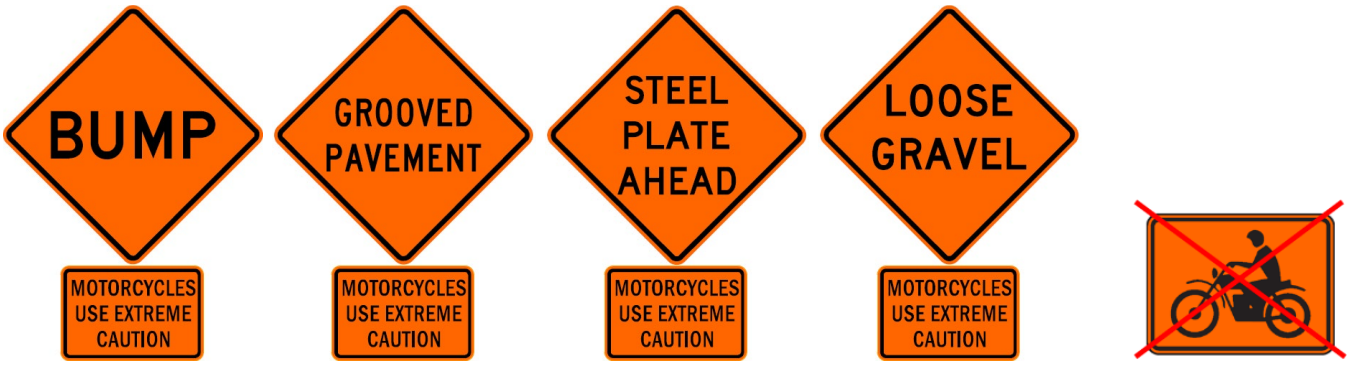
5.4(10) Special Motorcycle Warning Signage

Per Washington state law, per RCW 47.36.200, a "MOTORCYCLES USE EXTREME CAUTION" sign must accompany pavement condition warning signs for **construction or maintenance work zones** with grooved pavement, abrupt lane edges, steel plates, or gravel or earth surfaces.

This motorcycle warning sign requirement **does not** apply for:

- Permanent conditions (ROUGH ROAD)
- Existing or temporary rumble strips (even in work zones)
- Short-duration (1 hour or less) work operations including mowing, snow & ice removal, shoulder work, or debris removal
- Emergencies or incident response

In lieu of separate signs, WAC 468-95-306 adds a text-version of "MOTORCYCLES USE EXTREME CAUTION" supplemental plaque to pavement condition signs for Class A construction signs. The MUTCD's motorcyclist symbol plaque, W8-15P, has been deleted and is not used in Washington.

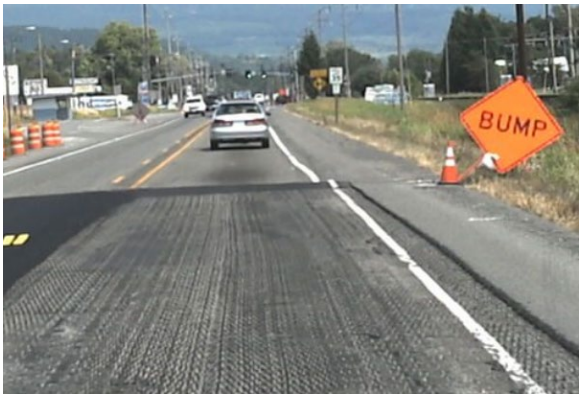


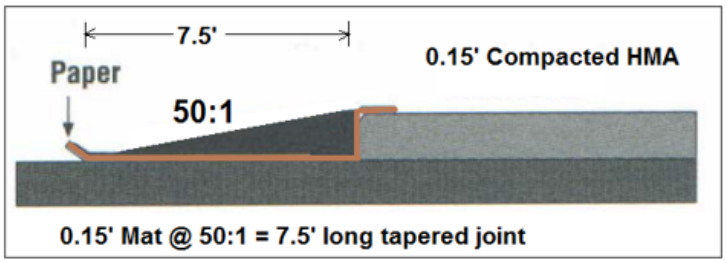
Common scenarios requiring this special motorcycle and pavement condition signage is shown below:

- **Concrete Diamond Grinding**: Recommended for 7 days after surface ground

- **HMA Cold Milling**

- **HMA Paving with Transverse Tapered Joints**

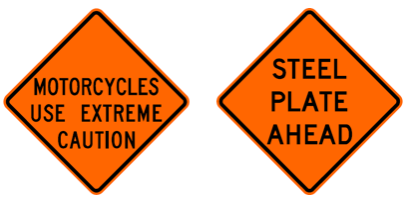




HMA 50:1 tapered transverse joint
required per Standard Specification 5-04.3(12)

- **Loose gravel/fresh oil** (BST "Chip-Seal" projects)

- **Steel Plate on Roadway**



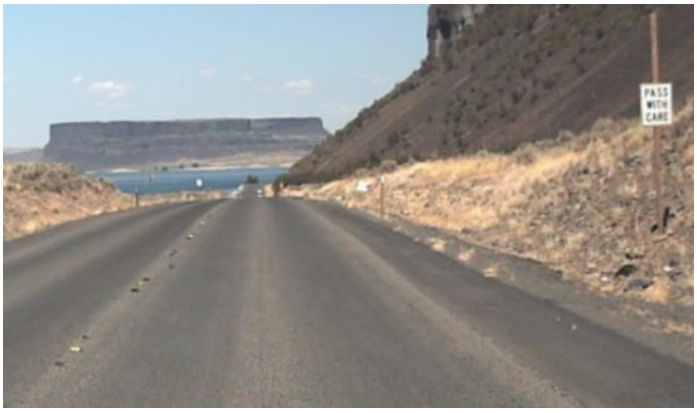
5.4(11) Class A Construction Signs

Class A construction signs are long-term signs left in place more than 8 or more days.

Class A signs are typically mounted wooden or steel plates per Standard Plan K-80.10. Larger signs need larger and/or multiple posts per Standard Specifications 9-35.3. Class A signs may also be mounted on traffic barriers. If approved by the Engineer, Class A signs may be tripod mounted.

Various ways Class A signs are commonly mounted include a single 4x4 wooden post (signs up to 16ft^2), double 4x4 wooden posts, barrier-mounted, and (when the Engineer approves) tripod-mounted.

For projects obliterating existing pavement markings (such as "chip-seal" or HMA paving projects), "DO NOT PASS" and "PASS WITH CARE" signs shall mark the passing zones on highways.



Class A signs also apply to overhead signage, particularly on freeways. Existing overhead signage may be modified or completely covered with new temporary sign sheeting or black PE sheeting:

The existing overhead sign (left photo) was modified using temporary sign sheeting and black PE sheeting when the double exit-ramp configuration was modified into a combined single exit-ramp during construction.

For additional information for Class A signage, see Standard Specification 1-10.3(3)A.

5.4(12) Class B Construction Signs

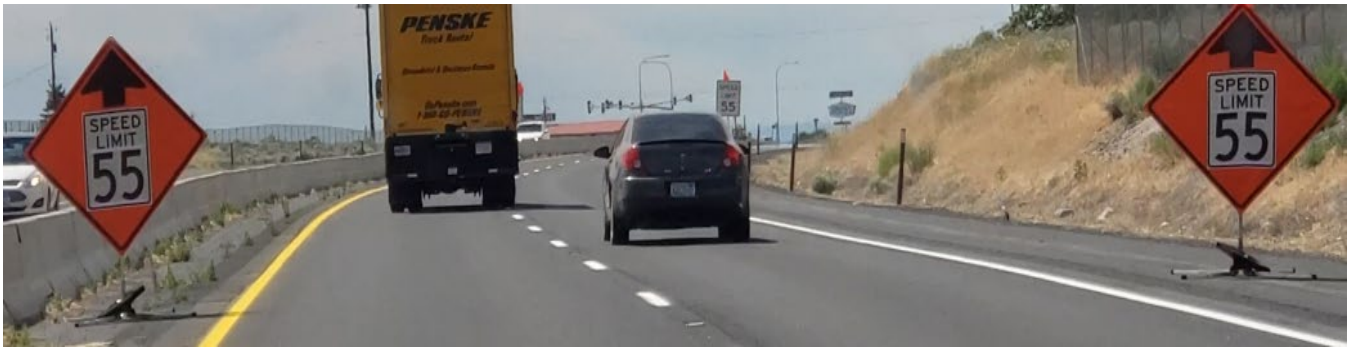
Class B construction signs are the most commonly used for daily/nightly temporary traffic control or for up to 7 calendar days, before being classified and paid as Class A signs.

Per MUTCD Figure 6F-2, **temporary signs shall be mounted 1-foot minimum** above the traveled way. When placed behind channelizing devices, typically 5-foot minimum mounting height is used to enhance visibility. Class B signs may be barrier-mounted, but special rectangular signs are often used in lieu of "clipping" diamond warning signs when narrow shoulders are present.


Channelizing devices will block signs when mounted at 1-foot (left photo); thus, use 5-foot mounting height (middle photo). Note, EXIT sign is mounted 7-foot (right photo) per MUTCD Standard statement on Page Notes for Figure 6H-42.



On freeways and other multi-lane highways, signs are often "gated", or placed on both shoulders for better visibility (large trucks may block passing motorist's view of signs otherwise):



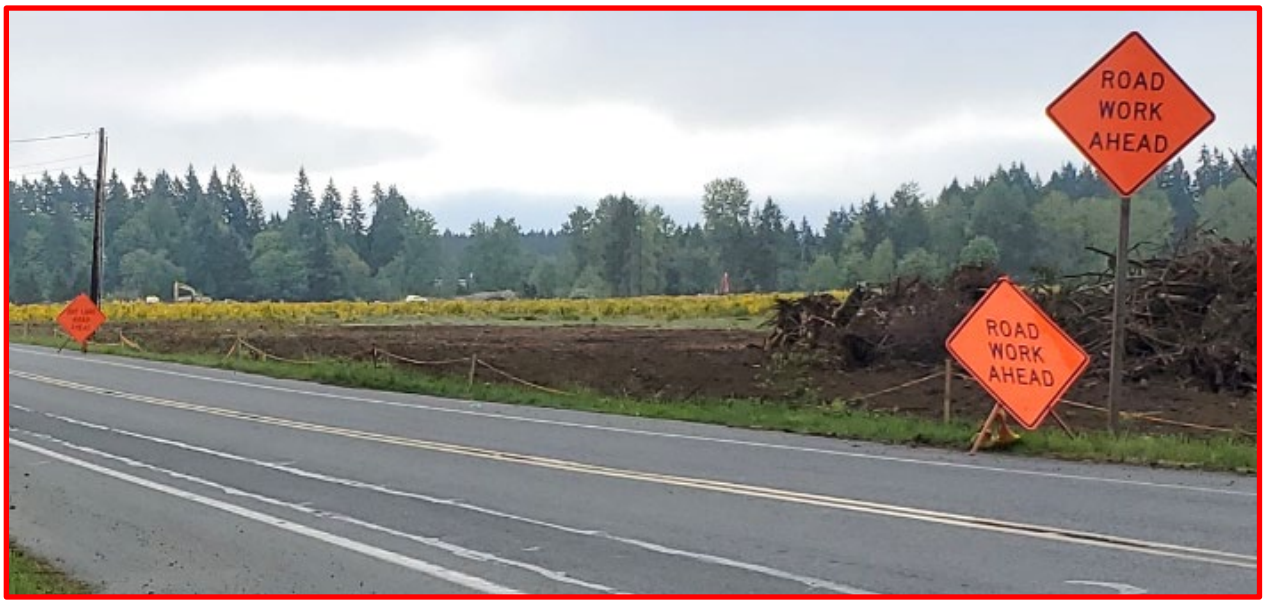
The photo below shows gated freeway signs consisting of a special 24”x48” rectangular warning sign that is barrier mounted on the left (diamond signs protrude well into the shoulder and can be struck by large commercial vehicles when the roadway is reduced to a single open lane). On the right, is a 5-foot mounted sign since it is behind the traffic safety drums (which are 3’ tall) for better visibility.

In congested, urban areas placing work zone signs is difficult. Avoid blocking sidewalks, left photo. Instead, position the sign to maintain a minimum 48” (4-foot) pathway with rubber base stands to minimize tripping hazards, middle photo. With Engineer approval or shown on Plans, use 7-foot mounting height, reduced sign size, or special 24”x48” signs (right photo) to better accommodate pedestrians.

Avoid blocking bike lanes with work zone signs, left photo. Instead, consider placing signs in utility strips between the street and sidewalk. Increase the sign’s mounting height to 5 feet if placed behind parked vehicles.

While Class A and Class B signs have different classifications, it is important to remember they are still the same construction sign in terms of temporary traffic control and are interchangeable.

For example, the photo below shows two "ROAD WORK AHEAD" signs, the post-mounted sign as Class A (in place for the entire project) and the tripod-mounted sign and Class B (for the flagging operation). There is no reason to install the "ROAD WORK AHEAD" sign twice in the same location:



Instead, simply use the Class A "ROAD WORK AHEAD" sign (when it is in the proper location relative to the Class B series) and then continue other the flagging operation Class B signs on tri-pods.

For temporary traffic control that is set up in the same location for the duration of a project (bridge work for example), strategically positioning Class A signs so they can be used in lieu of some Class B signs is a smart strategy.

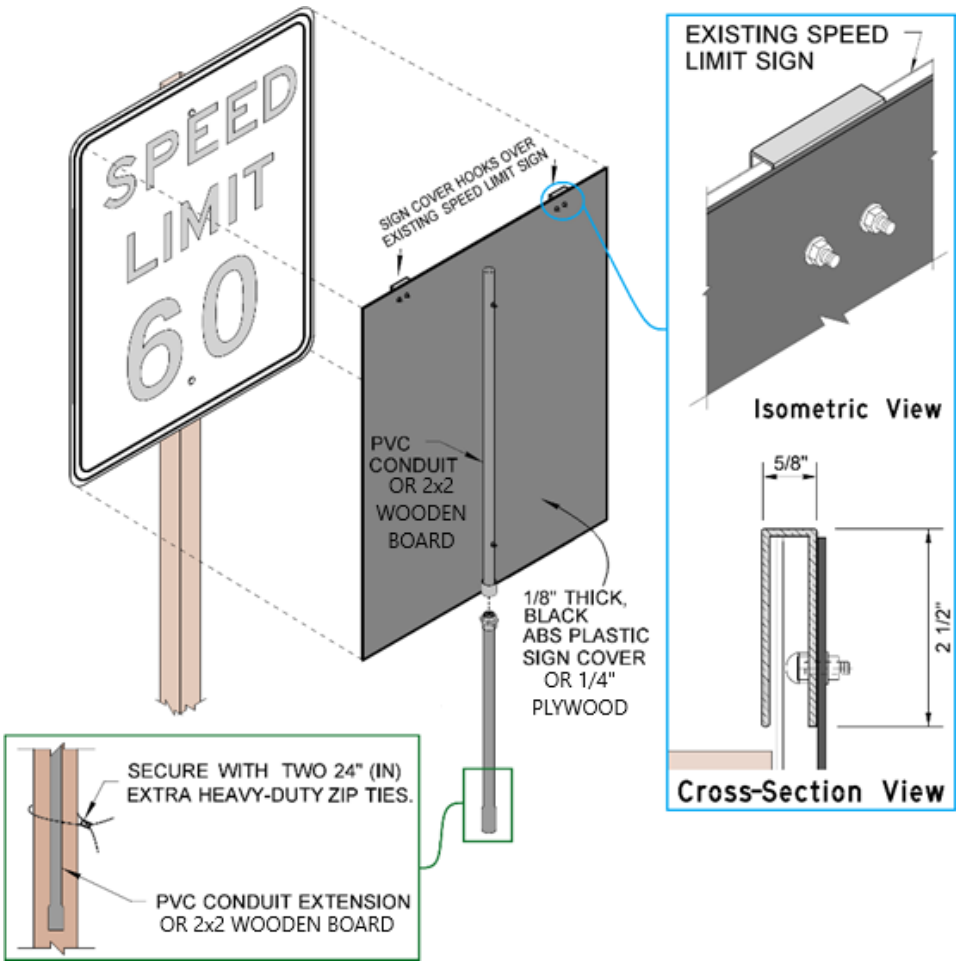
5.4(13) Covering Conflicting Signs

To avoid confusion for motorists and for reduced work zone speed limits to be enforced, the existing speed limit signs must be covered (left photo). If not covered, it will be unclear which speed limit is in effect and nearly impossible for law enforcement to issue citations (right photo).

<u>Short-Duration (7 Days or Less) Temporary Sign Covering Strategy</u>:

An acceptable strategy to cover temporary sign coverings in Washington has been accepted for durations up to 7 calendar days maximum and shall be removed from the work zone clear zone except when the reduced work zone speed limit is in effect.

Either use **1/4"** plywood or **1/8"-**thick ABS plastic black in color secured via U-brackets to hook the sign covering over the top of conflicting existing signs without damaging it. Either a 2 by 2-inch wooden board or 2" PVC conduit shall be attached to install and remove the temporary sign covering and secures it to the existing signpost with a 24" extra heavy-duty zip tie until the sign covering is removed. Several other states use this strategy and is shown below:



Temporary Sign Covering Strategy (All Durations):

Standard Specification 1.10.3(3)A, inappropriate and conflicting signs shall be removed or covered in accordance Standard Specification 8-21.3(3), which requires 4-mil black polyethylene sheeting. Adhesive tape is prohibited on the front face of the sign (it will damage the sign) but is allowed on the back face.

Work Zone Speed Limit Strategy for Projects:

An acceptable alternative to covering and uncovering signs on a daily or nightly basis is to remove or cover existing signs with 4-mil black PE sheeting per Standard Specification 1.10.3(3)A for the project duration while applicable (existing or reduced work zone speed limit) are mounted 5-foot tripods (two photo below):

This allows the WSDOT-approved 60 mph work zone regulatory speed limit to be easily place on the 5-foot tripods during the lane closure. When lane closure removed, the existing 70 mph (Trucks 60) speed limit is restored.

When the project is completed, the existing speed limit signs are replaced or uncovered.

5.5 Portable Changeable Message Signs (PCMSs)

PCMSs are per MUTCD Section 6F.60, WSDOT Standard Specifications 1-10.3(3)C and 9-35.5 for Construction or M54-44 Manual Section 1-6.5 for Maintenance.

PCMSs advise road users of **unexpected situations**. PCMSs are optional per MUTCD and are not crashworthy. PCMS messages are to be targeted, specific, and higher-level messages versus overusing them with generic messages repeating messages already on warning signs.

PCMS	
1	2
RIGHT 3 LANES CLOSED	60 MPH ZONE AHEAD
2.0 SEC	2.0 SEC

PCMS	
1	2
15MINUTE TRAFFIC HOLDS	EXPECT STOPPED TRAFFIC
2.0 SEC	2.0 SEC

PCMS	
1	2
512 EAST EXIT CLOSED	DETOUR TO EXIT 128
2.0 SEC	2.0 SEC

PCMS	
1	2
WORK ZONE AHEAD	USE CAUTION
2.0 SEC	2.0 SEC

PCMS	
1	2
ONE LANE ROAD AHEAD	FLAGGER AHEAD
2.0 SEC	2.0 SEC

PCMS	
1	2
RAMP CLOSED AHEAD	FOLLOW DETOUR
2.0 SEC	2.0 SEC

PCMSs typically use 2 phase messages @ 2.0 seconds (per Guidance in MUTCD 6F.60, ¶ 17); however, 3 phase @ 1.5 second PCMS messages are allowable. Most PCMSs utilize 3 lines @ 8 character per line.

PCMSs are highly effective for traffic queue mitigation, as discussed in Section 4.7.

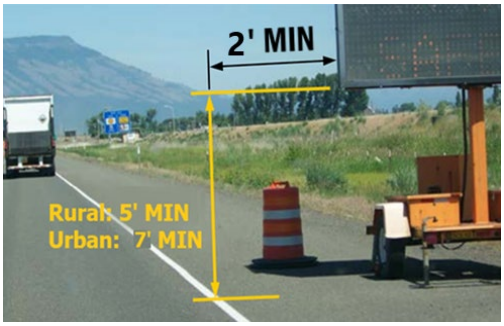
TCSs may make minor revisions to PCMS messages shown on traffic control plan provided the original intent is maintained and both the Contractor and Engineer concurs per Standard Specifications 1-10.2(1)B.

PCMS Usage Guidelines:

- PCMSs are not crashworthy; make them count if used
- Recommended for high-speed, high-volume roads
- Shall not be used to replace required signs
- Maintain 8+ seconds of visibility to approaching motorists
- Consider truck-mounted PCMSs on shadow vehicles

PCMS Placement:

- Provide **2+ feet** lateral clearance from edge of PCMS to edge of traveled way ("the edge line")
- Delineate PCMS transversely with 3+ channelizing devices
- Unless behind barrier or guardrail, remove PCMS from work zone clear zone when not in use
- Locate PCMS behind barrier or guardrail when practical



Knocked over devices are indicators of confused, distracted, or impaired motorists or just simply bad placement.

In the photo, the PCMS is located in a horizontal curve at an unsignalized, high-speed intersection for a state park. Motorists likely use the paved shoulder to decelerate into the state park. Also, the PCMS blocks visibility for those exiting the intersecting roadway.

Potential Mitigations:

- Relocate PCMS away from intersection to straight stretch of roadway with 8+ seconds of visibility.

Types of PCMSs:

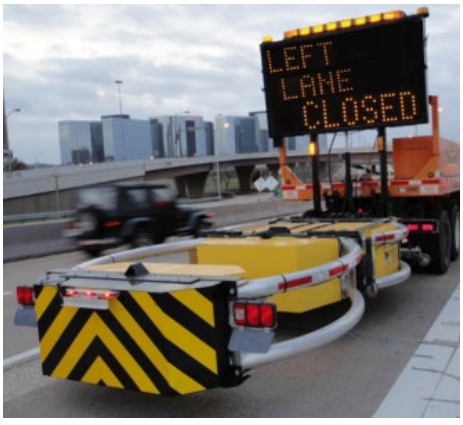
- Trailer-Mounted (11' wide, 18" letters). Desired on freeways with 3+ lanes

PCMS PORTABLE CHANGEABLE MESSAGE SIGN

- Mini PCMSs (6' wide, 12"+ letters) Sufficient for urban areas, highways, & 2-lane freeways

mPCMS MINI PORTABLE CHANGEABLE MESSAGE SIGN

- Truck-Mounted (~ 6' wide, 10+" letters)

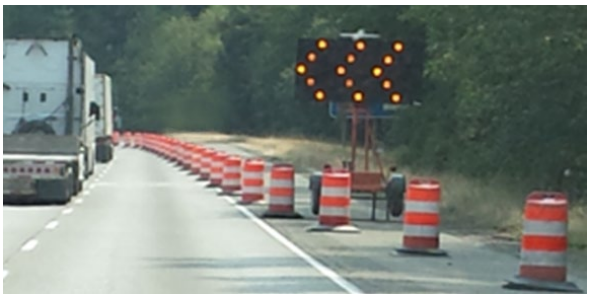


5.6 Arrow Boards (WSDOT: Sequential Arrow Signs)

The fundamental purpose is to provide enhanced delineation of lane closures, shoulder closures, and presence of work crews. Usage per MUTCD Section 6F.61 and WSDOT Standard Specifications 1-10.3(3)B and 9-35.4.

Arrow Board Placement & Usage:

- Separate arrow board required at each lane closure taper on freeways & multilane roadways
- Desired to position arrow boards at beginning of closure taper in adjacent closed shoulder or lane



- In constrained areas (such as urban areas), it is acceptable to place arrow board within closed lane where space allows (green arrows)

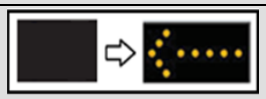
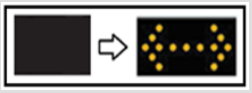
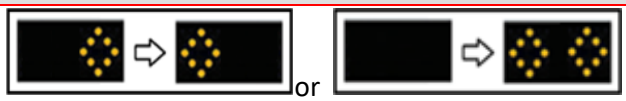
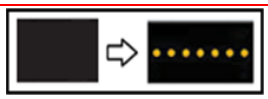
- Shall **not** be used at lateral traffic shifts or flagger-controlled lane closure tapers

- Arrow boards shall be Type C (96"x48") on stationary freeways & 45+ mph multilane lane closures
- Arrow boards may be Type B (60"x30") on mobile closures and roadways 40 mph or less
- Arrow boards are not crashworthy, so place them strategically, delineate with 3+ channelizing devices, and remove from work zone clear zone when not in use
- Color shall be yellow (also called amber) color on black background
- Per ATSSA *Quality Guidelines for Temporary Traffic Control Devices and Features*, **a maximum of 1 burnt out light is allowed** on arrow boards. If 2 or more lights are burnt out, the device must be repaired/replaced within 12 hours per Standard Specification 1-10.2(3).

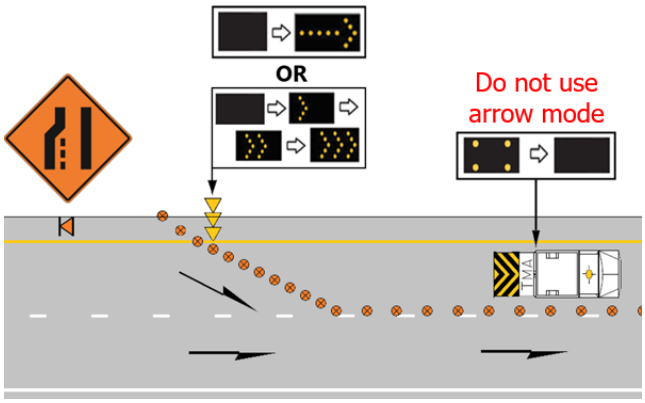
Connected Arrow Boards:

- Required on freeways for all new construction projects (check the Contract Provisions), connected arrow boards are equipped with wireless communication capabilities that automatically communicates the arrow board's status and location in real time.
- Existing arrow boards can be retrofitted with a kit, typically a small white box that attaches to the arrow board.
- Connected arrow boards are still paid as "Sequential Arrow Sign" by the hour.
- Eventually, connected arrow boards will be required multilane roadways 45 mph or higher.

Arrow Board Modes & Displays:

Mode	Location	Visual
Caution	Within Shoulder Closure Within Closure, Away from Tapers Prior to Work Crews	
Sequential Chevron	Right Lane Closure Taper on Multilane Roadway	
Flashing Arrow	Right Lane Closure Taper on Multilane Roadway	
Sequential Chevron	Left Lane Closure Taper on Multilane Roadway	
Flashing Arrow	Left Lane Closure Taper on Multilane Roadway	
Double Arrow Mode	Center Lane Closure Taper Lane Split Taper	
Flashing/Alternating Diamonds	Prohibited	
Flat Bar	Prohibited	

Arrow mode shall only be used at the lane closure taper or blocked lane. When within the lane closure, 4-dot caution mode shall be used.



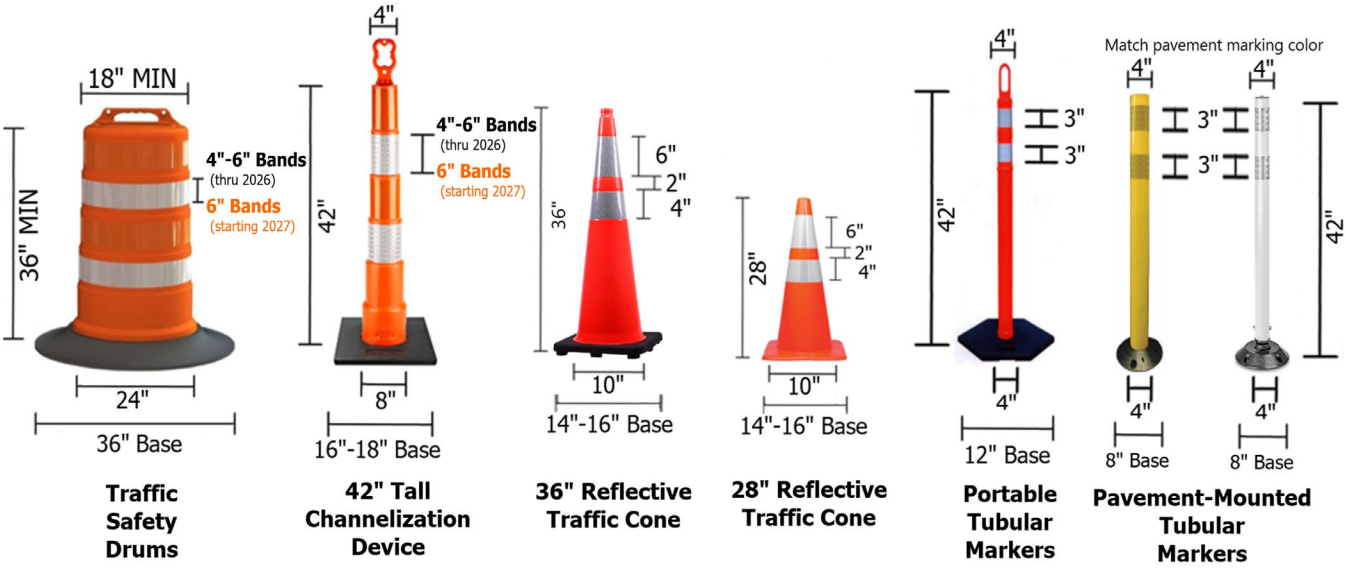
5.7 Channelizing Devices for Roadways

The fundamental purpose of channelizing devices is to delineate closures and safely guide road users using tapers to move traffic into position, reduce travel way width, separate road users from work area, pavement drop-offs, or opposing directions of traffic, and to mark or provide warning of hazards.

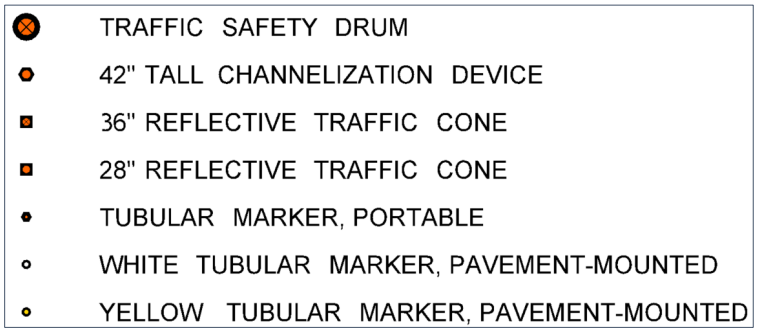
Usage is per MUTCD Section 6F.63 thru 6F.67 and WSDOT Standard Specifications:

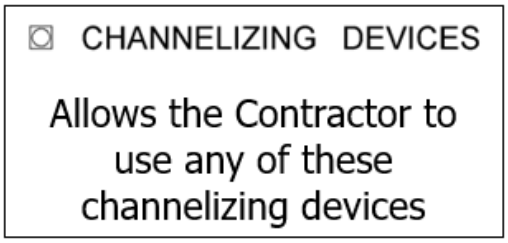
- Traffic Safety Drums 1-10.3(3)E & 9-35.7
- 42-Inch Tall Channelizing devices 1-10.3(3)G & 9-35.13
- Traffic Cones 1-10.3(3)G & 9-35.9
- Tubular Markers 1-10.3(3)H & 9-35.10
- Barricades 1-10.3(3)D & 9-35.6

Channelizing device Dimension, Layout, & Symbols



Per Standard Specifications 1-10.2(2), use channelizing devices shown on accepted traffic control plans:





Traffic safety drums are the most visible channelizing device with the highest target value.

Beginning in 2027, all traffic safety drums and 42" tall channelizing devices for Construction projects (not Maintenance) will be required to have 6" bands per Standard Specifications 9-35.7 and 9-35.13.

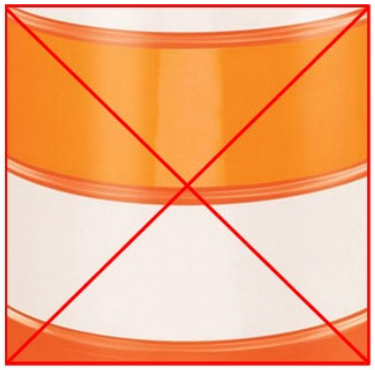
WSDOT prohibits using vertical panel devices, shown below, because they are often incorrectly placed (the downward "slants" points to direction of travel) and do not provide 360° visibility.

Retroreflectivity Sheeting

Per Standard Specifications 9-35.7 thru 9-35.13, channelizing devices shall have retroreflective sheeting which allows them to be visible at night to motorists via headlights. Reflectivity is graded as Type I thru XI (Type 1 thru 11). Higher the Type, brighter the sheeting at night.

Types are known in trade names as Engineering Grade (Type 1 & 2) to High Intensity Prismatic (Type 3 & 4) to Super Intensity (Type 8) to Very High Intensity (Type 9 thru 11) as shown below:

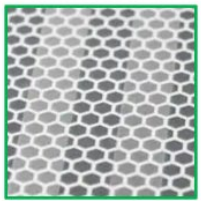
- Engineering Grade (Type I & II) is always **prohibited** on all channelizing devices
- High-Intensity Prismatic (Type III & IV) are allowed on all channelizing devices thru 2026
- Super Intensity (Type VIII) /Very High Intensity (Type IX-XI) will be required on traffic safety drums and 42"-tall channelizing devices beginning in 2027

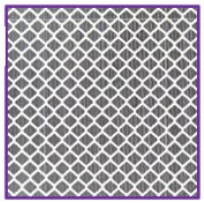


Type I or II
(Engineering-Grade)
Always Prohibited

Type III or IV
(High-Intensity Prismatic)

Type VIII thru XI
(Super Intensity)
(Very High Intensity)





Differences in 4" Type IV versus 6" Type VIII or better retroreflective bands is clearly below:

Type III (Type 3) versus Type XI (Type 11): Day

Type III (Type 3) versus Type XI (Type 11): Night

Thru 2026: 4"-6" Bands, Type III (Type 3) or better

Starting 2027: 6" Bands, Type VIII (Type 8) or better

See Standard Specifications 9-35.7 thru 9-35.13 for retroreflective sheeting requirements for each type of channelizing device. These specifications are summarized in the table below.

Traffic Safety Drums & 42-Inch Tall Channelizing devices

Retroreflective Sheeting by 2027

~~Type I, II (Engineering Grade)~~

Type III/IV (High-Intensity Prismatic)

Type VIII (Super High-Intensity)

Type XI (Very High Intensity)

Note: Existing drums + 42" chans may use Type III/IV thru 2026

Color

Retroreflective **Fluorescent** "Bright" Orange & White Bands

Material

Low-Density PE (LDPE)

Northwest Region Only: Type VIII, IX, XI required starting on new Construction projects.

* **Type III/IV sheeting allowed** on traffic safety drums and 42" channelizing devices thru 2026

36-Inch Traffic Cone & 28-Inch Traffic Cones

Band dimensions are per MUTCD

Retroreflective Sheeting by 2027

~~Type I, II (Engineering Grade)~~

Type IV (High-Intensity Prismatic) or higher

Note: Existing traffic cones may use Type III (High-Intensity).

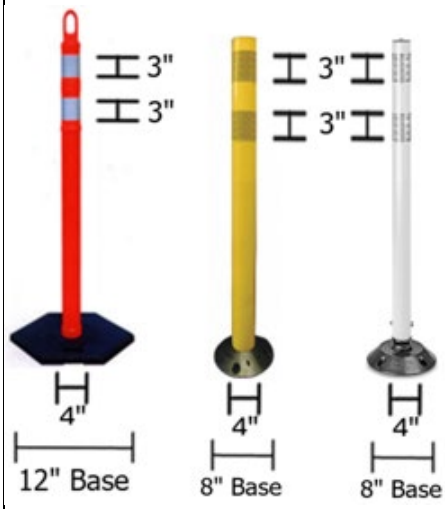
Color

Retroreflective White Bands

Material

Low-Density PE (LDPE)

Tubular Markers



Band dimensions are per MUTCD

Retroreflective Sheeting by 2027

~~Type I, II (Engineering Grade)~~

Type IV (High-Intensity Prismatic) or higher

Note: Existing tubular markers may use Type III (High-Intensity).

Color

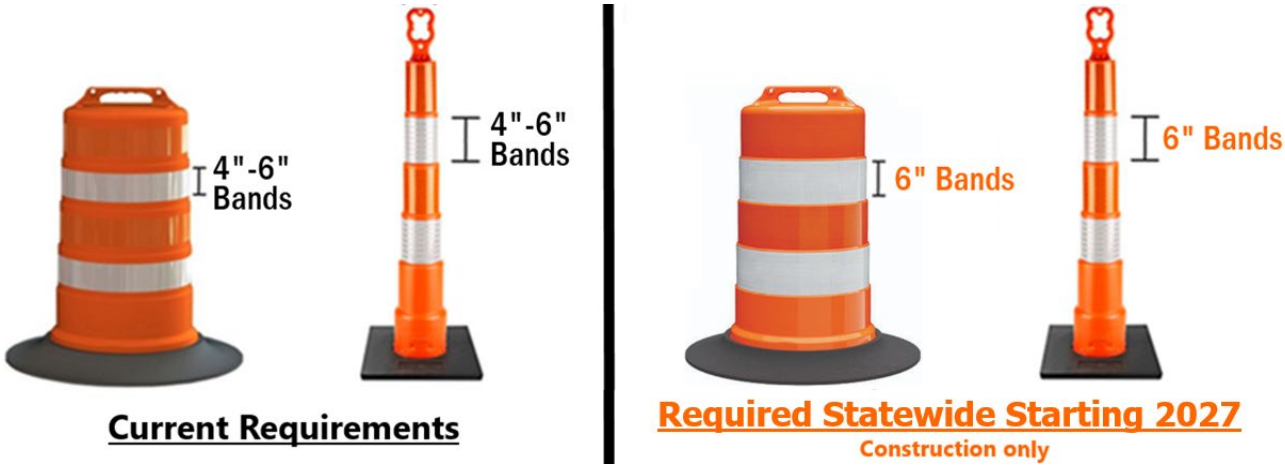
Reflective Yellow Bands

Reflective White Bands

Material

Low-Density PE (LDPE)

Beginning in 2027, all traffic safety drums and 42" tall channelizing devices for Construction projects (not Maintenance) will be required to have 6" bands with Type XIII-XI (Type 8-11) retroreflective sheeting per Standard Specifications 9-35.7 and 9-35.13.



Recommended to new traffic safety drums & 42" tall channelizing devices with 6" bands of **fluorescent** orange and white retroreflective sheeting of Super Intensity (Type 8) or Very High Intensity (Type 11)

- Type XI (Type 11) Trade Names: Diamond Grade, Omnicube

Warning Lights

Warning lights are portable battery-powered lights attached to channelizing devices.

There are four types of warning lights:

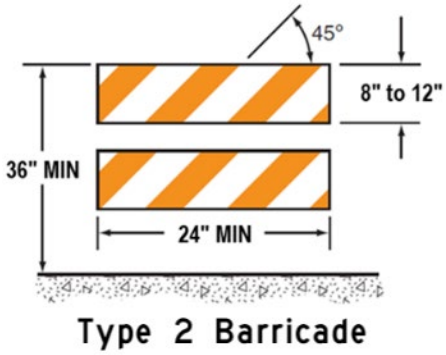
- **Type A:** Dim, flashing warning lights
- **Type B:** Bright, flashing warning lights
- **Type C:** Steady-burn lights
- **Type D (360° view):** Steady-burn lights

Warning lights on channelizing devices will be phased out statewide by 2027. After 2027, warning lights will only be used in isolated circumstances to draw attention to critical devices (such as a new stop ahead sign or new STOP sign). Thru 2026, WSDOT Northwest WSDOT Region is still requiring warning lights on traffic safety drums & 42-inch tall channelizing devices with 4" reflective bands.

Transportation Research Board has recommended discontinuing the use of warning lights. Based on Transportation Research Board Report 2458 Page 65-73 warning lights on are not as effective as quality retroreflective sheeting and cost $6,500/mile annually to maintain.

Barricades

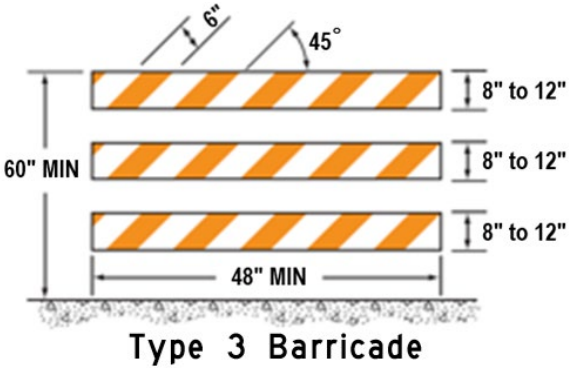
Type 2 barricades are typically used to mount no parking signage on low-speed roadways.



Type 2 Barricade

Type 3 Barricades are typically used for road and ramp closure applications. The downward "slants" points to the desired direction of travel.

Signs, up to 48"x30" typically, may be attached to the face of Type 3 barricades. Alternatively, temporary signs may be mounted on 1-foot tripods in front or 5-foot tripod behind of the barricade.



Type 3 Barricade

Longitudinal Channelizing Devices

Longitudinal channelizing devices are highly visible, lightweight, and deformable devices that interlock together with no gaps (except at roadway approaches, business accesses/driveways); making them excellent for pedestrian traffic control as discussed later in Section 8.8.

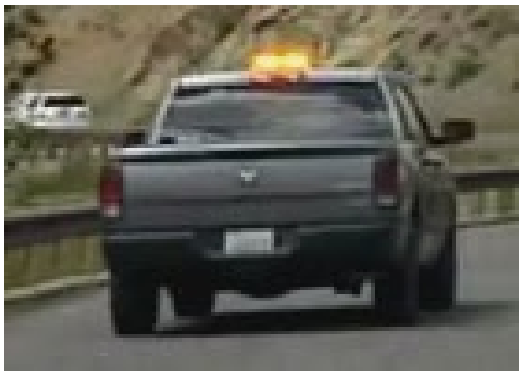
Water-filled "barriers" are not positive protection devices and will not stop vehicles, like concrete barrier. Instead, treat them like a traffic cone as they will not stop errant vehicles (even will filled with water) and the "barrier" will slide 6 feet with a 25-mph impact.

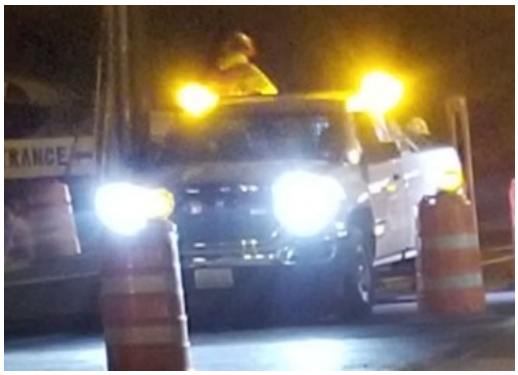
5.8 Traffic Control Vehicles

5.8(1) All Work Vehicles

Per WAC 204-21-130, all vehicles within a work zone must be equipped with **1+ flashing amber lamp**.

Most WSDOT vehicles use 2 Whelen brand LED strobes (Mini Lightbars) that are roof-mounted equipped with dimmers for nighttime use. LED lamps are preferred to avoid draining the vehicle's battery.





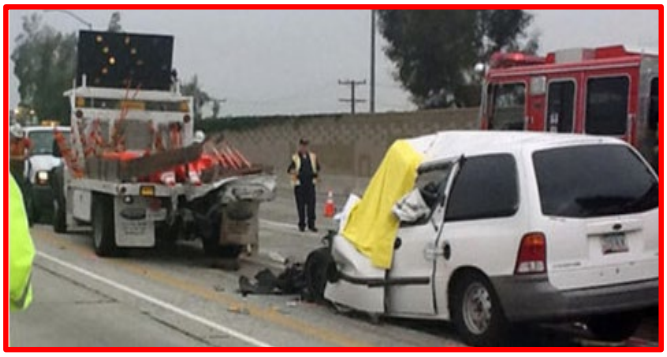
5.8(2) Protective Vehicle (PV)

Protective vehicles (PV) are work vehicles strategically positioned to protect workers or to block closed roadways or on-ramps. Protective vehicles do not have attenuators ("crash cushions"), so usage is typically limited to 40 mph or less to protect the traveling public (except for flagger/AFAD-controlled alternating traffic as speeds are assumed to be reduced approaching the flagger/AFAD station).

5.8(3) Transportable Attenuator (TA)

WSDOT standard practice to use transportable attenuators on 45+ mph roadways (except for flagger, AFAD, or temporary signal controlled alternating traffic operations since the speeds are low), which far exceeds MUTCD requirements. Transportable attenuators can be used on roadways 40 mph or less as well.

Transportable attenuators (TA) are the ultimate traffic control vehicle protecting **both** road users and work crews using an attenuator ("crash cushion") to safely stop most vehicles, even at high speeds:



- **Fatality**: At 65 mph, van hits protective vehicle without attenuator blocking closed freeway lane
- **No Injuries**: At 70 mph, semi-truck driver hits transportable attenuator blocking closed freeway lane

Types of Transportable Attenuators

Truck-Mounted Attenuator (TMA)
Most common, "folds up" during transport

Trailer-Mounted Attenuator
Hitched to trailer with special anti-rotation plate

TA Material Submittal Requirements

Transportable attenuators are available in TL-2 (40 mph or less) and TL-3 (all speeds):

TL-2 Attenuator
40 mph or less only

TL-3 Attenuator
Allowable for ALL speeds

Per Standard Specs 9-35.12(3), transportable attenuator approval is required via material submittal either using Qualified Product List (QPL Search) or WSDOT Request for Approval of Material (RAM).

Attenuator's Reflective Pattern

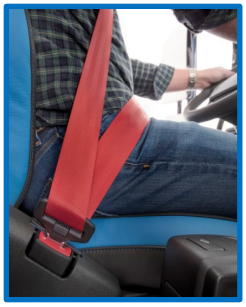
Per Standard Specifications 9-35.12, either alternating reflective yellow-nonreflective black chevron "Λ" pattern or an alternating reflective red-reflective white "Λ" chevron pattern is allowed.

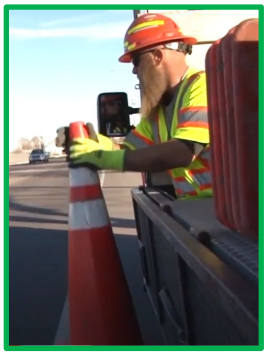
TA Wheel Positioning

Do not turn the front wheels "away from workers", which causes the TA to spin out of control. Instead, keep front wheels straight to allow the transportable attenuator to effectively use its weight and tire friction to absorb the errant vehicle's force as crash tested.

Required Restraints for Riders on TAs

When riding on a transportable attenuator, workers must be protected by the use of seats & seatbelts, standard guardrail systems, or personal fall restraint systems per DOSH Directive 6.55 (Section VI.A).



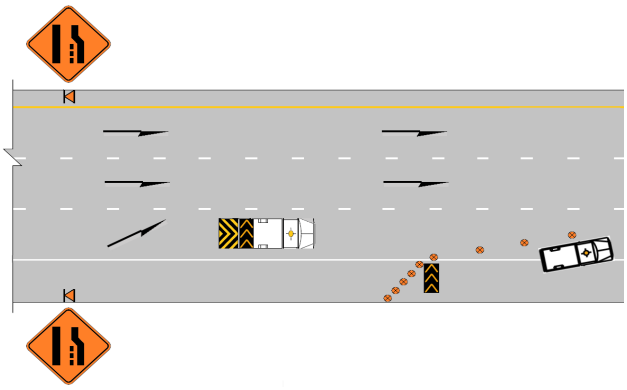


For additional requirements, see WAC 296-880 and WAC 296-865.

TA Requirements on 45+ mph Multilane Roadways (Including Freeways)

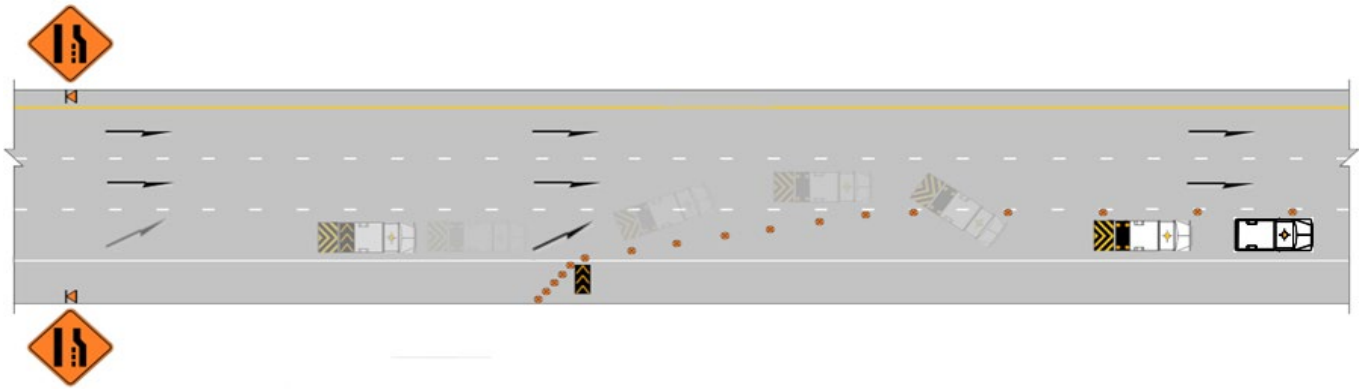
Per Standard Specification 1-10.3(2)C, **on 45+ mph multilane roadways, a transportable attenuator (in arrow mode) blocks any lane being closed/reopened to protect workers installing and removing devices.** Per M54-44 Manual Appendix 3, it is **required for WSDOT Maintenance personnel** as well.

This applies to the 1st lane closure as well as the 4th lane closure—it doesn't matter. Only the driver is permitted in this blocking transportable attenuator; **workers are prohibited**. The traffic control work crew can either be "on-foot" on the pavement, in a traffic control vehicle, or a second transportable attenuator (as shown in photo below).



Per Standard Specification 1-10.3(2)C:

Repositioned within closed lane, shadow TA (in caution mode) will shadow workers installing/removing the remaining devices within closure on 45+ mph roadways during setup & takedown.



TA Requirements for Highways & Roadways 40 mph or Less:

Transportable attenuators are not required to install "flagger tapers" on roadways 45+ mph.

Transportable attenuators are not required to install lane closures on roadways 40 mph or less.

5.8(4) Mobile Barrier System

This steel barrier system with an attenuator and arrow board on its rear is pulled by a semi-truck to provide transverse protection for workers from vehicular traffic. Usage is typically limited to moving within the closed lane adjacent to workers in 20'-60' stationary work areas (expansion joint, concrete panel) but may be also used when a single open lane is laterally shifted onto the shoulder.

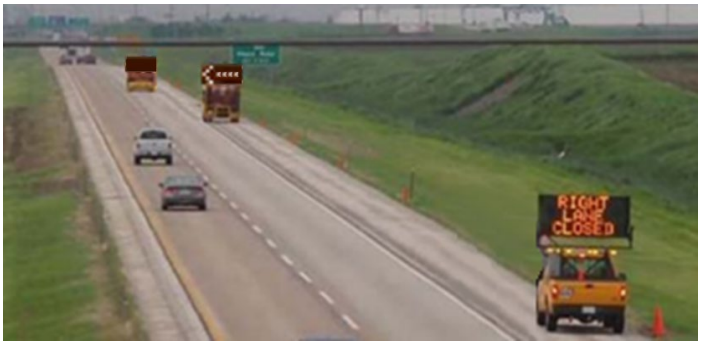
Consideration needs to be given that this is a long vehicle (80'-120') and is difficult to maneuver. Preplanning is required to avoid getting this vehicle stuck at ramp terminals.

5.8(5) Shadow Vehicles

Used for mobile closures, shadow vehicles serve to provide advance warning information to approaching motorists and serves to close lanes or shoulders in advance of the work vehicle and its associated protective vehicle(s). Advance warning vehicles may be protective vehicles (without attenuators), but typically lane closures will use transportable attenuators.

For Maintenance mobile operations, see M54-44 Manual Chapter 4 for detailed information.

These shadow vehicles often include a truck-mounted PCMS that also doubles as a Type B arrow board (60" x 30" or PCMS full-matrix board) to provide temporary traffic control information but older vehicles with just arrow boards will use warning signage.



Photos below show transportable attenuator versions of shadow vehicles:

5.9 Portable Temporary Traffic Signal System (PTSS)

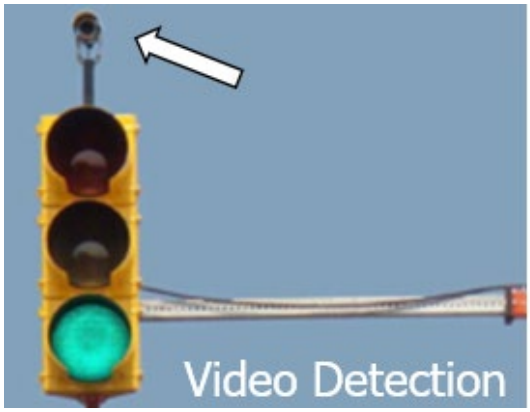
Known as "temporary signals", their fundamental purpose has traditionally been to alternate two-way traffic in a single open lane for long-term durations. Today's temporary signals are very powerful and capable of controlling complex intersections with vehicle, bicycle, and pedestrian detection and preemption for emergency vehicles and railroad crossings.

Temporary signal usage is per MUTCD Section 6C.14, Figure 6H-12 and WSDOT Standard Specifications 1-10.3(3)K and 9-35.14. Maintain a minimum 16.5' vertical clearance between the roadway and the bottom of the signal head (or its back plate) and place the temporary signal 40'-180' away from the stop bar (60'-120' is desirable).

There are several advanced features included on temporary signals including but not limited to:

- Countdown timer (to inform motorists when the green signal will appear)

- Video detection camera or Doppler radar (to detect vehicles, allowing automation of the signal without the expense and hassle of installing "traffic loops" into the existing pavement)

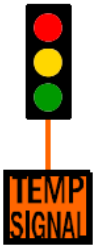


- Bicycle pushbutton is a modified temporary pedestrian push button located near the temporary stop bar used by bicyclists to request an extended all-red clearance signal time. Otherwise, temporary signals are timed for vehicular traffic to maximize traffic capacity and minimize delays.

  Bicycle pushbuttons are particularly useful when temporary signals are 500+ feet apart and a shared bicycle-vehicle lane is used to alternating traffic through a single open lane through the work zone.

  By timing the temporary signals for 25 mph vehicles (but accommodating bicycles on-demand via this pushbutton), we can avoid the excessive all-red clearance times that would otherwise result. This would be about 45 seconds each time the temporary signal changes when they are 1000 feet apart—which significantly reduces delay on busier roadways.

At driveways, business accesses, or intersecting roadway approaches between the mainline signals, there are smaller single-headed temporary signals ("cart" and trailer version, see photos below). These approach signals work in conjunction with traffic signals used on mainline via wireless communication.



<u>Driveway Assistance Devices (DADs)</u>:

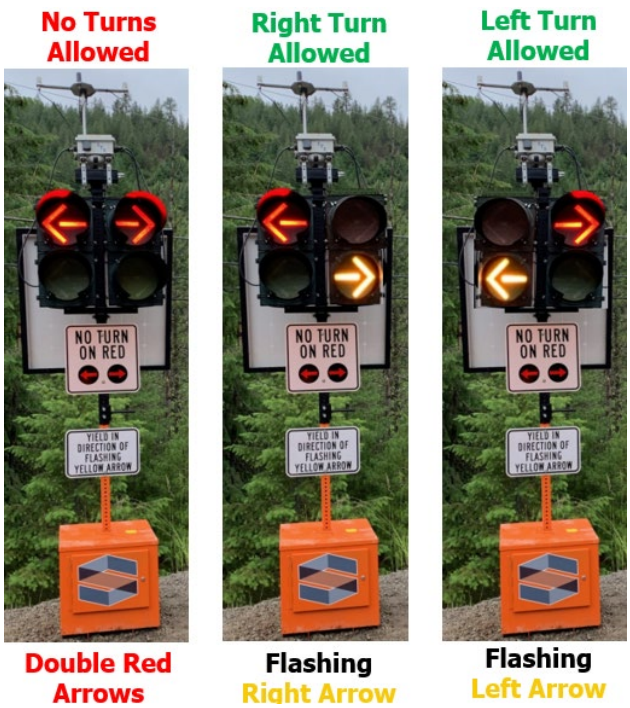
Some states, such as Michigan, are experimenting with Driveway Assistance Device (DAD) via FHWA.

DADs are used at driveways and business accesses between mainline signals by via red arrows (no turns) or flashing yellow arrows in the direction of permitted turns. Each DAD is sequentially coordinated with the mainline signals and permitted turns are allowed about 90% of the time without needing to turn both mainline signal red to allow movement from accesses.

Because DADs are not currently in the MUTCD or has yet to receive FHWA interim approval, Washington is not is using DADs at this time; instead, the single-headed temporary signal is used.

Hopefully, DADs eventually get approval from FHWA and Washington can begin implementing them.

See video for more information on operation of DADs.



5.10 Automated Flagger Assistance Device (AFAD)

Known as "robo-flaggers", AFADs are remotely operated by human flaggers positioned away from traffic instead of physically on the roadway, such as from inside a work vehicle within sight distance. This is especially beneficial when it is very cold or hot, windy, in areas with reduced sight distance or limited escape routes, on long bridges, or on long boring stretches of road. Video: Flagger in Nevada.

Just like with human flaggers, AFADs shall only be used to control one lane of approaching traffic and be illuminated at night. AFADs are not traffic control signals and shall not be used as a substitute or a replacement for a continuously operating temporary traffic control signal.

- Unless behind barrier or guardrail, remove AFAD from work zone clear zone when not in use.

AFAD usage is per MUTCD Section 6E.04, Figure 6E-1, and Figure 6E-2. WSDOT Standard Specifications do not currently cover AFADs, but projects may include an AFAD Special Provision.

Red/Yellow Lens AFAD: Steady red display & flashing yellow display. Video

For Construction, WSDOT requires Red/Yellow AFADs are required and recommended for Maintenance. Maintenance should avoid using the STOP/SLOW AFADs.

Placing 28" cones at 20' spacing at centerline for 200' is allowable to help reduce the occurrence of impatient drivers bypassing queues and entering into the work zone, which occurs rather frequently.

W20-7C

When using AFADs, use the W20-7C sign (AUTOMATED FLAGGER AHEAD) instead of W20-7A (Flagger Symbol) to minimize motorist confusion.

AFAD Typical Traffic Control Plans are now available:

- TC330: AFAD-controlled Alternating Traffic (45+ mph)
- TC332: AFAD-controlled Alternating Traffic + Rumble Strips (45+ mph)
- TC333: AFAD-controlled Alternating Traffic + Pilot Car Op (45+ mph)
- TC334: AFAD-controlled Alternating Traffic + Pilot Car Op + Rumble Strips (45+ mph)

- TC430: AFAD-controlled Alternating Traffic (40 mph or Less)
- TC432: AFAD-controlled Alternating Traffic + Rumble Strips (40 mph or Less)
- TC433: AFAD-controlled Alternating Traffic + Pilot Car Op (40 mph or Less)
- TC434: AFAD-controlled Alternating Traffic + Pilot Car Op + Rumble Strips (40 mph or Less)

5.11 Temporary Rumble Strips

The fundamental purpose is to mitigate distracted driving on 45+ mph highways approaching flaggers or AFADs as shown on accepted traffic control plans.

5.11(1) Portable Transverse Temporary Rumble Strips

The fundamental purpose is to mitigate distracted driving on 45+ mph highways approaching flaggers or AFADs as shown on accepted traffic control plans.

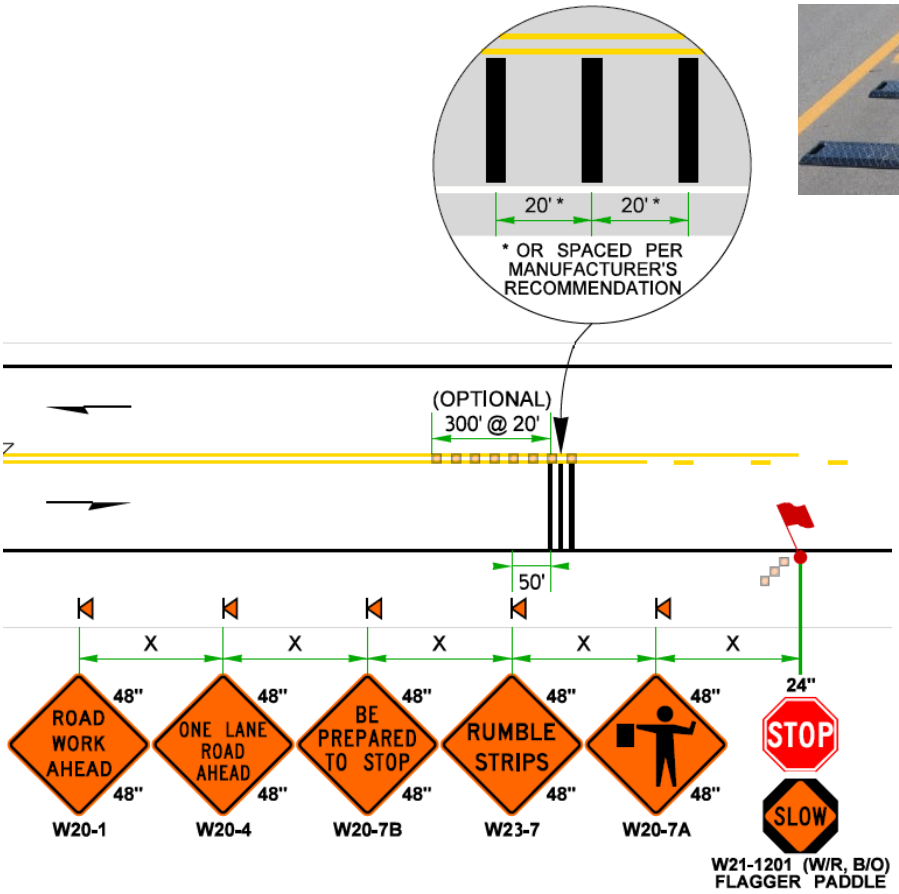
Portable rumble strips stay in place with friction alone (no adhesive used) and weigh 100+ pounds per rumble strip. These portable rumble strips are designed for motorcycles and 70+ mph operating speeds; however, **avoid placing them in horizontal curves and check for movement during hourly traffic control inspections.**

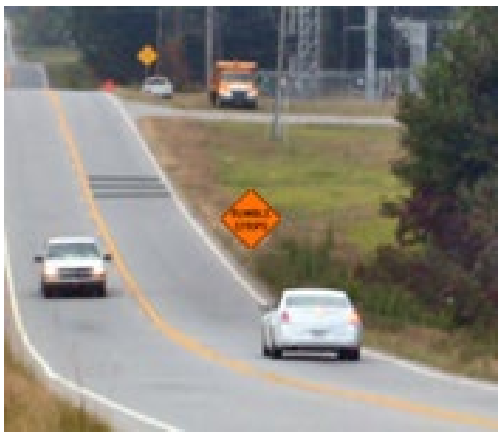
The performance of portable rumble strips depends greatly on the manufacturer. Currently, WSDOT permits portable rumble strips from only two manufacturers:

- PSS Roadquake 2F
- TrafFix Alert High Speed

Because the rumble strips are up to ¾" thick, edges are beveled. **Immediately remove portable rumble strips if there's a red line visible** (as they've instead upside down and pose a hazard).

Layout approaching a flagger station is shown below, but would be similar approaching AFAD:





Temporary rumble strips are placed transversely (perpendicular to flow of traffic) across the approaching lane in a single array of three rumble strips at 20' spacing or per the manufacturer's recommendation.

- On 60-65 mph highways, this distance can be increased up to 35 feet if needed.

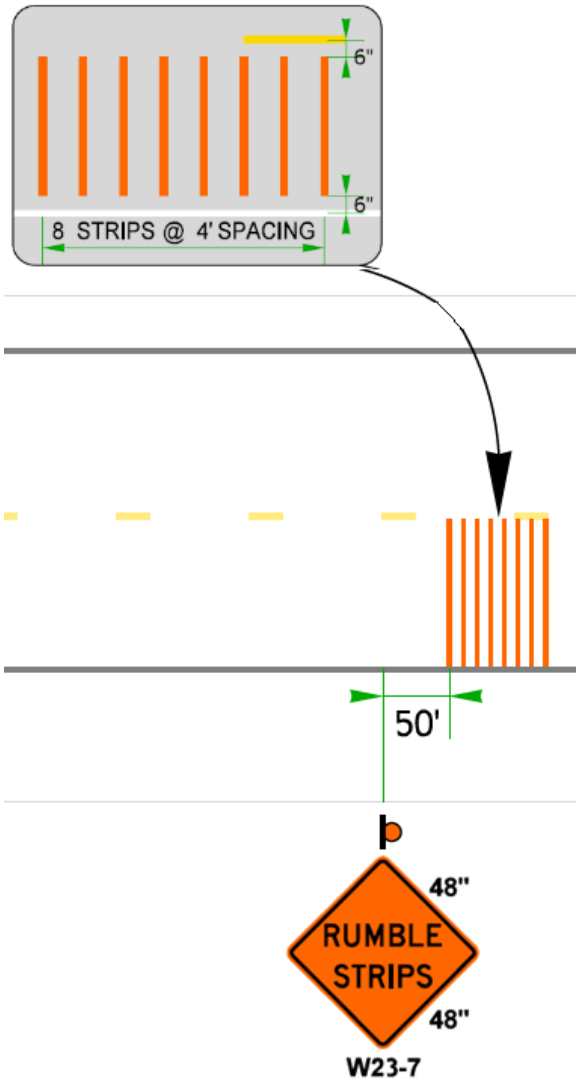
Note the added W23-7 "RUMBLE STRIPS" sign used about 50 feet prior to the rumble strip array. There is no MOTORCYCLES USE EXTREME CAUTION sign needed for rumble strips, see Section 5-4(9).

5.11(2) Adhesive Transverse Temporary Rumble Strips

The fundamental purpose is to mitigate distracted driving on highways approaching temporary traffic signals as shown on accepted traffic control plans. WSDOT does not typically use adhesive temporary rumble strips on multilane roadways or freeways.

Adhesive rumble strips stay in place with an adhesive that attaches it to the pavement. Do not use primer with the adhesive rumble strip or it will not be removeable. Orange-color adhesive rumble strips are used.

Because the rumble strips are only ¼" thick, a series of 8 adhesive rumble strips at 4-foot spacing is used (see figure below) to enhance the vibratory and sound effect:



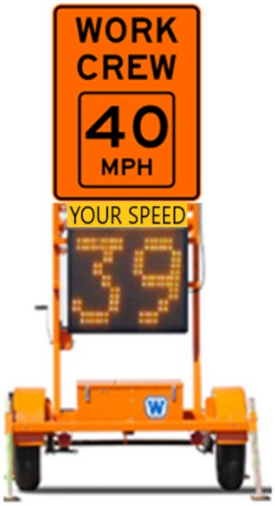
Note the added W23-7 "RUMBLE STRIPS" sign used about 50 feet prior to the rumble strip array. There is no MOTORCYCLES USE EXTREME CAUTION sign needed for rumble strips, see Section 5-4(9).

5.12 Radar Speed Display Signs

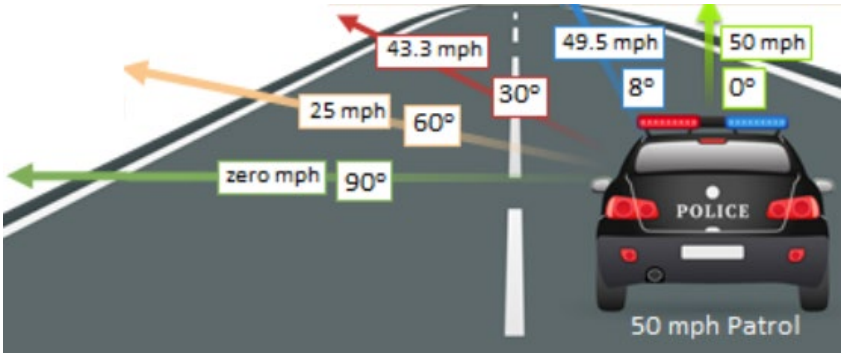
The fundamental purpose is speed reduction benefits, which average about 5 mph. National research has repeatedly shown the radar speed display sign (RSDS, also known as "speed trailer") as one of the most effective devices at reducing vehicle speeds, especially when using speed safety camera systems.

WSDOT Standard Specifications do not currently cover radar speed display signs, but projects may include a RSDS Special Provision. Either a black on white or black on yellow YOUR SPEED display may be used; however, note the 11th Edition of MUTCD (not yet adopted) will require the black on yellow YOUR SPEED display on new radar speed display signs.

Radar speed display signs are most effective when the speed display also includes the posted speed limit or advisory speed sign. The WORK CREW 40mph advisory sign is used when a single open freeway lane is laterally shifted onto the shoulder per WSDOT Project Delivery Memo 19-01.



Because RSDS use radar to measure vehicle speeds (just like police officers), it is important for it to be positioned within 15° of "straight-on" towards traffic; if the angle is 30° or more, the speed measurement is significantly off:



As stated in the RSDS Special Provision, the RSDS shall have traffic data collection capabilities [for speed]. To record and obtain the speed data, see the manufacturer's instruction. The speed data is typically obtained by inserting a portable USB flash drive into the back of the RSDS.

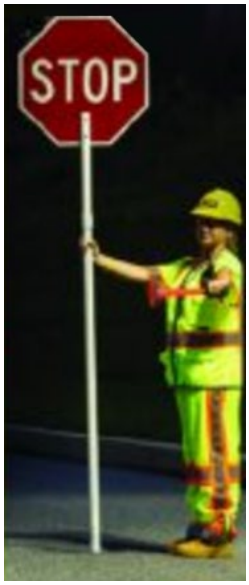
5.13 Nighttime Illumination

The fundamental purpose is to illuminate work areas, roadway, flagger stations, AFADs, and temporary traffic signals during hours of darkness with minimal glare to motorists. Lighting usage is per MUTCD Section 6F.82 and WSDOT Standard Specifications 1-10.3(1)A and 1-10.3(3)K.

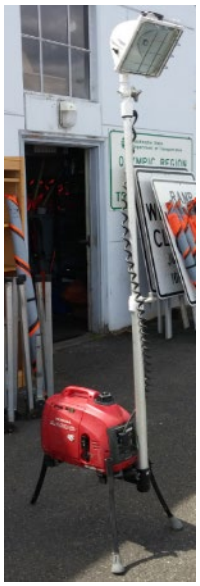
Important: **Flagging stations, AFADs, and temporary signals shall be illuminated during hours of darkness (1/2 hour before sunset to ½ hour after sunrise) with minimal glare to motorists.**

Sunrise and sunset times are available for Seattle, Yakima, and Spokane.

Photos below clearly demonstrate the illumination benefits at flagging stations and temporary signals at night. The left two photos show the same flagger, one without illumination and the other with:



Several illumination methods are shown below including the traditional diesel-power light plant, a "balloon" light plant (excellent to minimize glare), battery-powered light plant, and gasoline-powered light plant:



Like other non-crashworthy trailer-mounted devices, diesel powered light plants need to be strategically positioned or shielded behind guardrail or barrier, delineated transversely with 3+ channelizing devices, operated in as safe of a manner as practical, and removed when not in use. Note light plants may remain in place during daylight hours even when used to illuminate long-term temporary signals at night.

5.15 Intersection Conflict Warning System

Because it is undesirable to add temporary traffic signals on high-speed multilane roadways, a mitigation for additional turning traffic (typically detouring traffic from roadway closures) is to utilize an intersection conflict warning system (ICWS).

Essentially an ICWS utilizes radar sensors to detect entering and/or approaching traffic to activate beacons attached to warning signs; otherwise, the beacons do not flash making the system real-time.

5.16 Construction Vehicle Ingress Warning

On long-term projects, temporary barrier often separates the work area from traffic with openings to allow construction vehicles to leave (egress) and enter (ingress) the roadway via a deceleration or acceleration pocket.

Because of practicality, typically ingresses are designed to allow large construction vehicles to enter travel lanes at 10-mph below the speed limit, but a slower speed may be accepted by the Agency.

To enhance ingress safety, a construction vehicle ingress warning (CVIW) uses radar unit to detect entering construction vehicles to active flashing beacons on a warning sign (located 500’ ± in advance) for about 30-45 seconds. Otherwise, the beacons do not flash.

5.17 Temporary Barriers

While installation and removal is typically performed by separate subcontractors, TCSs still need to be familiar with temporary barriers; particularly their quality, delineation, and signage requirements.

As discussed in Section 4.6(3), **temporary barriers do not have the ability stop semi-trucks**. As previously discussed in Section 5.3(2), temporary work zone devices are designed for passenger cars and pickup trucks up to 62 mph (TL-3). Semi-trucks have far too much momentum to stop, even at 50 mph. Since semi-trucks typically travel around 65 mph, we must manage risk associated with them in work zones in other ways. Semi-trucks are approximately 20% of the total volume on Interstates.

5.17(1) Temporary Concrete Barrier

Temporary concrete barriers are typically used for long-term (4+ day), stationary work zones when equipment or materials must remain within the work zone clear zone or drop-off protection is required.

The fundamental purpose is positive separation between motorists, workers, pedestrians, bicyclists, and opposing directions of traffic and to delineate closures and safely guide road users. Usage is per MUTCD Section 6F.70, MUTCD Section 6F.85, and WSDOT Standard Specifications 6-10.3(5). For more details, see WSDOT Design Manual Chapter 1610.

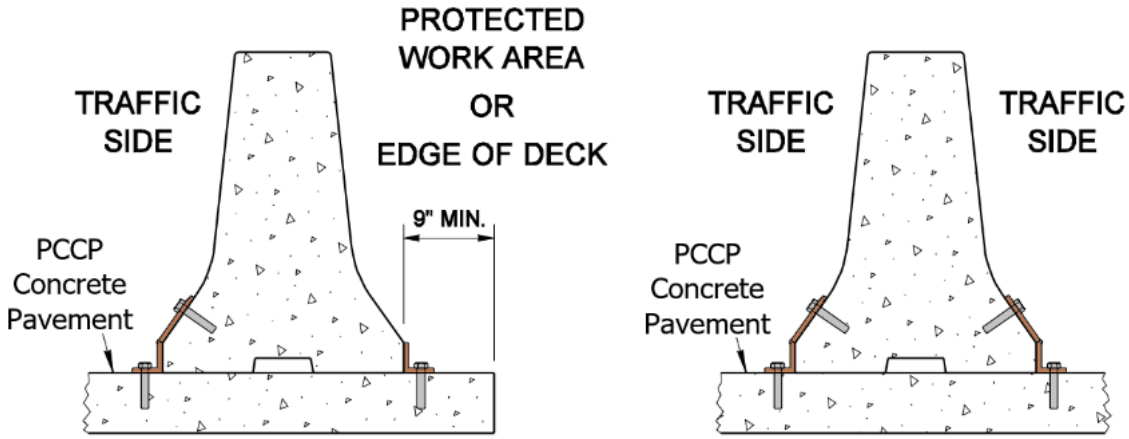
Three types of temporary barrier: Type 2 (Std. Plan K-80.32), Type 4 (Std. Plan K-80.34) and Type F (Std. Plan C-60.10). Type 2 is only allowed for temporary use in work zones; however, Contracts may require Type F. Type F is always required for permanent barrier. Type 4 is narrow base, 1'-4" wide.

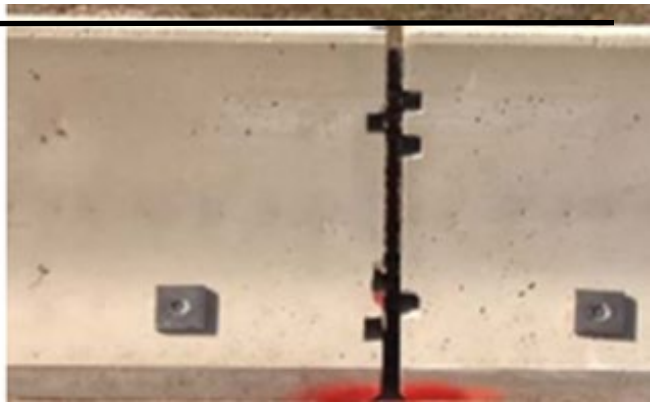
Per Standard Specifications 6-10.3(5), place reflective barrier delineators 6" down from the top on the traffic face spaced at 40' maximum on tangents and 20' maximum through curves. Some projects may upgrade to profiled linear delineation systems on barrier for enhanced visibility (see GSP).

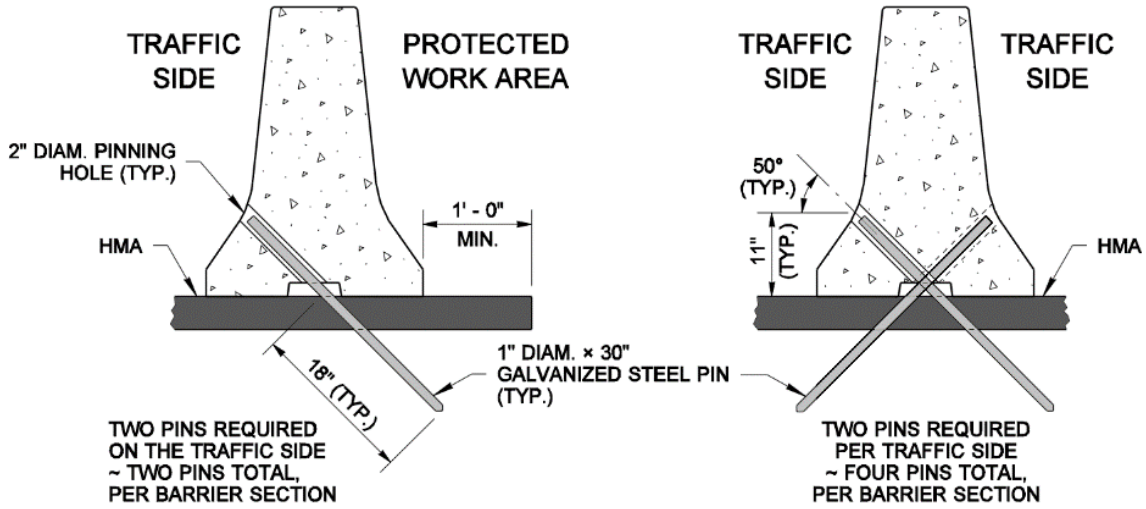
Temporary barriers are occasionally used for intermediate-duration (3 days or less) closures; however, it is time intensive, costly, and typically requires lane adjacent to the barrier to be closed. Because of this, it may be more practical to use traffic safety drums at 20-foot spacing adjacent to work crews instead.

Anchored Concrete Barrier

In situations when minimal deflection distance is needed, temporary concrete barriers are anchored to concrete (PCCP) or pinned to Hot Mix Asphalt (HMA) per Contract Plans or Standard Plan K-80.35 (Type F or Type 2 barrier) & Standard Plan K-80.37 (Type 4, Narrow Base).







5.17(2) Road Zipper System (Moveable Temporary Barrier")

The Road Zipper System uses a special machine to pick up and transfer the a special barrier to quickly close and reopen lanes on a daily/nightly basis for positive protection for workers on bridges (left photo below, see video) and to switch the center lane between two directions of traffic on a temporary 3-lane configuration for congestion management (right photo below, see video).

5.17(3) Temporary Steel Barrier

Temporary steel barrier weighs less than concrete (40 pounds/linear foot versus 400+), making it useful on old bridges, but increases its lateral deflection distance up to 8 feet (versus 3' for concrete barrier).

Per Standard Specification 6-10.3(5), steel barrier's lateral deflection distance must meet or be less than shown in the Contract Plans and installed in accordance with manufacturer's recommendations.


Temporary Steel Barrier

5.17(4) Barrier Screens & Fencing

Barrier-mounted glare screens help reduce headlight glare from oncoming vehicles, particularly useful for temporary freeway reconfigurations with both directions of traffic on the same side of the median separated by temporary barrier, like shown below:

Glare screens are especially beneficial at horizontal curves where headlight glare from oncoming vehicles is more noticeable. The "glare screens" are paddles (6 inches wide, 2 feet in height) placed at 1-foot spacing along the top of the barrier to form a "wall".

Screens severe to block the road users' view of activities that can be distracting to discouraging gawking. As an enhancement, steel fabric reinforced screen (chain-link fence behind the screen) serves to protect road users from flying construction debris. The left photo above shows it behind the guardrail, these screens can also be barrier-mounted or simply installed on fencing.

Fences serve separate road users (particularly pedestrians & bicyclists) from the work area and sometimes are used to delineate paths through work zones. Typically, fences are 6 feet in height.

When used adjacent to pedestrian paths, avoid creating tripping hazards by installing a continuous, detectable edge in front of the fencing and not having bases protrude into the walkway. The photo above on the right installed the fencing on top of barrier, which is acceptable and common in urban areas for temporary pedestrian and bicycle pathways.

5.18 Temporary Impact Attenuators

Temporary impact attenuators ("crash cushions") are crashworthy devices placed at the ends of barriers to protect errant vehicles by gradually decelerating a vehicle to a stop versus abrupt stop (video). Envision hitting a straw wall versus solid concrete, it is the same idea.

Usage is per MUTCD Section 6F.86 and WSDOT Standard Specifications 8-17. For more details, see WSDOT Design Manual Chapter 1620.

Even when flared outside the work zone clear zone, WSDOT prohibits blunt barrier ends due to the unacceptable crash risk to road users (right photo below: vehicle tested at 31 mph).

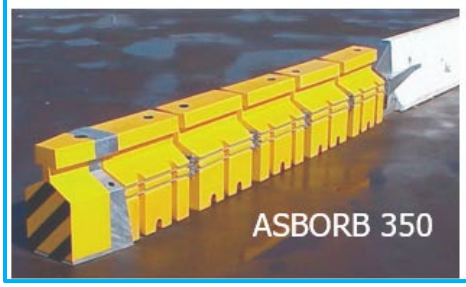
WSDOT requires attenuators on barriers on all 30+ mph roads, except at downstream ends on one-way roadways that cannot be impacted via legal movements by errant vehicles, such as freeways.

WSDOT policy **allows sloped barrier terminals on roadways 25 mph or slower**.
(See Standard Plan K-80.32 for Type 2 sloped terminal; Std. Plan C-60.10 for F-shape terminal)

As previously discussed in Section 5.3(2), there are TL-2 and TL-3 temporary impact attenuators.

TL-2 temporary impact attenuators: Only allowed for roadways **45 mph or lower** in work zones.

TL-2 APPROVED TEMPORARY IMPACT ATTENUATOR LIST	
ASBORB 350 (5+ ELEMENTS)	SLED (3+ MODULES)
ASBORB-M (2+ ELEMENTS)	ACZ-350 (2+ SECTIONS)
TRITON CET (6 SECTIONS)	N-E-A-T
ShorTRACC*	QUADGUARD CZ* (3+ BAY)
ADIEM 350*	QUEST TL-2*
* ATTENUATOR IS WIDER THAN 2.0'.	
TL-2 ATTENUATORS ONLY APPROVED FOR SPEEDS 45 MPH OR LESS.	



TL-3 temporary impact attenuators: Approved for all speeds in work zones.

TL-3 APPROVED TEMPORARY IMPACT ATTENUATOR LIST	
ASBORB 350 (9 ELEMENTS)	SLED (4 MODULES)
ASBORB-M (3 ELEMENTS)	ACZ-350 (4 SECTIONS)
TRITON CET (6 SECTIONS)	QUEST TL-3*
TRACC*	QUADGUARD CZ* (6 BAY)
* ATTENUATOR IS WIDER THAN 2.0'.	
TL-3 ATTENUATORS APPROVED FOR ALL SPEEDS.	

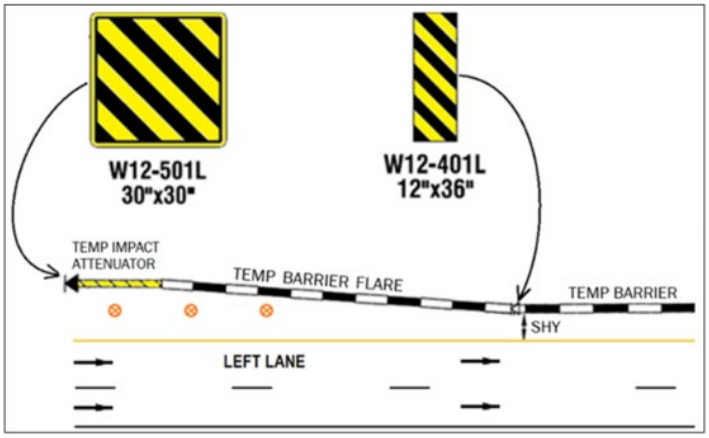
The traffic control plan or staging plan in the Contract should include a list of approved temporary impact attenuators allowed.

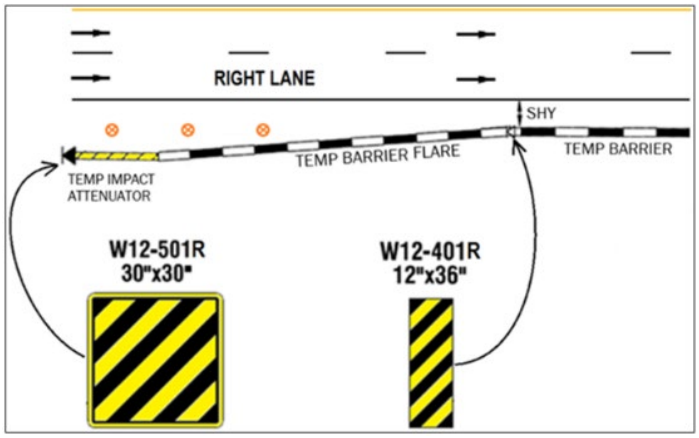
The TCS should verify the appropriate chevron sign is attached to the face of the impact attenuator, as discussed on the next page.

Temporary Impact Attenuator Signage:

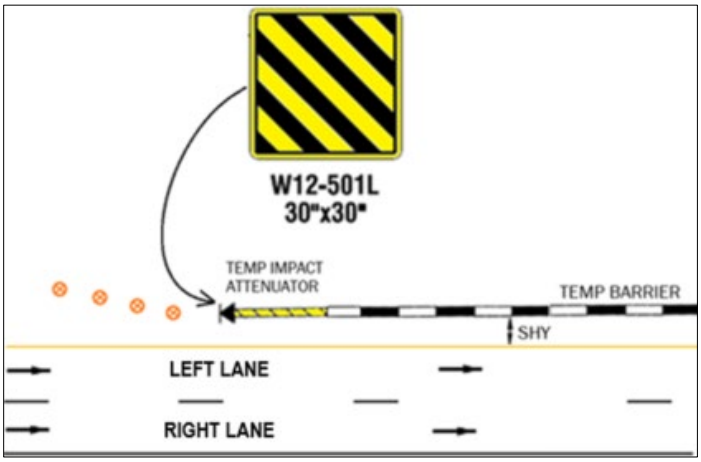
Proper signage is required on the faces of attenuators and explained below:

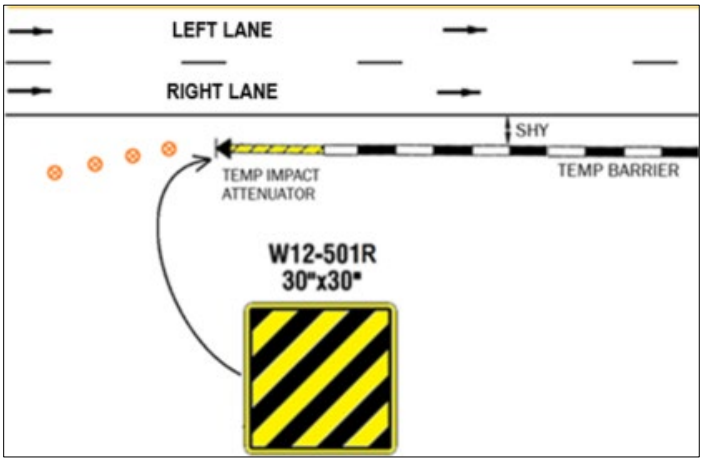
Flared barrier begins away and then tapers over towards travel lanes and requires a W12-401 barrier-mounted sign at the angle point (where the barrier stops flaring and begins running parallel to travel lanes) in addition to the W12-501 or W12-502 sign on the face of the impact attenuator.





When barrier simply runs parallel to traffic, only the W12-501 or W12-502 sign on the face of the impact attenuator is needed.





5.19 Temporary Pavement Markings

The fundamental purpose of permanent pavement markings is to delineate a clearly defined path for travel through the work zone for all road users in daytime, nighttime, dry, and wet conditions.

The fundamental purpose of temporary pavement markings is to provide continuous delineation within work zones whenever existing markings are obliterated or traffic is temporarily reconfigured.

Per WAC 468-95-310, temporary pavement markings may remain in place until it is practical to install permanent pavement markings (exceeding MUTCD's 14-day guidance per Section 6F.78, Paragraph 02).

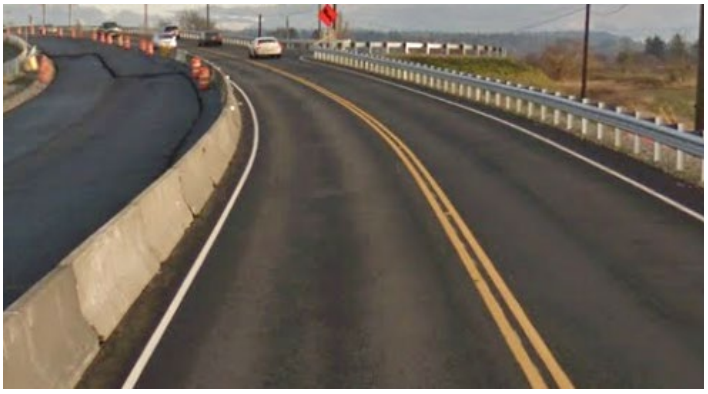
There are two types of temporary pavement markings with photos below:

Short-Duration Temporary Marking:

* A few weeks to a couple months
* Abbreviated layout pattern (Std. Plan. K-70)
* No edge/gore lines, unless specified in Contract
- 4-foot "skip" line (paint/tape)
- 6-foot "skip" (flexible pavement markers)

Long-Duration Temporary Marking:

* Lasts for several months or years
* Permanent marking patterns (Std. Plans M)
* Edge lines & gore lines used
* 10-foot "skip" lines (paint/tape)



Instead of preformed tape or paint, raised pavement markers (RPMs) are also used for long-duration temporary pavement markings. For edge lines, 5-foot spacing is used. See photo below:

Pavement marking usage is per MUTCD Section 6F.77-6F.79, except as modified by WAC 468-95-310; WSDOT Standard Specifications; and WSDOT Standard Plans:

- Pavement Markings 8-22 & 9-34
- Temporary Pavement Markings 8-23 & 9-34
  - Short-Duration Temp. Markings: 8-23.3(4)A & 9-34, Std. Plan K-70.20-01
  - Long-Duration Temp. Markings: 8-23.3(4)B, 8-22, 9-34; Std. Plans M
- Raised Pavement Markers 8-09 & 9-21

Temporary Pavement Marking Types

Paint + Glass Beads

Most common

Cheapest

3-months to 1 year

Poor wet & night visibility

Glass beads spread over wet paint

Short-Duration Tape

2-lane highway pavers

Moderate cost

2-3 months

Poor wet & night visibility

Doesn't stick well to existing pavement

Quickly removed in any weather condition

Long-Duration Tape

Long-term high-speed, high-volume roadways

Expensive

Up to 4 years

Superior wet night-time visibility that is durable

Removal becomes more difficult the longer tape is down.

Manufacturer is making a IR version that is much easier to remove after being installed for months.

Temporary Pavement Marking Types

Type 1 RPMs
(Raised Pavement Markers)
Fairly rare, installation slow
Moderate cost
Up to 2 years

OK wet & night visibility

Installation not as weather-sensitive as other markings

Prohibited on "chip-sealed" BST pavement

Type 1Y

Type 1W

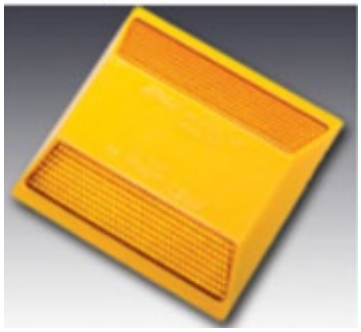
Type 2 RPMs
(Raised Pavement Markers)
Typical for long-duration temp markings, rarely used for short-duration

Moderate cost
Up to 2 years

Superior wet night-time visibility that is durable

Essential for projects "wintering-over" using temporary configurations

Type 2YY



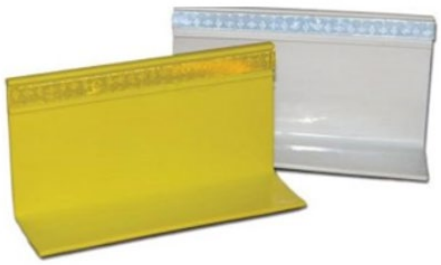
Type 2W

Flexible Pavement Markers
Cheap
A few weeks

OK wet & night visibility

Required for chip-seal
(Bituminous Surface Treatment)

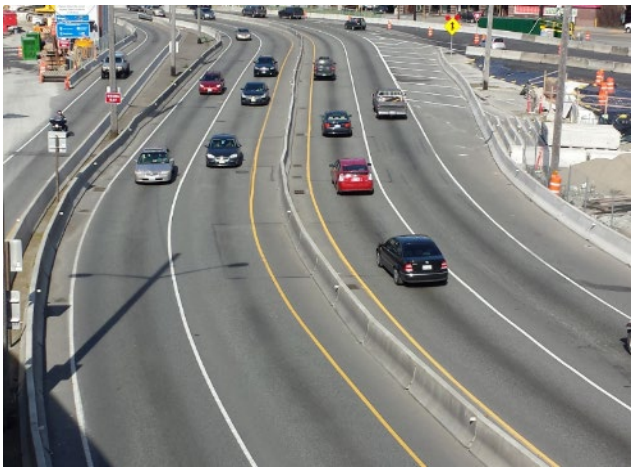
Prohibited on all other pavement types besides BST "chip-seal".



Pavement Marking Retroreflectivity

Retroreflectivity, R_L, is simply measures "how bright is the pavement marking". Higher R_L, the brighter.

Even during daytime, rainy conditions have a noticeable impact on the visibility of markings:

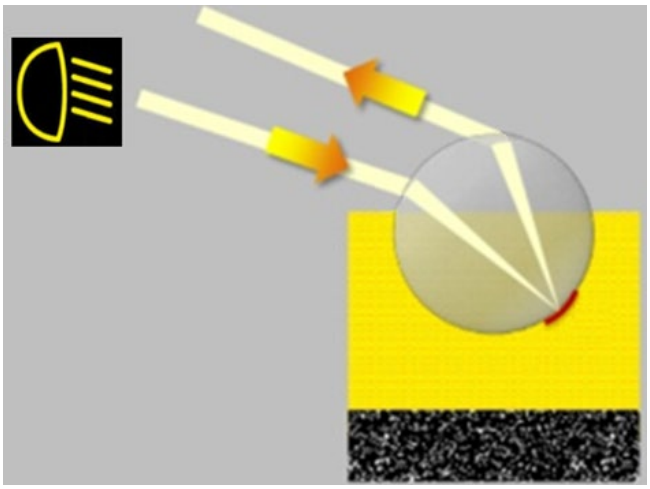


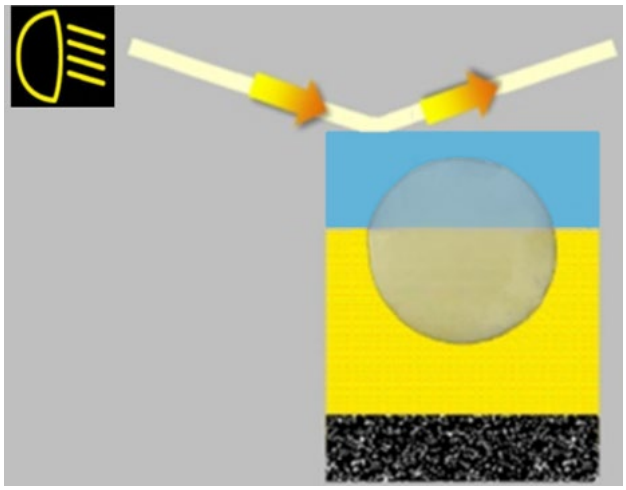
At nighttime, rainy conditions have a **dramatic** impact on visibility of markings, see below (video):

In the photos above, taken at the same location, the pavement markings become nearly invisible except for the surface-mounted Type 2 RPM (blue arrow), which significantly improves wet, nighttime visibility because it extends up above the layer of water on the roadway (profiled markers do the same thing).

What causes the pavement marking to "disappear"?

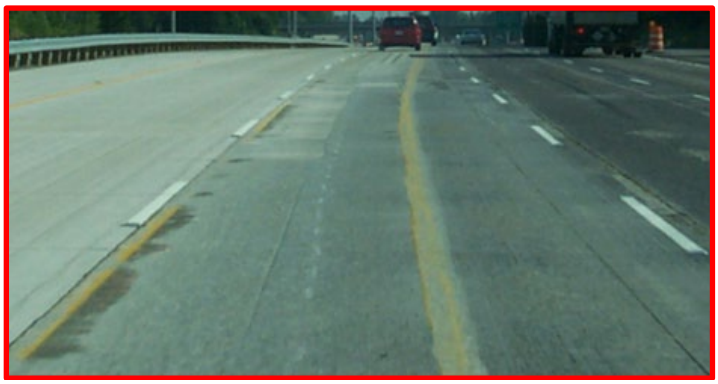
- During dry conditions, headlights hit the glass bead and is "bounced" back toward the driver and the marking is visible.
- During rainy nights, the headlight's beam simply ricochets off the water's surface never returning to the driver; therefore, the marking "disappears".





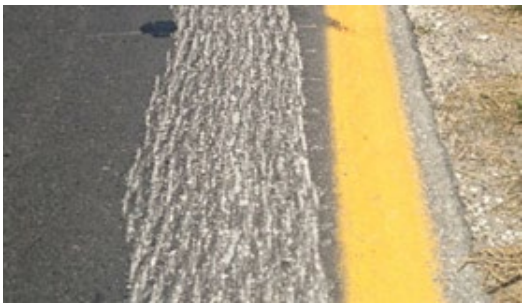
Removal of Conflicting Pavement Markings

During some projects, the roadway may be temporarily reconfigured from its original realignment using temporary pavement markings that requires the remove of existing pavement markings per Standard Specifications 8-22 and 8-23. Failing to completely remove conflicting lines can result in confusion, especially at night.



Even when removed, "ghost" lines of the existing pavement markings will remain; however, the pavement marking removal method will determine the severity.

Grinding: The pavement marking and pavement is pulverized via a grinder, leaving the most severe ghost markings. Per Standard Specifications 8-22, grinding is prohibited if it damages the roadways final driving surface (grinding is allowed down to just above the surface)



Water-blasting: The most gentle removal method of the three using high-pressured water, it minimizes ghost markings and is required for marking removal on final driving surfaces

Shot-blasting: The slowest removal method of the three (commonly used at airport runaways to remove rubber) using steel BBs, it minimizes ghost markings like water-blasting

An excellent alternative to actual removal is to cover existing lines, often for shorter-durations (weekends or a few days) via black preformed tape that goes over the line. For long-term reconfigurations lasting weeks or months, it is still better to completely remove the conflicting markings.

A significant benefit to using black tape to cover conflicting markings is when the tape is removed, the existing markings are already in place, making restoring the roadway configuration weather-independent.

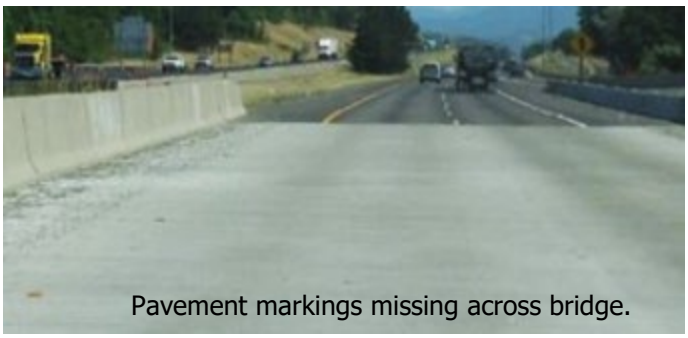
Tape: Black preformed tape is simply placed over the existing markings (in addition to temporary pavement markings) and then removed when no longer needed.

Pavement Marking Deficiencies

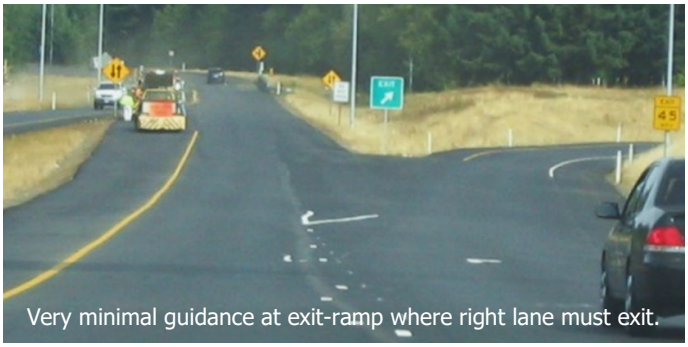
Per Standard Specification 1-07.23(1) and 8-23.3(4)D, temporary pavement markings shall be maintained in a serviceable condition throughout the project until the permanent markings are installed and shall maintain the striping (pavement markings) on the Roadway.

While not a responsibility of the Traffic Control Supervisor, per Standard Specification 1-10.2(1)B, the **TCS should note any pavement marking deficiencies during traffic control inspections and inform the Traffic Control Manager**. The Traffic Control Manager will take appropriate action to address the pavement marking issues either on the behalf of the Contractor or informing his/her managers ultimately with approval of the Engineer per Standard Specification 8-23.3(4)D.

After temporary pavement markings are installed and as needed to maintain pavement markings in a serviceable condition, a review of the marking's effectiveness should be performed. Typically, this is a responsibility delegated to the Traffic Control Supervisor.

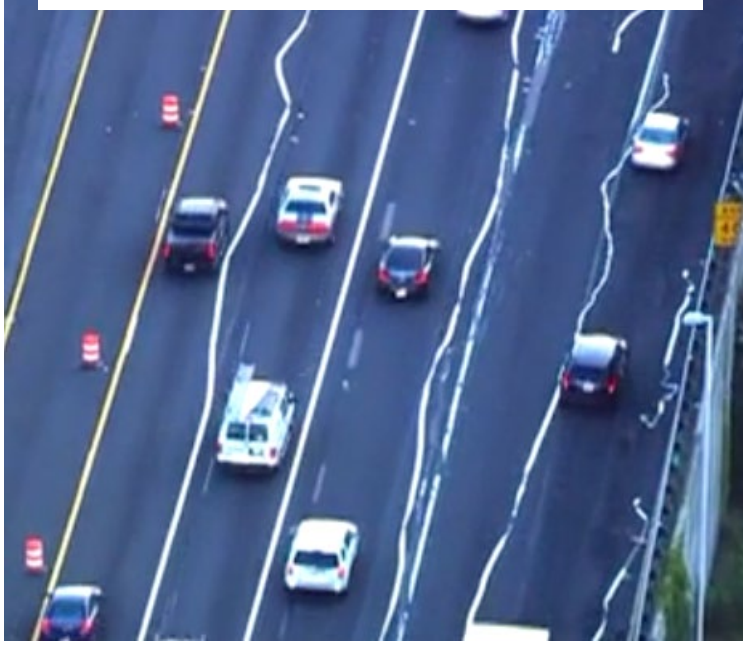


Pavement markings missing across bridge.



Very minimal guidance at exit-ramp where right lane must exit.

Tape markings failing to stay adhered to pavement.



Chapter 6 : Device Placement & Work Zone Components

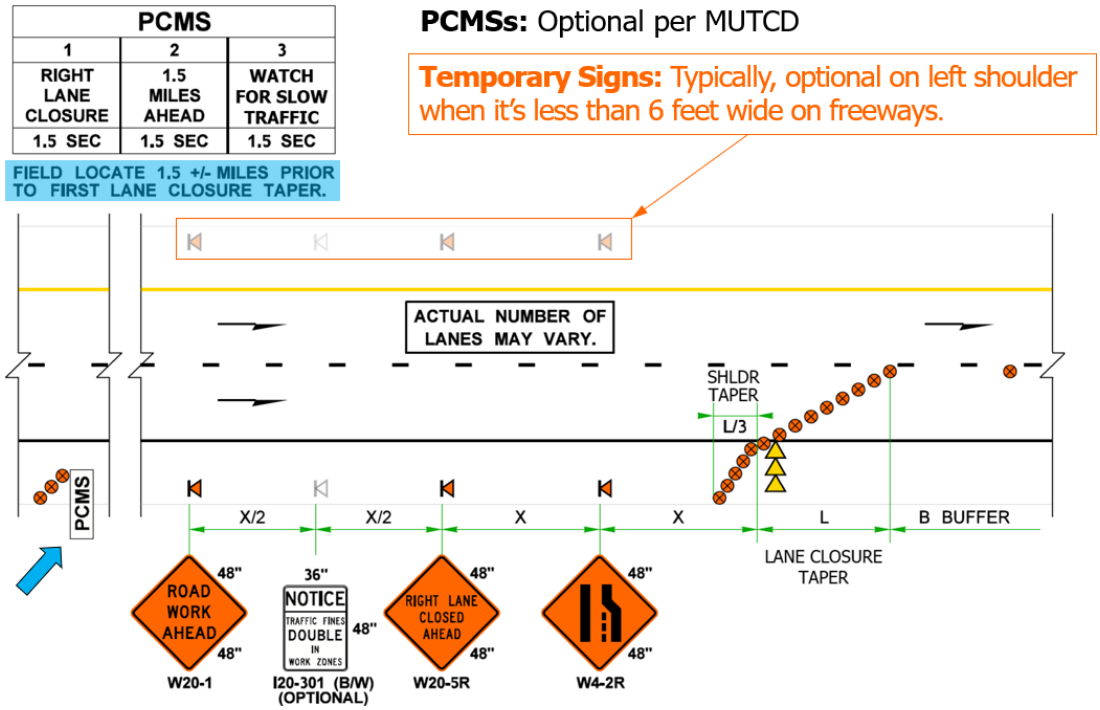
6.1 Summary

This chapter focuses on laying out the traffic control ranging from temporary sign spacing, channelizing device spacing and position, taper lengths, buffer spaces, and roll ahead distances.

6.2 PCMS Placement

Section 5.5 provides detailed information regarding PCMS messages, positioning, and usage. Recall, PCMSs are optional per MUTCD and supplement signage to advise road users of unexpected situations.

Traffic control plans will show the PCMS location, if required, along with messages:



The table below serves as reference for typical PCMS placement if not shown on traffic control plans:

Scenario	Typical PCMS Placement Locations
Shoulder Closure	Avoid using PCMSs
Lane Closure or Lane Shift	Prior to temporary construction signage • Freeways: 1.5± mile in advance of 1st lane closure merge taper • 45+ mph: 1± mile in advance of 1st lane closure merge taper • 40 mph or Less: Approximately "X" in advance of 1st construction sign
Queue Mitigation	½ mile advance of traffic queue is optimum Relocate back 1± mile in advance of where traffic queues expected to reach (Multiple PCMSs may be needed)
Notification of Upcoming Closures	Near the closure point, unless already shown on a temporary sign
Notification During Active Closures	Supplemental: 500' to ½± mile in advance of detour/alternate routes Approaching closure point (in advance of temporary construction signage)
Rolling Slowdowns	1± mile in advance of rolling slowdown starting location Include truck-mounted PCMS ½± mile advance of traffic queue
15+ Minute Traffic Holds	Locate in advance of where stopped traffic queue is expected to reach
Mobile Closures	PCMS (may be TA/truck-mounted) in advance and approaching closure

6.3 Construction Sign Spacing

Section 5.4 provides detailed information regarding construction signage, reflectivity, usage, and storage.

6.3(1) Temporary Sign Spacing & Adjustments

Washington has modified the temporary sign spacing used in MUTCD Table 6C-1 "Recommended Advance Warning Sign Minimum Spacing" in Section 6C.04:

Table 6C-1. Recommended Advance Warning Sign Minimum Spacing

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

Per WAC 468-95-300, temporary sign spacing in Washington is as follows:

SIGN SPACING = X (1)		
FREEWAYS & EXPRESSWAYS	50-75 MPH	1500' +/-
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	**200' +/- (2)**
URBAN STREETS	25 MPH OR LESS	**100' +/- (2)**

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.

(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.

Temporary sign spacing is based on the posted speed limit at the sign's location; if the regulatory speed limit changes in the work zone, spacing changes. Temporary sign spacing is **approximate (±) and adjustable** (increasing and decreasing spacing) by state law.

Scenarios requiring sign spacing adjustments include:

- Queues extend past the 1st warning sign (for 1+ mile queues, consider adding PCMS instead)
- Interchanges & intersections
- Business approaches & driveways
- On-street parking (move signs or increase mounting height to 5 feet)
- Avoiding blocking or being blocked by existing signs

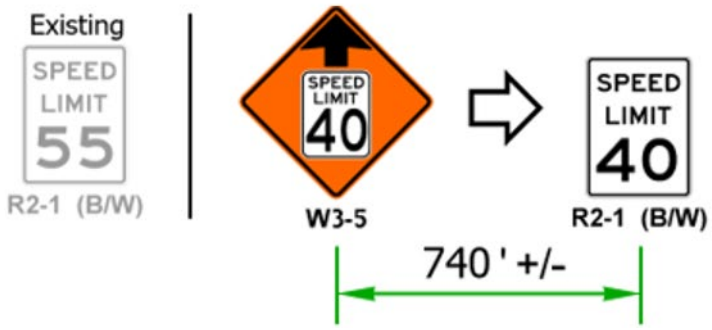
Important: When work zone sign spacing is adjusted, document how the situation was evaluated and why the adjustments were made. That way, in the event of a potential lawsuit, an explanation can be provided several years later.

6.3(2) Speed Limit Reduction Sign Spacing

For reduced work zone speed limits (WZSL) exceeding 10 mph, a W3-5 sign is positioned in advance of the reduced regulatory speed limit sign, R2-1.

A 5-mph reduction does not need the W3-5 sign, just use the R2-1.

For example, if the existing 55 mph zone is reduced to a 40 mph WZSL, then sign spacing between W3-5 and R2-1 signs is 740'±, exceeding the 500'± typically used in Sign Spacing table.



Sign Spacing Differs from Temp. Sign Spacing

SIGN SPACING = X (1)		
FREEWAYS & EXPRESSWAYS	50-75 MPH	1500' +/-
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	200' +/- (2)
URBAN STREETS	25 MPH OR LESS	100' +/- (2)

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.
(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.

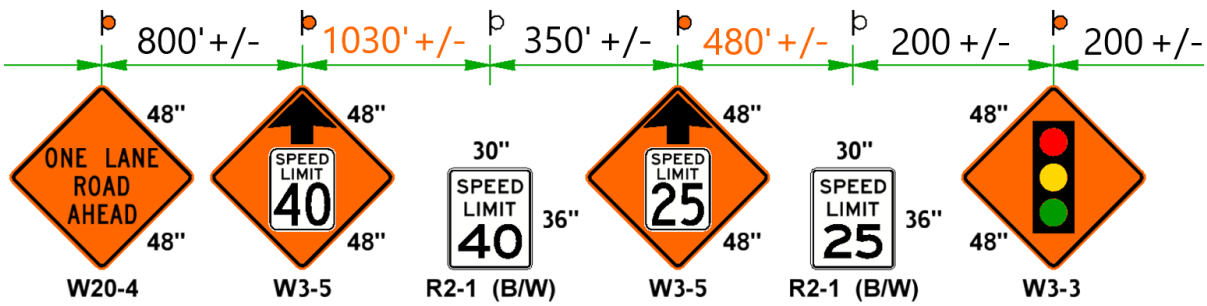
Temporary Sign Spacing Between W3-5 & R2-1 Signs

Reduced Speed Limit	Existing Speed Limit (mph)								
	70	**65**	**60**	**55**	**50**	**45**	**40**	**35**	**30**
65	430								
60	720	390							
55	1000	660	350						
50	1250	910	600	310					
45	1470	1140	820	540	270				
40	1670	1340	1030	**740**	470	230			
35	1850	1520	1200	920	650	410	200		
30	2000	1670	1360	1070	810	570	350	160	
25	2140	1800	1490	1200	940	700	480	290	120
20	2240	1910	1600	1310	1040	800	590	390	230

Note the actual temporary sign spacing can exceed the value in the table above; however, we want to avoid being significantly under the values above to allow sufficient distance to slow the vehicle to the reduced speed with minimal braking on level terrain.

WSDOT typically uses a double speed limit reduction whenever the work zone speed limit is 20+ mph lower than the existing speed limit, particularly approaching temporary signals.

- **Example:** Existing 60 mph zone reduced 25 mph WZSL approaching temporary signal.



60 → 40 mph: 1030'± spacing (not 800'±) 40 → 25 mph: 480'± spacing (not 350'±).

It is important to note the W3-5 → R2-1 sign spacing is different than typical sign spacing.

6.4 Channelizing Device Spacing

Section 5.7 provides detailed information regarding channelizing devices, retroreflectivity, and usage.

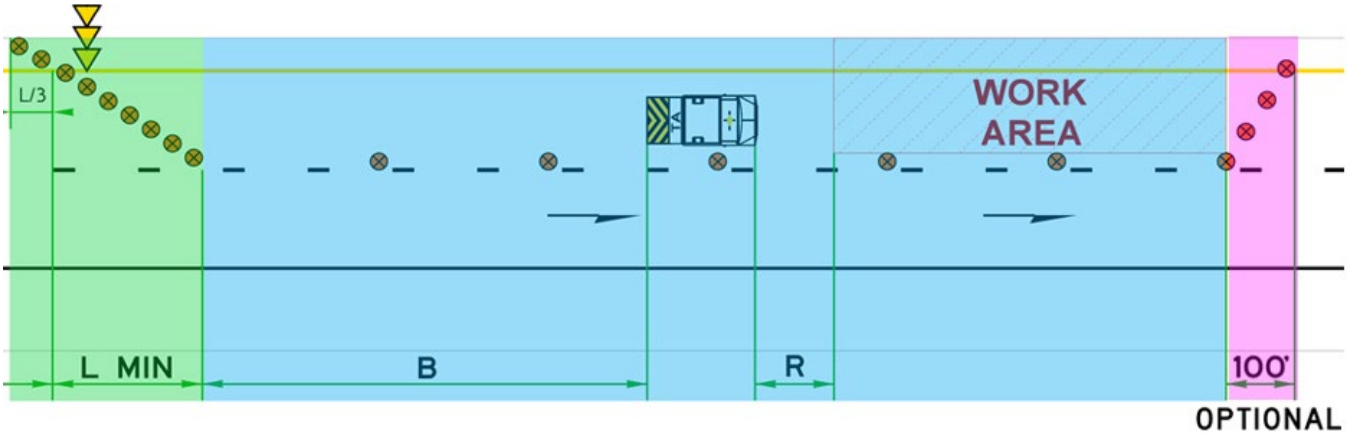
Per MUTCD, the taper spacing is the speed limit in feet & tangent spacing twice the speed limit in feet.

Per WAC 468-95-301, Washington has reduced maximum channelizing device spacing from those allowed in the MUTCD. To assist in layout, know broken lane lines ("skip lines") are 40' spacing:

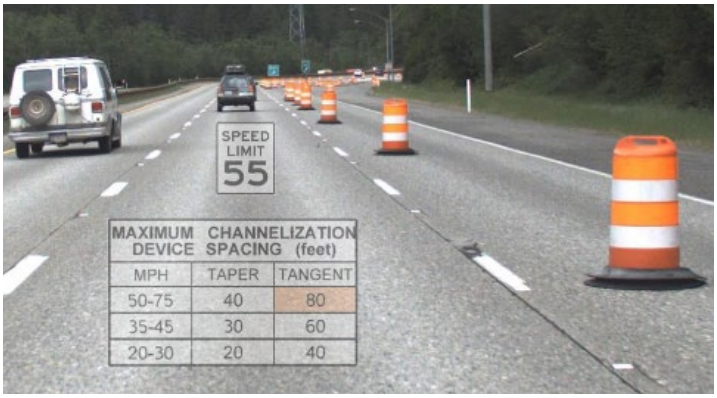
MAXIMUM CHANNELIZATION DEVICE SPACING (feet)		
MPH	TAPER	TANGENT
50-75	40	80
35-45	30	60
20-30	20	40

Channelizing device spacing **may ALWAYS be reduced**

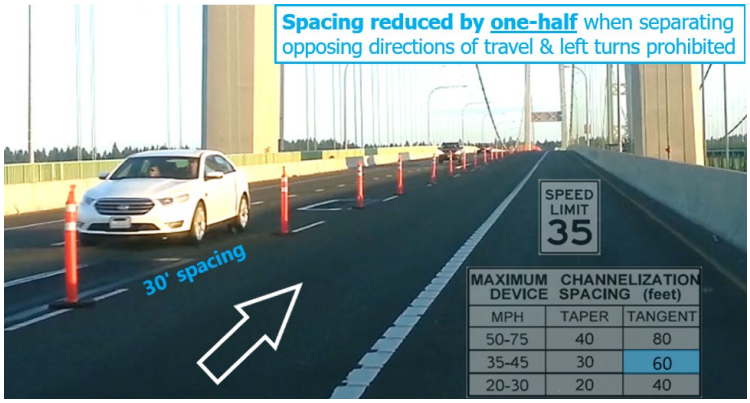
Reopening tapers @ 20'



Photos of 40' spacing (left) and 80' spacing (on right) shown below:



Photos of 60' spacing (left) and 30' spacing (right) shown below:



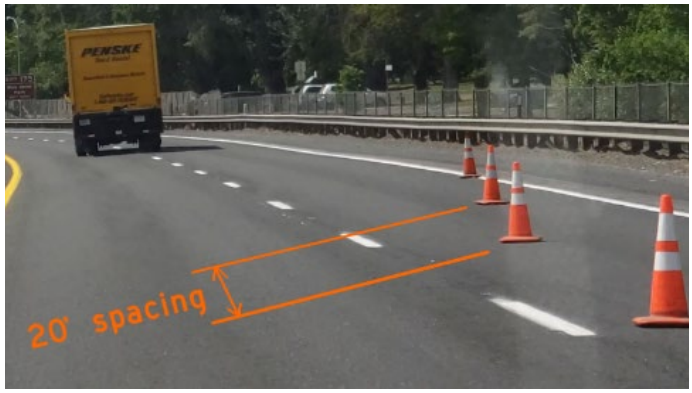
It is difficult to space devices at 30’ or 60’ because devices don’t always land on the broken lane lines. It is acceptable to decrease spacing to 20-foot and 40-foot for easier layout if needed.

Photos of 20’ spacing (left) and 10’ spacing (right) shown below:

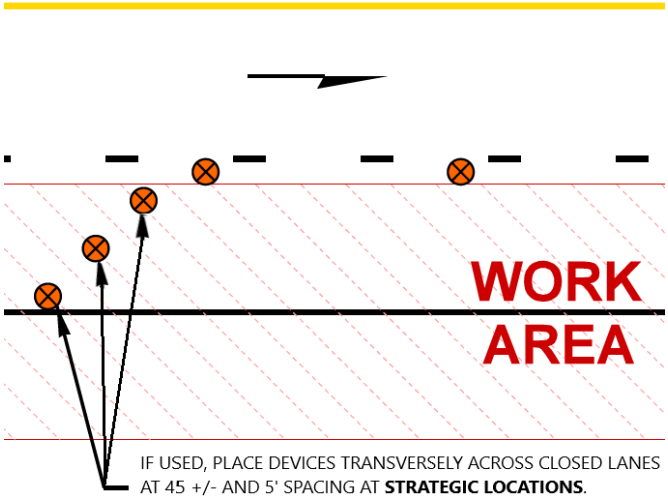
Reducing channelizing device spacing to 20’ adjacent to stationary work crews starting ahead of the protective vehicle/transportable attenuator is highly recommended, especially on high-volume freeways.

Where traffic is driving slowly near intersections or using devices to form turning radii into driveways, business accesses, or intersecting roadway approaches, reduce channelizing device spacing down to 5’-10’ to help guide motorists and keep them out of work areas.

“Flagging tapers” use channelizing device spacing of 10’ to 20’, as shown left photo below. Lane downstream (“reopening”) tapers on multilane roadways use 20’ spacing as shown in right photo below.



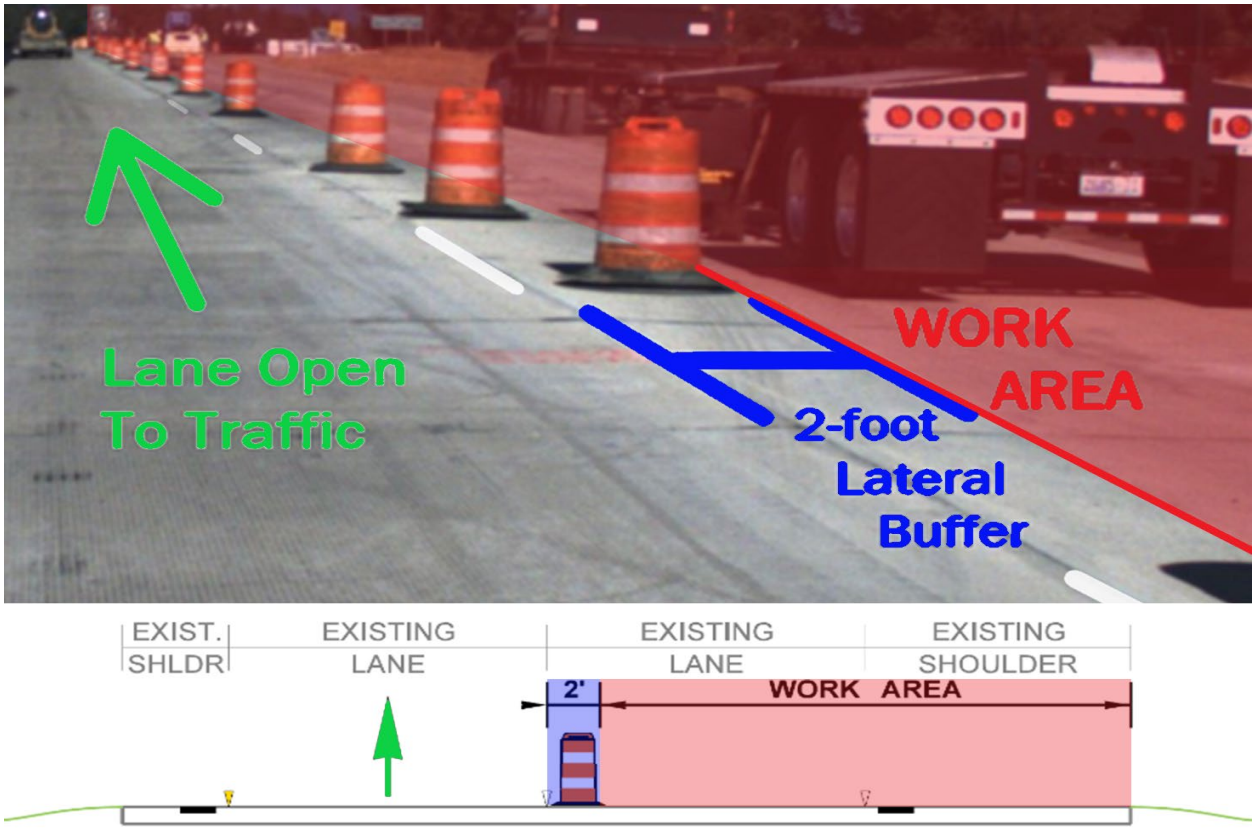
To help reduce vehicles errantly driving within closed lanes, channelizing devices can be strategically located (after temporary open exit-ramps, prior to work crews, etc.) across the closed lane. When used, a set of three channelizing devices are placed skewed towards the open lane of spacing @ 5’ spacing:



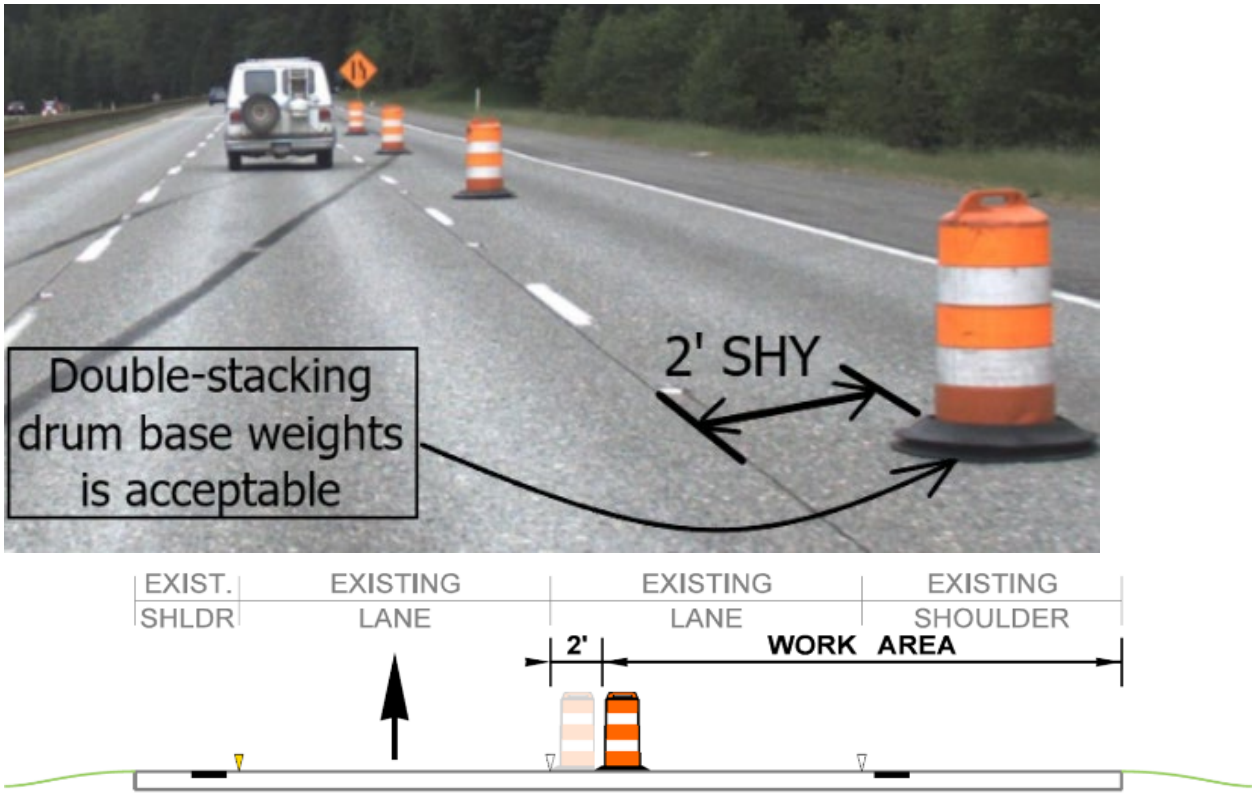
6.5 Channelizing Device Lateral Placement

Section 5.7 provides detailed information regarding channelizing devices, retroreflectivity, and usage.

Unless shown otherwise on traffic control plans, channelizing devices are placed up to the edge of adjacent open lanes. (Note: It's the work area with a 2-foot lateral buffer on 45+ mph roadways)



Acceptable to channelizing devices back 2 feet from the open lane reduce wind loading from semi-trucks (especially on rural freeways) in addition to using double base weights.

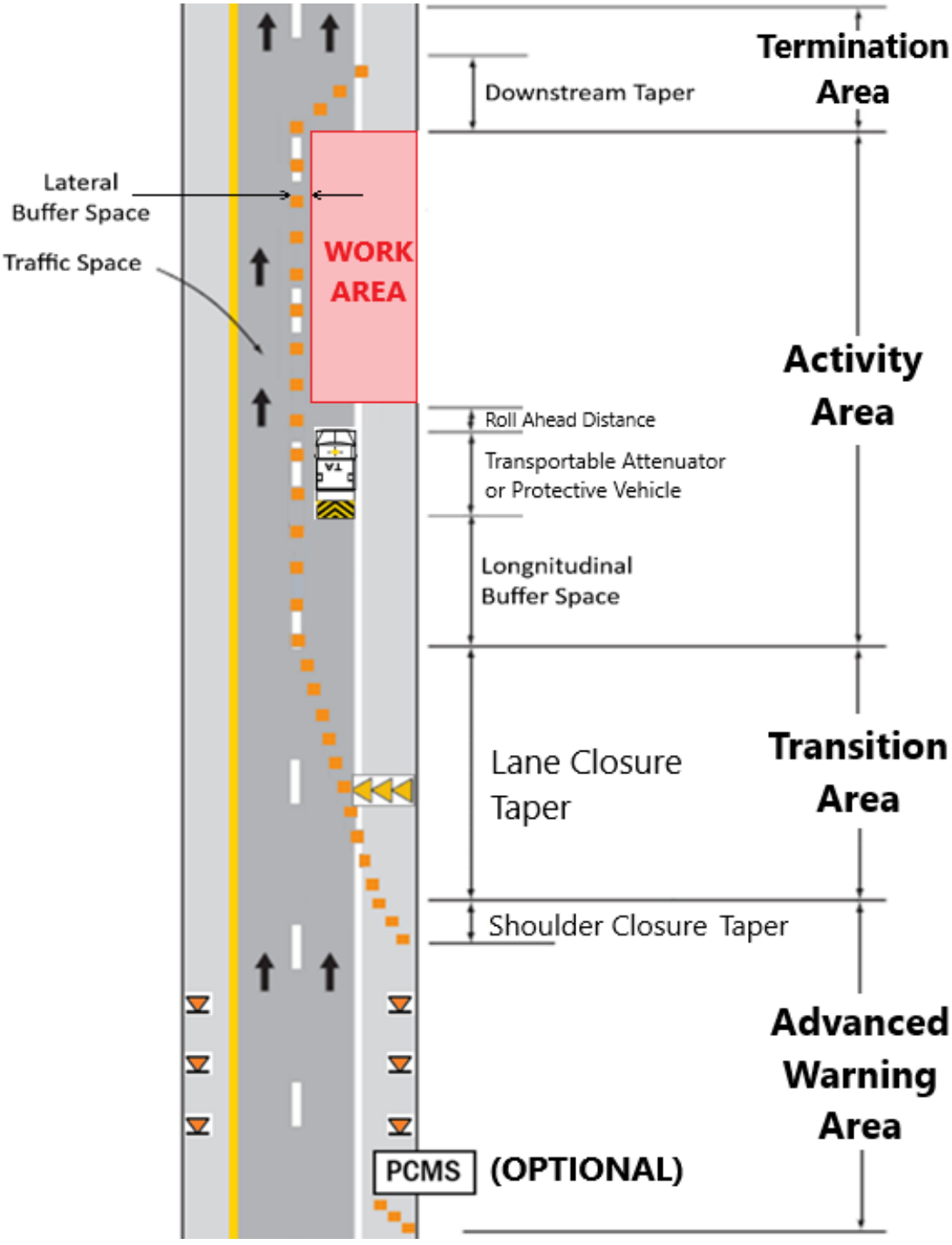


6.6 Work Zone Components & Traffic Control Layout

With PCMS and channelizing device placement and spacing addressed, now we can focus on the work zone components and how the traffic control is laid out.

Work zones have four key components shown below (2-lane freeway shown, other work zones similar):

1. **Advance Warning:** Provide information of the upcoming work zone & closures
2. **Transition:** Move road users into position for travel through the work area
3. **Activity:** Approaching and traveling adjacent to the work area
4. **Termination:** Closures reopened; normal operations restored



The work zone components/subcomponents discussed in this chapter will follow the Work Zone Component schematic above, so refer to this figure as needed.

6.7 Advanced Warning Area

The advanced warning area functions to provide information of the upcoming work zone & closures. This is commonly addressed with temporary signage but PCMSs may supplement.

Section 5.5 and Section 6.2 provides detailed information regarding PCMS.

Section 5.4 and Section 6.3 provides detailed information regarding temporary construction signage.

6.8 Transition Area

The transition area position road users for travel through the work area via tapers and tangents:

Taper Type	Minimum Taper Length
Merge	L
Shift	L/2
Shoulder Closure	L/3
One-Lane, Two-Way Traffic	50' – 100' per lane

MAXIMUM CHANNELIZATION DEVICE SPACING (feet)		
MPH	TAPER	TANGENT
50-75	40	80
35-45	30	60
20-30	20	40

6.8(1) Merge Taper (L)

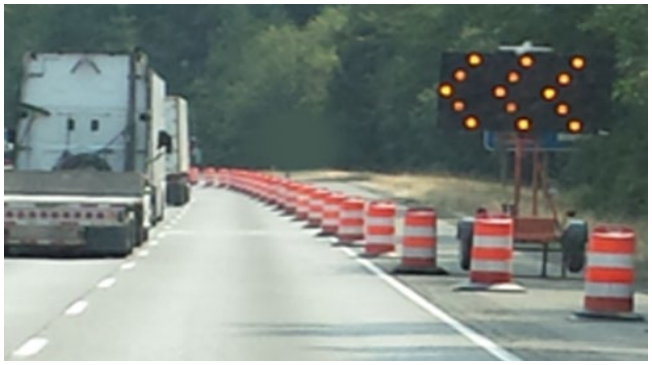
Commonly known as a "lane closure taper", merging tapers laterally move traffic into the adjacent lane at prevailing travel speeds, based on the posted speed limit.

These tapers require the longest distances because motorists must have sufficient time and distance to adjust their speeds and merge into the adjacent open lane before the end of the transition.

Location of merge tapers should avoid on-ramp merges, crossroads, and horizontal curves and adjusted by increasing longitudinal buffer spaces or tangents between multiple lane closure tapers.

As a last resort, sometimes is necessary to shorten lane closure tapers due to driveways, short block lengths, or other restrictive conditions. This is typically limited to urban environments on 40 mph or less roadways. Document the justification and observe driver performance to test its adequacy.

Lane Closure Taper Length = L	
Posted Speed Limit	**Formula**
≤ 40mph	$L = \frac{W * S^2}{60}$
≥ 45mph	$L = W * S$
W = Lane Width (feet) S = Posted Speed Limit (miles per hour)	



In lieu of using formulas to calculating tapers, use the table below for simplicity. The table assumes 12-foot lanes and rounds distances up based on maximum channelizing device spacing:

LANE CLOSURE TAPER LENGTH = L													
LANE WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
12'	L (feet)	80	140	180	270	330	540	600	680	720	800	840	920
On roadways 40 mph or less, lane closure taper may be reduced based on field conditions.													

Example calculations provided on the next page; table values are always conservative and larger than the calculated values as shown on the next page.

Merge Taper – 40 mph or Less Example:

Roadway Information: Speed Limit 35, 12-foot lanes

Lane Closure Taper Length = L	
Posted Speed Limit	**Formula**
≤ 40mph	$L = \frac{W * S^2}{60}$
≥ 45mph	L = W * S
W = Lane Width (feet) S = Posted Speed Limit (miles per hour)	

Calculation:

$$L = \frac{W * S^2}{60} = \frac{12 * 35^2}{60} = \frac{12 * 35 * 35}{60} = \mathbf{245'}$$

$$\boxed{\mathbf{L = 270'}}$$

(Rounded up based on 30' channelizing device spacing)

Merge Taper – 45+ mph Example:

Roadway Information: Speed Limit 70 (Trucks 60), 12-foot lanes

Lane Closure Taper Length = L	
Posted Speed Limit	**Formula**
≤ 40mph	$L = \frac{W * S^2}{60}$
≥ 45mph	L = W * S
W = Lane Width (feet) S = Posted Speed Limit (miles per hour)	

Calculation:

$$L = W * S = 12 * 70 = \mathbf{840'}$$

$$\boxed{\mathbf{L = 840'}}$$

(Already matches 40' chan. device spacing)

Instead of using calculations, the table below could have been used for these scenarios, even if it is conservative (assumes 12' lanes & rounds up based on maximum channelizing device spacing):

LANE CLOSURE TAPER LENGTH = L													
LANE WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
12'	L (feet)	80	140	180	270	330	540	600	680	720	800	840	920
On roadways 40 mph or less, lane closure taper may be reduced based on field conditions.													

6.8(2) Lane Shift Taper (L/2)

Lane shift tapers laterally move traffic into a different travel path at prevailing travel speeds. These tapers are shorter than merge taper because motorists are not required to merge into the adjacent lane.

Location of lane shift tapers may need to be adjusted if they fall near horizontal curves. Adjustments are typically accomplished by increasing longitudinal buffer or tangents adjacent to the shift.

When located in a horizontal curve and the lateral shift is towards the inside of the curve (this makes the curve sharper), it is recommended to double the shift taper length and use "L".

A tangent section should be provided prior to shift tapers, typically a distance of "L/2", per MUTCD Figure 6H-31, Figure 6H-32, Figure 6H-36.

In lieu of using formulas to calculating tapers, use the table below for simplicity. The table assumes 12-foot lanes and rounds distances up based on maximum channelizing device spacing:

LANE SHIFT TAPER LENGTH = L/2													
LANE SHIFT	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
6'	L/2 (feet)	20	40	60	90	90	150	160	200	200	200	240	240
12'		40	80	100	150	180	270	320	360	360	400	440	480
24'		80	140	180	270	330	540	600	680	720	800	840	920
On roadways 40 mph or less, lane shift taper may be reduced based on field conditions.													

Avoid placing lateral lane shifts that shift "into" the horizontal curve, making it a sharper curve. If the lateral shift taper cannot be practically relocated out of the horizontal curve, double the taper length to "L".

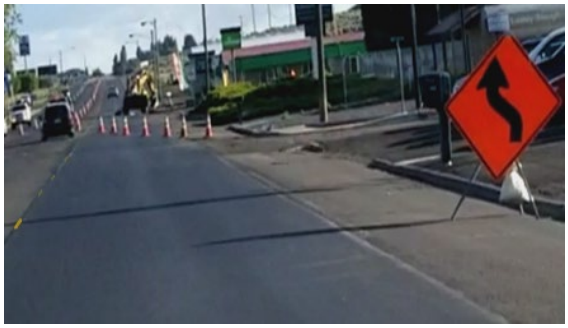
For lateral lane shift of 4+ feet, warning signs in advance:

W1-3R (30 MPH OR LESS) **W1-4L** (35+ MPH) **W24-1R** **W1-4BR** (Double Lane Shift to Right) **W24-1BR** Triple Shift to Right, then Left

In addition, there is an "ALL LANES" plaque, W24-1CP, can be used with the single lane symbols when multiple lanes are shifted. Combination shift signs are typically used when both shifts within 600 feet.

Shift Taper – 40 mph or Less Example:

Roadway Information: Speed Limit 35, 12-foot lateral lane shift



Calculation:

$$L/2 = \frac{1}{2} * \frac{W * S^2}{60} = \frac{12 * 35^2}{120} = \frac{12*35*35}{120} = \mathbf{122.5'}$$

$$\boxed{\mathbf{L/2 = 150'}}$$ (Rounded up based on 30' chan. device spacing)

Shift Taper – 45+ mph Example:

Roadway Information: Speed Limit 70 (Trucks 60), 12-foot lateral lane shift

Calculation:

$$L/2 = \frac{1}{2} * W * S = \frac{1}{2} * 12 * 70 = \mathbf{420'}$$

$$\boxed{\mathbf{L/2 = 440'}}$$ (Rounded up based on 40' chan. device spacing)

Because shift tapers are highly dependent on the actual shift, they are typically calculated, but tables may be used for common lateral lane shifts:

LANE SHIFT TAPER LENGTH = L/2													
LANE SHIFT	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
6'	L/2 (feet)	20	40	60	90	90	150	160	200	200	200	240	240
12'		40	80	100	150	180	270	320	360	360	400	440	480
24'		80	140	180	270	330	540	600	680	720	800	840	920
On roadways 40 mph or less, lane shift taper may be reduced based on field conditions.													

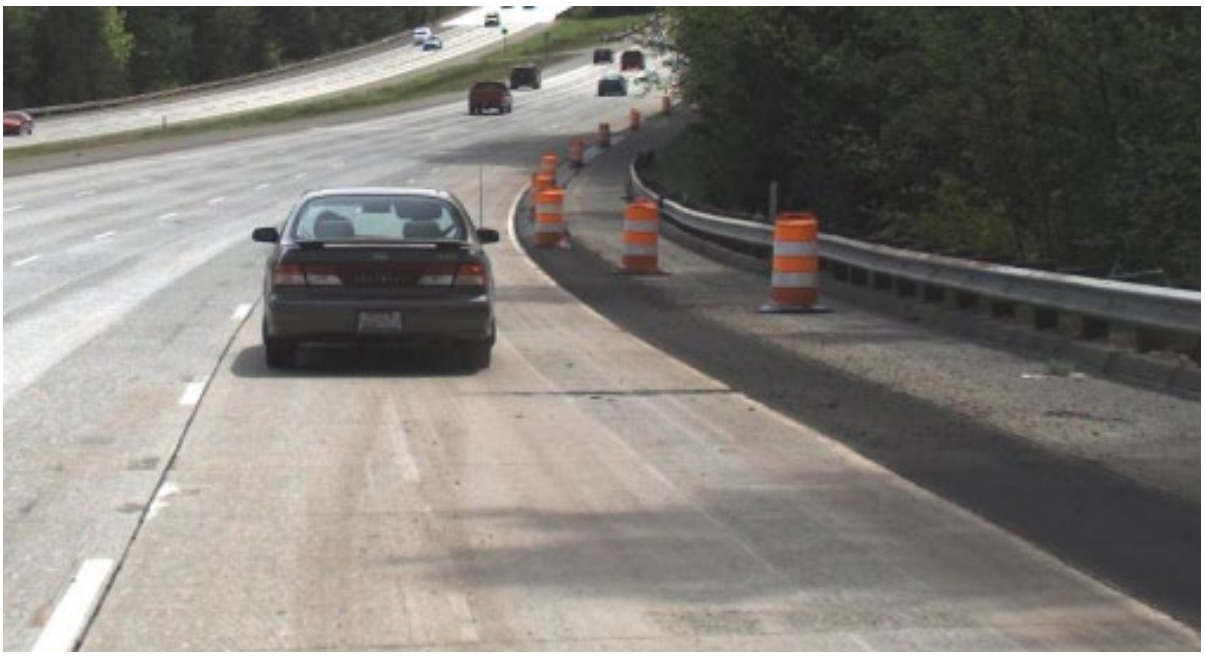
6.8(3) Shoulder Closure Taper (L/3)

Shoulder closure tapers are used independently and in conjunction with an adjacent lane closure. While not part of the traveled way, shoulder closures are necessary because motorists normally expect to use the shoulder in an emergency or when pulled over by the police.

Shoulder closure tapers are steeper than merge or shift tapers because motorists are not required to change their direction of travel. For peak-use shoulder lanes, use full merge taper (L) instead of (L/3).

A tangent is not required between shoulders and merge tapers.

Usage is per MUTCD Section 6C.08 and Figures 6H-3 thru 6H-7.



While dependent on the lateral lane shift distance, the following table rounds the taper length up based on maximum channelizing device spacing:

SHOULDER CLOSURE TAPER LENGTH = L/3													
SHOULDER WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
< 6'	L/3 (feet)	40	40	40	60	60	60	80	80	80	80	80	80
6'		40	40	40	60	60	90	120	120	120	160	160	160
10'		40	40	60	90	90	150	200	200	200	240	240	280

Example calculations provided on the next page; table values will be larger than the calculated values.

(Continued)

Shoulder Taper – Low Speed Example:

Roadway Information: Speed Limit 30, 6-foot shoulder

Calculation:

$$L/3 = \frac{1}{3} * \frac{W * S^2}{60} = \frac{6 * 30^2}{3*60} = \frac{6*30*30}{180} = 30'$$

$$\boxed{L/3 = 40'}$$ (Rounded up based on 20' chan. device spacing)

Shoulder Taper – High Speed Example:

Roadway Information: Speed Limit 60, 10-foot shoulder

Calculation:

$$L/3 = \frac{1}{3} * W * S = \frac{1}{3} * 10 * 60 = 200'$$

$$\boxed{L/3 = 200'}$$ (Already matches 40' chan. device spacing)

Instead of using calculations, the table below could have been used for these scenarios, even if it is conservative (assumes 12' lanes & rounds up based on maximum channelizing device spacing):

SHOULDER CLOSURE TAPER LENGTH = L/3													
SHOULDER WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
< 6'	L/3 (feet)	40	40	40	60	60	60	80	80	80	80	80	80
6'		40	40	40	60	60	90	120	120	120	160	160	160
10'		40	40	60	90	90	150	200	200	200	240	240	280

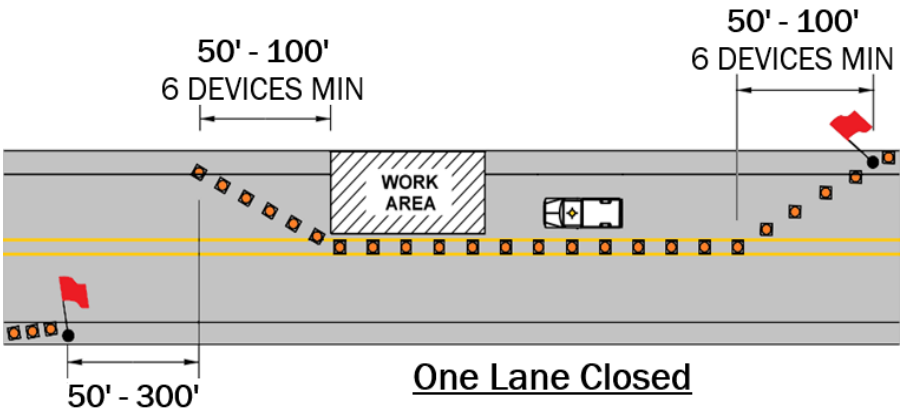
6.8(4) One-Lane, Two-Way Traffic Taper ("Flagger Taper")

Also known as a "flagger taper", these tapers are used to guide traffic into the open lane after being released by a flagger, AFAD, or temporary traffic signal. Usage is per MUTCD Section 6C.08 and Figures 6H-10 thru 6H-12.

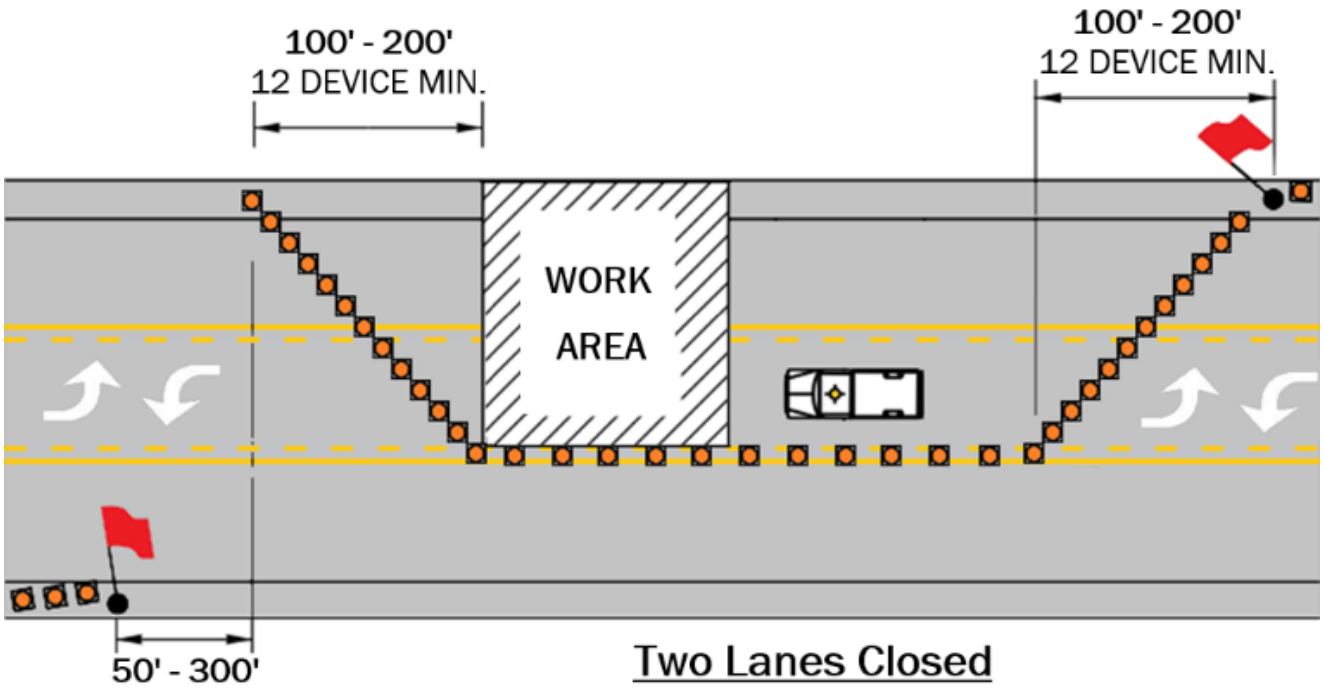
The closure taper remains 50'-100' per each lane closed for all speed limits; it does not change. It is recommended to extend this taper across the adjacent closed shoulder as well. The function of this taper is not to merge traffic, but to slow or stop traffic by giving the appearance of restricted alignment.

Channelizing device spacing is 10' to 20' with a minimum of 6 devices across each closed lane.

Below shows a two-way, one-lane flagger controlled **single** lane closure configuration and photo:



Below shows a two-way, one-lane flagger controlled **double** lane closure configuration and photo:



6.8(5) Tangent Between 2+ Lane Closures on Freeways

A tangent is provided between each lane closure merge tapers when multiple lanes are being closed on freeways. This tangent distance should be "2L" per MUTCD Guidance Section 6G.12, ¶ 12 and Typical Application 37. This tangent distance is adjustable (explained more below tables).

MAXIMUM DEVICE SPACING	CHANNELIZATION (feet)	
MPH	TAPER	TANGENT
50-75	40	80
35-45	30	60
20-30	20	40

Tangent Between Lane Closures on Multilane Roadways = 2L	
Posted Speed Limit	**Formula**
≤ 40mph	$2L = 2 * \left(\frac{W * S^2}{60}\right)$
≥ 45mph	$2L = 2 * (W * S)$
W = Lateral Lane Shift (feet) S = Posted Speed Limit (miles per hour)	

The 2L tangent is guidance per MUTCD Figure 6H-37 and Section 6H.01, ¶ 03.

- Tangent may also be increased, and is a useful strategy to move tapers out of horiziontal curves or other undesirable areas.
- Tangents may be reduced to "L" wever providing a full "2L" tangent is not practical.

When making these adjustemtns, TCS is to obtain Contractor (TCM) and Engineer (Project inspedtor) concurrance first. If the Engineer does not consider this a minor revision, then a modified traffic control plan will need to be submitted for Agency acceptance per Standard Spec. 1-10.2(2).

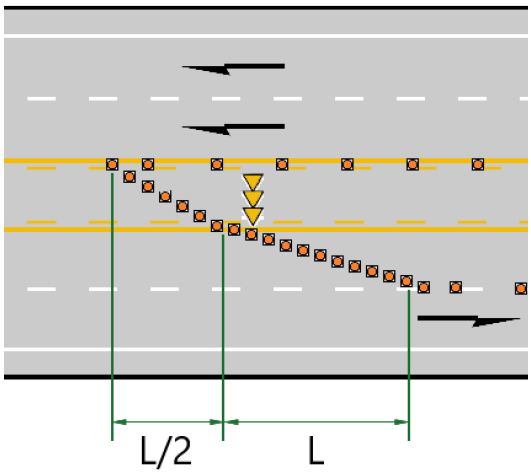
Instead of performing the calculations, the table can be used (conservative as it rounds up based on maximum channelizing device spacing):

TANGENT BETWEEN LANE CLOSURE TAPERS = 2L													
LANE WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
12'	2L (feet)	160	260	360	510	660	1080	1200	1320	1440	1560	1680	1800
Tangent may be adjusted (±) based on field conditions. Recommended minimum tangent = L.													

Tangent Exception: Two-Way Left Turn Lane Closures

No tangent is used between two-way left turn lane closure and the left lane closure on undivided highways with a dual center turn lane.

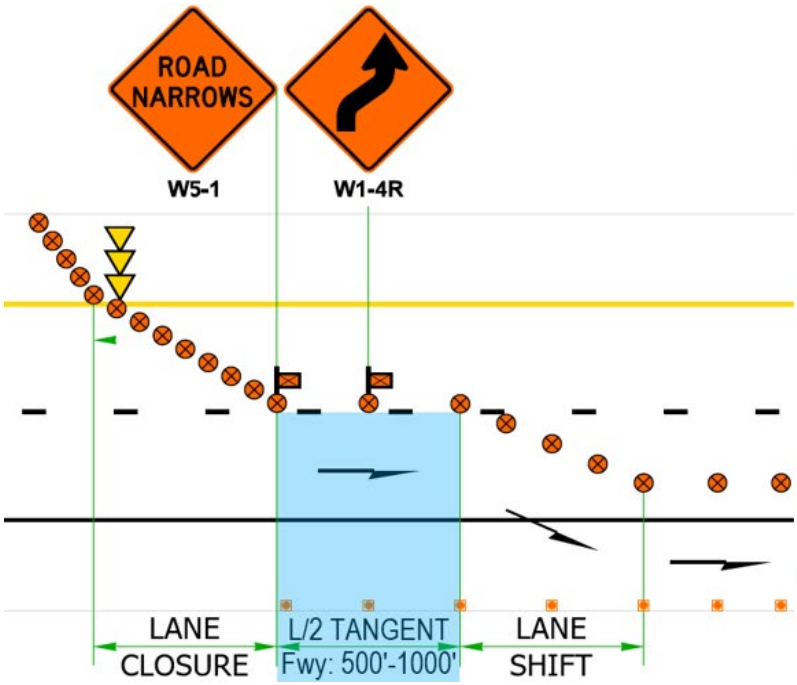
Since the two-way left turn lane is not an actual travel lane, it does not need an arrow board and a L/2 lane closure taper is sufficient. For clarity, the arrow board shown in the schematic to the right is for the left lane closure taper.



6.8(6) Tangent Prior to Lane Shift Tapers

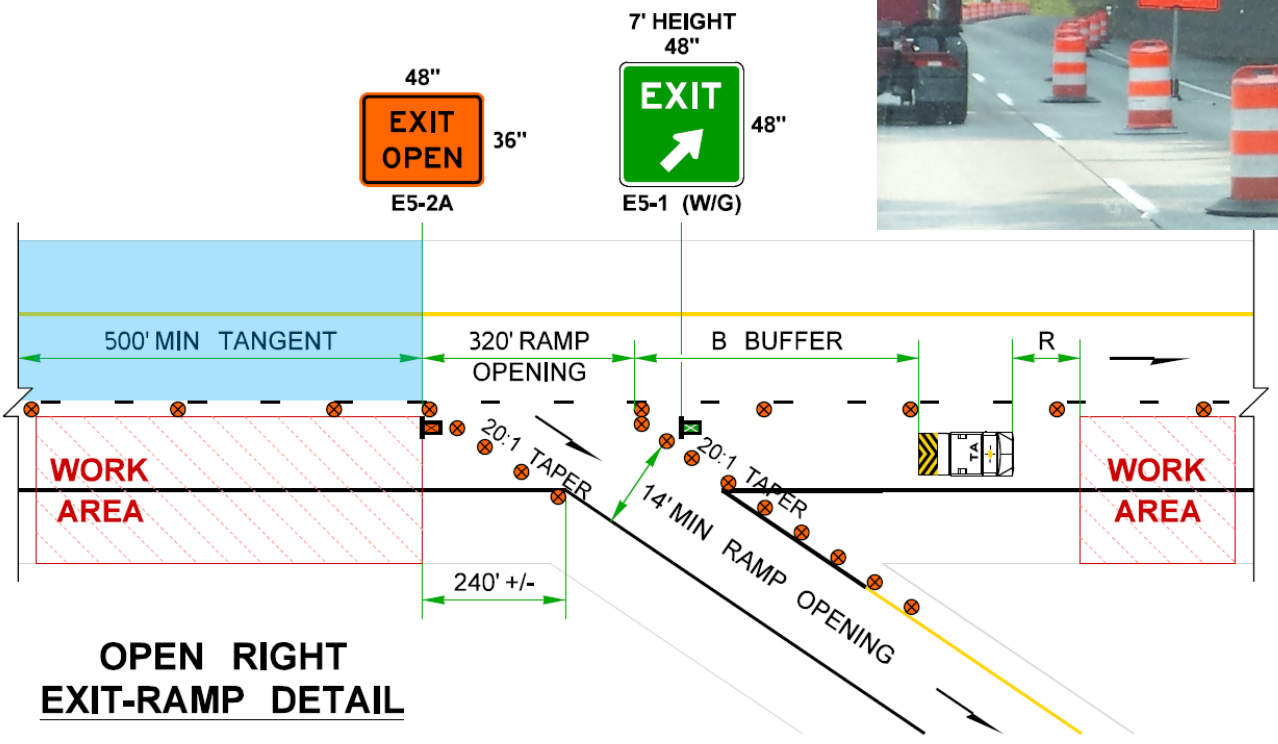
Per MUTCD Figure 6H-32 & Figure 6H-39, which are Guidance per Section 6H.01, ¶ 03, the tangent distance of one-half the merge taper (L/2) is typically used prior to shift tapers.

WSDOT typically uses 500'-1000' tangents on freeways.



6.8(7) Tangent Prior Open Exit-Ramps

Per MUTCD Typical Application 42 (Guidance per Section 6H.01, ¶ 03), a tangent distance of 1000' is used prior to temporary exit-ramps on freeways; however, this is excessive in most situations with minimal benefit. Thus, typical WSDOT practice is to use 500' tangents to minimize exit-ramp closures.

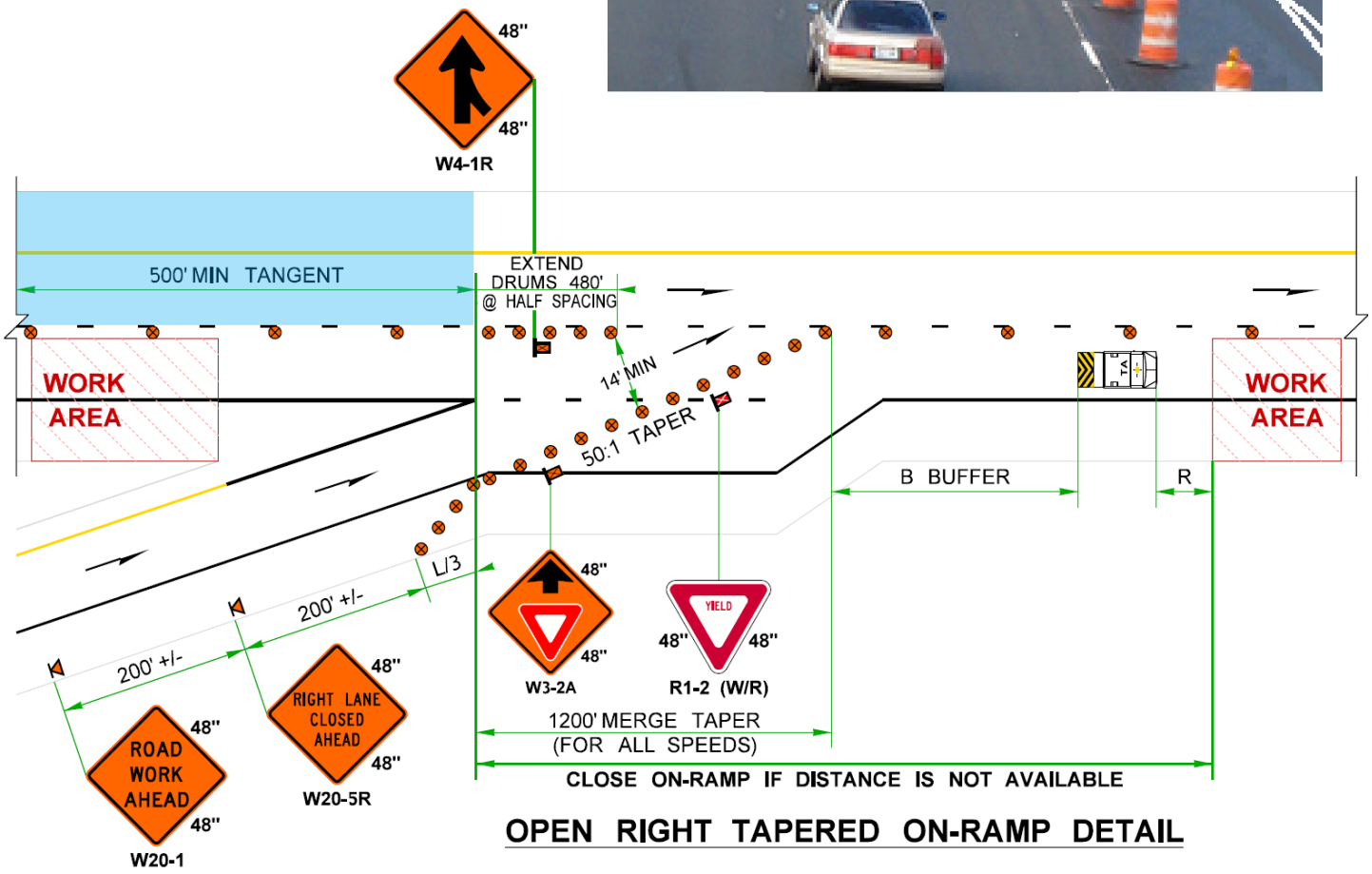


OPEN RIGHT
EXIT-RAMP DETAIL

6.8(8) Tangent Prior to Open On-Ramps

There is no MUTCD Guidance; however, typical WSDOT practice is to use 500' tangent distance on freeways prior to open temporary on-ramps.

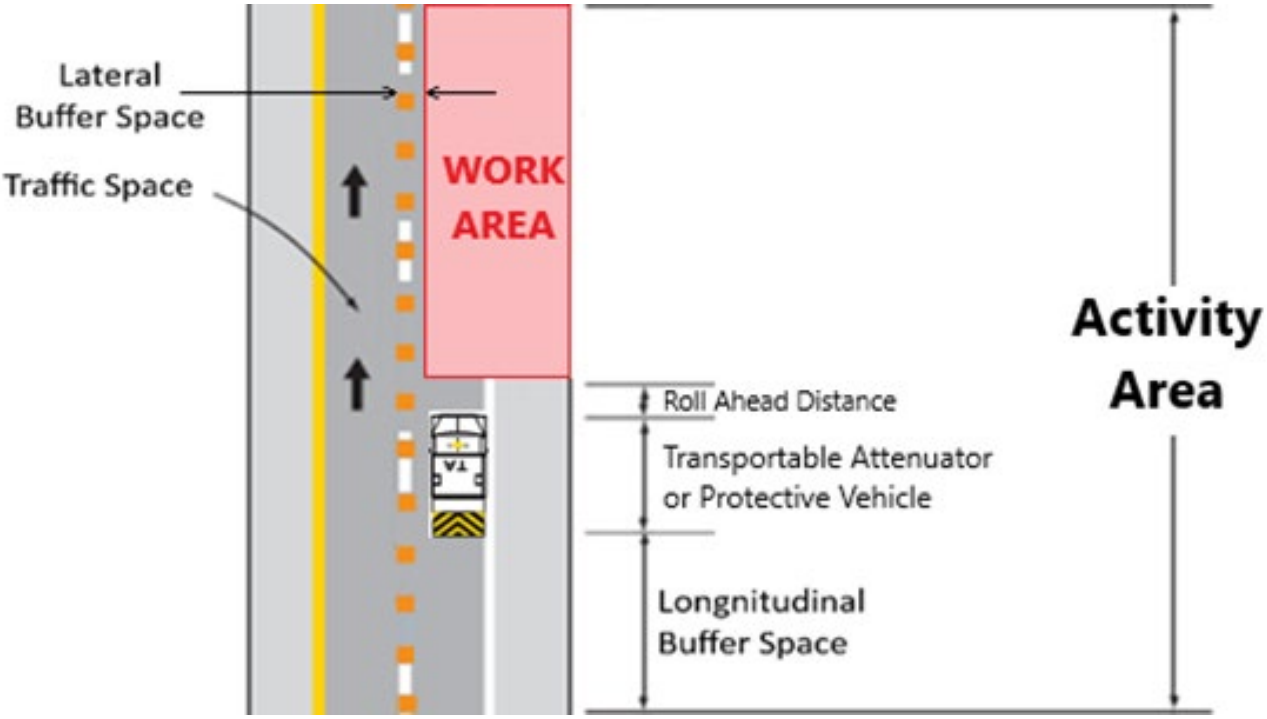
The figure below shows a tapered on-ramp, but there is also a parallel on-ramp (with the acceleration pocket prior to the merge taper) that is available in the Typical Traffic Control Plan Library. See Typical TC100s & TC200s.



6.9 Activity Area

The activity area includes the area of the roadway approaching and adjacent to where the actual work is occurring. The approaching area typically includes buffer spaces, protective vehicle or transportable attenuator, and roll ahead distances that are designed to enhance the safety of motorists and workers.

The activity consists of several components and is shown below:



6.9(1) Longitudinal Buffer (B)

Longitudinal buffer ("buffer") is a clear zone prior to the protective vehicle or transportable attenuators allowing errant motorists a recovery space to stop prior to the work area. Buffers must be free of vehicles, equipment, and supplies.

Per MUTCD Section 6C.06, longitudinal buffers are optional. WSDOT typical practice is to use full longitudinal buffers if feasible but adjust them as needed. See table below:

LONGITUDINAL BUFFER SPACE = B												
SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
LENGTH (feet)	115	155	200	250	305	360	425	495	570	645	730	820
Buffer space may be adjusted (±) based on field conditions.												

- A 40-mph zone would use a 305' buffer
- A 65-mph (trucks 60) zone would use 645' buffer, based on the higher 65 mph speed limit

Longitudinal buffers are the most adjustable work zone component:

- **Increasing buffer space**: Always allowable and useful to move tapers out of horizontal curves or other undesirable areas. Buffer space increase anyway as protective vehicles move downstream with work crews within the closure.
- **Decreasing buffer space**: Per Standard Specifications 1-10-2(1)B, longitudinal buffer space can be reduced with Contractor and Engineer concurrence. If the Engineer does not consider this a minor revision, then a modified traffic control plan will need to be submitted for Agency acceptance per Standard Spec. 1-10.2(2).

6.9(2) Protective Vehicle or Transportable Attenuator

As discussed in detail in Section 5.8(2) and Section 5.8(3), protective vehicles and transportable attenuators serve to protect both workers and the traveling public by being strategically positioned upstream of work crews, called a roll ahead distance—discussed more in the next section

Typically, protective vehicles are limited to roadways 40 mph or less because it does not have a crash cushion to absorb impacts at higher speeds. The exception situations where traffic is alternating on 45+ mph roadways due to the low speed expected approaching the work area.

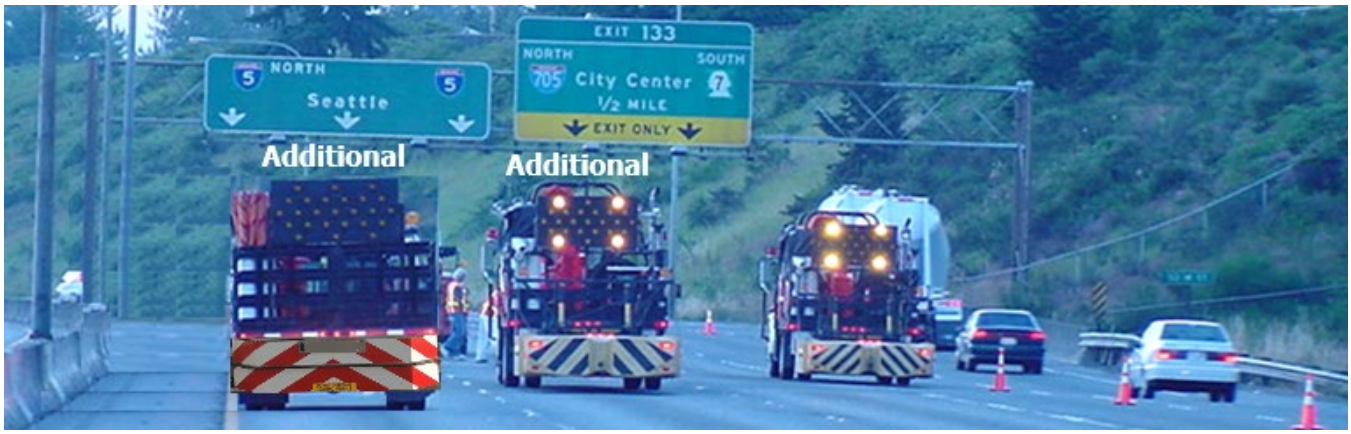
Typically used 40 mph or less

Typically used 45+ mph

Rather protective vehicles or transportable attenuators are allowed will be specified on accepted traffic control plans (for Construction) or in the WSDOT M54-44 Manual for Maintenance.

> Note: WSDOT's Northwest & Olympic Region typically require one transportable attenuator per closed lane on freeways and multilane roadways 45 mph or higher.

Additional protective vehicles (40 mph or less) or transportable attenuators (45+ mph) may be added to block each closed lanes instead of the closed and adjacent traffic to enhance protection of work crews and traveling public.



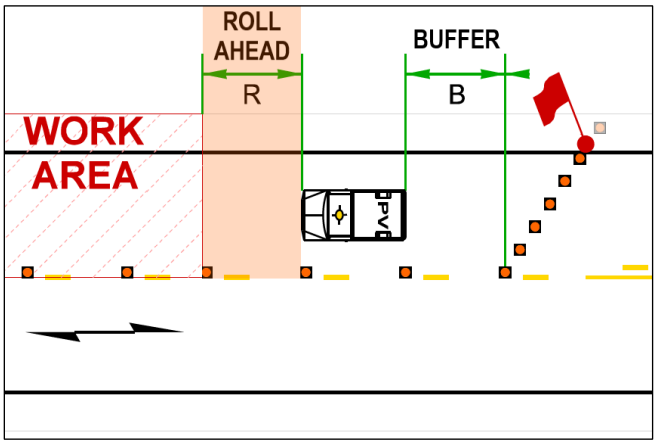
For long work areas with multiple work crews, additional PVs (≤ 40 mph) or TAs (45+ mph) can be added behind each work crew within the work area. For enhanced protection, multiple PVs or TAs may be used to block multilane closed lanes.

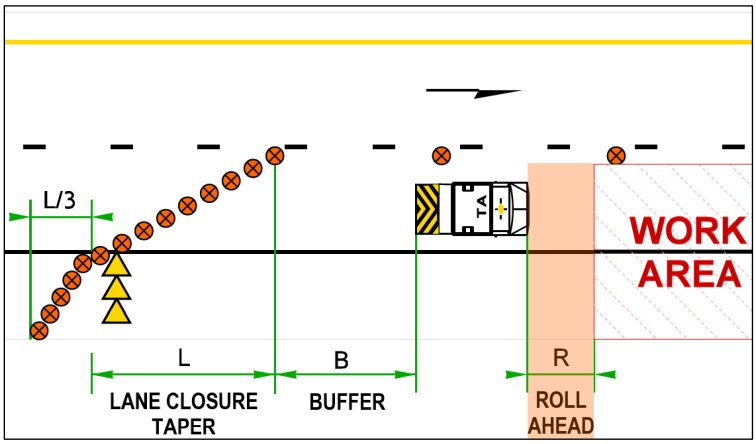
Per Standard Specifications 1-10-2(1)B, adding protective vehicles or transportable attenuators is a minor revision that can be made with Contractor and Engineer concurrence. If the Engineer does not consider this a minor revision, then a modified traffic control plan will need to be submitted for Agency acceptance per Standard Spec. 1-10.2(2).

After a stationary TA is positioned, we recommend removing the driver from the vehicle.

6.9(3) Roll Ahead Distance (R)

When an errant vehicle impacts a protective vehicle or transportable attenuator, both vehicles will leap ahead towards the work area. **Workers must remain clear of this area, or they'll be ran over.**





In the schematics above, roll ahead areas are shaded in orange after the protective vehicle (PV) on the left and transportable attenuator (TA) on the right.

Positioning of the PV/TA in advance of work crews is critical. Position it too close, the PV/TA will run over workers when impacted by an errant vehicle. Place the vehicle too far away and there's more space for errant vehicles to enter between the vehicle and workers.

Protective Vehicles:

PROTECTIVE VEHICLE ROLL AHEAD DISTANCE = R
STRATEGICALLY POSITION WORK VEHICLE TO PROTECT WORK CREW. 40' - 80' RECOMMENDED.

Protective vehicles are typically work trucks with the amber light(s) activated.

Stationary Transportable Attenuator:

Stationary means the TA has the parking brake engaged, either in Park or 1st gear (stick-shifts), and wheels are straight (do not turn the wheels).

STATIONARY TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R					
HOST VEHICLE WEIGHT LESS THAN 22,000 lbs.			HOST VEHICLE WEIGHT 22,000+ lbs.		
UP TO 40 MPH	45-55 MPH	60+ MPH	UP TO 40 MPH	45-55 MPH	60+ MPH
100'	123'	172'	74'	100'	150'

Distances based on TA weight (assume lighter TA if weight unknown) and posted speed limit based on *AASHTO Roadside Design Guide 2011 Edition* crash testing for **full-size pickup trucks at 62 mph**. Impacts from semi-trucks are much higher (explained on next page).

Roll Ahead Distance Examples:

- Stationary TA weight = 15,000 lbs; Speed Limit 40 R = 100'
- Stationary TA weight = 18,000 lbs; Speed Limit 65 (Trucks 60) R = 172'
- Stationary TA weight = 23,000 lbs; Speed Limit 50 R = 100'
- Stationary TA weight = 25,000 lbs; Speed Limit 70 (Trucks 60) R = 150'

Mobile Transportable Attenuator:

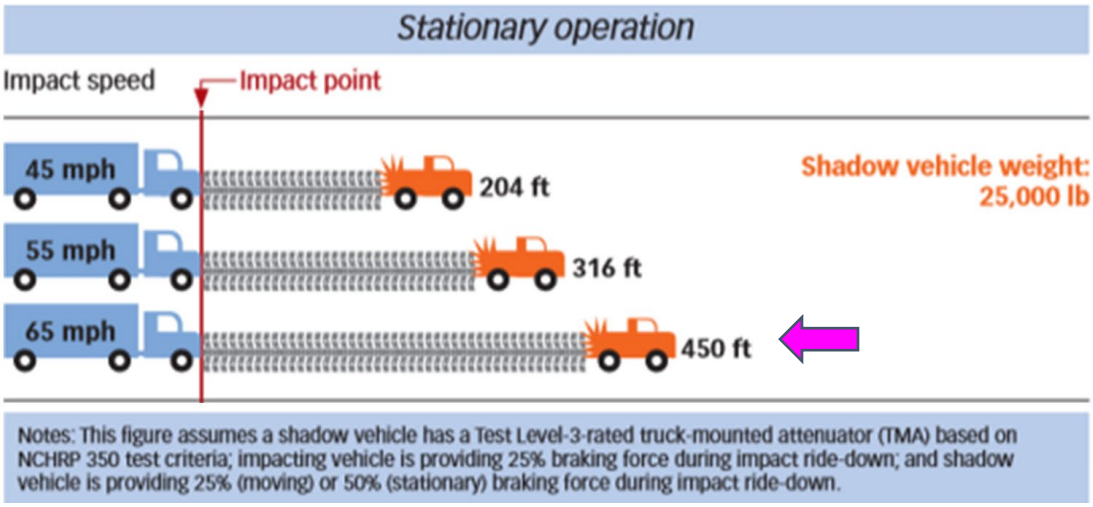
Mobile means the TA is moving along about 15 mph in advance of a moving operation where the parking brake cannot be set. Distances based on TA weight and posted speed limit:

MOBILE TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R					
HOST VEHICLE WEIGHT LESS THAN 22,000 lbs.			HOST VEHICLE WEIGHT 22,000+ lbs.		
UP TO 40 MPH	45-55 MPH	60+ MPH	UP TO 40 MPH	45-55 MPH	60+ MPH
100'	172'	222'	100'	150'	172'

- Mobile TA weight = 18,000 lbs; Speed Limit 60 R = 222'
- Mobile TA weight = 25,000 lbs; Speed Limit 70 (Trucks 60) R = 172'

"Stacking" TA Mitigation Strategy for Semi-Truck Impacts:

The roll ahead for semi-truck impacts will be substantially greater than the roll ahead distances provided in the tables above. As shown in the figure below, even with a 25,000 transportable attenuator (heavy) the roll ahead distance from 65 mph semi truck impact is 450 feet (well over the 150' shown in the table).



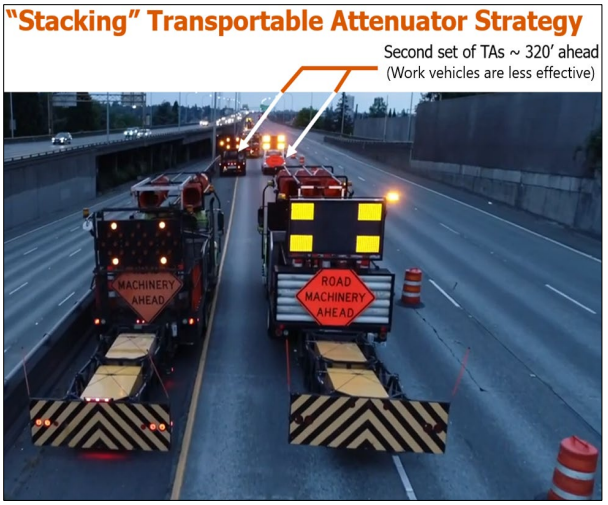
However, positioning a transportable attenuator 450 feet from work crews provides a substantial gap for errant motorists to enter the closure at strike the work crew. In situations when the longer roll ahead distance from semi-trucks is of particular concern, then "stacking the TAs" can help mitigate:

"Stacking the TAs" consists of adding a second TA ~ 320 feet (8 "skips") behind the primary transportable attenuator protecting work crews.

In a pinch, protective vehicles could be used behind work crews but is less effective.

Upon semi-truck impact, the rear transportable attenuator will leap ahead (absorbing the semi-truck's momentum via weight and friction) slowing it down over the 320 feet before crashing into the transportable attenuator protecting work crews.

By slowing down the semi-truck, the primary transportable attenuator can absorb the remaining momentum within the typical roll ahead distance. This strategy works up to about 65 mph for trucks.



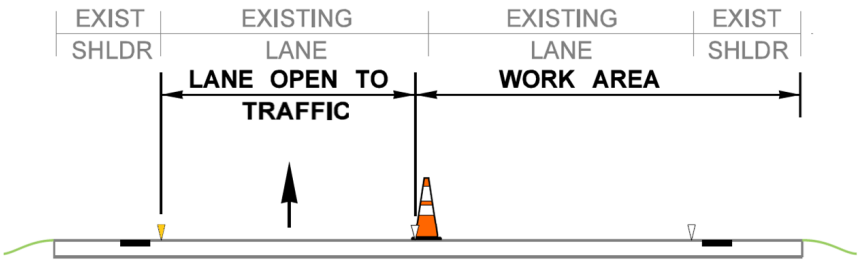
6.9(4) Lateral Buffer Space

Lateral buffer space separates traveled way from the work area or a hazardous area, such as an excavation or pavement drop-off but may also be used between opposing traffic.

The lateral buffer space is optional and, when used, should be determined based on engineering judgement per MUTCD Section 6C.06 ¶ 14 & 15.

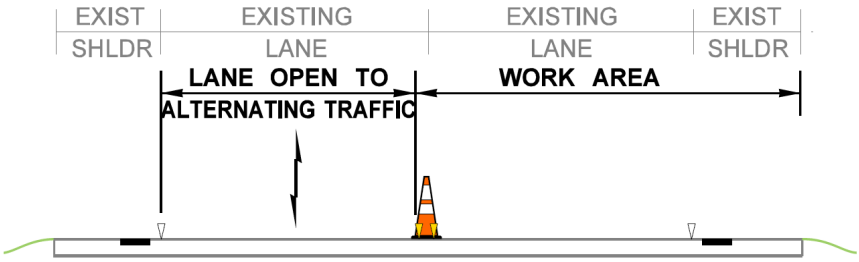
Roadways 40 or Less (Stationary Closures):

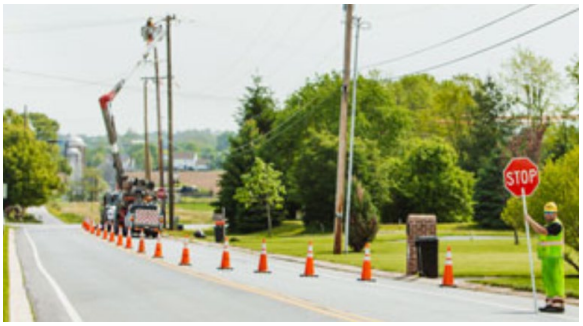
Typically, no lateral buffers are provided for stationary closures on roadways 40 mph or less.



Alternating Traffic (All Speeds):

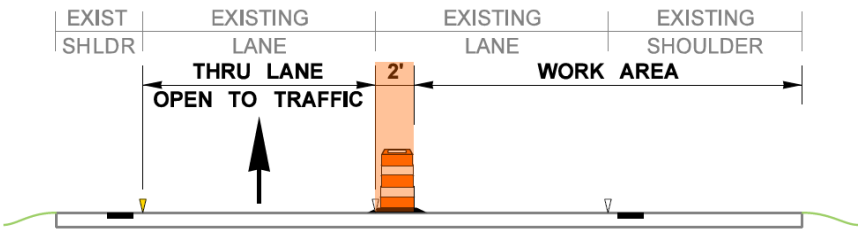
Typically, no lateral buffers are provided for stationary closures on all roadways (including 45+ mph) when traffic is alternating via flagger, AFAD, or temporary signal control as the vehicle speeds are slow.

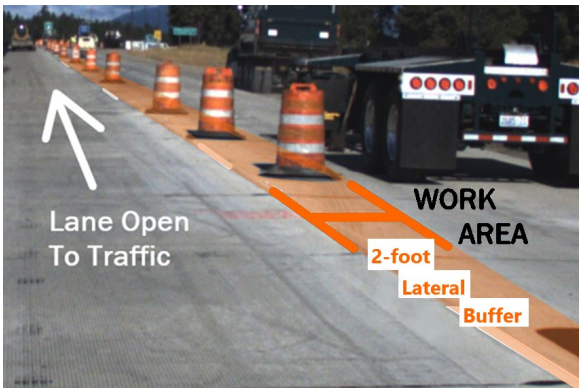




45+mph Multilane Roadways (Stationary Closures):

WSDOT typical practice is to provide 2-foot lateral buffer in stationary closures on 45+ mph multilane roadways & freeways. This helps keep workers from getting smacked by semi-truck mirrors.





- The 2-foot lateral buffer applies to the work area limits only (not the channelizing device)
- Channelizing device may be placed up to the edge of open lanes within the lateral buffer space

Mobile Closures (All Speeds):

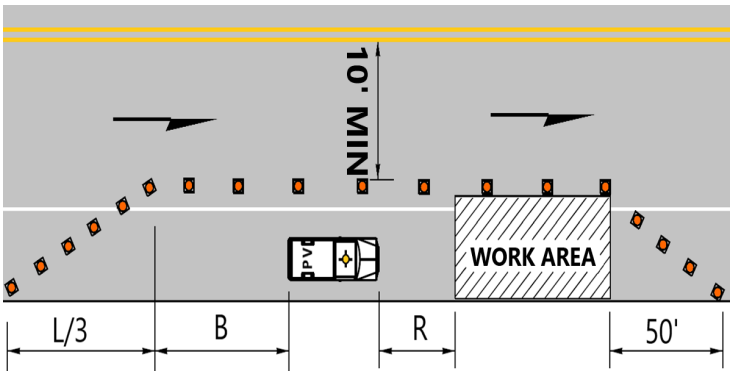
Typically, no lateral buffers are provided for mobile closures on all roadways.

6.9(5) Lane Encroachment

Lane encroachment reduces the travel width by moving channelizing devices a couple feet into the adjacent open traffic lane.

Roadways 40 mph or Less (Stationary Closures):

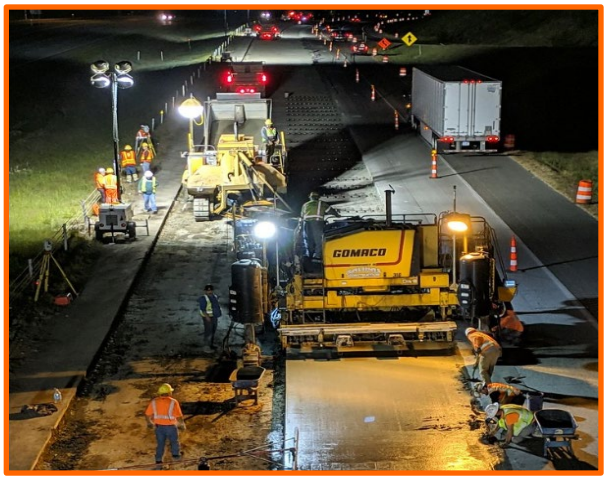
- Encroachment typically used for shoulder closures only. Channelizing devices may encroach into adjacent open lane (provide 10'+ lane typically); otherwise, use a lane closure.



45+ mph Roadways (Stationary Closures):

- If encroachment is necessary, close adjacent open lane until single lane is open.
- Then, laterally shift single open lane onto paved shoulder
  - See TC230s & TC250s in WSDOT Typical TCP Library for Construction, included in WSDOT M54-44 Manual for Maintenance operations

See Traffic Manual Section 5.18/5.19 for reduced work zone speed limit/advisory speed policy and approval requirements.

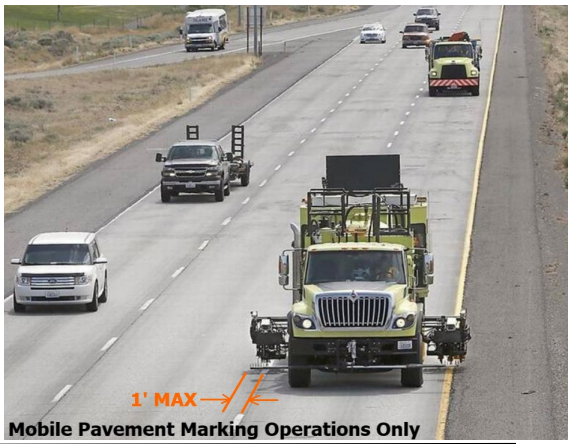


Mobile Closures (All Speeds):

1-foot encroachment into adjacent open lane is allowed for mobile pavement marking operations only. It is still permissible to close the adjacent open lane.

For all other work operations using mobile closures, no lane encroachment is permitted. If encroachment is necessary, then close the adjacent lane.

For mobile closures for Maintenance operations, see TCP29 thru TCP33 in the WSDOT M54-44 Manual

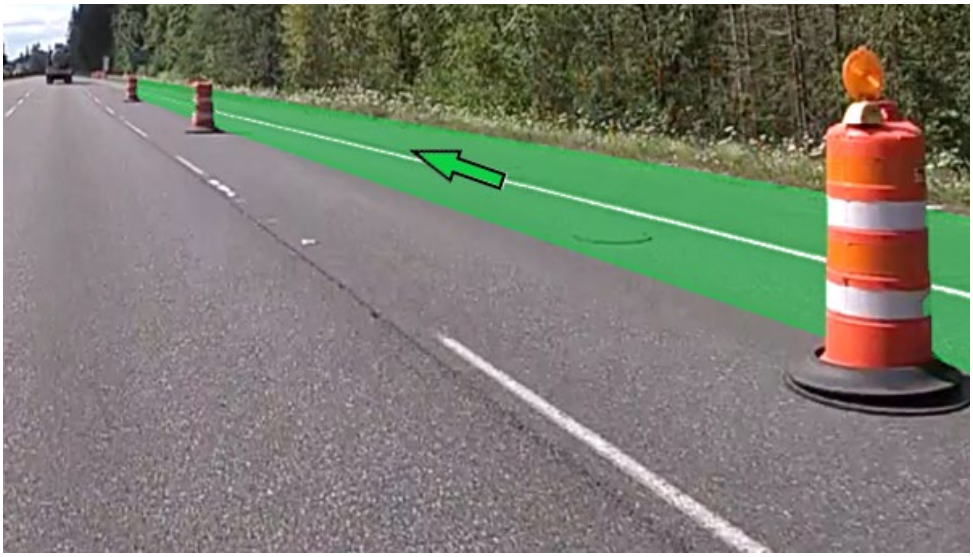


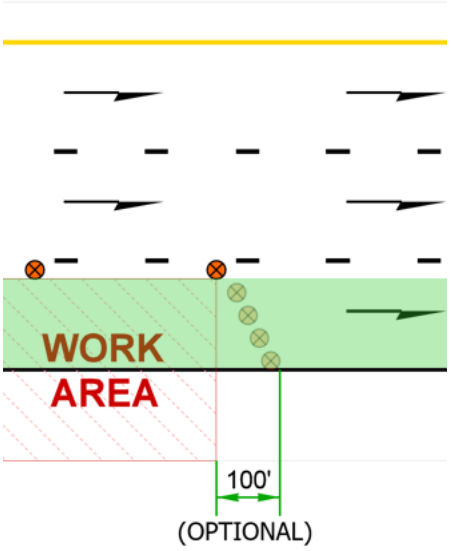
6.10 Termination Area

The termination area is used to return traffic to the normal traffic path and includes a downstream taper.

6.10(1) Downstream Taper on Multilane Roadways

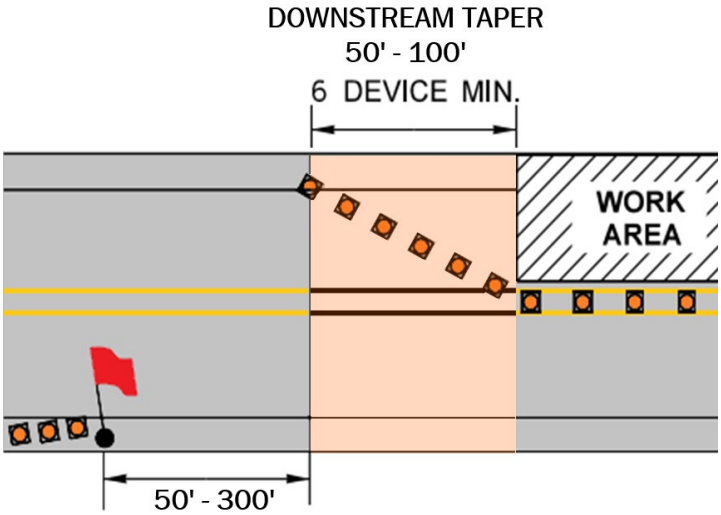
Eliminating the downstream taper, on multilane roadways, allows heavy construction vehicles to accelerate straight out of the work area into the reopened lane at speed versus having to weave between channelizing devices to enter high-speed open lanes of traffic at low speed.





6.10(2) Downstream Taper for Alternating Traffic

The downstream taper ("reopening taper") is used when alternating traffic to guide oncoming motorists into open lane after they are released by the flagger, AFAD, or temporary signal.



6.10(3) Shifting Tapers at Termination Area

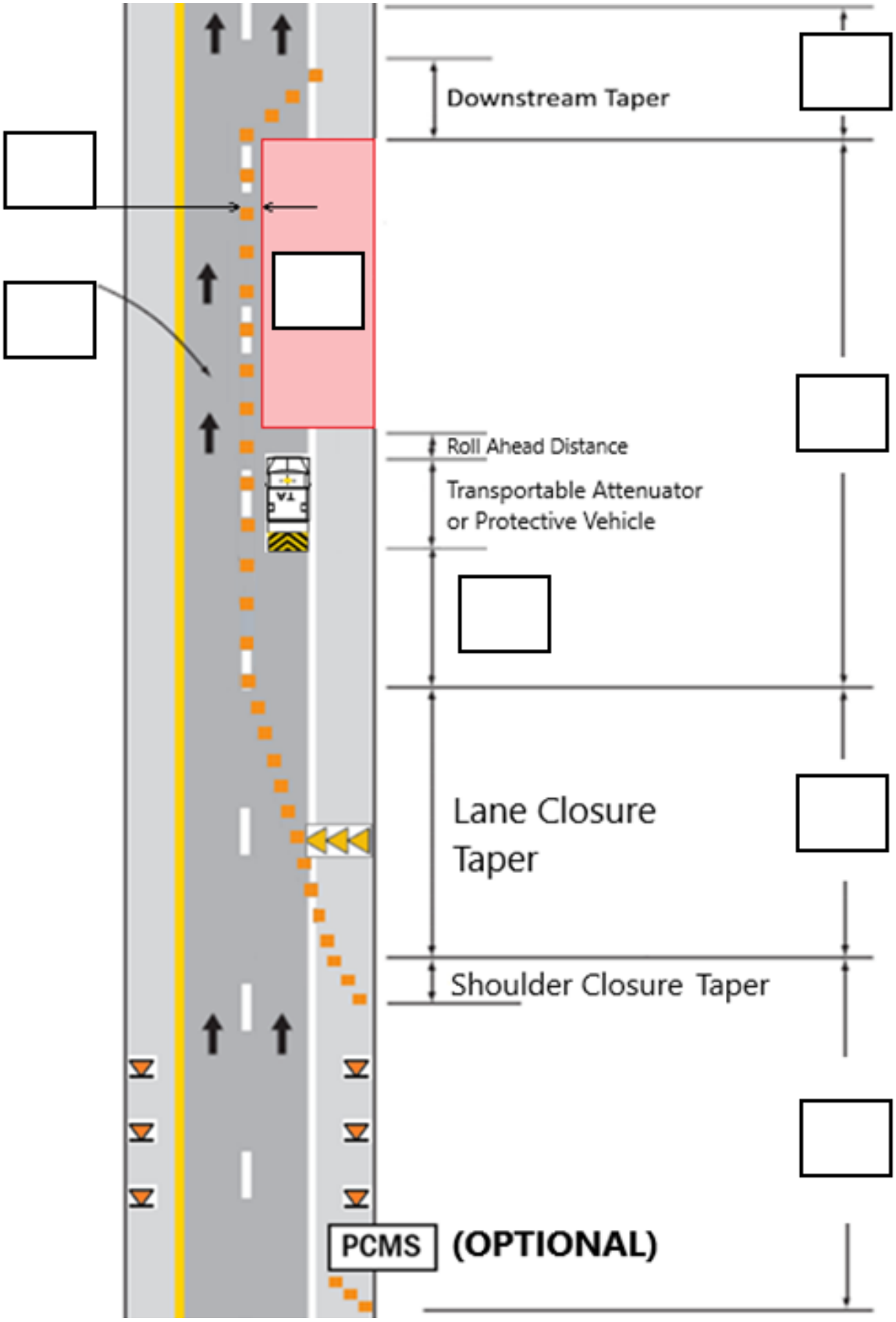
When a single open lane is shifted onto the shoulder, it is necessary to use shifting tapers in the termination area to guide traffic back into its normal path (see TC230s & TC250s in WSDOT TCP Library).

6.10(4) "END ROAD WORK"

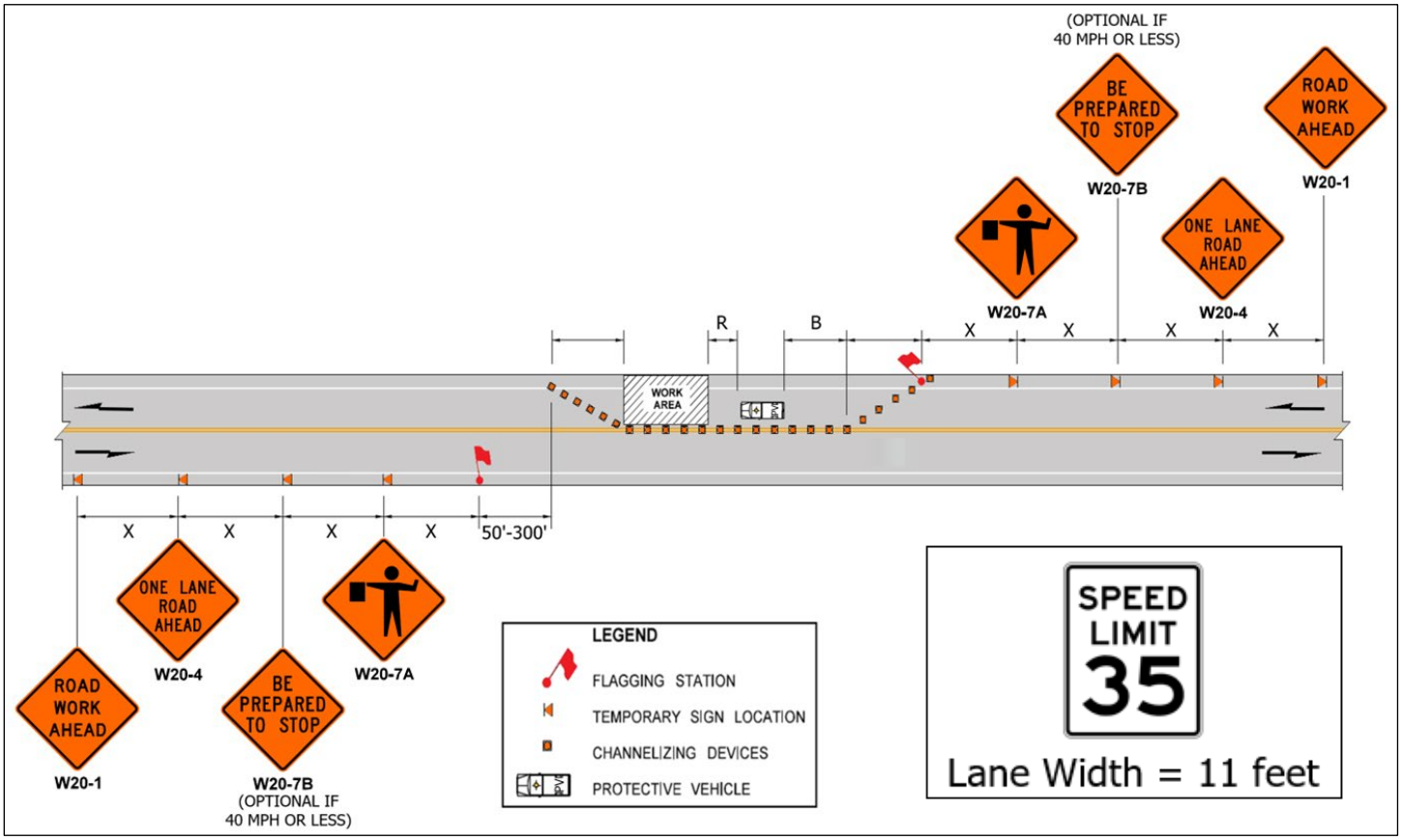
The "END ROAD WORK" sign is optional per MUTCD Section 6C.07 ¶ 02 **and should not be posted if still within a project's work zone limits**. This means the Class A "END ROAD WORK" signs farther downstream or another work area immediately follows.

Exercise 6-1 – Work Zone Component Identification

A) Longitudinal Buffer Space
B) Termination Area
C) Lateral Buffer Space
D) Traffic Space
E) Advanced Warning Area
F) Transition Area
G) Activity Area
H) Work Area



Exercise 6-2 – Traffic Control Plan Devices



Determine the following when using this flagging plan:

Sign size for diamond-shaped signs = _____" x _____"

Sign spacing = _____

Flagger taper length = _____

Longitudinal buffer = _____

Which channelizing device should be used? _____

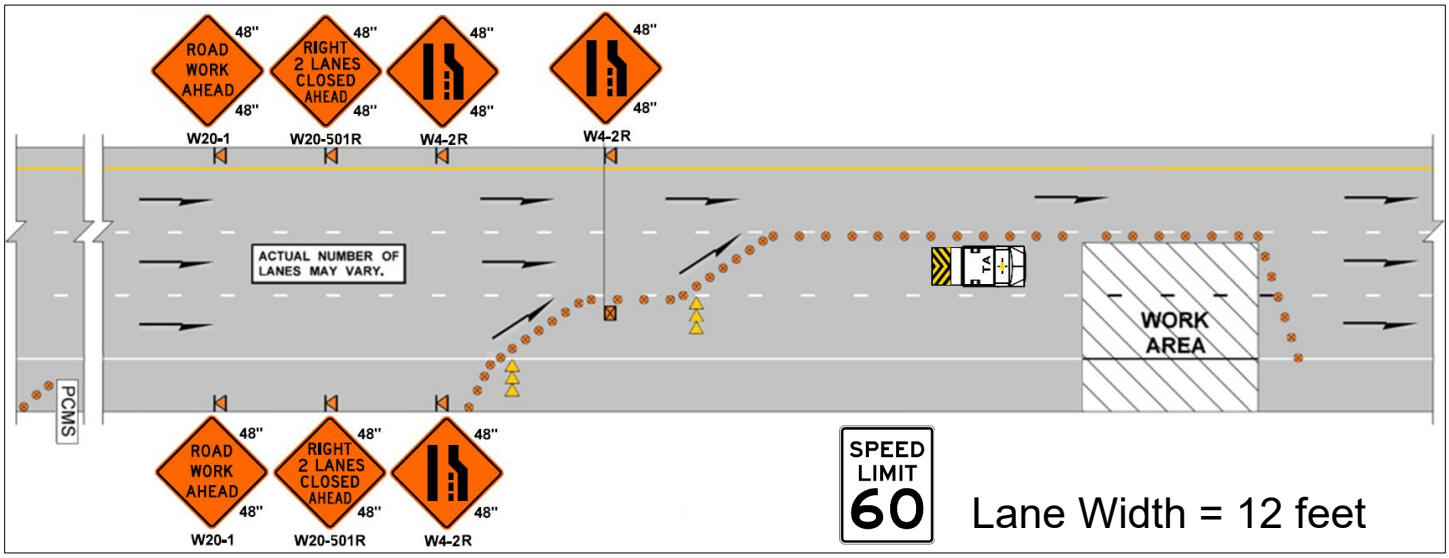
Channelizing devices spacing @ flagger taper = _____

Channeling devices spacing @ tangent = _____

Which element to extend to move flagger taper out of a horizontal curve?

_____

Exercise 6-3 – Traffic Control Plan Devices



Determine the following values when using this double right lane closure plan **on a freeway**:

Sign Spacing = _____

Lane closure taper = _____ feet

What is tangent between the first and second merging tapers? _____ feet

Channelizing device spacing at the merging tapers = _____ feet

Longitudinal Buffer = _____ feet

Roll Ahead Distance = _____ feet (TA weighs 25,000 pounds)

Are the Arrow Boards optional on freeways? _____

How could the TCS enhance worker safety (minor revisions)?

_____

_____

_____

Chapter 7 : Flagging & Traffic Control Labor

7.1 Summary

This chapter reviews all the standards, guidance and legal requirements for flaggers and traffic control labor in work zones as well as strategies for dealing with angry motorists.

7.2 Training and Certification

Per MUTCD Section 6B.01, ¶ 06, each person whose action affects work zone safety, from upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make.

Per MUTCD Section 6B.01, ¶ 04, routine day and night inspection of traffic control elements should be performed by individuals knowledgeable (trained and/or certified) in the principles of proper traffic control. Most importantly is to verify all traffic control on the project is consistent with the traffic control plan and are effective for all road users. If appropriate, temporary traffic control should be modified upon careful monitoring.

7.2(1) Traffic Control Labor Requirements

- No certification is required at this time
- Pre-activity training on device installation/removal procedures is highly recommended
- Traffic Control Technician courses/certifications are available from select vendors

Consider allowing staff read through this TCS course book when time allows (in the middle of the night between the installation and removal of traffic control). There are also Youtube videos available.

7.2(2) Flagger Requirements

Per Standard Specifications 1-10.3(1)A and WAC 296-155-305:

- Flaggers shall process a current flagging card issued by Washington, Oregon, Idaho, or Montana
- Flagging card shall be immediately available and shown to Agency upon request
- Flagger card is valid for **3 years**

There are several community and technical colleges that offer open enrollment for flagger training.

7.3 WAC 296-155-305: Signaling and Flaggers

Definition:

Flagger: A person who provides temporary traffic control

MUTCD: The Federal Highway Administration's Manual on Uniform Traffic Control Devices as currently modified and adopted by the Washington State Department of Transportation

(1) General requirements for signaling and flaggers

(a) You must first apply the requirements in this section. Then you must set up and use temporary traffic controls according to the guidelines and recommendations in Part VI of the MUTCD.

(b) Job site workers with specific traffic control responsibilities must be trained in traffic control techniques, device usage, and placement.

(2) When to use Flaggers

(a) Flaggers are to be used only when other reasonable traffic control methods will not adequately control traffic in the work zone.

(b) If signs, signals, and barricades do not provide necessary protection from traffic at work zones and construction sites or on or adjacent to a highway or street, then you must use flaggers or other appropriate traffic controls.

(3) Flaggers Signaling

(a) Flagger signaling must be with sign paddles approved by WSDOT and conform to the guidelines and recommendations of MUTCD.

(b) Sign paddles must comply with the requirements of the MUTCD [Standard Specifications 9-35.1 requires 24" STOP/SLOW paddles, exceeding the 18" MUTCD requirement].

(c) When flagging is done during periods of darkness, sign paddles must be retroreflective or illuminated in the same manner as signs.

(d) During emergency situations, red flags, meeting the specifications of the MUTCD, may be used to draw a driver's attention to particularly hazardous conditions. In non-emergency situations, a red flag may be held in a flagger's free hand to supplement the use of a sign paddle or lights.

(4) Adequate warning of approaching vehicles. Employers must:

- Position work zone flaggers so they are not exposed to traffic or equipment approaching them from behind.

  If this is not possible, then the employer, responsible contractor, and/or project owner must develop and use a method to ensure that flaggers have adequate visual warning of traffic and equipment approaching from behind.

  - The following are some optional examples of methods that may be used to adequately warn or protect flaggers:
    - Mount a mirror on the flagger's hard hat;
    - Use an observer;
    - Use "jersey" barriers.

- The department recognizes the importance of adequately trained flaggers and supports industry efforts to improve the quality of flagger training. However, training alone is not sufficient to comply with the statutory requirements of revising flagger safety standards to improve options available that ensure flagger safety and that flaggers have adequate visual warning of objects approaching from behind them.

(5) High-visibility garments for flaggers.

(a) While flagging during daylight hours, a flagger must at least wear, as an outer garment

- A high visibility safety garment designed according to Class 2 [or 3] specifications in ANSI/ISEA 107-1999 [Standard Specification 1-07.8(1) requires ANSI 107-2015 or later garments], American National Standard for High-Visibility Safety Apparel.
- Consisting of at least 775 square inches of background material that are fluorescent yellow-green, fluorescent orange-red in color;
- 201 square inches of retroreflective material that encircles the torso and is placed to provide 360 degrees' visibility around the flagger.
- A high visibility hard hat. The acceptable high visibility colors are white, yellow, yellow-green, orange or red in color

Definition:

Hours of Darkness: One-half hour before sunset to one-half hour after sunrise

(b) While flagging during hours of darkness, or when snow or fog limit visibility, a flagger must at least wear, as an outer garment

- A high visibility safety garment designed according to Class 2 [or 3] specifications in ANSI/ISEA 107-1999.
- Consisting of at least 775 square inches of background material that are fluorescent yellow-green, fluorescent orange-red in color;
- 201 square inches of retroreflective material that encircles the torso and is placed to provide 360 degrees' visibility around the flagger.
- ~~White coveralls~~, or other coveralls or trousers that have retroreflective banding on the legs designed according to ANSI/ISEA 107-1999 [Standard Specifications 1-07.8 requires ANSI/ISEA 107 Class E lower garments, which white overalls do not meet].
- A high visibility hard hat with at least 12 square inches of retroreflective materials applied to provide 360 degrees of visibility. The acceptable high visibility colors are white, yellow, yellow-green, orange or red in color

(6) Flagger training. Employers must make sure that**:**

(a) Each flagger must have in their possession a valid traffic control flagger card from Washington, Oregon, Idaho, Montana[.]

(b) The flagger card must show the following:

- Verification that the flagger training required is completed
- Date the flagger received their flagger training
- Name of the instructor providing the flagger training
- Name of the state that issued the flagger card
- The card's expiration date not to exceed three years from the date of issuance
- Flagger's picture or a statement that says "valid with photo ID."

(c) Flagger training must be based upon the MUTCD.

Exemption:

*Personnel that have not completed a flagger-training course may be assigned duties as flaggers only during **emergencies** (unforeseen occurrence endangering life, limb, or property). Emergency assignments are temporary and last only until a certified flagger can be put into the position.*

(7) Flagger orientation and traffic control plan.

(a) The employer, responsible contractor and/or project owner must conduct an orientation that familiarizes the flagger with the job site. This requirement applies each time the flagger is assigned to a new project or when job site conditions change significantly

The orientation must include, but is not limited to:

- The flagger's role and location on the job site;
- Motor vehicle and equipment in operation at the site;
- Job site traffic patterns;
- Communications and signals to be used between flaggers and equipment operators;
- On-foot escape route; and
- Other hazards specific to the job site.

(b) If flaggers are used on a job that will last more than one day, the employer, contractor and/or project owner must keep on-site, a current site specific traffic control plan. The purpose of this plan is to help move traffic through or around the construction zone in a way that protects the safety of the traveling public, pedestrians and workers.

The plan must include, but is not limited to, such items as the following when they are appropriate:

- Sign use and placement;
- Application and removal of pavement markings;
- Construction;
- Scheduling;
- Methods and devices for delineation and channelization;
- Placement and maintenance of devices;
- Placement of flaggers;
- Roadway lighting;
- Traffic regulations; AND
- Surveillance and inspection.

(8) Advance Warning signs.

(a) Employers must provide the following on all flagging operations:

- A three sign advance warning sequence is required on all roadways with a speed limit [40 mph or less]
- A four sign advance warning sequence is required on all roadways with a 45 mph or higher speed limit.

(b) Warning signs must reflect the actual condition of the work zone. When not in use, the signs must either be taken down or covered.

(c) Employers must make sure to follow Table 1 for spacing of advance warning sign placement.

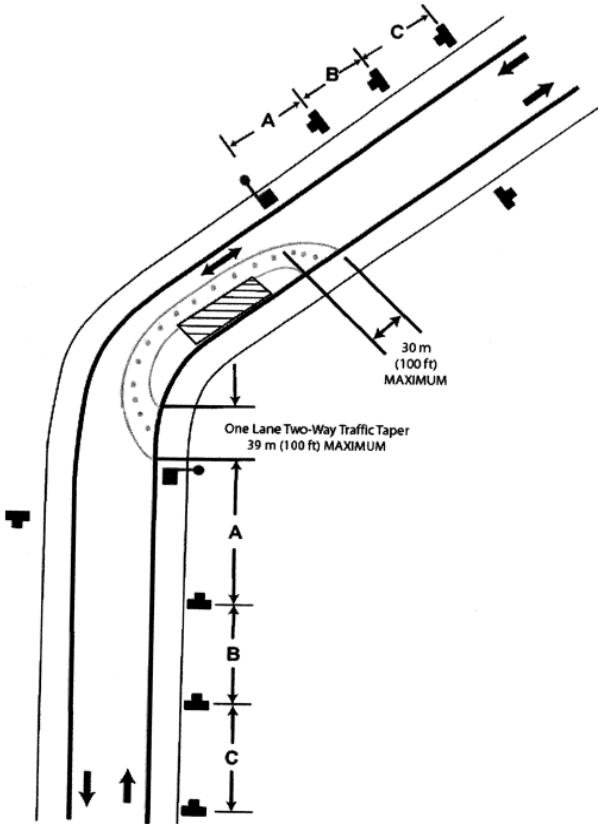
Table 1. Advanced Warning Sign Spacing

Road Type	**Speed**	**Distances Between Advance Warning Signs**			
		A**	**B****	**C****	**D****
Freeways & Expressway	70 55	1500 ft +/- or per MUTCD	1500 ft+/- or per MUTCD	1500ft+/- or per MUTCD	1500 ft +/- or per MUTCD
Rural Highways	65 60	800 ft +/-	800 ft +/-	800 ft +/-	800 ft +/-
Rural Roads	55 45	500 ft. +/-	500 ft. +/-	500 ft +/-	500 ft +/-
Rural Roads and Urban Arterials	40 35	350 ft. +/-	350 ft. +/-	350 ft. +/-	N/A
Rural Roads, Urban Streets, Residential Business Districts	30 25	200ft+/-***	200ft+/-***	200ft +/-***	N/A
Urban Streets	25 or less	100ft.+/-***	100ft+/-***	100ft.+/-***	N/A

* All spacing may be adjusted to accommodate interchange ramps, at grade intersections, and driveways.

** This refers to the distance between advance warning signs. See Figure 1, typical Lane Closure on Two-lane Road. This situation is typical for roadways with speed limits less than 45 mph.

*** This spacing may be reduced in urban area to fit roadway conditions.



Exemption:

In a mobile flagging operation, as defined by the MUTCD when the flagger is moving with the operation, the "flagger ahead (symbol or text)" sign must be:

- Within 1,500 feet of the flagger

  AND

- The flagger station must be seen from the sign.

If the terrain does not allow a motorist to see the flagger from the "flagger ahead" sign, the distance between the flagger and the sign must be shorted to allow visual contact, but in no case can the distance be less that the specified in Table 1, Advance Warning Sign Spacing.

(9) Providing a safe site for flaggers. Employers, responsible contractors and/or project owners must make sure that:

(a) Flagger stations are located far enough in advance of the work space so that the approaching road user will have sufficient distance to stop before entering the work space. Follow Table 2 for the distance of the flagger workstation in advance of the work space.

Table 2. Distance of Flagger Station in Advance of the Work Space

Speed (mph) *	Distance (ft.) **	Speed (mph) *	Distance (ft.) **
20	35	45	220
25	55	50	280
30	85	55	335
35	120	60	415
40	170	65	485

*Posted speed, off-peak 85th –percentile speed prior to work starting or the anticipated operating speed. [Longitudinal buffer space, B, exceeds this required distance]

** This spacing may be reduced to fit roadway and work site conditions. Distances greater than those listed in the table are acceptable.

(b) Flaggers stand either on the shoulder adjacent to the road user being controlled or in the closed lane prior to stopping road users. A flagger must only stand in the lane being used by moving road users after road users have been stopped.

Definition:

Road User: Vehicle operator, bicyclist, or pedestrian within a public roadway, including workers in temporary traffic control zone.

(c) Flagger workstations are illuminated during hours of darkness by floodlights that do not create glare that poses a hazard for drivers.

Note: To identify potential glare, observe the lighted area from various directions and angles on the main roadway after initial floodlight setup.

Exemption:

Emergency situations are exempt from these illumination requirements.

For the purpose of this rule, "emergency" means an unforeseen occurrence endangering life, limb, or property.

(d) Flaggers are not assigned other duties while engaged in flagging activities. [Such as functioning as a spotter for construction vehicles backing up or escorting pedestrians through a work zone]

(e) Flaggers do not use devices that may distract the vision, hearing, or attention.

- Examples of these devices include cell phones, pagers, radios, and headphones.
- Devices such as two-way radios used for communications between flaggers to direct traffic or ensure flagger safety are acceptable.

(f) Flaggers receive a rest period of at least 10 minutes, on the employer's time, for each 4 hours of working time.

- Rest periods must be scheduled as near as possible to the midpoint of the work period.
- A flagger must not be allowed to work more than three hours without a rest period.

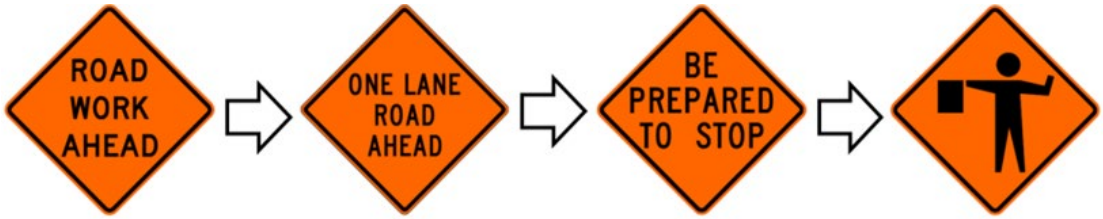
Exemption:

Scheduled rest periods are not required where the nature of the work allows a flagger to take intermittent rest periods equivalent to 10 minutes for each 4 hours worked.

7.4 Signs for Flagger Operations

7.4(1) Advanced Warning Signs

Per WAC 296-155-305, regardless of duration, a minimum of 3 signs are required if the speed limit is 40 mph or less; for 45 mph or above, a minimum of 4 signs are required approaching the flagging station.



W20-1 W20-4 W20-7B (OPTIONAL IF 40 MPH OR LESS) W20-7A

There may be times when traffic is not alternating in one open lane; thus, W20-4 should not be used and is replaced with an appropriate sign, such as:

W21-1 W21-30B W21-3 W21-8

7.4(2) Flagger STOP/SLOW Paddle

Per Standard Specifications 9-35.1, 24" STOP/SLOW flagger paddles are required for WSDOT construction projects (versus the 18" minimum per MUTCD Section 6E.03, ¶ 02).

Per WSDOT M54-44, 18" STOP/SLOW paddles are allowable but 24" is recommended for Maintenance.

The flagger in the photo to the right demonstrates the difference between 18-inch and 24-inch paddles. In windy situations, 24" STOP/SLOW paddles are very difficult to hold up for several hours. Contractors may request to use the 18-inch STOP/SLOW paddle as a no-cost change order.

Flagger paddles can be enhanced with flashing lights or beacons to significantly improve it conspicuity, especially during low-visibility or at night. For color requirements, see MUTCD Section 6E.03, ¶ 05-07.

WSDOT Special Provisions may specify this enhancement.

Flashing Light Enhancement

Flashing Beacon Enhancement

7.5 Personal Protective Clothing & Footwear Requirements for All Workers

WAC 296-155-200: Protective Clothing

- Short-sleeved shirt (sleeveless shirts are prohibited)
- Long pants extending beyond knee (shorts are prohibited)
- High-visibility garments when in close proximity to moving vehicles that is fluorescent green or fluorescent orange as the outer garment (WSDOT has stricter requirements, see below)

WAC 296-155-212: Foot Protection

"Substantial footwear, made of leather or other equally firm material, shall be worn by employees in any occupation in which there is a danger of injury to the feet through falling or moving objects, or from burning, scalding, cutting, penetration, or like hazard."

Left Photo:
Leather boot with composite toe meeting ASTM F2413-18 requirements is considered substantial footwear.

Top Right Photo:
Tennis shoes are prohibited.

Lower Right Photo:
Sandals are prohibited.

Standard Specification 1-07.8(2): High-Visibility Apparel for Non-Traffic Control Personnel

For Contractors, Standard Specifications require workers on foot in the work zone exposed to vehicle traffic or construction equipment to wear a **Class 2 or 3 apparel** (ANSI/ISEA 107-2015, or later version) as their outermost garment **and a hardhat** with 12 in^2 of 360° retroreflective material, day or night.

Standard Specifications now permit personnel to wear T-shirts or sweatshirts meeting ANSI requirements as their outer most garment. A separate high-vis garment is no longer required over the T-shirt or sweatshirt.

For WSDOT employees, refer to the *Safety Procedures & Guidelines Manual*.

Fluorescent green helps workers stand out from all the orange in work zones and is recommended.

While not required, it is also recommended for workers to wear Class E high-visibility pants ("clown pants") at night, explained on the next page.

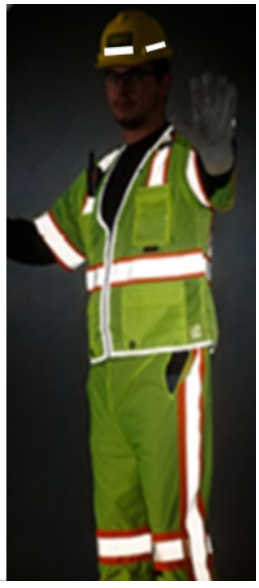
7.6 High-Visibility Apparel for Traffic Control Laborers & Flaggers

WSDOT recommends using fluorescent green high-visibility garments to help workers stand out from all the orange in work zones.

Per Standard Specifications 1-07.8(1) and WAC 296-155-305:

- **Daytime Hours with Clear Visibility**
  - ½ hour after sunrise to ½ hour before sunset (Sunrise/sunset: Seattle, Yakima, and Spokane)
  - **Class 2 or 3 Apparel** (ANSI/ISEA 107): **Fluorescent yellow-green recommended**, fluorescent orange-red, or fluorescent red OK. T-shirt or sweatshirt as outer garment OK.
  - Hardhat: 12 in^2 of 360° retroreflective material (white, yellow, yellow-green, orange, or red)

- **Hours of Darkness & Low-Visibility Conditions**
  - ½ hour before sunset to ½ hour after sunrise (Sunrise/sunset: Seattle, Yakima, and Spokane)
  - Low-Visibility Conditions: Fog, rain, snow, smoke (during daytime)
  - **Class 2 or 3 Apparel** (ANSI/ISEA 107): **Fluorescent yellow-green recommended**, fluorescent orange-red, or fluorescent red OK. T-shirt or sweatshirt as outer garment OK.
    - Fluorescent green helps workers stand out from all the orange in work zones
  - **AND Class E High-Visibility Pants** ("Clown Pants"); white overalls no longer allowed
  - Hardhat: 12 in^2 of 360° retroreflective material (white, yellow, yellow-green, orange, or red)

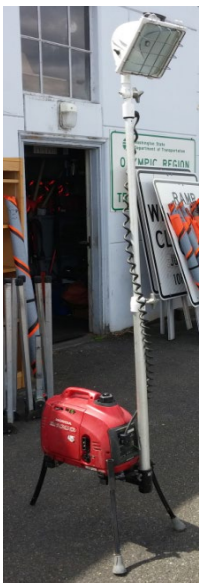


7.7 Flagger Station Nighttime Illumination Requirements

Per Standard Specifications 1-10.3(1)A and WAC 296-155-305: Flagger stations must be illuminated during hours of darkness (1/2 hour before sunset to ½ hour after sunrise), except during emergencies.

Left Two Photos: Differences between flagger visibility without and with illumination is remarkable.

Right Two Photos: Portable lighting: LED lamp +battery pack & HONDA generator +halogen light plant.



Existing luminaires or temporary project lighting may serve as flagger station lighting in lieu of portable light plants if the flagger is visible from at least 1000 feet (0.2 mile) away. As a "rule of thumb" the flagger station should within 50 feet of most luminaires and desirably positioned 20' downstream of the luminaire.

7.8 Flagging at Signalized Intersections

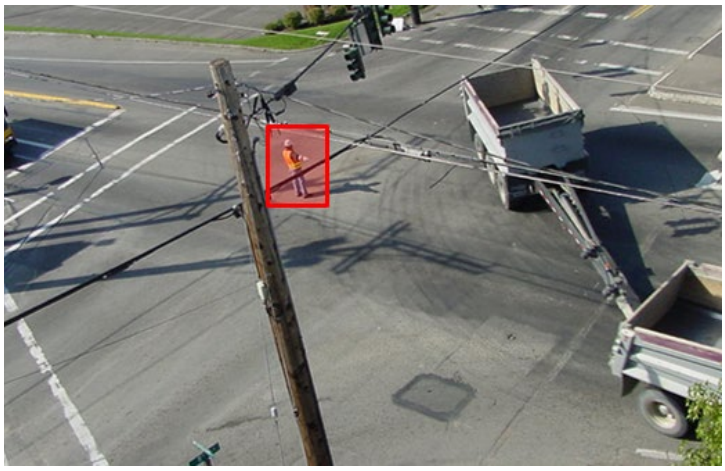
Per WAC 468-95-3015, traffic signals shall be placed in flashing mode (usually all-red) or turned off whenever flagging at or near signalized intersections. Leaving the signal functioning in "normal" mode is prohibited and L&I can issue citations for doing so, like shown in the right photo.

To turn off or place the signal on all-way flashing mode, access the traffic signal cabinet (located at corner of intersection). This cabinet is locked, so obtain a key from the Agency (state, county, or city) owning or controlling the traffic signal—City often control signals on State Routes in large cities instead of WSDOT.

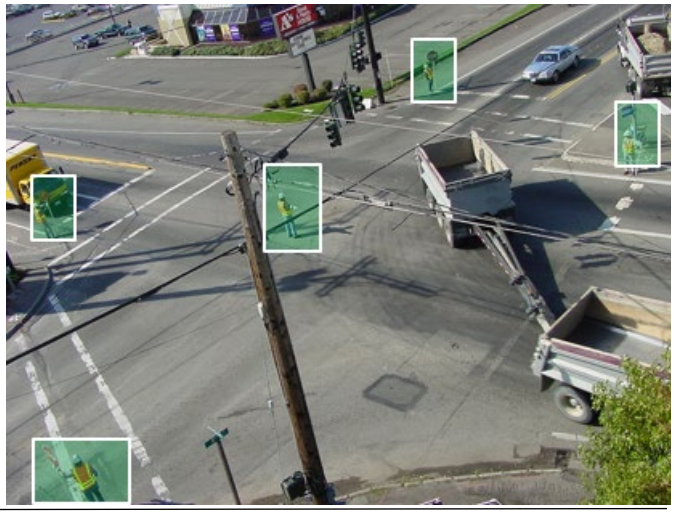
After opening the traffic signal cabinet, use the controller switches to place signal on "FLASH" or "OFF". To resume normal signal operations, move the controller switch to "AUTO".

7.9 Single Flagger Controlling Traffic Within Intersection Prohibited

Per WAC 468-95-302, a single flagger shall not flag from the center of the intersection (in emergencies OK).



To clarify, an **additional** flagger can be placed at the center of the intersection to guide motorists through the intersection (or roundabout) if each approach is controlled by separate flaggers.



A single uniform police officer (UPO) can control multiple approaches from the center of the intersection (without flaggers controlling traffic on each approach, although that is still allowable). At larger intersections with two thru lanes, it is recommended to use 2 UPOs to control traffic. See UPO video.

7.10 Flagger Station Considerations

While high-visibility garments and enhanced STOP/SLOW paddles help increase conspicuity of flaggers, all of these are for not if the flagger station is not properly positioned in the first place:

- **If feasible, maintain at least 8-10 seconds of visibility of approaching traffic**
- **Avoid flagger stations within or immediately following curves**
  - Washington flagger killed in 2000 when struck by vehicle at 50-60 mph was positioned within a horizontal curve. Investigation report.

- **As a flagger, never turn your back to traffic** (stand "sideways" instead)
  - Kentucky flagger killed in 2014 when struck by a vehicle 55 mph with his back turned to traffic. Investigation report.
- **Avoid flagger stations in the shade when feasible**

7.11 Warning Workers of Imminent Danger

Consider equipping your flaggers with air horns so fellow workers can be warned of imminent danger within a few seconds.

Such a situation may be an errant motorist blowing past the flagger station and is heading towards the work crew.

There are also work zone intrusion alarms available as well. See Section 7.14 for details.

7.13 Dealing with Angry Motorists

How does one know when motorists are upset? Oh we know…

Excessive delay without advanced notification or obvious reason, such as flaggers holding traffic for 20 minutes for a paver will make the most complacent driver nearly irate.

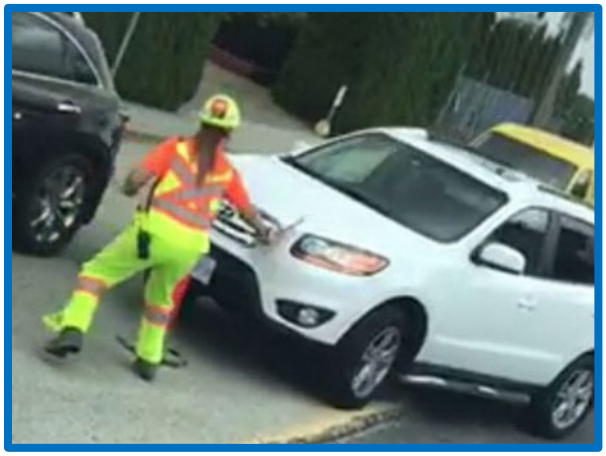
Often these frustrations are directed towards flaggers but may also be directed towards workers and made to Agencies.

Sometimes the complaints are legitimate (particularly those followed with a sound recommendation); other times, people complain for the sake of complaining.

Flaggers in particular are vulnerable to angry motorists. Flaggers need to protective themselves by:

- Smile and be pleasant
- Avoid challenging or extended eye contact with the angry motorist
- Deescalate the situation by apologizing for the inconvenience
- **Never stand directly in front of their vehicle; instead, stand off to the side**
- Always give yourself an escape path

Photos below contain hyperlinks to articles & videos of two real-life examples of flaggers being ran over by irate, mentally-ill motorists:



These flaggers made the critical mistake of standing directly of these vehicles with an angry driver.

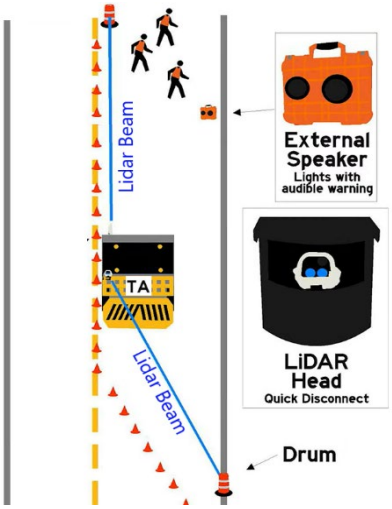
The British Columbia flagger in the right photo suffered a fractured skull with brain bleeding that disabled her for life. The courts decided not to charge the driver due to mental illness, who was sent to an institution for help. Whether we agree with this or not, it is the reality facing us in today's political climate. Photos below contain hyperlinks to articles & videos of two real-life examples of flaggers being ran over by irate, mentally-ill motorists:

Mitigation Strategies:

- Inform motorists of expected delays in advance (PCMS at a good turnaround location or just prior to a viable alternative route around the work zone)
- For 20-minute traffic holds, release traffic at :00, :20, and :40 past the hour. Use the PCMS in advance to inform motorists, but also communicate with the local drivers who can "time" their arrivals with the traffic releases.
- For 30-minute traffic holds, release traffic at :00 and :30 past the hour.

7.14 Work Zone Intrusion Countermeasures for Workers

There are alternative technologies available to reduce and mitigate vehicle intrusions into work zones that may be considered. These alert systems contain sensors that sense movement and orientation to detect vehicle intrusions. Currently, there is not a "silver bullet" work zone intrusion system available. Some of the systems available to Contractors include:



- **Overwatch** uses a LIDAR stand-alone or transportable attenuator-mounted unit that can be pointed both forward and rearward (at a slant along a taper even). When a vehicle breaks the LIDAR beam, the truck's horn/light bar is activated. See Youtube video for more information.

- **AWARE** (Advanced Warning and Risk Evasion) consists of multiple RAVEN sensors to monitor for errant vehicles with workers wearing WORKTRAX sensors (typically on hardhat) monitoring their location and producing audible and vibratory alerts. A threat deterrent for errant drivers consists of flashing strobes and audible alarms.

- **SonoBlaster:** Device consists of a motion sensor attached to traffic cones or other device that uses a compressed CO_2 cartridge to emit an audible alarm sound of 125 decibels for 15 seconds. While simpler to set up, false alarms do occur from work vehicles or when place too close to high-speed traffic that can knock over devices.

  SonoBlasters devices could be placed on transverse, skewed channelizing devices strategically placed within lane closures in advance of work crews.

- **Intellicone System:** System equips channelizing devices with sensors/wireless technologies to detect intrusions to provide warnings to workers via audible and visionary alarms.

- **Others:** Variations of the theme include systems that use pneumatic tubes ("traffic counter tubes") or BlueTooth. Working of the system is similar.

7.15 WISHA Regional Directive 27.20: Traffic Control & Flagging Operations

WISHA Directive 27.20 provides clarification on enforcement of Standards and Guidance in the MUTCD. In addition, it discusses requirements for short-duration work zones (those less than 1 hour). The Directive is summarized below:

- For any conflicts between MUTCD and WAC 296-155-305, the WAC must be followed.
- MUTCD Standard statements must always be implemented
- MUTCD Guidance statements must be considered; if not implemented, must explain how it was evaluated and why it was not implemented
    - Citations can be issued if the employer simply states "Guidance statements are not mandatory".
- For short-duration work zones (even 5-minutes unless an emergency) involving flagging, the 3-sign (40 mph or less) and 4-sign (45 mph and greater) requirement must still be met

The full WISHA Directive 27.20 is provided below and is slightly modified:

WISHA REGIONAL DIRECTIVE

WISHA Services
Department of Labor and Industries

27.20 Traffic Control and Flagging Operations
Date: Dec. 30, 2004

I. Background

In 1999, the Legislature passed the "Kim Vendl Act" requiring the department to undertake rulemaking to improve the safety of flaggers. While engaged in that rulemaking effort, L&I heard concerns from members of the Construction Advisory Committee (CAC) suggesting that the scope of the rulemaking was too narrow and noting that flaggers were not the only employees exposed to motor vehicle hazards. Due to the time constraints in the new statute, the department was not able to incorporate the broader issues into the flagger rulemaking project. After the new flagger rules were adopted, the department began meeting with stakeholders to develop rules for the protection of all employees working in the near proximity to motor vehicles. Although the initial effort was withdrawn in 2002 because of concerns that it was too sweeping and cumbersome, L&I developed a narrower proposal focused on the areas of greatest concern. One portion of the proposal, related to the need to protect employees from dump trucks when the trucks are backing up, was adopted on an emergency basis to ensure that workers were protected during the 2004 construction season. On December 1, 2004, the department adopted permanent rules that addressed the dump truck issue and other rules that improved the protections for employees working in the near proximity to motor vehicles.

The standard has historically relied to varying degrees on the Manual of Uniform Traffic Control Devices (MUTCD). In discussing traffic control, the MUTCD uses the following headings: Standard, Guidance, Option and Support to convey different levels of guidance. They are defined by the MUTCD as follows:

> ***Standard:*** *A statement of required, mandatory, or specifically prohibited practice regarding a traffic control device. All standards are labeled, and text appears in bold large type. The verb shall is typically used. Standards are sometimes modified by options.*

Guidance: *A statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. All Guidance statements are labeled and the text appears in large type. Guidance text is the same size as Standard text, but it is not bold. The verb should is typically used. Guidance statements are sometimes modified by Options.*

Option: *A statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. All Option statements are labeled, and the text appears in small type. The verb may is typically used.*

Support: *An informal statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements are labeled, and the text appears in small type. The verbs shall, should and may are not used in Support statements.*

One of the recurring questions raised in relation to the WISHA traffic control and flagging rules is how they relate to the MUTCD and the way in which employers are expected to treat these various MUTCD provisions. This directive describes the department's understanding of those relationships.

II. Scope and Application

This WISHA Regional Directive (WRD) provides guidance to WISHA enforcement and consultation staff when evaluating work zones where traffic control or flaggers are used. It will remain in place indefinitely, and replaces all other instructions on this issue, whether formal or informal.

III. Interpretive Guidance

A. What is the relationship between the Manual on Uniform Traffic Control Devices (MUTCD) and WAC 296-155-305, Signaling and Flagging?

When flaggers are used, employers are required to implement the requirements of WAC 296-155-305 and then supplement the requirements of the rule with the requirements and guidance in the MUTCD. If there is a conflict between the two, the requirements in the rule must be followed.

For all traffic control issues not addressed by the WISHA rule, whether or not a flagger is present, the employer is required to set up the work zone according to the requirements in the MUTCD. An employer's failure to implement appropriate traffic controls as required by the MUTCD is a violation of WAC 296-155-305(1)(a), with each individual omission an instance of the same violation.

B. What in the MUTCD is mandatory and what is recommended?

Employers are required to *implement* all applicable Standard statements related to the work zone (there are exceptions for Short Duration Work Zones (see Section III-D below)). Employers are required to *consider* Guidance statements and implement them when engineering judgment or study indicates they are appropriate. Options and Support statements are not required and the failure to implement an Option or a Support is not a violation of the rule.

C. Can an employer be cited for not implementing a Guidance statement?

Yes, an employer may be cited for not implementing a Guidance statement in the MUTCD

Employers are required to evaluate each Guidance statement that is applicable to the work zone they are establishing and then make a determination as to why they will or why they will not implement the recommendation.

A simple statement by the employer that the Guidance statement is not mandatory, if not accompanied by an explanation as to how it was evaluated and why it was not implemented, is not sufficient reason to comply with the rule.

D. *What are the exceptions for Short Duration Work Zones?*

The MUTCD defines a Short Duration Work Zone as a work that occupies a location for up to 1 hour. It goes on to say in a Guidance statement that "Safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change location."

The MUTCD provides for the use of fewer devices in short-duration work zones in the following Option Statement: "A reduction in the number of devices may be offset by the use of other more dominant devices such as rotating lights or strobe lights on work vehicles." The typicals in the MUTCD may provide guidance for short-duration work zones. Short duration work zones will be evaluated using the criteria set out in III-C above.

E. *When flaggers are used in short-duration work zones, is the employer allowed to eliminate some of the advance warning signs required by WAC 296-155-305?*

No. When flaggers are used in short-duration work zones, an employer must not reduce the number of advanced warning signs. Independent of the provisions of the MUTCD, WAC 296-155-305 requires three or four advanced warning signs whenever a flagger is used. This is consistent with the legislative intent of the "Kim Vendl Act" in providing greater protections for flaggers.

IV. Special Enforcement and Consultation Protocols

A. How is a WISHA inspector or consultant expected to evaluate an employer's implementation of MUTCD guidance statements or an employer's practices in a short-duration work zone to determine if there is a violation of WAC 296-155-305(1)(a)?

In addressing an employer's lack of implementation of a Guidance statement, including practices related to short-duration work zones, a WISHA inspector or consultant is expected to do with the following:

- Determine and document the employer's reason for not implementing the control;
- Determine and document who made the determination not to implement the guidance statement and their level of training (for example, Traffic Control Supervisor, Registered Professional Engineer, etc.);
- Determine and document the feasibility of the control in question;
- Determine and document whether the control would provide a greater margin of safety for the exposed employee(s);

B. What review requirements must be followed to issue a violation or hazard based on an employer's failure to follow an MUTCD Guidance statement?

Any proposed violation for the failure to implement a Guidance statement must be reviewed by the Safety Program Manager in WISHA Policy and Technical Services.

Approved:_____

Michael D. Wood, Senior Program Manager

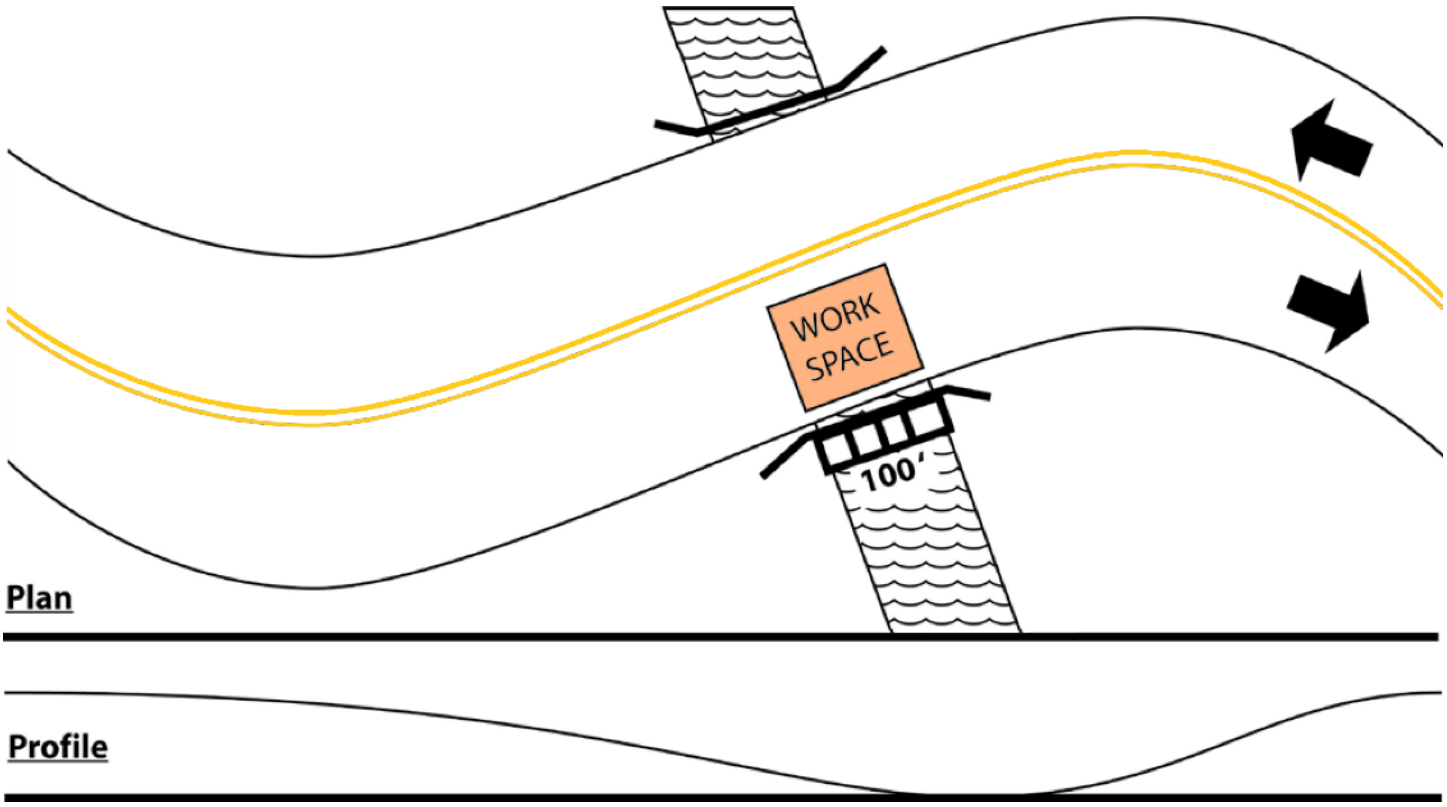
WISHA Policy & Technical Services

For further information about this or other WISHA Regional Directives, you may contact WISHA Policy & Technical Services at P.O. Box 44648, Olympia, WA 98504-4648 -- or by telephone at (360)902-5503. You also may review policy information on the WISHA Website (https://www.lni.wa.gov/safety-health/).

Exercise 7-1 – Identifying Special Requirements for Flagger Operations

You are a TCS and need to design a traffic control plan for a flagging operation scenario shown below:

- Speed Limit 45
- 12-foot lane width
- Work space is 100 feet in length
- Work operation occurs 6:00pm to 10:00pm



Chapter 8 Temporary Pedestrian Traffic Control

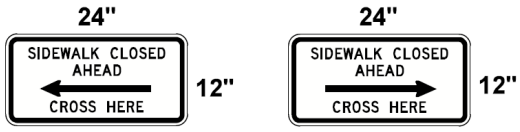
8.1 Summary

This chapter discusses the applicable laws and guidelines along with various pedestrian traffic control strategies and devices used to accommodate pedestrians thru or around work zones.

A wide range of pedestrians might be affected by work zones, including the young, elderly, and people with disabilities such as hearing, visual, or mobility. Pedestrians need a clearly delineated and usable access route either through or around the work zone.

Pedestrian trips are physically demanding, and detours can add considerable time and effort. Pedestrians have a low tolerance for out of direction travel and may choose risky options to avoid detours, such as jaywalking. Avoid this by alerting pedestrians to sidewalk or shared path closures in advance to prevent backtracking.

For example, if an opposite sidewalk is available, this can be accomplished using the R9-11 signs below at an existing crosswalk in advance of the closure instead of just placing "SIDEWALK CLOSED" at the actual closure point, which forces the pedestrians to retrace their path back to the crosswalk:



R9-11L (B/W) **R9-11R (B/W)**

Avoid lengthy detours may increase the pedestrian's exposure to inclement weather or excessive sun exposure—think of walking in those rainy, 35° F days or trying to push a wheelchair an extra 1000 feet on a hot, sunny 95° F-day that could pose health risks for some pedestrians.

When discussing temporary pedestrian traffic control, it is important to understand the following terms:

- **Detectable**: Having a continuous edge within 6 inches of the surface so that pedestrians who have visual disabilities can sense its presence and receive usable guidance information

8.2 ADA Regulations & Work Zones

Americans with Disabilities Act (ADA) is federal legislation passed in 1990 prohibiting discrimination based on disability and is regulated by the U.S. Department of Justice governing state and local public accommodations. Title II of the ADA requires permanent pedestrian facilities to meet ADA standard—unless it is demonstrated to be structurally impracticable (which is rare).

ADA Title II requires existing pedestrian facilities to be maintained in operable working condition. When they are temporarily disrupted by construction and maintenance then alternative pedestrian access and mobility should be provided through and around work zones to the **maximum extent feasible**.

The United States Access Board (Access Board) is an independent federal agency developing and maintaining design criteria, providing technical assistance and training, and enforcing accessibility standards for federally funded facilities. The Access Board created two guidelines under ADA:

- **ADA Accessibility Guidelines (ADAAG)**: Guidelines for meeting permanent ADA standards, but does not fully address public rights-of-way (sidewalks & pathways on public land)
- **Public Rights-of-Way Accessibility Guidelines (PROWAG)**: Guidelines developed in conjunction with Federal Highway Administration for newly designed and altered pedestrian facilities, including those affected by work zones.

ADAAG are for on-site facilities and do not completely cover pedestrian facilities within public right-of-way, which PROWAG addresses for newly designed and altered pedestrian facilities impacted by work zones.

8.3 PROWAG (Public Rights-of-Way Accessibility Guidelines)

PROWAG provides guidelines to help meet requirements in Title II of the Americans with Disabilities Act (ADA) federal legislation passed in 1990. Formally adopted by the Department of Justice, the PROWAG has become enforceable guidelines after Federal Highway Administration published the Final Rule.

PROWAG should be used as *Guidance* for work zone design impacting pedestrian facilities, including pedestrian traffic control plans. PROWAG currently provides **recommended best practices** for:

- Pedestrian access routes (permanent sidewalks, curb ramps, street crossings)
- Alternative pedestrian access routes (temporary pedestrian traffic control related to work zones)

PROWAG R204 covers Alternative Pedestrian Access Routes for pedestrian facilities impacted by work zones and requires compliance with MUTCD 6D.01, 6D.02, and 6G.05 for when pedestrian barricades and devices to comply with MUTCD 6F.63, 6F.68, and 6F.71. See Section 8.6 for details on these relevant MUTCD sections. See technical requirements for Alternative Pedestrian Access Routes in PROWAG R303.

It is important to understand temporary alterations to existing facilities are subject to ADA guidelines the **"maximum extent feasible"**. These are required to be shown on temporary traffic control plans.

- Example #1: A temporary sidewalk closure uses the closed adjacent on-street parking as a pedestrian bypass (see MUTCD Typical Application 28, Right Figure); however, the on-street parking pavement has a cross slope of 3% (versus 2% maximum per ADA).
    1. Because the bypass is temporary (shown on pedestrian traffic control plan), the 3% cross slope would be considered the maximum extent feasible and acceptable for the bypass detour. The street does not need to be repaved to meet the 2% cross-slope requirement.
- Example #2: A temporary sidewalk closure uses the open sidewalk on the opposite side of the roadway as the detour (see MUTCD Typical Application 28, Left Figure); however, the existing sidewalk and curbs do not meet current ADA standards.
    2. Because the detour is temporary (shown on pedestrian traffic control plan), the opposite sidewalk will be considered the maximum extent feasible even though it does not meet ADA standards. The opposing sidewalk does not need to be upgraded to ADA standards.

Example #3: A bridge without any sidewalks will be under construction, does temporary pedestrian access need to be provided during construction?

3. Technically no. Since the existing bridge lacks any pedestrian facilities, a temporary pedestrian facility is not required in the work zone.

For additional information, see Section 1010.04(8) in Chapter 1010 of the Design Manual.

8.4 Caltrans Temporary Pedestrian Access Routes Handbook

This Caltrans Temporary Pedestrian Access Routes Handbook provides a condensed version of PROWAG requirements in a user friendly manner for work zone configurations, known as "Alternative Pedestrian Access Routes".

Page 16 provides information regarding temporary curb ramp slopes steeper than 1:12 (8.33%) are permitted by PROWAG.

8.5 Vermont Bicycle and Pedestrian Work Zone Traffic Control Guide

While not a WSDOT resource, Vermont provides a valuable Bike/Ped Work Zone Traffic Control Guide useful as a work zone reference for pedestrian temporary traffic control.

8.6 Pedestrian-Related MUTCD Sections

In addition to PROWAG, the MUTCD will provide additional information regarding pedestrian traffic control on all public roads in the following sections summarized below:

Section 6A.01: General:

- The need and control of all road users (including pedestrians with disabilities) shall be an essential part of highway construction, utility work, and maintenance operations

Section 6D.01: Pedestrian Considerations:

- Provide advance notification of sidewalk closures (to minimize backtracking)
- The alternative pedestrian route should match the existing route's detectability and accessibility the extent feasible with a smooth, continuous hard surface based on ADDAG
- If maintaining an alternative pedestrian route is not feasible, consider a free bus shuttle or escort all pedestrians through the work zone
- Avoid leading pedestrians into conflicts with vehicles, equipment, or work operations
- Consider using audible information devices to better accommodate the visually impaired
- If using temporary traffic barrier to separate pedestrians from vehicles, do not use short intermittent segments of barrier

Section 6D.02: Accessibility Considerations:

- Alternative pedestrian route should have accessibility features consistent with the existing pedestrian facility
- When closing a sidewalk, the sidewalk should be completely blocked in a manner detectable to the visually impaired walking with a long cane
- Audible information devices are the most desirable way to provide information to visually impaired pedestrians

Section 6G.05: Work Affecting Pedestrian & Bicycle Facilities:

- When pedestrian routes are closed, provide alternative pedestrian routes that are detectable and have accessibility features consistent with the existing facility
- Pedestrians should not be exposed to unprotected excavations, open utility access, or overhanging equipment
- When pedestrian usage is high, enhance traffic control strategies and devices
- Avoid pedestrian detours whenever feasible and instead provide a continuous temporary route of 60-inches in width (48-inches minimum)
- Alternative pedestrian route should have accessibility features consistent with the existing pedestrian facility

Section 6F.63: Channelizing devices:

- Channelizing devices used for pedestrians shall be detectable to users of long canes and visible to persons having low vision. These devices should have a lower and upper surface—with the bottom edge of the lower surface less than 2" off the ground (may be flush) and the top edge of upper surface no more than 32" above the ground. ("CAUTION" tape between devices are prohibited)
- Channelizing devices shall be retroreflective

Section 6F.68: Type 1, 2, 3 Barricades:

- A 60-inch wide alternative pedestrian path should be maintained when possible; however, 48-inch wide paths with 60"x60" passing spaces every 200 feet is allowable.
- Protrusions, including traffic control devices, should not extend more than 4-inches into the pedestrian pathway. When necessary, provide a justification for doing so.

Section 6F.71: Longitudinal Channelizing devices:

- Shall be interlocked to delineate or channelize pedestrians without any gaps allowing pedestrians to stray from the channelization path
- Should meet crashworthy requirements if used to channelize vehicular traffic as well

8.7 Inadequate Pedestrian Traffic Control Devices & Strategies

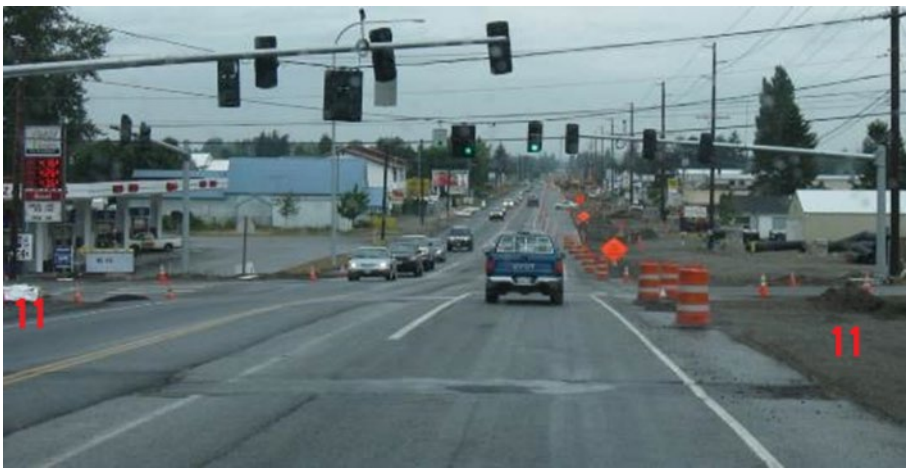
- (1) "CAUTION" tape is not detectable
  (2) PVC railing is not detectable
  (3) Plywood edge exceeds ¼" max (up to ½" requires 2:1 bevel)

- (4) High-Visibility Fence (HVF) is not detectable
  (5) Unprotected utility trench/drop-off

- (6) Inadequate delineation for a sidewalk closure bypass & vehicular traffic
  (7) No temporary curb ramp transition between sidewalk & roadway
  (8) Closing sidewalk with Type 2 barricade instead of a pedestrian channelizing device

- (9) Providing inadequate delineation for pedestrians forced into bike lane for a sidewalk closure Temporary sidewalk bypass less than 48" wide
  (10) Closing sidewalk with Type 3 barricade instead of a pedestrian channelizing device

- (11) Entire side of roadway under construction without maintaining pedestrian access
- (12) Existing pedestrian push button inaccessible at traffic signal



8.8 Appropriate Pedestrian Traffic Control Devices

8.8(1) Pedestrian Channelizing Device Across Sidewalk Closures

- Weighed in the back via sandbags for stability, these devices avoid creating tripping hazards and span across the entire closed sidewalk and are preferred to Type 2 and Type 3 barricades.

8.8(2) Pedestrian Channelizing Device for Delineation

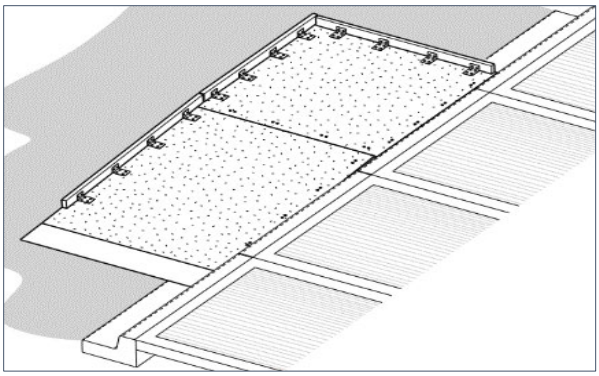
- Longitudinal pedestrian channelizing devices are modular and lock together to create a temporary pedestrian pathway while separating pedestrians from vehicles and equipment for long-duration projects. These devices have handrails and a continuous edge at the bottom (allowing blind pedestrians to smack the bottom with their cane)

8.8(3) Audible Information Devices

- Voice recordings allow TCS to speak customized messages that either playback on a continuous loop or activated by a sonar sensor (gray scale near top) when a pedestrian passes. These are very helpful for blind pedestrians to navigate through a work area and are currently optional per 2009 MUTCD but will become recommended in the new 11th edition of MUTCD when adopted.

8.8(4) Temporary Pedestrian Curb Ramps

- PSS produces modular curb ramps, expandable to any length, with a continuous bottom edge with handrail (PSS Innovations) or may be constructed by Contractors. Parallel temporary ramps are most common (TC53), shown below, but perpendicular versions are also available (TC52).



8.9(5) Water-Filled "Barrier"

- Water-filled "barrier" is longitudinal channelizing device that will not stop vehicles (even at 25 mph impact, these "barriers" slide 6 feet). With that said, they are excellent for delineating pedestrian pathways next to low-speed vehicular traffic in urban areas for long-term use.

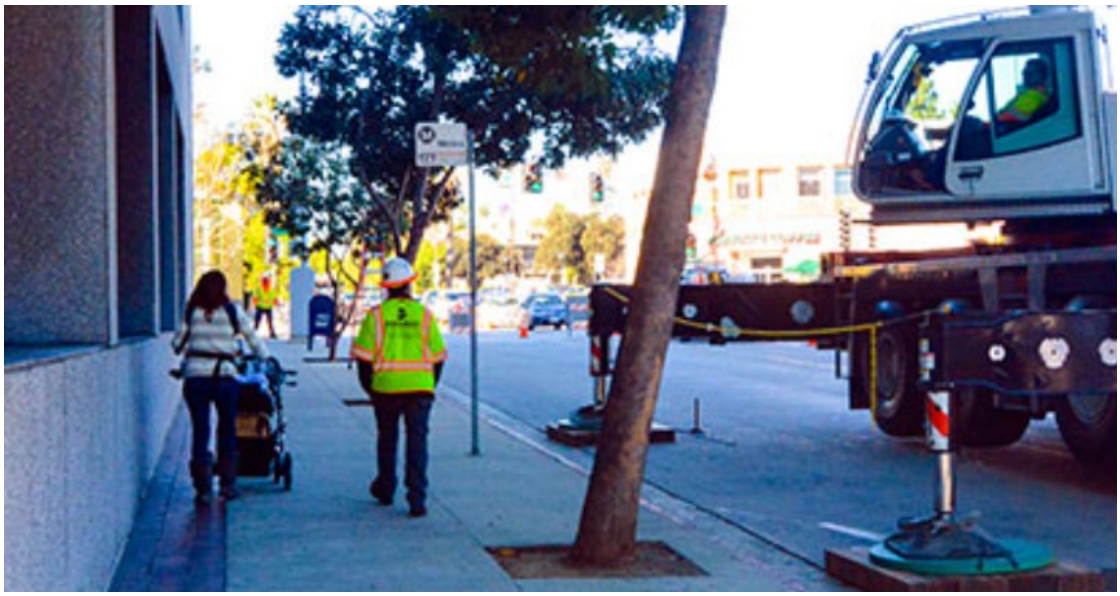
8.9(6) Temporary Concrete Barrier

- Temporary concrete barrier serves as both positive protection and delineation to separate pedestrians from motorists for long-term use.

8.9 Appropriate Pedestrian Traffic Control Devices & Strategies

8.9(1) Stop Work & Escort Pedestrians Thru Work Area

- Excellent strategy for short-duration work lasting a few hours on daily/nightly basis allowing workers to hold pedestrians until work operations are stopped before escorting them through the work area. In busier locations, a worker on either side of the work operation is recommended

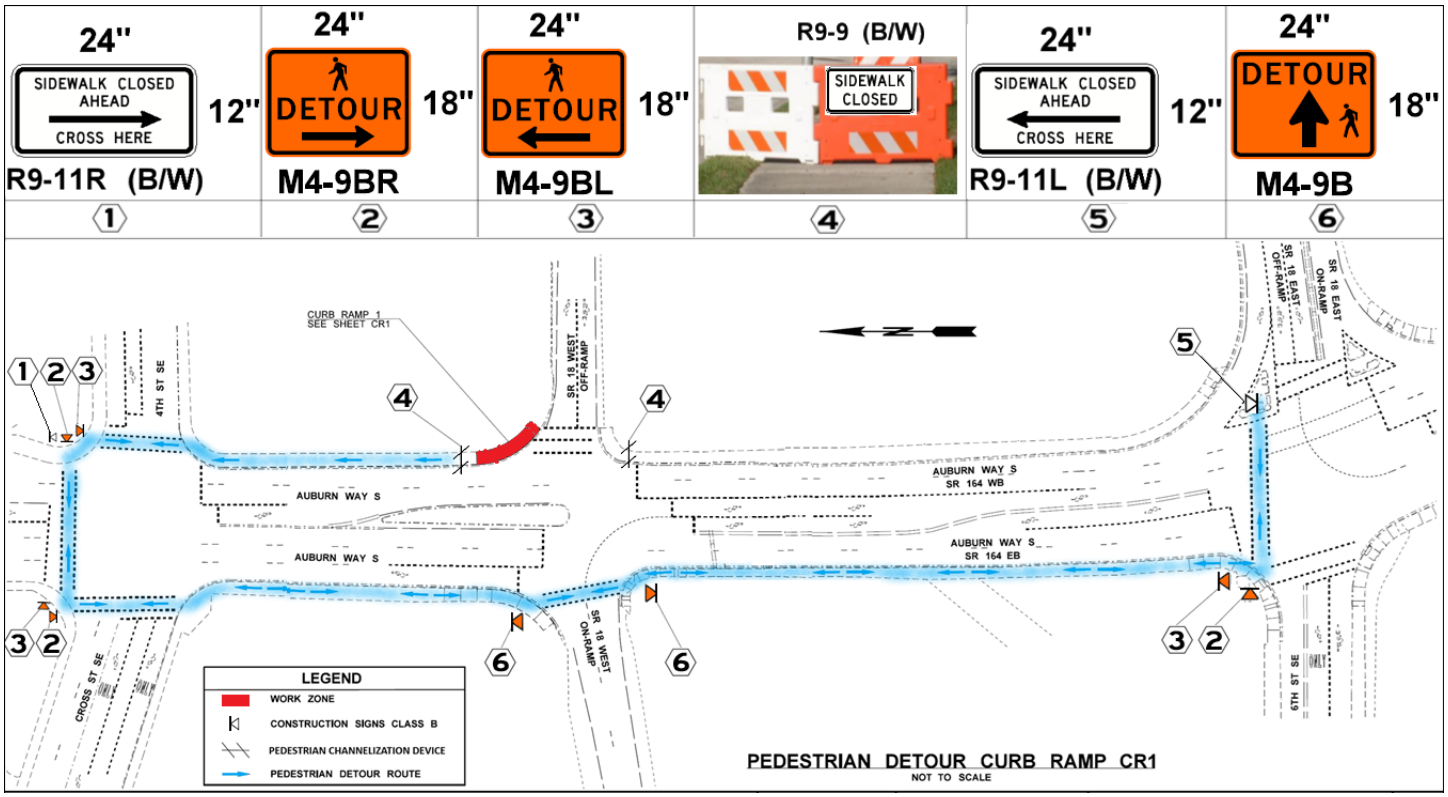


8.9(2) Free Pedestrian Shuttle

- There are times when providing pedestrians access through the work zone on foot is not practical or feasible. As an alternative, providing a free shuttle is quite effective to transport pedestrians (and bicyclists) through or around the work zone
  - **Daytime, higher pedestrian volume hours:** Bus shuttle service on 15-minute intervals
  - **Nighttime or very low pedestrian volumes:** Shuttle via call box (can be programmed to call on-duty Traffic Control Supervisor or other Contractor personnel)

8.9(3) Traditional Sidewalk Closure with Detour Via Opposite Sidewalk

- Strategy for both short-duration and long-duration closures where the sidewalk is torn up (curb replacement replacement). By informing pedestrians of sidewalk closure in advance at existing crosswalks at intersections, pedestrians can cross the roadway and utility the opposite sidewalk to bypass the closure. Detour signage used along detour route.



8.9(4) Temporary Pedestrian Bypass via Closed Lane or Plywood Walkways

- Providing an alternative pedestrian access path, with a smooth surface and detectable edging & handrail, around a sidewalk closure via a closed lane (left photo) or plywood walkways around a curb ramp replacement.

8.9(5) Portable Temporary Pedestrian Signals & Push-Buttons

- Portable temporary pedestrian signals can be incorporated into temporary traffic signals and existing permanent traffic signals (left photo). A temporary pedestrian push-button can be moved where needed on a push-cart and communicates wirelessly (middle photo). A close-up of the temporary push button on that same push-cart is very similar to permanent ones (right photo).

8.9(6) Flaggers Holding Vehicles to Allow Pedestrians to Cross

- When traffic is flagger-controlled, flaggers may hold traffic in all directions to allow pedestrians to cross the roadway, typically at intersections.

Chapter 9 : Temporary Bicycle Traffic Control

9.1 Summary

This chapter discusses the applicable laws and guidelines along with various bicycle traffic control strategies and devices used to accommodate bicyclists thru or around work zones.

Bicyclist trips are physically demanding, and riders are exposed to the weather. Bicyclists are somewhat more tolerant of out of direction travel than pedestrians, they are still sensitive to lengthy detours and delays due to additional weather exposure. It is important to be aware bicyclists generate significant heat while riding and can become quickly chilled in cold weather and overheated by sun in hot weather during long delays, affecting them well after the limits of the work zone. Bicyclists are also more likely than pedestrians to use rural routes that are far from services.

Bicyclists may have invested considerable energy before reaching a work zone such that turning back for an alternate route will be too taxing. Therefore, bicyclists need to be alerted about long delays or closures at a point where they can make an alternate route choice.

Today the bicycle options are increasing. Some bicycles or bicycle-type devices may take up more space than such as cargo bikes, bikes with trailers and recumbent bikes. People with disabilities also ride bikes, some of which take up more space than traditional bicycles.

9.2 Vermont Bicycle and Pedestrian Work Zone Traffic Control Guide

While not a WSDOT resource, Vermont provides a valuable Bike/Ped Work Zone Traffic Control Guide useful as a work zone reference for bicycle temporary traffic control.

9.3 New York City Guidelines for Bicycle Traffic Plans

While not a WSDOT resource, New York City provides a valuable Guidelines for the Maintenance and Protection of Traffic Plan for Cycling useful as a work zone reference for bicycle temporary traffic control.

Be aware many of the signs shown are custom to New York City and may need to be modified for use in Washington.

9.4 Bicycle-Related MUTCD Sections

In addition to PROWAG, the MUTCD will provide additional information regarding bicycle traffic control on all public roads in the following sections summarized below:

Section 6A.01: General:

- The needs and control of all road users (including bicyclists) shall be an essential part of highway construction, utility work, and maintenance operations

Section 6G.05: Work Affecting Pedestrian & Bicycle Facilities:

- Bicyclists should not be exposed to unprotected excavations, open utility access, or overhanging equipment
- When bicycle usage is high, enhance traffic control strategies and devices

9.5 Bicycle Traffic Control Strategies

- **<u>Flagger or AFAD-Controlled Alternating Traffic</u> (All speed limits)**:

  Limit the length of the lane closure to 1000’ or less, flaggers will coordinate to hold traffic in all directions to allow bicyclists to pass through the lane closure. It is acceptable to release bicycles from both directions concurrently, but let riders know about oncoming riders.

  Using R4-11 is not required since flaggers are controlling bicyclists and motorists separately.

- **<u>Temporary Signal-Controlled Alternating Traffic</u>:**

  If temporary signals within 1000 feet and speed limit 30 mph or less, combine bicycle and motor vehicles via shared lanes using R4-11 sign. For 35 mph speed limits, add the W15-1 MOD sign. For long-term work zones, bicycle traffic symbol may be added in the center of the shared lane. Signs and symbols shown on next page. See Typical Plans TC340 and TC341.

  If temporary signals more than 1500 feet apart, provide a 48” bicycle lane that is separated from motor vehicles like shown in the right photo below. For areas with significant bicycle volumes, consider increasing width to 60”. In areas with low bicycle volumes and work area restricted geometrically, it is acceptable to put two-way bicycle traffic in a single bicycle lane. Passing areas 72” wide every ~500’ is desired.

- **<u>Roadways with Speed Limit 30 mph or less</u>**:

  Combine bicycle and motor vehicles via shared lane using R4-11 sign.

  For long-term work zones, bicycle traffic symbol may be added in the center of the shared lane.

R4-11

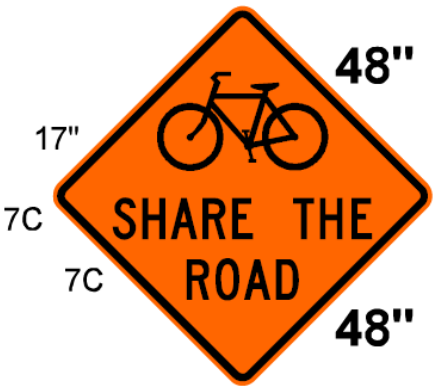
- **<u>Roadways with Speed Limit 35 mph or Higher (Excluding Multilane Roadways)</u>**:

  Combine bicycle and motor vehicles via shared lane using R4-11 sign. In addition, add W11-15 MOD in advance to highlight the presence of bicycles to motorists and every 1± mile thereafter.

  Use 36”x36 MIN for 35-40 mph roadways; 48”x48” for roadways 45 mph or higher.

R4-11

W11-15 MOD

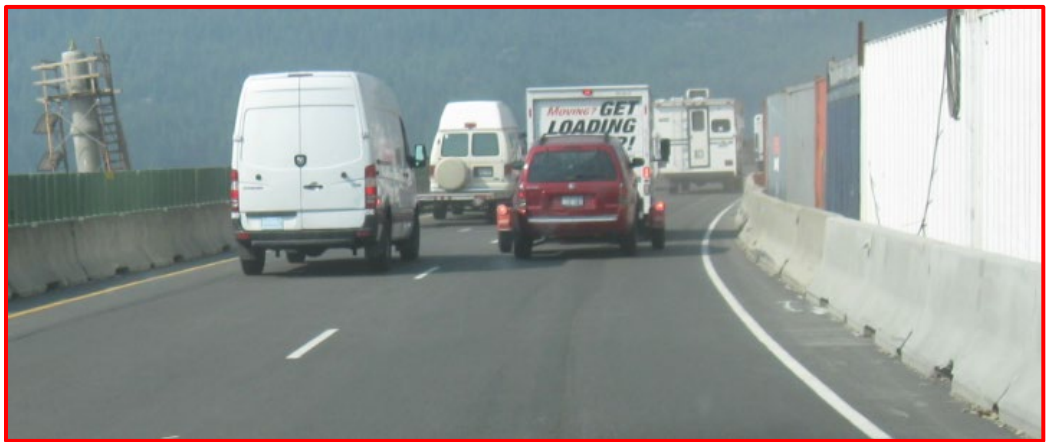


W11-15 MOD

- **<u>45+ mph Multilane Roadways & Freeways</u> (Except for Alternating Traffic)**:

  Shared vehicle-bike lanes are prohibited on 45+ mph multilane roadways, including freeways.

  Bicycles prohibited on freeways if shoulders less than 6 feet or in permanent bike restricted areas.



R5-6 (R/B/W)

- **<u>Lane Shift or Lane Closure to Create Temporary Bike & Pedestrian Paths</u>:**

  Using the closed lane, a 48" temporary bicycle lane & 48"-60" pedestrian path can be created within the lane closed off to traffic on roadways 35 mph or less in areas of high bike/pedestrian volumes

- **<u>Separated Double Bicycle Lanes for Each Direction within Lane Closure</u>:**

  In urban areas with very high bike volumes, closing a lane to provide 2-way bicycle traffic is possible.

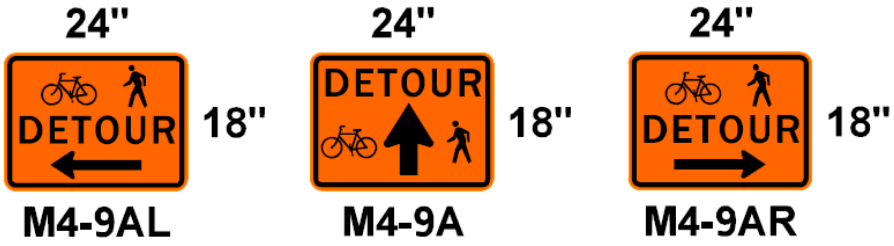
  Provide a 5-foot bike lane adjacent to the curb, 4' bike lane, and a 2' buffer with 28" tubular markers at 10-foot spacing as shown below.

- **<u>Detouring Bicycles to Sidewalks or Shared Paths</u>:**

  Bicyclists are flexible in they can be combined with pedestrians or slow-speed vehicular traffic; giving a lot of flexibility in how they are accommodated in work zones.

  In areas with bicycle lanes physically separated from vehicular traffic, bicycles should be detoured onto adjacent sidewalks.

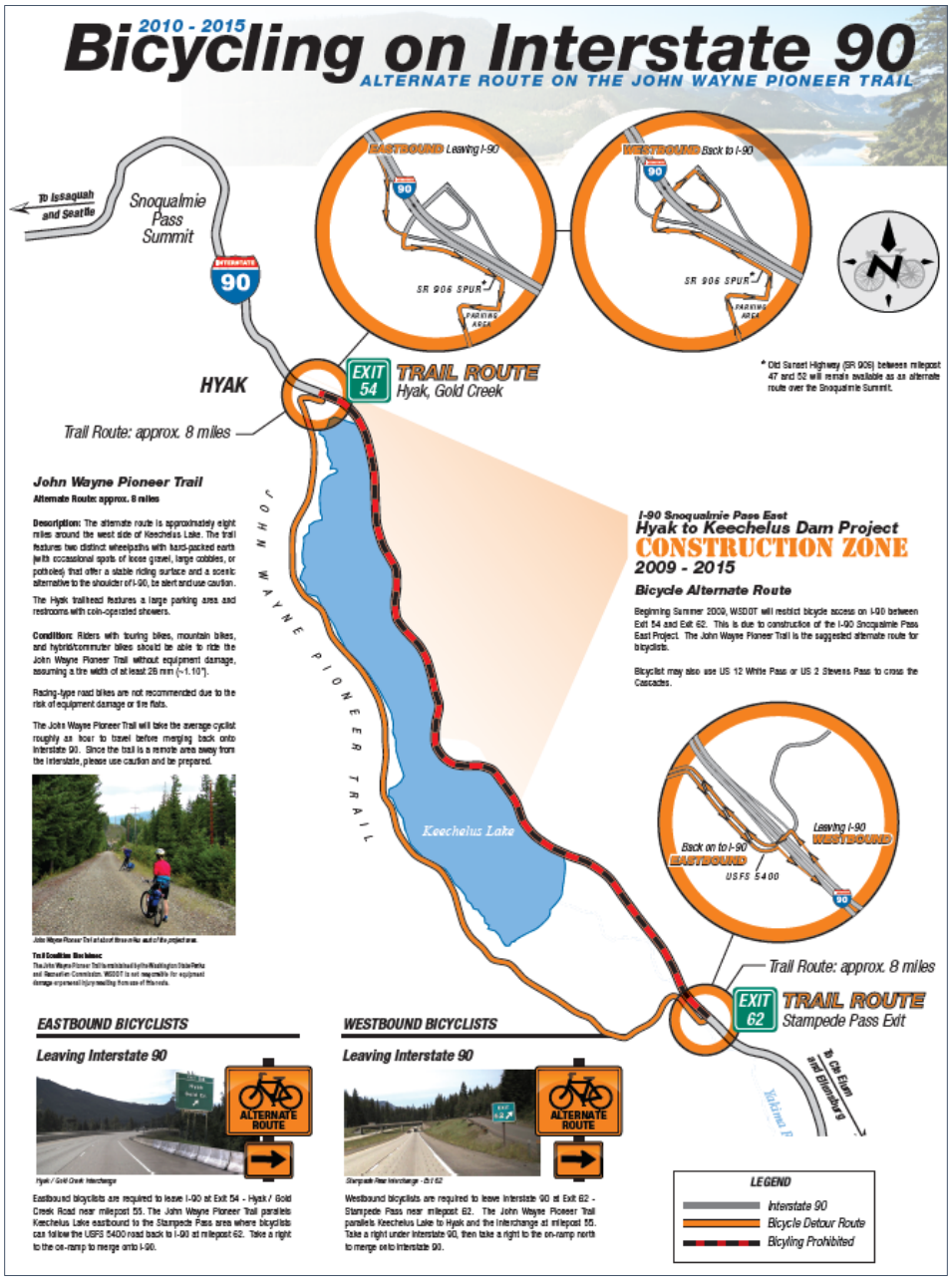
If the sidewalk is also closed and detoured, combine the bicycle and pedestrian detours:



- **<u>Free Bus Shuttle</u>:**

  Sometimes there is not a feasible way to bypass bicycles around or through the work zone. In such situations, using a free bus shuttle and driving bicycles (and pedestrians) through the work zone at 15-minute intervals is a viable alternative. Use a call box for low volumes or at night.

- Provide a detour or alternative routes for bicycles, including temporary diversions. Consider including a 1-page map/guide for longer, more complicated bike detours.



Chapter 10 : Reading Contract Provisions & TCPs

10.1 Summary

This chapter reviews relevant temporary traffic control requirements found in both design-bid-build and design-build projects to familiarize students with the locations of important temporary traffic control-related information. This information is important to a TCS during the review, implementation, and development of modified/new traffic control plans.

10.2 Construction Delivery Methods Used by Agencies

Design-Bid-Build (Traditional method):

- Design fully completed, Contractors bid, then Construction begins
- Agency provides complete Contract Plans & Specifications
- Agency completes Traffic Management Plan (TMP)
- Contractor completes construction only

Design-Build:

- Agency provides concept, scope, and specifications
- Design-Builder completes both design & construction
- Design-Builder develops and approves all Contract Plans & Traffic Management Plan (TMP)

10.3 Contract Plans

Design-bid-build projects include *project-specific* Contract Plans. WSDOT Contract Plan Example

While each Contract Plan will vary in its content, the following sections contain information applicable to temporary traffic control:

1. **Cover page**
   - Project's Location, title, and WSDOT project number
2. **Index**
3. **Vicinity Map**
   - May also include Class A sign locations on smaller projects
4. **Summary of Quantities**
   - Bid item payment information (lump sum versus paid by quantity)
5. **Staged Traffic Control Plan / Construction Staging**
   - Long-term traffic control including traffic control devices, signage, pavement marking, barrier, impact attenuator layout
6. **Construction Signing Plan**
   - Class A sign locations, typically ROAD WORK NEXT # MILEs and END ROAD WORK
7. **Traffic Control Plans**
   - Typical, project-specific, or site-specific traffic control plans
   - Includes either combined or separate pedestrian & bicycle traffic control plans
8. **Detour Plans**
   - Used in conjunction with traffic control plans closing roads or ramps

10.4 Contract Provisions (Design-Bid-Build)

Design-bid-build projects also include Contract Provisions. WSDOT Contract Provision Example.

Contract Provisions provide additional *project-specific* specification, measurement, and payment that supersedes Standard Specifications and Standard Plans. Key traffic control sections:

- **Cooperation with Other Contractors (1-05.4)**
  - Lists the expected adjacent projects occurring that requires Contractors to coordinate their work, sometimes projects may overlap. Information typically includes project title, anticipated construction dates, and Agency contact information.
- **Construction Under Traffic (1-07.23)**
  - Provides work zone clear zone information (for projects using Std. Spec 2021 or earlier)
  - Closure Restrictions
    - Allowable closure hours
    - Special Event closure restrictions
    - Holiday closure restrictions
    - Distance requirements between consecutive closures
    - Public notification requirements for closures
    - Advanced notification requirement for upcoming closure to Agency (3-week closure look-ahead schedule)
  - Drop-Off & Steel Plate Requirements
- **Liquidated Damages (1-08.9)**
  - Monies deducted from Contractor payment for late reopening of closures, which can be thousands of dollars per 15-minute interval (prorated to nearest 5 minutes)
- **Temporary Traffic Control (1-10)**
  - TCS certification requirements
  - TCS experience requirements on high-speed multilane roadways
  - Additional traffic control device specifications, measurement, and payment

10.5 Request For Proposal (Design-Build)

Design-build projects include an alternative form of Standard Specifications and Special Provisions that are combined together to create a Request For Proposal ("RFP") which consist of *project-specific specifications* for the entire project, including temporary traffic control.

In design-build projects, the Design-Build Contractor creates the Traffic Management Plan and traffic control plans; they are not included as part of the Contract. So additional traffic control and staged traffic specifications are included in RFPs. Key traffic control sections:

- **Maintenance of Traffic (2.22)**

  WSDOT RFP 2.22 Example

  - Nearly a "one-stop shop" for all temporary traffic control-related specifications
    - Sections 2.22.3.2 thru 2.22.3.4, 2.22.5.1, 2.22.5.2: Traffic Management Plans requirements by the Design-Builder.
    - Sections 2.22.4.2, 2.22.5.3: Creation of temporary traffic control plans requirements (also called "MOT Plans" in older contracts) by the Design-Builder
    - Section 2.22.4.1: Work Zone Traffic Engineering Manager requirements, including being a Washington Professional Engineer, who approves and signs MOT Plans. Note this is different than the Traffic Control Manager in the Standard Specifications.

- Section 2.22.4.3: Allowable closure hours, Special Event restrictions, Holiday restrictions
- Section 2.22.4.4: Traffic operations during construction requirements geared more towards long-term staging plans (such as minimum lane widths), including pedestrian and bicycle requirements.
- Section 2.22.4.5: Roadway maintenance, drop-off requirements, work zone clear zone, advance closure notification, and public notification
- Section 2.22.4.6: Temporary traffic control, pavement marking, and signage requirements
- Section 2.22.4.7: Traffic control personnel requirements (including TCS & flaggers)
- Section 2.22.4.8: Weekly drive-through digital video requirement
- Section 2.22.4.9: Traffic control procedures for flagging, rolling slowdown, and lane closures
- Section 2.22.4.10: Traffic control devices

10.6 Traffic Control Plans

Traffic Control Plans shall be included as part of the contract whenever vehicle, bicycle, or pedestrian traffic will be affected by the project. Standard Specifications 1-10.2(2) provides contractor's responsibilities for adopting, implementing, or modifying the traffic control plan.

Per MUTCD Section 6A.01, ¶ 10, traffic control plans shall be the responsibility of the public body [Agency] or official having jurisdiction. Per MUTCD Section 6C.01, ¶ 03, traffic control plans should be prepared by persons knowledgeable (trained or certified) about the fundamental principles of temporary traffic control. The design, selection, and placement of traffic control devices should be based on engineering judgement.

There are three different types of traffic control plans:

1. **Typical**
   - Generic plans applicable to multiple work locations on multiple roadways
   - Spacing & distance tables provided for various speed limits
   - Numerous Typical TCPs provided in WSDOT's Typical Traffic Control Plan Library
2. **Project-Specific**
   - Modified typical plans to fit a specific project or work location
   - Spacing & distances usually specified, minimal spacing & distance tables
   - Plan modified to match roadway configuration at work location
3. **Site-Specific**
   - Unique, customized plan for one specific location
   - All spacing & distances should be specified & verified
   - Show exact roadway configuration
   - Does not have to be a scaled drawing; schematic versions still acceptable

10.7 MUTCD's Typical Applications

MUTCD provides information on temporary control typical applications, work durations, location of work, plan modifications, and pedestrian and bicycle considerations in Chapter 6G (619-630).

MUTCD provides 46 Typical Applications, in Chapter 6H. Per Section 6H.01, ¶ 03 Typical Applications are considered Guidance, except when Standard statements are listed in their Notes.

It is important to know MUTCD Typical Applications cannot be used "as is". As highlighted in MUTCD TA-10 Example, numerous Washington state laws modify the Typical Application:

- For example, Table 6H-3 provides sign spacing distances that conflict with WAC 468-95-300 and WAC 468-95-317. **Do not use MUTCD Table 6H-3.**
- For example, Typical Application 6H-10 shows 3 warning signs for flagging; however, per WAC 296-155-305 a minimum of 4 warning signs is required on 45+ mph roadways in Washington.

Symbols used in the MUTCD Typical Application are provided in Table 6H-2; these symbols differ from typical symbols used in WSDOT traffic control plans.

In addition, typical practices by Agencies often exceed MUTCD minimum requirements.

- MUTCD permits 28" reflective cones to be used on 45+ mph roadways; however, WSDOT may require traffic safety drums on lane closure/shift tapers on multilane roadways.
- Per MUTCD, truck-mounted attenuator ("transportable attenuators") is optional on freeway lane closures; however, WSDOT standard practice requires a transportable attenuator.

Think of these traffic control as a spectrum: A year-long reconfiguration of Interstate 5 in downtown Seattle is going demand a higher level of quality traffic control than a 3-hour lane closure on a 25-mph, low-volume city street.

10.8 Minor Revisions & Enhancements to TCPs & Typical Applications

MUTCD typical applications are considered guidance unless their Notes have Standard statements per MUTCD 6H.01 ¶ 03. Notes are included with each Typical Application on the preceding MUTCD page.

Work zones are highly variable in terms of work location, road geometrics, traffic speed & volumes, and pedestrians and bicyclist volumes. Analyzing these field conditions, proper judgment must be used in selecting and enhancing these typical applications or typical traffic control plans.

Per Standard Specifications 1-10.2(1)B, TCSs can make minor revisions to traffic control plans (provided it has the concurrence of both the Contractor and Engineer) such as:

1. Adjusting temporary sign spacing
2. Adding signs (or PCMSs), adjusting sign sizes (MUTCD Table 6F-1, 578-580)
3. Substituting similar signs ("SHOULDER CLOSED AHEAD" instead of "SHOULDER WORK")
4. Adding channelizing devices @ reduced spacing (20' spacing @ work crews OK)
5. Adding additional transportable attenuators (45+ mph) or protective vehicles (40 mph or less)
6. Adjusting longitudinal buffer space
7. Modifying PCMS message for queue mitigation (see Section 4.8 and Section 5.5)

TCS should document modifications and enhancements in the TCS's Daily Report of Traffic Control.

Changes that are not considered minor revisions and are prohibited include:

- X Changing regulatory speed limit without Agency approval
- X Adding advisory speeds without Agency approval
- X Encroaching into open lanes unless traffic control plans allow
- X Using a protective vehicle instead of a transportable attenuator

Exercise 10-1: Reading Traffic Control Plans

You are a TCS on a WSDOT project and the Traffic Control Manager has given you the contract plans and provisions for the job.

Plan TC2, shown below, will be the first plan you will be required to implement once the project begins.

Answer the following questions:

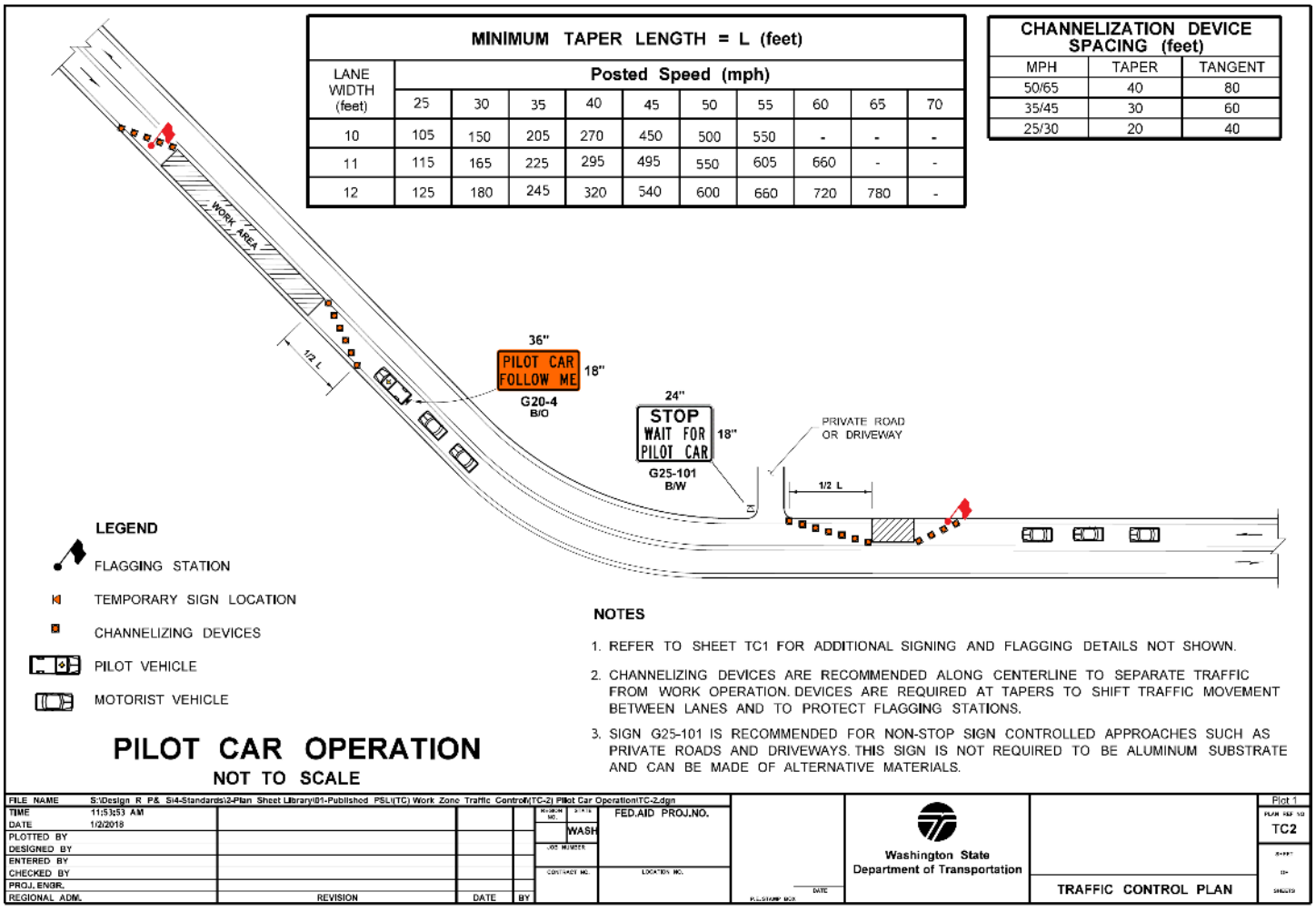
1. Where would time restrictions for using this plan be located for Contracts?

2. What size is the "ROAD WORK AHEAD" sign? Where is this information provided?

3. What type of channelizing devices are to be used?

4. Are there any devices needing to be installed prior to the work shift?

5. What type of sign stands are required for this plan?



LONGITUDINAL BUFFER SPACE = B									
SPEED (MPH)	20	25	30	35	40	45	50	55	60	65
LENGTH (feet)	115	155	200	250	305	360	425	495	570	645

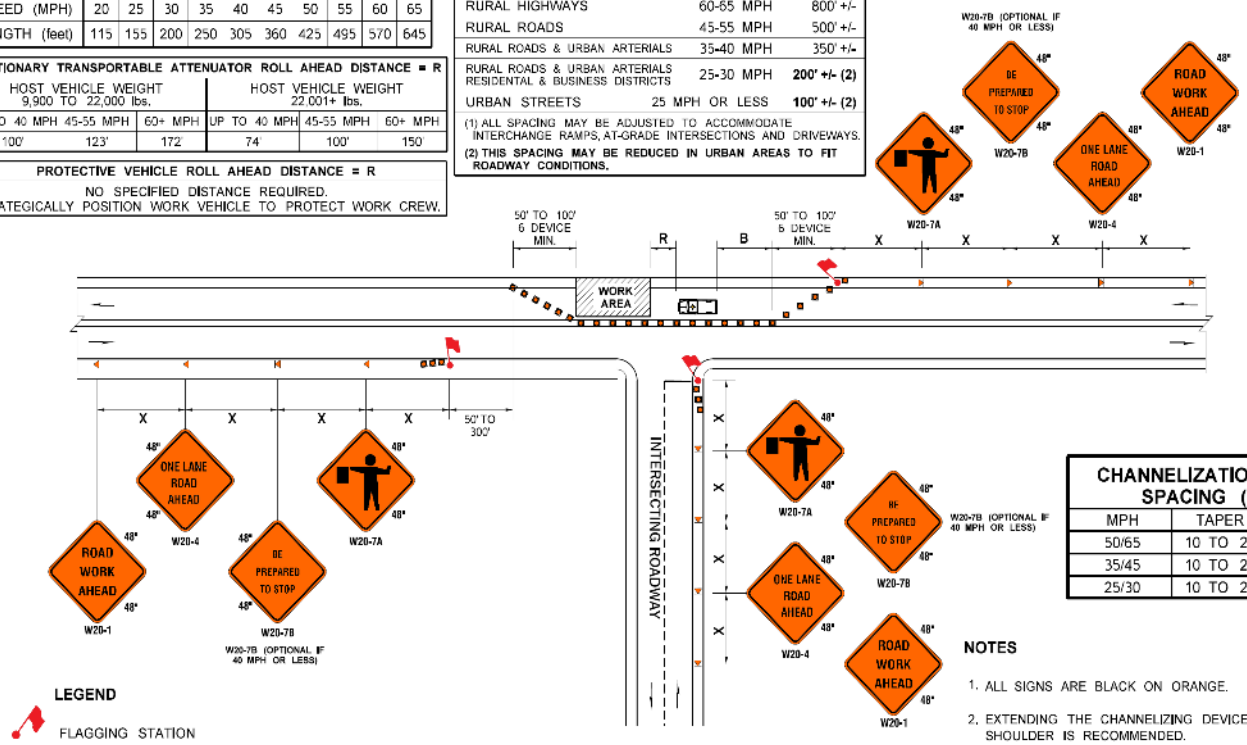
STATIONARY TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R					
HOST VEHICLE WEIGHT 9,900 TO 22,000 lbs.			HOST VEHICLE WEIGHT 22,001+ lbs.		
UP TO 40 MPH	45-55 MPH	60+ MPH	UP TO 40 MPH	45-55 MPH	60+ MPH
100'	123'	172'	74'	100'	150'

PROTECTIVE VEHICLE ROLL AHEAD DISTANCE = R

NO SPECIFIED DISTANCE REQUIRED.
STRATEGICALLY POSITION WORK VEHICLE TO PROTECT WORK CREW.

SIGN SPACING = X (1)		
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	**200' +/- (2)**
URBAN STREETS	25 MPH OR LESS	**100' +/- (2)**

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.
(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.



CHANNELIZATION DEVICE SPACING (FEET)		
MPH	TAPER	TANGENT
50/65	10 TO 20	80
35/45	10 TO 20	60
25/30	10 TO 20	40

LEGEND

- FLAGGING STATION
- TEMPORARY SIGN LOCATION
- CHANNELIZING DEVICES
- PROTECTIVE VEHICLE

NOTES

1. ALL SIGNS ARE BLACK ON ORANGE.
2. EXTENDING THE CHANNELIZING DEVICE TAPER ACROSS SHOULDER IS RECOMMENDED.
3. NIGHT WORK REQUIRES ADDITIONAL ROADWAY LIGHTING AT FLAGGING STATIONS. SEE THE **STANDARD SPECIFICATIONS** FOR ADDITIONAL DETAILS.
4. SEE **SPECIAL PROVISIONS** FOR WORK HOUR RESTRICTIONS.

ONE-LANE, TWO-WAY TRAFFIC CONTROL WITH FLAGGERS

NOT TO SCALE

FILE NAME	S:\Design R Fil\ St\-Standards\2-Plan Sheet Library\01-Published PSL\TC\ Work Zone Traffic Control\TC-1 One Lane, Two Way Traffic Control with Flaggers\TC-1.dgn						
TIME	3:05:14 PM						
DATE	1/2/2018						
PLOTTED BY	tiddelf						
DESIGNED BY							
ENTERED BY							
CHECKED BY							
PROJ. ENGR.							
REGIONAL ADM.		REVISION	DATE	BY			

FED.AID PROJ.NO.

Washington State Department of Transportation

TRAFFIC CONTROL PLAN

Plan No. TC1

Exercise 10-2: Reading Traffic Control Plans

You are a TCS on a WSDOT project and the Traffic Control Manager has given you the contract plans and provisions for the job.

Plan TC14, shown below, will be the next plan you will be required to implement.

Answer the following questions:

1. If the intersection has a traffic signal, what must happen?

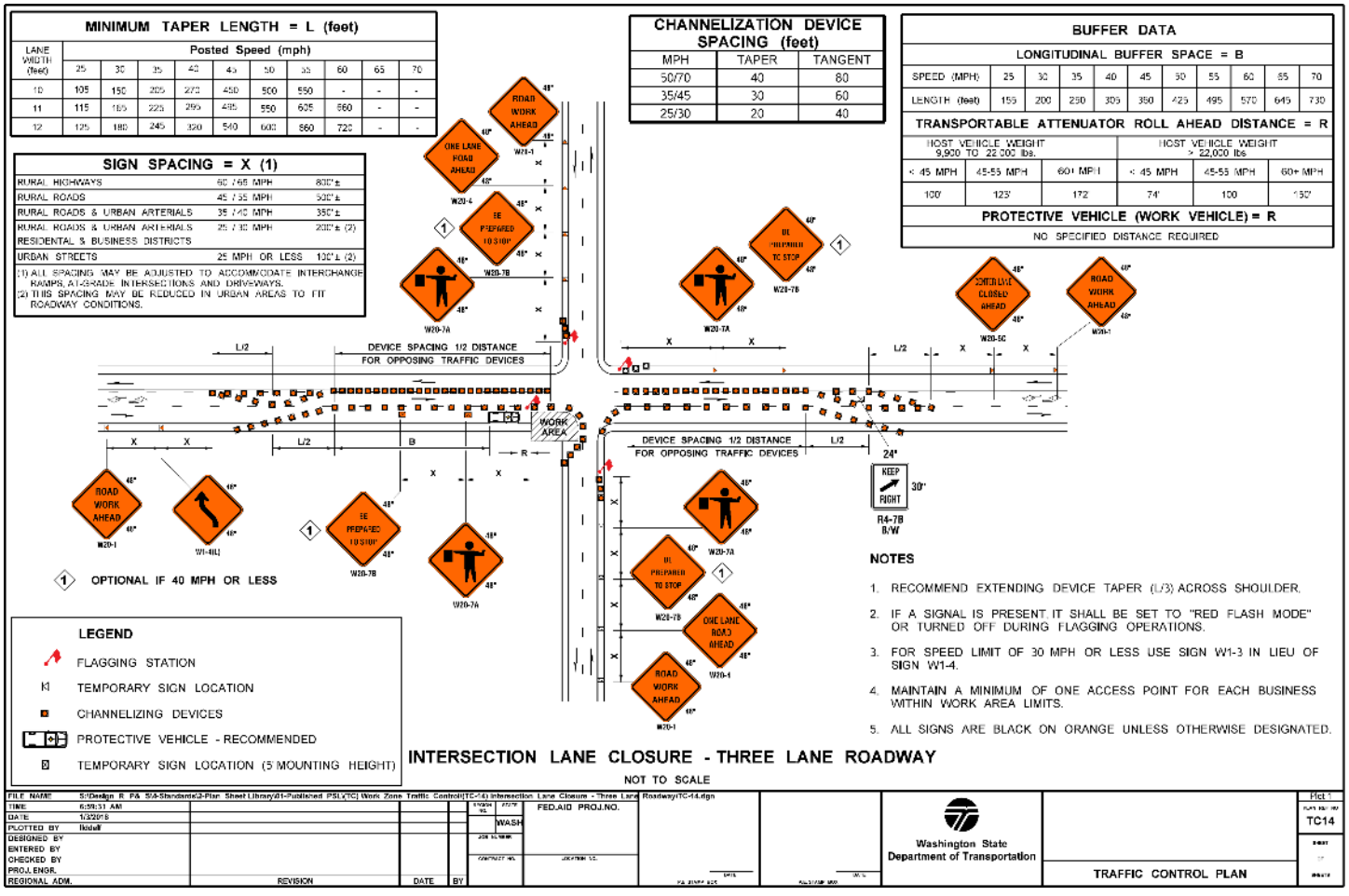
2. If this work occurs at night, what must happen at the flagger stations?

3. Which must occur first, the center turn lane closure or the lane shift (going to right)?

4. Is the "BE PREPARED TO STOP" sign required for 50 mph speed zones?

5. Is a protective vehicle, located prior to the work area, allowed for 55 mph speed zones with flagger-controlled traffic or must a transportable attenuator be used?

6. Can all the temporary signs be mounted at 1-foot height?



Chapter 11 : Installing & Removing Traffic Control Devices

11.1 Summary

This chapter discusses the process of installing and removing traffic control devices in temporary traffic control zones including preparation, the order of device installation, the treatment of existing signs, and the use of "shadow" or "protection" vehicles. Procedures for safely modifying, reinstalling, and moving traffic control devices are also discussed.

The installation, modification, and removal of traffic control devices for construction, maintenance, utility, and incident management operations can be enhanced by adequate preparation. **Installation and removal of temporary traffic control create situations that are often far more hazardous** than the operation of the completed zone because:

- Workers placing signage and channelizing devices in roadway adjacent to high-speed traffic, sometimes at points of high conflict, without the full protection of the devices being in placed
- The placement operation constitutes an unexpected situation for motorists as they are confronted with a roadway partially closed and a partially completed temporary traffic control.

Risks to both workers and road users can be significantly reduced with advanced preparation, well-trained and knowledgeable staff, keeping needed equipment and devices in good working order, and thorough understanding of installation and removal sequences and requirements.

11.2 Preparation for Installation

Benjamin Franklin is quoted to have said "If you fail to plan, you are planning to fail." This is definitely true for temporary traffic control.

The following serves as a guideline for TCSs to appropriately plan and prepare upcoming closures:

Project Pre-Planning:

1. Develop a working understanding of the Contract Plans, including traffic control and detour plans; MUTCD; Washington Modifications to MUTCD (WAC 468-95) and other work-zone related state laws; PROWAG; Standard Specifications; Contract Provisions or Request for Proposal (RFP); and the Contract's Measurement & Payment for traffic control.
2. Thoroughly review and understand
3. Understand the permitted closure hours & schedule accordingly
4. Create a complete inventory of required devices & equipment for each plan
5. Confirm devices & equipment are in good working condition; **have spare parts**
6. Thoroughly review project and surrounding area both on site and via Google Maps

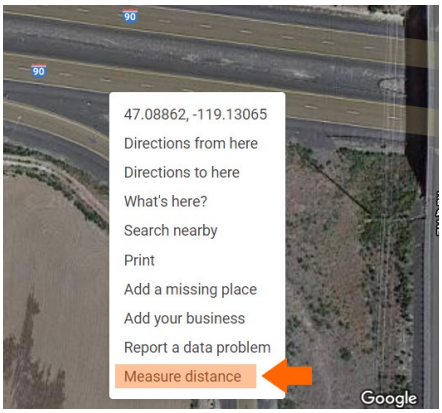
Prior to & Throughout Project:

7. Continuously train crew members to ensure they understand and/or are proficient in:
    - Traffic control installation & removal assignments
    - Mechanical operations of devices & equipment
    - Safety requirements & regulations
    - Avoid turning their back towards traffic
    - Avoid standing in front of parked vehicles within closures; stand on side way from traffic so the traffic control vehicle acts as a buffer
    - Know their escape paths (beware bridges)
    - When prudent & management concurrence, can serve as "spotters" for workers

Planning the Installation:

8. Coordinate with management to determine needed upcoming closures and their location
9. Layout complicated traffic control setups in advance
    - Strategy: Mark key locations with 18" reflective cones/ orange flags just off paved shoulder

10. Layout complicated traffic control setups in advance using Google Map's Distance tool, WSDOT SR View for Interstate & State Highways, or vehicle's odometer (0.1 mile ~ 500 feet).



11. Traffic Control Manager: Coordinate closures with affected agencies & organizations

    Prior to roadway and ramp closures, TCM coordinate the planned activities and closure times with all affected organizations in writing:
    - Washington State Patrol (WSP)
    - Local fire, police, emergency services
    - WSDOT and/or local engineering departments
    - Public transportation & transit agencies
    - School Districts
    - News media
    - Residents, businesses, industries, and other stakeholders
    - WSDOT Commercial Vehicle Services

Training and Instruction

All crew members should be trained for their tasks, with particular emphasis on safety. A rehearsal in the company yard, parking lot, or abandoned segment of a roadway may be desirable. These instructions are essential when either new or different procedures are used and when new members are added to the crew.

Crews need to be cautioned to face or stand sideways to oncoming traffic when feasible during the installation, modification, and removal temporary traffic control in addition to preparing for emergencies by planning escape routes, being trained in first aid, and having phone numbers readily available for the Traffic Control Supervisor, Traffic Control Manager, and Construction Superintendent.

To ensure that all crew members know their installation assignments, are thoroughly familiar with the mechanical operation of special devices, and to assure an efficient and speedy operation, the supervisor should review the installation process with his/her crew before going into the field. Learning how to raise an arrow board needs to be learned in the staging yard, not on the shoulder of Interstate 405.

11.3 Installing & Removing of Traffic Control Devices

Devices are installed in the direction that traffic moves—moving "downstream". Devices are removed in the opposite direction—moving backwards "upstream"; except for removing detour signs, which can be removed moving downstream.

While not perfect, consider watching this freeway single left lane closure installation/removal video (7:07).

> WSDOT only allows aluminum signs only on Construction (Fabric signs OK for Maintenance). Transportable attenuators are required to block the lane when the closure taper is being installed and removed on multilane roadways. Maintenance crews riding in traffic control vehicles installing/removing devices must be protected by a shadow vehicle. WSDOT does not use the diamond-shape "END ROAD WORK" signs. Moving signs or devices across open lanes should be avoided; Standard Specification 1-10.3(2)C prohibits moving channelizing devices across open lanes. Using a flagger with a "SLOW" paddle is prohibited on multilane roadway closures in Washington. Transportable attenuator is placed in the closed lane prior to work crews.

While not perfect, consider watching this 2-lane highway lane closure via flagger video (6:22).

> WSDOT does uses aluminum signs only on Construction (Fabric signs OK for Maintenance). WSDOT does not use the diamond-shape "END ROAD WORK" signs. Washington requires at least 4 warning signs on 45 mph roadways; 3+ on 40 mph or less roads. Typically, a protective vehicle or transportable attenuator is placed within the closed lane prior to work crews.

If both directions of traffic are affected, such installing devices in a two-way left turn lane ("center turn lane"), devices can be placed in both directions at the same time starting at each end farthest from the activity area or workspace in a manner that is not confusing to motorists.

When one direction of traffic will be laterally shifted into closed opposing traffic lanes (like in WSDOT Typical Plan TC-12), then temporary traffic control for the closing the opposing traffic lane shall be placed first. After all signs and devices are installed, then temporary traffic control to laterally shift traffic into the closed oncoming lane can be set up.

When signs or channelizing devices are to be installed and removed several times during the work operation, a spot may be painted on the roadway surface to indicate where each device is located. For other closures, a traffic cone can be used to denote the position. This enables the crew to reinstall the devices quickly and properly.

Drivers do not expect workers in the roadway setting up a temporary traffic control zone. Flashing work vehicle lights are required to be used and help warn motorists of the presence of vehicles and workers.

Flashing arrow boards and TMAs are valuable to assist the workers during placement or removal of channelizing devices for lane closures.

Placing Channelizing Devices

When closing a lane, tapers are laid out in a straight line starting at the shoulder. Each channelizing device is then placed in sequence moving downstream. When placed by hand, the devices should be moved out from the shoulder with the worker looking toward traffic as he/she moves into the lane to place the device.

Device Placement

Devices may be placed either by workers on foot or from a moving vehicle.

When riding within a work vehicle or transportable attenuator, workers must be protected by the use of seats & seatbelts, standard guardrail systems, or personal fall restraint systems per DOSH Directive 6.55 as discussed in Section 5.8(3).

When closing lanes on freeways or 45+ mph multilane roadways, a transportable attenuator (in arrow mode) is required to block the lane being closed to protect workers with only the operator allowed in that vehicle. After the lane closure taper is completed, the transportable attenuator (in 4-dot caution mode) is moved into the lane closure protecting workers installing the remaining devices. In addition, DOSH Directive 6.55 states a shadow vehicle (typically a second TA) should be considered behind transportable attenuators with workers for Contractors and WSDOT Maintenance personnel. For additional requirements, see WAC 296-880 and WAC 296-865.

Lateral Position

Typically, channelizing devices are placed at the edge of open lane. There may be situations when work area is sufficient even with devices are set back 1 to 2 feet from the open lane (but not more than 4 feet) as discussed in Section 6.5. By doing so, it reduces the chances of the device being hit and significantly reduces the wind loading (especially to traffic safety drums) by semi-trucks.

Traffic Control Procedures for Installing Lane Closures

Traffic control procedures for various lane closures types are provided in Standard Specifications 1-10.3(2)C and are installed in the following order:

1. PCMS (if shown on Plan)
2. Advance warning signs on opposite shoulder of lane closure (if applicable)
3. Advance warning signs on same shoulder as lane closure
4. Traffic control devices + additional signage within lane closure

Traffic Control Procedures for Removing Lane Closures

Traffic control procedures for various lane closure types are provided in Standard Specifications 1-10.3(2)C and are removed in the following order:

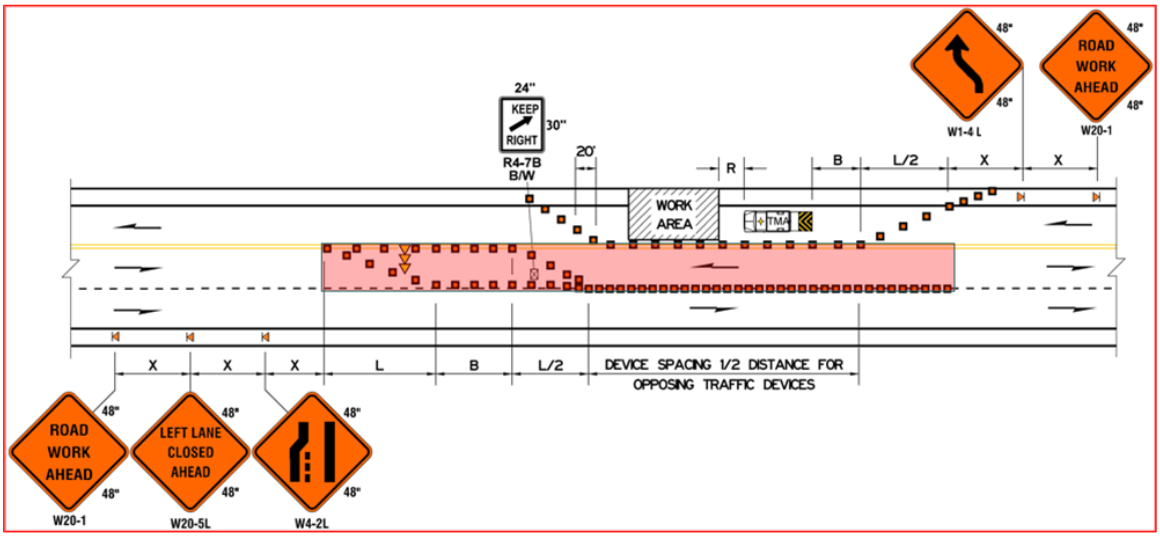
R1. Remove traffic control devices + additional signage going backwards within lane closure
R2. Going downstream on same shoulder as lane closure, remove advanced warning signs
R3. Going downstream on opposite shoulder as lane closure, remove advanced warning signs
R4. Remove PCMS

Remove detour signs going in the direction of traffic along the detour route, not in reverse.

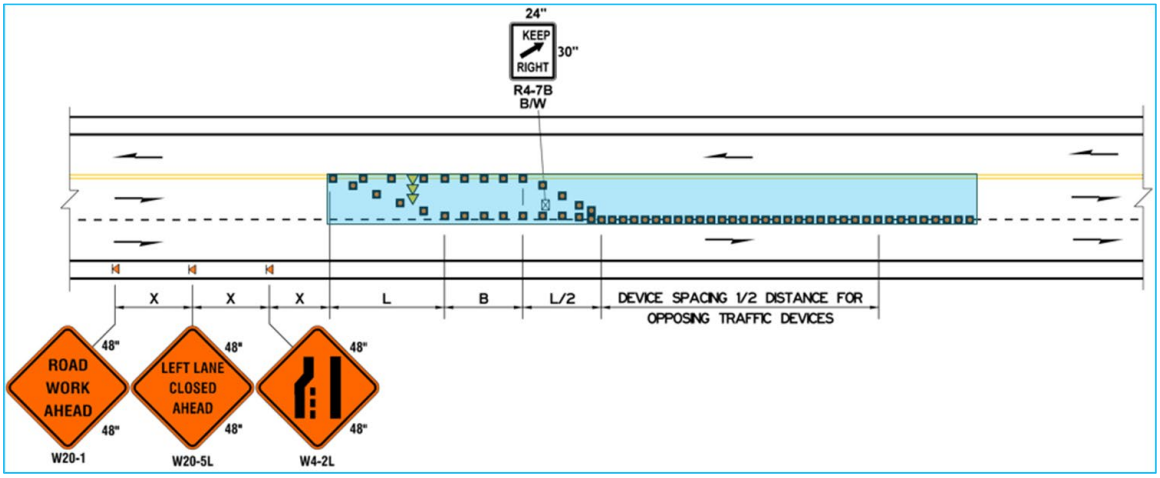
Per MUTCD Section 6B.01, ¶ 09, all traffic control devices shall be removed/covered as soon as practical when no longer needed or when work is suspended for short periods of time (lunch break).

Installation of Traffic Control in Both Directions Sequence

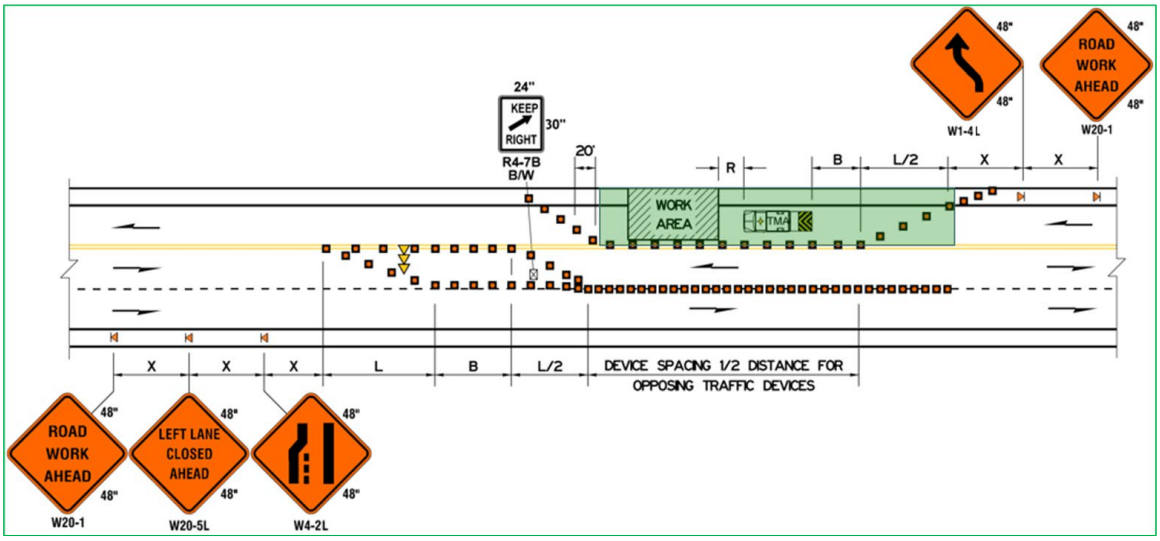
When shifting traffic into closed opposing traffic lanes (or two-way left turn lane)…sequence matters



First, close the oncoming traffic lane (or two-way left turn lane):



Then, install the traffic shift into the closed lane.



11.4 DOSH Directive 6.55

DOSH Directive 6.55 , provided below in modified format, needs to be followed when personnel will be working on a moving vehicles or equipment installing or removing devices.

DOSH DIRECTIVE

Department of Labor and Industries
Division of Occupational Safety and Health
Keeping Washington safe and working

6.55 **Channelizing Device Placement Operations**

Date: May 12, 2021

I. Purpose

This DOSH Directive provides guidance to DOSH compliance and consultation staff when they encounter channelizing device placement and/or retrieval operations from motor vehicles on publicly traveled roadways, highways or construction projects.

II. Scope and Application

This Directive applies to all DOSH compliance and consultation operations statewide regarding protection of employees per the requirements of WAC 296-155-610(2)(i), Securing Material and Employees.

This Directive has been updated with current references, and supersedes DD 6.55 dated July 10, 2019.

III. References

- Chapter 296-880 WAC, Unified Safety Standards for Fall Protection
- 296-155-610(2)(i), Securing material and employees (Motor Vehicles on Construction Sites)
- Manual on Uniform Traffic Control Devices (MUTCD) Part 6, 2009 Edition

IV. Background

This Directive is based on an inspection where employees were placing channelizing devices from a motor vehicle without the protection of seats and seatbelts. As a result of this inspection DOSH entered into an agreement with the employer, which provided alternate means of protection for employees when placing and/or retrieving channelizing devices. Since then, other employers have incorporated these alternate methods of protection into their operations. The alternate methods of protection are listed in Section VI of this Directive.

V. Definitions

- **Channelizing Device:** A device used to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades and longitudinal channelizing devices.
- **Work Zone:** An area of a highway with construction, maintenance or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating or strobe lights on a vehicle to the “END ROAD WORK” sign or the last TTC device.

VI. Enforcement Policies

A. When channelizing devices are being placed and/or retrieved from a motor vehicle, employees must be protected by the use of seats and seatbelts, standard guardrail systems or personal fall restraint systems, as defined in Chapter 296-800 WAC, Unified Safety Standards for Fall Protection.

B. Employers can use the alternate methods of protection while actively placing and/or retrieving channelizing devices in the following areas of a traffic control zone:
   - Shoulder taper
   - Transition area
   - Activity area
   - Downstream taper, as defined in MUTCD, Part 6, 2009 Edition.

C. When transporting employees, the requirements in WAC 296-155-610(2)(i), Securing Materials and Employees, are required to be met.

D. The equipment being used will be constructed in a manner suitable to sustain the load, including personnel. At no time will the equipment and personnel cause the gross vehicle weight rating (GVWR) of the vehicle to exceed the rating of any hitch or attachment used to secure the equipment.

E. Specifications for the strength and design of the vehicle-mounted platforms must be made available to the Department upon request.

F. A quick-release chain or gate will be used at either end of vehicle-mounted platforms. If the centerline of the platform is marked, the chain may be down for escape purposes only if employees stay on the safe side of the centerline.

G. Other protective measures such as a shadow truck, a vehicle with a truck-mounted attenuator to follow the work vehicle, or the use of law enforcement, will be considered.

H. Procedures for the placement and/or retrieval of channelizing devices from motor vehicles must be found in the employer's crash prevention program or other separate policies or documents.

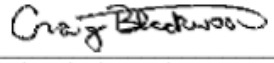
I. When DOSH consultation and compliance staff determine that the employer is following the procedures outlined above, DOSH considers it a de minimis violation, and will not issue a citation, or identify the violation as a hazard in the consultation report.

VII. References

DOSH staff should contact DOSH Technical Services if they have questions, or need additional guidance or interpretive assistance regarding traffic control requirements and channeling device placement and/or retrieval operations.

VIII. Review and Cancelation

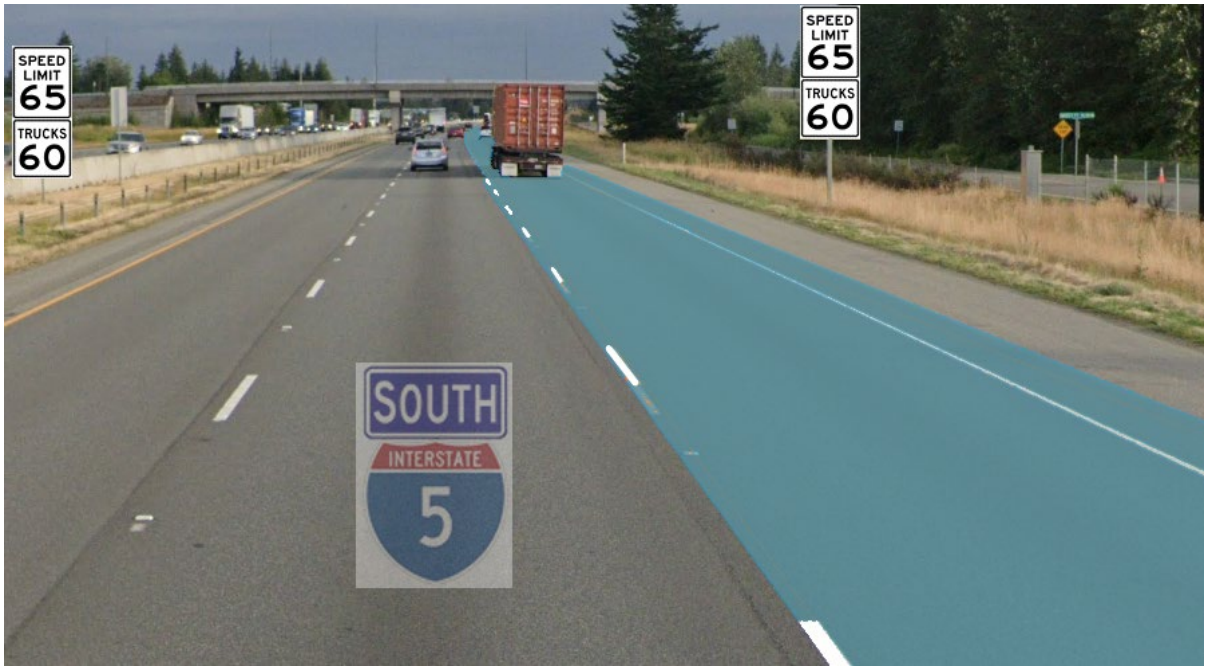
DOSH will review this Directive within two years from the issue date, and it will remain effective until superseded or canceled.

Approved: 

Craig Blackwood, L&I Acting Assistant Director
Division of Occupational Safety and Health

Exercise 11-1 – Traffic Control Layout

You are coordinating with the Traffic Control Manager about the upcoming work operation on Interstate 5 to repave, with Hot Mix Asphalt, the right lane highlighted in blue below:



Work Area Limits:	Southbound I-5 @ MP 204.50 to 203.00 (1.5 miles)
Work Area Coordinates:	48.1303694,-122.1858842 to 48.1079101,-122.185084
Roadway Configuration:	6' left shoulder, 12' lanes, 10' right shoulder
Work Operation:	Freeway HMA Paver Video

Step 1: Find out when this work is scheduled.

Traffic Control Manager says next Monday night (it's currently Thursday night the week prior).

Step 2: Determine what closure is needed for this work.

_____

Step 3: Using Google Maps, what features are nearby that could impact the traffic control layout?

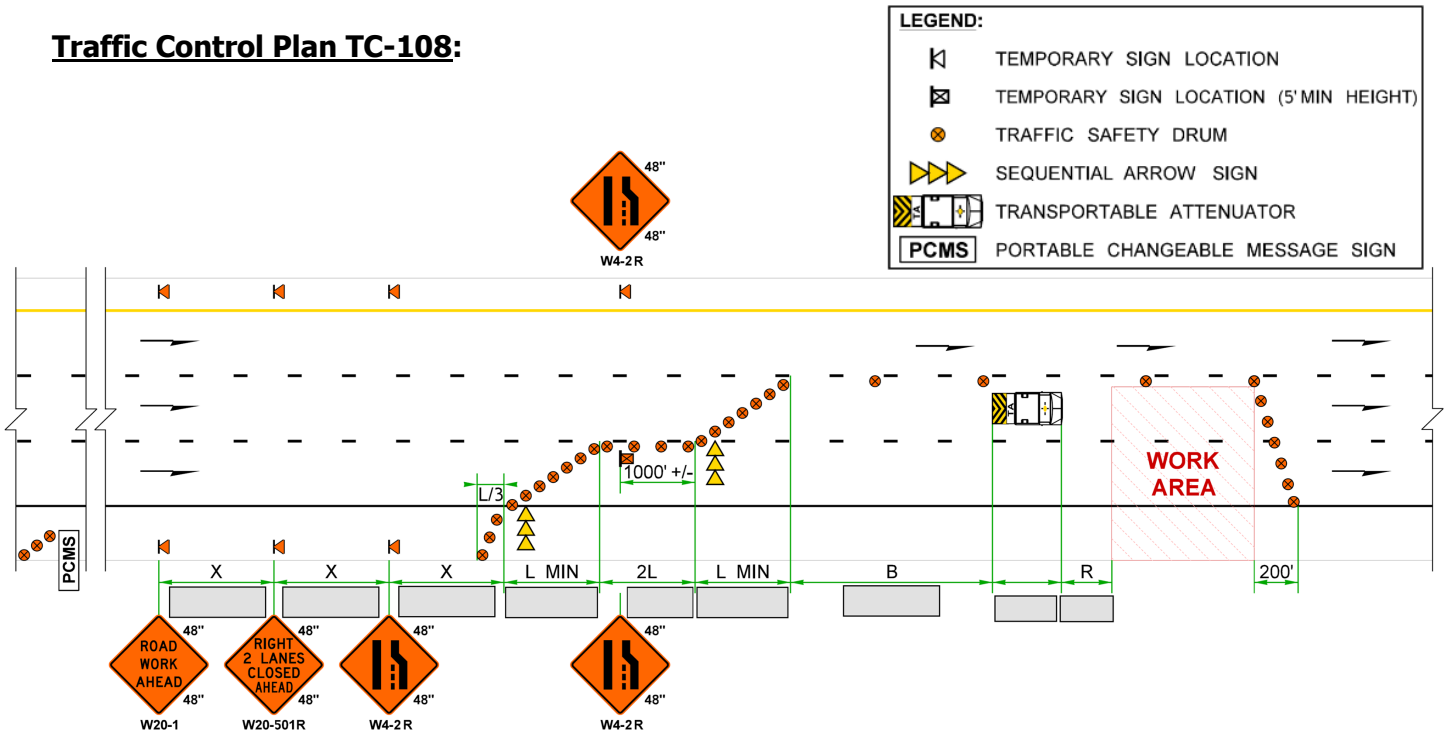
_____

_____

<u>Step 4</u>: Obtain the correct traffic control plan and determine the spacing/distances based on this scenario:

- Double right freeway lane closure including adjacent shoulder
- Speed Limit 65 (Trucks 60)
- 12-foot lane width
- 10-foot right shoulder width
- Assume transportable attenuator is 80 feet in length & 30,000 pounds in weight
- Work area is exactly 3 miles in length (5,280 feet in a mile)
- Closure layout not affected by on-ramps or exit-ramps; additional signage needed along prior on-ramp as it falls after the "ROAD WORK AHEAD" sign on mainline
- Use 20' channelizing device spacing for downstream taper

<u>Traffic Control Plan TC-108</u>:



SIGN SPACING = X (1)		
FREEWAYS & EXPRESSWAYS	50-75 MPH	1500' +/-
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	**200' +/- (2)**
URBAN STREETS	25 MPH OR LESS	**100' +/- (2)**

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.

(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.

SHOULDER CLOSURE TAPER LENGTH = L/3							
SHOULDER WIDTH	SPEED (MPH)	50	55	60	65	70	75
6'	L/3 (feet)	120	120	120	160	160	160
10'		200	200	200	240	240	280
FOR SHOULDERS LESS THAN 6', USE 3 DEVICES MINIMUM							

LANE CLOSURE TAPER LENGTH = L													
LANE WIDTH	SPEED (MPH)	20	25	30	35	40	45	50	55	60	65	70	75
12'	L (feet)	80	140	180	270	330	540	600	680	720	800	840	920
On roadways 40 mph or less, lane closure taper may be reduced based on field conditions.													

STATIONARY TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R			
HOST VEHICLE WEIGHT 9,900 TO 22,000 lbs.		HOST VEHICLE WEIGHT 22,001+ lbs.	
45-55 MPH	60+ MPH	45-55 MPH	60+ MPH
123'	172'	100'	150'

LONGITUDINAL BUFFER SPACE = B						
SPEED (MPH)	50	55	60	65	70	75
B (feet)	425	495	570	645	730	820

MAXIMUM CHANNELIZATION DEVICE SPACING (feet)		
MPH	TAPER	TANGENT
50-75	40	80
35-45	30	60
20-30	20	40

Step 5: "Layout" this double lane closure on Google Maps or via field visit. Does it work?

Exercise 11-2 – Traffic Control Inventory

For the scenario described in Exercise 11-1, determine the traffic control inventory needed:
(Remember: Add "1" extra channelizing device to get started)

Step 6: Determine Number of Channelizing devices In Each Segment:

Segment	Distance	Spacing	# Devices
Total			

Step 7: Traffic Control Inventory:

Device Description	Quantity
Portable Changeable Message Sign (PCMS)	
Temporary Signs	
Temporary Sign (5' Min Height)	
Arrow Boards	
Transportable Attenuator(s)	
Traffic Safety Drums	

11.5 Traffic Control Setup & Removal Example

Determining the layout and inventory for the Southbound I-5 double right lane closure in Exercise 11-1 and Exercise 11-2 is no small task, but our work is far from complete.

Now we have to focus on scheduling the installation and removal of this double lane closure.

After looking into the Contract Provisions (Design-Bid-Build projects) or Request for Proposal Section 2.22 (Design-Build projects), the closure hours on Monday night is as follows:

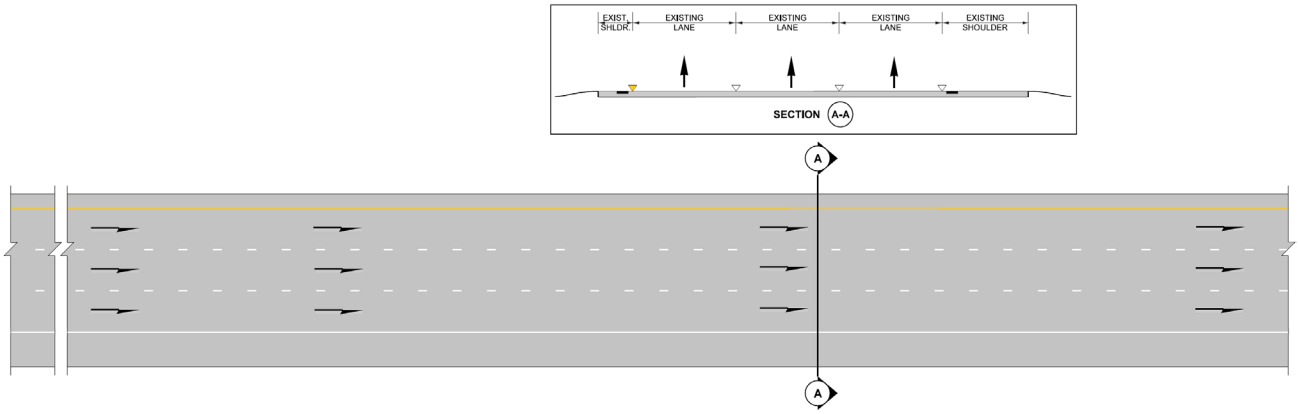
Southbound I-5 Permitted Lane Closure Hours		
	1 Lane Closed	**2 Lanes Closed**
Weeknight Closures (Sunday night – Thursday nights)	7:00pm – 4:15am (9.25 hours)	10:45pm – 3:45am (5 hours)

Summary of traffic control operations:

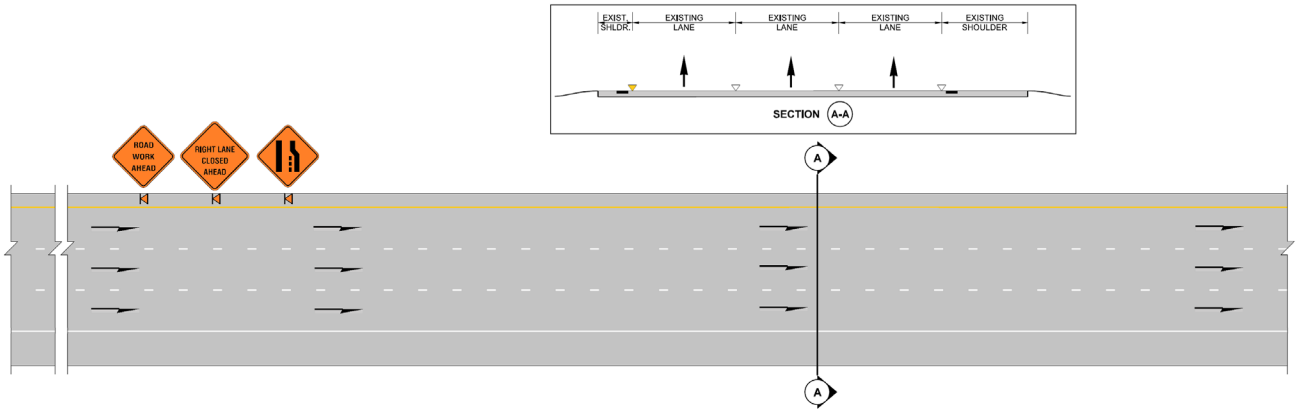
1. Close 1st right lane, the entire length of the work zone
2. Close 2nd right lane
3. Perform HMA paving work
4. Remove 2nd right lane closure
5. Remove 1st right lane closure

Traffic Control Operation Details:

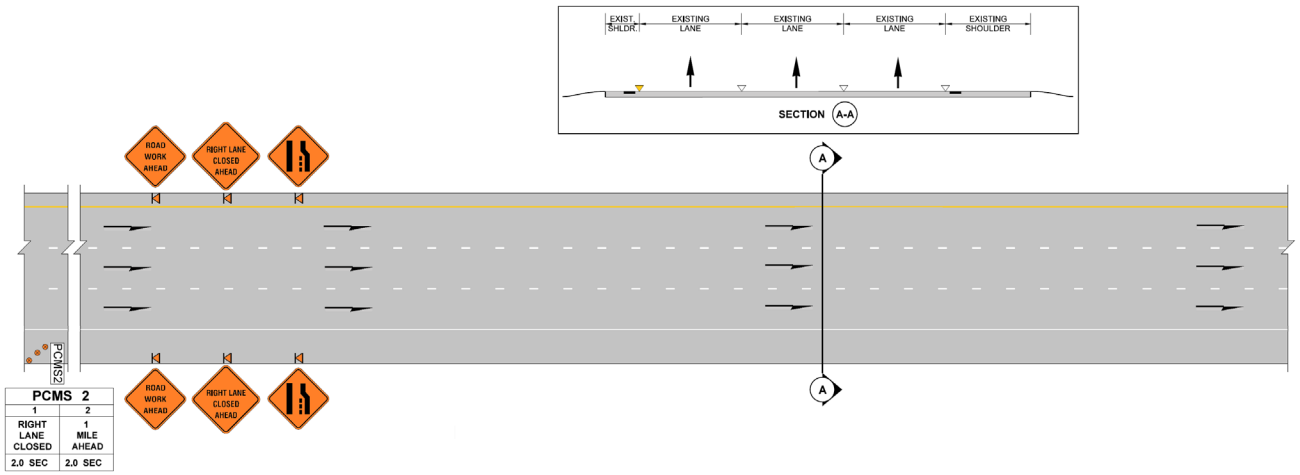
6:30pm: Existing Roadway before any temporary traffic control installed.



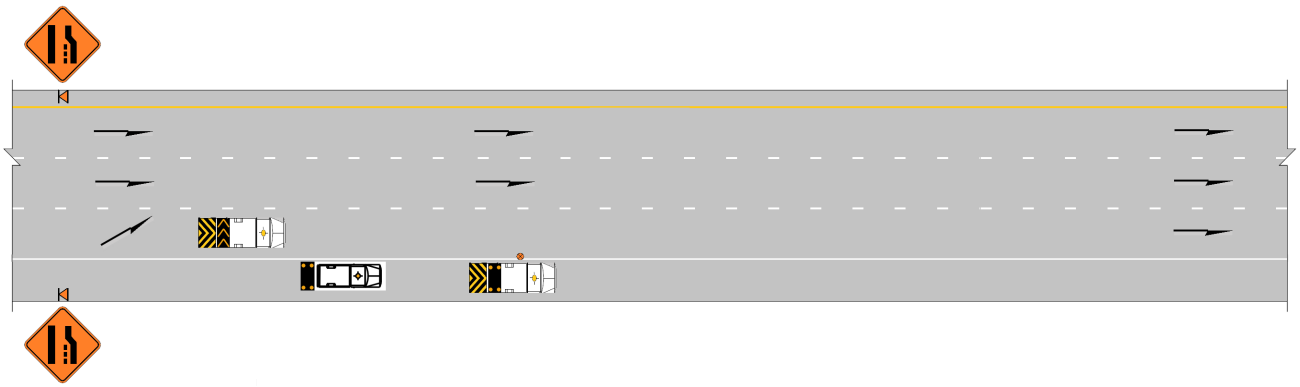
6:40pm: Place advanced warning signs on left shoulder



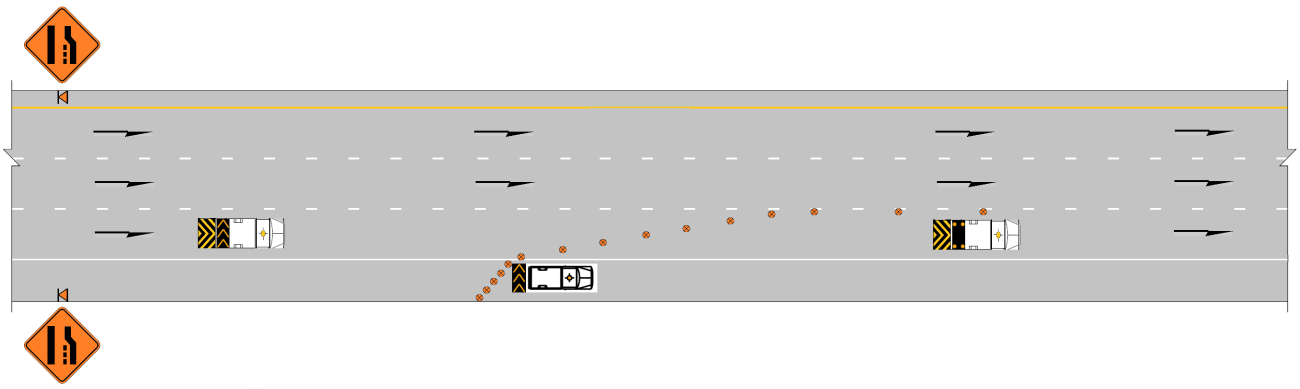
6:50pm: Place PCMS & advanced warning signs on right shoulder



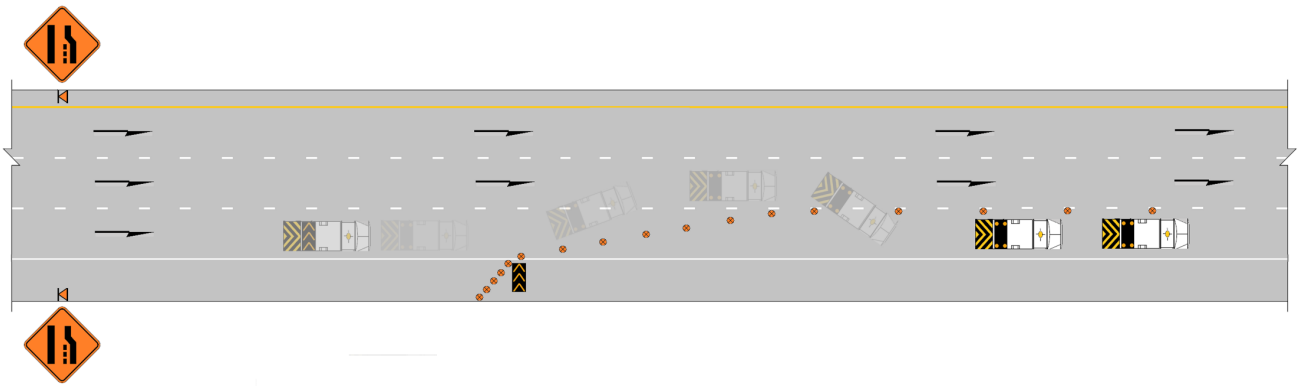
7:00pm: Block right lane with shadow transportable attenuator (TA).



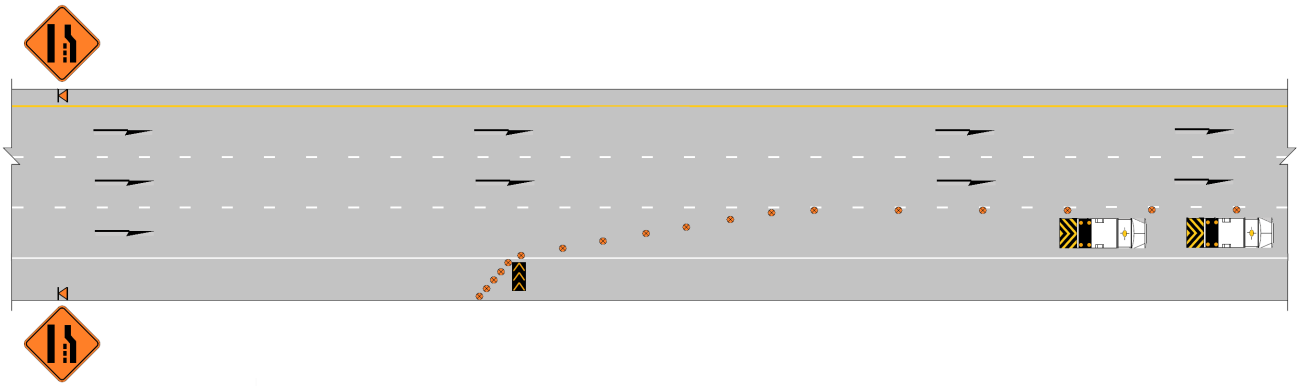
7:13pm: Install first right lane closure taper with arrow board.



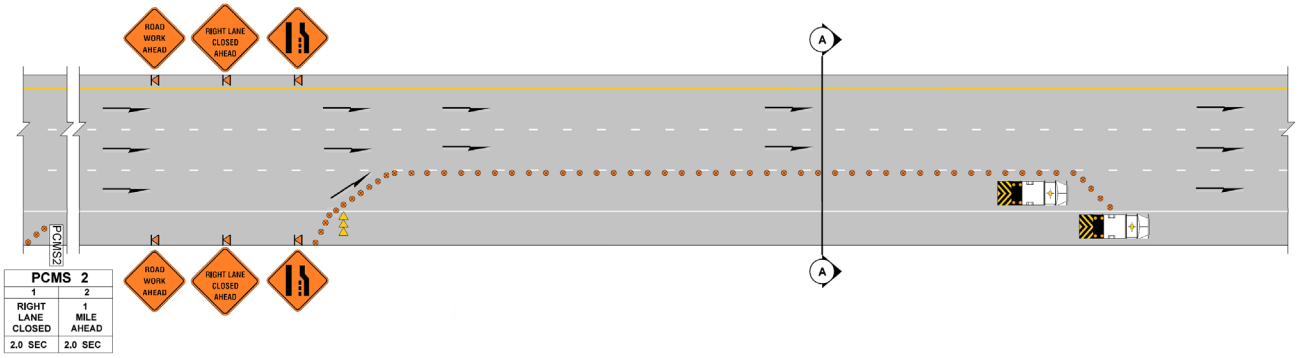
7:16pm: Pull shadow TA into lane closure behind TA with workers places channelizing devices.



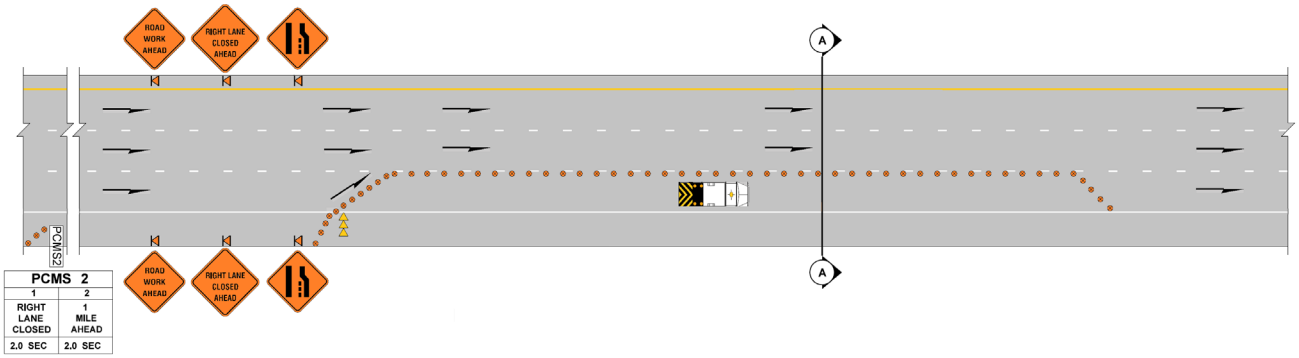
7:17pm: Place remaining devices + additional signs for single right lane closure to end of work area.



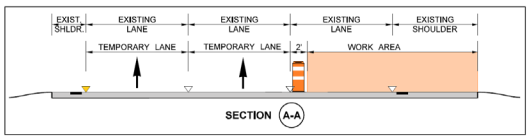
7:26pm: Single right lane closure installed.

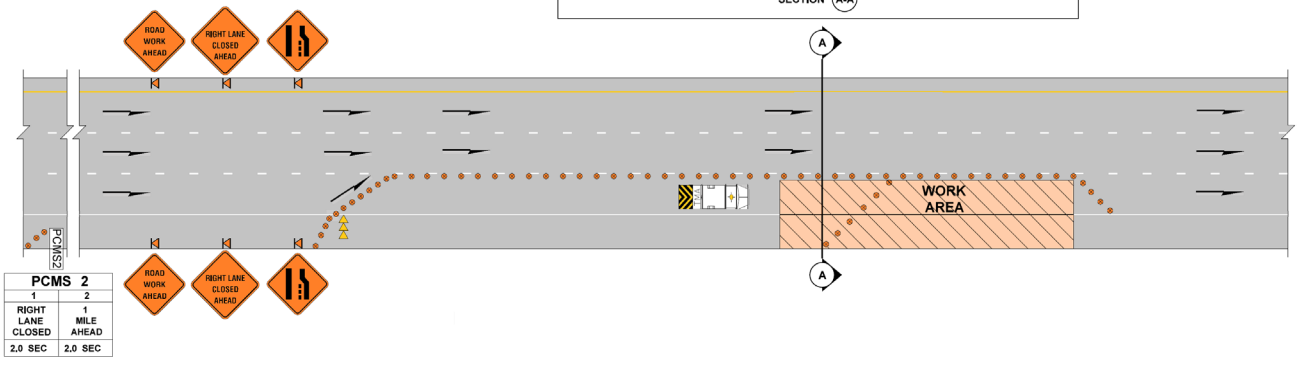


7:30pm: Transportable attenuator positioned prior to work area.



7:32pm: Work crews begin mobilizing into work area and prepare for the HMA paving operation. It is important to note crews cannot begin paving in the single right lane yet.

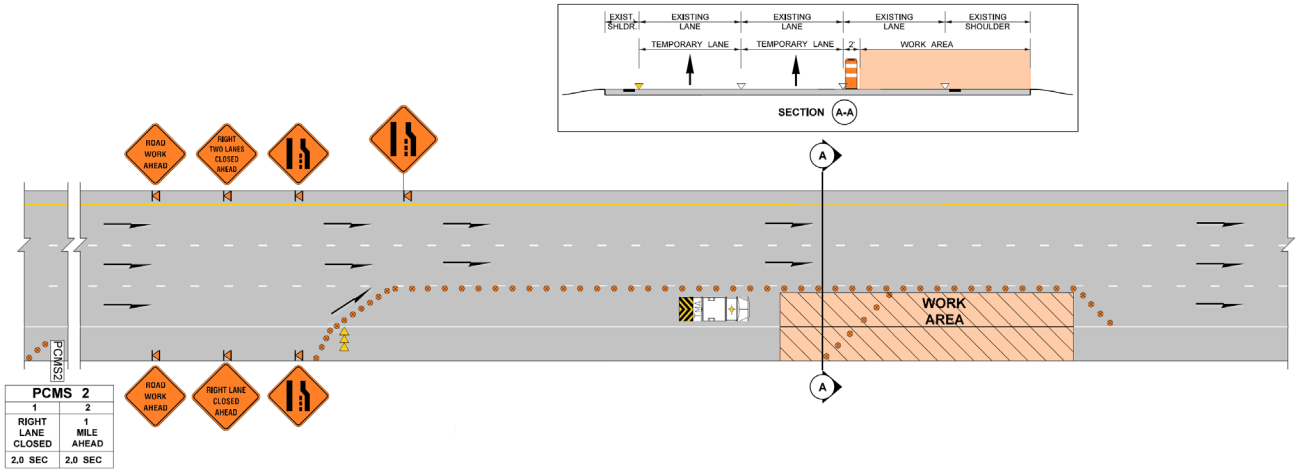




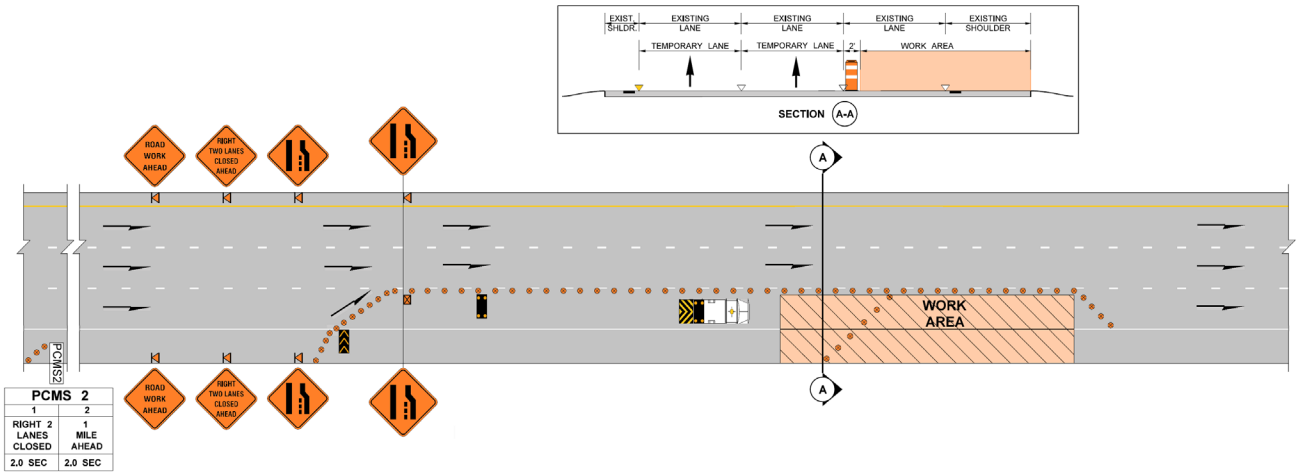
Now, Traffic Control Supervisor will perform a drive-thru inspection of the traffic control setup and traffic control crews wait until the second lane can be closed at 10:45pm. They'll start updating signage and prestaging needed devices starting about 10:15pm.

Southbound I-5 Permitted Lane Closure Hours		
	1 Lane Closed	**2 Lanes Closed**
Weeknight Closures (Sunday night – Thursday nights)	7:00pm – 4:15am (9.25 hours)	10:45pm – 3:45am (5 hours)

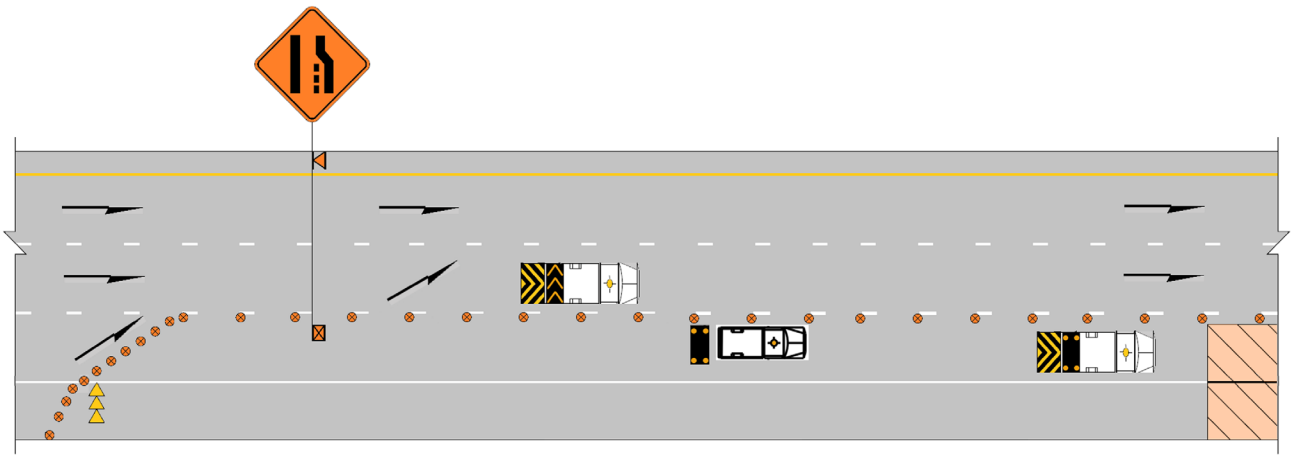
10:20pm: Prepare for the 2nd lane closure; update signage on left shoulder



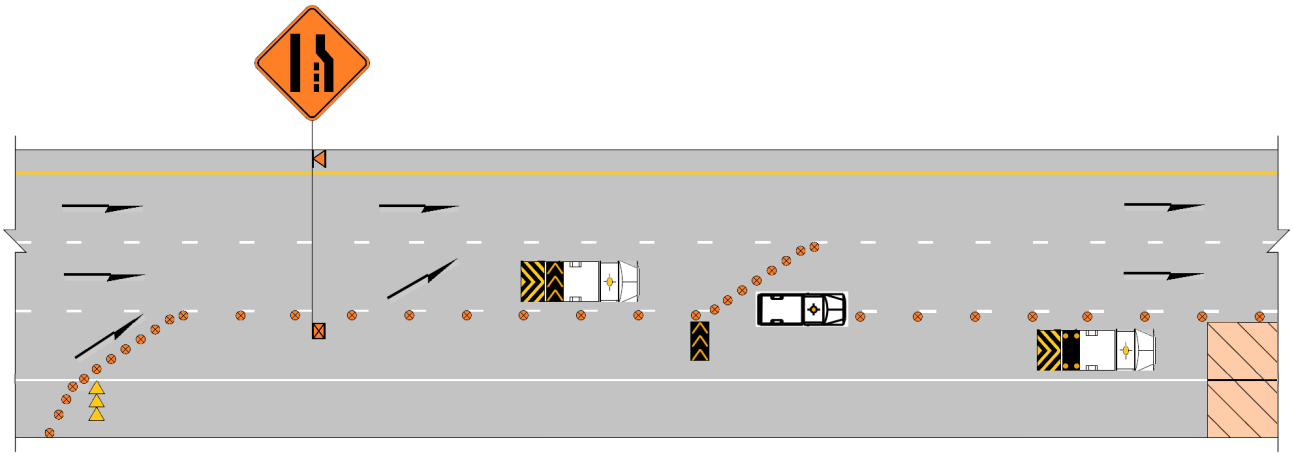
10:35pm: Update PCMS & signs on right shoulder. Pre-stage the arrow board for 2nd lane closure.



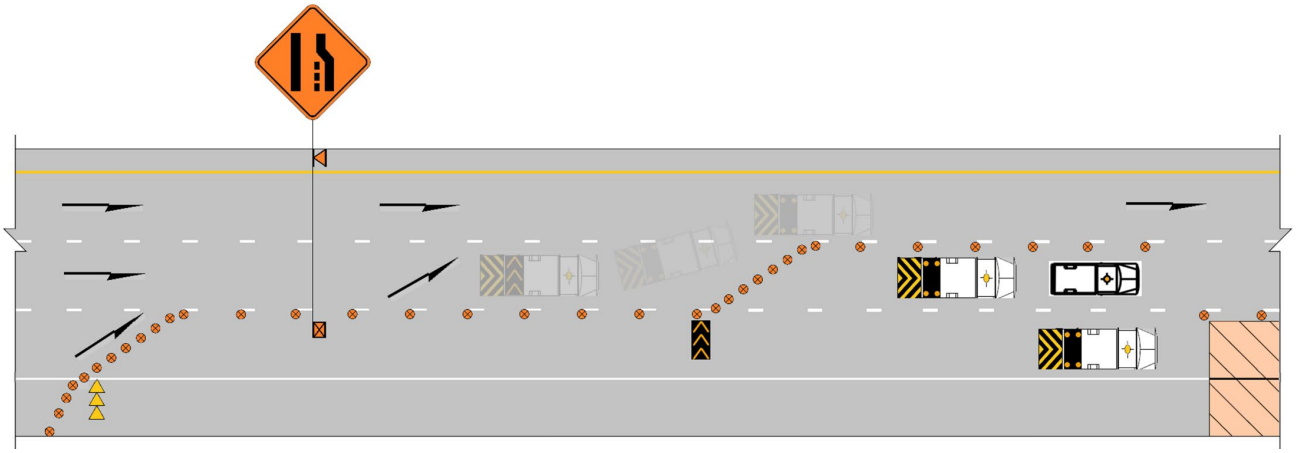
10:45pm: Block center lane with shadow transportable attenuator (TA).



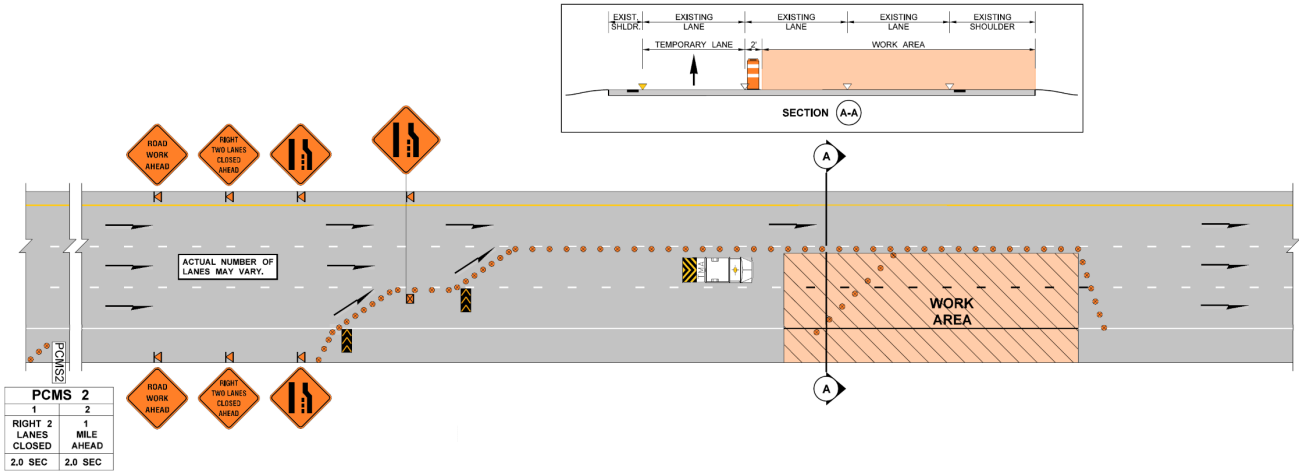
10:47pm: Slide over devices for the second lane closure taper. (Alternative methods may be used).



10:53pm: Second lane closure taper installed; shadow TA pulls into lane closure behind TC crews.



11:10pm: Traffic control crews complete installing 2nd right lane closure. Position TA behind work area (in closed lane adjacent to open lanes; additional TA can be added in the closed right lane.



Finally (after 4 hours of setting up traffic control) HMA paving crews can start their work operations and start paving the right lane + 2' of the right shoulder.

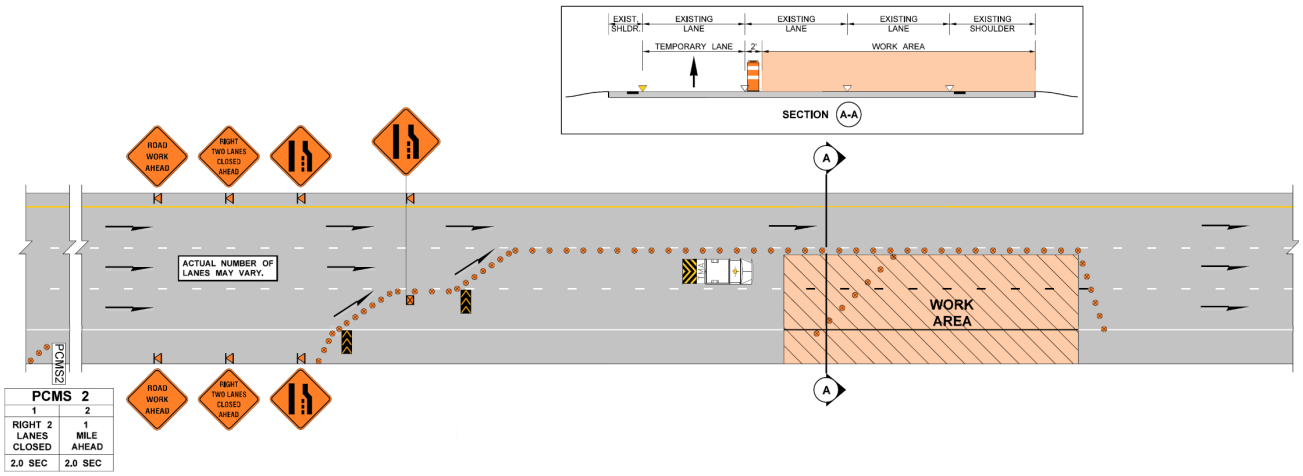
Now, Traffic Control Supervisor will perform hourly drive-thru inspection of the traffic control setup. Traffic control crews perform patrol and maintenance on traffic control devices and equipment, study upcoming closures, and commence training (such as reading this TCS course book...with coffee, lots of coffee!).

The Traffic Control Manager and TCS will need to discuss when traffic control needs to be removed (so lanes are reopened prior to the end of the permitted closure hours) as to avoid liquidated damages, which can be upwards of $1000s per 15-minute intervals.

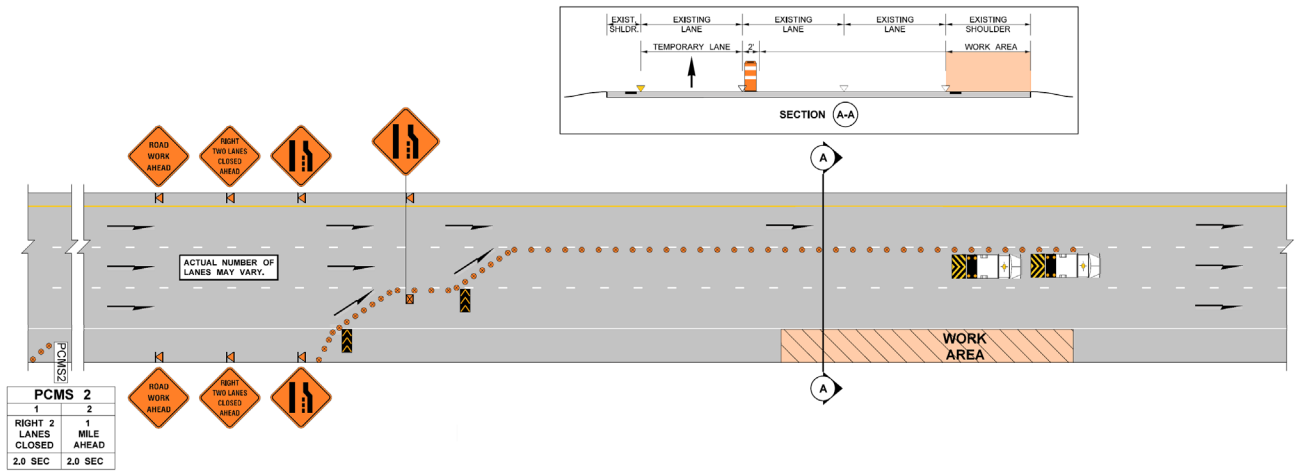
When performing HMA paving, the paving crews have to stop soon enough to install the 50:1 taper joint, finish compacting the HMA via rollers, clean up, demobilize, let the HMA pavement cool (from 325°F down to 175°F) to install temporary pavement markings. A well-trained traffic control crew can remove 1.5 miles of closure in 20 minutes, so the TCS wants to be in position and removing devices no later than 3:25am to get the 2nd lane reopened by 3:45am.

Southbound I-5 Permitted Lane Closure Hours		
	1 Lane Closed	**2 Lanes Closed**
Weeknight Closures (Sunday night – Thursday nights)	7:00pm – 4:15am (9.25 hours)	10:45pm – 3:45am (5 hours)

3:00am: Work crews finish up work and begin demobilizing.

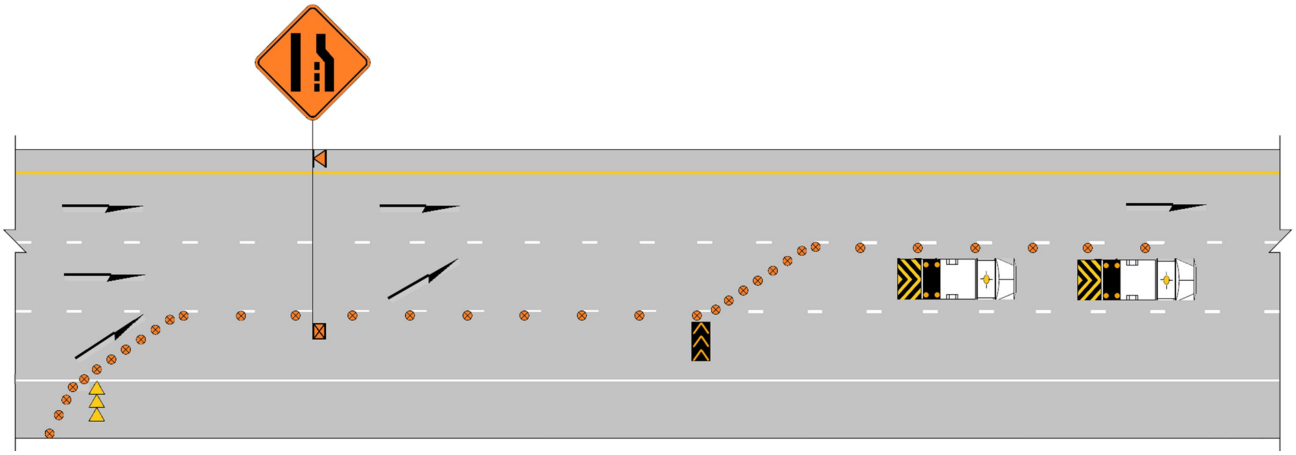


3:25am: Traffic controls are in position and begin removing the 2nd lane closure. Any remaining demobilizing is completed from the right shoulder.

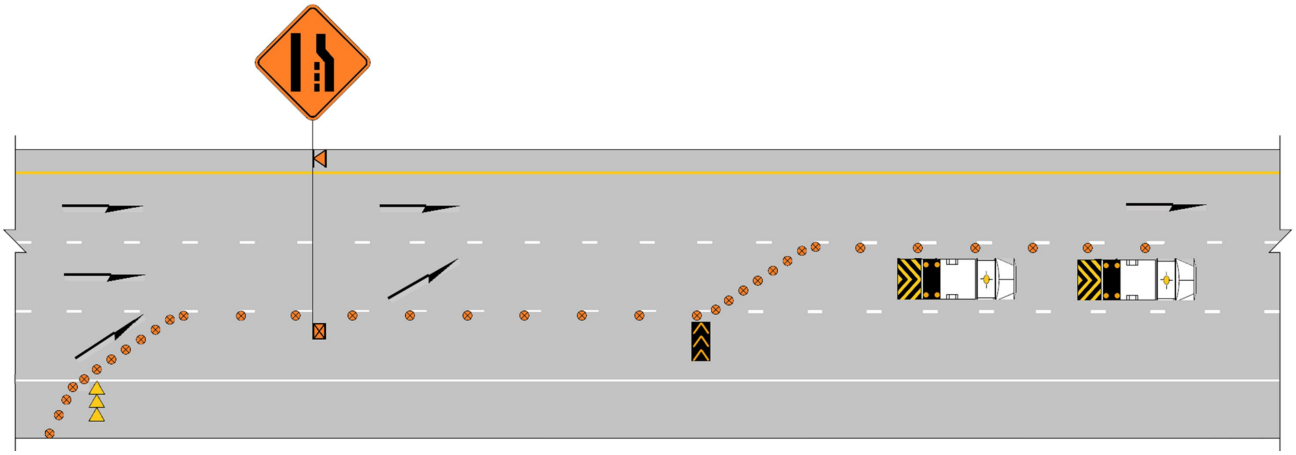


(Continued)

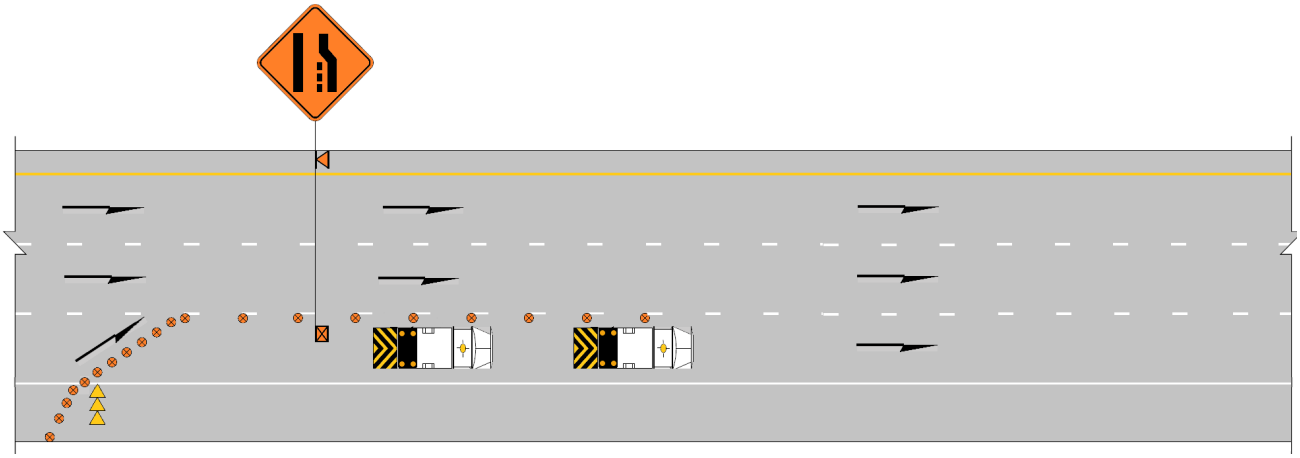
3:40am: Shadow TA protects front TA with crews picking up channelizing devices. Crews have nearly reached the 2nd lane closure taper.



3:42am: The second arrow board is removed and TAs transition along the closure taper down into the closed right lane. The final devices in the 2nd lane closure are removed.



3:45am: The 2nd right lane has been reopened. Crews continue removing the 1st lane closure.

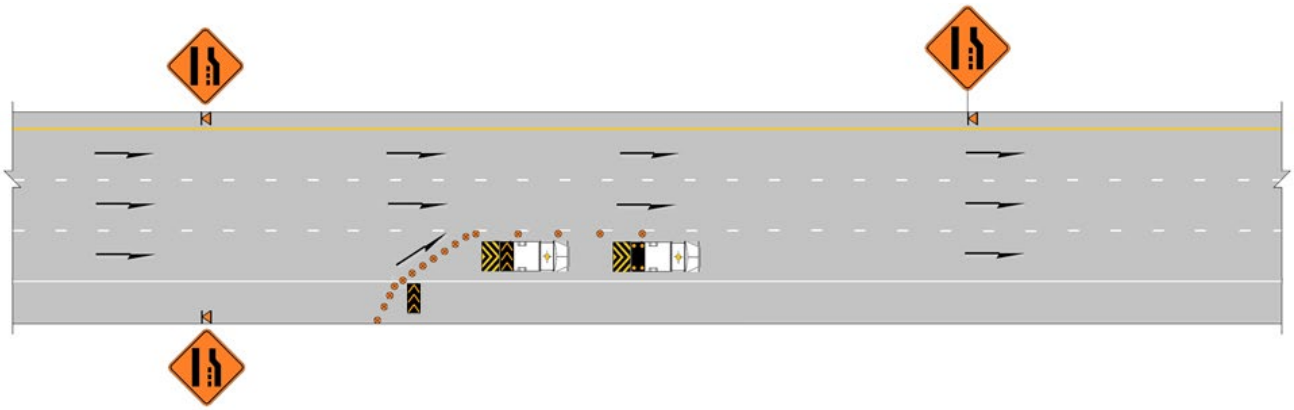


(Continued)

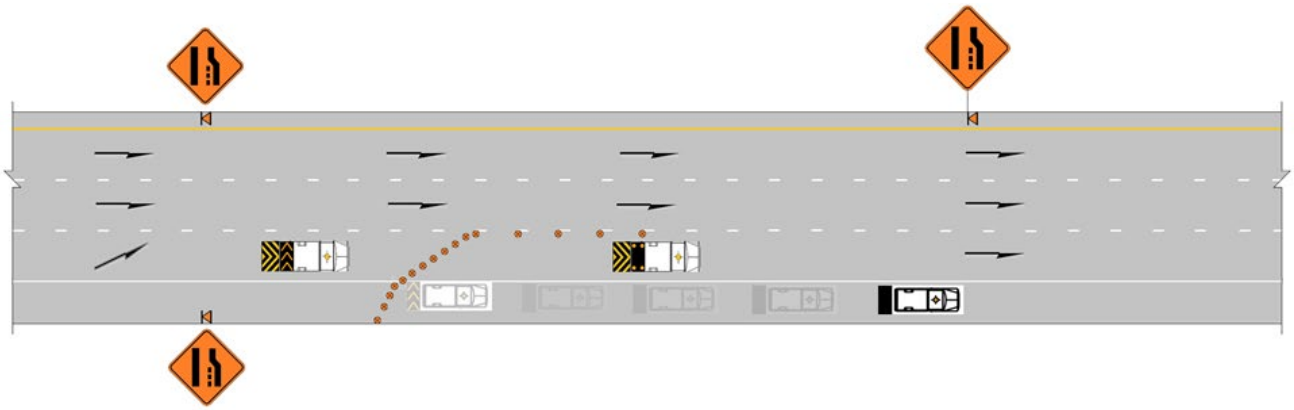
Now the traffic control crew focuses on removing the first right lane closure by 4:15am.

Southbound I-5 Permitted Lane Closure Hours		
	1 Lane Closed	**2 Lanes Closed**
Weeknight Closures (Sunday night – Thursday nights)	7:00pm – 4:15am (9.25 hours)	10:45pm – 3:45am (5 hours)

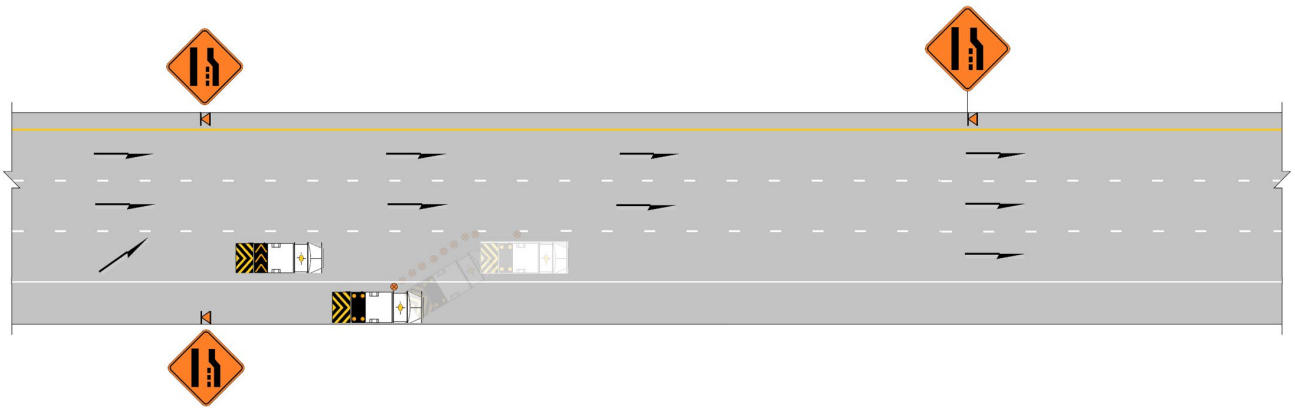
3:55am: Crews reach the 1st lane closure taper. The shadow TA repositions to block the lane closure taper (typically by "looping around" by legal travel movements using adjacent interchange, which takes several minutes).



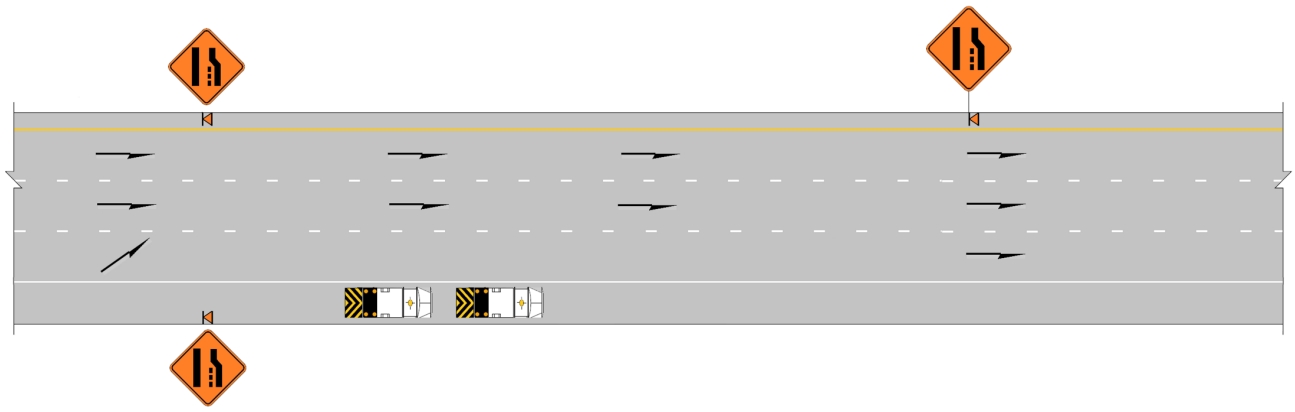
4:07am: After the shadow TA is blocking the lane closure taper, the trailer-mounted arrow board is removed and crews continue removing the remaining channelizing devices to reopen all lanes.



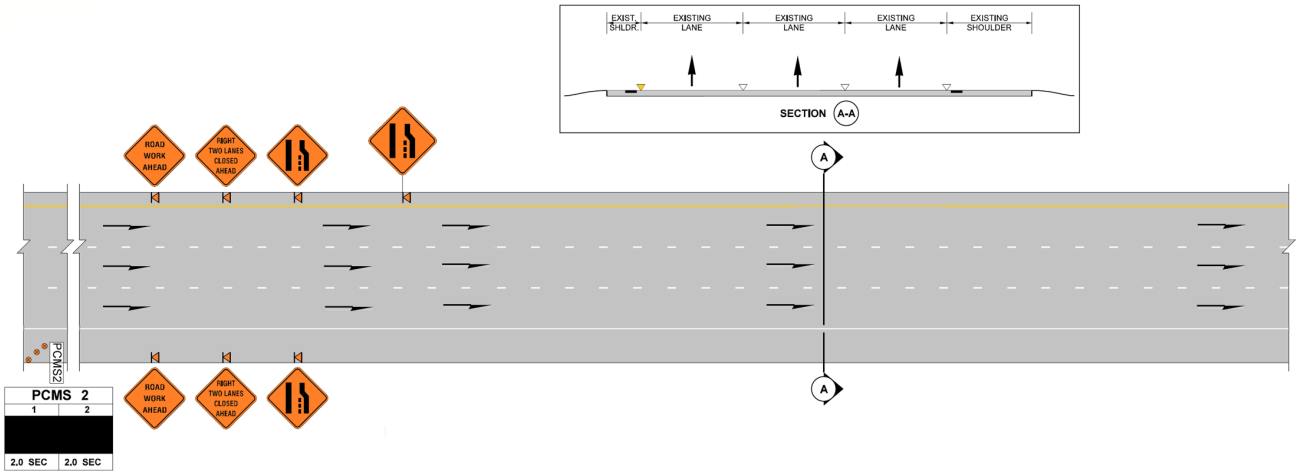
4:13am: Finish removing channelizing devices.



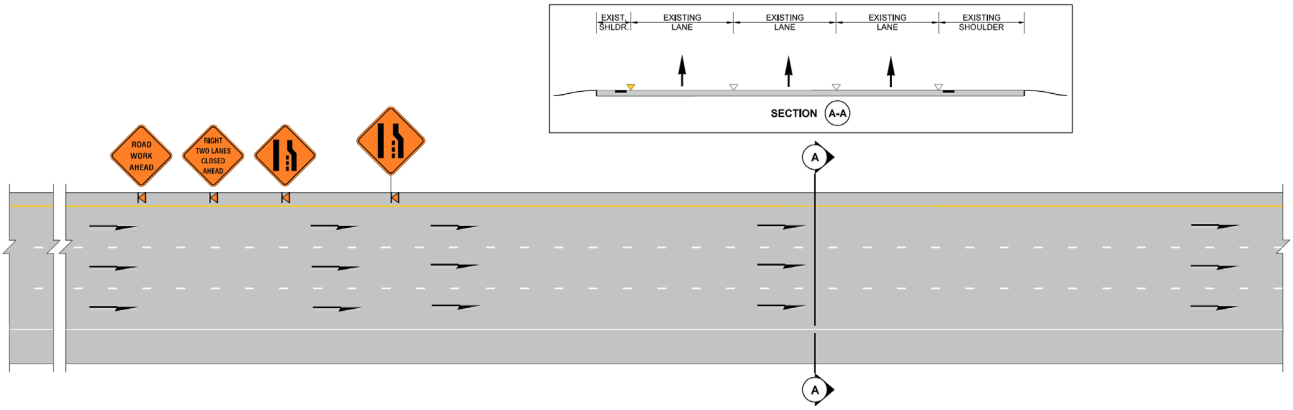
4:15am: All lanes reopened. Pull TAs over onto shoulder and demobilize.



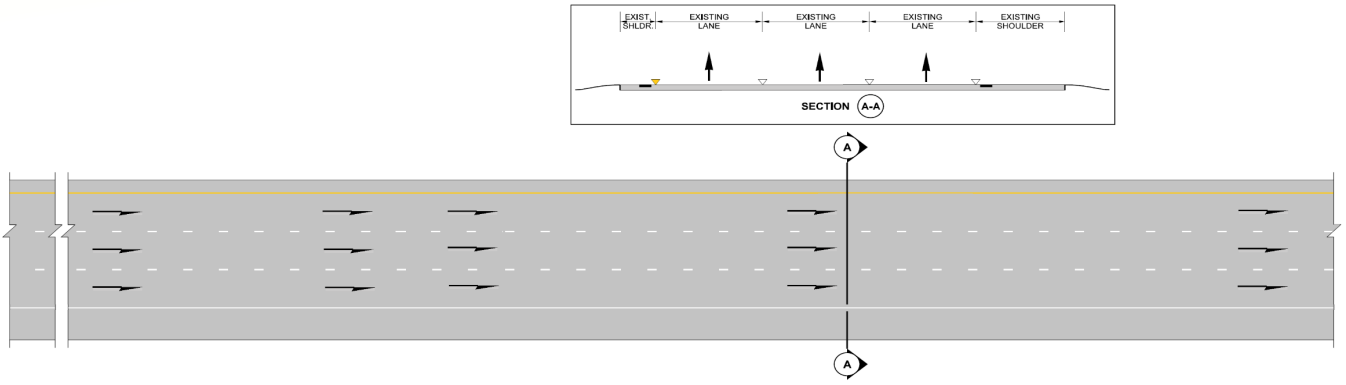
4:20am: Begin removing temporary signs, PCMS, and arrow boards from right shoulder.



4:30am: Begin removing temporary signs on left shoulder.

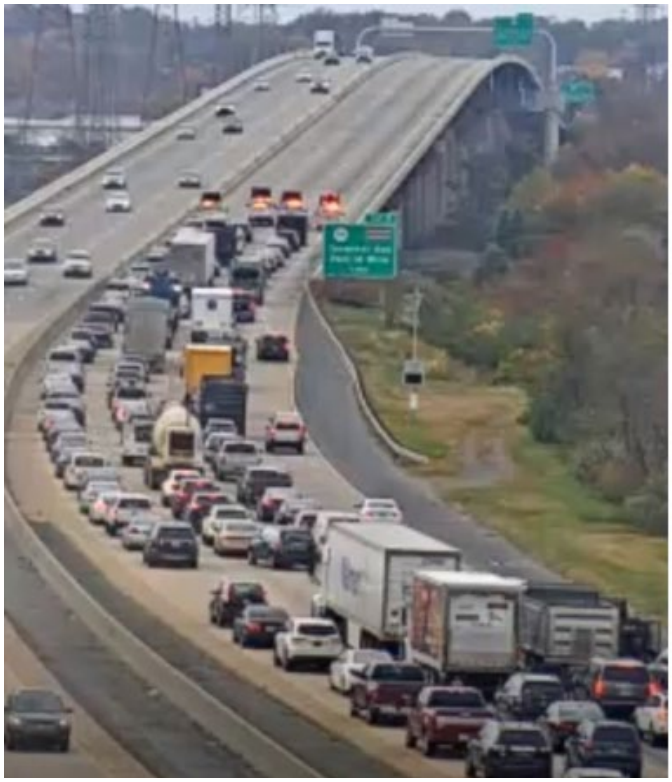


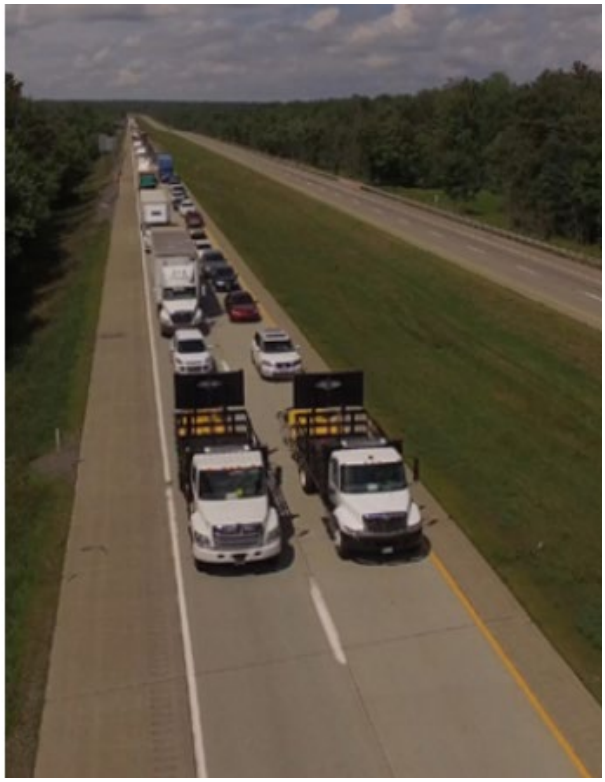
4:40am: All PCMSs, arrow boards, and signs removed from roadway (work zone clear zone). Traffic control crews return to Contractor's staging yard.



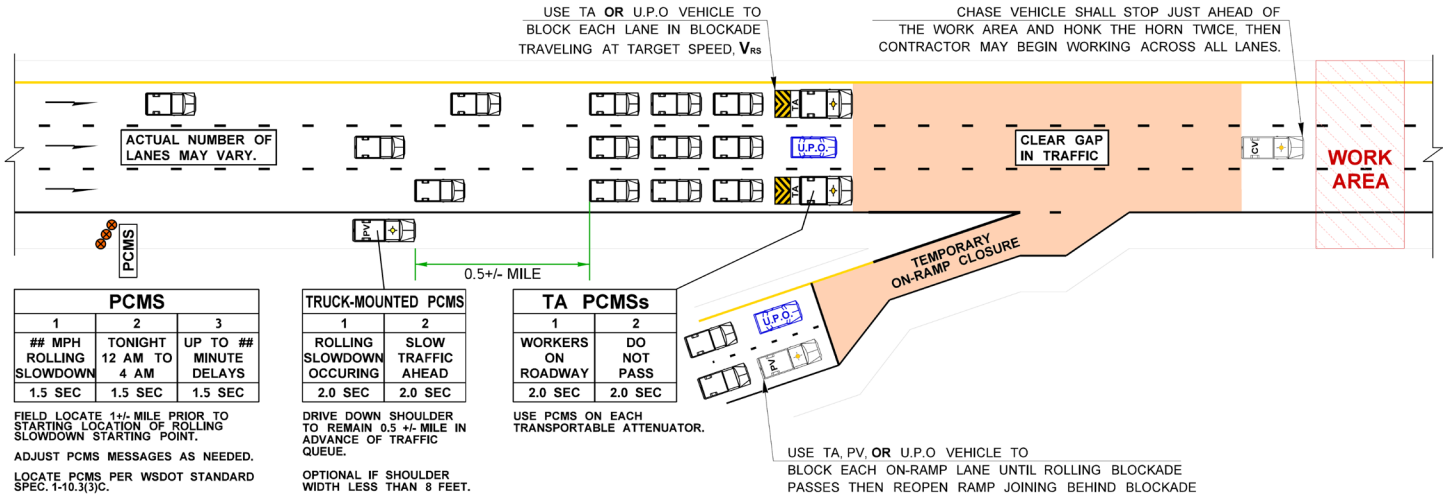
11.6 Rolling Slowdowns

Rolling slowdowns use a rolling blockade of vehicles in each lane, each equipped with amber warning lights, traveling at slow speeds to create a gap in traffic to enable completion of work activities requiring exclusive access across or over the directional roadway that would otherwise present significant risks to motorists. See Standard Specifications 1-10.3(2)B for additional information.





It is critical no traffic gets between the rolling blockade and work area. Within the limits of the rolling slowdown, traffic is held at most on-ramps, while freeway-to-freeway on-ramps should be closed with standard traffic control devices. Exit-ramps may remain open.



PCMS		
1	2	3
## MPH ROLLING SLOWDOWN	TONIGHT 12 AM TO 4 AM	UP TO ## MINUTE DELAYS
1.5 SEC	1.5 SEC	1.5 SEC

FIELD LOCATE 1+/- MILE PRIOR TO STARTING LOCATION OF ROLLING SLOWDOWN STARTING POINT.

ADJUST PCMS MESSAGES AS NEEDED.

LOCATE PCMS PER WSDOT STANDARD SPEC. 1-10.3(3)C.

TRUCK-MOUNTED PCMS	
1	2
ROLLING SLOWDOWN OCCURING	SLOW TRAFFIC AHEAD
2.0 SEC	2.0 SEC

DRIVE DOWN SHOULDER TO REMAIN 0.5 +/- MILE IN ADVANCE OF TRAFFIC QUEUE.

OPTIONAL IF SHOULDER WIDTH LESS THAN 8 FEET.

TA PCMSs	
1	2
WORKERS ON ROADWAY	DO NOT PASS
2.0 SEC	2.0 SEC

USE PCMS ON EACH TRANSPORTABLE ATTENUATOR.

Rolling slowdowns may commence with additional temporary traffic control already set up (such as lane closures). Rolling slowdowns are commonly used directionally on freeways due to their limited access. For other roadways, traffic holds are more appropriate.

Agency-accepted traffic control plans are required detailing the expected rolling slowdown duration, clear time at the work area, limits and target speed of the rolling slowdown, mainline rolling blockade details, chase vehicle details, temporary on-ramp closure details, portable changeable message signs used to warn traffic of the slowdown, and any other additional requirements.

Work activities that typically necessitate a rolling slowdown typically have work durations of less than 10 minutes and may include but are not limited to the following:

- Utility line installation or removal over a freeway
- Removing an existing sign structure spanning over the freeway
- Reconfiguration of all freeway lanes that are narrowed and laterally shifted in the same work shift when reopening lanes to switch traffic control (from left to right lane closures, or vice versa) is not feasible. Rolling slowdown is used to either switch the closure or install a chicane
- During installation of traffic induction loops for permanent traffic recorders that use a single lead-in across all freeway lanes to a stub-out to one shoulder to tie all the loops together. Rolling slowdown is used to either switch the closure or install a chicane
- Emergency roadway or bridge repairs having short work durations (≤ 10 minutes)
- With Agency's acceptance, move large equipment (cranes, drilling rigs, etc.) across the freeway verses demobilizing and mobilizing it that leads to considerable delays and increased costs
- With Agency's acceptance, provide construction vehicle ingress/egress movements between the work area onto mainline traffic in locations having minimal adverse traffic impacts and delays

Simultaneous freeway rolling slowdowns in multiple directions occurring at the same time is allowable when work operations occur across both directions of traffic; however, these are far more complicated. Typically, a Rolling Slowdown Coordinator and UPO coordinator is in radio contact with their crews and positioned near the work area to help orchestrate this more complex operation.

A directional freeway closure is recommended in lieu of freeway rolling slowdowns during the following work operations exceeding 15 minutes across all lanes in one direction such as:

- Setting new bridge girders
- Demolishing overhead bridge spans
- Removing overhead structural falsework
- Installing a new sign structure

11.6(1) Guidance

The following guidance applies when implementing rolling slowdowns:

- Avoid rolling slowdown durations exceeding 15 minutes (18 minutes used in a 70-mph zone)
- Target rolling slowdown speeds 40 mph less than the posted speed limit when feasible
- Detours around the limits of the rolling slowdown are not necessary
- Traffic should not be stopped during rolling slowdowns, except as a last resort due to a unique circumstance or due to an emergency
- Use transportable attenuator in each blocked lane on mainline. Consider adding a Washington Patrol (WSP) vehicle as a rolling blockade vehicle in one of blocked lanes
- Hold on-ramp traffic until the rolling blockade passes using construction or police vehicles placed prior to the paved gore in each on-ramp lane
- Avoid holding traffic on freeway-to-freeway on-ramps, which should be closed with standard traffic control devices and may include signed detour routes
- A chase vehicle should follow the slowest vehicle ahead of each directional rolling blockade up to the work area to ensure the roadway is clear

- For concurrent rolling slowdowns in two or more directions, position a Traffic Control Coordinator with a WSP Coordinator near the work area to coordinate the rolling slowdown, respond to any incidents, and to coordinate needed emergency response
- Inform Washington Patrol, local fire, police, emergency service agencies, and transit agencies (if applicable) at least 72-hours in advance of non-emergency rolling slowdowns
- For significant freeway rolling slowdowns occurring within Transportation Management Areas (Seattle-Tacoma, Spokane, and Kennewick-Richland-Pasco, Bremerton, Olympia-Lacey):
  - Limit permitted rolling slowdowns to hours of lowest volumes; 11:00 p.m. to 4:00 a.m. during weeknights and 11:59pm to 6:00 a.m. on weekends
- Require as part of the traffic control plan acceptance, a meeting with all necessary stakeholders to define responsibilities and ensure activities required for successfully executing a rolling slowdown will be followed
- Consider a PCMS to provide advanced notification of rolling slowdown to the public:

PCMS		
1	2	3
15MINUTE ROLLING SLOWDOWN	JUNE 13 SAT NITE 11PM-6AM	NB I-5 MP145 TO MP150
1.5 SEC	1.5 SEC	1.5 SEC

- During the rolling slowdown, use a trailer-mounted PCMS 1± mile in advance of rolling slowdown starting location (remaining stationary) with a truck-mounted PCMS trailing ½± mile from the rear of the traffic queue (moving down the paved shoulder):

PCMS		
1	2	3
15MINUTE ROLLING SLOWDOWN	JUNE 13 SAT NITE 11PM-6AM	5 NORTH MP145 TO MP150
1.5 SEC	1.5 SEC	1.5 SEC

TRUCK-MOUNTED PCMS	
1	2
ROLLING SLOWDOWN OCCURING	SLOW TRAFFIC AHEAD
2.0 SEC	2.0 SEC

11.6(2) Considerations

Consider the following when implementing rolling slowdowns:

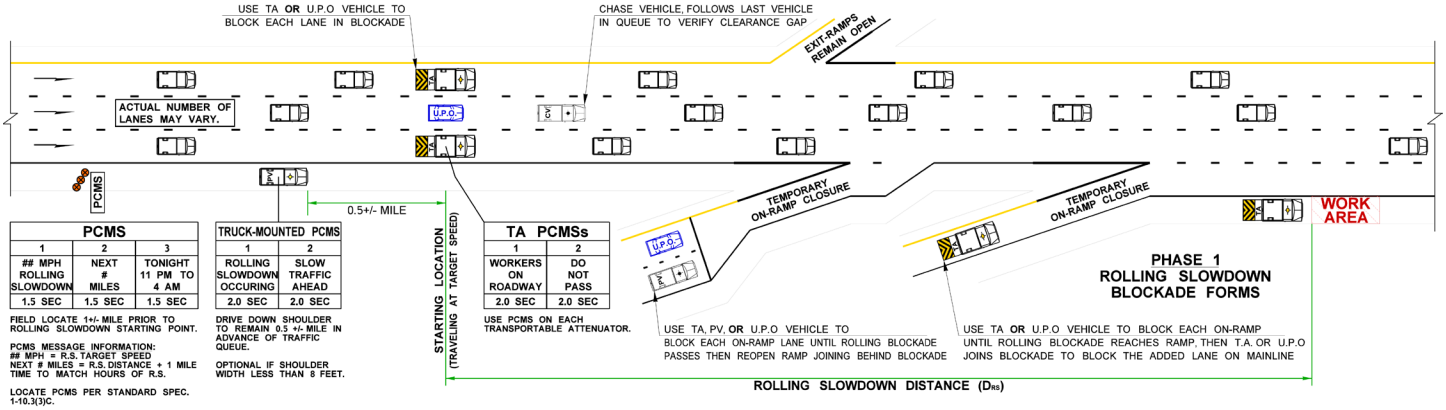
- As part of the rolling slowdown traffic control plan, consider specifying the development of an emergency contingency plan to handle traffic should unforeseen circumstances occur, including but not limited to:
  - An Emergency Medical Services vehicle transporting a critical care or specialty care patient needs urgent accommodation past the rolling slowdown
  - Work activity exceeds the planned available clear time
  - An errant vehicle gets around the rolling blockade or on-ramp traffic hold and is heading towards the work area
- Have traffic queue formations and their dispersals monitored by traffic control personnel during and after each rolling slowdown with plan of action to respond to problems that develop because of the traffic queue
- Requiring all traffic queues clear prior to commencing any subsequent rolling slowdowns

11.6(3) Typical Traffic Control Plan

A freeway rolling slowdown traffic control plan (TC182) is now available. Please note, Typical TCPs must still be accepted by the Agency. This section provides a detailed explanation of each of the five rolling slowdown phases shown in that typical plan to enhance TCS's understanding of this procedure.

First, understand a Uniform Police Officer (UPO) includes Washington State Patrol (WSP) and other sworn and active police officers from county or cities.

11.6(3)A Phase 1: Rolling Slowdown Blockade Forms



Prior to commencing the rolling slowdown, a PCMS is positioned about 1± mile in advance of the rolling slowdown starting point with a message modified as appropriate.

On-ramps within the limits of the rolling slowdown (between the starting point to the work area) need to be temporarily blocked with protective vehicle or UPO vehicle in each on-ramp lane, but a transportable attenuator may also be used. Locate these blocking vehicles at the ramp meter stop bars (if applicable) or prior to the paved gore to allow several vehicles to queue along the on-ramp. Freeway-to-freeway on-ramps should be closed with standard traffic control devices due to their high operating speeds. Exit-ramps may remain open.

Just prior to performing each rolling slowdown is completed, the Agency's Traffic Management Center should be informed.

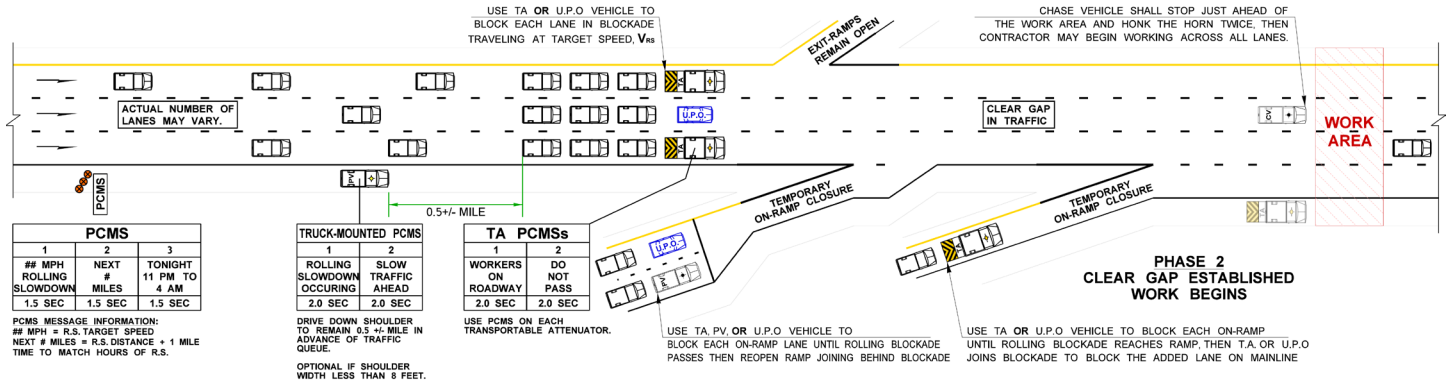
Knowing the starting point of the rolling slowdown is critical because the blocking vehicles need to enter onto the freeway, occupy all the blocked lanes on mainline, and then safely slow down to the target speed just prior to reaching the starting point. A truck-mounted PCMS will travel along the right shoulder right shoulder about ½± mile in advance of the rolling slowdown starting location but is optional if the shoulder width is less than 8 feet. To accomplish this, the rolling blockade and truck-mounted PCMS vehicle should be staged approximately 1 mile in advance of the starting location, preferably along an on-ramp shoulder where they can easily enter onto the freeway.

Typically, a transportable attenuator is used to block each mainline lane for the rolling blockade. A UPO vehicle may also be used within the rolling blockade or used supplementally to enforce the blockade. If a vehicle or vehicles attempt to bypass the blockade, the UPO vehicle will pursue and attempt to stop them while the chase vehicle operator is warned, and the work area cleared. When UPO vehicle leaves the rolling blockade, the remaining blockade vehicles will reposition laterally to partially block two lanes.

Once the blockade is established at the starting point, a chase vehicle will follow the last vehicle in front of the rolling blockade to verify the clear gap is established.

The work crews will typically be positioned within either a shoulder or lane closure (reducing the freeway down to a single open lane is accepted, provided Agency accepts). By the work crew being prestaged and ready, it minimizes the clear time needed to perform the work during the clear gap.

11.6(3)B Phase 2: Clear Gap Established & Work Begins



The rolling blockade has established a traffic queue behind it traveling at the target speed, with the truck-mounted PCMS (optional if shoulder less than 8') traveling down the shoulder while remaining ½± mile in advance of the growing traffic queue. This has allowed the creation of a clear gap between the rolling blockade and work area that took several minutes to create.

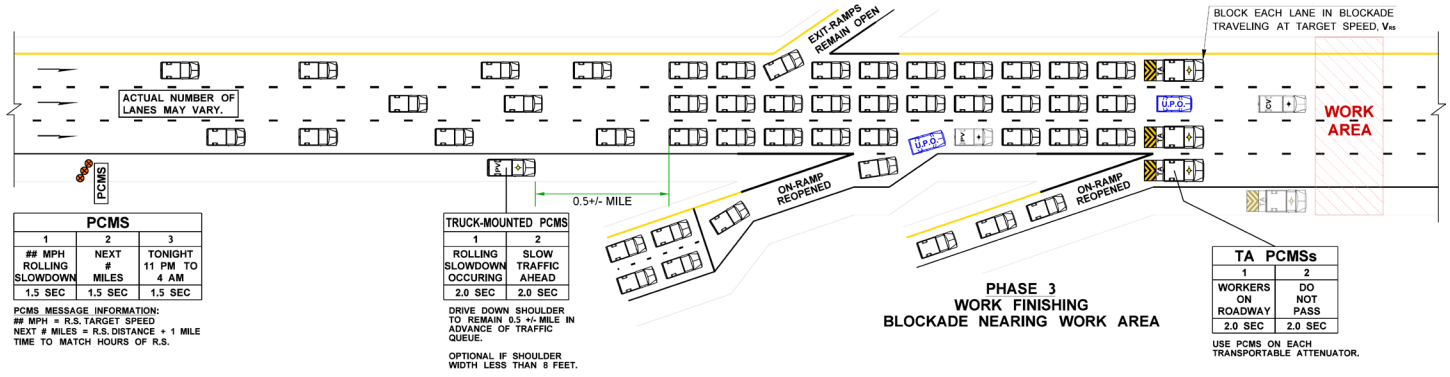
The chase vehicle has verified the clear gap and followed the slowest vehicle up to the work area, then honks the horn twice to inform work crews that all is clear. Work commences across the roadway while the chase vehicle operator remains on lookout for any approaching errant vehicles that got around the blockades. If needed, the chase vehicle operator will lay on the horn to warn work crews to evacuate the roadway immediately. A UPO vehicle can also be added here.

The chase vehicle operator will remain in radio communication between the work crew and rolling blockade to communication work progress. If work progress is taking longer than expected, the rolling slowdown speed can be reduced below the target speed as a last resort; however, avoid stopping traffic except in the event of an emergency.

Traffic is held at most on-ramps until the rolling blockade passes (except freeway-to-freeway on-ramps, which should be closed with standard traffic control devices). After the rolling blockade passes the gore, the on-ramp is reopened, and the blocking vehicles join within the queue behind the blockade.

For on-ramp adding a thru lane, the transportable attenuator blocks the on-ramp until the rolling blockade approaches, then it joins alongside the rolling blockade to block the added lane.

11.6(3)C Phase 3: Work Finishing, Blockade Nearing Work Area

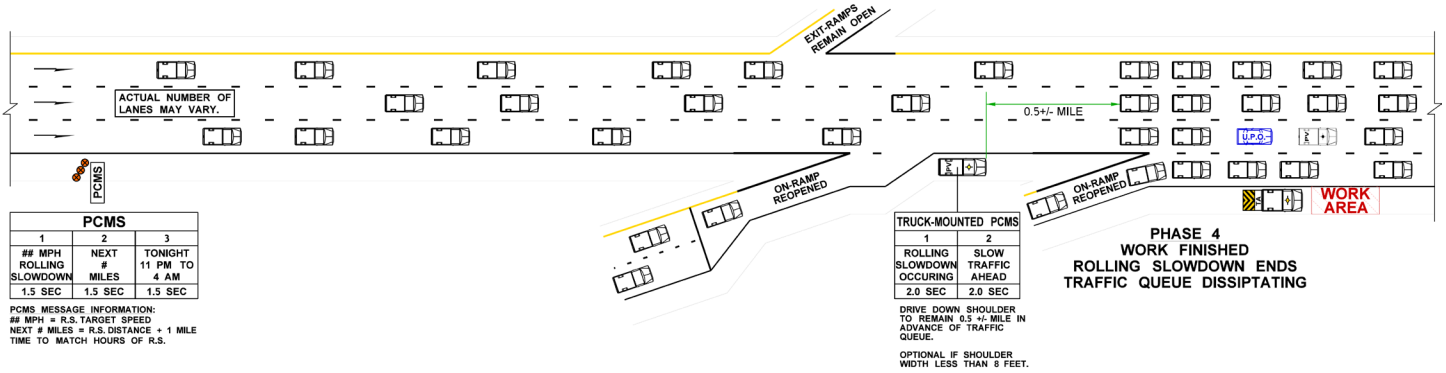


The rolling blockade is now approaching the work area while work finishes up. Workers are clearing the open lanes in preparation for the arriving traffic and moving into either a shoulder or lane closure that was installed prior to the rolling slowdown.

The on-ramps have been reopened after the mainline blockade passes; for on-ramps adding a thru lane, the transportable attenuator is now blocking the newly added lane.

The truck-mounted PCMS (optional if shoulder less than 8') is traveling down the shoulder while remaining ½± mile in advance of the ever-growing traffic queue.

11.6(3)D Phase 4: Work Finished, Rolling Slowdown Ends, Queue Dissipating

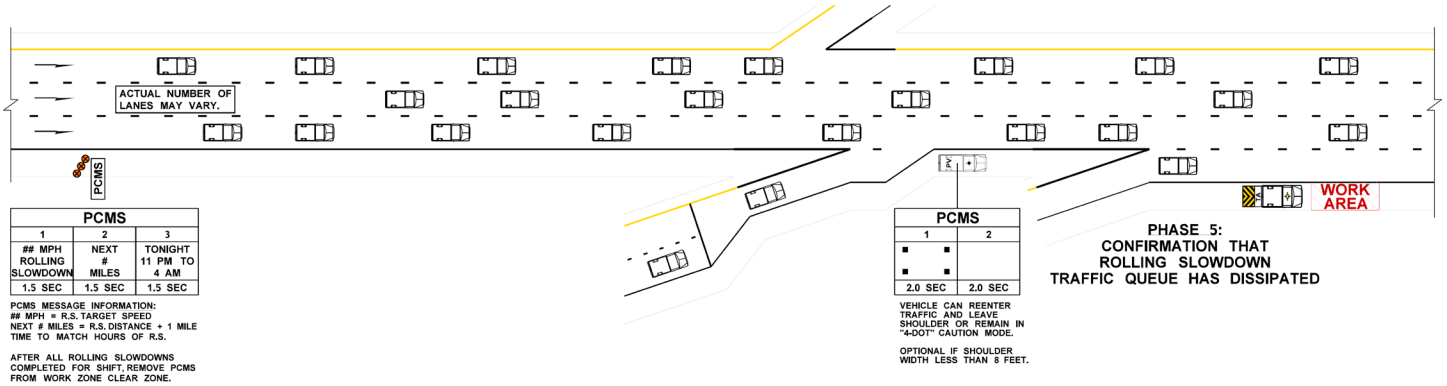


The rolling blockade has reached and passed the work area and have resumed normal traffic speeds. The blocking vehicles should move over to the right travel lane to allow motorists to pass.

This is a critical time for the truck-mounted PCMS to remain in place ½± mile in advance of the rear of traffic queue to warn the approaching traffic of slow traffic while the queue disperses, which takes a few minutes. It is critical to verify all queued traffic dissipates.

This additional step is recommended upon FHWA's response to NTSB investigation after a 47-passenger motor coach slammed into a stopped combination tractor-trailer at freeway speed killing 13 and injuring 30 just after a utility rolling slowdown operation ended on I-10 in Palm Springs, CA ended. The tractor-trailer was still stopped in the travel lane for 2 minutes after the rolling slowdown ended. Even with 20 seconds of visibility the fatigued motor coach driver hit the stopped tractor-trailer at freeway speed (55 mph).

11.6(3)E Phase 5: Rolling Slowdown Queue Dissipated



After verifying the rolling slowdown traffic queue has completely dissipated, the truck-mounted PCMS can be placed on "4-dot" caution mode and remain on the shoulder while another crew members performs a drive through throughout the rolling slowdown limits or go ahead and leave the shoulder.

If another rolling slowdown is occurring the same work shift, the advance PCMS can remain in place while crews reposition. Otherwise, remove the PCMS from the work zone clear zone when not in use.

When each rolling slowdowns is completed, the Agency's Traffic Management Center should be informed.

11.6(4) Data Table

The rolling slowdown data table below provides *typical* information for 5-minute and 10-minute clear times at the work area for various speed limits:

ROLLING SLOWDOWN DATA

SPEED LIMIT ($V_{TRAFFIC}$)	60 MPH		65 MPH (TRUCKS 60)		70 MPH (TRUCKS 60)	
ESTIMATED CLEAR TIME AT WORK AREA (T_{CLEAR})	5 MINUTES	10 MINUTES	5 MINUTES	10 MINUTES	5 MINUTES	10 MINUTES
ROLLING SLOWDOWN TARGET SPEED (V_{RS})	**20 MPH**		**25 MPH**	**20 MPH**	**30 MPH**	**25 MPH**
ROLLING SLOWDOWN DURATION (T_{RS}) **DISTANCE (D_{RS})**	8 MINUTES **2.5 MILES**	15 MINUTES **5 MILES**	9 MINUTES **3.75 MILES**	15 MINUTES **5 MILES**	9 MINUTES **4.5 MILES**	18 MINUTES **7.5 MILES**

SPEED LIMIT ($V_{TRAFFIC}$)	45 MPH		50 MPH		55 MPH	
ESTIMATED CLEAR TIME AT WORK AREA (T_{CLEAR})	5 MINUTES	10 MINUTES	5 MINUTES	10 MINUTES	5 MINUTES	10 MINUTES
ROLLING SLOWDOWN TARGET SPEED (V_{RS})	**15 MPH**		**15 MPH**		**18 MPH**	
ROLLING SLOWDOWN DURATION (T_{RS}) **DISTANCE (D_{RS})**	8 MINUTES **2 MILES**	15 MINUTES **4 MILES**	8 MINUTES **2 MILES**	15 MINUTES **4 MILES**	8 MINUTES **2.5 MILES**	15 MINUTES **4.5 MILES**

Example: For a 60-mph speed limit, the rolling slowdown would have:

- Target Speed = 20 mph
- Duration & Location = 15 minutes starting 5 miles prior to the work area
  This will yield roughly 10 minutes of clear time at the work area.

Example: For a 70 mph (Trucks 60) speed limit, the rolling slowdown would have:

- Target Speed = 25 mph
- Duration & Location = 18 minutes starting 7.5 miles prior to the work area
  This will yield roughly 10 minutes of clear time at the work area.

11.6(5) Equations & Calculation Examples

The equations below are used to determine any other combination of other rolling slowdown durations, speeds, and distances in addition to different clear times at the work area.

Known Variables:

T_{CLEAR} = Clear time needed at work area [minutes]

V_{RS} = Rolling slowdown target speed [mph]

$V_{TRAFFIC}$ = Slowest Vehicle Speed Expected [mph]

Variables to be Determined:

D_{RS} = Minimum rolling slowdown distance needed [miles]

T_{RS} = Rolling slowdown duration [minutes]

Equations:

$$D_{RS} = \frac{T_{CLEAR} \times V_{RS} \times V_{TRAFFIC}}{60 \times (V_{TRAFFIC} - V_{RS})}$$

$$T_{CLEAR} = \frac{60 \times (V_{TRAFFIC} - V_{RS}) \times D_{RS}}{V_{RS} \times V_{TRAFFIC}}$$

$$T_{RS} = \frac{60 \times D_{RS}}{V_{RS}}$$

$$V_{RS} = \frac{60 \times D_{RS}}{T_{RS}}$$

For rolling slowdown calculation examples, see WSDOT Traffic Manual Section 5-21.D-G.

11.7 Traffic Holds

Traffic holds shall not be used on freeway mainlines. On freeways, use rolling slowdowns.

All traffic holds shall be accepted by the Agency, including their permitted days/hours and duration, in a traffic control plan.

A traffic hold is a traffic control strategy used on non-freeways using flaggers and/or uniformed police officers (UPOs) to stop traffic in all directions to enable completion of work activities requiring exclusive access across or over the roadway that would otherwise present significant risks to motorists. UPOs include Washington Patrol and any local police agency.

When used, it is preferred to reduce each approach down to a single open lane using standard traffic control devices and advanced warning signage. It is optional to place a UPO vehicle with emergency lights activated on either side of the work area after the flaggers to help block the roadway.

Traffic holds also may be used on roadways where traffic alternates in a single lane via flagger-control, particularly in areas where there are no alternative routes and work is being completed in a narrow area requiring traffic to be held in all directions.

When holding traffic at or near signalized intersections, the traffic signal must be turned off or set to all-way red flashing mode per WAC 468-95-3015. Per WAC 468-95-302, only UPOs should flag at the center of the intersection except in an emergency; however, flaggers may control each intersection leg.

Work activities that typically necessitate a traffic hold may include but are not limited to the following:

- Utility line installation or removal over a roadway
- Installing or removing an existing traffic signal mast arm or sign structure over the roadway
- Reconfiguration of an intersection (converting a existing intersection into a roundabout; converting a diamond-interchange intersections to SPUI/diverging diamonds)
- Work operations posing undue hazards to the traveling public (such as rockslide scaling or unloading large freight adjacent to an open lane)
- Emergency roadway or bridge repairs having short work durations (≤ 10 minutes)
- Based on WSDOT's determination, there is justification for using a traffic hold to mobilize large equipment, (cranes, drilling rigs, etc.) across the freeway versus demobilizing and mobilizing the equipment would lead to considerable delays and increased costs
- Based on WSDOT's determination, there is justification for using a traffic hold to provide construction vehicle ingress/egress movements between the work area onto roadway traffic in locations that would have minimal adverse traffic impacts and delays but enhance safety

A directional roadway closure is recommended in lieu of traffic holds during the following work operations exceeding 30 minutes across all lanes in one direction such as:

- Setting new bridge girders
- Demolishing overhead bridge spans or barriers
- Removing overhead structural falsework

11.7(1) Guidance

The following guidance applies when implementing traffic holds:

- Typically avoid traffic hold durations exceeding 10 minutes when feasible
- If traffic hold durations are 15+ minutes on major arterial roadways:

PCMS		
1	2	3
EXPECT 15MINUTE DELAYS	09/15-19 NIGHTLY 11PM-5AM	AT SR527 & 180TH ST
1.5 SEC	1.5 SEC	1.5 SEC
DISPLAY 3 DAYS IN ADVANCE, EXCEPT DURING EMERGENCIES		

and

PCMS	
1	2
15MINUTE TRAFFIC HOLDS	BE PREPARED TO STOP
2.0 SEC	2.0 SEC
LOCATE ½± MILE IN ADVANCE OF QUEUE PCMS MAY BE TRUCK-MOUNTED	

- For longer term traffic hold durations of 30+ minutes consider specifying traffic is to be released at regular time intervals such as 00 and 30 past the hour. This assists in setting expectations with the driver and thereby able to plan their travel through the area:

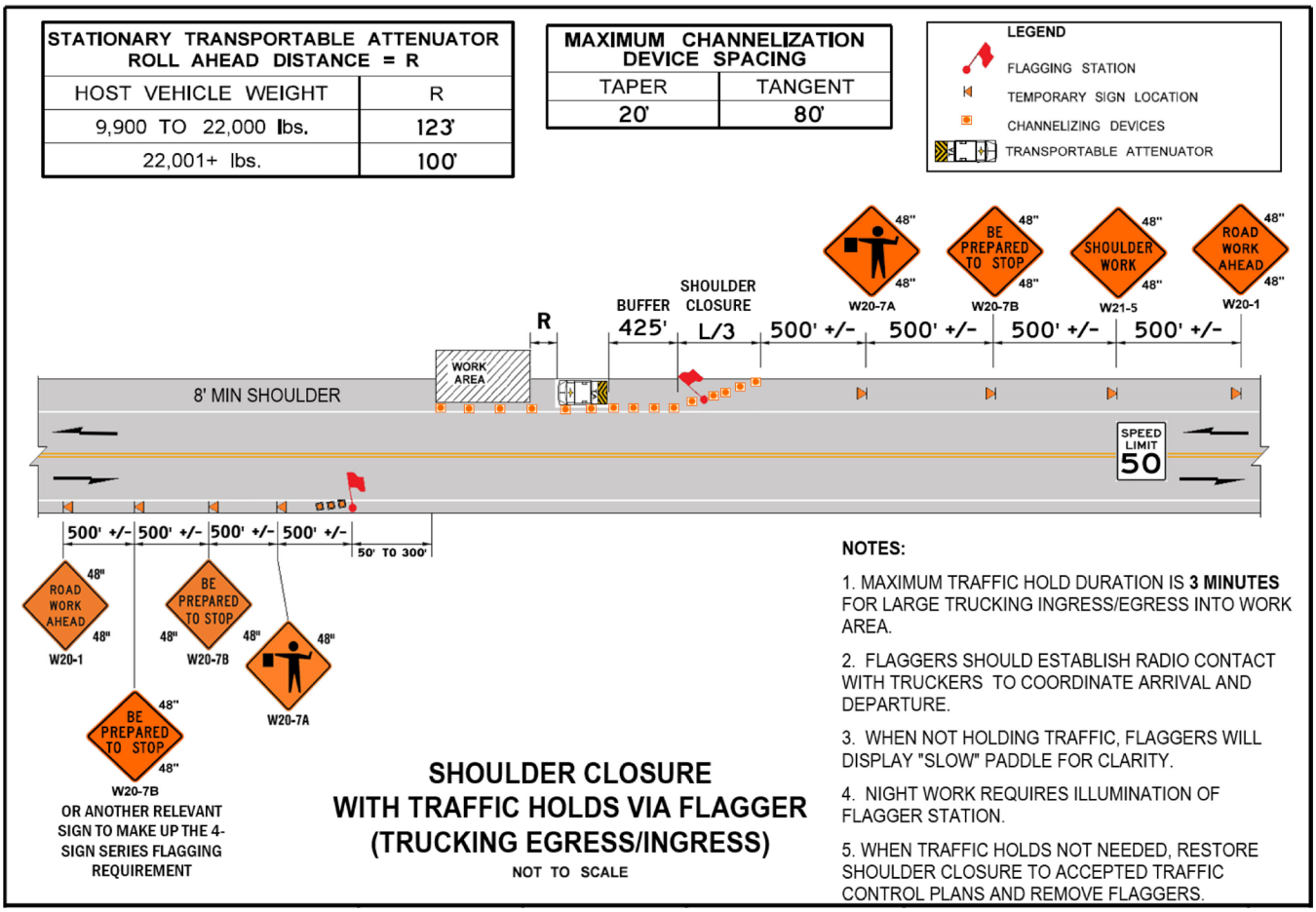
PCMS		
1	2	3
EXPECT 30MINUTE DELAYS	MAR13-17 MON-FRI 7AM-6PM	SR410 25 MILES AHEAD
1.5 SEC	1.5 SEC	1.5 SEC
DISPLAY 7 DAYS IN ADVANCE, EXCEPT DURING EMERGENCIES DESIREABLE TO PLACE JUST OUT OF TOWN OR NEAR AN ALTERNATIVE ROUTE.		

and

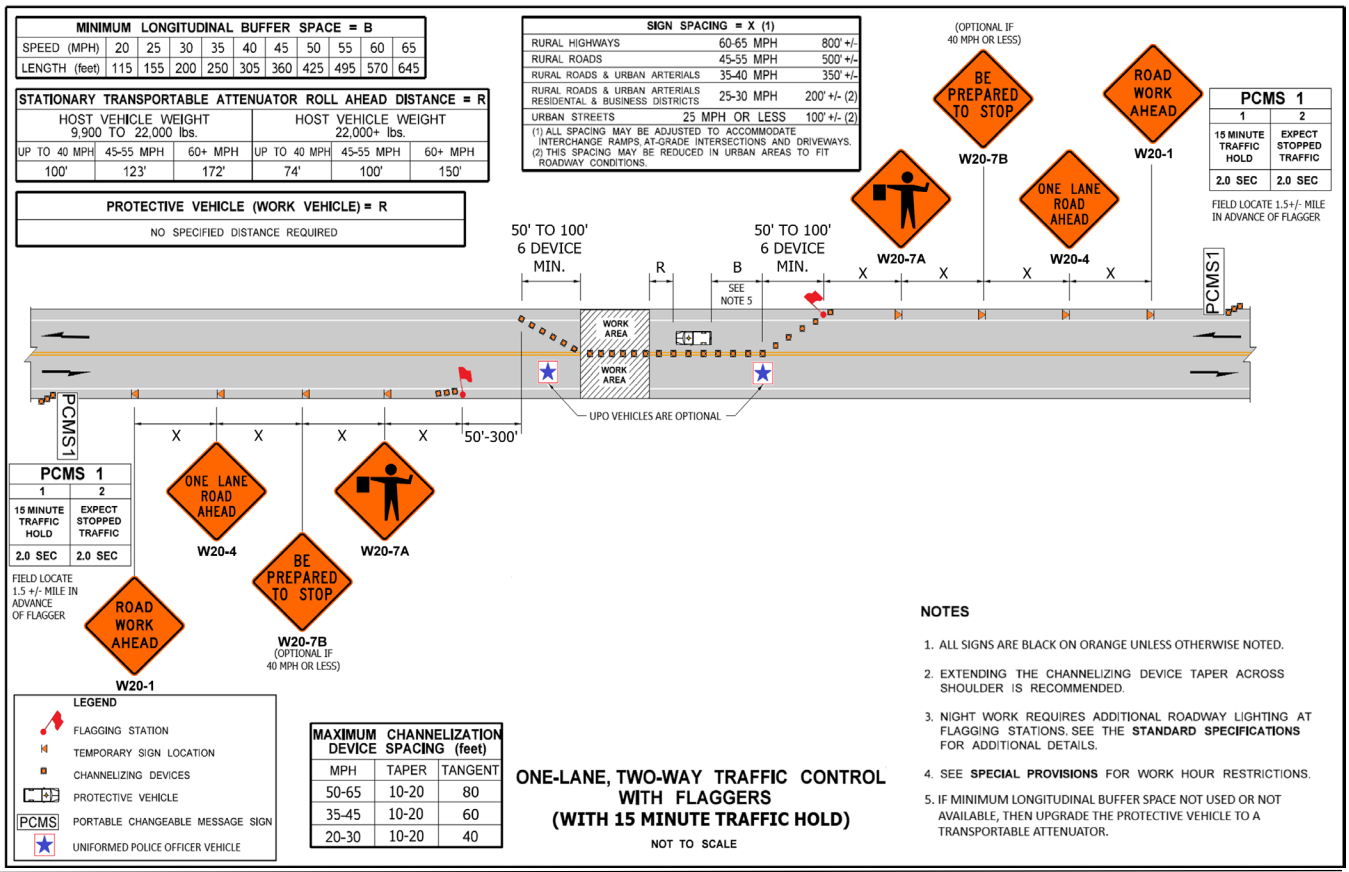
PCMS		
1	2	
30MINUTE TRAFFIC HOLDS	TRAFFIC RELEASED AT THE	TOP AND BOTTOM OF HOUR
1.5 SEC	1.5 SEC	1.5 SEC
LOCATE ½± MILE IN ADVANCE OF QUEUE PCMS MAY BE TRUCK-MOUNTED		

- At locations where bicyclists and motorists need to share a lane following the end of traffic holds, release motorists first allowing queues to clear and then allow bicyclists to proceed
- If feasible, release traffic in all directions until queues dissipate before commencing another traffic hold or alternating traffic
- To avoid severe traffic impacts, consider limiting permitted traffic hold hours to avoid impacting commuting and school traffic; use nighttime hours if needed
- Recommended to reduce each traffic approach to a single open lane with standard traffic control devices and advanced warning signage
- Inform Washington Patrol, local fire, police, emergency service agencies, and transit agencies (if applicable) at least 72-hours in advance of non-emergency traffic holds

11.7(2) Schematic of Traffic Hold via Shoulder Closure (Flaggers)



11.7(3) Schematic of 15-Minute Hold (Flaggers)



11.7(4) Typical Traffic Control Schematic of 30-Minute Hold (Temp Signal or Flaggers)

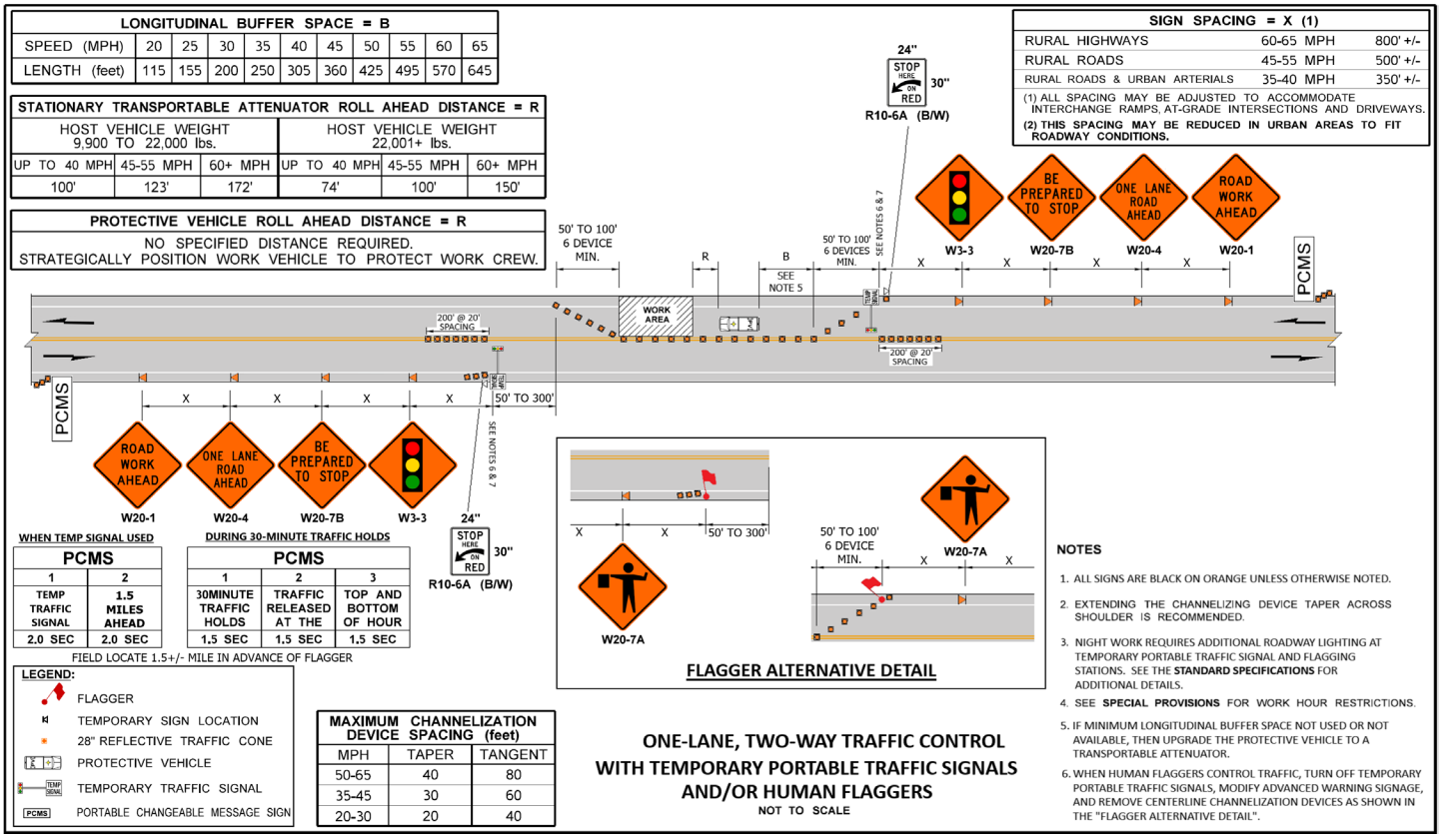
LONGITUDINAL BUFFER SPACE = B										
SPEED (MPH)	20	25	30	35	40	45	50	55	60	65
LENGTH (feet)	115	155	200	250	305	360	425	495	570	645

STATIONARY TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R					
HOST VEHICLE WEIGHT 9,900 TO 22,000 lbs.			HOST VEHICLE WEIGHT 22,001+ lbs.		
UP TO 40 MPH	45-55 MPH	60+ MPH	UP TO 40 MPH	45-55 MPH	60+ MPH
100'	123'	172'	74'	100'	150'

PROTECTIVE VEHICLE ROLL AHEAD DISTANCE = R
NO SPECIFIED DISTANCE REQUIRED. STRATEGICALLY POSITION WORK VEHICLE TO PROTECT WORK CREW.

SIGN SPACING = X (1)		
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.
(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.



FLAGGER ALTERNATIVE DETAIL

WHEN TEMP SIGNAL USED

PCMS	
1	2
TEMP TRAFFIC SIGNAL	1.5 MILES AHEAD
2.0 SEC	2.0 SEC

DURING 30-MINUTE TRAFFIC HOLDS

PCMS		
1	2	3
30MINUTE TRAFFIC HOLDS	TRAFFIC RELEASED AT THE	TOP AND BOTTOM OF HOUR
1.5 SEC	1.5 SEC	1.5 SEC

FIELD LOCATE 1.5+/- MILE IN ADVANCE OF FLAGGER

LEGEND:
- FLAGGER
- TEMPORARY SIGN LOCATION
- 28" REFLECTIVE TRAFFIC CONE
- PROTECTIVE VEHICLE
- TEMPORARY TRAFFIC SIGNAL
- PCMS — PORTABLE CHANGEABLE MESSAGE SIGN

MAXIMUM CHANNELIZATION DEVICE SPACING (feet)		
MPH	TAPER	TANGENT
50-65	40	80
35-45	30	60
20-30	20	40

ONE-LANE, TWO-WAY TRAFFIC CONTROL WITH TEMPORARY PORTABLE TRAFFIC SIGNALS AND/OR HUMAN FLAGGERS
NOT TO SCALE

NOTES

1. ALL SIGNS ARE BLACK ON ORANGE UNLESS OTHERWISE NOTED.
2. EXTENDING THE CHANNELIZING DEVICE TAPER ACROSS SHOULDER IS RECOMMENDED.
3. NIGHT WORK REQUIRES ADDITIONAL ROADWAY LIGHTING AT TEMPORARY PORTABLE TRAFFIC SIGNAL AND FLAGGING STATIONS. SEE THE **STANDARD SPECIFICATIONS** FOR ADDITIONAL DETAILS.
4. SEE **SPECIAL PROVISIONS** FOR WORK HOUR RESTRICTIONS.
5. IF MINIMUM LONGITUDINAL BUFFER SPACE NOT USED OR NOT AVAILABLE, THEN UPGRADE THE PROTECTIVE VEHICLE TO A TRANSPORTABLE ATTENUATOR.
6. WHEN HUMAN FLAGGERS CONTROL TRAFFIC, TURN OFF TEMPORARY PORTABLE TRAFFIC SIGNALS, MODIFY ADVANCED WARNING SIGNAGE, AND REMOVE CENTERLINE CHANNELIZATION DEVICES AS SHOWN IN THE "FLAGGER ALTERNATIVE DETAIL".

Chapter 12 : Traffic Control Plan Management & Evaluation

12.1 Summary

This chapter will discuss the tasks and procedures involved in the management and evaluation of temporary traffic control. Topics include inspection of the traffic control plans, maintenance of the traffic control devices, documentation of TCP installations, collection and analysis of crash and incident data, and modification of the TCP to correct problems or deficiencies.

12.2 Adopting or Submitting Modified Traffic Control Plans

Per Standard Specifications 1-10.2(2), the Contractor shall:

- Adopt the Contract's traffic control plans via Type 1 Working Drawing
- Submit modified/new traffic control plans for acceptance via Type 2 Working Drawing

Standard Specifications 1-05.3 include details regarding working drawings; but in summary, a Type 1 is submitted to the Agency for informational purposes at least 7 calendar days in advance while Type 2 is submitted for Agency review and comment at least 20 calendar days in advance.

It is critical to review and submit modified/new traffic control plans well in advance—do not wait until the working shift prior. The traffic control plan cannot be used until accepted by the Agency and may need to be submitted a few times before it is accepted.

Per Traffic Manual Section 5.23, traffic control plans are accepted via the stamps (with signature and date, sometimes from more than one Agency) below:

12.3 Minor Revisions to Traffic Control Plans

Per Standard Specifications 1-10.2(1)B, Traffic Control Supervisors can make minor revisions to the traffic control plan to accommodate site conditions (not considered modifications to TCP) provided that:

- the original intent of the traffic control plan is maintained
- the revision has concurrence from the Contractor
- the revision has concurrence from the Engineer (often delegated to Project Inspector)

Beware if the Engineer does not concur with the change or believes it is not a minor revision, then a new/revised traffic control plan must be submitted to the Agency.

Examples of acceptable minor revisions include:

- ✓ Adjusting temporary sign spacing or adding signs
- ✓ Reducing channelizing device spacing (20' spacing @ work crews OK)
- ✓ Increasing longitudinal buffer space
- ✓ Modifying PCMS messages for queue mitigation (WATCH FOR SLOW TRAFFIC)

Prohibited "Minor Revisions" examples:

- X Changing regulatory speed limit/advisory speeds without Agency approval
- X Encroaching into open lanes unless traffic control plans allow
- X Using a protective vehicle instead of a transportable attenuator

12.3 Pre-Construction Conference

The pre-construction ("Pre-Con") conference is a meeting between key Contractor, subcontractor, and Agency staff and typically occurs at the Agency's Construction Project Engineering Office.

These meetings occur after the project is awarded and before the first working day of construction begins. At this meeting, it should be indicated rather or not the Contract's traffic control plans will be adopted and/or modified/new traffic control plans will be submitted.

Prior to the Pre-Con, the TCM and TCS should thoroughly review the Contract Plans and Specifications, including traffic control bid items for measurement and payment. If there are any questions or clarity needed, this is the time to bring them up for discussion. Further details provided in Chapter 10.

Prior to or during the Pre-Con, provide TCS and flagging cards of the primary TCS and alternate TCS documentation as required by Standard Specifications 1-10.2(1)B. Some project specifications may require additional Traffic Control Supervisor experience beyond the certification, particularly for freeway traffic control.

The Pre-Con is a good time to greet and obtain contact information with the Agency's project inspector and chief inspector and should be attended by the Traffic Control Manager (TCM) and primary Traffic Control Supervisor (TCS).

After the meeting, the TCS may want to have a meeting with the Agency's project inspectors to determine their expectations, communication requirements (such as being informed when each closure occurs and is removed, who contacts the Agency Traffic Management Center to provide these updates), and traffic control measurement and payment information. Also discuss how accidents within work zones are handled (see Section 12.8). Discuss rather electronic versions or paper carbon forms are desired for completing the TCS Daily Report of Traffic Control; if paper carbon forms are needed, request them from the project inspector.

12.4 Implementing the Traffic Control Plan

Installation and removal procedures are discussed in Chapter 11 and Standard Specifications Section 1-10. Flagging & traffic control labor are discussed in Chapter 7.

12.5 TCS Traffic Control Inspections

Per Standard Specifications 1-10.2(1)B, the Traffic Control Supervisor shall perform:

- Initial inspection immediately after traffic control is installed
- Hourly inspection during working hours
- Once a shift, inspect nighttime lighting during working hours
- Daily, inspect traffic control during non-working days
- Weekly, inspect Class A construction signs
- Periodically, check condition of temporary pavement markings
- Be available via telephone 24/7 and have the ability to expeditiously correct any traffic control deficiency (be on site within 45 minutes after notification by the Engineer

A newly implemented temporary traffic control plan should be inspected and evaluated immediately after it has been installed to verify proper installation and to identify any operational issues. Corrections should be as soon as possible; this may include a modification to a plan be for it is used again.

During the initial inspection the following should be reviewed:

1. Verify field installations of signage and prior installed at the correct locations

2. Message content of signs should clearly communicate proper information to the motorist (are motorists showing signs of confusion—tapping brakes, etc.)

3. At all transition tapers, verify location, length, and channelizing device type and spacing

4. Verify any conflicting existing signs, traffic signals, and existing traffic control devices have been removed or temporarily covered.

5. Temporary pavement markings should have been applied and permanent markings completely removed if required by the staging plan or traffic control plan.

6. Verify that proper protection has been installed through the activity area to separate the buffer and workspaces from the traffic space and that a clear travel path has been defined for motorists.

7. If flaggers are used, verify their need, appearance, equipment, flagging techniques are correct. Verify the flagging locations have 8-10 seconds of visibility (if feasible). If the work zone can be safely and efficiently be operated without flaggers, then an alternative traffic control strategy should be discussed, and traffic control plan submitted for acceptance.

8. Workers within the closure should be properly equipped with safety vests Class 2 or 3 garment—Class E clown pants are optional. See Standard Specification 1-07.8(2).

9. Work vehicles should have their amber lights activated and parked away from open travel lanes so as not to create an unnecessary fixed hazard within the work zone clear zone.

The initial inspection should also include a night visit to the temporary traffic control zone that is left in place overnight.

11. The system of control devices should be checked to determine if they properly delineate the traffic path through the work zone at night.

12. Signs which are not needed after the workday has ended should be covered or removed.

13. Retroreflective materials on signs and channelizing devices should be clean and bright. Signs should be legible.

14. Temporary pavement markings should be in good condition and clearly delineate the travel path (even on wet, rainy nights). Conflicting permanent markings should be completely removed.

12.6 Patrolling & Maintenance

Once a temporary traffic control zone has been established, it must be patrolled and maintained so that it will function as effectively as when initially installed.

Periodic review of traffic control devices is necessary to assure that they are performing satisfactorily, that their condition and retroreflectivity is adequate, and that they have not been moved, damaged or otherwise rendered ineffective.

Per Standard Specifications 1-10.3(2)E, either the TCS performs or oversees that traffic control is patrolled and maintained hourly during working hours or at least once during each non-working day when temporary traffic control is in place.

Contractor shall patrol and maintain traffic control by:

- Resetting errant devices
- Assure visibility of all devices (wiping down dew and frost on signs as an example)
- Adjust location of signs due to changing conditions
- Update PCMS messages based on changing traffic conditions (adding/removing "WATCH FOR SLOW TRAFFIC" when queues expected or "SLOW TRAFFCI AHEAD" when queues present)

Periodic maintenance of traffic control devices is needed to service equipment and take corrective actions as the result of any combination of the following factors or events:

- Traffic crashes.
- Channelizing device displacement due to:
  - Vehicular contact
  - Work activities
  - Slip stream from trucks
  - Wind or storms
  - Worker actions
- Damage caused by construction activities.
- Weather damage.
- Equipment malfunction and bulb burnouts.
- Spent fuel or batteries.
- Physical deterioration.
- Road dust, dirt, grime, splatter, etc.
- Vandalism.
- Vegetation growth.
- Improper sign covers.
- Abrasion of pavement markings.

Traffic control installations may need to be inspected more often than required if traffic volumes and speeds are high or there has been a high frequency of incidents occurring. Long-term installations also need to be inspected at least once per non-working day. This would include periods when work is temporarily suspended, but the work zone remains in place, such as during weekends and holidays. Especially critical are holiday weekends because of typically higher recreational traffic volumes and the increased exposure of the temporary control devices to traffic.

Drive-Through Inspection

One way of performing an inspection is to drive through the work zone and observe motorists traveling through the area. The drive-through inspection enables the observer to see the traffic control devices from the perspective of the motorist and to perform the maneuvers required of other drivers. This type of inspection should be conducted in all lanes and in both directions (when applicable), on crossroads, from all entry and exit points within the control zone, and during day and night.

Detour routes and temporary diversions should be driven as well.

12.7 Traffic Control Documentation

Documentation is an essential part of the traffic control function. It is necessary for good planning and project accounting, and essential in instances of legal action.

Thorough documentation allows somebody else to retrieve information about a traffic control setup for lawsuits, claims, etc often as long as 2-3 years afterwards. Unless the setup is documented, even the same TCS will have a difficult time recollecting a setup from that long ago.

There are several methods for documentation:

1. **TCS Daily Report of Traffic Control** (WSDOT Forms 421-040A and 421-040B)
    - Available as triple carbon copy paper or electronic version
    - Thorough documentation is critical:
        - Start & end time of each closure & work
        - Location (Roadway & milepost/landmark description)
        - Which Contract traffic control, detour, or staging plan used
        - Equipment types used
        - Nighttime illumination information
        - Observations of traffic control
        - Minor revisions, changes, & maintenance, including times
        - Needed corrections noted during inspection & response
        - Crashes or incidents in the work zone
        - Include names of traffic control laborers & flaggers

2. **Digital Video of drive-through**
    - Example: GoPro and Garmin
    - MP4 format at 480p recommended (good balance between file size & quality)
    - Allows digital records to be maintained indefinitely by keeping files on hard drives

3. **Digital Photos**
    - Consider using for any accidents or incidents

4. **Special notes on traffic control plan regarding minor revisions**

Reports should include information about the control devices used on the project, how their arrangement permits traffic to flow, and any changes which were made to the traffic control plan.

A good technique for documenting the immediate thoughts and observations of the person performing the inspection is to use a portable voice recorder. Digital videos can be used to capture the driver's perspective of the temporary traffic control zone installation and can be useful in the event of legal action. It is important that such recordings be keyed to the project by station or milepost, and that these records be dated and identifies the person who performed the inspection.

These periodic inspections must be documented. In the event of lawsuits resulting from crashes in a work zone, or if complaints and grievances are filed by injured or inconvenienced roadway users. The work zone traffic control can then be reconstructed, especially if digital videos are obtained.

Washington State Department of Transportation

Contractor's Daily Report of Traffic Control - Summary

Page One

Contract Number	SR Number	Day	Date

Photos / Videos taken today for record? ☐ Yes ☐ No
If Yes, note locations:

Summary of TCS Activities

Contractor	Contractor's Traffic Control Supervisor's Signature

For WSDOT Project Office Only

Comments

To be Completed by Contractor's Traffic Control Supervisor (TCS)

DOT Form 421-040A EF
Revised 4/2004

Distribution: White - Contractor; Canary - Project Engineer

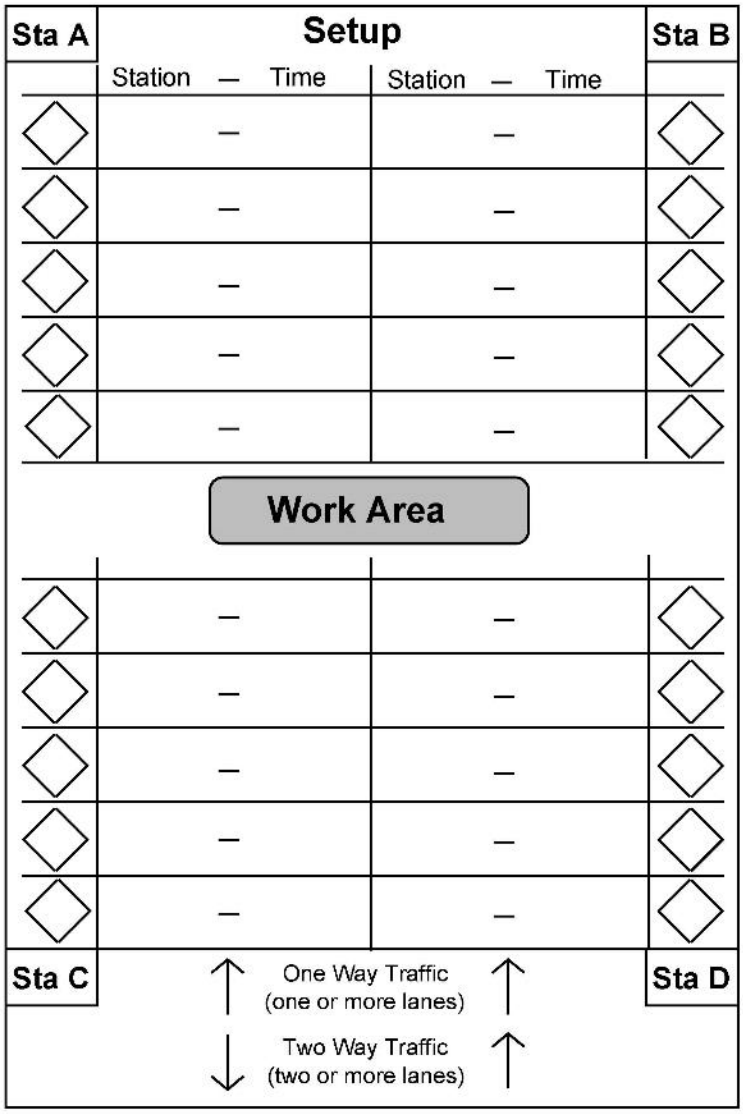
Washington State Department of Transportation

Contractor's Daily Report of Traffic Control - Traffic Control Log

Use separate sheets for each setup. (May be altered to record Class A signs.)

Page

Contract Number	SR Number	Day	Date



Legend

(List of Signs Used)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Cones ☐ Yes ☐ No

Piloted ☐ Yes ☐ No

Per Approved Plan ☐ Yes ☐ No

Plan Title _____

Flagger/Spotter Sta	Start	End	Hours
Station A			
Station B			
Station C			
Station D			

Other Traffic Control Labor			
Name	Start	End	Hours

_____
Contractor

_____
Contractor's Traffic Control Supervisor's Signature

Type of Traffic Control	Time Set Up	Time(s) Checked	Time Removed

To be Completed by Contractor's Traffic Control Supervisor (TCS)

DOT Form 421-040B EF
Revised 03/2008

Distribution: White - Contractor; Canary - Project Engineer

12.8 Responding to Work Zone Accidents

When an accident it reported to the Agency's Traffic Management Center, they'll call whomever the contact is for that closure in that vicinity (may be the TCS or the Project Inspector, depending on who calls the TMC for closure updates). Otherwise, either the TCS may witness the accident or have it reported to them via phone call.

Once the accident is discovered, inform the Agency's Project Inspector, Traffic Control Manager, and Contractor's Superintendent immediately. It is preferred to call the Agency's Traffic Management Center if they are already not informed—their teams can contact the needed first responders (police, ambulance, and fire response groups) as appropriate. If necessary, 911 can be contacted but be aware this is monitored by new agencies.

If prudent, measures to protect the accident victims can be taken if it does not compromise your crew's safety—including blocking the lane(s) behind the accident with traffic control vehicles (transportable attenuator if possible).

For minor fender benders without serious injuries, vehicles involved in the accident can be moved onto the shoulder or into closed lanes to reopen the blocked lanes, desirably with Engineer and Contractor concurrence, (some major closures have tow-trucks mobilized on site with Agency Incident Response Teams for this specific purpose).

In the event of suspected serious injury or fatality, leave the scene as it is unless otherwise informed by the Agency or first responders. In such collisions, extensive surveys and forensics are performed—often requiring closure of the roadway or multiple lanes for several hours.

Once the response is underway, digital photos of the accident may be taken. Document the license plate and vehicle information of those involved in the accident. The police officer on site will obtain driver information themselves and compile an accident report; obtain that police officer's contact information and report number (if generated) so the accident report can be obtained later.

Be aware of traffic queues—are they quickly increasing? To help reduce secondary and tertiary accidents at the end of the queue, consider placing a truck-mounted PCMS positioned ½± mile in advance of the growing queue to inform approaching traffic: "ACCIDENT AHEAD/WATCH FOR SLOW TRAFFIC" or similar message.

12.9 Legal Defense

Washington's legal system is among the most liberal in the country having joint-several liability. In short, this allows lawsuits to be filed against the subcontractor, Contractor, and project owner (Agency). If any of those folks are determined by a jury to be 1% responsible, then they pay.

As a result, lawsuits are rarely going to actual court; instead, they are often settled. To minimize liability and to reduce the amount of these settlements, it's important to:

- Have a traffic control plan & follow it
- Follow Standards; document sound reasons for not following Guidance and the evaluation used
- Exceed the required minimums
- Recognize and correct problems immediately
- **Excellent documentation**
- **Knowledgeable & proficient TCS**
- Well-trained & knowledgeable traffic control workers

Because of the legal system in Washington, many folks become ultra conservative and become very hesitant to make even simple, logistical decisions and modifications sometimes needed to keep legal incidents from occurring in the first place; instead, they focus on covering their own rears (at the expense of someone else).

A much better approach is to maximize your understanding of traffic control best practices, Standards, and Guidance to recognize and resolve issues before they happen and do so with sound logic and excellent documentation. In the event a legal incident occurs, you'll be able to go back to your documentations (maybe 3-4 years from now?) and explain exactly what was implemented and why any modifications were made. At best, this will help lead to the dismissal of the lawsuit; at worse, it will hopefully reduce the amount of settlement.

12.10 Work Zone Crashes

The Federal Code of Regulations 23 CFR Part 630, Subpart J, also contains language requiring that "construction zone crashes shall be analyzed" and used to continually correct deficiencies which are found to exist on individual projects, and to improve the content of future traffic control plans.

Crash Reports

Work zone crash information should be recorded by the TCS in daily traffic control inspection reports or on a special crash report form.

The purpose of the report form is to record information about the crash and the work zone traffic control existing at the time of the crash.

The investigation conducted by the project manager should focus on the status of the traffic controls at the time of the crash. All traffic controls should be shown in a diagram section of the report form including advance signing, flaggers, or police vehicles. (It may be possible to refer to either photographs or a traffic control plan if traffic controls are extensive.) The diagram will show the paths of vehicles involved and their relationship to the work activity and the work area traffic controls.

The narrative describes what happened in the crash, with emphasis on; the involvement of the work activity at the time of the crash; any problems observed in the work area traffic control devices; and comments of the investigating officer and witnesses. Information about the condition of traffic control devices or confirmation of the presence of specified devices should be included.

Additionally, the report must document actions which were taken by project personnel to identify and/or correct problems and hazards associated with the temporary traffic control layout, if any.

Crash Analysis

When a crash occurs within the project limits it does not automatically mean that a change in work zone traffic controls is required. Crashes are a statistically rare occurrence, the cause of can be very hard to determine, and most crashes usually are the result of a combination of factors.

The first step in determining the cause is to examine the relationship of the crash to the existing work zone traffic controls. If there appears to be a connection, the problem can be further examined by collecting conflict data or other data on work zone traffic operations that might be helpful, such as, crash data on the roadway before the work project started. If crashes in the project area have increased significantly since the work zone was established, and if there are significant differences between the types of crashes during the work activity and the types before the work began, the problem is probably associated with the work zone traffic control or the work activity.

The analysis of a set of data should include classifying the crashes and finding which classifications occur most frequently. Crashes are most classified by location; crash type; time of day; weather; light; road surface conditions; and severity.

The location can be classified as at an intersection or at another location in the work zone. For many work zones, particularly stationary ones, the location can be specified by the area of the work zone. It is important to classify crashes by work zone areas because of the varying traffic control requirements in each area based on driver responses required for safe operation.

Also, any special circumstances or driver comments about the crash should be noted, such as "the crash occurred in a traffic backup" or "driver did not perceive lane closure early enough to merge into open lane."

Incident Data

The collection of incident data can be useful either to support the crash data or to point out a hazardous condition before a crash occurs. Incident information should be recorded so it can be used by more than one person, can be referred to later, and can be used as a record of past conditions.

Like crashes, incidents should be recorded in the TCS's daily traffic control inspection reports, or on special incident report forms.

Record basic information about the incident, including the apparent paths of the vehicles involved in the incident or to show the location of damaged channelizing devices, skid marks, debris, etc.

Document any traffic control changes or other actions taken. If, for example, the locations of some advance warning signs were changed because of incidents in the transition area, the reasons for the changes should be documented. The reasons for not changing the locations of the other advance warning signs should also be documented.

Analysis of Other Data

In addition to crashes and incidents, the analysis of other data may also be needed to supplement crash and incident data. The kinds of data that are used to supplement crash and incident data include traffic volumes, speed data, and plans and photographs.

Project and Statewide Summaries

The work zone crash data process has two objectives:

1. To promote immediate analysis of work zone crashes and incidents by project managers.
2. To develop a database for statewide analysis of work zone crashes.

Washington's legal system is among the most liberal in the country having joint-several liability. In short, this allows lawsuits to be filed against the subcontractor, Contractor, and project owner (Agency). If any of those folks are determined by a jury to be 1% responsible, then they pay.

12.11 Problem Identification and Correction

When the analysis of a crash, incident, and other data indicates that a problem with the temporary traffic control arrangement exists, and when patterns for these problems have been determined, changes in the control strategy may be required. See Table 10-1 below to help identify possible safety and operational problems and the corresponding traffic control changes which may be appropriate to correct the condition.

TABLE 12-1*: Problem Identification & Corrective Strategies*

Location	Possible Problem	Possible Traffic Control Change
Advanced Warning Area	Insufficient advance warning	• Add warning signs or increase sign size sign size (48"x48") • Increase mounting height to 5-foot • Add PCMS with message that targets specific issue
	Queues extend beyond first advanced warning signs	• Increase sign spacing of warning signs • Add PCMS with "TRAFFIC QUEUES AHEAD / BE PREPARED TO STOP" prior to back of queue prior to back of queue prior to back of queue
	Approaching speeds too high High variance in speeds	• Request work zone speed enforcement patrols • Request temporary rumble strips prior to flagging stations • On 5%+ downgrades with heavy truck traffic, add PCMS just prior to beginning of downgrade with "STOPPED TRAFFIC AHEAD / TRUCKERS USE CAUTION"
	Signs not visible at night	• Clean or replace signs in Unacceptable quality • Verify orange signs have High-Intensity (Type X) reflective sheeting
	Advance warning signs too far upstream from transition	• Move warning signs more frequently
Transition Area	Improper lane changes	• Install 28" cones @ 20' spacing for 200' at centerline approaching flagger on 2-lane highways • Use arrow board at lane closure tapers on multilane roads • Lengthen closure taper • Move taper to location with 8+ seconds of visibility (avoid tapers immediately following curves)
	Insufficient work zone traffic capacity resulting in significant delays & queues	• **Reduce distance between flaggers** • PCMS in advance of feasible alternative routes to alert motorists to long delays • Public information outreach • Change work schedule to exclude peak traffic periods
	Signs or channelizing devices not visible at night	• Replace channelizing devices in Unacceptable quality • Verify channelizing devices have High-Intensity (Type III or Type IV) reflective sheeting
	Speeds too high or high variance in speeds	• Request work zone speed enforcement patrols
	Advance warning signs too far upstream from transition	• Move warning signs up more frequently
	Incident at curves or lane shifts	• Add W1-2 (B/O) signs prior to curves; request advisory speed, if approved add W13-1P (B/O) plaque • Improve nighttime delineation with temporary illumination • Enhance channelizing devices (traffic safety drums on outside of curve/lane shift)

Work Area	Workers within a few feet of open lanes	• If available, add spotters with worker(s) • Request workers were Class E “clown pants” for enhanced visibility • Submitted revised traffic control plan for acceptance that shifts open lane onto shoulder, farther away from workers

	Errant vehicles entering into closure	• Reduce channelizing device spacing
		  ○ Near intersections with low speeds: 5-10’ spacing
		  ○ Reduce device spacing down to 20’ spacing at work area
		• Add channelizing devices transversely across closure (5’ spacing @ ~ 45° angle) prior to work areas and other strategic locations

	Large trucks entering/leaving frequently	• Add warning signs in advance:  W21-30 W21-30A W21-30B • On highways, use a flagging operation to briefly hold traffic (2-3 minutes). • Instead of a lane closure, this could be a shoulder closure with flaggers simply stopping traffic in both directions briefly when needed and displaying “SLOW” paddle (a higher volume roadway strategy to minimize delays and queues)
	Motorists driving by excessively fast	• Modify a flagging operation with a pilot car to control traffic speeds through work area between flaggers
	Passing in a temporary no-passing zone (2-Lane, 2-Way Traffic on Divided Highways)	• Use yellow pavement-mounted tubular markers @ 40’ spacing along temporary centerline to discourage passing • Request additional police enforcement • Request temporary concrete barrier between lanes of travel
Entire Work Zone	Channelizing devices getting knocked over	• Pull back channelizing device 2’ shy from open lane • Add a second ballast base to device
	Pedestrians are walking on the roadway	• Provide clear alterative pedestrian route (see Section 8.7)
	Very low truck speeds on steep upgrades	• Provide a truck climbing lane to allow faster traffic to pass • Consider a truck detour
	Slow-moving mobile maintenance operations on rural 2-lane highways	• Require work crews to pull onto paved shoulder at regular intervals (~ 5-minutes) to allow queued vehicles to pass in areas with limited passing zones
	Motorists are hydroplaning due to poor drainage	• If temporary traffic barriers are present, use ones with scrubbers (holes at the bottom of the barrier to allow stormwater to drain through barrier).

Implementation of Corrective Action

When making corrective changes, the work team usually will start at the upstream end of the work zone. A device should not be moved from its original position to the new location if an additional hazard will be created by the absence of the device. For example, if the project engineer decides to move the entire set of advance warning signs upstream of a horizontal curve to improve sight distance, the best way is to install a new set of signs before removing the original signs.

In changing the location of a lane taper, the new taper should always be made fully operational before the existing taper and related traffic controls are removed. Taper refers to the cones, pavement markings, and/or barricades used to physically define the boundary of a lane closure. Depending on the location of the new taper, the advance warning signs also may have to be moved. If the taper is moved upstream, the signing may not provide adequate warning time and distance. Downstream moves may leave such a large gap between the advance warning signs and the activity area that motorists either forget that they are approaching a workspace or else lose respect for signing that appears to be needless. In either case, the motorists could be surprised to discover that they are required to maneuver their vehicle through an activity area. Therefore, signing changes as discussed above should usually precede changes in the lane taper.

Corrective actions should be implemented as soon as possible: however, trade-offs between leaving the existing hazard and creating a new hazard by making the change under adverse traffic conditions must be considered. For example, if a change to alleviate rush hour congestion is needed, should motorists suffer through another day of congestion and possible rear-end crashes, or should the team try to make an immediate change? The presence of the team making the change may be more hazardous than the congestion. Maybe the change is best implemented during an off-peak period.

Of course, each work zone is different and will have to be analyzed individually. Every corrective traffic control change must be justified, planned, carefully implemented, and documented to avoid creating additional hazards.

The expectation of the Contractor in performing corrective traffic control changes and payment for changes should be discussed at the preconstruction conference.

Documenting Changes

All traffic control changes should be documented. As a minimum, documentation should include:

- what was changed,
- when it was changed,
- why it was changed, and
- who changed it.

Traffic control plans should be updated to reflect existing conditions. Any standards or specifications that were followed as well as instructions to contractors should be noted in the project diary. Photography is also a good way to record the physical details of a traffic control change.

Evaluating Changes

All traffic control changes should be evaluated to ensure that the corrections are producing the desired results.

After implementing a corrective action, the TCS should inspect and evaluate the change to ensure that traffic flow and work zone safety have not been degraded. A minor change, such as relocating one sign, may require only a drive-through inspection to see that the sign has the correct message, is in the desired location, and is properly positioned toward oncoming traffic. A moderate or major traffic control change will require a more detailed investigation.

Chapter 13 : Scenarios (Traffic Control Design)

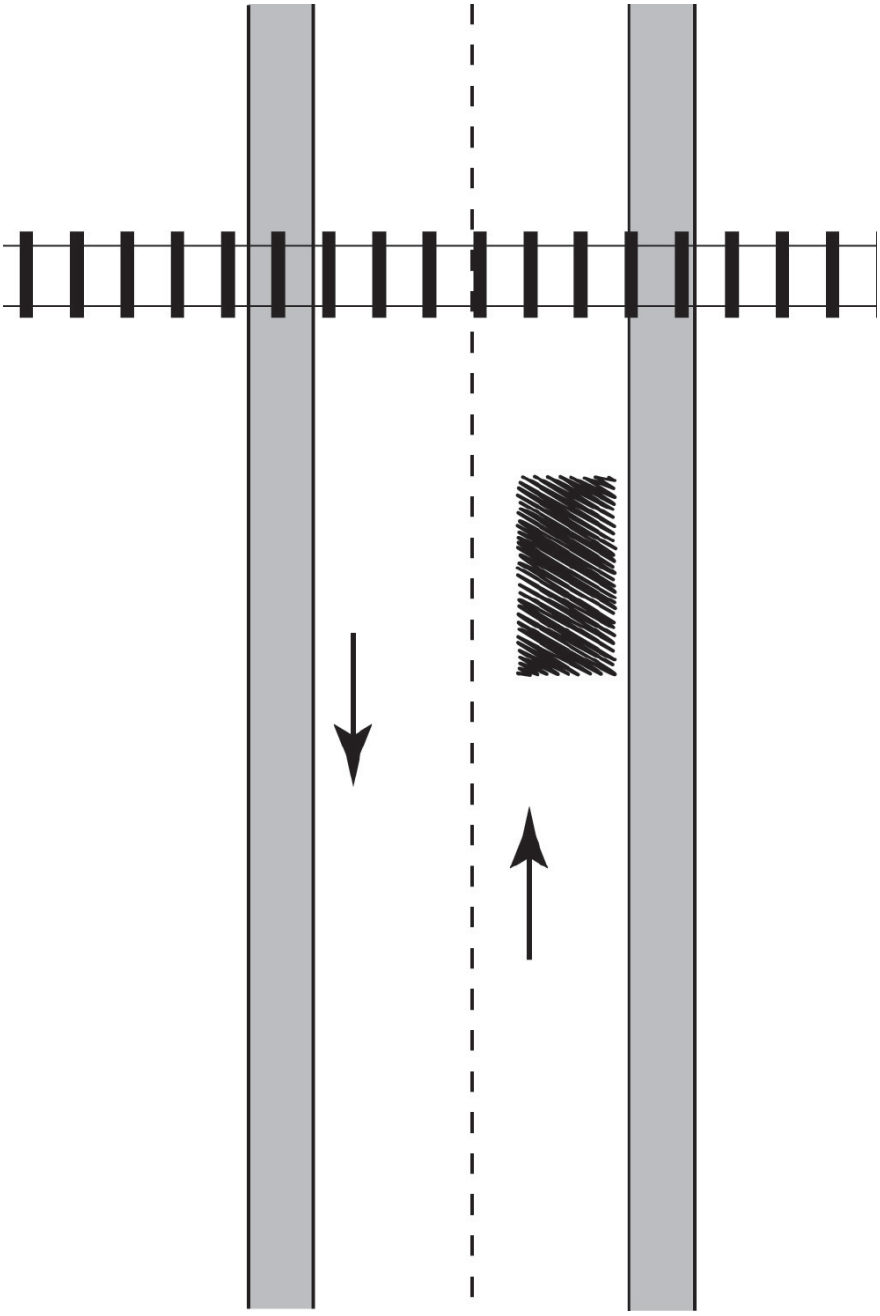
13.1 Summary

This chapter provides various scenarios to practice traffic control design. Using the knowledge obtained in this class, create a traffic control plan design based on the work area and roadway information provided for each scenario.

Scenario #1

Roadway Information:

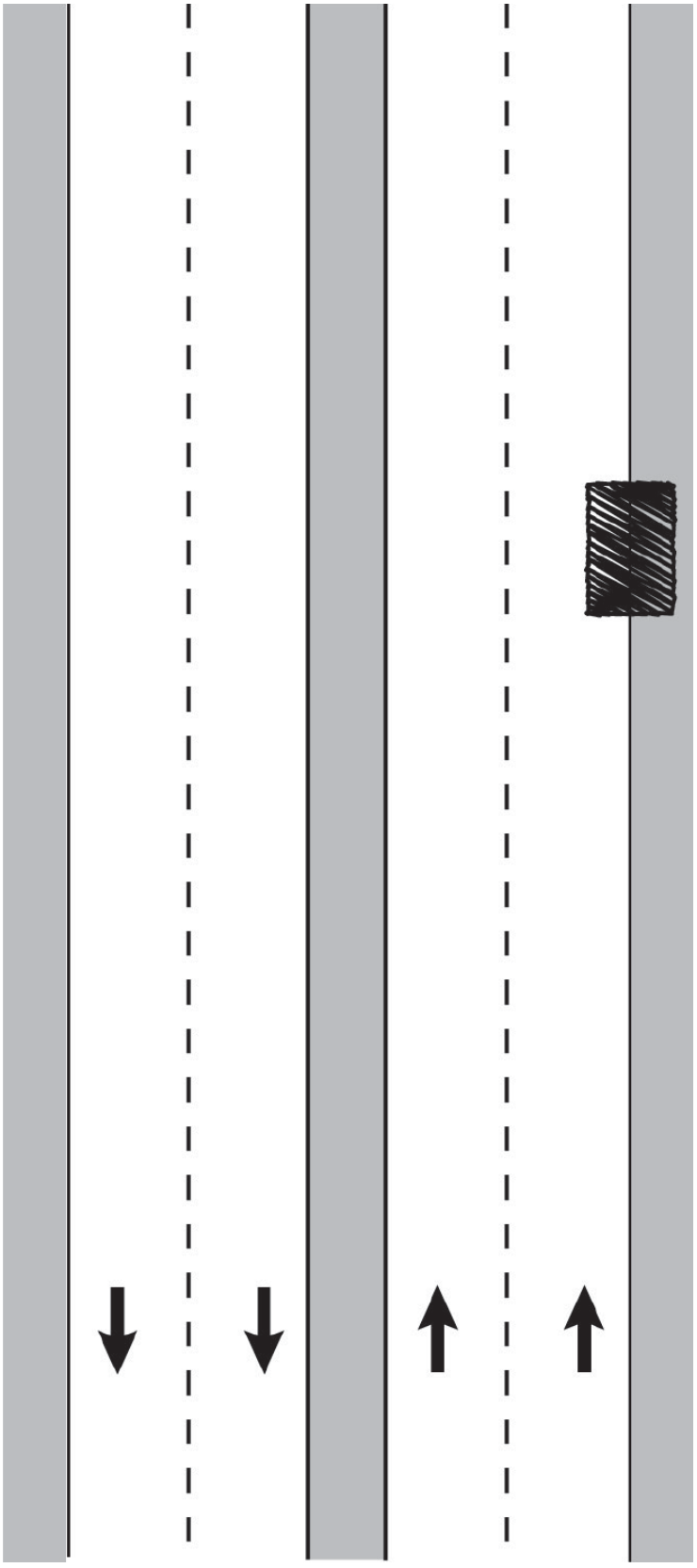
Speed Limit 50
10’ lanes & 8’ shoulders
Work Space = 200’ long
Work Operation = 12:00pm – 4:00pm



Scenario #2

Roadway Information:

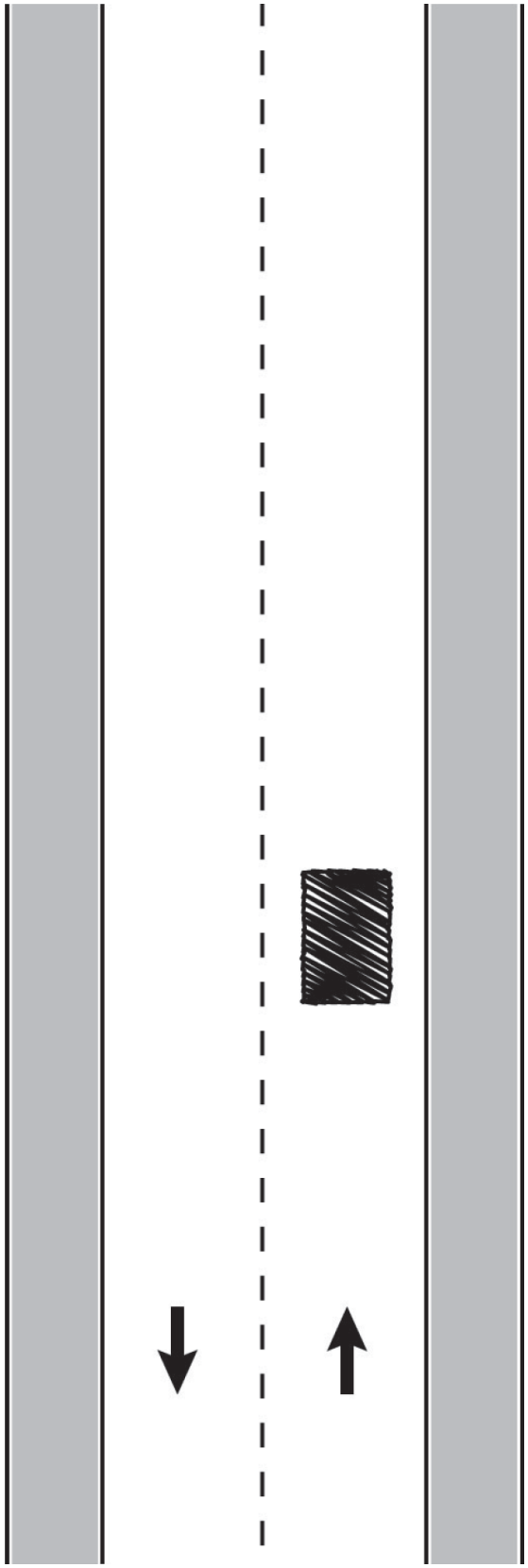
Speed Limit 60
12′ lanes & 10′ shoulders
Work Space = 1000′ long
Work Operation = 9:30am – 2:30pm



Scenario #3

Roadway Information:

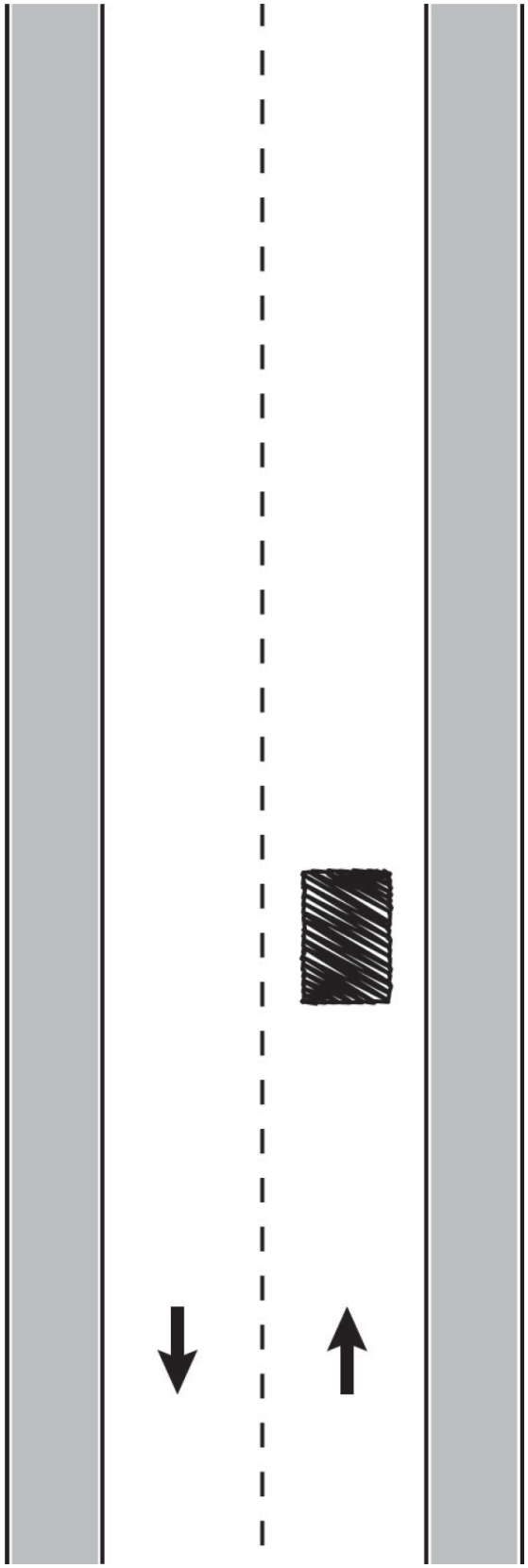
Speed Limit 55
11’ lanes & 8’ shoulders
Work Space = 500’ long
Work Operation = Continuous for 7 calendar days



Scenario #4

Roadway Information:

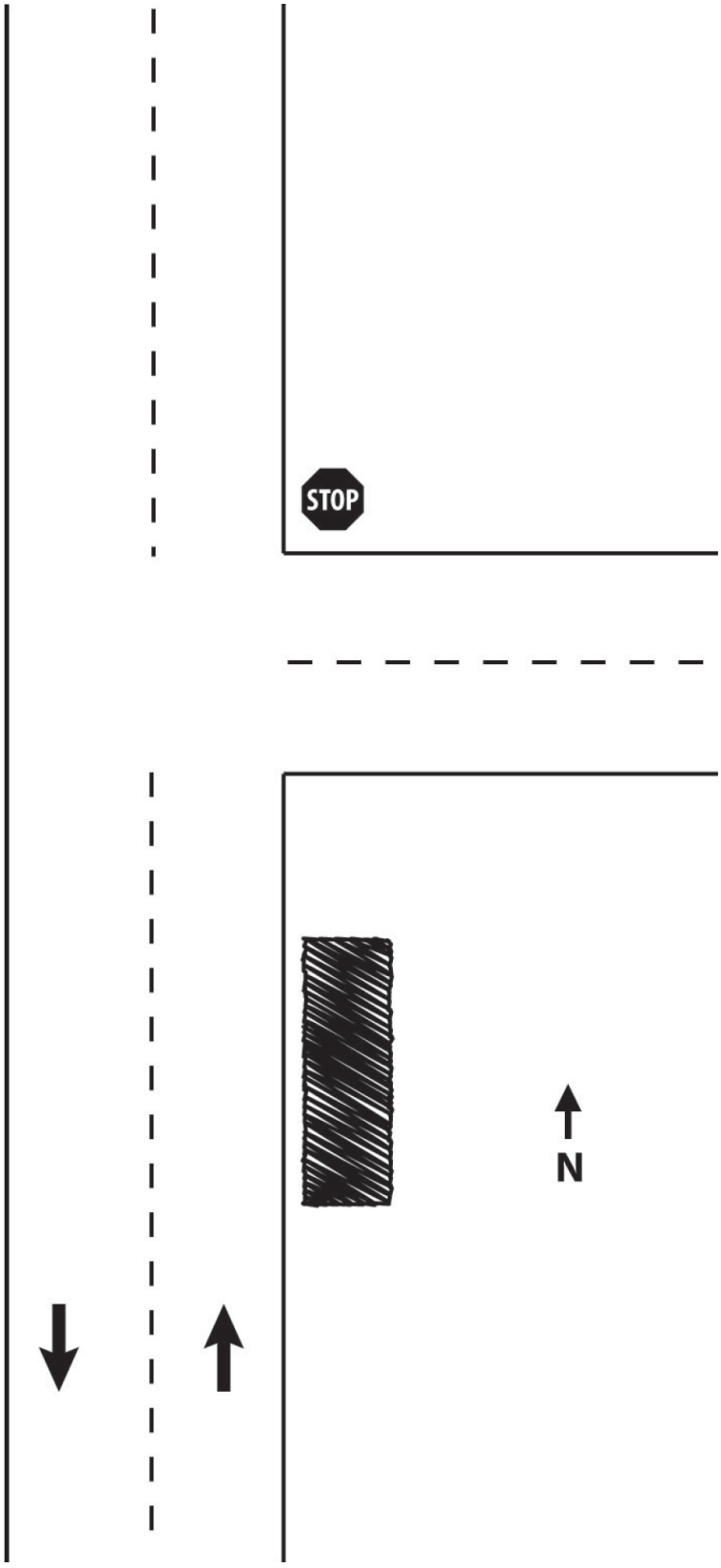
Speed Limit 55
11′ lanes & 8′ shoulders
Work Space = 2500′ long (~1/2 mile)
Work Operation = 9:00am – 3:00pm



Scenario #5

Roadway Information:

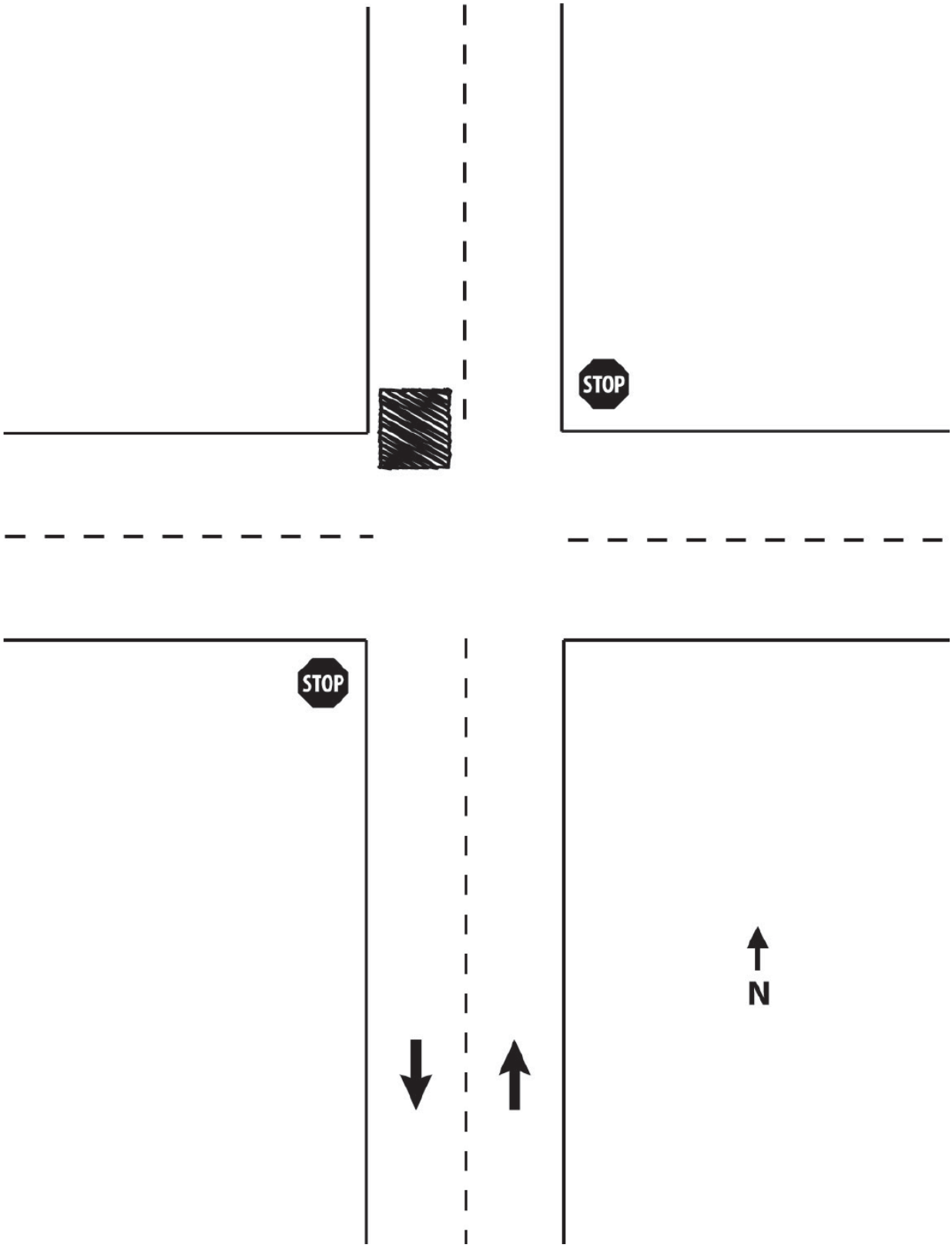
Speed Limit 25
11’ lanes, 4’ bike lane, & adjacent sidewalk
Work Space = 10’ x 50’
Work Operation = 11:00am – 1:00pm



Scenario #6

Roadway Information:

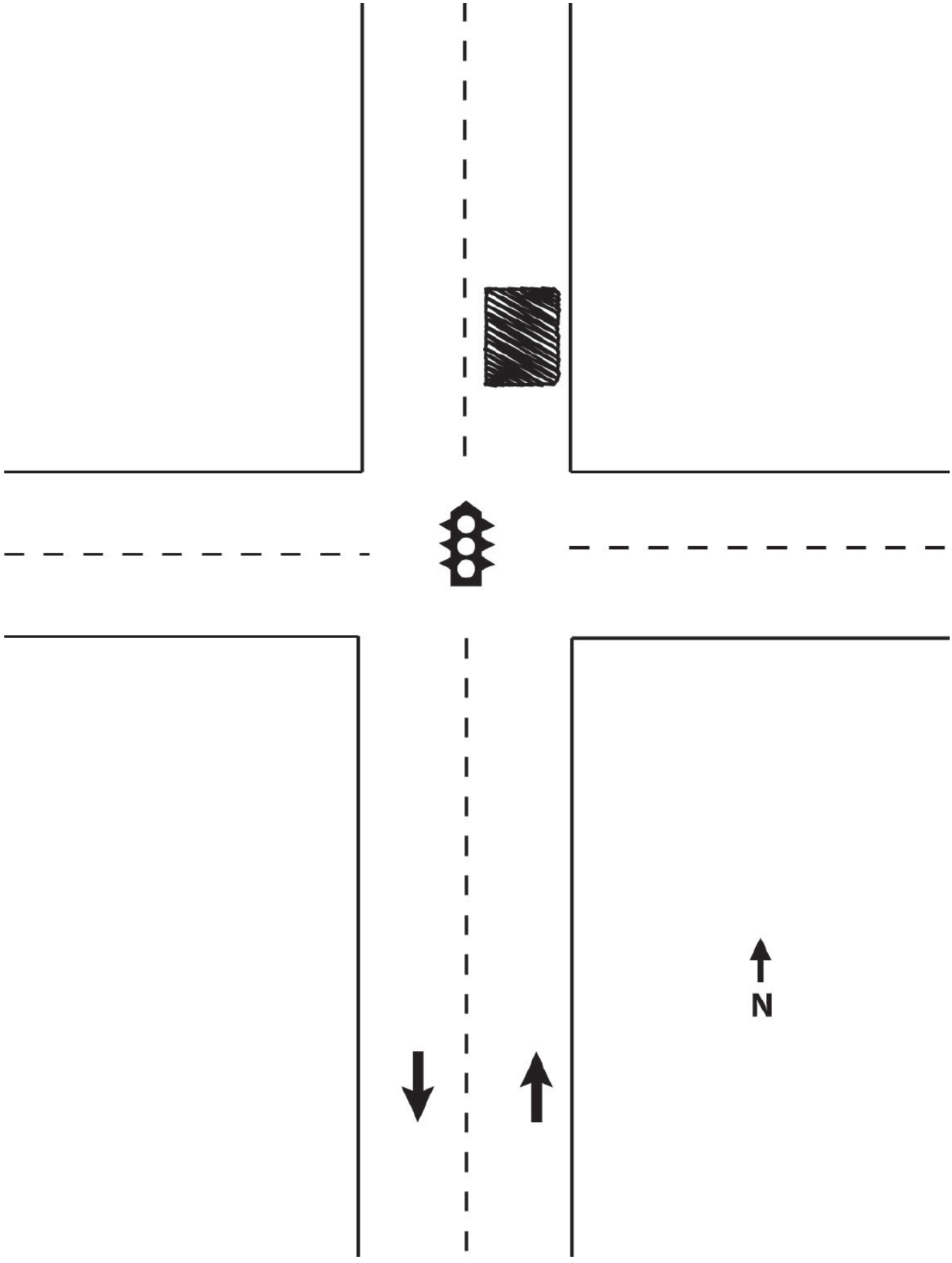
Speed Limit 25
10′ lanes & no shoulders (just curbs)
Work Area = 10′ x 10′
Work Operations = 9:00am to 3:00pm
Intersection = STOP in East/West only



Scenario #7

Roadway Information:

Speed Limit 35
11’ lanes & no shoulders (just curbs)
Work Space = 100’ long
Work Operation = 9:00pm to 5:00am
Intersection controlled via signal



Chapter 14 : Washington Modifications to MUTCD (WAC 468-95)

14.1 Summary

This chapter provides Washington's adoption and modification of the 2009 MUTCD as provided in WAC 468-95 (Washington Administrative Code).

Knowing these modifications are critical because they change Part 6 of the MUTCD in significant ways:

- Temporary sign spacing
- Channelizing device spacing
- Flagging within an intersection requirement
- Motorcycle Use Extreme Caution sign requirements
- Temporary pavement marking usage duration

WAC 468-95-010: General

The 2009 Edition of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), published by the Federal Highway Administration and approved by the Federal Highway Administrator as the national standard for all highways open to public travel, was duly adopted by the Washington state secretary of transportation. Revisions are incorporated into the December 2009 Edition of the MUTCD, except as may be modified herein, when published by the Federal Highway Administration.

The manual includes in part many illustrations, some of which depend on color for proper interpretation. The code reviser has deemed it inexpedient to convert these regulations and illustrations to the prescribed form and style of WAC and therefore excludes them from publication.

The document is available for public inspection at the headquarters office and all region offices of the Washington state department of transportation. Further, each city, town, and county engineering office in the state will have either a hard copy or an electronic copy of the MUTCD, with revisions and modifications for Washington, in its possession.

WAC 468-95-017: Engineering Judgement & Traffic Control Device Usage

Add the following Guidance to the end of paragraph 04 in MUTCD Section 1A.09:

> *The decision to use a particular device at a particular location should be made on the basis of either an engineering study or the application of engineering judgment. Thus, while this manual provides Standards, Guidance, and Options for the design and application of traffic control devices, this manual should not be considered a substitute for engineering judgment.*

Engineering judgment should be exercised in the selection and application of traffic control devices, as well as in the location and design of the roads and streets that the devices complement.

WAC 468-95-300: Temporary Sign Spacing

Amend MUTCD Table 6C-1 to read:

SIGN SPACING = X (1)		
FREEWAYS & EXPRESSWAYS	50-75 MPH	1500' +/-
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	**200' +/- (2)**
URBAN STREETS	25 MPH OR LESS	**100' +/- (2)**
(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.		
(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.		

For reference, MUTCD Table 6C-1 is provided on the next page:

Table 6C-1. Recommended Advance Warning Sign Minimum Spacing

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* Speed category to be determined by the highway agency

** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

WAC 468-95-301: Maximum Channelizing device Spacing

Add a new MUTCD Table 6C-5, Channelizing device Spacing, to Section 6C.08 to read:

MAXIMUM CHANNELIZATION DEVICE SPACING (feet)		
MPH	TAPER	TANGENT
50-75	40	80
35-45	30	60
20-30	20	40

For reference, MUTCD Section 6F.63 Paragraph 08 (Page 604) states channelizing devices spacing should not exceed 1.0 times the speed limit in mph at tapers and 2.0 times the speed limit in mph in tangents. Washington requires tighter spacing.

WAC 468-95-3015: Flagging at Signalized Intersection Requirements

Add a new Standard to MUTCD Section 6E.07 to read:

Standard:

Flagger directions at signalized intersections shall not be in conflict with signal displays and the signal must be either shut down or placed in flash mode as appropriate for the intersection operation except during emergencies.

WAC 468-95-302: Single Flagger at Center of Intersection Prohibited

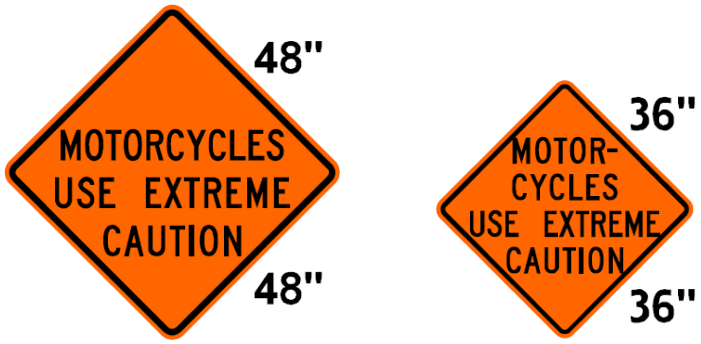
Add a new Standard to MUTCD Section 6E.08 to read:

> **Standard:**
>
> **A single flagger shall not flag from the center of an intersection, except when there is an emergency or when law enforcement is flagging. When flagging at an intersection there shall be a flagger controlling each intersection leg.**

For clarification, this WAC does not prohibit adding a flagger within an intersection when all approaches are controlled via flaggers. It simply prohibits a single flagger within an intersection controlling multiple approaches of traffic with no flagger controlling each approach.

WAC 468-95-305: Motorcycles Use Extreme Caution Sign

Pursuant to RCW 47.36.200, a warning sign displaying the word message motorcycles use extreme caution is added to MUTCD Figure 6F-4. The sign shall be diamond shaped with black letters on an orange background.



W21-1701 **W21-1701**

RCW 47.36.200: Pavement Conditions Requiring Warning Signage

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

WAC 468-95-306: Motorcycles Use Extreme Caution Supplemental Plaque

Pursuant to RCW 47.36.200, amend MUTCD Section 6F.54 to read:

A supplemental plaque displaying the message motorcycles use extreme caution is added to MUTCD Figure 6F-4. Delete the Motorcycle symbol (W8-15P) plaque from Figure 6F-4.

The motorcycles use extreme caution (W21-1701P) plaque (see Figure 6F-4) may be mounted below a loose gravel (W8-7) sign, a grooved pavement (W8-15) sign, a abrupt lane edge (W21-801), a metal bridge deck (W8-16) sign, or a steel plate ahead (W8-24) sign if the warning is intended to be directed primarily to motorcyclists.

W21-1701P (42" x 30") **W8-15P (Prohibited)**

WAC 468-95-307: Abrupt Lane Edge Warning Sign

This chapter provides Washington's adoption and modification of the 2009 MUTCD as provided in WAC 468-95 (Washington Administrative Code)

WAC 468-95-310: Temporary Pavement Marking Duration Extension & Layout

Amend MUTCD Section 6F.78 to read:

Standard:

All temporary pavement markings shall conform to the requirements of Chapters 3A and 3B. All temporary broken-line pavement markings shall use the same cycle length as permanent markings and be at least 2 feet long.

- Standard Specification 8-23.3(4)A requires 4-foot markings for short-duration temporary pavement markings
- Standard Specification 8-23.3(4)B refers back to Standard Specification 8-22.3(3) which requires 10-foot markings for long-duration temporary pavement markings.

Support:

Temporary pavement markings are those that may be used until it is practical and possible to install permanent markings.

Option:

Half-cycle lengths with a minimum of 2 feet [4 feet per Standard Specifications] stripes may be used on roadways with severed curvature (see Section 3A.05) for center lines in passing zones and for lane lines.

For temporary situations, for a two-lane or three-lane road, no-passing zones may be identified by using do not pass (R4-1), pass with care (R4-2), and no passing zone (W14-3) signs rather than pavement markings.

Guidance:

When used, the do not pass, pass with care, and no passing zone signs should be placed in accordance with Sections 2B.28, 2B.29, and 2C.45.

Most notably, WAC 468-95-310 modifies Guidance statement MUTCD's Section 6F.78, Paragraph 02 statement:

Section 6F.78 Temporary Markings

Guidance:

02 *Unless justified based on engineering judgment, temporary pavement markings should not remain in place for more than 14 days after the application of the pavement surface treatment or the construction of the final pavement surface on new roadways or over existing pavements.*

With this WAC, temporary pavement markings can remain in place until the permanent pavement markings can be installed.

WAC 468-95-317: Temporary Sign Spacing

Amend MUTCD Table 6H-3 to read:

SIGN SPACING = X (1)		
FREEWAYS & EXPRESSWAYS	50-75 MPH	1500' +/-
RURAL HIGHWAYS	60-65 MPH	800' +/-
RURAL ROADS	45-55 MPH	500' +/-
RURAL ROADS & URBAN ARTERIALS	35-40 MPH	350' +/-
RURAL ROADS & URBAN ARTERIALS RESIDENTAL & BUSINESS DISTRICTS	25-30 MPH	**200' +/- (2)**
URBAN STREETS	25 MPH OR LESS	**100' +/- (2)**

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERCHANGE RAMPS, AT-GRADE INTERSECTIONS AND DRIVEWAYS.

(2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.

For reference, MUTCD Table 6H-3 is provided on the next page:

Table 6H-3. Meaning of Letter Codes on Typical Application Diagrams

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* Speed category to be determined by highway agency

** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

Chapter 15 : Standard Specification (Work Zone)

15.1 Summary

This chapter provides work zone-related Standard Specifications with some sections greatly simplified, complex sections paraphrased, and additional information added to help TCSs navigate them. The complete, unedited Standard Specifications is available and applies to all WSDOT projects and Federal-Aid projects by local agencies (cities and counties).

1-07.8 High-Visibility Apparel [Full Text]

The Contractor shall require all personnel including service providers, subcontractors or material persons that are on foot in the work zone and are exposed to vehicle traffic or construction equipment to wear the high-visibility apparel described in this section.

The Contractor shall ensure that a competent person as identified in the MUTCD selects the appropriate high-visibility apparel suitable for the jobsite conditions.

High-visibility garments shall always be the outermost garments.

High-visibility garments shall be labeled as, and in a condition compliant with the ANSI/ISEA 107-2015 (or later version) and shall be used in accordance with manufacturer recommendations.

1-07.8(1) Traffic Control Personnel [Modified per GSP]

All personnel performing the Work described in Section 1-10 (including traffic control supervisors, flaggers and others performing traffic control labor of any kind) shall comply with the following:

1. During daylight hours with clear visibility, workers shall wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 garment with background material that are fluorescent yellow-green, fluorescent orange-red, or fluorescent red, and a high visibility hardhat that is white, yellow, yellow-green, orange, or red in color; and
2. During hours of darkness (½ hour before sunset to ½ hour after sunrise) or other low-visibility conditions (snow, fog, etc.), workers shall wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 garment with background material that are fluorescent yellow-green, fluorescent orange-red, or fluorescent red, and a high visibility hardhat that is marked with at least 12 square inches of retroreflective material applied to provide 360 degrees of visibility.

1-07.8(2) Non-Traffic Control Personnel

All personnel, except those performing the Work described in Section 1-10, shall wear high-visibility apparel meeting the ANSI/ISEA 107 Type R Class 2 or 3 standard.

1-07.23 Public Convenience and Safety [Full Text]

The Contractor shall be responsible for providing adequate safeguards, safety devices, protective equipment, and any other needed actions to protect the life, health, and safety of the public, and to protect property in connection with the performance of the Work covered by the Contract. The Contractor shall perform any measures or actions the Engineer may deem necessary to protect the public and property. The responsibility and

expense to provide this protection shall be the Contractor's except that which is to be furnished by the Contracting Agency as specified in other sections of these Specifications. Nothing contained in this Contract is intended to create any third-party beneficiary rights in favor of the public or any individual utilizing the Highway facilities being constructed or improved under this Contract.

1-07.23(1) Construction Under Traffic

The Contractor shall conduct all operations with the least possible obstruction and inconvenience to the public. The Contractor shall have under construction no greater length or amount of Work than can be prosecuted properly with due regards to the rights of the public. To the extent possible, the Contractor shall finish each section before beginning Work on the next. The Contractor shall enter interstate Highways only through legal movements from existing roads, streets, and through other access points specifically allowed by the Contract documents.

To disrupt public traffic as little as possible, the Contractor shall permit traffic to pass through the Work with the least possible inconvenience or delay. The Contractor shall maintain existing roads, streets, sidewalks, and paths within the project limits, keeping them open and in good, clean, safe condition at all times. Accessibility to existing or temporary pedestrian push buttons shall not be impaired. Deficiencies caused by the Contractor's operations shall be repaired at the Contractor's expense. The Contractor shall also maintain roads, streets, sidewalks, and paths adjacent to the project limits when affected by the Contractor's operations. Snow and ice control will be performed by the Contracting Agency on all projects. Cleanup of snow and ice control debris will be at the Contracting Agency's expense. The Contractor shall perform the following:

1. Remove or repair any condition resulting from the Work that might impede traffic or create a hazard.
2. Keep existing traffic signal and Highway lighting systems in operation as the Work proceeds. (The Contracting Agency will continue the routine maintenance on such system.)
3. Maintain the striping on the Roadway at the Contracting Agency's expense. The Contractor shall be responsible for scheduling when to renew striping, subject to the approval of the Engineer. When the scope of the project does not require Work on the Roadway, the Contracting Agency will be responsible for maintaining the striping.
4. Maintain existing permanent signing. Repair of signs will be at the Contracting Agency's expense, except those damaged due to the Contractor's operations.
5. Keep drainage Structures clean to allow for free flow of water. Cleaning of existing drainage Structures will be at the Contracting Agency's expense when approved by the Engineer, except when flow is impaired due to the Contractor's operations.

To protect the rights of abutting property owners, the Contractor shall:

1. Conduct the construction so that the least inconvenience as possible is caused to abutting property owners;
2. Maintain ready access to driveways, houses, and buildings along the line of Work;

3. Provide temporary approaches to crossing or intersecting roads and keep these approaches in good condition; and
4. Provide another access before closing an existing one whenever the Contract calls for removing and replacing an abutting owner's access.

When traffic must pass through grading areas, the Contractor shall:

1. Make cuts and fills that provide a reasonably smooth, even Roadbed;
2. Place, in advance of other grading Work, enough fill at all culverts and bridges to permit traffic to cross;
3. Make Roadway cuts and fills, if ordered by the Engineer, in partial-width lifts, alternating lifts from side to side to permit traffic to pass on the side opposite the Work;
4. Install culverts on half the width of the Traveled Way, keeping the other half open to traffic and unobstructed until the first half is ready for use;
5. After rough grading or placing any subsequent layers, prepare the final Roadbed to a smooth, even surface (free of humps and dips) suitable for use by public traffic; and
6. Settle dust with water, or other dust palliative, as the Engineer may order.

If grading Work is on or next to a Roadway in use, the Contractor shall finish the grade immediately after rough grading and place surfacing materials as the Work proceeds.

1-07.23(1)A Drop-Offs

1-07.23(1)A1 General Requirements

The Contractor shall conduct all operations to minimize any drop-offs (abrupt changes in roadway elevation) left exposed to traffic during nonworking hours. Unless otherwise specified in the Traffic Control Plan, drop-offs left exposed to traffic during nonworking hours shall be protected as follows with an accepted traffic control plan submittal in accordance with Section 1-10.2(2):

1. Drop-offs up to 0.20 foot, unless otherwise ordered by the Engineer, may remain exposed with appropriate warning signs alerting motorists of the condition.
2. Drop-offs more than 0.20 foot that are in the Traveled Way or Auxiliary Lane will not be allowed unless protected with appropriate warning signs and further protected as indicated in 3b or 3c below.
3. Drop-offs more than 0.20 foot, but no more than 0.50 foot, that are not within the Traveled Way shall be protected with appropriate warning signs and further protected by having one of the following:
   a. A wedge of compacted stable material placed at a slope of 4:1 or flatter.
   b. Channelizing devices (Type I barricades, plastic safety drums, or other devices 36 inches or more in height) placed along the traffic side of the drop-off and a new edge of pavement stripes placed a minimum of 3 feet from the drop-off. The maximum spacing between the devices in feet shall be the posted speed in miles per hour. Pavement drop-off warning signs shall be placed in advance and throughout the drop-off treatment.

c. A temporary concrete barrier, temporary steel barrier, or other approved traffic barrier installed on the traffic side of a drop-off with a new edge line placed a minimum of 2-feet from the traffic face of the barrier. The barrier shall have a lateral offset from the edge of the drop-off to the back of the barrier as follows:

   i. A minimum offset of 3' for temp. Type F/Type 2 unanchored concrete barrier.

   ii. A minimum offset of 1' for Type F/Type 2 concrete barrier when anchored on hot mix asphalt pavement as shown on Std Plan C-60.10 or K-80.35.

   iii. A minimum offset of 1' for temporary Type F concrete barrier anchored on cement concrete pavement as shown on WSDOT Std Plan C-60.10.

   iv. A minimum offset of 9" for Type F/Type 2 concrete barrier anchored on cement concrete pavement/bridge decks per Std Plan K-80.35.

   v. A minimum offset of 6" or 9" for Type F/Type 2 narrow base concrete barrier anchored on cement concrete pavement/bridge decks per Std Plan K-80.37.

   vi. A minimum offset following manufacturer recommendations for temporary steel barrier when not anchored; or when anchored on hot mix asphalt pavement, cement concrete pavement, or concrete bridge decks.

   vii. A minimum offset as directed by the Engineer for any barrier type or configuration not shown in this Section.

   An approved terminal, flare, or impact attenuator is required at the approach end of the barrier run, and is required at the trailing end of a barrier run in two-way operations when shown in the plans or as directed by the Engineer.

4. Drop-offs more than 0.50 foot not within the Traveled Way or Auxiliary Lane shall be protected with appropriate warning signs and further protected as indicated in 3a, 3b, or 3c if all of the following conditions are met:
   a. The drop-off is less than 2 feet;
   b. The total length throughout the project is less than 1 mile;
   c. The drop-off does not remain for more than 3 working days;
   d. The drop-off is not present on any of the holidays listed in Section 1-08.5; and
   e. The drop-off is only on one side of the Roadway.

5. Drop-offs more than 0.50 foot that are not within the Traveled Way or Auxiliary Lane and are not otherwise covered by No. 4 above shall be protected with appropriate warning signs and further protected as indicated in 3a or 3c.

1-07.23(1)B Open Trenches

1-07.23(1)B1 General Requirements

Unless behind guardrail or barrier, open trenches are prohibited within the Traveled Way, Auxiliary Lanes, Shoulders, or other areas in the work zone clear zone, backfilling and paving operations are required to reopen to traffic within the allowable closure.

If backfilling cannot be properly completed within a work shift and steel plates are allowed, the Contractor shall place steel plates over trenches during non-working hours.

When allowed, steel plates shall not be in place longer than 72 hours.

1-07.23(1)B2 Steel Plates

When steel plates are allowed the Contractor shall follow submittal requirements of this Section and have an accepted submittal prior to trench excavation.

1. Allowable use of steel plates within the Traveled Way, Auxiliary Lanes, Shoulders:

   a. Posted Speeds 35 mph or less: Steel plates allowed open or closed.

   b. Posted Speeds 40 mph and higher: Steel plates only allowed within closed highways.

2. Allowable use of steel plates within Pedestrian Pathways:

   Steel plates are allowed for open and closed Pathways. When allowed, the walking surface shall be painted with either a non-slip paint, anti-slip tape, or rolled roofing. The transverse edges shall be beveled at 2:1 with a maximum ¼" vertical lip.

1-07.23(1)B3 Signing

When steel plates are used to cover trenches within the Traveled Way, Auxiliary Lanes, or Shoulders, a "MOTORCYCLES USE EXTREME CAUTION" (W21-1701) and "STEEL PLATE AHEAD" (W8-24) advanced warning signs shall be used to alert motorists of the presence of the steel plates. Additional signage for Traveled Way, Auxiliary Lane and Shoulder closures are to be in accordance with accepted traffic control plans.

1-07.23(1)B4 Submittals

A Type 2E Working Drawing shall be submitted for all steel plates allowed by this Section. Steel plates shall be capable of withstanding, at a minimum, AASHTO HS-20 loading. The Working Drawing shall contain the following information:

1. Length and width of steel plates.
2. Thickness of steel plates.
3. Dimensions for excavation to be spanned and overlap of excavation.
4. Information on permanent nonskid surfaces.
5. Method of mounting, including anchorages, shoring, or other hardware to secure the steel plate or any other method to resist sliding.
6. Analysis of sliding forces when steel plates are installed within 300' of intersections to account for motor vehicle braking.
7. Paving details on and adjacent to the steel plate on all sides.
8. All calculations.
9. Steel grade, alloy composition, and welding details.
10. Schedule for maintenance of steel plates.

1-07.23(2) Construction and Maintenance of Detours

Unless otherwise approved, the Contractor shall maintain two-way traffic during construction. The Contractor shall build, maintain in a safe condition, keep open to traffic, and remove when no longer needed:

1. Detours and detour bridges that will accommodate traffic diverted from the Roadway, bridge, sidewalk, or path during construction;
2. Detour crossings of intersecting Highways; and
3. Temporary approaches.

Unit Contract prices will cover construction, maintenance, and removal of all detours shown in the Plans or proposed by the Contracting Agency.

The Contractor shall pay all costs to build, maintain, and remove all other detours, whether built for the Contractor's convenience or to facilitate construction operations. Any detour proposed by the Contractor shall not be built until the Engineer approves. Surfacing and paving shall be consistent with traffic requirements.

Upon failure of the Contractor to immediately provide, maintain, or remove detours or detour bridges when ordered to do so by the Engineer, the Contracting Agency may, without further notice to the Contractor or the Surety, provide, maintain, or remove the detours or detour bridges and deduct the costs from any payments due or coming due the Contractor.

1-07.23(3) Work Zone Clear Zone

The Work Zone Clear Zone (WZCZ) applies during working and nonworking hours. The WZCZ applies only to temporary roadside objects introduced by the Contractor's operations and does not apply to preexisting conditions or permanent Work. Those work operations that are actively in progress shall be in accordance with adopted and approved Traffic Control Plans, and other contract requirements.

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

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

The Contractor's nonessential vehicles and employees private vehicles shall not be permitted to park within the WZCZ at any time unless protected as described above.

Deviation from the above requirements shall not occur unless the Contractor has requested the deviation in writing and the Engineer has provided written approval.

Minimum Work Zone Clear Zone Distance

Regulatory Posted Speed	Distance From Traveled Way (Feet)
35 mph or less	10
40 mph	15
45 to 50 mph	20
55 to 60 mph	30
65 mph or greater	35

1-10 Temporary Traffic Control [Full Text]

1-10.1 General

Temporary traffic control refers to the control of all types of traffic, including vehicles, bicyclists, and pedestrians (including pedestrians with disabilities). The Contractor, utilizing contractor labor and contractor-provided equipment and materials (except when such labor, equipment, or materials are to be provided by the Contracting Agency as specifically identified herein), shall plan, manage, supervise, and perform all temporary traffic control activities needed to support the Work of the Contract.

1-10.1(1) Materials

Materials shall meet the requirements of the following Sections:

Traffic Control Materials 9-35

1-10.1(2) Description

Unless otherwise permitted by the Contract or approved by the Engineer, the Contractor shall keep all existing pedestrian routes and access points (including sidewalks, paths, crosswalks, and detectable warning surfaces) open and clear at all times.

The Contractor shall keep lanes, on-ramps, and off-ramps, open to traffic at all times except when Work requires closures. Ramps shall not be closed on consecutive interchanges at the same time, unless approved by the Engineer. Lanes and ramps shall be closed for the minimum time required to complete the Work. When paving hot mix asphalt the Contractor may apply water to the pavement to shorten the time required before reopening to traffic.

The Contractor shall provide signs and other traffic control devices not otherwise specified as being furnished by the Contracting Agency. The Contractor shall erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices necessary to warn and protect the public at all times from injury or damage as a result of the Contractor's operations, which may occur on or adjacent to Highways, roads, streets, sidewalks, or paths. No Work shall be done on or adjacent to any Traveled Way until all necessary signs and traffic control devices are in place.

The traffic control resources and activities described shall be used for the safety of the public, of the Contractor's employees, and of the Contracting Agency's personnel and to facilitate the movement of the traveling public. Traffic control resources and activities may be used for the separation or merging of public and construction traffic when such use is in accordance with a specific traffic control plan.

Upon failure of the Contractor to immediately provide flaggers; erect, maintain, and remove signs; or provide, erect, maintain, and remove other traffic control devices when ordered to do so by the Engineer, the Contracting Agency may, without further notice to the Contractor or the Surety, perform any of the above and deduct all of the costs from the Contractor's payments.

The Contractor shall be responsible for providing adequate labor, sufficient signs, and other traffic control devices, and for performing traffic control procedures needed for the protection of the Work and the public at all times regardless of whether or not the labor, devices or procedures have been ordered by the Engineer, furnished by the Contracting Agency, or paid for by the Contracting Agency.

Wherever possible when performing Contract Work, the Contractor's equipment shall follow normal and legal traffic movements. The Contractor's ingress and egress of the Work area shall be accomplished with as little disruption to traffic as possible. Traffic control devices shall be removed by picking up the devices in a reverse sequence to that used for installation. This may require moving backwards through the work zone. When located behind barrier or at other locations shown on the traffic control plans, equipment may operate in a direction opposite to adjacent traffic.

The Contractor is advised that the Contracting Agency may have entered into operating agreements with one or more law enforcement organizations for cooperative activities. Under such agreements, at the sole discretion of the Contracting Agency, law enforcement personnel may enter the work zone for enforcement purposes and may participate in the Contractor's traffic control activities. The responsibility under the Contract for all traffic control resides with the Contractor and any such participation by law enforcement personnel in Contractor traffic control activities will be referenced in the Special Provisions or will be preceded by an agreement and, if appropriate, a cost adjustment. Nothing in this Contract is intended to create an entitlement, on the part of the Contractor, to the services or participation of the law enforcement organization.

1-10.2 Traffic Control Management

1-10.2(1) General

It is the Contractor's responsibility to plan, conduct, and safely perform the Work. The Contractor shall manage temporary traffic control with his or her own staff. Traffic control management responsibilities shall be formally assigned to one or more company supervisors who are actively involved in the planning and management of field Contract activities. The Contractor shall provide the Engineer with a copy of the formal assignment. The duties of traffic control management may not be subcontracted.

The Contractor shall designate an individual or individuals to perform the duties of the primary Traffic Control Supervisor (TCS). The designation shall also identify an alternate TCS who can assume the duties of the primary TCS in the event of that person's inability to perform. The TCS shall be responsible for safe implementation of traffic control plans provided by the Contractor.

The primary and alternate TCS shall be certified by one of the organizations listed in the Special Provisions. Possession of a current Washington State TCS card and flagging card by the primary and alternate TCS is mandatory. A traffic control management assignment and a TCS designation are required on all projects that will utilize traffic control.

The Contractor shall maintain 24-hour telephone numbers at which the Contractor's assigned traffic control management personnel and the TCS can be contacted and be available upon the Engineer's request at other than normal working hours. These persons shall have the resources, ability and authority to expeditiously correct any deficiency in the traffic control system.

1-10.2(1)A Traffic Control Management

The responsibilities of the Contractor's traffic control management personnel shall include:

1. Overseeing and approving the actions of the Traffic Control Supervisor (TCS) to ensure that proper safety and traffic control measures are implemented and consistent with the specific requirements created by the Contractor's work zones and the Contract. Some form of oversight shall be in place and effective even when the traffic control management personnel are not present at the jobsite.
2. Providing the Contractor's designated TCS with the Contract or Engineer accepted traffic control plans (TCPs) which are compatible with the Work operations and traffic control for which they will be implemented.
3. Discussing proposed traffic control measures and coordinating implementation of the Contractor-accepted traffic control plan(s) with the Engineer.
4. Coordinating all traffic control operations, including those of subcontractors and suppliers, with each other and with any adjacent construction or maintenance operations.
5. Coordinating the project's activities (such as ramp closures, road closures, and lane closures) with appropriate police, fire control agencies, city or county engineering, medical emergency agencies, school districts, and transit companies.
6. Overseeing all requirements of the Contract that contribute to the convenience, safety, and orderly movement of vehicular and pedestrian traffic.
7. Reviewing the TCS's diaries daily and being aware of field traffic control operations.
8. Being present on-site a sufficient amount of time to adequately satisfy the above-listed responsibilities.
9. Have available at all times all applicable standards and specifications as described in Section 1-10.2(3).

Failure to carry out any of the above-listed responsibilities shall be a failure to comply with the Contract and may result in a suspension of Work as described in Section 1-08.6.

1-10.2(1)B Traffic Control Supervisor

A Traffic Control Supervisor (TCS) shall be present on the project whenever flagging or other traffic control labor is being utilized or less frequently, as authorized by the Engineer.

The TCS shall personally perform all the duties of the TCS. During nonwork periods, the TCS shall be available to the job site within a 45-minute time period after notification by the Engineer.

The TCS's duties shall include:

1. Having a current set of Contract or Engineer accepted traffic control plans (TCPs), applicable Contract Provisions as provided by the Contractor, the latest adopted edition of the MUTCD, including the *Washington State Modifications to the MUTCD*, the book *Quality Guidelines for Temporary Work Zone Traffic Control Devices,* the most current edition of the PROWAG, and applicable standards and Specifications.
2. Inspecting traffic control devices and nighttime lighting for proper location, installation, message, cleanliness, and effect on the traveling public. Traffic control devices shall be inspected at least once per hour during working hours except that Class A signs need to be checked once a week and nighttime lighting need to be checked only once a shift.

Traffic control devices left in place for 24 hours or more shall also be inspected once during the nonworking hours when they are initially set up (during daylight or darkness, whichever is opposite of the working hours). The TCS shall correct, or arrange to have corrected, any deficiencies noted during these inspections.

3. Preparing a daily traffic control diary on each day that traffic control is performed using WSDOT Form 421-040A and 421-040B, and submitting them to the Engineer no later than the end of the next working day. The Contractor may use alternate forms if approved by the Engineer. Diary entries shall include, but not be limited to:
    a. Time of day when signs and traffic control devices are installed and removed,
    b. Location and condition of signs and traffic control devices,
    c. Revisions to the traffic control plan,
    d. Lighting utilized at night, and
    e. Observations of traffic conditions.
4. Making minor revisions to the traffic control plan to accommodate site conditions provided that the original intent of the traffic control plan is maintained, and the revision has the concurrence of both the Contractor and the Engineer.
5. Attending traffic control coordinating meetings or coordination activities as necessary for full understanding and effective performance.
6. Ensuring that all needed traffic control devices and equipment are available and in good working condition prior to the need to install or utilize them.
7. Ensuring that all pedestrian routes or access points, existing or temporary, are kept clear and free of obstructions and that all temporary pedestrian routes or access points are detectable and accessible to persons with disabilities as provided for in the traffic control plans.
8. Have available at all times all applicable standards/specifications per Section 1-10.2(3).
9. Other work described in Section 1-10.3(1)A or in Section 1-10.3(1)B, provided that items #1 through #8 are accomplished.

1-10.2(2) Traffic Control Plans

The traffic control plans appearing in the Contract documents show a method of handling vehicle, bicycle, and pedestrian traffic. All construction signs, flaggers, and other traffic control devices are shown on the traffic control plan(s) except for emergency situations. If the Contractor proposes adding the use of flaggers to a plan, this will constitute a modification requiring acceptance by the Engineer.

When the Contractor's chosen method of performing the Work in the Contract requires some form of temporary traffic control, for vehicles, bicyclists, or pedestrians, the Contractor shall either: (1) submit a Type 1 Working Drawing designating and adopting, in writing, the traffic control plans from the Contract documents that support that method; or (2) submit a Type 2 Working Drawing consisting of the Contractor's plan that modifies, supplements or replaces a plan from the Contract documents. Any Contractor-proposed modification, supplement or replacement shall show the necessary construction signs, flaggers, and other traffic control devices required to support the Work. The Contractor shall be solely responsible for submitting any proposed traffic control plan or modification, obtaining the Engineer's acceptance and providing copies of the accepted traffic control plans to the Traffic Control Supervisor.

1-10.2(3) Conformance to Established Standards

Traffic control plans, signs, and all traffic control devices and procedures furnished or provided shall conform to the standards established in the latest WSDOT adopted edition (in accordance with WAC 468-95) of the MUTCD, published by the U.S. Department of Transportation. Flagging shall also be in accordance with WAC 296-155-305 and pedestrian traffic control shall also be in accordance with the Public Rights-of-Way Accessibility Guidelines (PROWAG) www.access-board.gov/prowag. Judgment of the quality of devices furnished will be based upon Quality Guidelines for Temporary Traffic Control Devices, published by the American Traffic Safety Services Association. Copies of the MUTCD and Quality Guidelines for Temporary Control Devices may be purchased from the American Traffic Safety Services Association, 15 Riverside Parkway, Suite 100, Fredericksburg, VA 22406-1022.

In addition to the standards of the MUTCD described above, the Contracting Agency enforces crashworthiness requirements for most work zone devices. The AASHTO Manual for Assessing Safety Hardware (MASH) has superseded the National Cooperative Highway Research Project (NCHRP) Report 350 as the established requirements for crash testing. Temporary traffic control devices manufactured after December 31, 2019 shall be compliant with the 2016 edition of the Manual for Assessing Safety Hardware (MASH 16) crash test requirements, as determined by the Contracting Agency, except as follows:

1. When a MASH 16 compliant device does not exist and none manufactured on or before December 31, 2019 are available, then a NCHRP 350 or MASH 09 device manufactured after December 31, 2019 is allowed with Engineer approval.
2. NCHRP-350 or MASH 09 devices manufactured on or before December 31, 2019 may continue to be used on WSDOT projects throughout their normal service life.
3. Small & lightweight channelizing or delineating devices (traffic drums, cones, flexible delineator posts) shall be either NCHRP 350, MASH 09, or MASH 16, as determined by the manufacturer of the device.
4. A determination of crashworthiness for acceptance of trailer-mounted devices such as sequential arrow signs [arrow boards], temporary traffic signals, area lighting supports, and portable changeable message signs is currently not required.

The condition of signs and traffic control devices shall be acceptable or marginal as defined in the book *Quality Guidelines for Temporary Traffic Control Devices*, and will be accepted based on a visual inspection by the Engineer. The Engineer's decision on the condition of a sign or traffic control device shall be final. A sign or traffic control device determined to be unacceptable shall be removed from the project and replaced within 12 hours of notification.

1-10.3 Traffic Control Labor, Procedures, and Devices

1-10.3(1) Traffic Control Labor

The Contractor shall furnish all personnel for flagging, for the execution of all procedures related to temporary traffic control and for the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations.

Vests and other high-visibility apparel shall be in conformance with Section 1-07.8.

1-10.3(1)A Flaggers

Flaggers shall be posted where shown on traffic control plans or where directed by the Engineer. All flaggers shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. The flagging card shall be immediately available and shown to the Contracting Agency upon request.

Flagging stations shall be shown on Traffic Control Plans at locations where construction operations require stopping or diverting public traffic. Flagging stations shall be staffed only when flagging is required. This staffing may be continuous or intermittent, depending on the nature of the construction activity. Whenever a flagger is not required to stop or divert traffic, the flagger shall move away from the flagging station to a safer location.

During hours of darkness, flagging stations shall be illuminated in a manner that ensures that flaggers can easily be visible and discernable as a flagger from 1000 feet by oncoming motorists.

Flagger station illumination shall meet the requirements of the MUTCD & these Specifications.

The Contractor shall provide portable lighting equipment capable of sufficiently illuminating a flagging station without creating glare for oncoming motorists or for the flagger while meeting the mobility requirements of the operation. The equipment shall be located on the same side of the roadway as the flagger, positioned 5 to 10 feet from the edge of traveled lane and aimed at the flagging station.

Flaggers shall be equipped with portable two-way radios, with a range suitable for the project. The radios shall be capable of having direct contact with project management (foremen, superintendents, etc.).

The Contractor shall furnish Stop/Slow paddles conforming to the requirements of Section 9-35.1 for all flagging operations.

1-10.3(1)B Other Traffic Control Labor

In addition to flagging duties, the Contractor shall provide personnel for all other traffic control procedures required by the construction operations and for the labor to install and remove any traffic control devices shown on traffic control plans. The Work shall consist of operating a pilot vehicle during one-way piloted traffic control, operating a traffic control vehicle or a chase vehicle during a rolling slowdown operation, operating any of the moving traffic control equipment, or adjusting signing during a mobile operation as described in Section 1-10.3(2)D, operating a vehicle or placing/removing traffic control devices required by a traffic control plan or performing preliminary work to prepare for placing and removing these devices, and relocation of any traffic control devices as Work progresses.

1-10.3(2) Traffic Control Procedures

1-10.3(2)A Alternating One-Lane, Two-Way Traffic Control

As shown on a traffic control plan or directed by the Engineer, on two-lane roadways, traffic may be placed in a single open lane under the control of flaggers, Automated Flagger Assistance Devices (AFADs), or temporary traffic signals to alternate the direction of traffic.

Side roads will be controlled by flaggers, AFADs, signals or closed. If flaggers and a pilot car are used, driveways and private roads may be controlled by signing informing drivers to wait for a pilot car. Flagger, AFAD or signal stations shall be illuminated at night.

If flaggers are used at an intersection, a flagger is required for each leg of the intersection and each direction of traffic should be reduced to one open lane approaching a flagger.

Contractor vehicles shall not use the open traffic lane except while following the same rules and routes required of the public traffic.

Alternating one-lane, two-way traffic controls shall remain in place until work is completed or the roadway can be opened in a safe operating condition.

1-10.3(2)B Rolling Slowdown

Rolling slowdown traffic control operations use a rolling blockade of vehicles traveling at slow speeds to create a gap in traffic to enable completion of work activities requiring access across or over all the directional lanes of a roadway. It is critical no traffic gets between the rolling blockade and work area. Rolling slowdown operations are not to be used for routine Work that can be addressed by standard lane or shoulder closure traffic control. When a short-term roadway closure is needed for an infrequent, nonrepetitive Work operation such as a sign bridge removal or utility wire crossing, the Contractor may implement a rolling slowdown on a multilane roadway, as part of an accepted traffic control plan.

The Contractor shall submit Type 2 Working Drawings consisting of a traffic control plan detailing the expected delay time, interchange ramp control, and rolling slowdown distance. A portable changeable message sign shall be placed ahead of the starting point of the traffic control to warn traffic of the slowdown. The sign shall be placed far enough ahead of the Work to avoid any expected backup of vehicles.

A rolling slowdown blockade requires one traffic control vehicle with flashing amber lights for each lane to be slowed, plus a traffic control vehicle to serve as a chase vehicle following traffic ahead of the blockade. These traffic control vehicles shall enter the roadway and form a moving blockade to reduce traffic speeds and create a clear area ahead of the blockade. When the chase vehicle reaches the work area, work may begin. All on-ramps and entrances to the Roadway between the moving blockade and Work operation shall be temporarily closed with traffic control vehicles and freeway-to-freeway on-ramps to be closed with standard traffic control devices. A portable changeable message sign shall be used far enough ahead of the operation to warn of slowed traffic. Communications between the Work operation and the moving blockade vehicles shall establish and adjust the speed of the blockade and closure times needed based on the work progress.

The Contractor shall submit Type 2 Working Drawings consisting of a traffic control plan detailing the calculated location where the traffic control vehicles shall begin the slowdown and the speed at which the moving blockade will travel based on the estimated time needed for closure. The duration of the rolling slowdown operation shall not exceed 15 minutes. The plan will also include the locations of portable changeable message signs, blockade vehicles, chase vehicle and ramp control vehicles needed for the operation.

The location where the traffic control vehicles shall begin the slowdown and the speed at which the moving blockade will be allowed to travel will be calculated to accommodate the estimated time needed for closure. The chase control vehicle shall follow the slowest vehicle ahead of the blockade. When the chase vehicle passes, the Contractor may begin the Work operation. In the event that the Work operation is not completed when the moving blockade reaches the site, all Work except that necessary to clear the Roadway shall cease immediately and the Roadway shall be cleared and reopened as soon as possible.

1-10.3(2)C Lane Closure Setup/Takedown

Where allowed by the Contract and shown on the traffic control plans or directed by the Engineer, the Contractor shall set up traffic control measures to close one or more lanes of a freeway or multi-lane roadway 45 mph or higher. When this is to occur, the following sequence shall be followed:

1. If shown on the traffic control plan, place portable changeable message sign(s).
2. Advance warning signs are set up on the Shoulder of the Roadway opposite the lane to be closed.
3. Advance warning signs are set up on the same Shoulder as the lane to be closed.
4. A transportable attenuator, with sequential arrow sign in arrow mode, is moved into the lane being closed to protect workers. Only the operator is allowed in the vehicle.
5. Channelizing devices and sequential arrow signs are placed to mark the closure taper as shown on the traffic control plan.
6. The transportable attenuator is repositioned within the closed lane, now with sequential arrow sign in caution mode, in advance of workers installing the remaining devices.

If additional lanes are to be closed, this shall be done in sequence with previous lane closures using the same sequence of activities. A transportable attenuator with sequential arrow sign is required during the process of closing each additional lane and is to be replaced with a sequential arrow sign without attenuator after the lane is closed. Each closed lane shall be marked with a separate sequential arrow sign at all times.

Channelizing devices shall not be moved by traffic control personnel across an open lane of traffic. If an existing setup or staging of traffic control devices require crossing an open lane of traffic, the traffic control devices shall be taken down completely and then set up in the new configuration.

Traffic control for lane closures shall be removed in the reverse order of its installation.

1-10.3(2)D Mobile Operations

Where construction operations are such that the Work is moving down the Roadway continuously or near continuous to the extent that the placement of stationary traffic control devices will not be effective, the Contractor may implement mobile traffic control. Moving traffic control shall always be conducted in the same direction as the adjacent traffic.

Where shown on a traffic control plan or directed by the Engineer, mobile traffic control shall consist of portable equipment, moving with the operation. A portable changeable message sign shall be established in advance of the operation, far enough back to provide warning of both the operation and of any queue of traffic that has formed during the operation. The advance sign shall be continuously moved to stay near the back of the queue at all times. A shadow vehicle with a transportable attenuator and sequential arrow sign shall be positioned and maintain a varying distance ahead of the protective vehicle to provide advance warning and maintain adequate sight distance to approaching traffic. The protective vehicle with transportable attenuator and sequential arrow sign shall be placed at the proper roll-ahead distance upstream of the work area.

1-10.3(2)E Patrol and Maintain Traffic Control Measures

At all times, when temporary traffic control measures are in place, the Contractor shall provide for patrolling and maintaining these measures. The Work shall consist of resetting errant devices, assuring visibility of all devices, cleaning and repairing where necessary, providing maintenance for all equipment, including replacing batteries and light bulbs as well as keeping motorized and electronic items functioning, and adjusting the location of devices to respond to actual conditions, such as queue length, unanticipated traffic conflicts and other areas where planned traffic control has proven ineffective.

This Work shall be performed by the Contractor, either by or under the direction of the Traffic Control Supervisor. Personnel, with vehicles if necessary, shall be dispatched so that all traffic control can be reviewed at least once per hour during working hours and at least once during each non-working day.

1-10.3(3) Traffic Control Devices

The Contractor shall provide the following traffic control devices as shown on the traffic control plans.

1-10.3(3)A Construction Signs

All construction signs required by traffic control plans, as well as any other appropriate signs directed by the Engineer shall be furnished by the Contractor. The Contractor shall provide the posts or supports and erect and maintain the signs in a clean, neat, and presentable condition until the need for them has ended. Post mounted signs shall be installed as shown in the Standard Plans. When the need for construction signs has ended, the Contractor, upon approval of the Engineer, shall remove all signs, posts, and supports from the project and they shall remain the property of the Contractor.

No passing zones defined by existing pavement markings that will be obliterated by construction operations shall be replaced by "Do Not Pass" and "Pass With Care" signs. The Contractor shall provide, install, and maintain the signs and posts until the passing zones have been reestablished by permanent pavement markings. The signs and posts shall then be removed and become the property of the Contractor when the Contractor is not responsible for pavement markings and when the markings by others is not completed when the project is Physically Completed, the posts and signs shall be left in place and shall become the property of the Contracting Agency.

All signs that conflict with the current traffic configuration or the current sign configuration shall either be removed or completely covered in accordance with Section 8-21.3(3). **If coverings are in place for 7 calendar days or less,** in lieu of Section 8-21.3(3), the signs may be covered in accordance with the following requirements:

1. Sheeting shall be either ¼-inch plywood or 1/8-inch thick ABS plastic
2. No damage shall occur to the face of the sign being covered
3. The sheeting shall be non-reflective and black in color with U-brackets attached to hook the sign covering over the top of the conflicting signs
4. A 2 by 2-inch wooden handle or a PVC conduit of 2-inch nominal diameter handle shall be attached to install and remove the sign covering
5. The handle shall be secured to the signpost with a plastic "zip" tie until the sign covering is removed.

Existing speed limit signs shall be covered or removed when temporary reduced speed limit signs are in place in accordance with the traffic control plan and uncovered when the temporary speed limit signs are removed.

Construction signs will be divided into two classes. Class A construction signs are those signs that remain in service throughout the construction or during a major phase of the Work. They are mounted on posts, existing fixed Structures, or substantial supports of a semi-permanent nature. Class A signs will be designated as such on the traffic control plan. "Do Not Pass" and "Pass With Care" signs are classified as Class A construction signs. Sign and support installation for Class A signs shall be in accordance with the Contract Plans or the Standard Plans. Class B construction signs are those signs that are placed and removed daily or are used continuously in one location for durations extending up to 7 calendar days and are mounted on portable or temporary mountings with a mounting height of 1 to 5 feet. Class B construction signs located continuously for durations longer than 7 calendar days in any one location shall be approved by the Engineer.

Where it is necessary to add weight to signs for stability, sandbags or other similar ballast may be used, but the top of ballast shall not be more than 4-inches above the Roadway surface and shall not interfere with the breakaway features of the device. The Contractor shall follow the manufacturer's recommendations for sign ballasting.

Signs, posts, or supports that are lost, stolen, damaged, destroyed, or which the Engineer deems to be unacceptable while their use is required on the project shall be replaced by the Contractor.

1-10.3(3)B Sequential Arrow Signs (Arrow Boards)

Where shown on a traffic control plan or ordered by the Engineer, the Contractor shall provide, operate and maintain sequential arrow signs. A sequential arrow sign is required for all lane closure tapers on a multilane facility. A separate sequential arrow sign shall be used for each closed lane. The sequential arrow sign shall not be used to laterally shift traffic. When used in the caution mode, the four-corner mode shall be used.

1-10.3(3)C Portable Changeable Message Sign

1-10.3(3)C1 General

Where shown on a traffic control plan or where ordered by the Engineer, the Contractor shall provide, operate, and maintain a portable changeable message sign (PCMS). A PCMS shall be a full sized PCMS mini portable changeable message sign (mPCMS), or truck- mounted PCMS. mPCMSs are compact version of full-size PCMSs. Truck-mounted PCMSs are permanently affixed to a traffic control vehicle and meant to be mobile.

1-10.3(3)C2 Lateral Clearance and Delineation

When feasible, position full sized PCMS or mPCMSs to provide at least 2 feet of lateral clearance from the nearest open lane and transversely delineate with at least 3 channelizing devices. For truck-mounted PCMSs, provide 2 feet of lateral clearance when feasible but transverse delineation is not required.

1-10.3(3)C3 PCMS Removal

The Contractor shall remove these devices from the work zone clear zone when not in use unless protected by barrier or guardrail.

1-10.3(3)D Barricades

Where shown on a traffic control plan or where ordered by the Engineer, the Contractor shall provide, install and maintain barricades. Barricades shall be kept in good repair and shall be removed immediately when, in the opinion of the Engineer, they are no longer functioning as designed.

Where it is necessary to add weight to barricades for stability, sand bags or other similar ballast may be used, but the height shall not be more than 4 inches above the Roadway surface and shall not interfere with the breakaway features of the device. The Contractor shall follow the manufacturer's recommendation for sign ballasting.

1-10.3(3)E Traffic Safety Drums

Where shown on a traffic control plan, or where ordered by the Engineer, the Contractor shall provide, install, and maintain traffic safety drums.

Used drums may be utilized, provided all drums used on the project are of essentially the same configuration and the devices conform to Section 1-10.2(3).

The drums shall be designed to resist overturning by means of a weighted lower unit that will separate from the drum when impacted by a vehicle.

Drums shall be regularly maintained to ensure that they are clean and that the drum and reflective material are in good condition. If the Engineer determines that a drum has been damaged beyond usefulness, or provides inadequate reflectivity, a replacement drum shall be furnished.

When the Engineer determines that the drums are no longer required, they shall be removed from the project and shall remain the property of the Contractor.

1-10.3(3)F Vacant

1-10.3(3)G Traffic Cones and 42-Inch Tall Channelizing devices

Where shown on a traffic control plan or where ordered by the Engineer, the Contractor shall provide, install and maintain traffic cones or 42-inch tall channelizing devices. Cones and 42-inch tall channelizing devices shall be kept in good repair and shall be removed immediately when directed by the Engineer. Where wind or moving traffic frequently displaces cones or tall channelizing devices, an effective method of stabilizing them, such as stacking two together at each location, shall be employed, or heavier weighted bases may be necessary.

1-10.3(3)H Tubular Markers

Where shown on a traffic control plan or ordered by the Engineer, the Contractor shall provide, install, and maintain tubular markers. Tubular markers shall be kept in good repair and shall be removed immediately when directed by the Engineer. Tubular markers are secondary devices and are not to be used as substitutes for cones or other delineation devices unless specifically shown on the traffic control plan.

Where the traffic control plan shows pavement-mounted tubular markers, the adhesive used to fasten the base to the pavement shall be suitable for the purpose, as approved by the Engineer. During the removal of pavement-mounted tubular markers, care shall be taken to avoid damage to the existing pavement. Any such damage shall be repaired by the Contractor at no cost to the Contracting Agency.

1-10.3(3)I Warning Lights and Flashers

Where shown on a traffic control plan attached to traffic control devices or ordered by the Engineer, the Contractor shall provide and maintain warning lights. Lights attached to signs or a specific device shall be a Type A or B, flashing. Lights attached to traffic safety drums or 42-inch tall channelizing devices shall be Type C, steady-burning. The devices and light unit shall conform to Section 1-10.2(3).

1-10.3(3)J Transportable Attenuator

Where shown on a traffic control plan or where ordered by the Engineer, the Contractor shall provide, operate, and maintain transportable impact attenuators consistent with the requirements of Section 9-35.12. These attenuators shall be available, on-site, for the entire duration of their projected use.

The transportable attenuator shall be positioned to separate and protect construction work zone activities from normal traffic flow.

During use, the attenuator shall be in the full down-and-locked position. For stationary operations, the host vehicle's parking brake shall be set.

A transportable attenuator may be used in lieu of a temporary impact attenuator when approved by the Engineer as part of a stage traffic control shift to protect an object such as blunt barrier end or bridge pier column that is located within the work zone clear zone. This use of a transportable attenuator is restricted to a maximum of 3 days or approved extension by the Engineer.

1-10.3(3)K Portable Temporary Traffic Control Signal

Where shown on a traffic control plan, the Contractor shall provide, operate, maintain, and remove a portable temporary traffic control signal system (PTSS) to provide automatic control of traffic through an intersection or alternating one-lane traffic operations on a two-way facility. A PTSS shall be defined as two or more traffic control units that operate together. The system shall be trailer-mounted, fully self-contained, and designed so that it can be easily transported and deployed at different locations.

The Contractor shall submit a Type 2 Working Drawing consisting of the manufacturer's specifications for the PTSS. A manufacturer's representative is required to demonstrate the capabilities of the PTSS prior to approval and provide training to contractor personnel as necessary.

Remote manual control of the PTSS by the Traffic Control Supervisor (TCS) or a qualified operator may be allowed if necessitated by Work area or traffic conditions and as allowed by the Engineer.

Each PTSS shall provide two signal displays for all road approaches and driveways with existing signalization. Where signal displays are used for driveways between primary PTSS signal displays, only one signal display may be used. Where a PTSS controls a roadway with a through movement, one of the signal displays for that approach shall be overhead. Where a PTSS controls a roadway without a through movement, such as the stem of a tee intersection, the use of an overhead signal display is not required if there is not enough room for the trailer and approved by the Engineer. Maximum distance between signal display trailers shall be 1,500 feet unless otherwise shown on the Plans or ordered by the Engineer in accordance with Section 1-04.4.

The Engineer or designee will inspect the signal system at initial installation/operation and approve the signal timing. Final approval will be based on the results of the operational inspection.

The TCS shall monitor and ensure that the PTSS is fully operational and maintained as specified by the manufacturer. This Work may include cleaning and replacing lamps and other routine maintenance as needed.

In the event repairs or adjustments are required, the Contractor shall respond immediately replacing the PTSS operations with flagger traffic control. Flagger control shall remain in operation until the Roadway can be safely reopened to traffic. PTSS repairs or replacement with a backup unit shall occur within 24 hours.

The Engineer will monitor the traffic, signal operation and order adjustments as needed based on traffic conditions. Timing adjustments require the approval of the Engineer.

As shown on the traffic control plan, temporary stop bars and "STOP HERE ON RED" Signs (R10-6) shall be provided at the location traffic is expected to stop during the red display. The stop bar locations shall be illuminated at night. The illumination shall be the responsibility of the Contractor and shall be adjusted to ensure minimal glare to motorists.

When not in operation, remove signal heads from the view of traffic or cover signal heads with bags made of non-ripping material specifically designed for covering signal heads, including reflective backplates. Do not use trash bags of any type. Remove, cover, fold, or turn all inappropriate signs so that they are not readable by oncoming traffic.

The Contractor shall provide and install all field wiring to make a complete and operational PTSS and shall maintain the system throughout the life of the Contract.

PTSS shall not be installed within 300 feet of an at-grade railroad crossing. PTSS shall not be installed where driveways or Roadway access points are located between the primary signal displays unless the intersecting roadways and driveways are controlled by another PTSS signal as part of the overall PTSS.

1-10.3(3)L Temporary Pedestrian Curb Ramps

Where shown on a traffic control plan, the Contractor shall provide or construct, install, maintain, and remove temporary pedestrian curb ramps. Install or construct temporary curb ramps as shown in the Plans, or according to the manufacturer's recommendations, if applicable. Temporary pedestrian curb ramp dimensions and grades shall comply with the plans. For curb ramps that cross, or are placed adjacent to a gutter line or other drainage Structure, provide an approved means to prevent water from accumulating at the bottom of the ramp or overflowing onto the ramp surface.

1-10.3(3)M Pedestrian Channelizing devices

Where shown on a traffic control plan or ordered by the Engineer, the Contractor shall provide, install, and maintain pedestrian channelizing devices.

Pedestrian channelizing devices shall be crashworthy when exposed to vehicular traffic. Devices used to channelize pedestrians shall be detectable to users of long canes and visible to pedestrians with vision disabilities. When used as a sidewalk closure, the device shall cover the entire width of the sidewalk. Pedestrian channelizing devices shall have continuous bottom and top surfaces. The bottom of the bottom portion shall be no higher than 2 inches above the walkway. The top edge of the bottom portion shall measure at least 8 inches above the walkway. The top of the top portion shall be no lower than 32 inches above the walkway. The top surface shall be smooth. Both upper and lower surfaces shall share a common vertical plane.

1-10.4 Measurement

1-10.4(1) Lump Sum for Project (No Unit Items)

When the Bid Proposal contains the item "Project Temporary Traffic Control", there will be no measurement of unit items for Work defined by Section 1-10 except as described in Section 1-10.4(3). Also, except as described in Section 1-10.4(3), all of Sections 1-10.4(2) and 1-10.5(2) are deleted.

1-10.4(2) Item Bids With Lump Sum for Incidentals

Flaggers will be measured by the hour. Hours will be measured for each flagging station, shown on a traffic control plan, when that station is staffed in accordance with Section 1-10.3(1)A. When a flagging station is staffed on an intermittent basis, no deduction will be made in measured hours provided that the person staffing the station is in a standby mode and is not performing other duties. Work performed by the TCS will not be measured.

Other Traffic Control Labor will be measured by the hour. Hours will be measured for each person performing the Work described in Section 1-10.3(1)B. Work performed by the TCS will not be measured.

Construction Signs, Class A will be measured by the square foot of panel area for each sign designated on a traffic control plan as Class A or for each construction sign installed as ordered by the Engineer and designated as Class A at the time of the order. Class A signs may be used in more than one location and will be measured for each new installation. Class B construction signs will not be measured. Sign posts or supports will not be measured.

Sequential Arrow Sign will be measured by the hour for the time that each sign is operating as shown on a traffic control plan.

Portable Changeable Message Sign will be measured by the hour for the time that each sign is operating as shown on a traffic control plan.

Transportable Attenuator will be measured by the hour for the time that each host vehicle with mounted or attached impact attenuator is in place as shown on a traffic control plan.

Patrol and Maintain Traffic Control Measures will be measured by the hour. The hours of one person will be measured for each patrol route that the Contractor performs the Work described under Section 1-10.3(2)E, Patrol and Maintain Traffic Control Measures, regardless of the actual number of persons per route.

1-10.4(3) Reinstating Unit Items With Lump Sum Traffic Control

The Contract Provisions may establish the project as lump sum, in accordance with Section 1-10.4(1) and also include one or more of the items included above in Section 1-10.4(2). When that occurs, the corresponding measurement provision in Section 1-10.4(2) is not deleted and the Work under that item will be measured as specified.

1-10.4(4) Owner-Provided Resources

The Contract Provisions may call for specific items of labor, materials, or equipment, noted in Section 1-10 as the responsibility of the Contractor, to be supplied by the Contracting Agency. When this occurs, there will be no adjustment in measurement of unit quantities.

1-10.5 Payment

1-10.5(1) Lump Sum for Project (No Unit Items)

"Project Temporary Traffic Control", lump sum.

The lump sum Contract payment shall be full compensation for all costs incurred by the Contractor in performing the Contract Work defined in Section 1-10 except for costs compensated by Bid Proposal items inserted through Contract Provisions as described in Section 1-10.5(3).

When the Bid Proposal contains the item "Project Temporary Traffic Control", except as described in Section 1-10.5(3), all of Section 1-10.5(2) is deleted.

1-10.5(2) Lump Sum for Project (No Unit Items)

"Traffic Control Supervisor", lump sum.

The lump sum Contract payment shall be full compensation for all costs incurred by the Contractor in performing the Work defined in Section 1-10.2(1)B.

"Pedestrian Traffic Control", lump sum.

The lump sum Contract payment shall be full compensation for all costs incurred by the Contractor in performing the Work for pedestrian traffic control defined in Section 1-10.

"Flaggers", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all costs incurred by the Contractor in performing the Work defined in Section 1-10.3(1)A.

"Other Traffic Control Labor", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all labor costs incurred by the Contractor in performing the Work specified for this item in Section 1-10.4(2).

"Construction Signs Class A", per square foot.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all costs incurred by the Contractor in performing the Work described in Section 1-10.3(3)A. In the event that "Do Not Pass" and "Pass With Care" signs must be left in place, a change order, as described in Section 1-04.4, will be required. When the Bid Proposal contains the item "Sign Covering", then covering those signs indicated in the Contract will be measured and paid according to Section 8-21.

"Sequential Arrow Sign", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all costs incurred by the Contractor in performing the Work described in Section 1-10.3(3)B and for procuring all Sequential Arrow Signs required for the project and for transporting these signs to and from the project.

"Portable Changeable Message Sign", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all costs incurred by the Contractor in performing the Work described in Section 1-10.3(3)C and for procuring all portable changeable message signs required for the project and for transporting these signs to and from the project.

Transportable Attenuator", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all costs incurred by the Contractor in performing the Work described in Section 1-10.3(3)J and for procuring all Transportable Attenuators for the project and for transporting these signs to and from the project, except for costs compensated separately under the item "Repair Transportable Attenuator".

"Repair Transportable Attenuator", by force account.

All costs of repairing or replacing transportable attenuators that are damaged by the motoring public while in use as shown on a traffic control plan will be paid for by force account as specified in Section 1-09.6. To provide a common Proposal for all Bidders, the Contracting Agency has estimated the amount of force account for "Repair Transportable Attenuator" and has entered the amount in the Proposal to become a part of the total Bid by the Contractor. Transportable attenuators damaged due to the Contractor's operation or damaged in any manner when not in use shall be repaired or replaced by the Contractor at no expense to the Contracting Agency.

"Other Temporary Traffic Control Devices", lump sum.

The lump sum Contract payment shall be full compensation for all costs incurred by the Contractor in performing the Work defined in Section 1-10.3(3) and which costs are not compensated by one of the above-listed items.

"Portable Temporary Traffic Control Signal", lump sum.

The lump sum Contract payment shall be full compensation for all costs incurred by the Contractor in performing the Work as described in Section 1-10.3(3)K, including all costs for traffic control during manual control, adjustment, malfunction, or failure of the portable traffic control signals and during replacement of failed or malfunctioning signals.

"Patrol and Maintain Traffic Control Measures", per hour.

The unit Contract price, when applied to the number of units measured for this item in accordance with Section 1-10.4(2), shall be full compensation for all labor costs incurred by the Contractor in performing the Work specified for this item in Section 1-10.4(2).

1-10.5(3) Reinstating Unit Items With Lump Sum Traffic Control

The Contract Provisions may establish the project as lump sum, in accordance with Section 1-10.4(1) and also reinstate the measurement of one or more of the items described in Section 1-10.4(2). When that occurs, the corresponding payment provision in Section 1-10.5(2) is not deleted and the Work under that item will be paid as specified.

8-21 Permanent Signing [Work-Zone Related Section Only]

8-21.3 Construction Requirements

8-21.3(3) Sign Covering

When notified by the Engineer, the Contractor shall cover or uncover certain signs to facilitate and control the operation of the project. The covering shall consist of 4 mils minimum thickness black polyethylene sheeting of sufficient size to entirely cover the sign, unless otherwise approved by the Engineer, and shall extend over the edges of the sign and fastened on the back. The Contractor shall not use any type of adhesive tape on the face of the signs. Other methods of covering may be considered if approved by the Engineer.

8-21.4 Measurement

Sign covering will be measured in square feet of the area of the sign covered.

8-21.5 Payment

Payment will be made for each of the following Bid items that are included in the Proposal:

"Sign Covering", per square foot.

9-35 Temporary Traffic Control Materials [Full Text]

9-35.0 General Requirements

Temporary traffic control materials in this section consist of various traffic communication, channelization and protection items described in Section 1-10 and listed below:

- Stop/Slow Paddles
- Construction Signs
- Wood Sign Posts
- Sequential Arrow Signs
- Portable Changeable Message Signs
- Barricades
- Traffic Safety Drums
- Traffic Cones
- Tubular Markers
- Warning Lights and Flashers
- Transportable Attenuator
- 42-Inch Tall Channelizing devices
- Portable Temporary Traffic Control Signal
- Temporary Pedestrian Curb Ramps
- Pedestrian Channelizing devices

The basis for acceptance of temporary traffic control devices and materials shall be visual inspection by the Engineer's representative. No sampling or testing will be done except that deemed necessary to support the visual inspection. Unless otherwise noted, requests for Approval of Material (RAM) and Qualified Products List (QPL) submittals are not required. Certification for crashworthiness according to NCHRP 350 or the Manual for Assessing Safety Hardware (MASH) will be required as described in Section 1-10.2(3).

"MUTCD", as used in this section, shall refer to the latest WSDOT adopted edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. In the event of conflicts between the MUTCD and the Contract provisions, then the provisions shall govern.

9-35.1 Stop/Slow Paddles

Paddles shall conform to the requirements of the MUTCD, except that the minimum width shall be 24 inches.

9-35.2 Construction Signs

Construction signs shall conform to the requirements of the MUTCD and shall meet the requirements of NCHRP Report 350 for Category 2 devices or MASH. Except as noted below, any sign/sign stand combination that satisfies these requirements will be acceptable. Post mounted Class A construction signs shall conform to the requirements of this section and additionally shall conform to the requirements stated in Section 9-28.

Aluminum sheeting shall be used to fabricate all construction signs. The signs shall have a minimum thickness of 0.080 inches and a maximum thickness of 0.125 inches.

All orange background signs shall be fabricated with fluorescent orange Type VIII, IX or XI reflective sheeting in accordance with Section 9-28.12. All post-mounted orange signs shall use a nylon washer between the twist fasteners (screw heads, bolts or nuts) and the reflective sheeting.

The use of plywood, fiberglass reinforced plastic, fabric rollup signs, and any other previously approved sign materials except aluminum or aluminum composite is prohibited.

All Class A and Class B signs shall utilize materials and be fabricated in accordance with Section 9-28 and the Washington State *Sign Fabrication Manual* M 55-05. A fabrication decal as stated in Section 9-28.1 is not required for construction signs. All regulatory signs having a red background (i.e., Stop, Yield) shall be fabricated with Type III or IV sign sheeting. All other regulatory information signs (i.e., Speed Limit, Traffic Fines Double in Work Zones) shall have Type IV sheeting.

9-35.3 Work Zone Sign Posts

Post sizes for construction signs shall be as follows:

One Post Installation

Post Size	Max. Sign Sq. Ft.
Wood 4x4	16.0
Wood 4x6	20.0
Wood 6x6	25.0
Wood 6x8	36.0
Steel 2" (ST-1, ST-3)	12.0
Steel 2¼" (ST-1, ST-2, ST-3)	17.0
Steel 2½" 12-gage perforated square tube (ST-1, ST-3)	21.0
Steel 2½" with 2¼" 7' Insert 12-gage perforated steel (ST-2)	38.0

Two Post Installation

(For signs 5 feet or greater in width)

Post Size	Max. Sign Sq. Ft.
4x4	36.0
4x6	40.0
6x6	50.0
6x8	75.0*

Two Post Installation

(For signs 5 feet or greater in width)

Post Size	Max. Sign Sq. Ft.
**Steel 2¼" 12-gage perforated square tube	34.0
**Steel 2½" 12-gage perforated square tube	42.0
**Steel 2½" with 2¼" 7' Insert 12-gage perforated steel	77.0

*The Engineer shall determine post size for signs greater than 75 square feet.

Wood sign posts shall conform to the grades and usage listed below. Grades shall be determined by the current standards of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Wood Products Association (WWPA).

4 × 4	Construction grade (Light Framing, Section 122-b WCLIB) or (Section 40.11 WWPA)
4 × 6	No. 1 and better, grade (Structural Joists and Planks, Section 123-b WCLIB) or (Section 62.11 WWPA)
6 × 6, 6 × 8, 8 × 10	No. 1 and better, grade (Posts and Timbers, Section 131-b WCLIB) or (Section 80.11 WWPA)
6 × 10, 6 × 12	No. 1 and better, grade (Beams and Stringers, Section 130-b WCLIB) or (Section 70.11 WWPA)

Steel sign posts shall conform to the Standard Plans and Section 9-06 and 9-28.

Two post installations require slip bases per Standard Plan G-24.40.

See Standard Plan G-24.50 for single post sign support (ST-1, ST-2, ST-3) details

9-35.4 Sequential Arrow Signs

Sequential Arrow Signs shall meet MUTCD requirements supplemented with the following:

Sequential arrow signs furnished for stationary lane closures on freeways and multi-lane roadways 45 mph and higher shall be Type C. Sequential arrow signs for mobile operations and for multi-lane roadways 40 mph or less may be Type B.

The color of the light emitted shall be yellow.

The dimming feature shall be automatic, reacting to changes in light without a requirement for manual adjustment.

9-35.5 Portable Changeable Message Signs (PCMS)

A PCMS will be a full-sized PCMS, mPCMS, or truck-mounted PCMS and shall meet the following requirements:

1. PCMSs shall meet the requirements of the MUTCD.
2. PCMSs shall use light emitting diode (LED) technology capable of emitting a yellow or amber image when displayed with a flat black image matching the background when not activated.
3. PCMSs shall be capable of displaying 3-lines of at least 8 alphanumeric characters with a minimum of one pixel separation between each line.
4. PCMSs shall be capable of displaying 2 phases of messages at 2.0 second display each in addition to 3 phases of messages at 1.5 second display each.
5. The PCMS panels and related equipment shall be permanently mounted on a trailer or truck with all needed controls and power generating equipment.
6. The sign display shall be covered by a stable, impact resistant polycarbonate face. The sign face shall be non-glare from all angles and shall not degrade due to exposure to UV light.
7. PCMSs shall be capable of simultaneously activating all pixels for the purpose of pixel diagnostics. This feature shall not occur when the sign is displaying an active message.
8. The light source shall be energized only when the sign is displaying an active message.

9. Primary source of power shall be solar power with a battery backup to provide continuous operation when failure of the primary power source occurs.
10. The sign controller software shall be NTCIP compliant.
11. Minimum PCMS character shall be:
    a. For full sized PCMSs characters shall be at least 18 inches in height.
    b. For mPCMS characters shall be at least 12 inches in height.
    c. For truck-mounted PCMS characters shall be at least 10 inches in height.

9-35.6 Barricades

Barricades shall conform to the requirements of the MUTCD. The alternating orange and white retroreflective bands shall be fabricated from IV (High Intensity) or a higher type sheeting as described in Section 9-28.12.

9-35.7 Traffic Safety Drums

Traffic safety drums shall conform to the requirements of the MUTCD and shall have the following additional physical characteristics:

Material	Fabricated from low-density polyethylene that meets the requirements of ASTM D4976 and is UV stabilized.
Overall Width	18-inch minimum regardless of orientation.
Shape	Rectangular, hexagonal, circular, or flat-sided semi-circular.
Color	The base color of the drum shall be fade resistant safety orange.
Base	A separate ballast shall be used to resist overturning or other movement from wind gusts or other external forces.

If a warning light is attached to a traffic safety drum, the method of attachment shall ensure that the light does not separate from the drum upon impact. The drum and light units shall meet the crashworthiness requirements of NCHRP 350 or MASH in accordance with the manufacturer as described in Section 1-10.2(3). Beginning on January 1, 2027 warning lights shall no longer be used on drums.

Until December 31, 2026 traffic safety drums may have 4-inch or 6-inch retroreflective bands fabricated from Type III or Type IV or higher sheeting type as described in Section 9-28.12.

Beginning January 1, 2027 traffic safety drums shall have 6-inch retroreflective bands. A minimum of 4 retroreflective horizontal bands, alternating fluorescent orange and white starting with the top stripe being fluorescent orange, shall be used. Retroreflective bands shall be fabricated from Type VIII, IX, or XI (Super/Very High Intensity) reflective sheeting as described in Section 9-28.12. Drums of different retroreflective band types shall not be intermixed within the same closure (place all the High Intensity drums together, then switch to the Super/Very High Intensity drums for the remainder of the closure, or vice versa). When recommended by the manufacturer, drums shall be treated to ensure proper adhesion of the reflective sheeting.

9-35.8 Vacant

9-35.9 Traffic Cones

Cones shall conform to the requirements of the MUTCD, except that the minimum height shall be 28 inches or 36 inches, as specified in the traffic control plan.

White retroreflective bands shall be fabricated from Type IV (High Intensity) or a higher reflective sheeting as described in Section 9-28.12.

9-35.10 Tubular Markers

Tubular markers shall conform to the requirements of the MUTCD, except that the minimum height shall be 28 inches or 42 inches, as specified in the traffic control plan.

For portable tubular makers, the base color shall be fade resistant safety orange with white retroreflective sheeting. A separate ballast shall be used to resist overturning or other movement from wind gusts or other external forces.

When pavement-mounted tubular markers are specified, they shall be stabilized by affixing them to the pavement using an adhesive. Adhesive used to glue the device to the pavement shall meet the requirements of Sections 9-02.1(8) or 9-26.2. Pavement-mounted tubular makers base color and retroreflective sheeting shall match the color of the adjacent pavement marking, either white or yellow.

White retroreflective bands shall be fabricated from Type IV (High Intensity) or a higher reflective sheeting as described in Section 9-28.12. When recommended by the manufacturer, tubular markers shall be treated to ensure proper adhesion of the reflective sheeting.

9-35.11 Warning Lights and Flashers

Warning lights and flashers shall conform to the requirements of the MUTCD.

9-35.12 Transportable Attenuator

Transportable attenuators are Truck-Mounted Attenuators (TMA) or Trailer-Mounted Attenuators (TMA-trailer). The transportable attenuator shall be mounted on, or attached to, a host vehicle that complies with the manufacturer's recommended weight range.

Ballast used to obtain the minimum weight requirement, or any other object that is placed on the vehicle, shall be securely anchored such that it will be retained on the vehicle during an impact. The Contractor shall provide certification that the transportable attenuator complies with NCHRP 350 Test level 3 or MASH Test Level 3 requirements.

Lighter host vehicles proposed by the Contractor are subject to the approval of the Engineer. The Contractor shall provide the Engineer with roll-ahead distance calculations and crash test reports illustrating that the proposed host vehicle is appropriate for the attenuator and the site conditions.

The transportable attenuator shall have a chevron pattern on the rear of the unit. The pattern shall consist of 4-inch to 8-inch alternating nonreflective black and retroreflective yellow or alternating retroreflective red and white sheeting, slanted at 45 degrees in an inverted "V" with the "V" at the center of the unit.

9-35.12(1) Truck-Mounted Attenuator

The TMA may be selected from the approved units on the QPL or submitted using a RAM.

The TMA shall have an adjustable height so that it can be placed at the correct elevation during usage and to a safe height for transporting. If needed, the Contractor shall install additional lights to provide fully visible brake lights at all times.

9-35.12(2) Trailer-Mounted Attenuator

The TMA-trailer may be selected from approved units on QPL or submitted using a RAM.

If needed, Contractor shall install additional lights to provide fully visible brake lights at all times.

9-35.12(3) Submittal Requirements

For transportable attenuators listed on the QPL, the Contractor shall submit the QPL printed page or a QPL Acceptance Code entered on the RAM (WSDOT Form 350-071) for the product proposed for use to the Engineer for approval. The Contractor shall submit a RAM for transportable attenuators not listed on the QPL.

9-35.13 42-Inch Tall Channelizing devices

42-inch tall channelizing devices shall have the following additional physical characteristics:

Material	Fabricated from low-density polyethylene that meets the requirements of ASTM D4976 and is UV stabilized.
Overall Height	42-inch minimum regardless of orientation.
Overall Width	4-inch minimum at the top tapered to 8-inch minimum at the bottom regardless of orientation.
Shape	Rectangular, hexagonal, circular, or flat-sided semi-circular.
Color	The base color of the drum shall be fade resistant safety orange.
Base	A separate ballast shall be used to resist overturning or other movement from wind gusts or other external forces.

If a warning light is attached to a 42-inch tall channelizing device, the method of attachment shall ensure that the light does not separate from the channelizing device upon impact. The channelizing device and light units shall meet the crashworthiness requirements of NCHRP 350 or MASH per the manufacturer as described in Section 1-10.2(3). Beginning on January 1, 2027 warning lights shall no longer be used on 42-inch tall channelizing devices.

Until December 31, 2026 42-inch tall channelizing devices may have 4-inch or 6-inch retroreflective bands fabricated from Type III or Type IV or higher sheeting type as described in Section 9-28.12.

Beginning January 1, 2027 42-inch tall channelizing devices shall have 6-inch retroreflective bands. A minimum of 4 retroreflective horizontal bands, alternating fluorescent orange and white starting with the top stripe being fluorescent orange, shall be used. Retroreflective bands shall be fabricated from Type VIII, IX or XI (Super/Very High Intensity) reflective sheeting as described in Section 9-28.12. 42-inch tall channelizing devices of different retroreflective band types shall not be intermixed within the same closure (place all the High Intensity drums together, then switch to the Super/Very High Intensity drums for the remainder of the closure, or vice versa). When recommended by the manufacturer, 42-inch tall channelizing devices shall be treated to ensure proper adhesion of the reflective sheeting.

9-35.14 Portable Temporary Traffic Control Signal

Portable temporary traffic control signals systems (PTSS) shall meet the requirements of the MUTCD and these specifications.

The PTSS shall be fully operational for traffic actuated, pre-timed, or manual control. The PTSS shall support the number of signal phases necessary to control traffic through the applicable Work area.

Controllers shall be capable of controlling all displays required for each PTSS system. Controllers shall demonstrate conflict-monitoring capability, consistent with the requirements of Section 9-29.13(2) item number 5, with a flashing red display in all directions. The controller shall be capable of terminating the all red clearance for the preceding movement, such that the previous movements can be repeated.

Signal head displays shall be either hard wired or controlled by radio signal. Manual operation will not require hardwiring or radio control except for the use of two-way radio communication by manufacturer trained qualified operators.

The system shall be equipped with a means of informing the operator of signal indications, such as a light on the back of each signal head that illuminates when the signal displays a red indication, during manual operation.

Each PTSS shall include vehicle detection and shall be capable of operating either as fixed time or traffic actuated. The detection system shall provide presence detection (continuous call to the controller) while there is a vehicle, including bicycles, in the detection zone. When specified in the Contract, each designated PTSS shall include a pushbutton for bicycles that will extend the all-red time to accommodate bicycle travel through the applicable work area. Each pushbutton shall be placed such that it is accessible to bicycle users and include signing with instructions for bicyclists.

PTSS signal displays shall be trailer mounted. PTSS trailers with overhead signal displays shall provide two signal displays, with at least one display mounted overhead and the two displays at least 8 feet apart horizontally. The minimum vertical clearance to the traveled way for this signal display is 16.5 feet. Where there is no direct line of sight between stop line locations, each trailer shall include a digital timer display showing the time remaining to the next green indication; digits shall be a minimum of 6 inches in height. Ground mounted signal display trailers shall provide one signal display. Vertical height to the bottom of a single signal display shall be a minimum of 8 feet (10 feet preferable).

Vehicular signal heads shall be of the conventional type with standard ITE approved, 12- inch ball LED display. Tunnel visors shall be provided for all indications.

Back plates shall be furnished and attached to the signal heads. Back plates shall be constructed of 5-inch-wide .050-inch-thick corrosion resistant louvered aluminum, with a flat black finish. A highly retroreflective yellow strip, 1 inch wide, shall be placed around the perimeter of the face of all vehicle signal backplates to project a rectangular image at night toward oncoming traffic.

Trailers shall have a leveling jack installed at all four corners. The crank for the leveling jacks and trailer hitch shall be locked. The signal pole and mast arm assemblies shall be of the collapsible type, which can be erected and extended at the job site. The mast arm assemblies shall be firmly attached to the trailer to form a stable unit, which can withstand an 80 mph design wind speed with a 1.3 gust factor.

The portable temporary traffic control signal shall be powered using a self-contained battery system capable of providing over 12 days of continuous operations without solar array assistance. A solar panel array will be allowed.

9-35.15 Temporary Pedestrian Curb Ramps

Temporary pedestrian curb ramps shall be constructed as shown in the traffic control plans or be pre-manufactured devices meeting the requirements of the ADA Accessibility Standards, see Chapter 4: Ramps and Curb Ramps at https://www.access-board.gov/.

9-35.16 Pedestrian Channelizing devices

When exposed to vehicular traffic, pedestrian channelizing devices shall meet the crashworthiness requirements of NCHRP 350 or MASH as described in Section 1-10.2(3). The bottom and top surfaces of the pedestrian channelizing device shall have 6-inch retroreflective bands matching the body color of the device fabricated from IV (High Intensity) or a higher type reflective sheeting as described in Section 9-28.12.

Chapter 16 : WSDOT Work Zone Speed Limit Policy

16.1 Overview

Changing the regulatory work zone speed limit or advisory speeds is not a minor revision a TCS is authorized to make. All regulatory work zone speed limit or advisory speeds must be approved by WSDOT and/or the local agency with jurisdiction along with required documentation and notices.

See Section 5-18 for policy and Section 5-19 for approval protocol in Chapter 5 of the WSDOT Traffic Manual when update is published in 2025.

Equitable consideration of safety and mobility of all road users and work crews is important while acknowledging reducing the regulatory speed limit shall be avoided as much as practical and be limited to specific locations with restrictive features to avoid increasing speed variance and the potential for crashes as drivers will reduce their speeds only if they clearly perceive the need to do so per the MUTCD.

WSDOT categorizes speed limit reductions and advisory speeds for work zones as follows:

- **Continuous regulatory speed limit reductions** are in place 24 hours a day for four or more consecutive calendar days for restrictive roadway geometrics, features, or conditions exceeding ½ mile in length in most scenarios.
- **Intermittent regulatory speed limit reductions** are in place only during temporary lane closures for active work operations without temporary barrier separation. Existing or continuous regulatory speed limit maintained otherwise.
- **Advisory speeds**, associated with a warning sign, are used for a restrictive roadway geometrics, features, or conditions ½ mile or less such as restricted sight distance, a median crossover, or temporary roadway realignments. Advisory speeds are based on the reduced design speed or ball-banking and may be in place either continuously or intermittently. Advisory speeds may be used when existing speed limit is maintained.

Length of regulatory speed limit reductions shall be minimized beginning no more than ½ mile prior to restrictive roadway geometrics, features, or conditions with the existing speed limit restored within 500’ ± afterwards, except when within 1 mile of existing reduced speed zones.

Duration of regulatory speed limit reductions shall be minimized to only when restrictive, temporary roadway geometrics, features, conditions exceeding ½ mile in length, or temporary lane closure when active work operations are present. Restore the existing speed limit as soon as practical afterwards or when directed by Region Transportation Operations.

Regulatory speed limits shall be black on white background, advisory speeds black on orange. Speed limit reduction ahead (W3-5, orange background) signs are required for regulatory speed reductions of 10 mph or greater. For speed limit reductions 20 mph or greater, a two step reduction should be used (60 → 40 → 25) with separate W3-5 and R2-1 signage.

16.2 WSDOT Work Zone Speed Limit Policy (E1060)

Until Traffic Manual is updated in 2025, Secretary’s Executive Order E1060 provides policy for the use, approval, required documentation, and required notices for work zone speed limits and advisory speeds.

For WSDOT approval, submit speed reduction requests through the Engineer. For Local Agencies, submit reduction requests through the city or county traffic office or Engineer.

16.3 WSDOT Project Delivery Memo 19-01

Replaced when the Traffic Manual is updated in 2025, WSDOT's Project Delivery Memo 19-01 provides policy for intermittent speed limit reductions/advisory speeds on freeways. Intermittent reductions are in place for 3 days or less (daily, nightly, and weekend-duration closures).

In summary,

Freeway Shoulder Closure: No speed reduction permitted

Freeway Lane Closures: Optional (see TC223 or TC243 as examples)

Maintaining existing posted speed limit is allowable. Reduced work zone speed limit recommended including, but not limited to:

- Workers have no means of escape from motorized traffic (e.g., tunnels, bridges, etc.)
- Workers actively present within one-half lane width of adjacent open lane(s) not protected by barriers
- High operation speeds combined with high traffic volumes are anticipated

Existing Speed Limit	Work Zone Speed Limit (Optional)
70	**60**
60	**50**

Radar Speed Display Sign: Optional

Single Open Freeway Lane Shifted Onto Paved Shoulder: Required (examples: TC234 or TC254)

Both work zone variable regulatory speed limit and advisory speed shall be used when a single open freeway lane is shifted onto the shoulder.

This traffic shift configuration is necessitated by work operations including but not limited to:

- **Two-lane freeway** with the work area extending up to the lane line adjacent to traffic for work including HMA pavement, concrete pavement, and/or expansion joint rehabilitation.
- **Three-lane freeway** with the work area including both lanes and extending up to the lane line adjacent to traffic for work including HMA pavement, concrete pavement, and/or expansion joint rehabilitation.

Existing Speed Limit	Work Zone Speed Limit	Advisory Speed @ Work Crew
70	**55**	**40**
60	**45**	**40**

Radar Speed Display Sign: Required for Construction & Optional or Maintenance

Chapter 17 : Work Zone Collision Statistics

Washington work zone crash statistics is available at WSDOT Work Zone Safety webpage.

National work zone crash statistics is available at: FHWA Work Zone Facts and Statistics

National and State work zone crash statistics is available at: workzonesafety.org National Work Zone Safety Information Clearinghouse.

WSDOT's Gray Notebook contains quarterly updates of WSDOT's multimodal systems and programs, including fatality and serious injury statistics.

Appendix A: Tools for Supervision

Supervision of Traffic Control Flaggers & Traffic Control Labor

This appendix will provide the Traffic Control Supervisor with some basic fundamentals on communication, organization and management practices. These skills are necessary to effectively manage the resources available to you in order to safely complete the end goal ~ project completion.

Leadership

The American Heritage Dictionary defines leadership as "the capacity or ability to lead." This or any definition infers that one who leads must have certain abilities, traits, or skills. It is safe to assume that these skills are developed from birth, through the formative years and into adulthood. It is an ongoing process that will never be completed. We will never be the "best," we can only strive to be a "better" leader or supervisor.

Many articles and books have been written on the subject of "leadership skills," and you as a foreman or supervisor may have read some of the material that has attempted to define what these skills are. It is very possible that you have and are currently using these skills everyday. Some of these skills are for managing people and some of these are technical skills.

With the volume of printed materials and literature concerning leadership and supervisory skills, it is hard to determine what traits are important in supervisors. However, we have put together a list of skills needed for being a good supervisor.

- **Dependability** - As a supervisor you have the duty to achieve the goals that have been set. A Traffic Control Zone can present many different and sometimes difficult objectives that must be met and carried out. A reliable supervisor is a necessity.

- **Diplomatic** - The supervisor must have the ability to interpret the policies and practices of the company and explain these to all workers and visitors on the site.

- **Discipline** - A supervisor must have the confidence in his/her abilities as a leader to make the right moves at the right time. He/she must know when and how to act, according to the rules and regulations at the site. You must not be persuaded to alter or adjust the standard operating procedures at others request. You must also be trained to know not only how and why a task is done, but also why the procedure must be done properly.

- **Enthusiastic** - A keen interest in the job as it progresses and in your fellow workers, is an important human skill on a traffic control job. You must be able to convey this interest in a positive way to show that you are concerned about the worker, the motorist, the pedestrian, the flagger, and the contractor. The energy and adrenaline must flow. It does take effort, but the effort is contagious and worthwhile. Enthusiasm spreads.

- **Motivated** - Not only must you be enthusiastic, but you must be prompted to an action with a sense of purpose. This is why training is important. You must know the proper actions to take and you must also know the purpose, or the reason for taking those actions. Again, motivation can and will be contagious, if done in a positive manner.

- **Recordkeeping** - As the designated "Certified Traffic Control Supervisor" you will be required by the Washington State Department of Transportation to keep a complete and accurate daily diary of the job site. Due to liability associated with traffic control projects, this diary may be needed in the future by the WSDOT, your company, or more important, by you, to document your actions.

- **Responsible** - The certified traffic control supervisor has a greater magnitude of responsibilities and liabilities, but unlike normal construction sites, the supervisor should have written objectives and procedures. By being disciplined and motivated you will be able to successfully, without injuries or exposures, complete the objectives. It is your duty and obligation to be accountable and liable for your actions, and the actions or your crew. By following the written procedures, you are fulfilling your duties and have acted in a responsible manner.

- **Understanding** - Traffic control sites and the worker can be complex and confusing. It is important that a supervisor comprehend the sometimes-vague elements of the site and workers. Each is different and inseparable. You must muddle through the politics of human actions and reactions. You must learn why Joe has been late the last three mornings in a row and you must know how his late arrivals affect others on the crew and the progress of the clean up. You must be open to the current and flow of workers, workers moods and how they impact the site and work. It is up to the supervisor, to interpret and adapt to these issues, in order to ensure smooth completion of the project.

- **Vigilant** - As a supervisor you must keep your hand to the pulse, your ear to the rail. You must be aware of what is going on around you. You must expect the unexpected and; you must be keenly watchful to detect danger and changes. Being safe relies on observation for unsafe conditions and acts. Being a good supervisor relies on knowing all that goes on around you. But, you must be disciplined and motivated to follow the right procedures. It is not enough to be aware, you must act on the knowledge gained. A good supervisor does not allow others to do his job, to fulfill his/her responsibilities. The supervisor must act.

Basic Fundamentals

All organizations, whether they are manufacturers of a product, providing services, or a traffic control contractor have only four resources to utilize: People, Money, Materials, and Time. Most organizations will tell you the most important ingredient is people.

Influencing behavior of other people is perhaps one of the most important parts of a "Traffic Control Supervisor's" job. Management, after all, is getting the right things accomplished through the active support of others. But gaining the active support of other people doesn't necessarily come naturally. It's a supervisor skill, which has to be learned.

So, in order to get the positive results you want from the people with whom you work, you must behave; that is, express feelings, utilize your skills, and show attitudes toward them in the same way that you would have them behave toward you. Simply put, the basic fundamentals that will be discussed are:

Give Clear, Complete Instructions

Not only does a supervisor need some level of human and technical skill but also he or she must have the mechanism to convey these abilities to workers, co-workers and superiors. That mechanism is communications. The definition of communication is the act or process of exchanging or inter-changing thoughts or information. Exchanging or interchanging thoughts involves not only spoken words, but facial expressions, gestures and body movements.

Studies have shown that supervisors can be expected to devote 50-90% of their time to communicating. This explains the importance of the "communication cycle." Communication involves five (5) key points:

- Take time giving instructions
- Show how whenever possible
- Keep information simple and logical
- Ask for feedback, "do you understand"
- Follow-up the next day or later to see if instructions were followed correctly

As a supervisor and human you have the skills mentioned above. You may have these skills at varying levels. Some of you may be very good at it, some not.

Communicate – Let Employees Know How They Are Doing

One (1) is the "Communication Cycle." All the skills you have and the implementation or use of those skills is dependent on the level of communication skills you have. A person who has all the necessary skills may not be a "communicator" and therefore cannot be a supervisor. Many try and many are not good supervisors. Most people however, have adequate communication skills and survive the "cycle."

The next item or hurdle that the "potential" supervisor must clear is "attitude," in particular his or her attitude. At this juncture a person can be generally supportive, optimistic and complimentary or he/she may be demeaning, passive and pessimistic. You know what traits a good supervisor would display.

A supervisor must be informative and he/she must be able to pass on the technical information and complex procedures in a way that is clear and understandable. A supervisor/teacher must be enthusiastic, motivated, understanding and vigilant. A supervisor must know when his teachings are not being absorbed, and how to avoid or overcome that situation. A teacher must not be afraid of sharing knowledge and he or she must be confident in his/her abilities. A good supervisor is willing to give all information, the how and why, not just the "because I said so." The supervisor/teacher is also an example, a person, a fellow worker, a human being, one that workers can look to and respect.

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Give Credit When It's Due

Research shows that people work at levels that are consistent with their perceptions of their own competence. Those perceptions are directly related to self-esteem. Furthermore, those perceptions can be significantly enhanced or damaged by the way a supervisor relates to an employee.

The direct relationship between an employee's level of self-esteem and an employee's level of performance makes the maintenance and enhancement of self-esteem a critical managing tool. For one of the obvious goals of the asbestos supervisor is to increase productivity by raising levels of performance. An employee who feels competent is much more likely to perform competently.

One of the most important principles is the use of reinforcement techniques, especially positive reinforcement. Because the events that follow a given behavior are important to most people, reinforcement techniques are a potent method of changing behavior - either strengthening desirable behavior or diminishing undesirable behavior. There are two strategies that you can use to change behavior:

- **Positive Reinforcement**. One way to increase the likelihood of a performance or behavior recurring is to follow that performance with a positive event. A positively reinforced response has a greater probability of recurring simply because it pays off.
- **Punishment**. One way to decrease the likelihood of recurrence of a behavior is to follow the behavior with an unpleasant event. A response is punished when the following event causes the behavior to decrease in frequency. There are often negative side effects associated with punishment, so it must be used selectively.

Despite the fact that each strategy listed can successfully modify or change behavior, it is recommended that Positive Reinforcement be used most often. Generally speaking, positive reinforcement has a much more predictable effect than punishment. Punishment does not weaken behavior as effectively as positive reinforcement strengthens behavior. Although many supervisors will point to the effectiveness of punishment, research shows that punishment can have negative side effects. The side effects of criticism or punishment are:

- Defensive behavior
- Hostility, anger, de-motivation
- Sabotaging behavior

The primary result of using positive reinforcement is that performance improves because there is an increase in the frequency of praise.

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Involve People In Your Decisions

We make decisions constantly, but most of us are not aware of the procedures or steps we take to arrive at a decision. The supervisor on a site will be faced with many decisions and it will be sometimes necessary for the supervisor to solve complex problems. The following basic steps have been generally accepted as a way to arrive at a decision.

1. Identify the problem
2. State the basic objective or goal
3. State the constraints, assumptions and facts
4. Generate possible solutions and evaluate them
5. Select a solution and break it into component parts
6. Create a detailed plan to obtain the objective

The supervisor must make information available to the workers in his/her crew. It is the supervisor's responsibility to pass on his/her knowledge and make it available to all. On the other hand, it is important to gather as much information from other people on the situation in order to reach an informed decision.

All the workers on a traffic control project have been trained and most are knowledgeable in the aspects of the site. You, as a supervisor, must know at least as much. The best supervisors have broad and deep insight of the project and people. You must keep abreast of current developments, state-of-the-art equipment/procedures and new innovations. Discussions with others research and experience, can contribute to a broadening of your knowledge. You must be motivated to read magazines, periodicals, and trade publications to keep up to date. Other courses and academic offerings can be helpful to improve and expand your knowledge.

Maintain an Open Door Policy

Often, the most effective solutions to on-the-job situations can be determined only if open communications are established and maintained between supervisors and employees. Since you, being the "boss," can always speak up and make use of your "high potency" position, your efforts to create more effective on-the-job communications invariable need to be directed toward helping your employees talk more freely. Encourage them to offer personal reactions, opinions, suggestions, and problem-solving ideas in a non-defensive manner, which builds their self-esteem, self-confidence, competence, and personal involvement.

Rather than shutting off input from employees, a supervisor should be concerned with maximizing the flow of information from employees. In short, supervisors should encourage, first, the employee to talk more; and, second, to talk less themselves.

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Organization

The best supervisors are also the best organizers. He/she must be able to direct personnel and equipment in the most efficient manner. Productivity is directly related to the organization the supervisor displays. The supervisor is generally needed in many different locations at the same time, meeting and dealing with workers, consultants and building owners.

Planning Ahead

Step six of the decision making process is to create a detailed plan. First of all, the plan must be attainable with the workers and equipment you have at your disposal. If not, frustration ends up making the plan counter-productive. Secondly, you must take everything that has been talked about in this section thus far, and lay out steps of action. It is still up to you to assign the workers and material, and to motivate, until the process or procedures are accomplished. Next to organization, planning is the most important aspect of the supervisor's job.

Establishing Priorities

Know your priorities. It's well worth the effort to sit back and decide not only what you want done, but also in what order you want it done. Establishing these priorities up front will decrease the potential for misunderstandings and missed target dates. When people have specific guidelines and priorities to follow, interpersonal and job-related "complications" are far less likely to occur.

Setting your priorities is a crucial part of any plan. It helps you to decide what is important and not important, what must be dealt with now and what can be put off until later. Supervisors, who can quickly prioritize their plans, will be capable of obtaining their end goal more efficiently.

When putting your plan to work, the supervisor will need to constantly re-prioritize the tasks as the project progresses. If today's task does not get completed because of lack of time that does not mean it should be number one on the list tomorrow. The most important or crucial task at the moment must have top priority.

Setting your priorities is not as simple as it looks, it is part of the six step decision making process discussed earlier. Setting priorities can be an enormous challenge for the supervisor and learning to follow such a method will help you to achieve your goals.

Setting Goals

It is important that the supervisor set goals for the workers, who need to know what is expected of them on the job. The short-term goals for the present job need to be explained. While longer-term employees may only need limited direction to effectively carry out a job, shorter-term employees may need more direction from the foreman or other workers. Long term goals, like job advancement, also must be made clear to the workers. Job advancement may be to a foreman's level, or to a more interesting job.

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Good Management Practices

Supervising styles can vary considerably from person to person. A new supervisor is faced with unfamiliar challenges and mental stress. If this happens, that person can sometimes react negatively and end up losing the respect of the workers right from the beginning. If you use the following simple guidelines in your new position, it should help make the transition easier--both for you and your new employees.

Don't Be Power Happy

Supervisors have been known to become "Power Happy" after receiving their newfound authority. You need to protect yourself from inflating your own ego with self-worth and elevated importance. A good supervisor would never ask his workers to do anything that he would not do also.

By occasionally jumping in and getting dirty alongside the crew, the supervisor will begin to gain additional respect from the workers and humble himself in the process. However, do not jump in and believe that your short burst of energy will motivate the crew to last for eight hours. On the other hand, you can't do a proper job of supervising if you are doing all the work.

Have Patience

Your patience will be tested from several different angles. You will have new paperwork to fill out and meetings to attend, budgets to stay inside of and deadlines that must be met. New hires with little or no actual experience may take longer to perform their duties than you allowed for and slow the schedule up.

When you feel that you are losing your patience, slow down momentarily and step back, take a deep breath; now, put things in perspective. Remember, worry about changing the things that you can control, NOT the things you can't.

Learn to Delegate Responsibility

The key to time management for the supervisor is learning how to delegate responsibility and authority. Knowing how to delegate is critical to increasing your own productivity as a supervisor. Initially, however, it can be a difficult skill to learn. People are usually promoted into management because they've shown a talent for getting results. But once you're a supervisor, you don't have enough time to get the results demanded all by yourself. You have to get other people to produce the results for you. You have to multiply your talent through the talents of others.

As you begin this process, your initial reaction will be to delegate the work you find unpleasant or boring and keep the work that gives you psychic rewards. The important thing to realize is that the same work you find unpleasant or boring will probably be judged in the same way by those to whom you delegate it. So, as you make your list, be tough-minded about not keeping all the "gems" for yourself!

Don't let the "80-20 Rule" rule you. The 80-20 Rule, also known as Plato's Principle, states that 20% of your people do 80% of the work, while the other 80% of your people do the remaining 20% of the work. If you relate the 80-20 Rule to your own organization, you'll probably find the proportions are close, if not exact. You'll also find that you'll be tempted to delegate to that 20% almost exclusively.

Resist the temptation! If you let the 80-20 Rule you, you will "burnout" your producers, while failing to give the other 80% an opportunity to grow by assuming responsibility. The result? A very real danger of increasing turnover in both groups because your producers will see themselves as unfairly overloaded, while some of the other 80%, will see a lack of opportunity.

Evaluate Your Decisions

When making decisions, look at both sides of the issue, write the pro's and con's down on a piece of paper before deciding. Your verdict will affect other people and businesses. Therefore, try not to "shoot from the hip" too often, as you are the one who must live with it, and an uninformed decision may be too expensive.

Take the time during each day to think about what is ahead so that you may plan and prepare for those projects. You will soon learn that by pre-planning and becoming prepared for the day's events, the project will proceed smoother, and you will be better equipped for decisions and emergencies that will come up throughout the job.

Supervising Friends

You are now the supervisor of the project and friends may attempt to solicit preferential treatment. This must never be allowed to happen. It is vital that relationships be kept professional, fair, and equal at all times.

If this principal is ignored, you may jeopardize losing the rest of the crew's respect and create hard feelings. Then groups or cliques will begin to form creating friction and conflicts between personnel, all of which is counterproductive for both you and the project.

Problems with Personnel

Interpersonal conflicts are like a contagious disease, they can spread very quickly if not isolated and treated as soon as possible. Still, many supervisors are reluctant to move quickly once they become aware of an interpersonal conflict between two employees on their crew.

The motives aren't difficult to understand. The very phrase, "interpersonal conflict", means the dispute is private. The "Don't butt in" and "It's not my responsibility", ethic is strong in our society, especially as we relate our private lives to the private lives of others. Supervisors may become confused about playing a role that seems to get stuck between the public world of work, and the more private world of interpersonal conflicts. There are three things that you should do to help you in settling these conflicts.

Develop an early warning system. One-on-one meetings with each of the employees on your crew will often allow you to detect conflicts before they become bitter. Ask your employees open-ended questions, such as, "Do you feel everyone is doing their fair share?" If that person singles out another worker, then ask the same questions to that person.

Don't procrastinate if you see a conflict. Reasons for procrastinating, rather than settling the dispute can range from feeling you're too busy, to worrying about a confrontation, to hoping the problem will work itself out in time. Strangely enough, managing your time will is one of your most important assets as a supervisor, and you will spend less time settling conflicts if you settle them quickly.

Develop a plan to deal with personnel. We actually spend very little time planning on how to deal with other people. Supervising people is not some kind of an "art" that can only be learned through years of experience; it's a process that can be learned through careful preparation and practice.

Employment Practices

Problem Solving

Workers will have problems on traffic control jobs. Not only will they face the normal problems associated with any work, but also those that can surface when workers are being exposed to traffic, or are being told not to perform the job safely and correctly. Workers may have concerns about various aspects of the work situation. The supervisor who understands the job requirements and who takes the time to explain them can help relieve problems.

The supervisor should be aware when problems of any kind appear on the job. Workers often are the first to recognize a problem on the job, and should be encouraged to report all problems immediately. The supervisor must then take measures to correct problems before crashes occur. The supervisor should inform the workers what is being done to correct the problems.

Supervisors should understand that workers have alternatives if their valid complains are neglected. If workers think their health is threatened, they can report their problems to state and federal agencies.

Hiring Practices

Some supervisors may be responsible for hiring new employees. In the event that this becomes your responsibility, there are several points of law that a supervisor must be aware of. Job discrimination on the basis of race, color, creed, national origin, sex, marital status, HIV status, age or handicap is illegal.

If you are responsible for the hiring, here are some of the questions that may not be asked during pre-employment interviews:

- Have you ever been arrested?
- Questions which show preference for persons under 40 years old.
- Whether applicant is a citizen
- Information regarding spouse, spouse's employment, or salary, children, childcare arrangements, or dependents
- Health or handicap inquiries unrelated to fitness to perform job
- Height/weight questions
- Marital status
- Type or condition of military discharge
- Inquiries about applicant's name or national origin that divulges marital status, lineage, ancestry, descent, birthplace, mother tongue
- Questions asking applicant to list clubs, organizations, societies, or lodges to which they belong
- Requests for photographs
- Inquiries concerning race, color of skin, hair, eyes etc
- Inquiries about religion or creed
- Names of person with whom you reside-whether you rent or own
- Any inquiry concerning sex

Disciplining the Employee

When discipline is necessary, it should come as no surprise. As a rule, it should have been preceded by a discussion around improving the employee's performance. But, when the specific objectives set in the performance improvement discussion are not met, then discipline may be necessary.

Employees may not be disciplined on the basis of race, color, creed, national origin, sex, marital status, HIV status, age or handicap. All employees should be informed, in writing, of the company's disciplinary and termination policies. Disciplinary action may be taken for any variety of reason including:

- Failure to comply with health and safety regulations.
- Tardiness to work
- Drug and/or alcohol use on the job
- Insubordination
- Theft of company property

Some types of action that may be taken against the problem employee may include verbal warnings, a written reprimand, suspension and lastly, termination. Regardless of the company infraction made (and how many times it was made), you and your company must have clear-cut guidelines for determining the severity of the infraction and the type of action to be taken.

Discipline should be specific, and it should fit the offence - that is to say, it should be neither too severe nor too lenient. Above all, a supervisor who disciplines an employee must follow through. Otherwise, his or her credibility will be destroyed and, with it, the ability to lead.

Know also, that discipline often evokes a hostile reaction from the employee being disciplined. Such reactions can be avoided by remembering to keep your focus on the behavior, the circumstances or the actions that have led to this meeting. Afterward, write down as much of the word-for-word conversation as you can remember, (document) and keep it on file. If, later, you find that discipline is ineffective with a certain employee, you may choose to terminate him/her. In that case, your file of previous discussions and disciplinary actions is essential.

Important: The purpose of discipline is not to punish; but to improve performance and thus productivity.

- Review past discussions and agreements.
- Ask why performance agreements have not been met
- Describe the disciplinary action you are taking.
- Summarize the necessary actions to be taken and offer your assistance.

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Terminating the Employee

Employees may not be fired on the basis of race, color, creed, national, origin, sex, marital status, HIV status, age or handicap. All employees have already been informed, in writing, of the company's termination policies. Termination action may be taken for any variety of reasons including:

- Failure to comply with health and safety regulations.
- Habitual tardiness to work.
- Use of alcohol or drugs on the job.
- Insubordination
- Theft of company property

Again, regardless of the company infraction made, you and your company must have clear-cut guidelines for determining the severity of the infraction and if termination is a justified action to take. Remember:

- Inform employees of the rules when hired, in writing
- Investigate infractions fairly - get all the information
- Document all decisions

The inability to terminate is often the telltale flaw in a supervisor who is otherwise quite successful. The reality of having to confront another human being and tell that person they haven't made the grade can be so overwhelming that some people will do anything to avoid it.

The act of termination itself should be well organized and should not be a lengthy meeting. It is not a time for debate or long discussions, these should have already taken place during the time when the employee was trying to improve his or her performance or was being disciplined. During your conversation with the employee, remember to:

- Outline the lack of improvement in job performance
- Inform the person of the decision to terminate him/her
- Respond to the person's reaction, listening actively while keeping the focus on the causes for termination
- Outline personnel actions which have been taken
- Offer continuing assistance and support

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Sexual Harassment

It is illegal in the State of Washington to harass someone on the basis of their sex. Construction is a predominantly male occupation, which may provide an atmosphere that is conducive of harassment situations. Sexual harassment may include:

- Sexual jokes, comments and innuendoes
- Unwelcome invitations to sexual activity
- Unwelcome touches, pinches and hugs
- Pressure to engage in sexual activity as a condition of employment or promotion
- Sexual assault

Remember what one-person views as being harassment may not be by another. You as the supervisor on the job and the employers most direct representative, are responsible for recognizing and dealing with harassment, such as:

- Sexual harassment by management - whether the employer knows about it or not.
- Sexual harassment by co-workers, if the employer knows about it, but does nothing.
- Sexual harassment by non-employees in the workplace such as vendors, customers, consultants, air monitoring technicians, etc. - if the employer knows about it and does nothing.
- Sexual harassment that results in promotion of one employee over other employees who are denied raises or promotions because of sexual harassment directed at another employee.

Note: *Sexually harassed employees can sue for damages. These sexual harassment complaints against employers have brought large financial awards to victims in recent years.*

If an employee complains to you about sexual harassment on the job, remember to:

- Listen attentively, don't laugh.
- Never assume it was the employee's fault.
- Encourage the harassed employee to say NO.
- Take action, talk to the offender -follow the companies standard disciplinary procedures.
- Take action immediately! If you don't, it will only get worse.

As the designated supervisor responsible for your project, what should you do to help prevent this problem? Here are a few recommendations:

- Distribute and post a written policy that sexual harassment will not be tolerated.
- Train management, staff and employees in ways to deal with sexual harassment.
- Establish procedures for registering sexual harassment complaints as part of company procedure.