

CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

Section 6C.01 Temporary Traffic Control Plans

Support:

Whenever the acronym “TTC” is used in this Chapter, it refers to “temporary traffic control”.

Standard:

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

Support:

A TTC plan describes TTC measures to be used for facilitating road users through a work zone or an incident area. TTC plans play a vital role in providing continuity of reasonably safe and efficient road user flow when a work zone, incident, or other event temporarily disrupts normal road user flow. Important auxiliary provisions that cannot conveniently be specified on project plans can easily be incorporated into Special Provisions within the TTC plan.

TTC plans range in scope from being very detailed to simply referencing typical drawings contained in this Manual, standard approved highway agency drawings and manuals, or specific drawings contained in the contract documents. The degree of detail in the TTC plan depends entirely on the nature and complexity of the situation.

Guidance:

TTC plans should be prepared by persons knowledgeable about the fundamental principles of TTC and work activities to be performed. The design, selection and placement of TTC devices for a TTC plan should be based on engineering judgment.

Coordination should be made between adjacent or overlapping projects to check that duplicate signing is not used and to check compatibility of traffic control between adjacent or overlapping projects.

Traffic control planning should be completed for all highway construction, utility work, maintenance operations, and incident management including minor maintenance and utility projects prior to occupying the TTC zone. Planning for all road users should be included in the process.

Provisions for effective continuity of accessible circulation paths for pedestrians should be incorporated into the TTC process. Where existing pedestrian routes are blocked or detoured, information should be provided about alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities. Access to temporary bus stops, reasonably safe travel across intersections with accessible pedestrian signals (see Section 4E.06), and other routing issues should be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.

Option:

Provisions may be incorporated into the project bid documents that enable contractors to develop an alternate TTC plan.

Modifications of TTC plans may be necessary because of changed conditions or a determination of better methods of safely and efficiently handling road users.

Standard:

This alternate or modified plan shall have the approval of the responsible highway agency prior to implementation.

Guidance:

Provisions for effective continuity of transit service should be incorporated into the TTC planning process because often public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including persons with disabilities, if applicable (see Section 10A.05 for additional light rail transit issues to consider for TTC).

Provisions for effective continuity of railroad service and acceptable access to abutting property owners and businesses should also be incorporated into the TTC planning process.

Reduced speed limits should be used only in the specific portion of the TTC zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A TTC plan should be designed so that vehicles can reasonably safely travel through the TTC zone with a speed limit reduction of no more than 10 mph.

A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the TTC zone. Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed, and additional TTC warning devices should be used.

Reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so.

Support:

Research has demonstrated that large reductions in the speed limit, such as a 30 mph reduction, increase speed variance and the potential for crashes. Smaller reductions in the speed limit of up to 10 mph cause smaller changes in speed variance and lessen the potential for increased crashes. A reduction in the regulatory speed limit of only up to 10 mph from the normal speed limit has been shown to be more effective.

Section 6C.02 Temporary Traffic Control Zones

Support:

A TTC zone is an area of a highway where road user conditions are changed because of a work zone or an incident through the use of TTC devices, uniformed law enforcement officers, or other authorized personnel.

A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the

END ROAD WORK sign or the last TTC device.

An incident area is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a traffic incident, natural disaster, or special event. It extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where road users return to the original lane alignment and are clear of the incident.

Section 6C.03 Components of Temporary Traffic Control Zones

Support:

Most TTC zones are divided into four areas: the advance warning area, the transition area, the activity area, and the termination area. Figure 6C-1 illustrates these four areas. These four areas are described in Sections 6C.04 through 6C.07.

Section 6C.04 Advance Warning Area

Standard:

When the work space is within the traveled way, except for short-duration and mobile operations, advance warning shall provide a general message that work is taking place.

Guidance:

When the work space is within the traveled way except for short duration and mobile operations, advance warning should supply information about prevailing highway conditions if possible and should indicate how motor vehicles can move through the TTC zone.

Support:

The advance warning area is the section of highway where road users are informed about the upcoming work zone or incident area.

Option:

The advance warning area may vary from a single sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to a series of signs in advance of the TTC zone activity area.

Guidance:

Typical distances for placement of advance warning signs on freeways and expressways should be longer because drivers are conditioned to uninterrupted flow. Therefore, the advance warning sign placement should extend on these facilities as far as 0.5 mile or more.

Figure 6C-1. Component Parts of a Temporary Traffic Control Zone

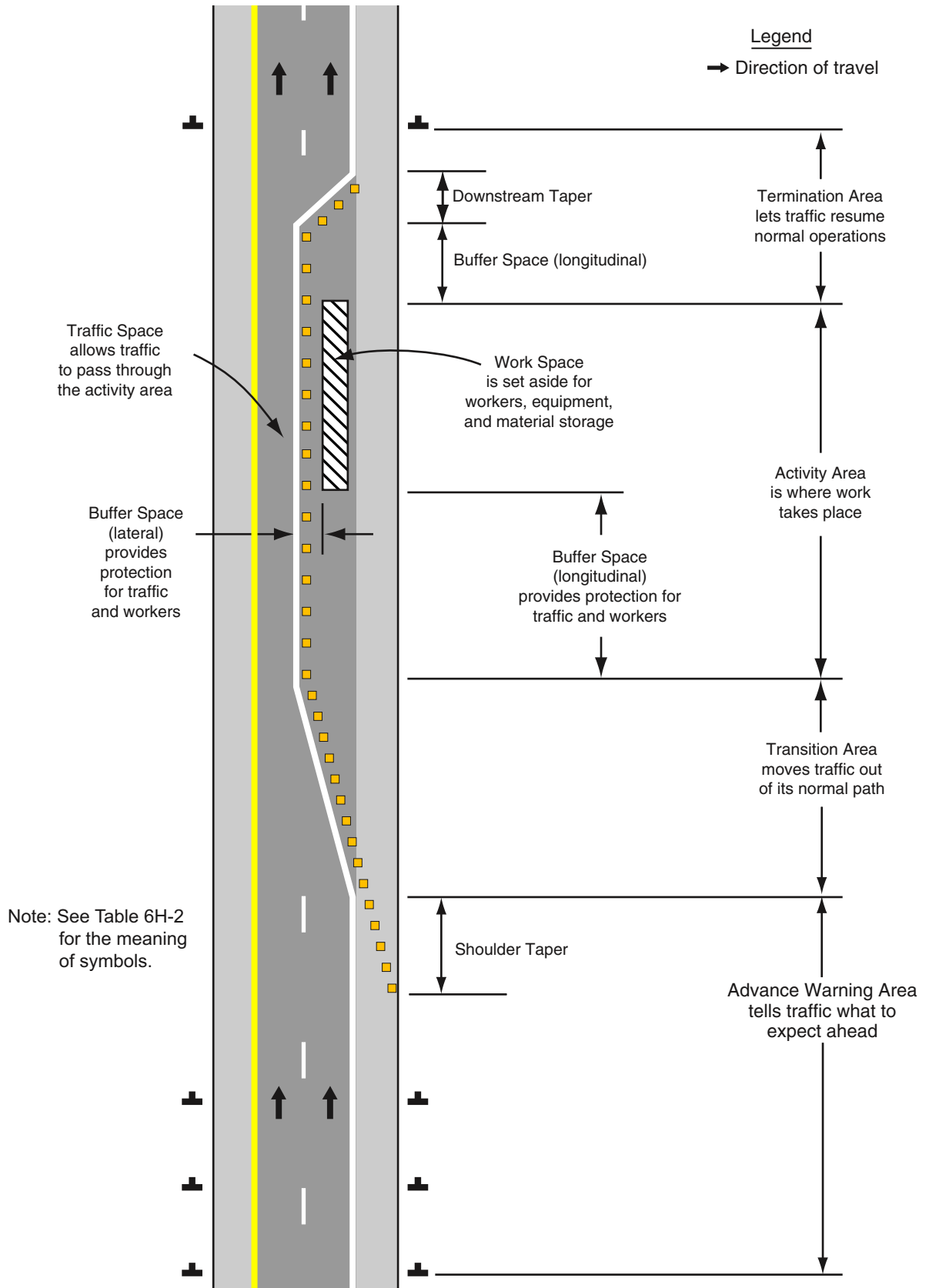


Table 6C-1. Suggested Advance Warning Sign Spacing

Road Classification	Posted Speed (MPH)	Sign Spacing (Feet)
Conventional Highways	25	100
	30	120
	35	160
	40	240
	45	320
	50	400
	55*	500
	60*	600
	65*	700
	70*	800
	75*	900
	80*	1000
Expressways or Freeways	All Speeds	See Typical Applications**

Notes:

*Distance between signs should be increased to have 1500 feet advance warning.

**Distance between signs should be increased to have ½ mile or more advance warning.

On urban streets, the effective placement of the first warning sign in feet should range from 4 to 8 times the speed limit in mph, with the high end of the range being used when speeds are relatively high. When a single advance warning sign is used (in cases such as low-speed residential streets), the advance warning area can be as short as 100 ft if assuming 25 mph posted speed. When two or more advance warning signs are used on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance (see Table 6C-1).

Since rural highways are normally characterized by higher speeds, the effective placement of the first warning sign in feet should be substantially longer—from 8 to 12 times the speed limit in mph. Since two or more advance warning signs are normally used for these conditions, the advance warning area should extend 1,500 ft or more for open highway conditions (see Table 6C-1).

Option:

Advance warning may be eliminated when the activity area is sufficiently removed from the road users' path so that it does not interfere with the normal flow.

Section 6C.05 Transition Area

Support:

The transition area is that section of highway where road users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

Standard:

When redirection of the road users' normal path is required, they shall be channelized from the normal path to a new path.

Support:

In mobile operations, the transition area moves with the work space.

Section 6C.06 Activity Area

Support:

The activity area is the section of the highway where the work activity takes place. It is comprised of the work space, the traffic space, and the buffer space.

Table 6C-2. Longitudinal Buffer Space

Speed * (mph)	Length (feet)
20	40
25	60
30	90
35	120
40	155
45	195
50	240
55	295
60	350
65	410
70	475
75	540
80	615

* Posted speed

Based upon American Association of State Highway and Transportation Officials (AASHTO) braking distance portion of stopping sight distance for wet and level pavements (A Policy on Geometric Design of Highways and Streets, AASHTO, 2004, p. 112). This AASHTO document also recommends adjustments for the effect of grade on stopping and variation for trucks.

The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

Guidance:

Position of channelizing devices along the activity area should be based on engineering judgment.

Option:

The work space may be stationary or may move as work progresses.

Guidance:

Since there might be several work spaces (some even separated by several miles) within the project limits, each work space should be adequately signed to inform road users and reduce confusion.

Support:

The traffic space is the portion of the highway in which road users are routed through the activity area.

The optional buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

Guidance:

Neither work activity nor storage of equipment, vehicles, or material should occur within a buffer space.

Option:

Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow. The activity area may contain one or more lateral or longitudinal buffer spaces.

A longitudinal buffer space may be placed in the initial portion of a closed lane in advance of a work space.

The longitudinal buffer space may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in Figure 6C-2.

Table 6C-2 may be used as a guide to determine longitudinal buffer space.

Support:

Typically, the buffer space is formed as a traffic island and defined by channelizing devices.

When a shadow vehicle, arrow panel, or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the vehicle, arrow panel, or changeable message sign constitutes the buffer space.

Figure 6C-2. Types of Tapers and Buffer Spaces

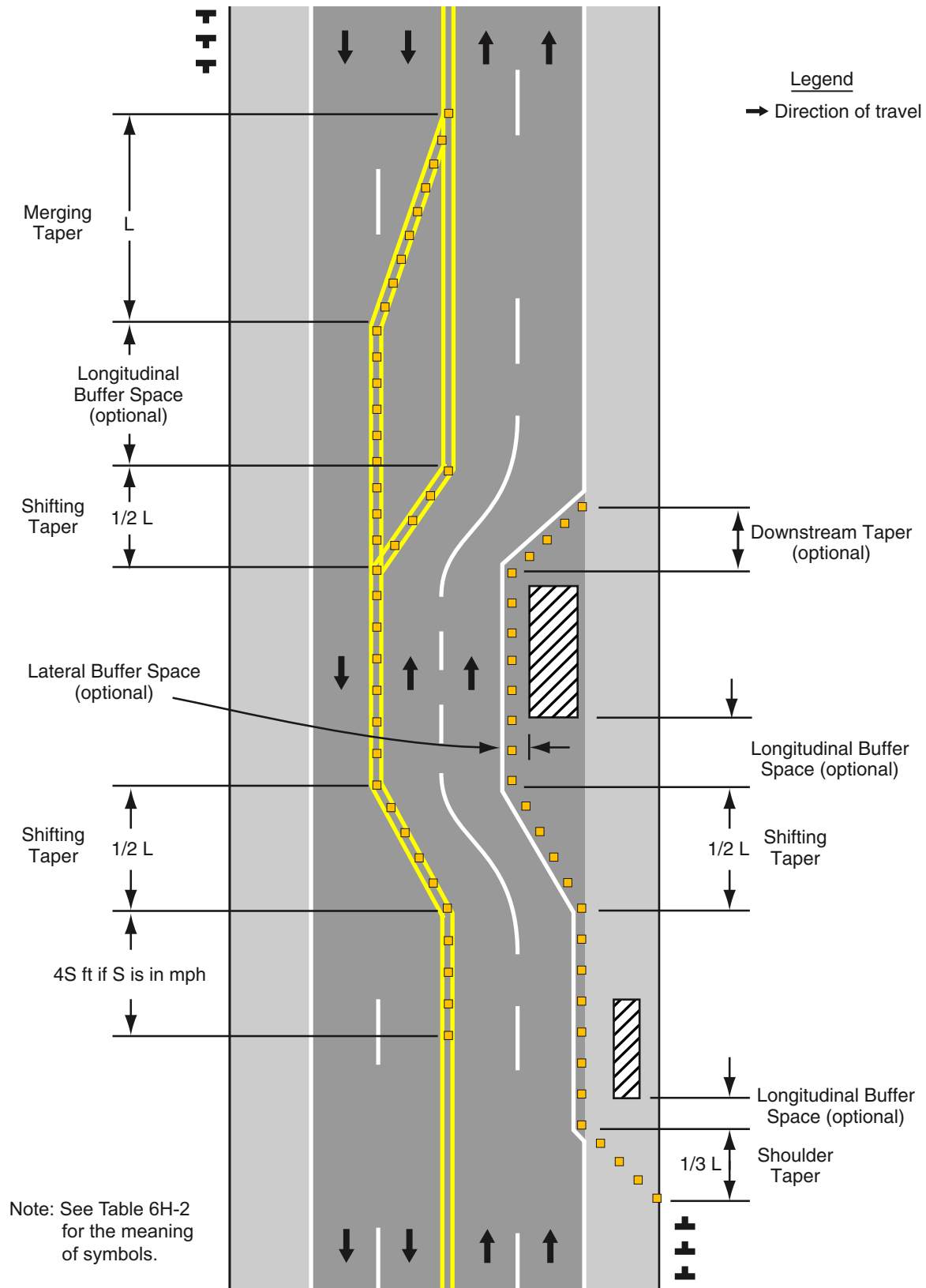


Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length (L)*
Merging Taper	at least L
Shifting Taper	at least 0.5L
Shoulder Taper	at least 0.33L
One-Lane, Two-Way Traffic Taper	50 to 100 ft
Downstream Taper	100 ft per lane

Option:

The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figures 6C-1 and 6C-2, or such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows.

Guidance:

The width of a lateral buffer space should be determined by engineering judgment.

Option:

When work occurs on a high-volume, highly congested facility, a vehicle storage or staging space may be provided for incident response and emergency vehicles (for example, tow trucks and fire apparatus) so that these vehicles can respond quickly to road user incidents.

Guidance:

If used, an incident response and emergency-vehicle storage area should not extend into any portion of the buffer space.

Section 6C.07 Termination Area**Standard:**

The termination area shall be used to return road users to their normal path. The termination area shall extend from the downstream end of the work area to the last TTC device such as END ROAD WORK signs, if posted.

Option:

An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.

A longitudinal buffer space may be used between the work space and the beginning of the downstream taper.

Section 6C.08 Tapers**Option:**

Tapers may be used in both the transition and termination areas. Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves, or other influencing factors, the length of the tapers may be adjusted.

Support:

Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. Types of tapers are shown in Figure 6C-2. The one-lane, two-way taper is shown in Figure 6C-3.

Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The test concerning adequate lengths of tapers involves observation of driver performance after TTC plans are put into effect.

Guidance:

The criteria for determining the taper length (L) is shown in Table 6C-3 and 6C-4 and should be the minimum used.

The maximum distance in feet between devices in a taper should not exceed 1.0 times the speed limit in mph. The one-lane, two-way and downstream tapers should have a minimum distance of 50 feet and should have devices spaced at approximately 20 feet.

Table 6C-4: Merging Taper Lengths and Spacing of Channelizing Devices

Posted Speed	Formula	Minimum Desirable Taper Lengths *			Suggested Maximum Spacing of Channelizing Devices	
		10' Offset	11' Offset	12' Offset	On a taper	On a Tangent
30	$L = \frac{WS^2}{60}$	150'	165'	180'	30'	60' – 75'
35		205'	225'	245'	35'	70' – 90'
40		265'	295'	320'	40'	80' – 100'
45	L = WS	450'	495'	540'	45'	90' – 110'
50		500'	550'	600'	50'	100' – 125'
55		550'	605'	660'	55'	110' – 140'
60		600'	660'	720'	60'	120' – 150'
65		650'	715'	780'	65'	130' – 165'
70		700'	770'	840'	70'	140' – 175'
75		750'	825'	900'	75'	150' – 185'
80		800'	880'	960'	80'	160' – 195'

* Taper lengths have been rounded off.

L = Length of Taper (Ft.) W = Width of Offset (Ft.) S = Posted Speed (MPH)

Support:

A merging taper requires the longest distance because drivers are required to merge into an adjacent lane of traffic at the prevailing speed.

Guidance:

A merging taper should be long enough to enable merging drivers to adjust their speeds and merge into a single lane before the end of the transition.

Support:

A shifting taper is used when merging is not required, but a lateral shift is needed. When more space is available, a longer than minimum taper distance can be beneficial. Changes in alignment can also be accomplished by using horizontal curves designed for normal highway speeds.

Guidance:

A shifting taper should have a length of approximately 0.5 L (see Tables 6C-3 and 6C-4).

Support:

A shoulder taper may be beneficial on a high-speed roadway where shoulders are part of the activity area and are closed, or when improved shoulders might be mistaken as a driving lane. In these instances, the same type, but abbreviated, closure procedures used on a normal portion of the roadway can be used.

Guidance:

If used, shoulder tapers should have a length of approximately 0.33 L (see Tables 6C-3 and 6C-4). If a shoulder is used as a travel lane, either through practice or during a TTC activity, a normal merging or shifting taper should be used.

Option:

A downstream taper may be useful in termination areas to provide a visual cue to the driver that access is available back into the original lane or path that was closed.

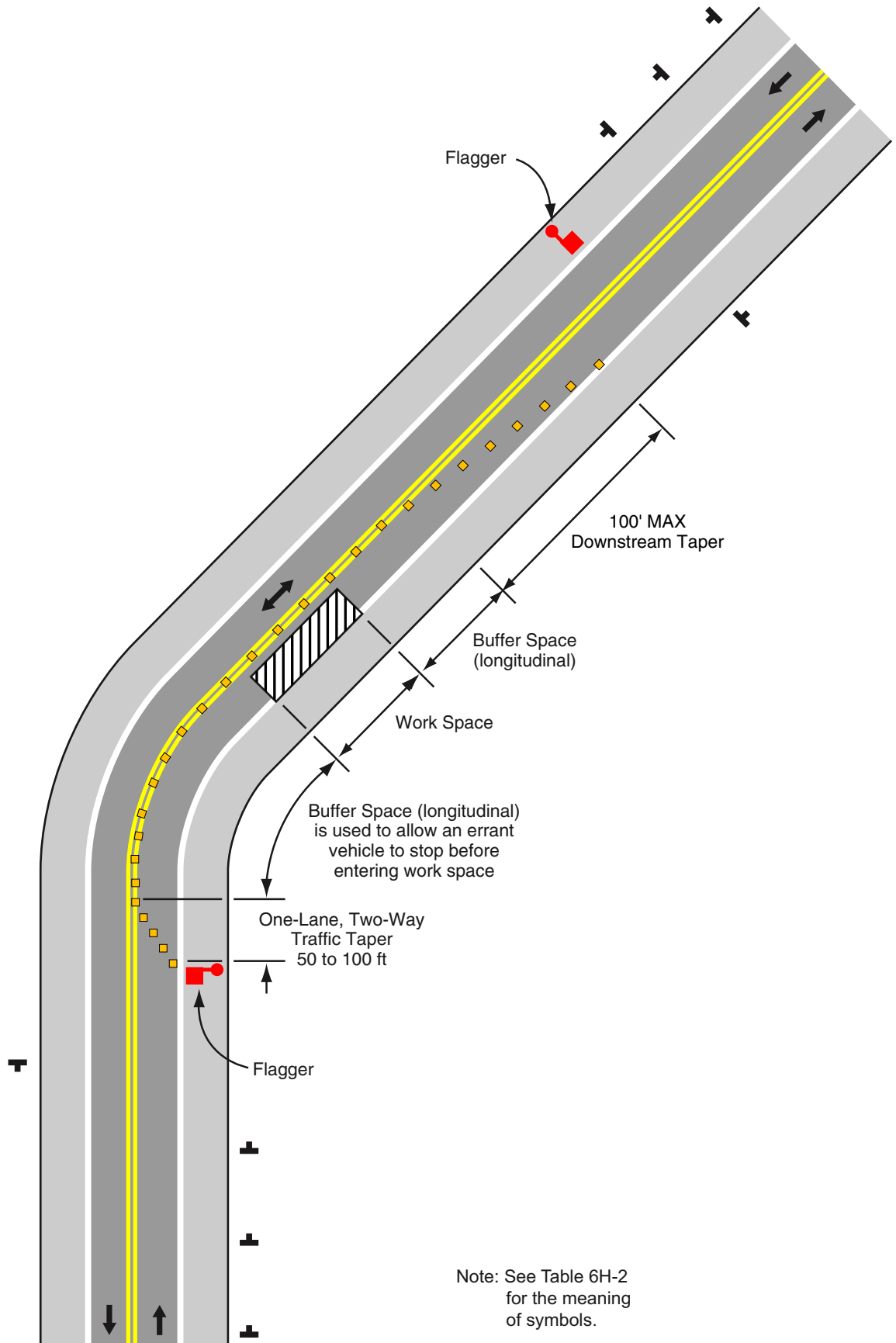
Guidance:

When used, a downstream taper should have a length of approximately 100 ft per lane with devices placed at a spacing of approximately 20 ft.

Support:

The one-lane, two-way taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction.

Figure 6C-3. Example of a One-Lane, Two-Way Traffic Taper



Guidance:

Traffic should be controlled by a flagger or temporary traffic control signal (if sight distance is limited), or a STOP or YIELD sign. A taper having a length of at least 50 ft with channelizing devices at approximately 20 ft spacings should be used to guide traffic into the one-way section.

Support:

An example of a one-lane, two-way traffic taper is shown in Figure 6C-3.

Section 6C.09 Detours and Diversions**Support:**

A detour is a temporary rerouting of road users onto an existing roadway in order to avoid a TTC zone.

Guidance:

Detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original roadway.

Support:

A diversion is a temporary rerouting of road users onto a temporary roadway or alignment placed around the work area.

Section 6C.10 One-Lane, Two-Way Traffic Control**Standard:**

When traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated.

Guidance:

Provisions should be made for alternate one-way movement through the constricted section via methods such as flagger control, a flag transfer, a pilot car, traffic control signals, or stop or yield control.

Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles.

If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures, a pilot car with a flagger used as described in Section 6F.54, or a traffic control signal should be used to control opposing traffic flows.

Support:

At a spot constriction, such as an isolated pavement patch on highways with lower speeds and adequate sight distance, the movement of traffic through one-lane, two-way constrictions tends to be self-regulating.

Section 6C.11 Flagger Method of One-Lane, Two-Way Traffic Control**Option:**

When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.

Guidance:

When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times. When good visibility and traffic control cannot be maintained by one flagger station, traffic should be controlled by a flagger at each end of the section. One of the flaggers should be designated as the coordinator. Flaggers should be able to communicate with each other orally, electronically, or with manual signals. These manual signals should not be mistaken for flagging signals.

Section 6C.12 DELETED**Section 6C.13 Pilot Car Method of One-Lane, Two-Way Traffic Control****Option:**

A pilot car may be used to guide a queue of vehicles through the TTC zone or detour.

Guidance:

The operation of the pilot vehicle should be coordinated with flagging operations or other controls at each end of the one-lane section. The pilot car should have the name of the contractor or contracting authority prominently displayed.

Standard:

The **PILOT CAR FOLLOW ME (G20-4)** sign (see Figure 6F-4, Sheet 4 of 4) shall be mounted at a conspicuous location on the rear of the vehicle.

Section 6C.14 Temporary Traffic Control Signal Method of One-Lane, Two-Way Traffic Control

Option:

Traffic control signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones (see Figure 6H-12 and Chapter 4G).

Section 6C.15 Stop or Yield Control Method of One-Lane, Two-Way Traffic Control

Option:

STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-way TTC zone when drivers are able to see the other end of the one-lane, two-way operation and have sufficient visibility of approaching vehicles.

Guidance:

If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.

