CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

Section 6C.01 Temporary Traffic Control Plans

Support:

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

Standard:

02 **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:

03 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.

04 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:

05 *TTC plans should be prepared by persons knowledgeable (for example, trained and/or certified) 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.*

06 *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.*

07 *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.*

08 *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.09 of the 2009 MUTCD), 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:

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

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

Guidance:

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

12 *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 8A.08 of the 2009 MUTCD for additional light rail transit issues to consider for TTC).*

13 *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.*

14 *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.*

Standard:

15 **Speeds shall only be reduced within construction/maintenance work zones by the Regional Traffic Engineer upon completion of an engineering and traffic study warranting the reduction. Documentation of the speed reduction change shall be performed and maintained (see Work Zone Speed Analysis form, TE-350).**

Guidance

16 *TTC plans should be designed in accordance with the approach speeds prior to construction when possible.*

17 *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 in ten-mile per hour increments, and additional TTC warning devices should be used.*

18 *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:

19 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:

01 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.

02 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, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC device.

03 An incident zone is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a traffic incident (see Section 6I.01). 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.

04 A planned special event often creates the need to establish altered traffic patterns to handle the increased traffic volumes generated by the event. The size of the TTC zone associated with a planned special event can be small, such as closing a street for a festival, or can extend throughout a municipality for larger events. The duration of the TTC zone is determined by the duration of the planned special event and its affect on traffic volumes.

Section 6C.03 Components of Temporary Traffic Control Zones

Support:

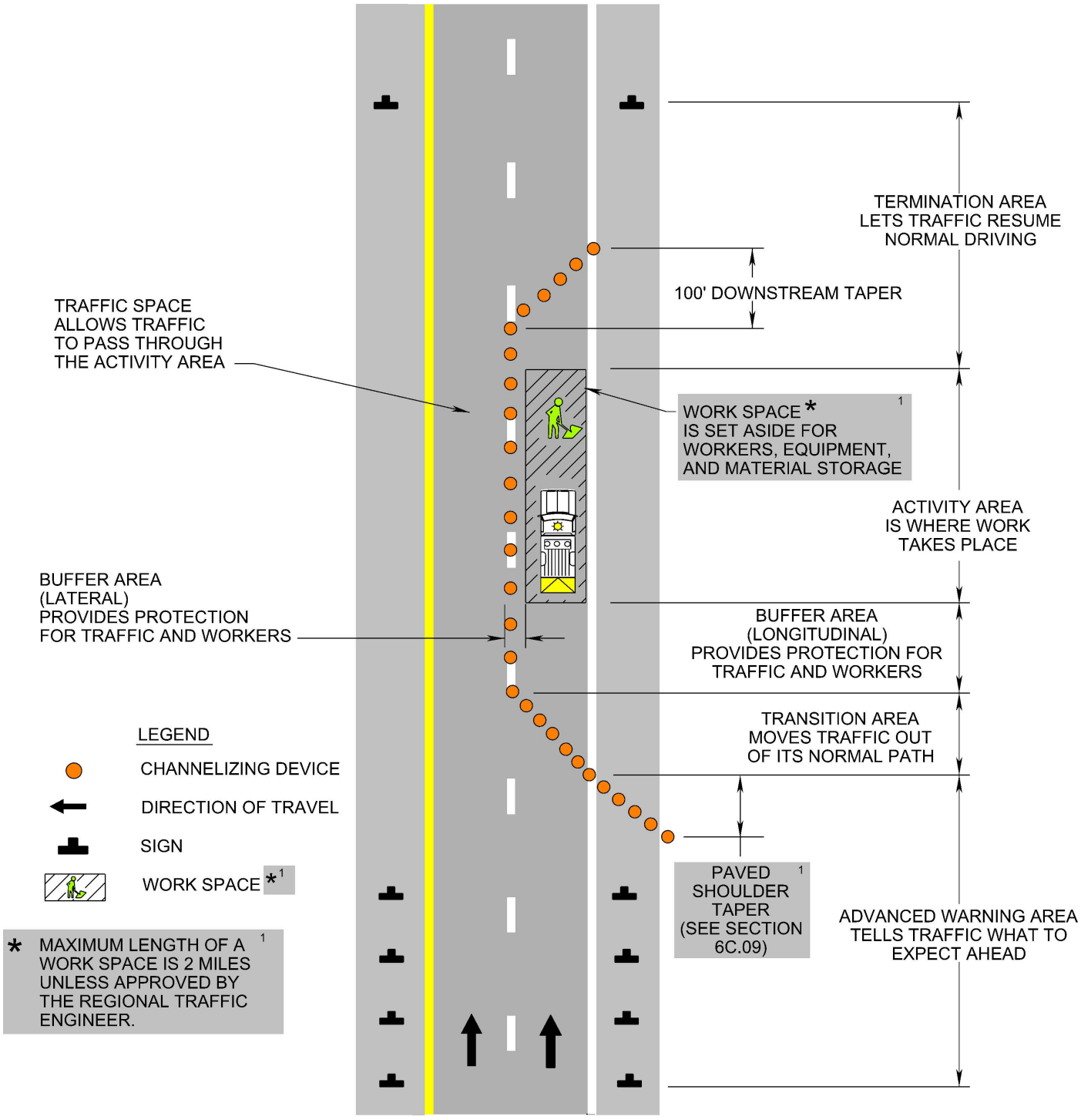
01 Most TTC zones are divided into five areas: the advance warning area, the transition area, the buffer space area, the activity area, and the termination area. Figure 6C-1 illustrates these five areas. These five areas are described in Sections 6C.04 through 6C.08.

Section 6C.04 Advance Warning Area

Support:

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

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



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Option:

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

Guidance:

03 *Sign spacing distance should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less (see Table 6C-1).*

Option:

04 Low speed urban streets with speeds of 25 mph or less may reduce the spacing to 100' - 200' between signs. Urban streets with speeds of 30 to 40 mph may use 250' to 350' between signs.

05 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 (See Appendix A for clear zone requirements) and approved by the Regional Traffic Engineer.

Table 6C-1, Recommended Spacing of Advance Warning Signs[1]

Road Type	Spacing (Feet)
Urban street with 25 mph or less posted speed	100 – 200
Urban street with 30 to 40 mph posted speed	250 – 350
*** All Other Roadways with 45 mph or less posted speed**	350 – 500
All Other Roadways with greater than 45 mph posted speed	500 – 800
Limited Access highways	1300 – 1500

* Urban streets with greater than 40 mph posted speed limits fall into this category.

Support:

06 The need to provide additional reaction time for a condition is one example of justification for increasing the sign spacing. Conversely, decreasing the sign spacing might be justified in order to place a sign immediately downstream of an intersection or major driveway such that traffic turning onto the roadway in the direction of the TTC zone will be warned of the upcoming condition. In addition, in urban conditions, it is generally better to attempt to place all advance warning signs within a one block area versus spreading out over several blocks, provided that motorists have time to recognize and react to the signs.

Section 6C.05 Transition Area

Support:

01 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:

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

Support:

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

04 Because it is impractical in mobile operations to redirect the road user's normal path with stationary channelization, more dominant vehicle-mounted traffic control devices, such as arrow boards, portable changeable message signs, and high-intensity rotating, flashing, oscillating, or strobe lights, may be used instead of channelizing devices to establish a transition area.

Section 6C.06 Buffer Space

Support:

01 The 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.

Standard:

02 **Neither work activity nor storage or placement of equipment, vehicles (including law enforcement), or material shall occur within a buffer space**.

Option:

03 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.

Guidance:

04 *A longitudinal buffer space should be placed 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.*

05 *If a longitudinal buffer space is used, the length should be as shown in Table 6C-2 and is based on the posted speed limit. These distances should be increased for downgrades and other geometric conditions that affect stopping distance.*[1]

Support:

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

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

Option:

08 The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figure 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.

Table 6C-2, Length of the Longitudinal Buffer Space

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 – 120
25	155 – 165[1]
30	200 – 210
35	250 – 260
40	305 – 325[1]
45	360 – 380
50	425 – 445
55	500 – 530[1]
60	570 – 600[1]
65	645 – 675
70	730 – 760
75	820 – 850

Guidance:

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

10 *Where traffic barrier service is being utilized, consideration should be given to the maximum dynamic deflection for the type of barrier service being used so that the effective buffer space between the barrier and work area is achieved (see Appendix A for barrier dynamic deflection values).*

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Option

11 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:

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

Section 6C.07 Activity Area

Support:

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

02 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.

Option:

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

Guidance:

04 *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.*

05 *The maximum length of the work space should not exceed two miles unless approved by the Regional Traffic Engineer (see Figure 6C-1)*[1].

Support:

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

Section 6C.08 Termination Area

Standard:

01 **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.**

Guidance:

02 *An END ROAD WORK sign should be used to inform road users that they can resume normal operations as determined by engineering judgment.*[1]

Option:

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

Standard:

04 **If the entire project is signed for a reduced speed, and an original speed limit sign is not within 1000 feet of the END ROAD WORK (G20-2 (V)) sign, signs depicting the original speed limit shall be erected 500'± past the END ROAD WORK sign. On secondary roads without posted speed limits, an END WORK ZONE SPEED LIMIT (R2-12) sign shall be used in place of erecting an R2-1 sign. If only part of the project is signed for a reduced speed, then the original speed limit shall be posted 500'± past the work area (see TTC-52).**[1]

Section 6C.09 Tapers

Option:

01 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.

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Support:

02 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.

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

Type of Taper	Taper Length (L)
Merging	L= Minimum
Shifting	L Desired, ½ L Minimum
Shoulder	⅓ L Minimum
Two-Way Traffic	50 Feet Minimum,100 Feet Maximum
Downstream	50 Feet Minimum,100 Feet Maximum
L= Taper Length, W= Width of Offset, S= Posted Speed Limit	

Table 6C-4, Taper Length Chart

Taper Length (L)					
Posted Speed Limit (mph)	Width of Offset (Feet)				Remarks
	9	10	11	12	
≤ 25	95	105	115	125	$L= S^2W/60$
30	135	150	165	180	"
35	185	205	225	245	"
40	240	270[1]	295[1]	320	"
45	405	450	495	540	L=SW
50	450	500	550	600	"
55	495	550	605	660	"
60	540	600	660	720	"
65	585	650	715	780	"
70<	630	700	770	840	"
Limited Access highway merging taper length (L) shall be 1000 feet regardless of the posted speed and SW=L is desired for the shifting taper length with ½L being the minimum.					

03 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:

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

05 *The appropriate taper length (L) should be determined using the Table 6C-4.*

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06 *The maximum distance in feet between devices in a taper should not exceed 20 feet at posted speeds up to 35 mph, and 40 feet for posted speeds greater than 35 mph.*

Support:

07 A merging taper requires the longest distance because drivers are required to merge into common road space.

Guidance:

08 *A merging taper should be long enough to enable merging drivers to have adequate advance warning and sufficient length to adjust their speeds and merge into a single lane before the end of the transition.*

Support:

09 A shifting taper is used when 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:

10 *A shifting taper should have a length of approximately ½ L (see Tables 6C-3 and 6C-4). Limited Access highway shifting taper should be SW=L with ½ L being the minimum.*

Standard:

11 **On roadways with paved shoulders having a width of 8 feet or more, a shoulder taper shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.**[1]

Guidance:

12 *If used, shoulder tapers should have a length of approximately ⅓ L (see Tables 6C-3 and 6C-4). If a shoulder or parking lane is used as a travel lane, either through practice or during a TTC activity, a normal merging (L) taper or shifting (½ L) taper should be used.*

Option:

13 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:

14 *When used, a downstream taper on a multi-lane roadway should have a length of approximately 50 feet minimum to 100 feet maximum with devices placed at a spacing of approximately 20 feet contained within the lane adjacent to the open travel lane (see Figure TTC-18.*

Support:

15 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.

Guidance:

16 *Traffic should be controlled by a flagger or a STOP or YIELD sign. A short taper having a maximum length of 100 feet with channelizing devices at approximately 20-foot spacing should be used to guide traffic into the one-way section. A 50 to 100 foot downstream taper should also be used to guide motorist back to the open travel lane.*

Support:

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

Section 6C.10 Detours and Diversions

Support:

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

Guidance:

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

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

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Figure 6C-2, Examples of Types of Tapers and Buffer Spaces

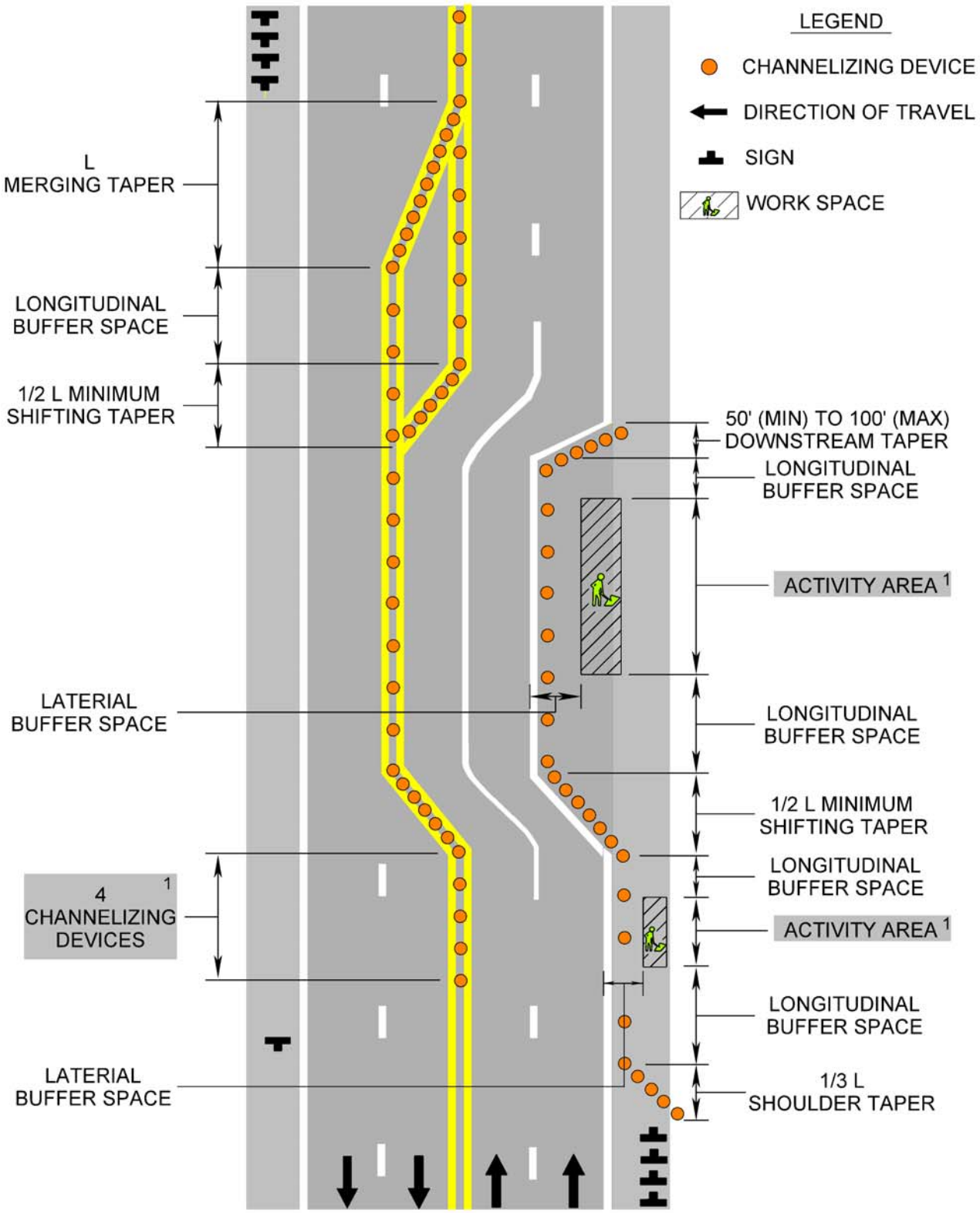

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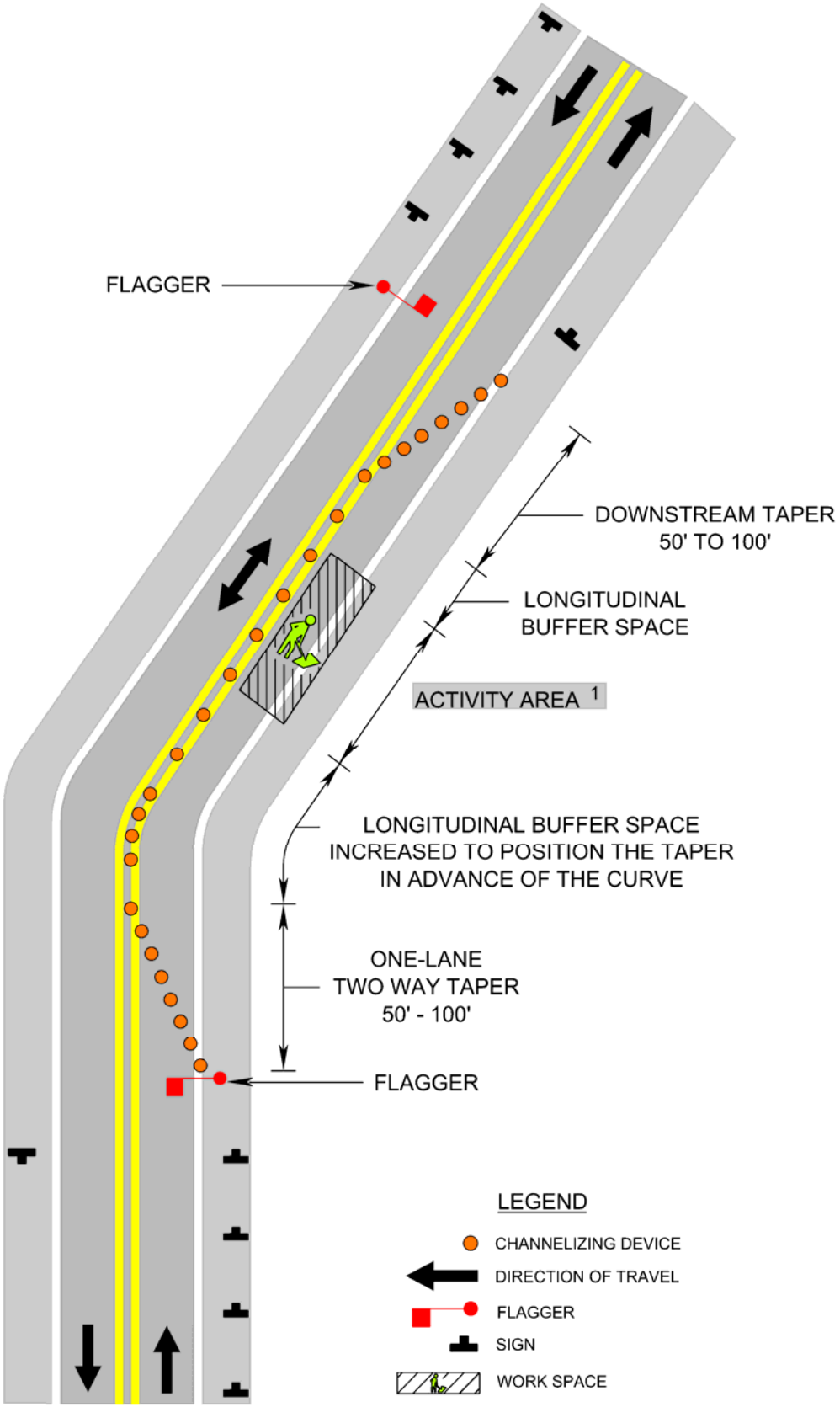
Figure 6C-3, Example of a One-Lane, Two-Way Taper



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Section 6C.11 One-Lane, Two-Way Traffic Control

Standard:

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

Guidance:

02 *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.*

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

04 *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 Sections 6C.14 and 6F.63, or a traffic control signal should be used to control opposing traffic flows.*

Option:

05 If the work space on a low-volume (less than 500 vpd) street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.

06 On roadways 20 foot or less in width, cones for channelization may be eliminated due to limited room for vehicles to pass activities and equipment in the remaining travel lane.

Standard:

07 **A one-lane, two-way taper shall be used to close the lane with work activities for conditions described in Paragraph 6.**

Section 6C.12 Flagger Method of One-Lane, Two-Way Traffic Control

Option:

01 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:

02 *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 or lead flagger. 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.13 Flag Transfer Method of One-Lane, Two-Way Traffic Control

Support:

01 The driver of the last vehicle proceeding into the one-lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that it is reasonably safe to allow traffic to move in the other direction. A variation of this method is to replace the use of a flag with an official pilot car that always follows the last road user vehicle proceeding through the section.

Guidance:

02 *The flag transfer method should be employed only where the one-way traffic is confined to a relatively short length of a road, usually not more than 1 mile in length.*

Section 6C.14 Pilot Car Method of One-Lane, Two-Way Traffic Control

Option:

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

Guidance:

02 *The operation of the pilot vehicle should be coordinated with flagging operations or other controls at each end of the one-lane section.*

Standard:

03 **The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted at a conspicuous location on the rear of the vehicle. The pilot car shall have the name of the contractor or contracting authority prominently displayed.**

04 **A flagger shall be stationed on the approach to the activity area to control vehicular traffic until the pilot vehicle is available.**

Section 6C.15 Temporary Traffic Control Signal Method of One-Lane, Two-Way Traffic Control

Option:

01 Traffic control signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones as approved by the Regional Traffic Engineer (see Figure TTC-25, Chapter 4H of the 2009 MUTCD and Standard TS-1 of the Road and Bridge Standards).

Section 6C.16 Stop or Yield Control Method of One-Lane, Two-Way Traffic Control

Option:

01 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:

02 *The use of STOP or YIELD signs for traffic control on low-volume roads at a one-lane, two-way work zone should have written approval from the Regional Traffic Engineer. See warrants for No-Passing Zones at Curves in Chapter 3B of the 2009 MUTCD.*

03 *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.*