

CHAPTER 8 - TEMPORARY TRAFFIC CONTROL

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8-1.00 INTRODUCTION

8-1.01 Purpose

This chapter is intended to show applications of basic principles of temporary traffic control and assist in developing temporary traffic control plans including Transportation Management Plans, plan sheets, specifications, special provisions, etc.

8-1.02 Scope

This chapter has been written to supplement, not to replace, the [MN MUTCD](#). This chapter includes guidelines varying from planning traffic control to fit the needs of a particular activity to the reasons for keeping accurate records. The guidelines should be useful to any qualified individual involved with planning, designing, installing, maintaining, and inspecting temporary traffic control zones. Individuals are qualified by means of training in temporary traffic control practices, having a basic understanding of the principles of traffic control in work zones, or having experience in applying traffic control in work zones.

Other road authorities are encouraged to review the MN MUTCD and establish guidelines to meet their needs.

8-1.03 Relation to Other MnDOT Standards and Guidelines

As stated, this chapter is to supplement, not to replace, Part 6 Temporary Traffic Control of the latest edition of the [MN MUTCD](#). The MN MUTCD includes the Field Manual for Temporary Traffic Control Zone Layouts (See Chapter 6K).

The guidelines contained in this chapter and in temporary traffic control plans should conform to, or be of higher standards than, the MN MUTCD and other MnDOT technical standards and guidelines. Adequate protection of the workers, traveling public, and other road users (including pedestrians and bicyclists) is the primary goal of any traffic control.

8-1.04 Chapter Organization

This chapter is divided into nine major sections:

- [8-1.00 Introduction](#)
- [8-2.00 Glossary](#)
- [8-3.00 Responsibility](#)
- [8-4.00 Temporary Traffic Control Planning and Implementation](#)
- [8-5.00 Temporary Traffic Control Strategies and Controlling Criteria](#)
- [8-6.00 Temporary Traffic Control Devices](#)
- [8-7.00 Temporary Traffic Control Plans](#)
- [8-8.00 Temporary Traffic Control Reviews](#)
- [8-9.00 References](#)

8-2.00 GLOSSARY

Refer to the [MN MUTCD](#) (including the Field Manual) for definitions of common temporary traffic control (TTC) terminology. Definitions of terms found within this manual and other resources that are not included within the MN MUTCD are listed below.

Alternate Pedestrian Route (APR)

A temporary pedestrian facility created to replace an existing pedestrian facility impacted by a work zone. The APR needs to be at the same level of accessibility as the pre-existing pedestrian route.

Barricade Mounted Signs

Traffic control signs that are mounted on barricades.

Intelligent Work Zone

A system of devices that provides motorists and/or workers “real-time” information for improved mobility and safety through a work zone.

Occupied Work Space

A work space is considered to be occupied when workers are present within the work space. Temporary Traffic Control (TTC) devices should continuously be reviewed by workers and adjustments made as needed.

Pavement Markings

Final Pavement Marking

The pavement marking that will be installed until the next time the pavement marking is scheduled to be renewed (typically one or more years). Final markings would include full length centerline markings, edge lines, and messages.

Temporary Pavement Marking

The pavement marking that will be installed in staged, long-term temporary traffic control zones. The purpose of temporary pavement markings is to communicate the temporary traffic control condition that is different from prior or final conditions. This type of pavement marking is at least of the same dimensions as final pavement markings. The temporary markings will either be removed or covered with another pavement surface prior to the application of the final markings. The temporary markings would include full-length centerline markings, edge lines, and messages. All temporary pavement markings shall be in conformance with the [MN MUTCD](#) Parts 3 and 6F. Temporary pavement markings shall also follow the specifications of final pavement markings. Temporary pavement markings typically possess wet retroreflective/recoverable properties.

Interim Pavement Marking

Interim pavement markings are those that are allowed to remain in place until the earliest date when it is practical and possible to install pavement markings that meet the [MN MUTCD](#) Part 3 standards for pavement markings (temporary or final pavement markings). In other words, they are a thinner marking applied in order to maintain traffic until the final pavement markings can be placed. These are used for very short term staging purposes. Interim pavement markings should not be left in place for more than 14 calendar days unless they meet the requirements of temporary or final markings.

Temporary Raised Pavement Marker (TRPM)

Retroreflective pavement markers applied to the roadway surface which maintain retroreflective properties during wet weather conditions. TRPMs are used alone to substitute for pavement marking segments or to provide wet weather capabilities to other pavement markings.

Portable Support Mounted Signs

Traffic control signs that are mounted on portable sign supports.

Positive Protection

The use of devices that contain and redirect vehicles, reducing the risk of vehicle intrusion into the work space.

Public Information Plan (PIP)

In relation to Transportation Management Plans (TMPs), a plan that informs the public of the impacts on traffic and the general area during or prior to construction.

Significant Project

In relation to Transportation Management Plans (TMPs), a project that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on the [Minnesota Work Zone Safety and Mobility Policy](#) and/or engineering judgment.

Temporary Pedestrian Access Route (TPAR)

A temporary, continuous, and unobstructed walkway within a pedestrian circulation path that provides accessibility.

Transportation Management Area (TMA)

An area designated by the Secretary of Transportation, having an urbanized area population of over 200,000, or upon special request from the Governor and the MPO designated for the area. There is only one TMA in Minnesota – the seven county Twin Cities area, which includes Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties.

Transportation Management Plan (TMP)

A plan that lays out a set of coordinated strategies and describes how these strategies will be used to manage the impacts of a project during construction. It includes the TTCP, TOP, and PIP (if needed). The scope of the project will dictate the level of effort and detail of the TMP. The TMP can range from the citation of a specific layout from the Field Manual that is being followed to a full report that includes a Temporary Traffic Control Plan (TTCP), a Transportation Operations Plan (TOP) (including traffic modeling), and a Public Information Plan (PIP).

Transportation Operations Plan (TOP)

In relation to Transportation Management Plans (TMPs), a plan that includes Demand Management Strategies, Corridor/Network Management Strategies, Work Zone Safety Management Strategies, and Traffic/Incident Management and Enforcement Strategies.

Zipper Merge

A method of merging traffic in a lane reduction (typically two lanes to one lane). Motorists use both lanes of traffic until reaching the defined merge area, and then alternate in “zipper” fashion into the open lane.

- In an Active Zipper Merge, detection, algorithms, and communication devices tell drivers when to use the Zipper Merge.
- In a Passive Zipper Merge, signs or portable changeable message signs (PCMSs) are used to notify drivers to use Zipper Merge when backups occur.

8-3.00 RESPONSIBILITY**8-3.01 General Responsibility**

It is essential that multiple functional units within the districts be involved in providing input into the Transportation Management Plan for each temporary traffic control situation. Further information can be found in [Section 8-4.00 Temporary traffic control Planning and Implementation](#).

8-3.02 Legal Responsibility

Minnesota Statute Sections [169.06](#) and [169.07](#) provide that: (1) traffic signs shall be placed only by the authority of a public body or official having jurisdiction, for the purpose of regulating, warning, or guiding traffic; and that (2) no traffic sign or its support shall bear any message that is not essential to traffic control. Any unauthorized sign placed on the highway right-of-way by a private organization or individual without authority constitutes a public nuisance, and all such unofficial and nonessential signs should be removed.

Minnesota Statute Sections [169.06](#), Subd. 1-4 and [169.07](#) establishes the legal authority for MnDOT and local units of government to: (1) place and maintain markings, (2) require obedience to official markings, (3) prohibit the display of unauthorized markings, and (4) prohibit interference with official markings. Markings shall be placed only by the authority of the public body having jurisdiction over the highway, road, or street for the purpose of regulating, warning, or guiding traffic. Pavement and curb markings, object markers, and delineators are all normally within highway, road, or street rights-of-way and therefore, should never be installed except under public authority.

Minnesota Statute Sections [326.02](#) and [326.03](#) requires that engineering work wherein the public welfare or the safeguarding of life, health, or property is concerned or involved, such as the development of Temporary Traffic Control Plans, be performed or supervised only by Professional Engineers trained in the relevant subject.

Construction contractors and public utility companies are permitted to erect temporary construction and maintenance signs and place temporary pavement markings at work sites to protect the public, equipment, and workers provided that such signs and markings conform to the standards of the [MN MUTCD](#) and the proper authority has been given by MnDOT.

[Minn. Stat. Sec. 169.14, Subd. 5d](#) allows the establishment of a Workers Present Speed Limit. Refer to the document "Speed Limits in Work Zones Guidelines" located on the [Speed Limits in Minnesota](#) website for additional information.

8-4.00 TEMPORARY TRAFFIC CONTROL PLANNING AND IMPLEMENTATION

8-4.01 Temporary Traffic Control Goals

During planning for temporary traffic control (TTC) zones, the greatest payoff in terms of safety and convenience at a cost commensurate with the hazards and problems involved should be the goal. A properly installed temporary traffic control zone will allow traffic to pass through or around a work zone safely. It requires time and effort for planning, installation, and maintenance.

Work zone traffic control planning is based upon analysis of the work activity as it relates to the provision of adequate safety and capacity. Questions to consider include: What is the likelihood of motorists failing to negotiate the work zone safely? What are the consequences of such action on workers, traveling public, and other road users (including pedestrians and bicyclists)?

Planning for traffic control through a construction work zone may be more involved than for maintenance or utility zones because of the differences in traffic disruption and duration of the work. The exposure of traffic to potential hazards is a function of the traffic volume and the length of time that the closure will be in effect. The goals common to all temporary traffic control zones are to:

- Protect the workers,
- Minimize crashes and crash severity, and
- Minimize inconvenience and conflicts as a result of the work.

Federal regulations also require that workers are as safe as practicable through the use of:

- Exposure control measures such as road and ramp closures, median crossovers, detours, and accelerated construction techniques,
- Positive protection devices such as barrier, truck/trailer mounted attenuators, and vehicle arresting systems,

- Other traffic control measures such as credible signing, portable changeable message signs, arrow boards, rumble strips, pilot cars, etc.

8-4.02 Transportation Management Plans (TMPs)

A Transportation Management Plan is a plan that lays out a set of coordinated strategies and describes how these strategies will be used to manage the impacts of a project during construction. It includes the:

1. Temporary Traffic Control Plan (TTCP),
2. Transportation Operations Plan (TOP), and
3. Public Information Plan (PIP), if needed.

The scope of the project will dictate the level of effort and detail of the TMP. The TMP can range from the citation of a specific layout from the [Field Manual](#) that is being followed, to a full report that includes a TTCP, TOP (including traffic modeling), and PIP.

The development of the TMP will take into consideration the safety and mobility of workers and all users of the transportation system (motorists, pedestrians, and bicyclists). The TMP process is detailed in [Technical Memorandum 12-03-T-02 Minnesota Work Zone Safety and Mobility \(WZSM\) Policy](#). This process includes a Work Zone Mobility Impact Assessment that will identify the appropriate level of TMP for the project. The level of TMP will then dictate the necessary documentation for the project. This could be as little as identifying the appropriate layout from the [Field Manual](#), to a full Temporary Traffic Control Plan, a Traffic Operations Plan (possibly including traffic modeling), and a separate Public Information Plan. These components of the TMP are listed in the Tech Memo, as well as overall guidance in the development of each of the components. Each district should develop templates and procedures to develop these components to meet their district needs and characteristics.

The following is additional guidance that may be used as the TMP is being followed through the project development process.

Responsibility

Involvement from each of the functional areas is needed to insure that adequate consideration is given to proper temporary traffic control for all operations. In order to assure that this commitment is met, it will require early involvement by all parties including project management, pre-design, design, traffic, maintenance, and construction. Typical guidelines have been developed for the various stages.

Scoping and Environmental Documentation

During the scoping/preliminary design development phase, the Project Manager should review the scope of the project with staff from Traffic, Construction, and Detail Design to determine traffic control concepts for the proposed construction. Construction staging should be determined by the traffic carrying capacities of the roadway under construction, bypasses, or detours. Consideration should be given for other construction work in the proposed highway corridor or general vicinity by other than MnDOT forces such as cities and counties.

Metro District has created a TMP Scoping Worksheet that allows the documentation of possible work zone mobility impacts. Districts are encouraged to develop their own version of this worksheet so that impacts to traffic are considered in the Scoping phase. The TMP Scoping Worksheet can be found at the [Metro District Traffic Engineering Work Zones and Pavement Marking](#) page.

The Federal Highway Administration (FHWA) also requires that traffic control considerations and effects be mentioned in the environmental documentation. Traffic operations analyses (such as modeling) may need to be performed to assess the mobility of the proposed temporary traffic control, depending on the level of TMP for the project. Commitments made to stakeholders that impact the mobility of road users should be entered into the TMP which is initiated in this phase.

Detail Design

The Detail Design staff should involve staff from Traffic, Construction, and appropriate FHWA personnel as

the final detail plans are being developed so that the necessary details for traffic control are worked into the TMP. This may range in scope from a very detailed plan (or proposal) designed solely for a specific project, to a reference to a standard specification, a section of the MN MUTCD, or a standard agency manual. The TMP requirements shall be incorporated into the plans, specifications, and estimate (P.S. & E). If the complexity of a project warrants, a traffic control layout may be prepared by the District Traffic Engineer and be included in the P.S. & E.

On some projects it may be appropriate to provide broad TTC Plan parameters in the P.S. & E., and then permit the successful bidder to develop a detailed TTC Plan and use it if MnDOT and FHWA find it acceptable.

The Detail Design staff should involve staff from Traffic, Construction, and the District Work Zone Safety Coordinator personnel to develop detailed time and traffic provisions.

The pay items to be included in the plans must be determined by the district during design. Individual projects may have varying pay items depending on size, complexity, and location. Districts are encouraged to use appropriate pay items to the fullest practical extent.

Construction

During the construction stage, the resident/project engineer will generally be the MnDOT person responsible for implementing the TMP and reviewing the temporary traffic control. The resident/project engineer may delegate this authority. This should be done at or before the pre-construction conference.

The responsible person should have the following duties:

- Develop a familiarity with the [MN MUTCD](#), the contract plans and special provisions, the current [Minnesota Standard Specifications for Highway Construction](#) and its supplements.
- Coordinate MnDOT personnel assigned to the project relative to proper techniques of traffic safety and traffic operations prior to beginning construction and specifically how they relate to the TTC Plan. The District Traffic Engineer and others shall be available to assist in this task.
- Ensure that all affected agencies such as State Patrol, local Police, fire departments, sheriff's office, hospital, ambulance services, local government, post office, school districts, etc., are informed of the scope of the project and how it may affect their individual needs and services. The Public Information Plan (PIP) of the TMP is extremely critical in the case of a total detouring of traffic. The District Public Affairs Coordinator and/or the Office of Communications may be of help in this responsibility.
- As identified in the PIP, notify the major local news media (TV, radio stations, newspapers, etc.), local tourism associations, AAA, local legislators, etc. of the scope of the project prior to beginning operations. Cooperation with the Contractor and any involved local government agencies is advised. All items of interest should be included:
 - Type of work to be performed.
 - Hours the highway will be fully opened to traffic.
 - Hours of restricted usage.
 - Type and place delays can be expected.
 - Suggested alternate routes.
 - Duration of the project.
 - Location of the detour, if applicable.
 - Anticipated completion date of project.
 - A name and phone number the public can contact for information or to make comments about the project.

At appropriate times during the life of the project the responsible person should update the information mentioned above so that the public is kept current on the status of the project. The Public Affairs Coordinator may be of help in this responsibility.

- Update 511 at the start of construction, listing details on how traffic is affected.
- Monitor the Contractor's operations with regard to traffic and safety operations and enforce the requirements of the contract. On some projects, it may be necessary to change the TTC Plan during construction, depending on the contractor's schedule, progress of utility work, etc. If this is done, the TMP needs to be modified as well.
- Review traffic operations through the project limits, including the condition of all traffic control devices on a regular basis.

8-5.00 TEMPORARY TRAFFIC CONTROL STRATEGIES AND CONTROLLING CRITERIA

8-5.01 Lane Width

For temporary traffic control purposes, a minimum lane width of 10 feet shall be provided. The lane width should be no less than 11 feet on multi-lane roads. Reduced widths should be analyzed for the off-tracking of the design vehicle. AutoTurn within MicroStation, or other comparable methods, may be used for the analysis.

When shoulders are provided, the minimum width should be no less than one foot. When barrier is used, a lateral buffer of at least two feet should be provided.

8-5.02 Crossovers and Bypasses (Diversion)

A crossover is a construction staging technique used to shift traffic from one side of a divided roadway onto a portion of roadway not under construction, typically sharing the remaining roadway with opposing traffic. A specific type of crossover, known as a bypass (or diversion), moves traffic onto a temporary alignment constructed either in the median or adjacent to the original alignment. Crossovers are an effective method for completing construction of a roadway by replacing or repairing the roadway or a structure while maintaining traffic in both directions.

As mentioned in [Section 8-4.01 Temporary Traffic Control Goals](#), recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is exposure control measures. Crossovers and bypasses are an effective means for providing long-term positive separation between workers and live traffic. Strong consideration should be given to this exposure control method.

Crossovers are typically used on freeways, but may be used on divided highways with limited at-grade accesses. Lane closures and traffic shifts are typically used on multi-lane divided expressways, but crossovers are an option for long-term stationary work.

Construction of a bypass typically consists of a temporary roadway alignment (possibly construction of a temporary structure as well). The limits of the bypass extend from the initial reverse curve leaving the existing roadway to the final reverse curve tying the alignment back into the existing roadway.

8-5.02.01 Design Speed for Crossovers and Bypasses

As stated in the [MN MUTCD](#) Part 6, design speed for the reverse curves used in a crossover or bypass should be no less than 10 miles per hour below the posted speed prior to work starting. If unusual site conditions require that a lower design speed be used, the signing should reflect an advisory speed determined by engineering judgment or study.

8-5.02.02 Roadway Lighting for Crossovers and Bypasses

On long term projects, the use of roadway lighting may be beneficial and should be considered especially when there are unusual site conditions that would require a lower design speed.

8-5.02.03 Crossed-Over Two-Lane, Two-Way Traffic on One Side of Divided Facility

Once the traffic has been crossed over to the roadway not under construction, how to divide traffic must be considered. There are a few options available:

- Pavement Markings
The use of pavement markings alone should only be used on low speed facilities.
- Surface Mounted Delineators (see [MN MUTCD](#), Part 6F.65.1)
These are used to supplement pavement markings and should be used on higher speed facilities such as expressways or freeways.
- Temporary Barrier
Temporary barrier is a consideration where a physical barrier is desired between the traffic flows. Traffic volume, travel speed, geometrics, and duration are all factors to consider when evaluating the use of barrier.

One design element to be aware of is to protect hazards from both directions of travel – the TTC design should incorporate protection measures (barrier, attenuation, etc.).

8-5.03 Closures and Detours

As mentioned in [Section 8-4.01 Temporary Traffic Control Goals](#), recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is exposure control measures. Temporary road closures and detours are an effective method of exposure control. Strong consideration should be given to this exposure control method.

Temporary road closures are being used more commonly even on major freeways where parallel routes exist. These closures should generally take place during off peak travel times, such as nights and weekends.

8-5.03.01 Establishing and Maintaining Detours

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

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

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

- Detour routes must accommodate height, width, weight, length, off-tracking, and other physical characteristics of the design vehicle (the largest vehicle expected to use the detour). The designer of the temporary traffic control plan should coordinate with the [Office of Freight & Commercial Vehicle Operations Overdimension Permits](#).
- Appropriate and adequate detour signing for the entire route in both directions.
- For conditional or periodic detours, using multiple portable changeable message signs (PCMSs) can provide real-time advance warnings or notifications.
- Coordination with the [Regional Traffic Management Center \(RTMC\)](#) for considerations with [511 traveler information](#).
- Coordination with local road agencies for proposed detour route(s). This should look at proposed work that the local road agency is performing that may impact the detour route.
- Agreements with local road agencies regarding the payment for the road life used by the detour, and if MnDOT or the local road agencies will maintain the roadway during the life of the detour.

8-5.03.01.01 Governing Laws Regarding Temporary Roads and Detours

Applicable laws for establishing and maintaining detours are found in Minn. Stat. Sec. [160.12](#), [160.16](#), [Subd. 2](#), [160.2715](#), [161.24](#), [Subd. 3](#), and [161.25](#).

8-5.03.01.02 Detailed Detour Procedures

The following information provides a general overview of the process for establishing and maintaining detours. Details on establishing a detour or haul road can be found in the:

- MnDOT [Right of Way Manual](#), Sections 115.6 and 115.7, and
- MnDOT [Construction Tools - Haul Roads & Detours](#) website.

Details on detour agreement procedures can be found at:

- [Cost Participation and Maintenance Responsibilities with Local Units of Government Manual](#), Section III.B.2 Detour,
- [Technical Memorandum No. 13-19-MAT-01, Detour Restoration Road Life Analysis using the Equivalent Overlay Method](#), and
- [Technical Memorandum No. 10-09-TS-03, Revised Detour Restoration Road Life Formula for the Gas Tax Method](#).

8-5.03.01.03 Selection of a Detour Route and Detour Agreement Development

When a route is to be selected for a detour, the appropriate personnel should be consulted as soon as possible for review of the proposed route. The district should designate a person to coordinate this review. The review team may include the District Traffic Engineer, District State Aid Engineer, District Design Engineer, Project Engineer, Area Maintenance Engineer, as well as the local road authorities of the road(s) which will be affected. The information obtained in this review should include a detailed surface condition report, recommendations for reinforcement or modification of the proposed route, and recommendations for traffic control and signing on the proposed route.

Detour Agreement

A Detour Agreement is required to compensate the local road authority for the road life consumed by the detoured traffic. The district will write simple detour agreements. The Cooperative Agreements Unit of the [Office of Project Management & Technical Support](#) will author complex detour agreements. See MnDOT's [iHUB Project Management and Technical Support - Cooperative Agreements](#) website for Detour Agreement Boiler Plates.

Detour Traffic Control Devices

Once the detour route has been established and the Detour Agreement initiated, the Traffic Engineer and the Area Maintenance Engineer should work together to develop the signing layout and have the necessary signs prepared. The Project Engineer should consult with the Traffic and Area Maintenance Engineers to determine the advance notice needed before the detour is to go into effect. The advance notice should allow enough time to have all signing and other traffic control devices properly installed and reviewed before traffic is diverted onto the detour. Traffic control devices (particularly signing and pavement markings) along the detour should be brought to State Highway standards – this work is usually performed by the contractor of the construction project.

The detour will become a temporary trunk highway on the date the trunk highway markers are erected and will remain in effect until the markers are removed and the local road authority has been compensated per the terms of the Agreement.

Detour Documents

The detour documents (primarily the map of the detour) will be kept by the Project Engineer for the duration of the detour. A copy of the document is sent to the permit office at CO, Rm 153, Mailstop 420. The Project Engineer will notify the local road authority, by letter, when the detour signing is removed. Once the detour is released, the date of the release and the signature of the local road authority is affixed to the document. The

District Engineer or designee will also sign the document. The documents are then submitted to the Legal Descriptions/Commissioner's Order Unit (Mailstop 632) of the [Office of Land Management](#) for a Commissioner's Order to be assigned and entered into the permanent record.

When a detour is found to be necessary after actual construction has begun and is requested by the contractor, the above procedure is followed except that generally the Project Engineer coordinates the route review. In addition, a Supplemental Agreement will have to be written documenting the change from the original contract.

8-5.03.01.04 511 Notification of a Detour

For construction projects, district staff (either Construction or Public Affairs) should notify 511 staff of the detour through the use of a faxed-in lane closure form. Currently each district has their own form. The [511 Traveler Information Protocol Website](#) contains more detailed information. More formal 511 notification methods will be forthcoming.

8-5.03.01.05 Maintenance of a Detour

Unless other arrangements are made in the construction contract, it will be assumed that the detour is to be maintained by state forces (see [MnDOT Maintenance Manual](#), Chapter 11, Section 4.02 Maintenance Work on Detours). However, if conditions make it advisable to have local authorities maintain their own roads, such arrangements are made in the Detour Agreement at the time the route negotiations are conducted. See the [MnDOT Maintenance Manual](#), Chapter 11, Section 4.0 Detour Agreement, for specific instructions on maintenance agreements.

8-5.03.01.06 Unofficial Detours

Unofficial detours are when a portion of traffic is not found to follow the official detour and local roads are being used – this can lead to degradation of the local roads. An unofficial detour agreement is written with a local unit of government, most often a township, to allow MnDOT to compensate them for increased maintenance costs, over and above the average expenditures associated with local or through-traffic using local roads rather than an official detour route that was established as part of a construction or reconstruction project. Increased costs of maintenance on the local roadway, not including improvement costs, are documented by the local road authority and submitted to the MnDOT district for payment consideration.

If the district concurs with the additional costs, an unofficial detour agreement is written to provide payment to the local road authority. If MnDOT and the local road authority cannot agree upon the amount of additional maintenance costs that should be paid, the "Gas Tax Method" ([Technical Memorandum No. 10-09-TS-03](#)) may be used for determining payment for a detour placed on paved roadways. An agreement or payment will not be written for less than \$500. Unofficial Detour Agreements are written by the district or the Cooperative Agreements Unit in the [Office of Project Management & Technical Support](#).

8-5.03.01.07 Haul Roads

Follow the guidance and procedures found on the [Construction Tools - Haul Roads and Detours](#) website.

8-5.03.01.08 Emergency Detours

Follow the guidance stated in the [MnDOT Maintenance Manual](#), Chapter 11, Section 5.0 Emergency Detours.

8-5.03.02 Road Closed, Open to Local Traffic

When the ROAD CLOSED, LOCAL TRAFFIC ONLY sign or the ROAD CLOSED TO THRU TRAFFIC sign is used, the portion of road beyond that sign is still open to the residents and businesses beyond. The road needs to meet the overall standards and guidelines of safe travel.

The ROAD CLOSED sign on barricades across the road width indicates a full closure point beyond which construction activities may proceed without interference from traffic. Traffic control devices may not be necessary in this area.

8-5.04 Delay Time

In general, traffic should not be delayed by more than 15 minutes. If it is expected (through traffic flow modeling or experience) that traffic will be delayed more than this, the TMP will need to consider additional public information efforts and demand management strategies (see [Technical Memorandum No. 12-03-T-02 dated February 6, 2012 - Minnesota Work Zone Safety and Mobility Policy](#)).

8-5.04.01 Detour Delay Time

In long term work zones, the overall travel time due to detours may exceed 15 minutes; however, additional public information efforts should be identified in the TMP and implemented. Unless the travel time is exceedingly high, demand management strategies are not necessary.

8-5.04.02 Maximum Flagger Hold Time

Flagging operations should limit the hold time to 15 minutes and should coordinate to reduce the delay.

8-5.05 Flagging Operations (Updated December 2018)

Flagging procedures, when used, can provide positive guidance to the motorist traversing the work area. Part 6 of the [MN MUTCD](#) contains methods, procedures, and specifications for flagging. Work zone flaggers have the authority to stop vehicles and hold vehicles in place until it is safe for the vehicles to proceed per [MN Statute 169.06 Subd 4a](#). MN Statute 169.06 gives authority to other individuals to stop and hold traffic, such as over-dimensional load escort drivers, motorcycle road guards, and police officers. The requirements in this section apply only to work zone flaggers. Refer to the [Minnesota Flagging Handbook](#) which is part of the MN MUTCD, for overall state standards and procedures.

The MN MUTCD requires that high visibility clothing be worn by flaggers, though the requirement for a high visibility hat is a SHOULD statement. To enhance the visibility of flaggers on the State Highway system, MnDOT requires that a high visibility hat be worn by flaggers unless the work site requires hard hats.

The MN MUTCD recommends that every flagger be trained in flagging operations. To assure this on the state highway system, any person acting as a flagger on the state highway system is required to attend a training session taught by a MnDOT Qualified Flagger Trainer within 1 year prior to the start date of the work. A Flagger Qualification Card, signed by the MnDOT Qualified Flagger Trainer, shall be carried by the Flagger as proof of training. In addition, the latest version of the Minnesota Flagging Handbook shall be in the possession of the Flagger while flagging for the work.

8-5.05.01 Approach Lanes to Flagging Operation

Flagging operations are most effective when a single lane of traffic approaches the flagger. Due to this, multi-lane roads should include a lane reduction prior to the flagger station. At intersections with dedicated turn lanes, the flagger station should be located at the beginning of the furthest upstream taper location.

8-5.05.02 *Flagger Station Lighting*

As stated in the [MN MUTCD](#), Part 6E.8, flagger stations shall be illuminated at night. The average maintained illuminance should be a minimum of 5 foot candles (54 lux). Balloon lighting or floodlights may be used; however, if floodlighting is used, it shall not produce a disabling glare condition for approaching road users, flaggers, or other workers.

Vehicle headlights shall not be used to illuminate the flagger station.

8-5.05.03 *Delay Times due to Flagging Operation*

As stated in Section [8-5.04.02](#), flagging operations should limit the hold time to 15 minutes and flaggers should coordinate to limit the delay to the traveling public.

8-5.05.04 *Flagging at Signalized Intersections*

When flagging a signalized intersection, the signal must be turned off or turned to flashing mode. Only a licensed uniformed law enforcement officer may override a fully operational traffic control signal system.

8-5.05.05 *Flagging on Freeways*

Flaggers should not be used to control traffic on a freeway due to the potential of creating a speed differential which could result in a higher risk of rear-end crashes or vehicular evasive maneuvers that result in work area intrusions.

When a full closure is needed on a freeway for a very limited time (i.e. to set bridge beams), a flagging operation may be used at night when volumes are low; however, a law enforcement officer shall be used and the duration of the operation should be less than 15 minutes. See Layout 6K-73 in the [Field Manual](#).

8-5.05.06 *Side Roads Within the Temporary Traffic Control Zone*

For lengthy flagging areas that contain side roads, a flagger and/or appropriate signing for each intersecting side road within the limits of the active work area should be considered. Also consider provisions to contact and notify individual private residences along the highway within the work area of the process for entering and exiting their property.

8-5.05.07 *Temporary Stop Signs Alternative to Flagging*

Temporary stop signs are an acceptable alternative to flagging on roads with less than 1500 ADT and clear sight between the stop areas. See Layout 6J-12 located in Part 6, of the [MN MUTCD](#).

8-5.05.08 *Pilot Car Operations*

Pilot Cars may be used in conjunction with flaggers to guide platoons of vehicles through lengthy two-way, one-lane work areas. Pilot cars may be considered when:

- Lane closures exceed ½ mile and sight distance between the flagger stations is obscured,
- Workers are immediately adjacent to the traveled lane,
- There are multiple isolated activities occurring throughout the work area.

When used, it may be worthwhile to notify residents along the corridor of the proper way to enter the highway while the pilot car is in operation. This should be considered as the public information plan of the TMP is being developed.

8-5.05.08.01 Pilot Car Maximum Speeds

Limiting the travel speed of the pilot car should be considered for the flagging operation, particularly when the pilot car is passing workers in the lane adjacent to traffic. If the travel speed of the pilot car is limited to 45 mph near workers, the project may not need to implement a Workers Present Speed Limit of 45 mph.

8-5.05.09 Automated Flagger Assistance Devices (AFADs)

The AFAD is an automated, trailer-mounted device used as an option for flagging within a two-way, one-lane work zone operation. These devices are controlled by either one or two flaggers, depending on the visibility of the queues controlled by each AFAD. An advantage of AFADs is that they remove the flaggers from the flagging stations. Two types of AFADs are available:

1) STOP/SLOW AFAD

This type uses a STOP/SLOW sign, similar to a flagger paddle, that alternately displays the STOP face and the SLOW face, depending on the direction of the flagging operation.

2) Red/Yellow Lens AFAD

This type displays either a steadily illuminated CIRCULAR RED lens or a flashing CIRCULAR YELLOW lens, depending on the direction of the flagging operation.

The general requirements for each can be found in Part 6E of the [MN MUTCD](#). MnDOT also requires that a gate arm be included for either option when used on the state highway system. Compared to portable signals, AFADs may allow more flexibility to react to varying queues as they are controlled by a flagger(s).

8-5.05.10 Portable Signals

Portable signals are an alternative to a standard flagging operation. A portable signal operation requires that district traffic staff set up the timing of the signals. Compared to AFADs, portable signals require fewer employees to staff the work zone as flaggers are not necessary. Portable signals are also useful for alternating one way traffic operations in unattended work zones.

8-5.06 Speed Limits in Work Zones

There are several methods of signing available for speed control in work zones. These methods are:

- Advisory Speeds,
- Workers Present Speed Limits, and
- 24/7 Construction Speed Limits.

Under certain conditions, a Workers Present Speed Limit is required by Minnesota Statute. For additional information, details, and typical layouts, see “Speed Limits in Work Zones Guidelines” found on MnDOT’s [Speed Limits in Minnesota](#) website.

8-5.07 Positive Protection

As mentioned in Section [8-4.01 Temporary Traffic Control Goals](#), recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is the use of positive protection devices. Strong consideration should be given to this exposure control method.

The FHWA defines “Positive Protection Devices” as devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in the [National Cooperative Highway Research Program \(NCHRP\) Report 350](#) or the [Manual for Assessing Safety Hardware \(MASH\)](#). The determination of when to use positive protection is based on engineering judgment. Numerous products and devices can be used to provide different degrees of positive protection, devices more commonly used in Minnesota are described in this section.

8-5.07.01 Temporary Barriers for Positive Protection

While portable concrete barrier has historically been the primary choice in Minnesota, other options are available. The options and considerations include:

- Portable Concrete Barrier
 - ⌋ Usually used for long-duration activities where work space is limited and either worker/traffic exposures or road user/work area hazard exposures are present on a regular basis.
 - ⌋ Adequate space is required for barrier deflection or the barrier needs to be pinned to the pavement surface.
 - ⌋ Adequate space is needed for equipment to install/move/remove the barrier.
 - ⌋ Barrier must be placed on rigid pavement surface (bituminous or concrete) to remain crashworthy.
 - ⌋ Adequate contractor ingress/egress points will be needed either at barrier ends or mid-run.
 - ⌋ All exposed ends must be treated with some manner of impact attenuation or protection.
- Steel Barrier
 - ⌋ While not widely used, steel barrier options are on MnDOT's [Approved/Qualified Products for Temporary Barrier List](#) (APL). It has several advantages over portable concrete barrier - including ease and reduced cost of transport, speed of installation, durability, portability once on-site, and weight per foot to minimize bridge dead-loading.
 - ⌋ When anchored, steel barrier equals concrete barrier in providing a safe and effective positive protection device with minimal deflection; however, unanchored, steel barrier has significantly higher deflection.
 - ⌋ On shorter term projects, steel barrier may be more cost-effective than portable concrete barrier due to the reduced transportation costs and set up time.
 - ⌋ End treatment is still necessary.
- Water-Filled Barrier
 - ⌋ Also not widely used, water-filled barrier options are on MnDOT's [APL](#). It also has some advantages over portable concrete barrier - including ease and reduced cost of transport, speed of installation, and portability once on-site.
 - ⌋ Water-filled barrier has higher deflection than portable concrete barrier and steel barrier.
 - ⌋ Some types of water-filled barrier can act as its own end treatment.
- Moveable Barrier
 - ⌋ Moveable barrier has been used successfully on a few MnDOT projects and there is an option on MnDOT's [APL](#).
 - ⌋ Moveable barrier is most effective for projects where lane configurations must change regularly (e.g. reversing peak traffic flows, lane reductions during non-peak hours, multiple longitudinal work areas (e.g. micro-silica deck pours, bridge deck joint replacements)) and other locations where barrier is warranted, but the shorter duration of the activity makes placement of standard concrete barrier challenging and risky.
 - ⌋ Advance coordination, communication, and project planning is needed to include in a construction project.

8-5.07.02 Protection Vehicles and Truck/Trailer Mounted Attenuators (TMAs)

Protection vehicles may be used to provide positive protection in work areas where intrusions are a concern. Protection vehicles may be equipped with a TMA; however, any protection vehicles operating totally or partially within a traffic lane should be equipped with a TMA. Protection vehicles with TMAs are primarily used for mobile and short duration activities.

Long term work zones may also benefit from the use of protection vehicles, including situations such as:

- Isolated areas of work in a long work area where workers are in the lane adjacent to traffic,
- Road closure locations where intrusions are a concern.

8-5.08 Cable Median Barrier

Forthcoming

8-5.09 Lighting

Lighting of nighttime work zones should be considered carefully as it can enhance the overall safety of the temporary traffic control area; however, the negative impacts of glare on the driver needs to be minimized. The following are some objectives of nighttime work zone lighting:

- To provide the appropriate level of lighting that allows construction work to be completed safely and effectively,
- To reinforce both the intent of the traffic control plan as well as provide better guidance for drivers traveling through the work zone, and most importantly,
- To improve the overall safety of the workers and traveling public.

8-5.09.01 Roadway Lighting

Forthcoming

8-5.09.02 Work Area Lighting

Work area lighting can enhance the safety of workers and the traveling public. [NCHRP Report 498 Illumination Guidelines for Nighttime Highway Work](#) examined this in detail and developed some recommendations. This section contains guidelines from this report that may be used if work area lighting is being considered.

Three categories were recommended based on considerations such as minimum lighting levels recommended by the [Illuminating Engineering Society](#) (IES), federal and state lighting requirements and guidelines, research, and expert opinions. Researchers found these categories to adequately account for a majority of highway and bridge-related construction and maintenance activities. Examples of work zone tasks and their associated recommended illumination levels are summarized below.

Recommended Illumination Levels by Task

Examples of Tasks	Illumination Level	Average Minimum Maintained Illuminance
All work operations areas; <ul style="list-style-type: none"> • setup of lane or road closures, • lane closure tapers, and • flagging stations. 	Level I	54 lux (5 foot-candles*)
Areas on or around construction equipment; <ul style="list-style-type: none"> • asphalt paving, • milling, and • concrete placement/removal. 	Level II	108 lux (10 foot-candles)
Pavement or structural crack/pothole filling; <ul style="list-style-type: none"> • joint repair, • pavement patching/repairs, • installation of signal/electrical/mechanical equipment. 	Level III	215 lux (20 foot-candles)
A foot candle (fc) is defined as unit of illumination that is equal to one lumen per square foot, or 10.764 lux.		

Level I

Level I illuminance is important in areas where the work crew is in motion, moving from spot to spot. This level of illuminance is appropriate for tasks requiring low accuracy, involving slow-moving equipment, and where there are large objects to be seen.

Level II

Level II illuminance is recommended for areas on or around construction equipment to provide a safer environment for the workers operating the equipment, allowing them to perform tasks that require a moderate level of accuracy, as described above.

Level III

Level III illuminance is appropriate for those tasks that require a greater level of visual acuity or for tasks with a higher level of difficulty.

The following types of work zones and factors should be considered when selecting the types of lighting that are best suited for the work zone.

- Mobile work zones, such as a paving operation

If the work zone is mobile, the length of the work activity for one night may dictate either that the lighting plan be continuous for the length of the work zone or that a mobile system be used so that the lighting moves with the various work activities.

- Stationary work zones
Work duration would determine the type of lighting in this situation. A long-duration work zone could use roadway luminaires mounted on temporary poles, while shorter duration work zones could use trailer-mounted light towers or balloon lighting at fixed locations.
- Glare
Glare from the lighting systems should be minimized for both the workers and any adjacent motorist. Glare should be considered from each direction and on all approaching roadways and opposing lanes of traffic, even those separated by grass medians.
- Light Trespass
Trespass occurs when light spills onto private property. This could be a problem in a residential area and could require shielding as a preventative measure.

8-5.09.03 Vehicle Lighting for Temporary Traffic Control

Appropriate vehicle lighting is required to enhance the conspicuity of vehicles within temporary traffic control zones. This applies to both day and night time operations. All mobile equipment, operating within the limits of a TTC zone with potential exposure to passing traffic, shall be equipped with operable warning lights that meet the appropriate requirements of the SAE specifications listed below. This would include closed roads that are open to local traffic only. This also includes any vehicle that enters the traveled roadway at any time. MnDOT maintains an APL for [Vehicle Safety Lights](#) – all vehicle lighting packages must be from this APL.

- 360 Degree Rotating Lights - SAE Specification J845
- Flashing Lights - SAE Specification J595
- Flashing Strobe Lights - SAE Specification J1318

Lights shall be mounted so that at least one light is visible at all times from a height of 3.5 feet and from a 60-foot radius about the equipment. In order to meet the 360 degree at 60-foot radius requirement supplemental lighting may be used. All supplemental lights must be SAE Class 1 certified.

Per the MN MUTCD, vehicle warning lights shall be operating and visible when a vehicle decelerates to enter a construction work zone and again when a vehicle leaves the work zone and enters the traveled traffic lane.

8-5.10 Drop-offs

Drop-offs or abrupt edges are inevitable during some construction activities. Protecting or not protecting drop-offs with temporary concrete barrier within the clear zone depends on the depth of the drop, the proximity to live traffic, speeds, volumes, roadway geometry, and duration of the exposed hazard. The [Field Manual](#) contains longitudinal drop-off guidelines for drop-offs of less than 12 inches (See Figure 6K-7 & Longitudinal Drop-off Guidelines).

For drop-offs of greater than 12 inches, see the [MN MUTCD](#), Part 6F.85 Temporary Traffic Barriers for guidance regarding the placement of temporary barrier, particularly Table 6F-5.

When temporary barrier is used, anchorage is required if the temporary barrier is close to the drop-off. [MnDOT Standard Plan 5-297.680](#) covers portable concrete barrier anchoring and requires anchoring when the portable concrete barrier is within two feet of the drop-off. If steel barrier is used to protect the drop-off, consult the manufacturer's specifications for anchoring requirements.

8-5.11 Zipper Merge

The Zipper Merge is a method of merging where drivers are encouraged to use both lanes up to a defined merge point and then take turns merging. This is typically used with a lane reduction in a congested work zone. Early merging is still being encouraged when drivers are traveling at highway speeds as that gives drivers a

better opportunity to find a gap in the through lane prior to the lane reduction. Districts are encouraged to incorporate the Zipper Merge TTC when volumes are expected to exceed 1500 vehicles per hour. There are two methods for implementing a Zipper Merge in a lane reduction:

1) Active Zipper Merge

An Active Zipper Merge uses Intelligent Work Zones elements (detection, algorithms, and communication) to actively direct drivers when to use both lanes and where to merge. This type of Zipper merge is shown in the [Minnesota IWZ Toolbox](#) document in the layout *Dynamic Lane Merge* and the templates *Active Zipper Merge (Right Lane Closure & Left Lane Closure)* found on [OTE's TTC – Template Sheets website](#).

2) Passive Zipper Merge

A Passive Zipper Merge uses signs and/or PCMSs to notify drivers that both lanes should be used when there are backups. This leaves the decision to the driver as to whether a backup exists or not. This type of Zipper Merge is shown on Layout 6K-50 46 for a Mobile Lane Closure and Layout 6K-58 for a Standard Lane Closure in the [Field Manual](#). There are also templates on [OTE's TTC – Template Sheets website](#) for Passive Zipper [Merge Right Lane Closure](#) and Passive Zipper [Merge Left Lane Closure](#).

The Active Zipper Merge has been found to lead to higher compliance among drivers than the Passive Zipper Merge, but both methods have been shown to be successful - particularly in longer term work zones.

8-5.12 Intelligent Work Zones

Intelligent Work Zones (IWZ) use standard system components (detection, analysis, and communication) to provide a real-time notification system to provide drivers, project personnel, and the agency with information about work zone conditions. OTE has published the [Minnesota IWZ Toolbox](#) as a guideline for selecting an appropriate IWZ System for existing work zone traffic issues and to mitigate anticipated issues on scheduled projects. The IWZ System descriptions contained in the toolbox are intended as brainstorming material and should lead to practical solutions to a project's unique expected conditions. The layouts and examples are purposely left void of many dimensions, except where particular distances are highly recommended, and engineering judgment is required to customize the system to a project.

8-5.13 Innovative Contracting Methods

Innovative contracting methods (such as Lane Rentals, ABC, Best-Value, etc) are initiatives to reduce construction time and delivery of projects, improve quality, and develop new processes to administer projects. These supplement traditional low-bid, design-bid-build contracting. See MnDOT's [Office of Construction and Innovative Contracting](#) website for guidelines and full descriptions of the innovative contracting methods.

8-5.14 Other Travel Mode Considerations

Temporary traffic control plans are generally focused on vehicular traffic; however, there are other modes of travel that must be considered and should be incorporated into the plan documents.

8-5.14.01 Pedestrians

Pedestrians need to be considered in the development of the TTC plan. The [MN MUTCD](#) states:

MN MUTCD Part 6D.1 – Pedestrian Considerations

Standard: If the TTC (temporary traffic control) zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.

MN MUTCD Part 6D.2 – Accessibility Considerations

Standard: When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

Due to these Standard statements, the districts are highly encouraged to include a Pedestrian TTC Plan within the TMP documents (this could typically be in the overall TTC plan). If not within the project documents, contractors have difficulty implementing pedestrian routes within construction projects.

In general, the Pedestrian TTC Plan should clearly show pedestrian diversion routing and necessary traffic control devices with locations of sidewalk barricades, pedestrian channelizers, temporary curb ramps, temporary walkway surfaces, and communication devices (signing and audible/tactile devices, as needed). If a detour is provided, include signing for the detour.

Sidewalks or multi-use trails that are direct routes should be detoured as little as possible. As stated in the [MN MUTCD](#), Part 6, Chapter 6D, “Pedestrians should be provided with a convenient and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or a footpath(s).” This includes keeping the re-routing as short as is practical. The routing order of preference should be:

1. Provide the Alternate Pedestrian Route (APR) on the same side of the street as the disrupted route utilizing bypasses.
2. Where it is not feasible to provide a same side APR, provide an APR on the other side of the street.
3. Where it is not feasible to provide an APR on the other side of the street, provide an APR detour with trailblazing signs.

Recreational trails may have longer detours as these are generally used for recreation, not direct access routes.

OTE has published [template sheets](#) for Alternate Pedestrian Routes (APR) bypasses/detours and Temporary Pedestrian Access Route (TPAR) devices. These may be modified and inserted into plans or used as a reference in developing a Pedestrian TTC plan.

8-5.14.02 Bicyclists

Bicyclists need to be considered in the development of the TTC plan. The [MN MUTCD](#) states:

MN MUTCD Part 6A.1 – General

Standard: The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.

MN MUTCD Part 6G.5 – Work Affecting Pedestrian and Bicycle Facilities

It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.

Dedicated bike lanes should be addressed in the TTC plan. [Minn. Stat. Sec. 169.18, Subd. 7\(d\)](#) states:

Whenever a bicycle lane has been established on a roadway, any person operating a motor vehicle on such roadway shall not drive in the bicycle lane except to perform parking maneuvers in order to park where parking is permitted, to enter or leave the highway, or to prepare for a turn as provided in Section 169.19, Subdivision 1.

If a TTC setup directs vehicular traffic into the marked bike lane, the bike lane needs to be closed prior to this location and the bikes either need to be diverted/detoured or share the road warning signs need to be placed.

8-5.15 Clear Zones

The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways. Due to the nature of a work zone, the amount of horizontal clearance is often limited. Further, driver awareness is often heightened. As a result, lateral clear zone requirements are generally less. Work zone clear zones do not override the permanent clear zone - meaning existing roadside features should not be removed to meet work zone clear zone requirements; however, if work activities expose hazards which were not previously in the clear zone (such as in crossovers) then protections should be provided. Engineering judgment is regularly used to determine tolerable clear zone widths in work zones. Depending on site restrictions, it may only be feasible to provide an operational clearance - often as little as two feet.

Staging needs and opportunities for positive separation between workers and traffic should be considered. Actual clear zone distances should be maximized, where possible. When clear zone distances are critical within a given project or stage, distances should be identified within the project documents.

Clear zone determinations should take into account traffic speeds, volumes, roadway geometry, available right of way, and duration of work. Any specific clear zone widths needed for construction should be documented in the project file.

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

Clear zones also apply to Drop-off conditions, see Section [8-5.10 Drop-offs](#) for further information.

8-5.16 Business Impact Mitigation

Business impact mitigation is an important part of MnDOT's public involvement and project development processes, and is also addressed in [Minnesota Statute 160.165](#), Mitigating Transportation Project Impacts on Business. The purpose of business impacts mitigation is to:

- Involve businesses more in the project development process,
- Keep businesses informed regarding project issues,
- Help businesses understand a project and its potential impacts,
- Mitigate construction impacts to businesses as feasible (includes reducing and, if practical, preventing negative impacts to businesses).

Substantial business impacts is defined as "Impairment of road access, parking, or visibility for one month or longer, for one or more businesses". If the project is expected to cause substantial business impacts, specific actions need to be performed by the Project Manager and/or identified in the TMP. See [Business Impact Mitigation](#) from MnDOT's Highway Project Development Process for additional information and guidance.

The statute requires that one of the mitigation efforts that must be considered is signage. See "[Temporary Business Signing in Work Zones](#)" in Section 8-6.02.02 for guidance.

8-5.17 Public Information

The [Minnesota Work Zone Safety and Mobility Policy](#), Technical Memorandum No. 12-03-T-02, requires that public information be included in the TMP for projects of certain levels of impact. Some strategies are identified in this section.

8-5.17.01 Traveler Information - 511

511 is a public service of MnDOT to help drivers access information about road conditions, work zones, traffic incidents, commercial vehicle restrictions, and weather information via the phone, the web, or handheld

devices. Most TTC projects that are expected to impact traffic are included in 511. The use of 511 satisfies the public information requirements on many projects. TTC implementations that are anticipated to impact traffic are sent to 511 staff, which then enters the data into 511. 511 notifications are generally provided to the Regional Traffic Management Center (RTMC) during the construction project.

8-5.17.02 Advance Notice of Construction

This generally consists of MnDOT Public Affairs staff notifying the public of upcoming projects using a variety of means including pre-season construction kick-offs, project website updates, constant contact emails, print media, and press releases.

When used, Public Information methods should be identified in the TMP.

8-5.17.02.01 Temporary Signing Options

One method of advance notice uses some of the Construction Information (G20) series of signs found in the [MnDOT Standard Signs Summary](#). In particular, the following are often used:

- G20-X1 - Closure Notice
- G20-X2 - Work Zone Advance Notice
- G20-X15 - Ramp Closure Advance Notice

These are used to notify drivers that regularly use that road that construction will be starting. This may help drivers determine if alternate routes should be used once construction begins. These signs are typically installed five to seven days in advance of the actual start of construction.

8-5.17.03 Portable Changeable Message Sign (PCMS) Strategies

PCMSs may be used in addition to or instead of the advance notice signs listed above. See the [2012 CMS Manual of Practice](#) for the appropriate use of PCMS as well as approved messages.

8-6.00 TEMPORARY TRAFFIC CONTROL DEVICES

8-6.01 General Requirements of Temporary Traffic Control Devices

All TTC devices used on MnDOT street and highway construction or maintenance work shall conform to the specifications of the latest edition of the [MN MUTCD](#), the [MnDOT Standard Specifications for Construction](#), and all other appropriate MnDOT technical manuals.

8.6.01.01 Crashworthiness of TTC Devices

MnDOT requires that all TTC devices used (with the exception of Category 4) are crashworthy in accordance with the [National Cooperative Highway Research Program \(NCHRP\) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features"](#) or the [American Association of State Highway and Transportation Officials \(AASHTO\) "Manual for Assessing Safety Hardware \(MASH\)"](#).

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

- **Category 1** - Low-mass devices such as channelizing devices. Devices typically self-certified for crashworthiness.
- **Category 2** - Devices with higher mass that are frequently crash tested. Examples include permanent and portable sign supports, barricade supports, and small portable (balloon) lighting.
- **Category 3** - Much higher mass and requires correct installation and protection. Mandatory crash-testing. Examples include temporary barrier and TMAs.

- **Category 4** - Devices posing the greatest risk to motorists – Examples include trailer-mounted devices (PCMS, portable signals, flashing arrow boards, large portable light plants). These are currently exempt from crash testing as the benefit of these devices generally outweighs the risk; however, they:
 - Should be shielded where possible,
 - Should be removed when not needed,
 - Must be delineated - MnDOT interprets this to require type B channelizing devices (see [Field Manual](#), Layout 6K-7).

8-6.01.02 Approved Product List/Qualified Product List (APL/QPL)

The following TTC Devices have a MnDOT [Approved Product List](#) upon which only these devices are allowed to be used for MnDOT street and highway construction or maintenance work.

- [Sign Sheeting Materials](#)
- [Automated Flagging Assistance Devices](#)
- [Portable Changeable Message Signs](#)
- [Flashing Arrow Boards](#)
- [Portable Signal Systems \(Trailer and Pedestal Mounted\)](#)
- [Temporary Barrier](#)
- [Stationary Crash Cushions](#)
- [Truck/Trailer Mounted Attenuators](#)
- [Vehicle Safety Lights](#)
- [Longitudinal Pedestrian Channelizers](#)
- [Longitudinal Channelizing Curb \(non-concrete\)](#)
- [Temporary Rumble Strips](#)

[Pavement markings](#) have a QPL upon which only these pavement marking materials are allowed to be used on the State Highway system.

8-6.01.03 TTC Devices Not on APL/QPL

MnDOT does not maintain an APL/QPL for the TTC devices listed below:

- Channelizing devices - the installer of channelizers must self-certify that the device complies with all the specifications found in the [MN MUTCD](#) and [Standard Plate 8000j](#). See Section [8-6.04 Channelizing Devices](#) for more information.
- Portable Sign Structures - the installer of portable sign structures shall provide documentation (upon request) that the device complies with the specifications of the MN MUTCD (including crashworthiness). There are proprietary and non-proprietary crashworthy designs for barricades available. See [MN Designed Crashworthy Sign Support Structures](#) for designs of non-proprietary crashworthy portable sign supports.
- Temporary Pedestrian Access Route (TPAR) Devices - the installer of these devices and systems must self-certify that they comply with all the specifications found in Part 6 of the [MN MUTCD](#) and the [November 2005 version of the Public Right-Of-Way Accessibility Guidelines - PROWAG](#). Dimensions and other requirements may be found in the [Field Manual](#).
- Portable Precast Concrete Barrier (PPCB) - MnDOT has a [Standard Plate \(8337C\)](#) for portable precast concrete barrier.

8-6.01.04 Sheeting Requirements of TTC Devices

Some TTC devices (signs, channelizing devices, etc) include sheeting and there are requirements based on their use. The [Sign Sheeting Materials APL](#) includes the sheeting type requirements for each application/device.

8-6.01.05 Quality Standards of TTC Devices

The use of temporary traffic control zone devices subjects them to wear which does not occur with permanent devices. Although errant vehicles cause much of the damage to the devices, they also deteriorate in appearance from wear occurred during their storage, shipment, installation, relocation, and removal. Whenever a high number of these worn and damaged devices appear on the same project, the general appearance of the Temporary Traffic Control Zone deteriorates, reducing the level of safety provided to the workers, pedestrians, and traveling public.

Quality standards have been developed in an effort to offset the deterioration in the appearance of TTC devices. A determination of the condition of device quality should be made at several stages: while in storage, during preparation for delivery to the Temporary Traffic Control Zone, during initial set up, and periodically during the course of the work. Suppliers and contractors are encouraged to apply this standard prior to delivery of devices to the job site. Doing so will minimize agency involvement and reduce costs related to on-site replacement.

The Quality Standards section of the [Field Manual](#) includes Quality Classifications and Requirements for the majority of temporary traffic control devices, while considering the duration of the work zone. These standards are intended to address the day-to-day operations of traffic control within a Temporary Traffic Control Zone and are not meant to cover the needs of emergency situations.

8-6.02 Signs

The primary means by which the agency communicates with road users is through the use of signs. In order to be effective, there needs to be some distance between signs for the driver to be able to read, understand, and if necessary, react to the message communicated by the sign. Refer to the [MN MUTCD](#) Parts 2 and 6 for standards on signs.

8-6.02.01 Regulatory and Warning Signs

Regulatory signs communicate laws and warning signs communicate conditions of which the driver needs to be aware. These signs take precedence over guide signs when placed along a TTC route.

8-6.02.02 Guide Signs

The placement and revision of guide signs is important to providing traffic control through work zones. However, placement of these signs should not interfere with construction information signs or necessary regulatory and warning signs.

A. Construction Information Signs

One commonly used construction information sign is the advance notice guide sign. It is used to provide notice of when and where construction or maintenance will occur. There are two types of advance notice guide signs:

1. Signs that inform motorists of a date or a day when construction and/or closures will begin, and
2. Signs that inform motorists of exact location(s) of construction that is underway.

It is important that in-place guide signs be covered or modified to reflect actual conditions. For example if a ramp is closed, all advance guide signs should be properly modified to inform the motorist of the closure. For short term closures this signing is impractical and warning signs may be used to provide this information.

B. Temporary Business Signing in Work Zones

MnDOT construction projects have frequently caused disruption of traffic patterns in business areas and have sometimes caused difficulty and confusion for motorists attempting to reach specific businesses or groups of businesses. This has resulted in the development of temporary business signs for use in construction areas.

Temporary business signs are used to improve driver guidance, create safer operations, and reduce the impact on businesses created by construction activities and detours. When temporary business signs are deemed necessary, they should be included as part of the Traffic Control Plan (TCP) for the construction project.

Properly placed and designed temporary business signing may alleviate business impacts due to the construction project. Inadequately designed signs with illegible messages may become traffic safety hazards and reflect poorly on the project and the businesses. The guidelines described in the following sections for temporary business signing have been developed with a balance between the standards utilized for permanent signing and the need for temporary supplemental signing during construction to guide motorists to businesses that depend upon the normal traffic flow for customers. Allowing a sign for a specific business during a construction project will not be justification for permanent business signing as governed by other parts of the TEM and MN MUTCD.

Location and Installation of Temporary Business Signs

Temporary business signs, classified as supplemental guide signs, shall not interfere with permanent or construction signing. As commonly practiced, when space becomes restricted, the hierarchy for sign installation is regulatory, warning (permanent and construction), and guide signs, in that order, over supplemental guide signs. All temporary business signs should conform to the [MN MUTCD](#), this Manual, and Minnesota's standards for guide sign design to the extent practical and possible. All temporary business signing shall be removed when the impact to traffic ends, or at such time that permanent changes in the affected area are completed.

A system of temporary business signs should be designed such that multiple sign structures are not required in a single location. However, in situations where a second structure is required, the structures should be placed a minimum distance apart along the right-hand side of the roadway as shown in Table 8-1 below. Temporary business sign structures shall not be combined with other signs on one structure and shall be installed in accordance with current practices for temporary construction signs, including all crashworthy standards.

Posted Speed Limit	Minimum Distance Between Business Signs
< 45 mph	100 feet
45 - 55 mph	150 feet
> 55 mph	300 feet

Table 8-1 Temporary Business Sign Structure Spacing

Business signing should not be installed on freeways except as needed to replace existing signage for major traffic generators or regional shopping centers. Refer to [Chapter 6](#) of this Manual, Section 6-7.09 Supplemental Guide Signing Programs.

All temporary business signing that is proposed by MnDOT to guide traffic will be funded by MnDOT and installed by MnDOT or contract forces. Any additional temporary business signing proposed by the businesses and allowed by MnDOT shall be funded by the businesses. All temporary business signs shall comply with Minnesota Statutes, [Chapter 173, Signs and Billboards Along Highways](#). Any signs installed off state right-of-way shall conform to any local ordinances for advertising and/or business signing.

Temporary Business Signing Plan Guidelines

The district should study all local businesses to estimate the extent of the work zone impact on each business and determine which should be classified as “traffic sensitive” or “regionally significant”. Traffic sensitive businesses may lose a large portion of their patrons to similar businesses with easier access. These businesses typically include fuel/convenience stores, restaurants/cafes/fast food, and lodging/camping. Other typical businesses may be those previously identified through Supplemental Guide Signing Programs. Regionally significant businesses are visited by non-local traffic, and the traveling public would be impacted if the access was reduced. These areas may include retail centers, transportation hubs, recreational centers, or geographical areas. A district may develop other uniform guidelines to determine whether a business is “traffic sensitive” and what types of “regionally significant” businesses may qualify in their regional part of the state.

Temporary business signing is an option for alleviating the project’s work zone impact on traffic sensitive or regionally significant business areas. MnDOT districts and partnering jurisdictions or organizations should work with businesses to suggest marketing plans to encourage continued customer patronage during construction. The marketing plans for individual businesses and/or business areas may include special advertisements via local media to inform customers of the appropriate directional information.

Types of Temporary Business Signs

Temporary business signing should be designed such that motorists are guided to the businesses through a series of easy decisions. Routes to the area businesses should be trail-blazed in successive steps such that the signing may remain understandable and legible. The first type of business signing to be encountered should be generic in regards to the business names and provide the most practical signage that easily directs traffic to any type of business or group of businesses. These signs are Business Access signs or Business Service signs. To provide the motorist adequate information to make route decisions, Business Identification signs to specific business (or business area) locations or entrances may be required.

BUSINESS SIGN LETTER AND STRUCTURE SIZES:

Although many signage options are available for temporary business sign structures, there are maximum allowable sign structure sizes and minimum letter size requirements. The maximum height of the temporary business sign structure is determined by the U-Post Wind-load charts for typical Type ‘D’ sign sizes without using breakaway I-Beam construction. Refer to the following tables for typical sign structure sizes based upon recommended letter sizes and maximum number of messages allowed per structure.

The lettering sizes are chosen to provide legibility based upon traffic speed and typical distances to the signs. Although standard sign series fonts shall be used, the standard word and line spacing on the temporary business signs may be reduced to help fit longer business names onto the standard sign blanks. Refer to the following tables for recommended letter sizes. The alternate smaller letter sizes should only be used when a resulting narrower sign structure is required due to lateral space restrictions.

BUSINESS ACCESS SIGNS:

The BUSINESS ACCESS (G20-X6) sign should be provided as the primary trailblazing sign option. This sign is listed in the [MnDOT Standard Signs Manual](#) G-Series, in three standard sizes, making it readily available for short term detour and business access situations.

The G20-X6 sign may be supplemented with a plaque to provide guidance to a specific business center or portion of a business area through an understandable name/designation. A business area may be designated by a larger anchor business, geographic location, recognizable business area name, or a temporary project name or logo associated with local advertising.

Refer to Table 8-2 below for sizes.



Roadway Type	Posted Speed Limit	G20-X6	
		width	height
2 Lane - 2 Way	40 mph or less	36"	24"
	45 mph or greater	48"	36"
Multi-Lane	40 mph or less	48"	36"
	45 mph or greater	66"	48"

Table 8-2 Temporary Business Access Signs

BUSINESS SERVICE SIGNS:

A BUSINESS SERVICE (G20-X8) sign may be installed indicating the types of business services that are available, with a limit of six categories per sign. The major business service types include gas, food, lodging, camping, grocery, and shopping, but when space allows, other generic types may be included such as mall or hardware. If needed for clarification the sign may include a destination. The destination may be a city name, an area designation such as SOUTH SIDE, a street name, or shopping center name.

Refer to Table 8-3 below for typical font and letter heights for various roadway types.



Roadway Type	Posted Speed Limit	Recommended Font	Minimum Font	G20-X8	
				Typical Panel Width (1)	
				1 column	2 column
2 Lane - 2 Way	40 mph or less	5" C	4" C	42"	60"
	45 mph or less	5" C	5" C	42"	60"
Multi-Lane	40 mph or less	6" C	5" C	60"	72"
	45 mph or greater	8" C	6" C	84"	96"

Note (1): Widths may vary. See the examples which show various combinations of messages.

Table 8-3 Temporary Business Services Signs

BUSINESS IDENTIFICATION SIGNS:

Businesses may require temporary business identification signs. These are generally needed when the business' normal signing is not visible from the trailblazing route. These signs may be designed as either individual panels or as a single panel guide sign.

Examples of typical businesses that may be approved for identification are Major Traffic Generators such as shopping centers or recreational centers. Businesses, attractions, and other destinations currently signed through several of the "Requestor Pay" Supplemental Guide Signing Programs may be approved for signing.

Temporary Business Panel Signs:

Although the alternative font sizes and panel sizes are shown to provide flexibility when selecting a sign size, the following guidelines should be followed:

- Sign Assembly designs may inter-mix single line signs with double line signs while not exceeding the maximum assembly height.
- Business names should be listed in order of distance from sign. When arrows are used for each business, then the order should be through-left-right.
- Font sizes and series shall not be mixed on a sign assembly.

Refer to Table 8-4 on the following page for typical font and letter heights for various roadway types.



Table 8-4 Temporary Business Panel Signs

BUSINESS GUIDE SIGN EXAMPLES

4-3" D is a MIN. alternate size for low speed 2L-2W

18" logo OPTIONAL

4-3" D

48"

6-4.5" D

6-4.5" D is recommended letter sizes for ALL speed 2L-2W and multi-lane roads

18" logo OPTIONAL

Mayhill Road

Last Oasis Mall

Franklin Eatery

72"

6-4.5" D

72"

6-4.5" D

72"

48" x 24" logo OPTIONAL

Major Generators signs should have a larger letter size than typically recommended for the road and may be considered for recognizable logos.

48" x 24" logo OPTIONAL

Major Generators signs should have a larger letter size than typically recommended for the road and may be considered for recognizable logos.

8-6" D

96"

Temporary Business Guide Signs:

A temporary business sign structure made up of individual panels may be replaced by a single panel guide sign. Although the maximum sign size remains the same as the combined panel signs, since the borders between business names may be removed, additional lines of text or a logo may be placed on the sign.

Design options may be utilized to optimize the legibility and clarity of the message. The options include but are not limited to:

- Use the business center name or refer to the anchor businesses' names.
- Use easily recognizable business center logos.
- Use a special project logo to identify business areas.
- Use horizontal lines or borders to separate names.
- Repositioning the arrow may provide for longer business names.

Refer to Table 8-5 for typical font and letter heights for various roadway types.

	2 Lane – 2 Way		Multi-lane	Major Traffic Generator (3)	
	ALL Speeds	≤ 40 mph	ALL Speeds	ALL Speeds	≤ 40 mph
Minimum Font Size and Series (5)	6-4.5" D	4 – 3" D	6-4.5" D	8 – 6" D	6-4.5" D
Approx. No. of Characters per Line (1)	10	11	10	11	10
No. of Characters per Line w/o Arrow (2)	14	14	14	14	14
Maximum No. Lines of Text Allowed	6	6	5	4	4
Recommended Sign Panel Width (4)	72"	48"	72"	96"	72"
NOTE 1	Approximation made using the recommended panel width with an average character width, and a standard directional arrow (left or right) included on the text line.				
NOTE 2	Approximation made using the recommended panel width with an average character width, and the directional arrow is placed at the bottom of the sign replacing one of the lines of text.				
NOTE 3	Businesses qualifying as Major Traffic Generators and/or Regional Shopping Centers should be trail blazed with larger font sizes (reference TEM Chapter 6).				
NOTE 4	Three widths (48, 72, & 96") are standardized for typical post spacing. Larger signs may be designed if required.				
NOTE 5	Refer to the Standard Signs Manual for proper arrow sizes depending upon orientation and placement.				

Table 8-5 Temporary Business Guide Signs

8-6.02.03 Sign Mounting in TTC Zones

Refer to [MN MUTCD](#) Part 6F for standards on placement and mounting post-mounted and portable mounted signs. Whenever possible, all temporary signs should be post mounted using the currently accepted crashworthy supports as detailed in [Layout 20 of the TTC Plan Sheet templates](#).

Temporary signs that will remain in place for 30 days or less may be mounted on portable crashworthy support structures as defined in [MN MUTCD](#) Part 6F. See [Minnesota Design Temporary Sign Supports passing NCHRP 350](#) for non-proprietary NCHRP Report 350 tested and approved temporary sign support structures.

Any portable signs placed on a sidewalk must:

- Allow a 48 inch clear walkway adjacent to the portable sign.

- Not be a tripping hazard. Any portable sign supports that extend into the walkway shall be no greater than ½ inch in height; if the support is greater than ¼ inch, then the support must be tapered between the ¼ inch and ½ inch dimensions. Alternatively, a detectable edge may be placed around the sign supports.
- Allow no portion of the sign to extend any greater than 4 inches into the clear walkway between the heights of 27 inches and 80 inches.
 - If there are sidewalk intrusion issues, consider post-mounting the temporary sign or use the [NCHRP 350 Compliant 5 Feet Portable Sign Stand for 48" x 48" Diamond portable sign](#).

Unless designed and crash tested with other ballasting systems, the ballast system for use on portable support mounted signs is sandbags. See [Section 8-6.05 Ballast](#) for more information.

8-6.02.04 Sign Overlays and Coverings

When it is necessary to cover an in-place sign, or place an overlay on an existing or work zone sign, care must be taken to preserve the sheeting on the existing sign.

Partial Sign Overlay on TTC Sign

Separate demountable plates were introduced to allow greater flexibility in some cases of rigid work zone signing. Demountable legend plates should meet all of the following standards:

- Legend plates shall have proper legend.
- The legends shall be of proper letter size and series.
- The plates shall be properly fastened to the sign face and shall have plastic spacers behind them to provide a minimum clearance of 1/8 inch from the existing legend.
- The plates shall be made from the same type of retroreflective material as the sign face.
- The sign sheeting shall be oriented the same as the sign face material.

The following signs are allowed to utilize demountable legend plates as detailed in the MnDOT [Standard Signs Manual](#).

- Lane Reduction Transition (Right or Left) Sign (W4-2)
- MERGE w/Arrow Sign (W20-X3)
- RIGHT/LEFT TWO LANES CLOSED Sign (W20-X13)
- Vehicle Mounted Signs for Mobile Operations Sign (W21-X4M) (~~W21-X4~~)
- RIGHT/LEFT LANE CLOSED Sign (W20-X5) (~~W21-X5~~)

Signing for moving operations also allows the use of demountable legend plates.

All work zone signs not listed above shall have the legend directly applied to the sign face as detailed in MnDOT specifications 3352.2.A.5.c Screen Processed Painted Legend and 3352.2.A.5.d Pigmented Plastic Film Legend. See MnDOT [Standard Specifications for Construction](#) for details.

The sign face and partial overlay shall maintain a uniform color and brilliance when viewed during both daytime and nighttime hours.

Temporary Sign Covering

When it is necessary to cover an in-place sign, care must be taken to preserve the in-place sign since some coverings may cause permanent damage to the sign face sheeting. Burlap, ropes, wire fasteners, or strapping should not be used as they may abrade the sign sheeting surface. Tape should not be applied to the sign sheeting surface because sunlight will cause it to bond permanently. Pre-mask or application tape must be removed prior to exposure to sunlight. Paper or plastic covers should not be used as heat and moisture entrapment can cause permanent damage to the reflective sheeting on the sign face.

Sign covers shall be rigid panel (such as sheet aluminum or plywood) and provide a minimum spacing of 1/8 inch (1 inch maximum) between the overlay panel and the sign. The spacers shall be a material that will not harm the sign sheeting face (such as plastic or rubber). For more detail on rigid sign covers for smaller signs, see [TTC Template Typical Temporary Sign Framing and Installation Details](#).

Sign Panel Overlays

When it is necessary to modify the legend of an in-place sign, care must be taken to preserve the sign. A legend revision, such as EXIT CLOSED, on an overhead sign should be sheet aluminum and installed with minimum 1/8 inch spacers. The spacers shall be a material that will not harm the sign sheeting face (such as plastic or rubber).

8-6.03 Pavement Markings in Temporary Traffic Control Zones (Updated May 2019)

Through many work zones, traffic is moved from one lane to another. Traffic must be given clear direction as to which pathway to follow. Pavement markings such as center lines and edge lines provide direction for the motorist. Pavement marking modifications are required in long term TTC Zones (which are in place for 3 days or more) that contain transitions or alignment change areas - see Layout 6J-1 in the [MN MUTCD](#). All temporary pavement markings should have wet retroreflective/recoverable (WR) properties. See [Section 8-6.03.03 Temporary Pavement Markings Guidelines](#) for more details.

This section applies to all MnDOT construction and maintenance activities with TTC zones of at least 350 feet in length on tangent sections and of 50 feet in length or longer on curves of 6 degrees or greater. As stated in [Section 8-6.01.02 Approved Product List/Qualified Product List \(APL/QPL\)](#), pavement markings have a QPL (see [MnDOT Approved/Qualified Products List](#)) upon which only these pavement marking materials are allowed to be used on the State Highway system. This includes interim, temporary, and final pavement marking installations.

Following are the minimum requirements for pavement markings prior to opening a road to traffic (for exceptions, see [Section 8-6.03.02 Interim Pavement Marking Guidelines](#)):

- Multi-lane Undivided Roadways - all double yellow centerlines, lane lines, and broken line stripe pavement markings.
- Multi-lane Divided Roadways - all lane lines.
- Three and Five Lane Roadways with Two-Way Left Turn Lanes - all solid yellow lines with yellow, broken line stripe pavement markings and lane lines (for five lane sections).
- Two Lane Undivided Roadways - all centerlines.

8-6.03.01 Pavement Marking Definitions

See [Section 8-2.00 Glossary](#) for definitions of pavement markings used in TTC zones.

8-6.03.02 Interim Pavement Marking Guidelines

Interim pavement markings are any pavement markings that are not the final marking or are temporarily placed for staging purposes. Interim broken line stripe pavement markings shall use the same cycle length as final pavement markings (50 feet) and shall be a minimum of 2 feet in length. If the cycle length is not 50 feet and the section to be striped is greater than 350 feet in length but less than 1¼ miles in length, the interim marking shall match the cycle length at either end of the project. See [Interim Pavement Marking Template Sheets](#) and [MN MUTCD](#) Part 6, Figure 6F-8b.

Material specifications and tolerances for interim pavement markings will be the same as for final pavement markings, with the following exception. When final pavement markings are to be epoxy, and paint is used for interim solid lines, a 10-mil thick layer application of paint shall be used. In this case, beads should be applied at a rate of 6 lbs/gal. Removal of this thin layer of paint is not required prior to placing the epoxy.

Temporary raised pavement markers (TRPMs), when used as interim pavement markings, shall be installed in accordance with [Section 8-6.03.04 Temporary Raised Pavement Markers \(TRPMs\)](#) of this chapter.

In areas where paint or tape will not adhere to the surface (i.e. chip or sand seal operations), temporary raised pavement markers may be used to simulate a centerline as detailed in [Section 8-6.03.04 Temporary Raised Pavement Markers \(TRPMs\)](#) of this chapter.

The minimum required interim pavement markings shall be installed prior to opening the roadway to traffic and should not be left in place for more than 14 calendar days unless they meet the requirements of temporary or final markings. Minimum required interim pavement markings include:

- Multi-lane Undivided Roadways - all double yellow centerlines, interim lane lines, and interim broken line stripe pavement markings.
- Multi-lane Divided Roadways - all interim lane lines.
- Three and Five Lane Roadways with Two-Way Left Turn Lanes - all solid yellow lines with yellow interim broken line stripe pavement markings and interim lane lines (for five lane sections).
- Two Lane Undivided Roadways - all centerlines, turn lanes, bypass lanes, and outlines for any painted islands.

If the Average Daily Traffic (ADT) is less than 1500 and the Project Engineer determines that it is not possible or practical to install interim pavement markings on Two Lane Undivided Roadways before opening the road to traffic, Figure 6F-8a in Part 6 of the [MN MUTCD](#) may be followed, also shown in [Interim Pavement Marking Template Sheets](#). If the ADT is greater than 400, then this layout shall be limited to three days.

8-6.03.03 Temporary Pavement Markings Guidelines

Typically, the markings placed for staging purposes on long term projects are temporary, meaning they will eventually be covered by surfacing materials or removed completely. The material used for temporary pavement markings should be selected based upon whether the marking is placed on the final surface (such as a lane shift crossing the final surface) or not, as well as how long the marking needs to last. Temporary pavement markings are to be installed to the same specifications as final pavement markings. All temporary pavement markings should include WR properties, though they are not required to be recessed. To increase pavement marking conspicuity in work zones, temporary pavement markings in tapers and transitions should be installed at a minimum of six inches in width. Removable preformed pavement marking tape, paint, or epoxy are typically used.

Temporary or final markings and all other pavement markings including edge lines, channelizing lines, lane reduction transitions, gore markings, and other longitudinal markings, and the various non-longitudinal markings (stop lines, railroad crossings, crosswalks, words, symbols, etc) should be installed within 14 calendar days.

The time limitations for installing temporary or final markings begin when construction operations first remove the in-place markings from the roadway. The time limitations restart any time temporary or final markings are restored.

Edge lines through transition and alignment change areas shall be marked with temporary pavement markings with WR properties. Transition and alignment change areas include: lane closure tapers, lane shifts, sharp curves, shifts onto temporary roadways or detours, etc.

The following systems are considered to be temporary WR pavement markings:

- Temporary WR pavement marking preformed tape lines
- Pavement marking paint or multi-component lines with WR elements
- Temporary pavement marking tape lines supplemented with temporary raised pavement markings (TRPMs)
- Pavement marking paint or epoxy lines supplemented with TRP

As with other pavement markings, there is an [APL for TRPMs](#) and a [QPL for WR Pavement Markings](#).

There is a high risk of damage or removal of WR products by snow plowing operations. Therefore, temporary WR pavement markings should be refreshed in the next construction season (unless they were recessed).

8-6.03.04 Temporary Raised Pavement Markers (TRPMs)

TRPMs are normally used with construction zone markings. They are commonly referred to as “temporary markers” or “TRPMs”. TRPMs are glued to the roadway with a bitumen or epoxy adhesive. Most markers of this type consist of a plastic body with a reflective surface.

TRPMs are to be replaced when they become damaged or have been removed by traffic. These markers will be inspected on a routine basis and replaced as necessary. TRPMs shall not be used as an interim pavement marking between October 1 and May 1 because of snowplowing operations.

Another general type of temporary raised marker is the “peel and stick” type. These typically have a paper backing that is removed to expose a butyl/adhesive pad. The marker is then applied to the roadway and firmly pressed in place.

TRPMs may be used to simulate solid lines without the use of any other pavement marking material, or they may be used to supplement other types of pavement markings. See [Interim Pavement Marking Template Sheets](#) and Layout 6J-2 in Part 6 of the [MN MUTCD](#) for guidelines on how to use TRPMs to simulate and supplement pavement markings.

TRPMs are classified into four types as follows:

- TRPM Type 1 - These markers are acceptable for use on all roadways for short or long term projects. They may be used to supplement or simulate solid or broken lines.
- TRPM Type 2 - These markers are acceptable for use on projects with Average Daily Traffic (ADT) of less than 3000. They may be used to supplement or simulate solid or broken lines.
- TRPM Type 3 - These markers are acceptable for use on all roadways for short or long term projects. They may be used to supplement solid or broken lines. These markers are NOT acceptable to simulate solid or broken lines. If these markers do not conform to the color requirements herein they shall not be placed directly on the pavement marking line.
- TRPM Type 4 - These markers are acceptable for use on chip or sand sealing operations. These markers are designed to be placed prior to the sealing operation with a protective cover that is removed after the seal coat is applied.

As with other pavement markings, there is an [APL for TRPMs](#).

8-6.03.05 Pavement Marking Removals

The removal of pavement markings must be done with care, especially within a TTC zone where excessive scarring can mislead drivers. See [TEM](#) Chapter 7, Pavement Markings for more information.

8-6.03.06 Final Pavement Marking Guidelines

Standard final striping plan sheets shall be included in each Project Construction Plan. Refer to [TEM](#) Chapter 7, Pavement Markings for more information.

8-6.04 Channelizing Devices

Overall channelizing device standards and guidelines can be found in the [MN MUTCD](#), Part 6. Refer to this section for the categorization and different types of channelizing devices. More specific standards are found on [Standard Plate 8000j](#), which shall be used in construction projects.

As with other devices, all channelizing devices need to be crashworthy. There are proprietary and non-proprietary crashworthy designs for barricades available. Documentation should be provided from the vendor/contractor to verify crashworthiness. See the [MnDOT Type III Crashworthy Barricade Designs](#) for designs of non-proprietary crashworthy Type III barricades.

8-6.05 Ballast

Ballast is important so that TTC devices have limited movement due to wind caused by weather or vehicles. It is also important that the entire system of the device and ballast is crashworthy.

Sandbags are the most common ballast for TTC devices. When sandbags are used, they should be constructed so they will not readily rot or allow the sand to leach when exposed to the highway environment. Also, the sandbag should be constructed of a material which will allow the bag to break and disperse its contents when struck by an errant vehicle. Sandbags should not be filled to the extent that they become too heavy to be readily moved when a traffic control device is relocated. The number and size of sandbags used as traffic control device ballast should be kept to the minimum needed to provide stability for the device. During freezing conditions, the sand for bags shall be mixed with a deicer to prevent the sand from freezing. Sandbags shall not be suspended from the traffic control device. For proprietary devices, check with the manufacturer for ballasting requirements.

Ballasting requirements are shown on MnDOT's non-proprietary crashworthy [portable sign support structure](#) and [barricade structure](#) designs.

Other ballasting methods, such as the manufacturer provided weighted bases, may be used on TTC devices provided that the system is crashworthy.

8-6.06 Temporary Barriers

There are a variety of barriers available to be used for drop-off, hazard, and worker protection. There is an [APL for temporary barriers](#), which includes moveable concrete, steel, and water-filled barriers. MnDOT also has a [Standard Plate \(8337C\)](#) for portable precast concrete barrier (PPCB). A discussion about the advantages and disadvantages of the various types of temporary barrier can be found in Section [8-5.07.01 Temporary Barriers for Positive Protection](#).

As stated in the [MN MUTCD](#), Part 6, each type of temporary barrier (steel, water-filled, or concrete, etc.) requires a specific basic minimum length to achieve its crashworthy compliance. Refer to the barrier's crash testing results to determine the minimum length needed for predicted crash deflections. Shorter intermittent segments of temporary barrier shall not be used because they nullify the containment and redirective capabilities of the temporary barrier. The PPCB minimum length of installation shall be 200 feet.

[Standard Plate \(8337C\)](#) is available for PPCB. As stated in Section [8-5.10 Drop-offs](#), when temporary barrier is used, anchorage is required if the temporary barrier is close to the drop-off. [MnDOT Standard Plan 5-297.680](#) covers PPCB anchoring and requires anchoring when the portable concrete barrier is within two feet of the drop-off.

8-6.06.01 Attenuation (Crash Cushions) for Temporary Barrier

This section details the general requirements for crash cushions used to protect the end(s) of temporary barrier in highway work zones. The [stationary crash cushion APL](#) contains the cushions that are allowed - installation must follow the manufacturer's instructions.

One way to categorize crash cushions is the redirective ability. This refers to what happens to the vehicle if the attenuator is hit on the side. Non-redirective attenuators will allow the vehicle to go through the attenuator and redirective attenuators will redirect the vehicle toward the roadway. This should be considered when choosing the type of crash cushion to use.

8-6.06.02 Temporary Barrier Delineators

Temporary barrier delineators provide delineation along the barrier to assist the driver. Top mounted barrier delineators will have a minimum of 24 square inches of reflective surface area and are to be placed at 25 foot spacing on top of the barrier when the barrier is within 10 feet of traffic unless otherwise noted in the TTC plan. If the plan requires side mounted barrier delineators (such as when glare screen is used on top of the barrier), they will have a minimum of 12 square inches of reflective surface area and be placed at 12½ foot spacing.

8-6.06.03 Temporary Raised Pavement Markers (TRPMs) on Temporary Barrier

TRPMs at 12½ foot spacing may be placed on the temporary barrier to substitute for an edge line.

8-6.06.04 Glare Screen on Temporary Barrier

Glare screens can be helpful in reducing headlight glare on head-to-head traffic situations that are separated by temporary barrier.

8-6.07 Portable Changeable Message Signs (PCMS)

See the [2012 CMS Manual of Practice](#) for the appropriate use of PCMS as well as approved messages.

8-7.00 TEMPORARY TRAFFIC CONTROL PLANS

8-7.01 General

During the roadway plan development, designers must be aware of the need for a TTC Plan. The TTC Plan will specify TTC devices and include plan sheets that indicate how and where the TTC devices are placed for each stage of the project. These devices include drums, cones, barricades, temporary signing, temporary striping, etc. and are used to direct and assist drivers in safely moving through the construction area.

To develop the TTC Plan, coordination meetings between design, construction, and traffic personnel are recommended throughout the development of the project documents. The number and extent of these meetings will vary according to the complexity, length, and duration of the project. The construction office will be a valuable resource in providing the time frames necessary for construction activities. In addition to this chapter of the TEM and the [MN MUTCD](#), traffic office staff will develop the TTC plan using information in the TMP.

MnDOT Office of Traffic Engineering ([OTE](#)) has developed the [Traffic Control Plan Development Course and Manual](#) that goes into specific detail (particularly in Chapter 5) regarding how to develop a TTC Plan Set, including plan assembly steps, assembly checklists, common plan set issues, etc. TTC Plan Designers are encouraged to follow the process defined within the Manual.

8-7.02 Requirements for Temporary Traffic Control Plans Submitted to MnDOT

The MN MUTCD requires the development of project specific TTC Plans to facilitate travel of road users through a work zone. A TTC Plan may range from a reference to the Minnesota Temporary Traffic Control Field Manual to a detailed set of plans and specifications. Layouts from the Field Manual may be used for projects that last 3 days or less. For long-term projects (or complicated projects that last 3 days or less), Minnesota Statutes, Minnesota Rules, and the MN MUTCD require the development of a TTC Plan signed by a Professional Engineer. These requirements apply to plans submitted to MnDOT by permit applicants or TTC plans submitted to MnDOT pursuant to a MnDOT contract.

The [Requirements for Temporary Traffic Control Plans Submitted to MnDOT](#) and the [Attachment A – Detour for Special Events](#) documents detail the requirements and exceptions. These documents have also been added to the [MnDOT Traffic Engineering Temporary Traffic Control Manuals and Guidelines](#) web page. The [Requirements for TTC Plans Submitted to MnDOT](#) document is considered part of the Traffic Engineering Manual, but has been published as a separate document for easier reference by other manuals, specifications, or applications.

8-8.00 TEMPORARY TRAFFIC CONTROL REVIEWS

8-8.01 General

The TTC in work zones should be reviewed by traffic, construction, maintenance, and others to assure compliance with TTC standards and guidelines, as well as to verify that traffic is flowing safely and without confusion through the work area.

8-8.02 Project Review

For each project, an individual shall be assigned the responsibility for traffic control.

On construction projects, the Contractor should designate a specific person by name and telephone number and provide this information to the Project Engineer. On large projects, the review of traffic control should be assigned to an employee within the agency's organization. Routine inspections of the traffic control installations should be carried out by these individuals.

On maintenance projects, after the installation of the TTC devices, a lead worker should review the TTC deployment for adequacy (i.e. drive through the work area, as needed).

The [Field Manual](#) contains a sample Project Inspection Checklist (Figure 6K-1 40) as a resource for the responsible person.

8-8.03 Temporary Traffic Control Periodic Reviews

One of the duties of the recommended District Work Zone Safety Coordinator (as stated in the [Minnesota Work Zone Safety and Mobility Policy](#)) is to make periodic reviews of maintenance and construction projects to determine the adequacy of the TTC plan and to assist project and maintenance personnel with compliance to the plan. If there is not a Work Zone Safety Coordinator established in the district, a district employee should be delegated this responsibility.

The inspector will be faced with the need to make decisions during the inspection and must exercise judgment in establishing appropriate practices.

8-8.04 Frequency of Reviews

Prior to the daily work beginning, the supervisor and/or inspector should complete a comprehensive TTC inspection including all signs, pavement marking material, and channelizing devices that are being used.

During the work shift, TTC devices should be routinely monitored and misaligned devices should be readjusted on an hourly basis.

When the devices in a short-term stationary TTC zone cannot be monitored and repaired on an hourly basis, then the requirements for an intermediate-term stationary/night time TTC layout shall be utilized.

Less frequent but periodic inspections should be performed by senior staff of the contractor (typically the superintendent) and the agency (the District Work Zone Safety Coordinator, the resident engineer, and/or the District Traffic Engineer or designee).

8-8.05 Record Keeping of Temporary Traffic Control Deployment

Good record keeping procedures suggest that the time and location of the installation and removal of traffic control devices be documented, as well as any incidents of note (e.g. vehicular crashes, intrusions). Although this can be time consuming for a moving maintenance operation, it is important to record significant traffic control actions taken by the field crew. It is desirable that this include:

- 1) Starting and ending time of work,
- 2) Location of work,

- 3) Type, condition, and position of traffic control devices,
- 4) Names of personnel,
- 5) Type of equipment used,
- 6) Any change in temporary or permanent regulatory devices, and
- 7) If it occurs, crash and intrusion data.

Major projects will require more detailed record keeping as they may involve higher funding amounts, outside (Federal or State Aid) funding sources, and longer distances and times of physical exposure to the workers, motorists, or pedestrians.

8-9.00 REFERENCES

1. [MnDOT Temporary Traffic Control Work Zone Safety Resources](#)
2. MnDOT, Minnesota Manual on Uniform Traffic Control Devices ([MN MUTCD](#)), current edition.
3. [Minnesota Statutes](#).
4. MnDOT, Speed Limits in Work Zones Guidelines (see [Speed Limits in Minnesota](#) website for current document).
5. MnDOT, [Technical Memorandum 12-03-T-02, Minnesota Work Zone Safety and Mobility \(WZSM\) Policy](#).
6. MnDOT, [Right of Way Manual](#), current edition.
7. MnDOT, [Cost Participation and Maintenance Responsibilities with Local Units of Government Manual](#), current edition.
8. MnDOT, [Technical Memorandum No. 13-19-MAT-01, Detour Restoration Road Life Analysis using the Equivalent Overlay Method](#).
9. MnDOT, [Technical Memorandum No. 10-09-TS-03, Revised Detour Restoration Road Life Formula for the Gas Tax Method](#).
10. MnDOT, [Maintenance Manual](#), current edition.
11. Transportation Research Board, [National Cooperative Highway Research Program \(NCHRP\) Report 350](#), "Recommended Procedures for the Safety Performance Evaluation of Highway Features".
12. American Association of State Highway and Transportation Officials, [Manual for Assessing Safety Hardware \(MASH\)](#).
13. Transportation Research Board, [National Cooperative Highway Research Program \(NCHRP\) Report 498 Illumination Guidelines for Nighttime Highway Work](#).
14. MnDOT, [Standard Plans](#).
15. MnDOT, Minnesota Intelligent Work Zone (IWZ) Toolbox (see [Work Zone - Manuals and Guidelines](#) website).
16. MnDOT, [2012 CMS Manual of Practice](#).
17. United States Access Board, [November 2005 version of the Public Right-Of-Way Accessibility Guidelines - PROWAG](#).
18. MnDOT, [Standard Plates](#).
19. MnDOT Traffic Control Plan Development Course Manual (see TTC Plan Development, [Work Zone - Manuals and Guidelines](#) website).