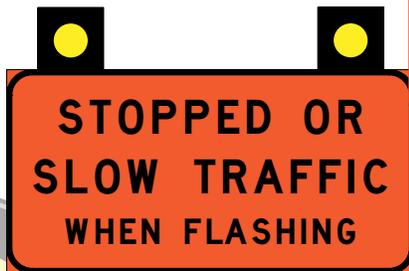


# Minnesota IWZ Toolbox

Guideline for  
Intelligent Work Zone  
System Selection



Written, compiled and illustrated by the  
Minnesota Department of Transportation  
Office of Traffic Engineering



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### **Traffic Responsive IWZ Systems**

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### **Vehicle Responsive IWZ Systems**

Excessive Speed Warning .....	VR-1
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### **Environmental Responsive IWZ System**

Hazardous Roadway Warning.....	ER-1
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### **Appendix A**

Decision Tree to Identify Potential ITS/TWZ Scoping Needs .....	A-1
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#### **NOTE:**

The IWZ Toolbox layouts indicate approximate locations for the detection and communication elements of each system. The system may be modified, combined, enhanced or simplified as necessary for a particular project. Real time data collected may allow modifications to the traffic control to better facilitate traffic flow. Post processing of the data may be used to improve future projects.

## Introduction

The Intelligent Work Zone (IWZ) Toolbox has been prepared 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 this toolbox are intended as brainstorming material and should lead to practical solutions to a project's unique problems. The examples are purposely left void of many dimensions, except where particular distances are highly recommended. Engineering judgment is required to customize the system to a project.

IWZ Systems may be sorted into three category types based upon detectable stimuli: **1) Traffic, 2) Vehicle, and 3) Environmental.** The 3 categories are shown below with their typically associated systems:

**1) Traffic Responsive Systems** collect and respond to average traffic characteristics such as speed and volume of a group of vehicles. The systems react to trends of increasing/decreasing values. The combination of these basic systems form the basis for Route Management Systems (or Traveler Information Systems) by analyzing and reporting information in various ways. These applications may include:

- Travel Time Information (Trip Time or Estimated Delay)
- Speed Advisory Information
- Congestion Advisory Information
- End of Queue Warning
- Active Zipper Merge
- Traffic Responsive Temporary Signals
- Temporary Ramp Metering

**2) Vehicle Responsive Systems** collect and respond to individual vehicle characteristics such as speed, dimensions, and location. When adverse conditions are detected by these systems, motorists need immediate warnings in order to respond. These applications may include:

- Excessive Speed Warning (including Dynamic Speed Display Signs)
- Over Dimension Warning
- Work Zone Intrusion Warning
- Construction Vehicle Warning
- Emergency Pulloff Detection

**3) Environment Responsive Systems** collect and respond to changing non-traffic conditions including weather or roadway conditions, or working characteristics such as the presence of workers. These applications include:

- Hazardous Condition Warnings (flooding, ice, fog, smoke, dust, etc.)
- Electronic Workers Present Speed Limit

The real-time data collected for any of these systems may be combined, averaged, analyzed for trends, and utilized for several informational uses. For example, data collected for 'Stopped Traffic Warnings' may be used to control an 'Active Zipper Merge' system or to calculate change in "Travel Time" through a corridor.

## Typical System Components

Each IWZ System in the Toolbox is a collection of standard system components which have been combined to produce a useful real-time system. The individual component functions include the collection of data, verifying the accuracy of the data, transmitting the data, storing and managing the data, analyzing the data, and/or providing the data to the motorist.

### Detection Components

Traffic detection systems placed alongside roads rely on real-time traffic data, which reflects current conditions of the traffic network, to improve safety and operation on roads and in work zones. Various types of detection components are discussed in detail in the **Minnesota Department of Transportation (MnDOT) ITS Design Manual**. Other detection systems will detect environmental conditions or the presence of workers.

### System Monitoring Components

Typical redundancies should be built into most systems (based upon risk assessment for the system failure) and the various types of quality control testing or system monitoring may be utilized. System Communication Components are the typical forms of transmitting data, some of these may include:

- Cell Phones
- Internet - Wireless Access Points
- Public media announcements,
- Radio
- Hard wired
- Optical, etc.

### System Analysis Components

Analysis algorithms are designed or modified for each application of an IWZ System to fit the conditions of the project. Algorithms can be designed with apparent limitations and strengths, and field testing is necessary to ensure the quality of the data analysis.

### Data Management Components

The storage of data and analysis of the data for various trends, events, etc. may utilize many different database systems.

### Dynamic Informational Components

Dynamic components provide information to the motorists and may include:

- 511 Systems (internet and phone/cell phone),
- Changeable message signs (CMS) in dynamic mode,
- Static signs with dynamic features,
- Remotely activated traffic control devices,
- Audible or visual alarms,
- Dedicated websites,
- CB Radio, etc.

## Supplementing Existing System Components

MnDOT, through the Regional Transportation Management Center (RTMC) and Southern Regional Communications Center (SRCC) has the capability to provide a variety of IWZ systems for MnDOT construction and maintenance projects. However, MnDOT's detection devices, communications networks, or traveler information systems may not be adequate for a proposed IWZ system. Discrepancies may be due to construction interrupting permanent installations, or that the existing system components do not extend to the project area.

IWZ System components provided by a contractor would supplement the services of the RTMC or TOCCs, when various devices/services are not currently available and may include any of the component types listed above.

## **Toolbox Definitions**

### **Advisory Speed**

A recommended speed for vehicles based on the current roadway conditions or operating characteristics. Advisory Speeds are not enforceable.

### **Benefits**

Anticipated effects of mobility and safety when an IWZ System is properly designed and deployed. Mobility and safety measures may be within the work zone or surrounding network, and may include the public, workers, or the constructibility of the project.

### **Blank Out Sign**

A traffic control device that is capable of displaying one or more alternative messages or a blank mode when no message is displayed.

### **Changeable Message Sign (CMS)**

A sign that is capable of displaying more than one message changeable manually, by remote control, or by automatic control. The device is considered “portable” when trailer mounted and is abbreviated as PCMS. A CMS insert is a changeable message sign element placed in a static sign.

### **Devices (Components)**

The individual parts or subsystems that makeup a working IWZ System. Examples include: cameras, detectors, signs, data monitoring or recording equipment, communication systems, Temporary Traffic Control (TTC) devices, and remotely activated alarms.

### **Intelligent Work Zone (IWZ) System**

An automated system of devices that provides motorists and/or workers real-time information for improved safety and mobility through a work zone. The devices are integrated to monitor traffic operating characteristics or roadway conditions and to react with a predetermined response.

### **Options**

Various options may be available for portions of an IWZ System. Options should be considered that achieve satisfactory results with lower levels of ‘system complication’ and cost.

### **Planning Guidance**

Conditions under which an IWZ system may be considered for deployment as part of a project’s Temporary Traffic Control plan.

### **Regulatory Speed Limit**

The speed applicable to a section of highway as established by law.

### **Static Sign**

A traffic control device with a message printed on standard signs either regulatory, warning, or guide signs.

### **Travel Delay**

The estimated amount of additional travel time necessary to traverse the work zone or detour around it.

### **Travel Time**

The estimated amount of drive time from the motorist’s current location to an identified location.

Symbols Used in IWZ Toolbox Layouts		
Symbol	Device	Definition
		<b>Sign</b> Roadside location symbol shown on left with example message shown on right.
		<b>Changeable Message Sign (CMS)</b> <b>Portable Changeable Message Sign (PCMS)</b> Roadside location symbol shown on left with an example of two alternating messages shown on right.
		<b>Dynamic Flashing Warning Sign</b> Roadside location symbol shown on left with example message shown on right.
		<b>Non-Intrusive Detection Device</b> The symbol denotes any type of detection device. The actual location and number of devices will vary from the toolbox layout.
		<b>Static Guide Sign</b> Roadside location symbol shown on left with example message shown on right.
		<b>Static Guide Sign with CMS Insert</b> Roadside location symbol shown on left with example message shown on right.
		<b>Temporary Traffic Control (TTC) Device</b> The symbols denote standard TTC devices as defined by the MN MUTCD and the Field Manual of TTC Layouts. To highlight the IWZ Systems, only a minimal amount of TTC devices have been shown in the toolbox layouts. Key devices shown may include standard warning signs, Type III barricades, channelizing devices, and flashing arrow panels.

### General IWZ Toolbox Notes

- Advance warning signs and other standard TTC devices have not been shown on the layouts in the toolbox. Refer to the MN MUTCD and the TTC Long Term Typical Applications for typical layout examples.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Toolbox layouts are NOT drawn to scale.

<b>Tool Box Acronyms</b>	
<b>ADT</b>	Average Annual Daily Traffic
<b>CMS</b>	Changeable Message Sign
<b>DSD</b>	Dynamic Speed Display Sign
<b>EQWS</b>	End of Queue Warning System
<b>ITS</b>	Intelligent Transportation Systems
<b>IWZ</b>	Intelligent Work Zone
<b>MnDOT</b>	Minnesota Department of Transportation
<b>MN MUTCD</b>	Minnesota Manual on Uniform Traffic Control Devices
<b>PCMS</b>	Portable Changeable Message Sign
<b>RTMC</b>	Regional Traffic Management Center
<b>SRCC</b>	Southern Regional Communications Center
<b>TTC</b>	Temporary Traffic Control

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## PLANNING GUIDANCE

- The work zone may cause 15 minutes or more of additional travel time.
- The work zone causing the delay is within 10 miles of the first sign location (a distance of more than 10 miles may affect the accuracy of the travel time posted).
- The work zone is along a route to recreational destinations and known truck routes.

## BENEFITS

- The system should inform drivers what the estimated travel time is between their current location and a specific destination beyond them (to maintain accuracy of the travel time posted, the distance should be up to 10 miles maximum).
- The system will give drivers information which should:
  - enable them to decide whether to change routes,
  - provide them with the opportunity to notify others of their estimated arrival time,
  - may reduce driver frustration, and
  - lead to less diversion of traffic on to alternate routes when not wanted.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For Traveler Time Information System, see cost estimates for **Mobility and Traveler Information Systems** in the resource document found at <http://www.dot.state.mn.us/its/scoping.html> for the most recent estimates for ITS/TWZ Scoping.

## OPTIONS

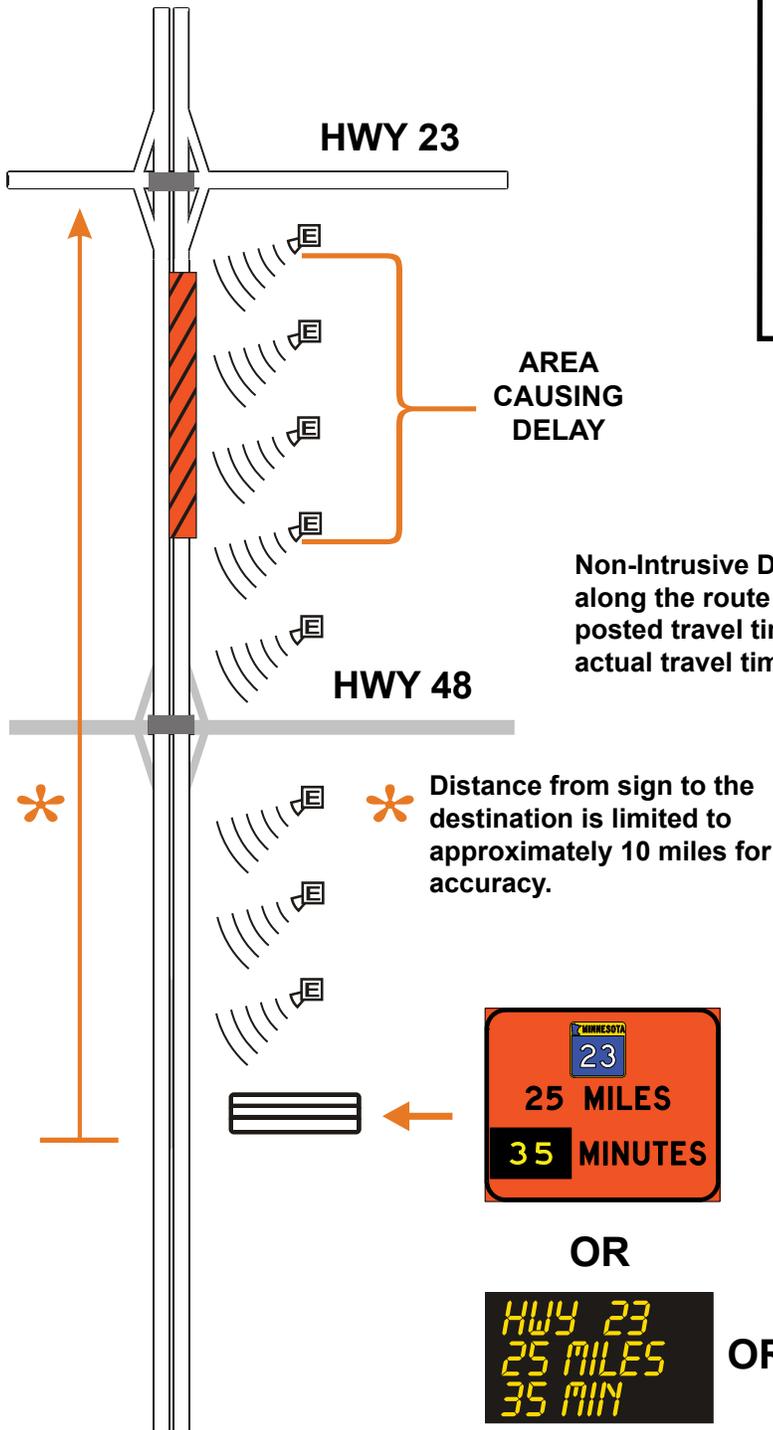
- The PCMS may be replaced with lower cost static signs equipped with a CMS insert. The characters would display the real-time travel time in the work zone downstream.
- Consideration should be given to posting an alternate route and travel time for additional driver information.
- The CMS may be supplemented with other informational devices.



## NOTES

- Refer to the layout on the following page for an example of the Travel Time Information System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

Non-Intrusive Detection should be spaced along the route as needed so that the posted travel time is within 10% of the actual travel time.

Distance from sign to the destination is limited to approximately 10 miles for accuracy.

Consideration should be given to posting an alternate route and travel time for additional driver information such as the one below.

OR

OR

## PLANNING GUIDANCE

- The work zone may cause 15 minutes or more of additional travel time.
- The work zone causing the delay is located more than 10 miles beyond the CMS location (preferably 25 to 50 miles or more, such that multiple alternate routes are available).
- The work zone is along a route to recreational destinations and known truck routes.
- If there is a significant gap in detection between sign and/or work zone, or there isn't a good travel time destination, then consult with RTMC to determine appropriate travel delay information.

## BENEFITS

- The system will let drivers know the amount of anticipated delay caused by an upcoming work zone.
- The system will give drivers information which will allow them to decide whether to change routes, provide them opportunity to notify others of their estimated arrival time, and generally provide drivers sufficient information to calm tempers when they arrive at the cause of the delay.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Traveler Delay Information System, see estimates for Mobility and Traveler Information Systems in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## OPTIONS

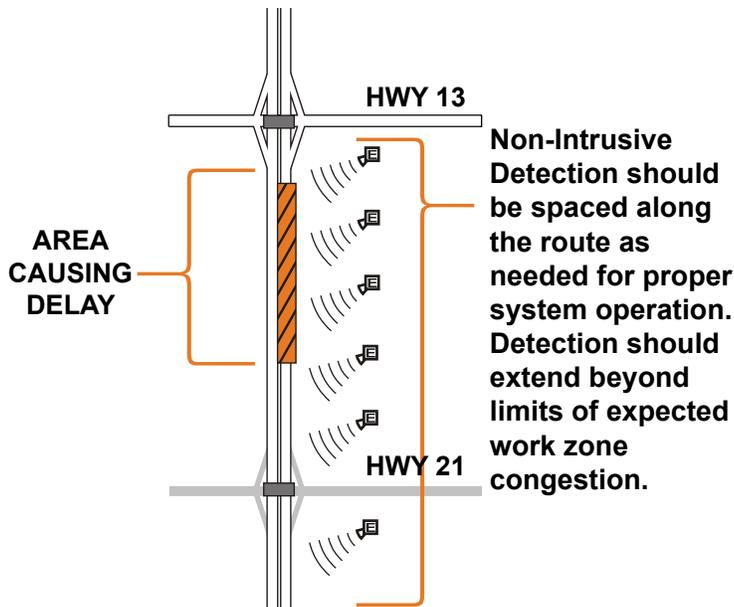
- The PCMS may be replaced with lower cost static signs equipped with a CMS insert. The characters would display the real-time travel time in the work zone downstream.
- Consideration should be given to posting an alternate route and travel time for additional driver information.
- The system may be converted to a Travel Time system within 10 miles of the destination location.
- The CMS may be supplemented with other informational devices.



## NOTES

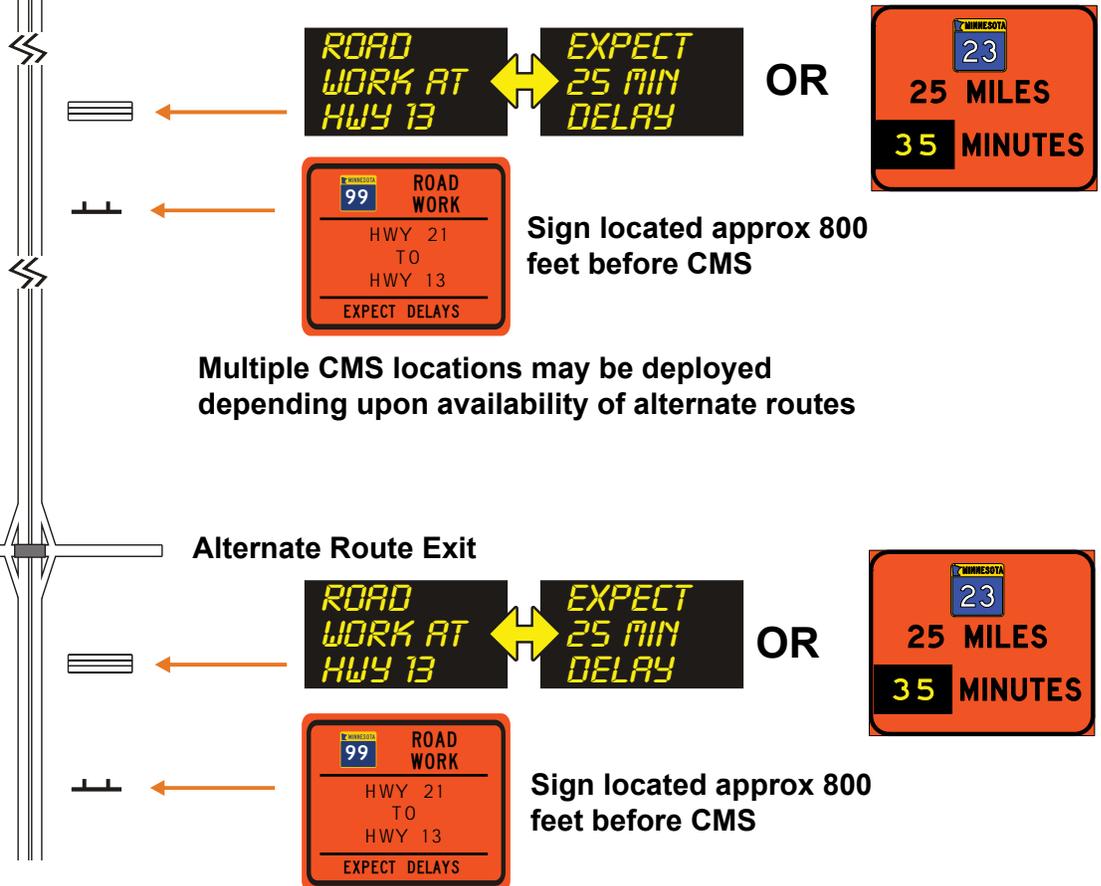
- Refer to the layout on the following page for an example of the Travel Delay Information System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



### PLANNING GUIDANCE

- The work zone queue is estimated to slow traffic at least 20 mph below the posted speed limit.
- The schedule of the construction activities being performed AND the design of the work zone are such that the vehicles are not required to be slowed to the same speed 24 hours per day.

### BENEFITS

- The system should advise drivers by providing notification 1/2 - 1 mile ahead of slower moving traffic and provide an appropriate vehicle speed to allow them to travel through the work zone with minimal braking.
- The system may smooth the transition between faster and slower moving traffic.
- The system may increase capacity of the roadway through the work zone by maintaining uniform travel speeds that are optimal for the current volume of traffic, and prevent the system from becoming 'unstable' and reaching congested conditions.

### SCOPING

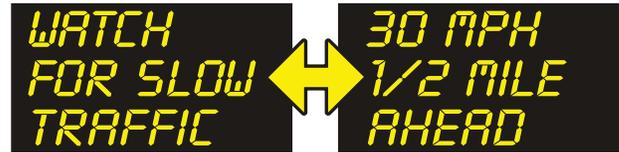
Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

#### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Downstream Speed Notification System, see estimates for **Motorist Advisory Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

### OPTIONS

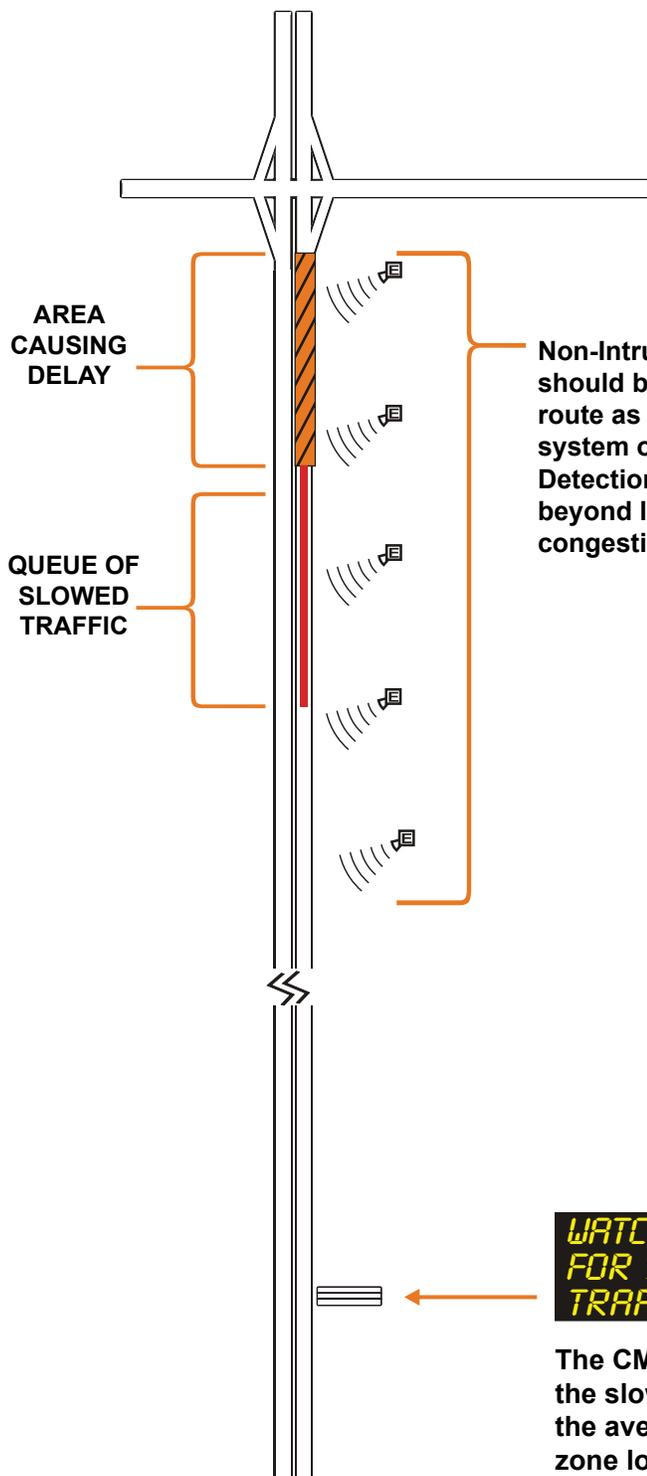


- The PCMS may be replaced with lower cost static signs equipped with a CMS insert. The characters would display the real-time speed in the work zone downstream.

### NOTES

- Refer to the layout on the following page for an example of the Downstream Speed Notification System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



Non-Intrusive Detection should be spaced along the route as needed for proper system operation. Detection should extend beyond limits of work zone congestion.

### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



The CMS should be located 1/2 - 1 mile before the slow traffic queue. The displayed speed is the average speed detected entering the work zone location. Based upon this information, the motorist may adjust speed to anticipate the slower traffic. Longer work zones may have multiple CMS.

### PLANNING GUIDANCE

- Queue lengths are estimated to vary greatly, day-by-day and hour-by-hour such that a suitable location for the TTC advance warning signage can not be predicted. Note: signs placed more than a mile ahead of confirmation are typically forgotten by the motorist.
- Queue lengths may encroach upstream beyond a motorist’s reasonable expectations for stopped traffic and there is probability that the geometrics (terrain) may cause poor visibility of end of traffic queues, causing short reaction times and panic stopping.
- The alternate routes available prior to the queue must have the capacity to accept vehicles that may deviate based upon the information displayed on the CMS.
- The queue is estimated to stop downstream of the first occurring CMS in the system.

### BENEFITS

- The system should alert drivers of an upcoming traffic slow-down or stopped traffic, providing time to determine possible route alternates, and to be prepared to stop safely.
- The system provides current traffic status information to drivers so that drivers can choose to divert to avoid the situation, to reduce driver anxiety, and to reduce crashes involving drivers encountering unexpected stopped traffic.
- Traffic may divert to alternate routes.

### SCOPING

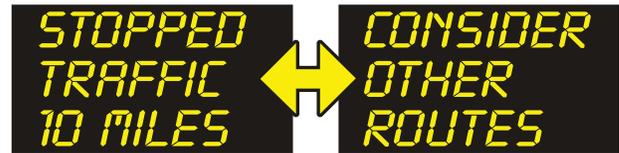
Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/ scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

#### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Congestion Advisory Information System, see estimates for **Motorist Advisory Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

### OPTIONS



- When traffic queue lengths are reasonably predictable, warning motorists of stopped / slowed traffic may be accomplished with the use of typical TTC warning signs placed prior to the anticipated beginning of queue.
- The system may be combined with “Dynamic Merge”, “Stopped Traffic Warning” and/or “Travel/Delay Time” systems.

### NOTES

- Refer to the layout on the following page for an example of the Congestion Advisory Information System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

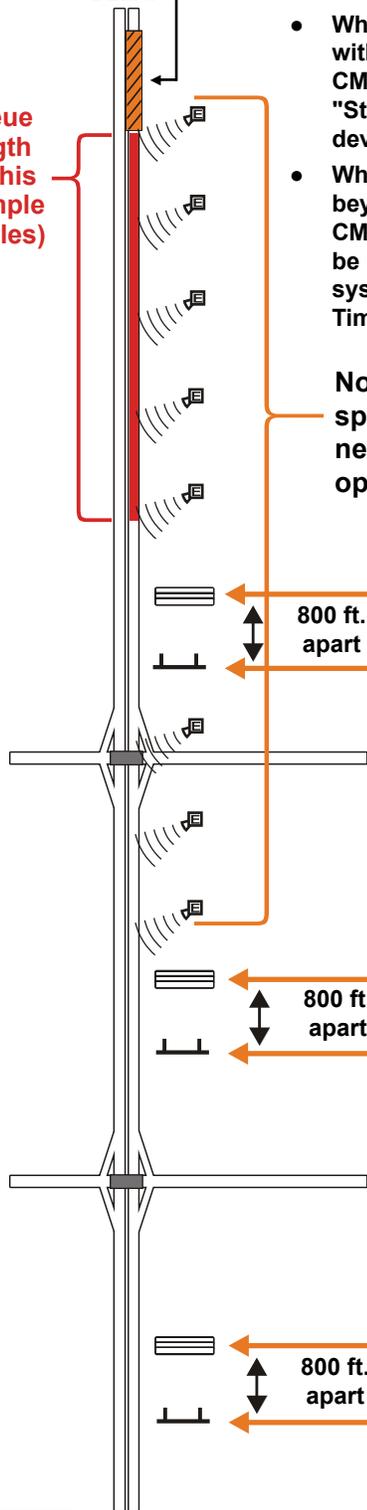
WORK ZONE CAUSING DELAY

Queue length for this example (4 miles)

**OPERATIONAL NOTES:**

- When no queue is detected, all the CMS should be blank unless used for another IWZ system.
- When the queue approaches within one mile of any CMS, the CMS should operate as a "Stopped Traffic Advisory" device.
- When the queue extends beyond any CMS location, the CMS should be blank, or it may be utilized for another IWZ system such as Travel/Delay Time Information.

Non-Intrusive Detection should be spaced along the route as needed. for proper system operation.



STOPPED TRAFFIC 1 MILE    BE PREPARED TO STOP

800 ft. apart

ROAD WORK  
35  
5 MIL AHEAD  
EXPECT DELAYS

Example messages:  
When alternate routes exists prior to the queue.

STOPPED TRAFFIC 10 MILES    CONSIDER OTHER ROUTES

800 ft. apart

ROAD WORK  
35  
15 MIL AHEAD  
EXPECT DELAYS

Example messages:  
Travel/Delay Time Information.

STOPPED TRAFFIC 10 MILES    EXPECT 25 MIN DELAY

OR

STOPPED TRAFFIC 20 MILES    CONSIDER OTHER ROUTES

800 ft. apart

ROAD WORK  
35  
25 MIL AHEAD  
EXPECT DELAYS

**NOTES**

- Analysis should be done ahead of time for alternate route viability, signing placement, and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

**PLANNING GUIDANCE**

- Queue lengths are estimated to vary greatly, day-by-day and hour-by-hour such that a suitable location for the TTC advance warning signage can not be predicted. Note: signs placed more than a mile ahead of confirmation are typically forgotten by the motorist.
- Queue lengths may encroach upstream beyond a motorist’s reasonable expectations for stopped traffic and there is probability that the geometrics (terrain) may cause poor visibility of end of traffic queues, causing short reaction times and panic stopping.
- Queues initiated on crossroads are estimated to cause traffic conflicts and/or delays on the mainline road, such as backups beyond the length of ramps, through or around turns in intersections, or other hazardous congestion situations.

**BENEFITS**

- The system should alert drivers of an upcoming traffic slow-down or stopped traffic and that prompt action is required, providing time to determine possible route alternates, and to be prepared to stop safely.
- It is anticipated that the system will reduce rear-end crashes.
- Traffic may divert to alternate routes.

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for End of Queue Warning System (EQWS) see estimates for **Motorist Advisory Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

**OPTIONS**

- When using PCMSs, the system may be combined with other IWZ systems, such as Active Zipper Merge, Congestion Advisory, and/or Travel Time/Delay.

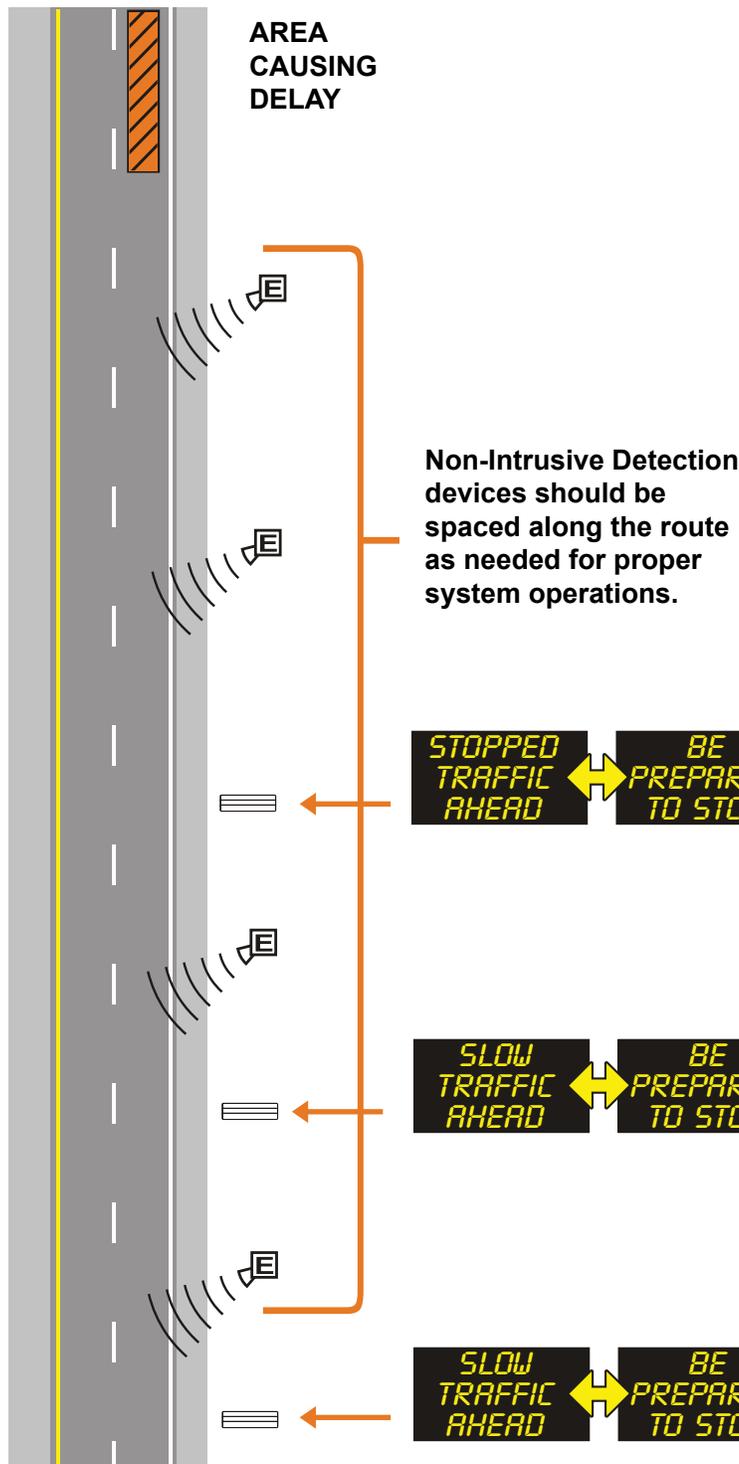
**NOTES**

- Refer to the layout on the following page for an example of the End of Queue Warning System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



Non-Intrusive Detection devices should be spaced along the route as needed for proper system operations.

The signs are spaced incrementally (consider 1/2 to 1 mile spacing) and are activated in response to queued traffic when the queue is detected between signs.

When no queue is detected, all the CMS should be blank or used for another ITS system.

STOPPED TRAFFIC AHEAD ↔ BE PREPARED TO STOP

OR



G20-X17

SLOW TRAFFIC AHEAD ↔ BE PREPARED TO STOP

OR



G20-X17

SLOW TRAFFIC AHEAD ↔ BE PREPARED TO STOP

OR



G20-X17

As the queue extends beyond a CMS location, the sign should switch to only the "Prepare to Stop" message.

**PLANNING GUIDANCE**

- Two or more lanes of traffic must merge when one or more lanes are closed to traffic.
- Although queues may develop at low volumes for many reasons, typically, the volume must exceed 1500 vehicles/hour to sustain a queue that was caused by merging lanes.
- Estimated queue lengths may encroach beyond an upstream intersection or interchange operations.
- The speeds and lane occupancy volumes are anticipated to vary unpredictably causing the motorist to have trouble identifying the best lane usage practice, such as using both lanes versus moving into the continuous thru-lane.

**BENEFITS**

- The system should alert drivers of an upcoming traffic slow-down or stopped traffic, and inform them to use both lanes until the designated merge point.
- It is anticipated that the system will reduce the length of the upstream queue by 40%, which may reduce conflicts at preceding access points.
- By utilizing all traffic lanes, the differential speed between lanes is greatly reduced since both lanes travel at approximate the same speed.
- Motorists are given positive directions on lane usage and merging which clears misunderstandings between drivers and reduces road rage.

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

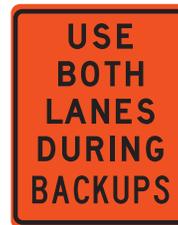
- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Active Zipper Merge see estimates for **Motorist Advisory Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

**OPTIONS**

- The Active Zipper Merge system may be combined with End of Queue Warning Systems, Congestion Warning, and/or Travel Time/Delay Systems.
- The Passive Zipper Merge system (see [Field Manual Layout 58](#)) may be used as it has been shown to be effective; however, experience has indicated that the Active Zipper Merge has increased compliance over the Passive Zipper Merge.



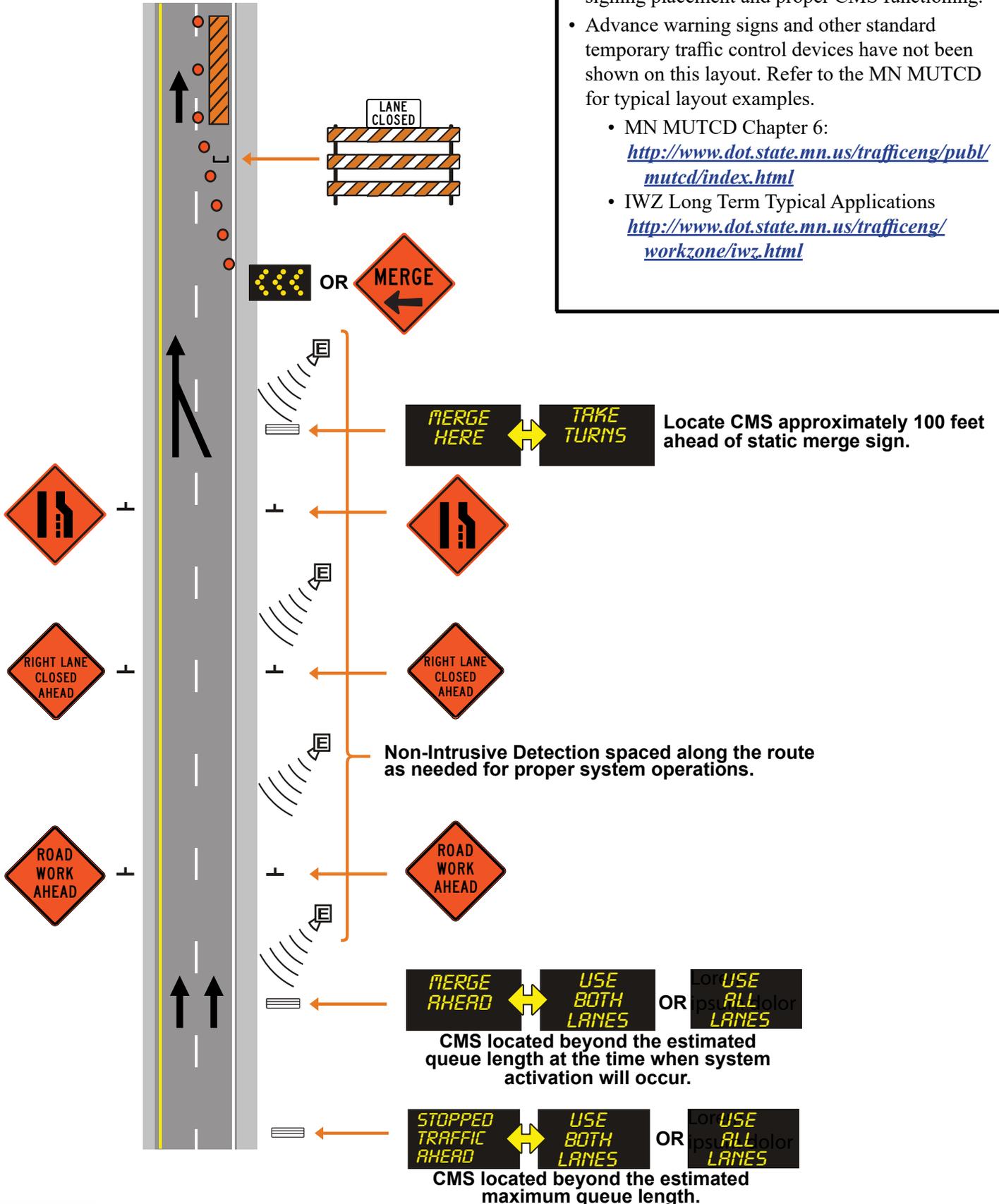
**NOTES**

- Refer to the layout on the following page for an example of the Active Zipper Merge System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



**PLANNING GUIDANCE**

- When hazardous roadway conditions, such as a temporary unusually tight curve, a rough road surface, which require extra driving precautions are present.
- When workers are directly adjacent to travel lanes and a lane or portion thereof is closed to traffic without protection of positive barrier.
- May be used with advisory speed or regulatory speed limits.

**BENEFITS**

- Dynamic speed display signs have been shown to improve compliance with advisory speed and regulatory speed limits.

**MINIMUM SPECIFICATIONS ON DYNAMIC SPEED DISPLAY SIGN EQUIPMENT**

Display size of the DSD sign is dependent on the size of the speed plaque used.

Advisory		Regulatory	
Plaque Size	DSD display MIN.	Plaque Size	DSD display MIN.
18" x 18"	10" character	24" x 30"	10" character
24" x 24"	10" character	30" x 36"	10" character
30" x 30"	14" character	36" x 48"	14" character
36" x 36"	14" character	48" x 60"	14" character

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources..

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Dynamic Speed Display (DSD) see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

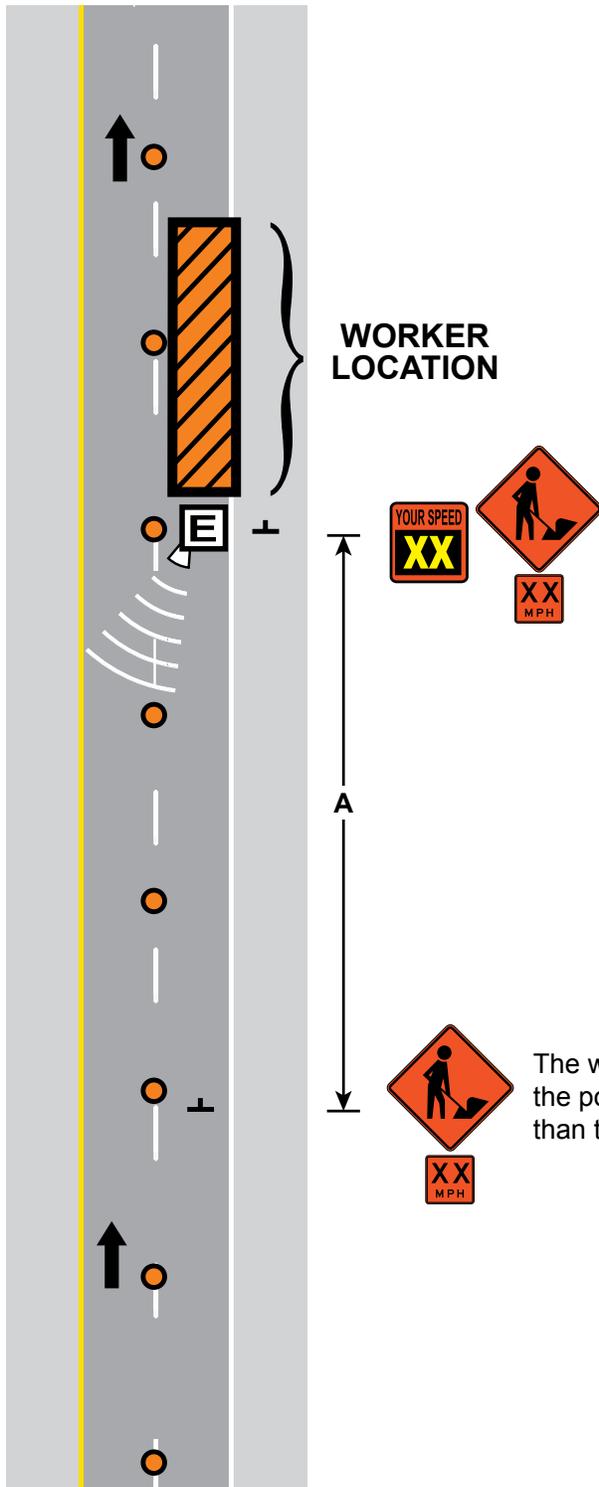
**OPERATIONAL GUIDELINES**

The DSD sign should remain blank when no traffic is detected. When traffic speed is detected over the advisory speed, the sign should flash at 50-60 cycles per minute. For speeds detected over a set max speed (generally 10 mph over the advisory speed limit on roadways with posted speed limits of 40 mph or lower, and 20 mph over on roadways with posted speed limits of 45 mph or higher) the display should go blank.

**NOTES**

- Refer to the layout on the following page for an example of the DSD System in use.
- Approved messages should be listed in the Special Provisions and approximate locations should be shown on the TTC plans. All displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



## NOTES

- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>
- This layout shows a Dynamic Speed Display used with a Workers Present Warning Sign and an Advisory Speed plaque. A Dynamic Speed Display may be used with either an Advisory Speed plaque or a regulatory speed limit.
- When the DSD sign is used with an Advisory Speed plaque, a warning sign shall be displayed adjacent to the DSD sign location. The Advisory Speed Plaque may be attached to the warning sign, or mounted on the DSD sign device. The “YOUR SPEED” sign on the DSD device shall be black on orange.
- When utilizing the DSD sign with a regulatory speed limit such as a Workers Present speed limit, the “YOUR SPEED” sign on the DSD device shall be black on orange. The DSD sign shall be either placed adjacent to the posted speed limit sign, or the appropriate speed limit sign shall be mounted to the DSD device.

The warning sign assembly may be omitted if the posted advisory speed is 10 mph or less than the posted regulatory speed.

## PLANNING GUIDANCE

- Workers Present Speed Limit may be required when workers are directly adjacent to travel lanes and a lane or portion thereof is closed to traffic. See document “[Speed Limits in Work Zones Guideline](#)”.
- The Electronic Workers Present Speed Limit is a good option when workers are present at multiple locations in an extended work zone (5 miles or greater).

## BENEFITS

- The system should alert drivers to the new temporary posted speed limit.
- The Electronic Workers Present Speed Limit allows the speed limit to be adjusted more easily throughout the work zone where workers are present. This may be done with an electronic communications device or using proximity devices on workers themselves.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Electronic Workers Present Speed Limit see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

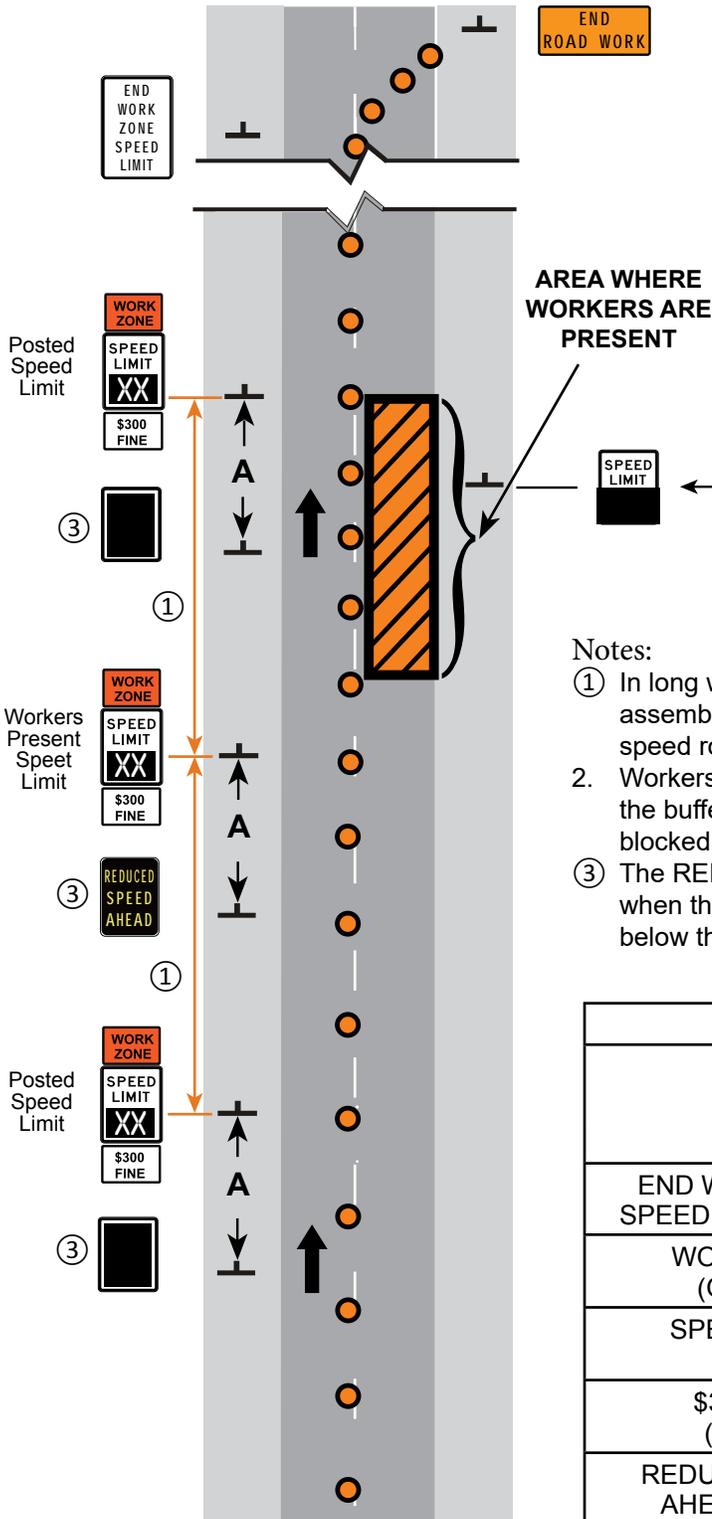
## OPTIONS

- May be placed at the expected location of workers or at each mile of a long work zone.
- The displayed speed limit on each Workers Present Speed Limit assembly may be controlled by a defined person tracking worker location or by devices on the workers.

## NOTES

- Refer to the layout on the following page for an example of the Electronic Workers Present Speed Limit in use.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



**NOTES**

- The “A” distance is found in the Field Manual (MN MUTCD Part 6K) Distance Charts.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

When the Workers Present Speed Limit system is implemented, all in-place speed limit signs shall be covered or removed.

**Notes:**

- ① In long work zones, the workers present speed limit sign assembly should be repeated at 1 mile intervals for high speed roads. Use 1/2 mile spacing on low speed roads.
2. Workers Present Speed Limit assemblies may be placed in the buffer or work space as long as the assemblies are not blocked by vehicles or devices.
- ③ The REDUCED SPEED AHEAD blank out sign shall be used when the workers present speed limit is more than 10 MPH below the preceding speed limit.

SIGN	MINIMUM SIGN SIZES	
	Posted Speed Limit Prior to Work Starting	
	≤ 40 mph	≥ 40 mph
END WORK ZONE SPEED LIMIT (R2-12)	24" X 36"	36" X 54"
WORK ZONE (G20-5aP)	24" X 18"	36" X 24"
SPEED LIMIT (R2-1)	24" X 30"	36" X 48"
\$300 FINE (R2-6bP)	24" X 18"	36" X 24"
REDUCED SPEED AHEAD (W3-5)	36" X 36"	48" X 48"

## PLANNING GUIDANCE

- Queue lengths may encroach upstream beyond a motorist's reasonable expectation for stopped or slow traffic due to turning vehicles.
- Example: On a divided highway which is temporarily reduced to a 2-lane 2-way operation with allowed left turns.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Turning Traffic Ahead Warning System see estimates for **Motorist Advisory Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## BENEFITS

- The system should alert drivers of an upcoming traffic slow-down or stopped traffic due to allowed turns and to be prepared to stop safely.
- It is anticipated that the system will reduce rear-end crashes.

## OPTIONS

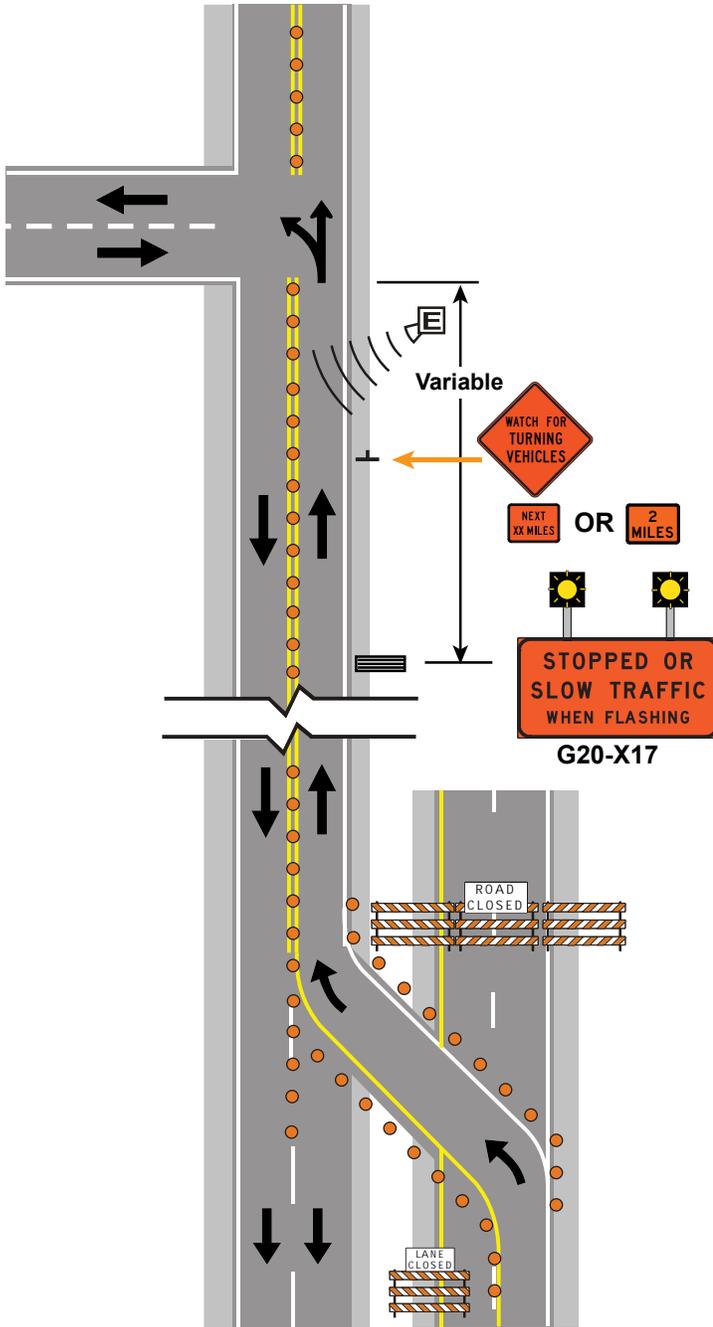
- When traffic queue lengths are reasonably predictable, warning motorists of stopped / slowed traffic may be accomplished with the use of typical TTC warning signs placed prior to the anticipated beginning of queue.
- Either a PCMS or an appropriate warning sign equipped with dynamically automated flashing lights may be used.
- The flashers or PCMS warning are activated in response to queued traffic when the traffic is waiting for the lead vehicle to turn.

## NOTES

- Refer to the layout on the following page for an example of the Turning Traffic Ahead Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- The first CMS message should describe the hazard ahead. Whereas, the second message should state the action that needs to be taken.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

Example: On a divided highway which is temporarily reduced to a 2-lane 2-way operation with an allowed left turn.



### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

Non-Intrusive Detection should be spaced along the route as needed for proper system operations.

If multiple left turns are present along a stretch of a road, an advance warning sign advising drivers to watch for turning vehicles may be placed with an advisory distance plaque. Distance may be specified as miles or feet.



The signs are activated in response to queued traffic.

When no queue is detected, all the CMS should be blank or used for another ITS system.

**PLANNING GUIDANCE**

- There is a temporary change in the ramp or roadway that will potentially have a negative impact on ramp traffic merging with the mainline traffic.
- There is a temporary reduction in capacity of through lanes due to either a reduction in the number of lanes, or a reduction in the width of lanes of traffic, causing a backup of traffic during peak periods.
- There is a temporary increase in volume due to detoured traffic that exceeds the capacity of through lanes.
- Nearby signals on the cross street or ramp terminals create platoons of vehicles entering the freeway creating turbulence and shock waves.

**BENEFITS**

- The system meters on-ramp traffic during road work activities to improve safety and/or consistent traffic flow.
- Improves capacity of freeway by reducing turbulence and shockwaves caused by entering traffic.
- Improves safety by providing uniform traffic speeds.

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/ scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Temporary Ramp Metering see estimates for **Route Management Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

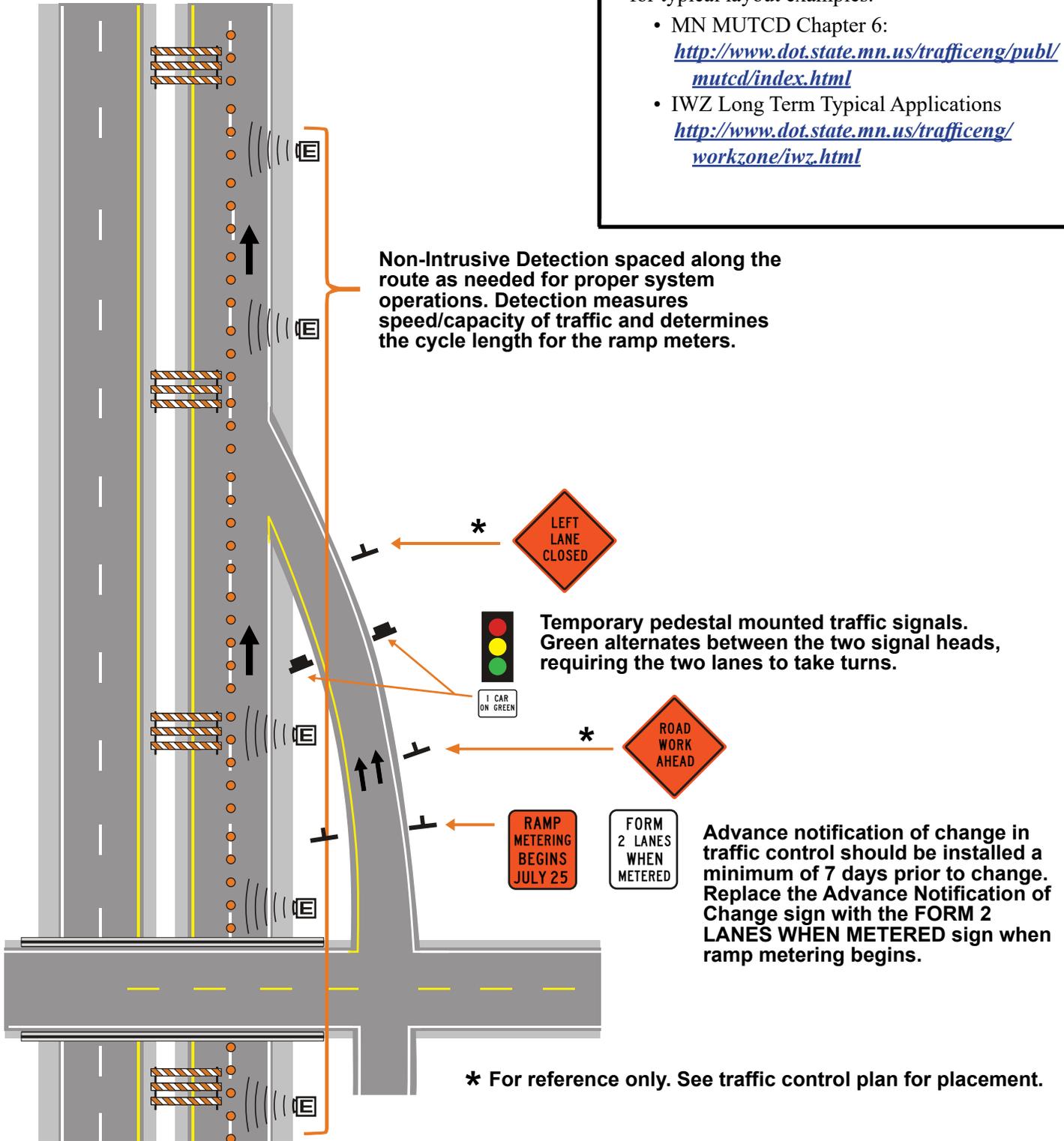
**NOTES**

- Refer to the layout on the following page for an example of the Temporary Ramp Metering System in use.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



## PLANNING GUIDANCE

- Traffic must reduce speed to safely navigate an unexpected hazardous condition such as a temporary sharp curve, rough road surface, end of pavement, bump, etc.

## BENEFITS

- System should alert a driver that they have entered a portion of the work zone at a speed substantially above the advisory speed limit.
- The system provides sufficient time to slow down for the hazardous condition.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Excessive Speed Warning see estimates for Motorist Warning Systems in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

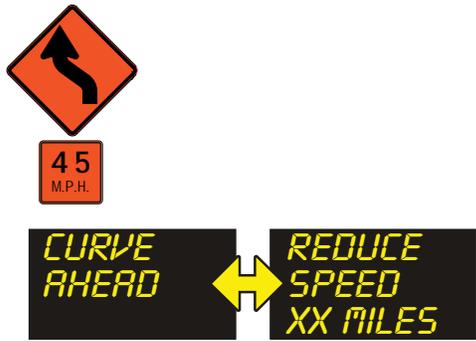
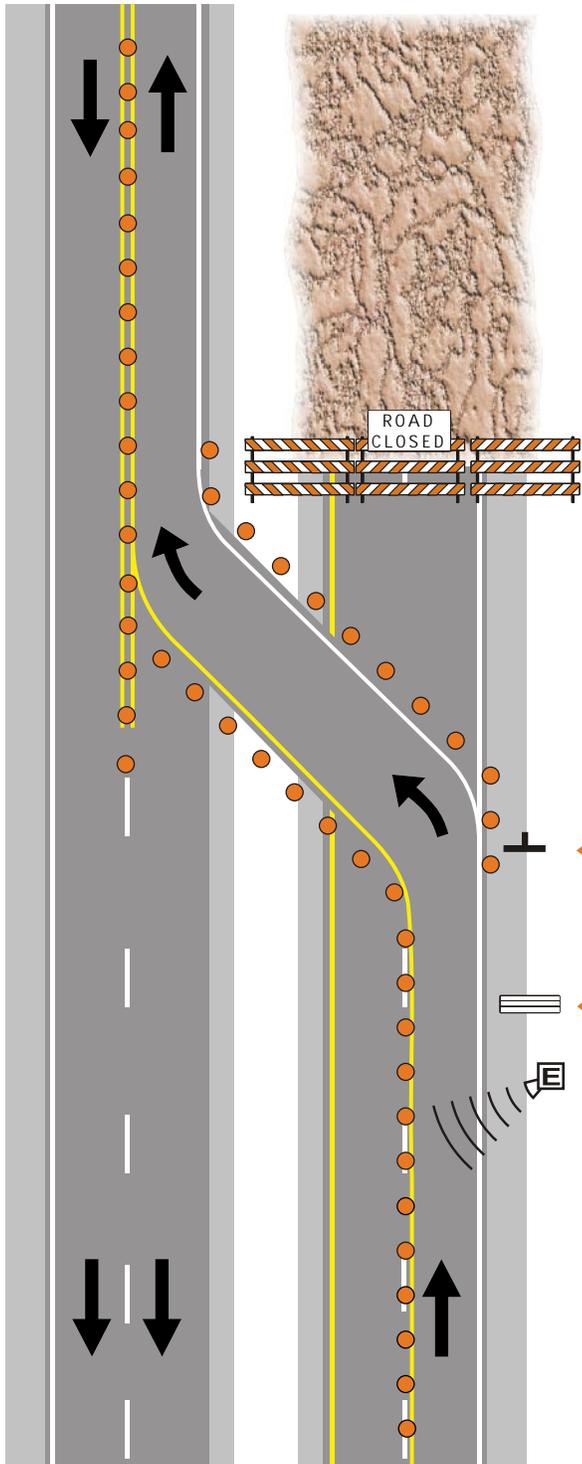
## NOTES

- Refer to the layout on the following page for an example of the Excessive Speed Warning System in use.
- Signs tend to be most effective where there are two lanes or less in one direction of travel.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- The first CMS message should describe the hazard ahead Whereas, the second message should state the action that needs to be taken.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



Non-Intrusive Detection placed along the roadway as needed for proper system operations.

The PCMS is blank until triggered by unsafe approaching speed.

**PLANNING GUIDANCE**

- Construction causes geometry or weight restriction that impacts various vehicle types to not be able to navigate the work zone. Examples include lane widths of less than 11’, reduced vertical clearances, curve geometry that won’t permit tractor-trailer combinations, bridge weight restrictions, etc.
- When non-compliant over-dimension vehicles try to travel through the work zone.
- Communicate with the appropriate permits staff when these systems are to be used.

**BENEFITS**

- The system should alert a driver that their vehicle is over dimension and they are required to use an alternate route.
- An additional warning message may be added to alert a driver to stop if they failed to use the alternate route.
- The system may be used to alert workers that an over dimension vehicle is approaching.

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/ scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Over Dimension Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

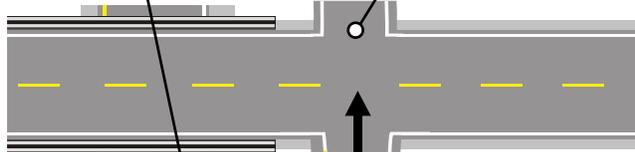
**NOTES**

- Refer to the layout on the following page for an example of the Over Dimension Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- The first CMS message should describe the hazard ahead. Whereas, the second message should state the action that needs to be taken.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

POINT OF CLEARANCE RESTRICTION  
(an example may include height or width reductions due to bridge repairs or painting)

RETURN ROUTE  
(Entrance Ramp)



A siren or horn alarm may be included to alert workers of a vehicle intrusion.

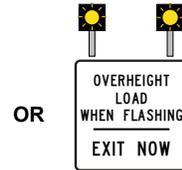
ROOM TO STOP AND PULL OVER BEFORE RESTRICTION

A siren or horn alarm may be included to alert the vehicle driver.

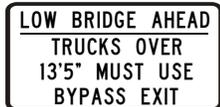
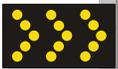


Non-Intrusive Detection placed to determine whether an over-dimension vehicle missed the exit.

ALTERNATE ROUTE EXIT



Non-Intrusive Detection placed along the roadway as needed to measure for over-dimension vehicles.



**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

## PLANNING GUIDANCE

- The Intrusion Warning System generally warns drivers and workers when vehicles enter the buffer and work space of a work zone.
- In a reactive application where drivers have been failing to follow flagger directions.
- Workers are adjacent to open high-speed traffic lanes without protection of temporary barrier.

## BENEFITS

- The systems should alert a driver that they have intruded into a buffer and/or work space.
- An intrusion system should alert workers that a vehicle has intruded into the buffer and/or work space and give them enough time to take evasive actions.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

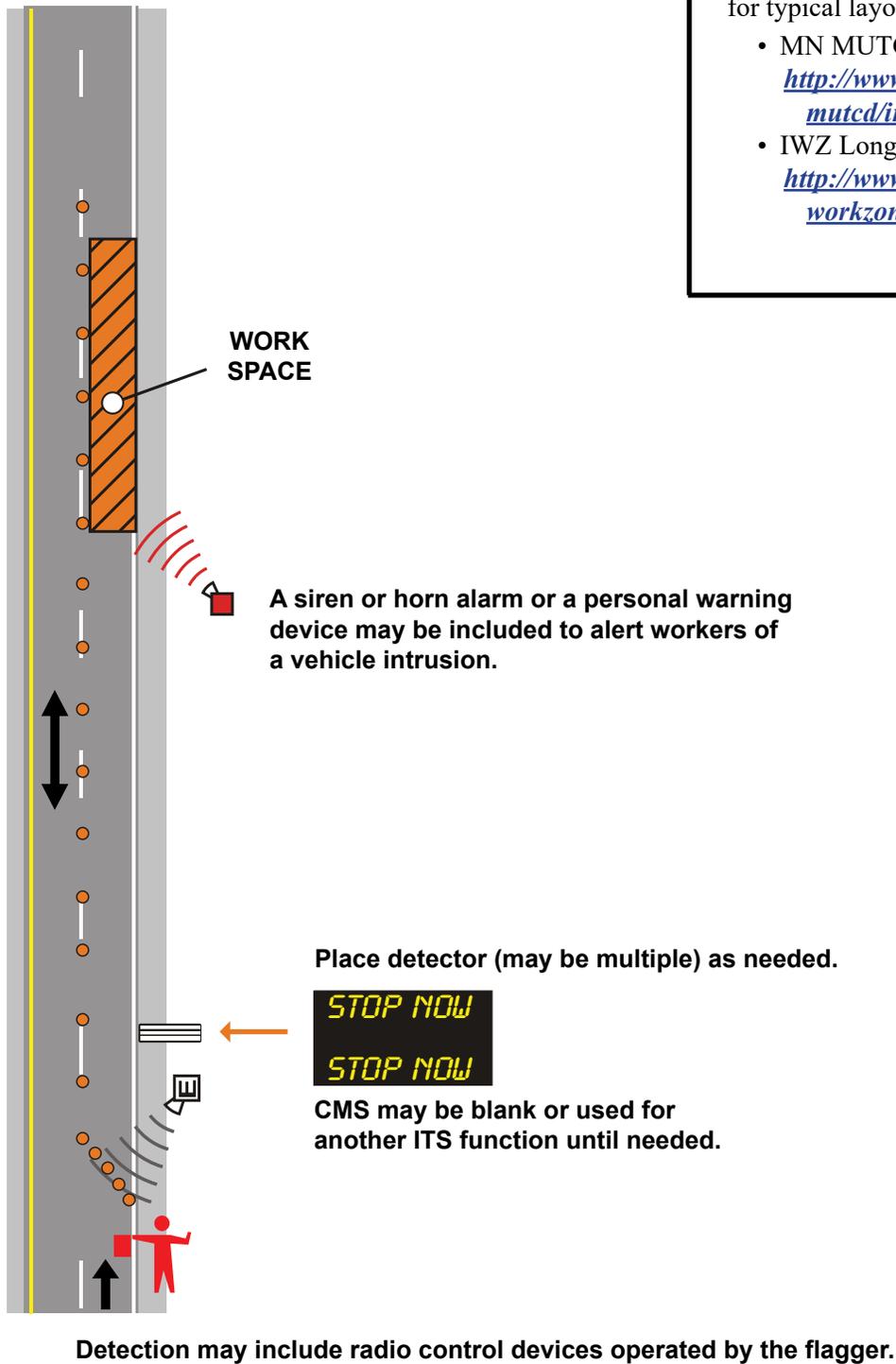
### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Work Intrusion Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## NOTES

- Refer to the layout on the following page for an example of the Work Space Intrusion Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

**PLANNING GUIDANCE**

- The trucks must utilize the mainline roadway to accelerate.
- A truck merge lane can not be provided on the project.
- There is a sight restriction where trucks must enter the open traffic lane.
- There is insufficient space for a truck acceleration lane prior to entering the open traffic lane.
- The ADT on the roadway is above the level where truck drivers can easily find a gap in traffic and accelerate within the traffic lane without causing traffic to suddenly adjust speed or change lanes.

**BENEFITS**

- The system should alert drivers so that they are aware of slowly accelerating construction vehicles entering the traffic lane.
- The system should provide sufficient time for drivers to react appropriately, such as slowing down or changing lanes to facilitate safe merging of construction vehicles.

**SCOPING**

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/ scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

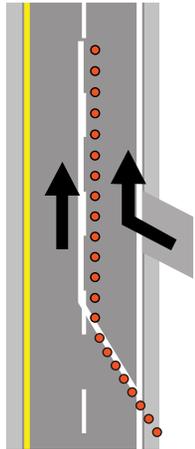
**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Trucks Merging Traffic Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

**NOTES**

- Refer to the layout on the following page for an example of the Construction Vehicles Merging Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale



**CONSTRUCTION VEHICLES MERGING**

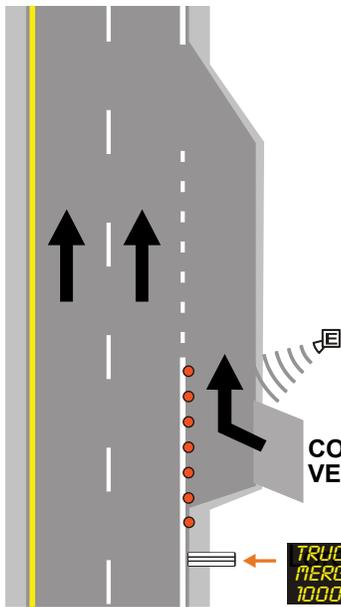
Typically, IWZ Systems are not needed for construction traffic in this scenario.

Dedicated Lane

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>
- Non-Intrusive Detection placed along the roadway as needed for proper system operations. The detection may include radio control devices operated by the truck drivers.

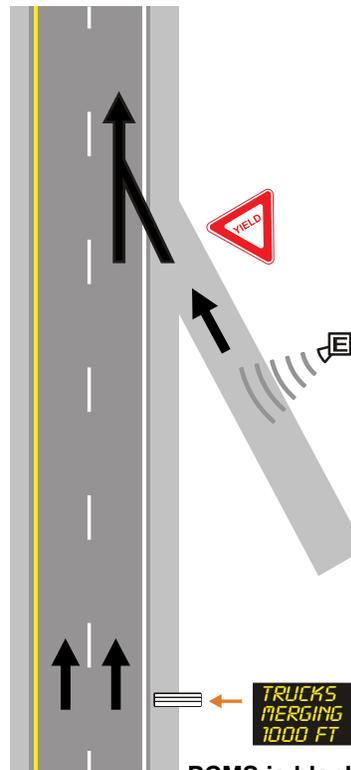
**Acceleration Lane**



**CONSTRUCTION VEHICLES MERGING**

PCMS is blank unless Construction Vehicles are merging into the traffic lanes.

**No Acceleration Lane**



**CONSTRUCTION VEHICLES MERGING**

PCMS is blank unless Construction Vehicles are merging into the traffic lanes.

OR



**PLANNING GUIDANCE**

- Where crossing truck traffic moves much more slowly than anticipated by oncoming traffic.
- When higher ADT or poor sight conditions exist such that trucks have difficulty finding appropriate gaps, additional traffic control systems (such as flaggers or temporary signals) should be considered.
- Consider the use of flaggers where there is not adequate decision sign distance and/or high traffic volumes.
- Not for use on freeways.

**BENEFITS**

- Drivers are alerted to slow moving construction vehicles crossing the roadway. This system allows drivers to adjust speeds to react appropriately.

**SCOPING**

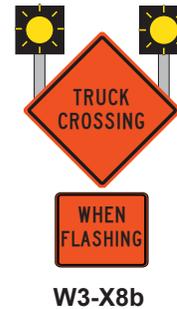
Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/ scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

**Cost Estimates For ITS/IWZ Scoping**

- For additional information including the most recent cost estimates for Trucks Crossing Traffic Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

**OPTIONS**



**W3-X8b**

- Either a PCMS or an appropriate warning sign equipped with dynamically automated flashing lights may be used.

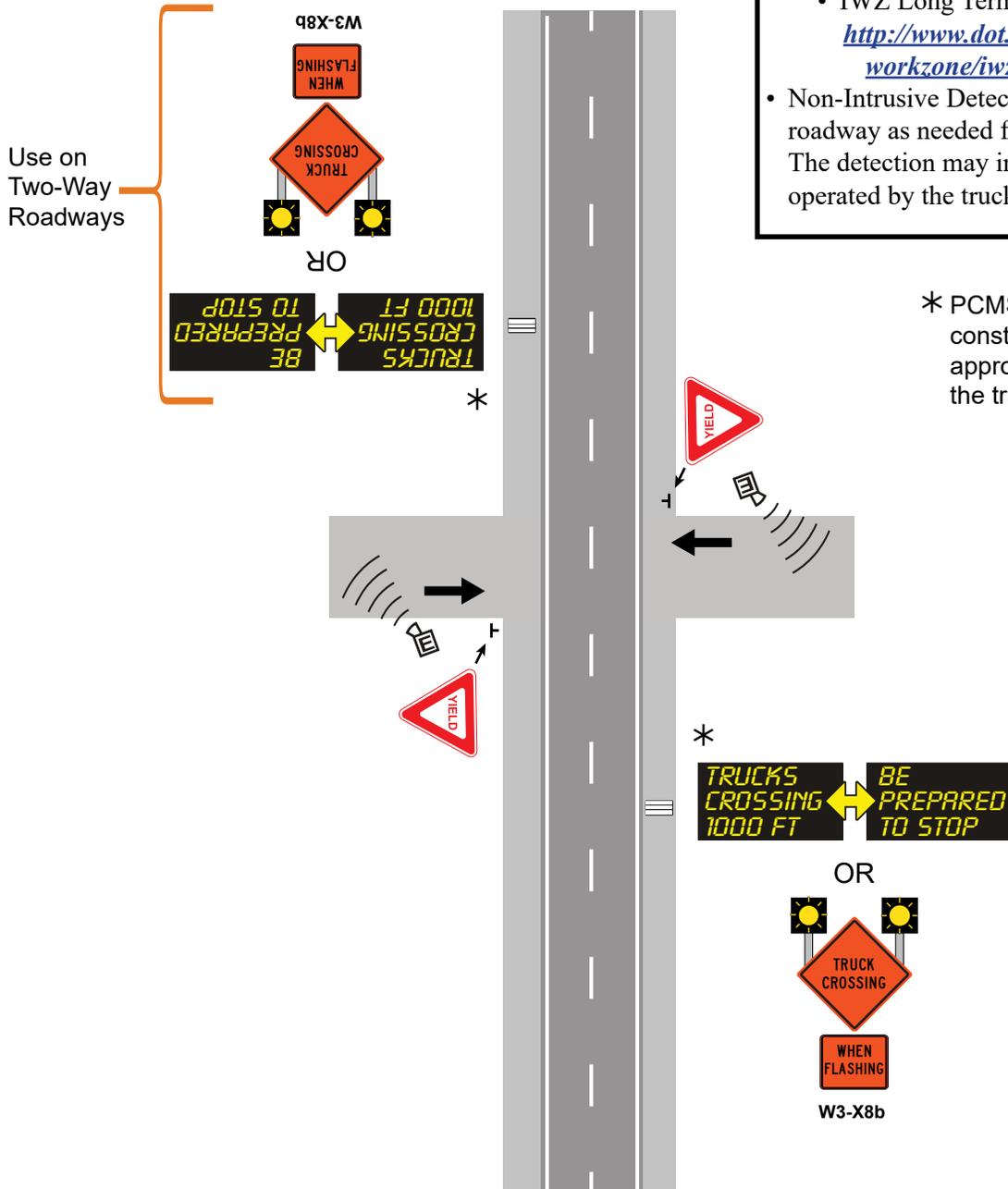
**NOTES**

- Refer to the layout on the following page for an example of the Trucks Crossing Traffic Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale

**NOTES**

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications <http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>
- Non-Intrusive Detection placed along the roadway as needed for proper system operations. The detection may include radio control devices operated by the truck drivers.



## PLANNING GUIDANCE

- Trucks must utilize the mainline roadway to decelerate in order to enter the work space which may result in:
  - a. Vehicles following trucks into the work space, and/or
  - b. Traffic may be required to adjust speed or change lanes.

## BENEFITS

- The system should alert drivers of a decelerating truck exiting the faster moving traffic lane.
- The system should provide sufficient time for drivers to react appropriately, such as slowing down or changing lanes to facilitate safe operation of construction vehicles.
- Drivers are less likely to follow vehicles into the work zone.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Trucks Exiting Traffic Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## OPTIONS



## NOTES

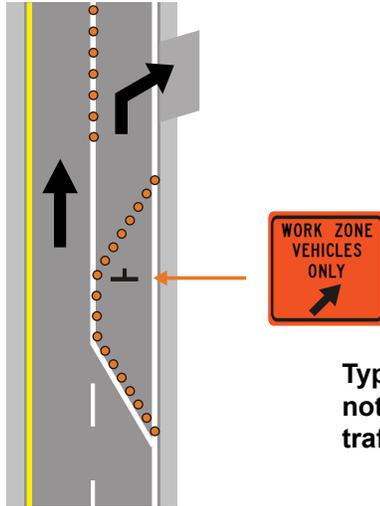
- Refer to the layout on the following page for an example of the Trucks Exiting Traffic Warning System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions Section for graphic symbols and terms.

Layouts are NOT drawn to scale

### NOTES

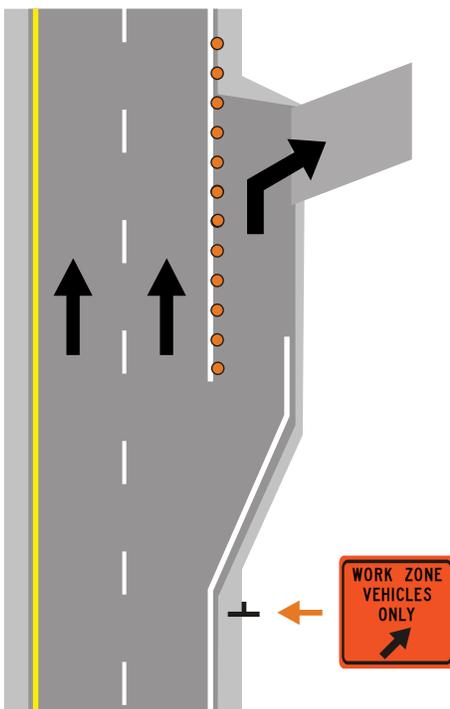
- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

#### Dedicated Lane



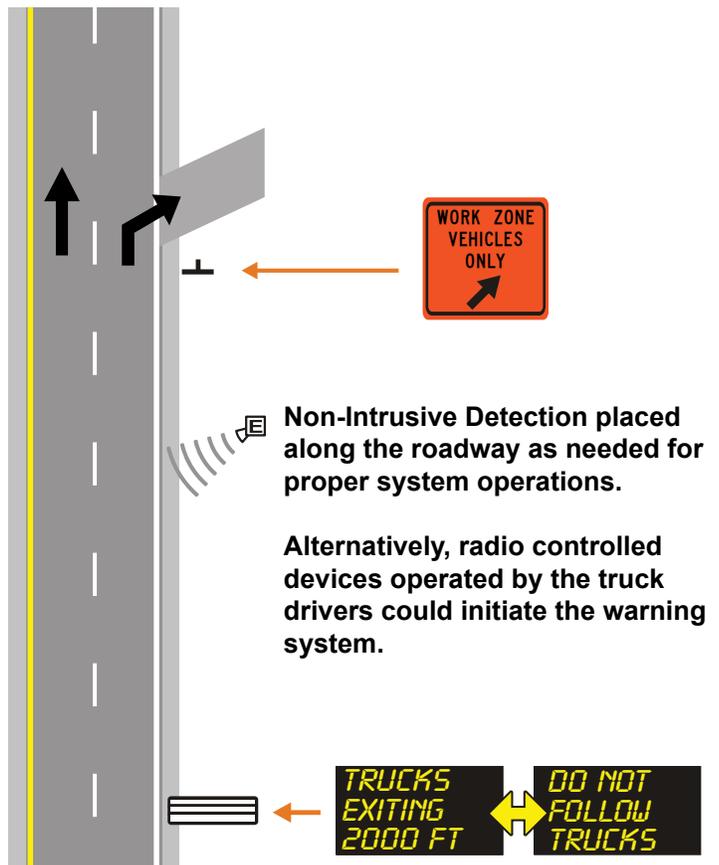
Typically, IWZ Systems are not needed for construction traffic in this scenario.

#### Deceleration Lane



Typically, IWZ Systems are not needed for construction traffic in this scenario.

#### No Deceleration Lane



Non-Intrusive Detection placed along the roadway as needed for proper system operations.

Alternatively, radio controlled devices operated by the truck drivers could initiate the warning system.

## PLANNING GUIDANCE

- When providing emergency pull-offs for 2-lane, 2-way operations implemented on one side of a previous multi-lane divided highway facility.

## BENEFITS

- Drivers are alerted that there is a vehicle in the pull-off area. This system allows drivers to adjust speeds and use caution.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

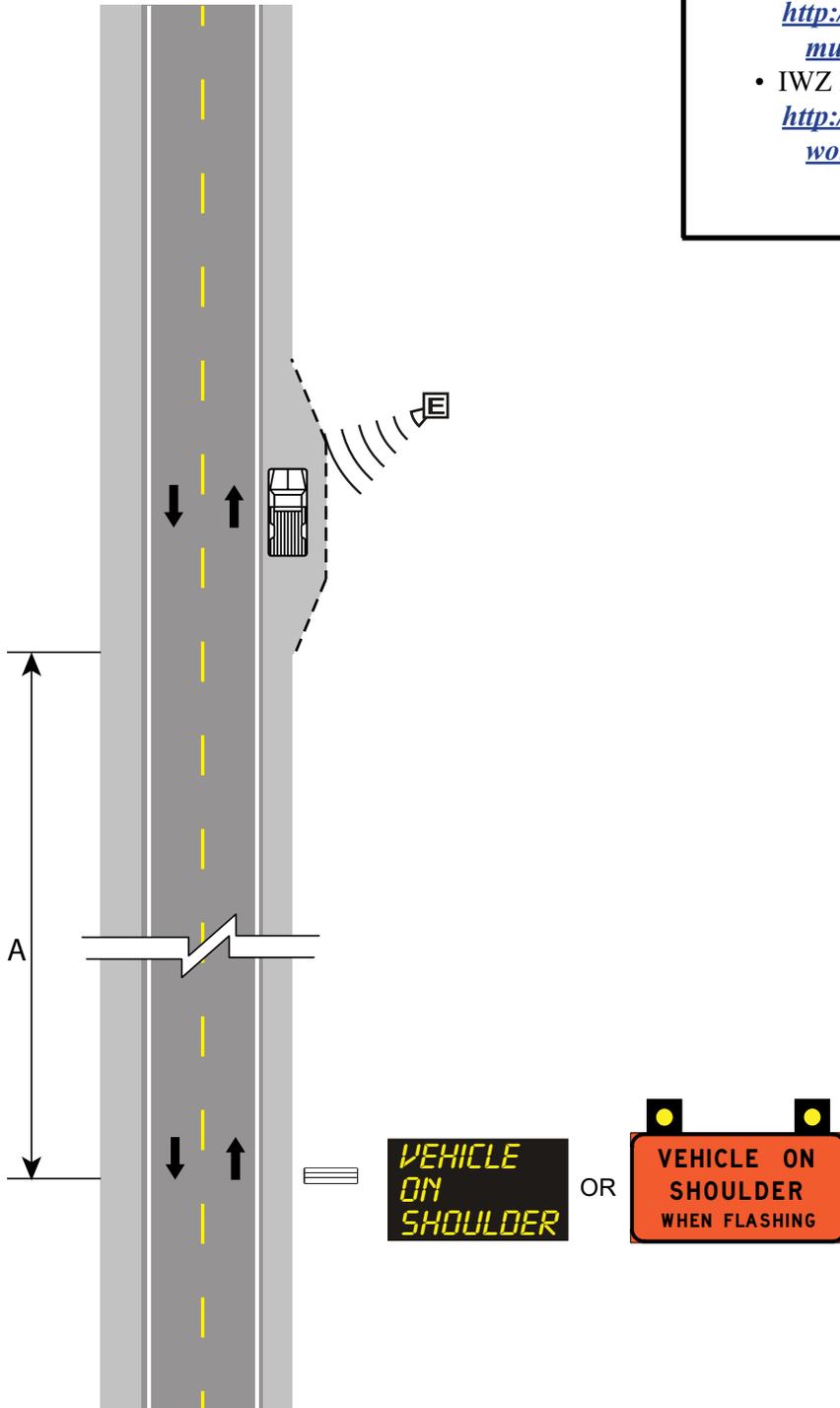
### Cost Estimates For ITS/IWZ Scoping

- For additional information including the most recent cost estimates for Trucks Exiting Traffic Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## NOTES

- Refer to the layout on the following page for an example of the Emergency Pulloff Detection System in use.
- Approved CMS messages should be listed in the Special Provisions and approximate CMS locations should be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions section for graphic symbols and terms.

Layouts are NOT drawn to scale.



### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/pub/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>

## PLANNING GUIDANCE

- Deploy when a temporary situation may cause a hazardous driving condition such as:
  - Flash flooding
  - Obscured visibility (fog, smoke)
  - Slippery conditions

## BENEFITS

- The system gathers real-time data to inform travelers of weather and road surface conditions either through pre-trip traveler information systems or through en-route information dissemination systems so that they can take corrective actions.
- The system immediately notifies construction staff of the situation such that they may swiftly respond to weather events in order to promote safe travel and maintain travelers' mobility.

## SCOPING

Use the Decision Tree to Identify Potential ITS/IWZ Scoping Needs (see Appendix A) during the planning/scoping phase to:

- determine which IWZ system(s) should be used (or combined);
- estimate IWZ system(s) costs;
- and identify resource needs, including time and resources.

### Cost Estimates For ITS/IWZ Scoping

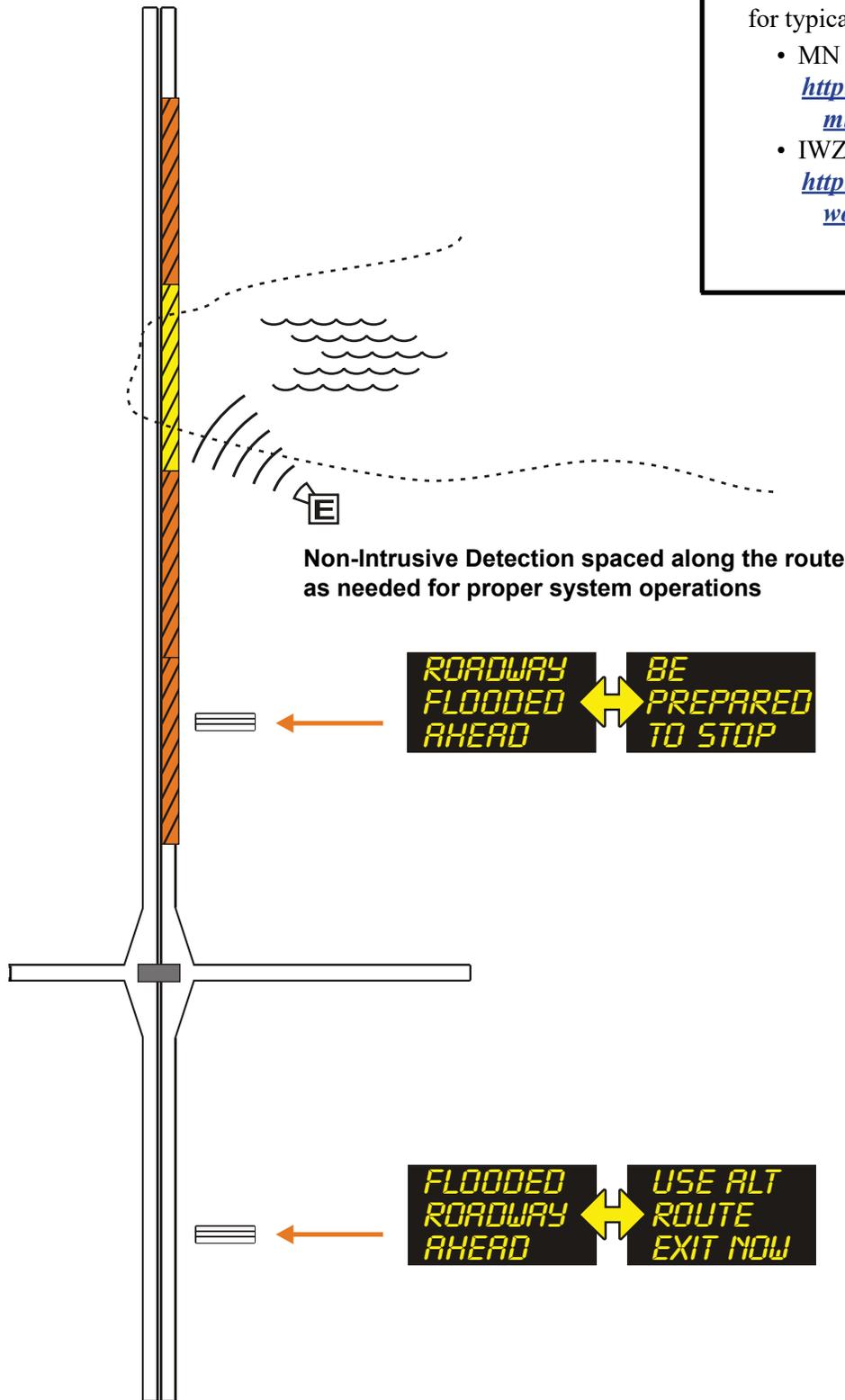
- For additional information including the most recent cost estimates for Hazardous Roadway Warning see estimates for **Motorist Warning Systems** in the resource document in: <http://www.dot.state.mn.us/its/scoping.html>.

## NOTES

- Refer to the layout on the following page for an example of the Hazardous Roadway Warning System in use.
- Approved CMS messages should be shown on the TTC plans and listed in the Special Provisions. Approximate CMS locations should also be shown on the TTC plans. All CMS displays should be blank when messages are not warranted.
- Refer to the Toolbox Definitions Section for graphic symbols and terms.

Layouts are NOT drawn to scale

Example: Area prone to Flash Flooding due to poor roadway drainage during a construction stage.



### NOTES

- Analysis should be done ahead of time for signing placement and proper CMS functioning.
- Advance warning signs and other standard temporary traffic control devices have not been shown on this layout. Refer to the MN MUTCD for typical layout examples.
  - MN MUTCD Chapter 6:  
<http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
  - IWZ Long Term Typical Applications  
<http://www.dot.state.mn.us/trafficeng/workzone/iwz.html>



# **Appendix A**

## **Decision Tree to Identify Potential ITS/TWZ Scoping Needs**

See <http://www.dot.state.mn.us/its/scoping.html> for the latest version of these documents.