

## CHAPTER 503

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# Maintenance of Traffic

Design Memorandum	Revision Date	Sections Affected
19-12	Oct. 11, 2019	<p>Ch. 81-83 superseded by Ch. 503.</p> <p>Following sections effective with Stage 2 submittal on or after November 1, 2019.</p> <ul style="list-style-type: none"> <li>• <b>503-3.04(13) Pedestrian Accessibility</b></li> <li>• <b>503-3.05 Positive Protection</b></li> <li>• <b>503-7.0 Temporary Traffic Control Devices</b></li> </ul> <p>All other sections effective with Stage 1 submittals on or after October 11<sup>th</sup>.</p>
20-12	Aug. 2020	503-3.05(04)
20-24	Nov. 2020	503-7.03 and 503-7.03(01)
21-10	Apr. 2021	503-4.02

23-04	May 2023	503-2.02, 503-2.02(01),503-2.04(03) ,503-2.05(01),503-2.05(02),503-3.01(03),503-3.01(04),503-3.01(04),503-3.04(02),503-3.04(03),503-3.05(02),503-3.05(07),503-7.01(03),503-7.01(05),503-7.04(02),503-7.05, and 503-7.07
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# MAINTENANCE OF TRAFFIC

## 503-1.0 GENERAL [Rev. May 2023]

Where the normal operation of a roadway is suspended, the maintenance of traffic (MOT) design and plan details will provide for the continuity of vehicle, bicycle, and pedestrian traffic as well as access to property and utilities. MOT has two objectives:

1. provide for reasonably safe and efficient road-user movement through or around a roadway work zone to protect workers, incident responders, and equipment.
2. provide for the efficient completion of the construction or maintenance activities interrupting the normal operation of the roadway.

MOT design should begin during the planning phase of a project and continue through the project's completion of construction. The [\*Indiana Manual on Uniform Traffic Control Devices \(IMUTCD\)\*](#) requires that MOT design consider the needs and safety of construction workers and road users, including persons with disabilities, in accordance with the Americans with Disabilities Act of 1990 (ADA).

Maintenance of Traffic needs are addressed through a project specific Transportation Management Plan (TMP). As a result, all projects should have a TMP. All TMP's should include a Temporary Traffic Control Plan (TTCP). The TTCP may include project specific plan details (typically referred to as MOT plan sheets), standard drawings, contract provisions, references to a typical application from the MUTCD, or a combination of these.

For projects that have significant impacts to the public (see Section 503-2.02), and when necessary for other projects, the TMP will include a Transportation Operations Plan (TOP), and a Public Information Plan (PIP). Project specific TOP and PIP are not required and typically not needed for non-significant projects; however, INDOT's Standards and standard business practices provide certain TOP and PIP measures on many projects particularly those that affect travel lanes or shoulders. For instance, notices of lane closures are posted by the district office to INDOT's website for viewing by the public shortly before the closure takes effect. The Engineer's Report should indicate if a project will have significant impacts and if a TMP that includes a TOP and PIP will be required.

The guidance and procedures contained in this chapter should be applied to design-build projects as well as design-bid-build projects. Technical provision prepared for design-build projects should include this requirement.

## **503-2.0 TRANSPORTATION MANAGEMENT PLAN [Rev. May 2023]**

A Transportation Management Plan (TMP) is an overall strategy to accommodate traffic during road work that minimizes adverse impacts and maximizes safety or and mobility. The TMP should minimize the exposure to potential hazards for both motorists and highway workers in the work zone vicinity. The TMP should also minimize the vehicular delay in the work zone vicinity.

All projects require a TMP. The scope, content, and degree of detail present in a TMP will vary based in part on the project being identified as significant or non-significant in relation to work zone impacts, see Section 503-2.02.

### **503-2.01 Federal Highway Administration (FHWA) Rules on Work Zone Safety [Rev. May 2023]**

The Work Zone Safety and Mobility Rule and the Temporary Traffic Control Devices Rule appear in the [Code of Federal Regulations 23 CFR 630 Subparts J and K](#) respectively.

The Work Zone Safety Rule requires every state to have a policy for the systematic consideration and management of work zone impacts on all federal-aid highway projects. The Temporary Traffic Control Devices Rule supplements the Work Zone Safety and Mobility Rule that addresses traffic control devices, positive protection, and police enforcement in work zones.

The INDOT [Policies, Processes, and Procedures for Work Zone Safety and Mobility](#) (*Work Zone Safety and Mobility Policy*) demonstrates compliance with the CFR, sets forth the work zone assessment management policy, as well as the work zone data collection procedure. The policy is available from the INDOT [Work Zone Safety webpage](#).

### **503-2.02 Work Zone for Significant and Non-Significant Projects [Rev. May 2023]**

All projects will be identified as either significant or non-significant in relation to work zone impacts. This determination should be made during project scoping and documented in the Engineer's Report. A Significant Work Zone Impact Determination Worksheet is available on the editable documents webpage of the IDM to provide a record of this determination, the worksheet should be completed and attached to the Engineer's Report.

The *Work Zone Safety and Mobility Policy* should be reviewed to determine whether a project is considered to have significant impact or non-significant impacts.



If the Significant Work Zone Impact Determination Worksheet was not included with the Engineer's Report, then the designer should complete the worksheet early in the design process, directly after receiving the notice to proceed, and submit it to the INDOT Technical Services Division as an Addendum to the Engineer's Report.

### **503-2.02(01) Significant Projects [Rev. May 2023]**

A significant project as it relates to the proposed Transportation Management Plan (TMP) is defined as a project which causes sustained work zone impacts greater than what is considered tolerable based on INDOT policy and/or engineering judgment. The TMP should be developed in accordance with 23 CFR 630.1010 for significant projects and will include the proposed Transportation Operations Plan (TOP), the Public Information Plan (PIP), and the Temporary Traffic Control Plan (TTCP).

1. Interstate Projects. All Interstate system projects within the boundaries of a designated Traffic Management Area and that occupy a location for more than three days with either intermittent or continuous lane closures are considered significant. See Section 503-2.03 for designated Traffic Management Areas.
2. Additional INDOT Criteria. A project, regardless of route type, may be deemed significant based on the considerations listed below:
  - a. Where the project scope of work consists of major reconstruction or new construction
  - b. Where there are high traffic volumes, 12,000 AADT for two lane highways and 30,000 AADT for multilane highways;
  - c. Where the project is in an urban or suburban area (will pedestrian access be restricted);
  - d. Where side street or driveway access will be closed off for more than one daytime; or will access to a local business be significantly impacted.
  - e. Where ramps or interchanges will be closed,
  - f. Where the road will be closed for more than one daytime period and where emergency vehicles or school access could be affected, school bus stops in/around the work zone, significant employer, or an industrial facility (quarry, power plant, etc.) will be affected by the work
  - g. Where timing and seasonal impacts may be significant;

During design development, when changes to the project scope cause a project to be deemed significant in accordance with the items above, the project manager should be notified as soon as possible.

### **503-2.02(02) Non-Significant Projects [Rev. May 2023]**

In general, a work zone that does not include criteria listed above will be deemed non-significant. The TMP for non-significant projects is only required to include a TTCP, but a TOP and PIP may be provided if the designer or district determines a need.

### **503-2.03 Indiana Traffic Management Area**

Indiana Traffic Management Areas are defined in the *Work Zone Safety and Mobility Policy* and consist of predominantly urban counties. They include

- Cincinnati (all of Dearborn County)
- Evansville (all of Vanderburgh and Warrick Counties)
- Fort Wayne (all of Allen County)
- Gary (all of Lake, La Porte, and Porter Counties)
- Indianapolis (all of Marion, Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, and Shelby Counties)
- Louisville (all of Clark and Floyd Counties)
- South Bend/Elkhart (all of St Joseph and Elkhart Counties)

A work zone in a Traffic Management Area that involves intermittent or continuous interstate lane closures of a duration longer than three days is considered a significant project.

### **503-2.04 TMP Development [Rev. May 2023]**

For a project with non-significant work zone impacts, the designer may coordinate TMP development without a formal team being established. For these projects the designer should coordinate with other involved parties including district Construction and district Technical Services.

#### **503-2.04(01) The TMP Team [Rev. May 2023]**

The TMP team is responsible for developing and implementing the TMP for a significant project. Typically, the TMP team is multi-disciplined and will consist of a representative from each entity that will be involved in the implementation of the project. The designer should contact all of the pertinent entities to form the TMP team. For a particular project, representatives from the pertinent entities may include the following:

1. project designer;
2. project manager;
3. district Scoping Manager;
4. district Construction Office;
5. district Traffic Office;
6. Work Zone Safety Office;
7. local public agency;
8. ITS Engineering Office
9. Public Safety Operations Office
10. FHWA Indiana Division Transportation Engineer;
11. Central Office Strategic or District Communications; and
12. others as deemed necessary, for example, emergency responders and school officials.

During the design phase, it will be the designer's responsibility to implement the recommendations of the TMP team. The TMP is to be discussed in detail at the preliminary and final field checks in addition to any meeting of the team. During the construction phase, it will be the project engineer's or project supervisor's responsibility to implement the recommendations of the TMP team and to consult the TMP team before making significant changes to the TMP. Performance issues during construction may require the TMP team to consider adjustments to elements of the TMP to improve mobility or safety. After the project is completed, the TMP team should evaluate the effectiveness of the TMP and prepare a final report documenting the findings and results of the TMP. This report should be included in the final construction record (in ERMS) and a copy sent to the Work Zone Safety Section. Sample Transportation Management Plans are available at the [FHWA Work Zone Management Program website](#).

#### **503-2.04(02) TMP Team Responsibilities [Rev. May 2023]**

The TMP team is responsible for deciding the transportation management strategy plan to be implemented for the project. The Engineers' Report may have designated a particular strategy for the TMP team, e.g., a detour, temporary runaround, or intermittent closure. The *IMUTCD*, Chapters 6G and 6H, may have a work zone application that is most relevant on point for the project. Regardless of which strategy has been designated, the TMP team is still responsible for collecting data, considering alternatives, analyzing feasible transportation management strategies based on the guidance given in the Engineers' Report, and making a final recommended transportation management plan. As the plan becomes finalized, the TMP team should write and keep a report that is also submitted with final tracings to be placed in the project file. The report should include the following sections:

1. Summary. A description of the location, project scope along with pertinent information about the existing roadway (e.g. number and width of lanes, AADT, projected construction

year, crash data, goals, objectives, official and local detour routes, businesses, residences, local emergency responders, etc.)

2. Temporary Traffic Control Plan. This section should indicate the traffic control strategy to be used, including recommended construction phasing, any special scheduling or contract considerations, indication of whether an exception to the [Interstate Highway Congestion Policy](#) (IHCP) is needed, and if so, whether it has been obtained, portable changeable message sign use, etc. See section 503-3.02.
3. Transportation Operations Plan. Strategies recommended to mitigate adverse impacts to the public and workers during construction. See section 503-4.0.
4. Public Information Plan. Off-site means for disseminating information on the project. See section 503-5.0
5. Maintenance of Traffic Plan Sheets. The MOT sheets may include MOT typical cross section(s) showing phased construction, plan sheets detailing each phase of construction, detour sheets, advanced signing sheets, plans for modifications or improvements to detour routes, etc. These plan sheets will be incorporated in the plan set or for smaller project included in the contract information book.
6. Vicinity Map. This map is to be included where detours are specified or alternative routes will be utilized by traffic. The map should be a large enough scale to show land use, side streets adjacent to the project area, detours, and alternative routes.
7. Meeting Minutes/Notes. The designer should include minutes from meetings where the TMP is discussed as well as a list or tabulation of suggestions for the TMP that are made by team members or other concerned parties. This record should note not only the suggestion but their resolution keeping in mind that some suggestions will not be incorporated into the TMP but all merit consideration.

If a detour is selected as the traffic control strategy, the TMP team should consider whether improvements are needed to the detour route, e.g., widening of the detour route, adding turn lanes at critical intersections, improved signal timing, and other features as noted in [503-2.05\(01\)](#). The designer or project manager will work with the district to secure approval from the Local Public Agency (LPA) for each detour agreement that may be necessary between the State and a LPA for a local road to be used as a detour or alternate route. See *Indiana Code* [IC 8-23-21](#) and [INDOT Detour Policy](#). The project manager should work with Construction management and the INDOT attorney assigned to the district to write the agreement. The attorney will provide standard contract terms and provisions that should be used but will need information on the work along the detour

route that INDOT will take responsibility for. This policy applies to roads only within the state of Indiana, should an official detour route involve roadway segments in adjacent states the district should coordinate with representatives from those state(s).

### **503-2.04(03) Significant Interstate Projects Not Requiring Exceptions to the IHCP [Add. May 2023]**

In keeping with the principle that the extent of the TMP is based on the expected impacts to traffic, for projects that are significant due to being in a Transportation Management Area but do not require an exception to the IHCP, the TMP may be simplified from the level of detail necessitated by a project that requires an IHCP exception. The use of a simplified TMP is particularly supported in cases where the project will not involve a reduction in the number of lanes, a reduction in lane or shoulder width, or affect ramp access. Even though the TMP needed for these projects may be simplified (e.g., MOT plans with TOP and PIP measures that are done as standard agency practice), a meeting specific to MOT should be held directly after Notice to Proceed is issued to verify that a simplified TMP is appropriate, e.g., that an IHCP Exception will not be needed.

For projects with a simplified TMP a completed Traffic Control Plan Checklist, which is available from the Department's [Editable Documents](#) webpage under Traffic Maintenance (MOT), may serve as the TMP Report. The project should require no more than a single lane or shoulder closure in a segment(s) where the closure is allowable at any time per the pre-approved schedules found in the IHCP: <https://www.in.gov/indot/safety/work-zone-safety/interstate-highways-congestion-policy/>

### **503-2.04(04) Starting the TMP Design- All Projects [Add. May 2023]**

The first step is to review the traffic control strategy identified in the Engineer's Report. Regardless of the strategy identified, the viability of a complete or one directional road mainline closure with detour or crossover/runaround should be checked with the appropriate worksheet unless the work will not occupy a travel lane or would do so for no longer than three seven days. If the work will not occupy a travel lane for more than three seven days these strategies need not be considered. The analysis of closure with detour viability may be stopped when any of the various factors show non-viability, for example it is not necessary to complete the entire worksheet if the only practical detour has a bridge with a load posting. This review will be particular useful when there is a significant gap in time between the issue of the engineer's report and when design commences as well as in other circumstances. For example, when a full closure with detour is the strategy identified but the project will be bundled so that the availability of the detour route(s) need to be reconfirmed.

If the designer/TMP determines that a different strategy is to be used the procedure in 503-2.05 should be followed including notifying the district Asset Management of the change.

Closure of a freeway ramp for any duration work may be considered, particularly in urban areas where access to and from nearby interchanges is available. This strategy may be the most desirable when work is being done on the ramp, adjacent to the gore area, at a bridge overpass over mainline in the within the interchange, at ramp intersections with the crossing road, or when mainline capacity is reduced such that additional traffic from an entrance ramp will generate queuing or safety issues.

### **503-2.05 Traffic Control Strategies [Rev. May 2023]**

#### **503-2.05(01) Traffic Control Strategy Terminology and Guidelines [Rev. May 2023]**

The following traffic control strategy terms are defined as follows:

1. Complete Road Closure with Detour. This work zone type involves total closure of the roadway in one or both directions of travel where work is being performed, and rerouting the traffic to existing alternate routes. This strategy can also be used for certain hours of the day, e.g., 8 p.m. to 6 a.m. on weekdays and from 8 p.m. to 8 a.m. on weekends.

Detour examples appear in *IMUTCD*, Chapter 6H. This application is desirable and feasible where access to properties on the closed route can be maintained and there is unused capacity on roads that comprise an alternative route or the alternative route can be modified or improved to accommodate the additional traffic demand. See Figure 503-2A for typical capacities of various types of roadways. Examples of improvements or modifications to the detour route include:

- a. signal phasing or timing adjustments
- b. prohibition of on-street parking
- c. restricting/prohibiting turn movements at intersections and/or driveways.
- d. additional guide signing along multilane detours. The *IMUTCD* and INDOT *Standard Drawings* detail single lane detour routes.
- e. change in posted speed limit. It may be necessary to reduce the speed limit should the detour route be near or at capacity.
- f. temporary widening for turn lanes
- g. change in intersection control type (e.g. temporary signalization)
- h. temporary changes in channelization (e.g. installing a reversible lane to better accommodate both morning and afternoon peak traffic)
- i. pavement replacement, resurfacing, or patching.
- j. large or small structure repair or replacement

In addition to maintaining an official detour on state highways, INDOT may be required to repair a county highway being used as an unofficial detour, per current detour policy and the *Indiana Code* [IC 8-23-21-2]. The determination of what local route is designated as an unofficial detour is a joint decision between INDOT and the LPA. The designer should be prepared to make recommendations to INDOT on route selection, its existing condition, and any needed improvements to make the route usable during construction.

Local roads may also be used for the official detour provided they are viable and the agency(s) of jurisdiction agree. When a local road is used as the official detour an unofficial local detour will not be identified. For additional information see [INDOT's Detour Policy](#)

Requests for Interstate main line closures (full closure) require FHWA Indiana Division Administrator approval. Requests should be sent by INDOT (Deputy Commissioner), with the information outlined in section 503-2.05(03). The approval process begins with early coordination with the FHWA Transportation Engineer for the respective district. The time for coordination and approval of full Interstate main line closures may vary but generally takes three to six months.

Interstate ramp to Interstate ramp closures should also be submitted to the FHWA Indiana Division Transportation Engineer, or other Division representative, for approval.

2. Lane Closure on a Multi-Lane Highway. This work zone type closes one or more normal traffic lanes. Examples of lane closure work zones appear in *IMUTCD*, Chapter 6H. Capacity and delay analyses may be required to determine whether serious congestion will result from a lane closure. Use of the shoulder or median area as a temporary lane will help mitigate the problems arising from the loss in capacity. Upgrade or replacement of existing pavement or placement of temporary pavement may be necessary.

When a center lane closure is needed, on an interstate or freeway, the lane(s) to the left should also be closed. This is a safer and more viable method for the contractor compared to the adjacent lanes on the right and left being open to traffic. To be in accordance with the Interstate Highway Congestion Policy, lane closures, including center lane closures, typically are allowed at night or on weekends. Long term lane closure applications may require type 4 temporary traffic barriers (moveable).

3. Lane Closure on a Two-Lane Road. This work zone type involves utilizing one lane for both directions of traffic. Examples of lane closures on a two-lane road appear in *IMUTCD*, Chapter 6H. Flaggers or temporary traffic signals are used to coordinate the two directions of traffic. If flaggers, as opposed to temporary traffic signals, will be used,

consideration should be given to specifying Automated Flagger Assistance Devices in the TTCP. This should be discussed with district Construction at the preliminary field check. This work zone type may not be suitable for higher traffic volume roads (AADTs exceeding 10,000). Flagging operations may not be suitable where the closure will extend over several nights at one location.

As an alternative to flagging Portable Temporary Traffic Signals should be considered anywhere that the sight distance to the flagger's location would be limited, or when the project will require traffic control at night. For bridge thin overlay projects on two-way, two-lane roadways, Portable Temporary Traffic Signals should be used instead of flaggers. Fixed temporary signal should be used if the project duration at any one location will be greater than 4 months and if electrical service already exists or would cost less than \$5000 to provide- see section 503-7.04 for information on temporary signals.

4. Lane Shift. This work zone type involves using the shoulder or the median as a temporary traffic lane. *IMUTCD*, Chapter 6H provides an example of a lane shift on a freeway. To use this technique, it may be necessary to upgrade the shoulder to adequately support the anticipated traffic loads. This technique may be used in combination with other work zone types or as a separate technique.
5. Median Crossover. This work zone type involves routing all of one direction of the traffic stream across the median to the opposite traffic lanes. This application may also incorporate the use of the shoulder or a lane shift to maintain the same number of lanes. Examples of median crossovers appear in *IMUTCD*, Chapter 6H. For an interstate route or other divided highway, transferring traffic from a divided facility to two-way operations on one roadway should be used only if one or more of the following conditions are satisfied:
  - a. the crossover is allowed by the IHCP, or there are suitable grounds for an exception;
  - b. an alternate detour is unavailable or for an interstate is not cost-effective; or
  - c. pavement and shoulder structures can accommodate traffic in their existing state or be reasonably upgraded to do so.

Section 503-3.0 discusses the design issues relative to designing a two-way application, e.g., maximum length. If this application is used, opposing traffic must be separated with positive barriers, drums, cones, or vertical panels throughout the length of the two-way operation. Section 503-7.0 discusses the channelization devices that may be used with this layout. One construction technique involves the reconstruction of the shoulder to allow it to be used as a travel lane. Once traffic is shifted to a two-way operation, the availability of the shoulder as a third lane provides for an improved buffer between the bi-directional traffic and can facilitate emergency access.



6. Split Median Crossover. This method allows for multiple lanes to be maintained in one or both directions of travel by crossing one lane of traffic over to the side of the opposite direction of travel and maintaining one or more lanes on the side of the original direction of travel. Two lanes or more are maintained on the side that is not crossed over. This type provides additional capacity compared to the median crossover but does not offer the same safety advantages for motorists and workers. See INDOT *Standard Drawings* series 801-TCCO, Temporary Construction Crossover, for details for a four-lane maintained freeway application.
7. Runaround (Road Closure with Diversion). This work zone type involves the total closure of the roadway in one or both directions where work is being performed and the traffic is rerouted to a temporary roadway constructed within the inner right of way. An example of a road closure with diversion appears in *IMUTCD*, Chapter 6H. This application may require the purchase of temporary right of way and requires extensive preparation of the temporary roadway.
8. Runaround by Temporary Bridge. On a divided highway it may possible to accomplish the runaround within the existing right of way by installing a temporary bridge in the median. Standard drawings have not been developed; therefore, plan-specific detailing is required.
9. Shoulder Work with Minor Encroachment, or Lane Constriction. This work zone type is configured by reducing the width of one or more lanes to retain the number of lanes normally available to traffic. An example of shoulder work with minor encroachment is shown in *IMUTCD*, Chapter 6H. This application is the least disruptive work zone type, but it is only appropriate if the work area is mostly outside the normal traffic lanes. Narrow lane widths may reduce the facility's capacity, especially where there is significant truck traffic. The use of a shoulder as part of the lane width will help reduce the amount of lane-width reduction that can be required. Where this type is applied for a long-term work zone, the current lane markings must be removed to avoid motorist confusion.
10. Temporary Road Closure. This work zone type involves stopping all traffic in one or both directions for a relatively short period of time to allow the work to proceed. An example of a temporary road closure appears in *IMUTCD* Chapter 6H. For a project on an interstate route the preferred method to accomplish a short term road closure is with a rolling slowdown. A rolling slowdown provides for the same work period as a short term stationary closure but reduces the likelihood of end of queue crashes as vehicles do not stop but rather continue to move at a 20 mph pace. Consult the [IHCP](#) to determine whether a temporary road closure is acceptable on an interstate for the project location and for details on rolling slowdowns.

11. Work Duration. The period for which a worksite will be present on or adjacent to a roadway is classified as described in *IMUTCD*, Chapter 6G.

### **503-2.05(02) Selecting a Traffic Control Strategy [Rev. May 2023]**

Selection of the appropriate traffic control strategy represents one of the most significant elements of effective work zone traffic management. The identification of an appropriate strategy at an early stage in the planning process can significantly reduce the amount of time spent on analysis and expedite overall project planning and design. For all projects, traffic and the work area should be separated to the greatest extent possible.

A Traffic Control Strategy memo is available from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT), a memo specific for rural interstates is also available. The memo should be used to communicate and request feedback on the selected strategy whether the strategy is as identified in the engineer's report or whether a change is recommended. The guidance in this section should be used to verify the recommendation in the Engineer's report regardless of the type of strategy that is initially recommended. This procedure applies to design-build as well as design-bid-build contracts. The designer should inform district Asset Management of changes in the traffic control strategy to ensure the scope is revised accordingly. See Section 503-3.01(03) for additional information on the TTCP development schedule.

Except for work at a single bridge on a freeway where use of a temporary structure in the median (median runaround) should be considered before other options, the separation between traffic and the work zone should be maximized by considering strategies in the following order:

1. Complete Road Closure with Detour. Full consideration should be given to a complete closure of the roadway segment under construction while maintaining traffic through a detour on a designated route. Providing complete separation of traffic from the work area significantly improves worker safety and potentially decreases construction time. Risk for the traveling public is also reduced, including rear end crashes due to queuing, conflicts with construction traffic, navigation of changing traffic patterns due to phase changes, debris, etc.

A Detour Worksheet is available from the [Editable Documents webpage](#), under Traffic Maintenance (MOT). The worksheet should be used for determining the viability of a complete closure with detour. Factors to consider when evaluating a complete road closure are discussed below. The assessment should be coordinated with the district Office;

If it becomes apparent that a complete closure is not viable after evaluating several factors, the assessment may be concluded without examining the remaining factors.

Factors that should be considered when determining viability of a complete closure include:

- a. Location of work activity. If travel lanes will not be impacted or occupied by work, workers, equipment, or materials, a complete closure with detour may not be viable or needed.
- b. Duration of work. A complete closure utilizing a detour may not be viable for projects that are brief in duration (i.e. detour is needed only for no more than 7 days) particularly if modifications to or significant work along the detour route is needed.
- c. Interstate vs. Non-Interstate project. The detour for a project on the interstate should be on another freeway. See Section 503-2.05(03). The detour for a project not on an interstate highway may be along other highways on the state system, local roads, or a combination of the two with the local road being an “unofficial” detour. Local roads may provide a much shorter, viable route. When a local road is used as an official detour a signed agreement with the agency of jurisdiction is required.
- d. Ability of the detour route(s) to accommodate the displaced traffic. Peak hour volumes for the highway under closure should be added to the corresponding volumes for the detour route(s). If available, weekend volumes should also be examined. Note that peak hour weekend volumes may be estimated for any road/segment by applying seasonal adjustment factors to the weekday “average” counts. Hourly traffic volumes for the state highway system and a number of local roads as well as the seasonal adjustment factors are available through the [INDOT Traffic Count Database System](#). The amount of additional, displaced traffic added to the normal volumes on the detour may be reduced by the amount that is likely to take other alternative routes. The designer should check with district Technical Services on the amount of diversion.

The capacity estimate used for a detour leg that is not a freeway should be based on the type of traffic control for traffic along the detour. If a detour leg has multiple intersections that are controlled by signals or if the detour route approaches are stop controlled or a combination of both types of traffic control, the lowest capacity estimate should be used. See Figure 503-2A for typical capacity of various types of roadways. Additional information on capacity is available from the *Highway Capacity Manual* and from on INDOTs [IHCP Analysis Tools webpage](#)

Should the demand on the detour routes exceed 95% of the capacity of the detour route(s) a determination must be made as to whether the detour route(s) can be modified to provide additional capacity; for instance temporary signals may be used to replace stop signs at intersections along the detour. If demand exceeds 95% of the detour route capacity even after modifications, then the complete closure may not be viable pending the extent to which the detour will be over capacity.

Should the demand on the detour routes approach 95% of the capacity consideration may still be given to modifications that would increase capacity in order to provide a better level of service.

The assessment of detour route(s) should take into account geometry, vertical clearance, pavement condition, bridge/structure status, condition, the condition of large and small structures and heavy vehicle demand. For example, roads with narrow lanes or frequent shifts in horizontal alignment may not be suitable for a detour. Some roads may not accommodate a significant amount of, or even any, heavy vehicles.

Turning radii should be at least 125 ft for 90 degree angles, for other turning angles Chapter 46, table 46-2D should be used to determine the needed turning radius based on a WB-67 design vehicle. Lanes should be at least 10 ft in width, 11 ft if the detour will need to accommodate a significant amount of heavy vehicles, 200 heavy vehicles per day. Vertical grades should be no greater than 8%

If the segment under construction is used for permitted oversized vehicles the routes that comprise the detour should be checked to see if oversized vehicles can be accommodated. The INDOT CARS Program should be consulted about whether the segment carries oversized vehicles; the district Construction office should be notified of expected restrictions that will impact oversize and overweight permitting in order to update information in CARS. See the [CARS Program Truckers Information](#) page.

A check should be done as to whether the detour route being considered will be restricted in any way, e.g. under construction, during the time the detour is needed. If so, a different route should be considered. If none are available, a complete closure with detour may not be viable

A check should be done as to whether the detour route under consideration will be used as a detour for other projects. If so, the displaced traffic from the other projects should be included in the capacity check.

- e. Added travel time or distance via the detour route(s). Detours that add excessive travel time or distance may render a complete closure not viable. There is no set rule on how much added travel time motorists will find acceptable. The locale and duration of the detour should be considered. Engineering judgment must be applied to each project individually.
- f. Driveways located within the construction limits. Access for property owners must be maintained during construction – complete closures may not allow access while single direction closures may better accommodate. The street network adjacent to the construction limits may be used to provide access. Input from the community and businesses affected by the closure should be considered. The community and businesses affected by the closure may be more receptive to the detour strategy if it will substantially reduce construction time (e.g. a two year project could be completed in four months with a detour).
- g. Schools and emergency services. The decision for a complete closure should be communicated with stakeholders, for example, local officials, emergency responders, and school officials.

Added time for emergency response and for travel to/from schools (where applicable) should be considered. Emergency responders are usually able to work around a closure, but not always. Added travel time to the nearest hospital is a factor to consider. Responders may be able to adjust boundaries with neighboring jurisdictions while the road is closed. It may be possible to keep a crossing of one or more side street approaches (at intersections) open for emergency vehicles but closed the road for all other vehicles.

School districts near the project should be contacted to get information about school bus stops and school access routes. Higher concentration of these may make another possible detour route more desirable. The webpage for IndianaMAP, <http://maps.indiana.edu>, contains a statewide directory of both public and private schools including district boundaries. The school data layers are under the infrastructure tab and can be displayed along with the layer that shows the roadway network.

- h. Detour Length. The availability of rest areas, truck stops, and fuel stations should be considered for detours longer than 25 miles.
- i. Other factors as determined by district Technical Services.

2. Median Crossovers and Runarounds. The *IMUTCD* collectively refers to these options as Road Closure with Diversion. Should a complete closure not be viable, then a median crossover (divided highways only) or a runaround should be considered. These strategies provide separation by diverting traffic from the roadway in the immediate work area.

A Crossover and Runaround Viability Worksheet is available from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT). The worksheet should be used to document the decision to use a median crossover or runaround and incorporated into the project file. Any revisions should be shared with the TMP team.

3. Maintaining Traffic Adjacent to the Work Area. If it is determined that it is not possible to use a work zone strategy that separates traffic from the work zone, then types that maintain traffic through the work area should be evaluated and the relative merits weighed. Factors that should be considered include length of the work zone, duration of work, time of work, number of lanes, widths of lanes, traffic speeds, and right of way. Considering these and other factors, reasonable alternatives can be narrowed to a select few for further review. Only a small number of feasible work zone alternatives will emerge for a particular project and only one may be practical.

Figure 503-2B provides additional guidelines for identifying feasible work zone alternates based on roadway type, lane-closure requirements, shoulder width, traffic volume, availability of right of way, and detour routes. Key terms appearing on this figure are defined in section 503-2.05(01). Since every work zone location will have a variety of conditions, an all-inclusive selection matrix is not practical.

When selecting a strategy, local policy and regulations should be recognized. Many jurisdictions have adopted safety regulations and public convenience policies as safeguards against the unacceptable impacts of work zones. These regulations and policies can impose additional constraints regarding the types of traffic control strategies that may be implemented. Knowing these constraints can help eliminate infeasible alternates from consideration. The public convenience policies or local regulations may specify peak hour restrictions, access requirements, noise level limitations, material storage and handling, excavation procedures, work zone length, and number of traffic lanes that must remain open.

As feasible alternatives are identified, the advantages and disadvantages of each relative to construction cost, constructability, and safety for both motorists and workers need to be evaluated, shared with the TMP team when applicable, and documented. Construction time, motorist delay, and impacts to businesses and communities should also be considered. Typically, an alternative that displays the most advantages and least disadvantages is selected but value judgments about how to weigh each consideration will need to be made

by the TMP team. Seldom is one work zone type the most advantageous to all these considerations. Additional guidance on assessing work zone impacts and comparing alternatives may be found at:

[https://ops.fhwa.dot.gov/wz/resources/impact\\_factsheet.htm](https://ops.fhwa.dot.gov/wz/resources/impact_factsheet.htm)

NCHRP Report 581: Design of Construction Work Zones on High Speed Highways.

NCHRP Report 627: Traffic Safety Evaluation of Nighttime and Daytime Work Zones

Should the strategy selected be a complete closure with detour, the designer should coordinate with INDOT's Freight Manager in the Multi-modal Division. The Freight Manager will work with the Department of Revenue and the State Police to implement and enforce the change in routing.

### **503-2.05(03) Complete Closure of an Interstate [Rev. May 2023]**

Complete closure of an interstate in both travel directions concurrently is only practical where other freeways are available for the detour route, usually in urban areas. Therefore, traffic control strategies for rural interstate projects should start with consideration of crossing over traffic to one side at a time. If both entering and exiting crossovers are located proximate to the construction limits and if they are in need of only temporary traffic control, then the crossover strategy should be selected. If crossovers would need to be constructed or reconstructed, then closure of a single direction at a time with detour should be considered. If closure in a single direction is not viable then construction or reconstruction of crossovers should be considered for projects other than those involving a single bridge. For projects involving a single bridge a runaround utilizing a temporary bridge should be considered. If a crossover or runaround is not viable, then traffic will be maintained adjacent to the work area; see Sections 503-2.05(02) items 2 and 3.

A complete closure of a segment or systems ramp may be the best alternative where other freeways are available for detouring. In accordance with 23 CFR 658.11, complete mainline closures require FHWA approval. An analysis demonstrating that full closure is the best traffic control strategy should be submitted with the request. This analysis should include all feasible alternatives to a closure and address the following issues

1. safety problems supporting the closure;
2. impact of the closure on construction time
3. viability of the proposed detour route(s). An Interstate Detour Worksheet is available from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT). The worksheet should be completed and the following assessed based on the findings:
  - a. the added travel time, delay along the detour.

- b. the route's ability to safely accommodate commercial vehicles;
  - c. coordination with other projects including a statement of planned work on the detour route and identification of thr any other projects that might use the same detour;
4. impact of the closure on interstate commerce;
  5. evidence of consultation with local governments as well as the Governor or delegate on any adjacent state that may be directly affected.
  6. public outreach efforts and feedback

The request should be submitted to the FHWA Division Office. by the Project Manager or INDOT Designer. Once the FHWA has concurred with the request an exception to the IHCP should be submitted for approval.

The detour for ramp closures at system interchanges should be on other freeway facilities or system interchange ramps when these facilities are adjacent to the closed ramp. However, when other freeways or system ramps are not adjacent, ramps at full or modified cloverleaf service interchanges may be used as a potential detour route. An operational analysis of the ramps ability to function as a detour as defined by items 1 through 3 should be performed and an estimate of the savings in travel time compared to use of a system interchange ramp should be provided. The FHWA should be notified of plans to close any interstate ramp and be given an opportunity to review and comment

The Indiana Motor Trucking Association should be notified of complete Interstate, and Interstate Ramp to Interstate Ramp closures once that decision has been made. This should occur as soon as information on the detour route and timetable for the closure is known. Notification should come from an INDOT member of the TMP team and a copy of the notification should be provided to the FHWA.

**503-2.05(04) Work Zone Phasing for Maintaining Traffic adjacent to the Work Area [Rev. May 2023]**

The sequencing of construction for a project can greatly affect the traffic flow through the work area. In addition to the traffic control strategies discussed in Section 503-4.01, this section provides summaries of the strategies that should be considered during the development of a TMP. These strategies must be reviewed and adjusted to satisfy each project location and situation. The



strategies discussed below are not all-inclusive, thus other options may be available for the location under consideration.

1. Reconstruction by Halves or Sides. This approach involves the reconstruction of all lanes in one direction while the opposing lanes share the same roadway with traffic in the other direction. See Figure 503-2C, Reconstruction by Halves or Sides. This concept can also be extended to reconstruction by thirds or other portions. When applying this sequencing method to a project involving a six-lane facility, traffic is restricted to two lanes in each direction. This can require using the shoulders, reducing the lane widths, or providing minor widening. Under certain circumstances, depending on the median width and shoulder configuration, the inner lane of a two-way operation may not be readily accessible during an emergency. Providing for emergency turnouts or emergency-vehicle access at appropriate intervals on the segment under construction should be considered. Some advantages and disadvantages of this strategy include the following.
  - a. Advantages.
    - 1) It provides an effective work area.
    - 2) Workers are well-separated from the traffic stream.
    - 3) Worksite access can be arranged with minimal interference from the general traffic flow.
  - b. Disadvantages.
    - 1) Crossovers are required.
    - 2) There is a need for positive separation of the traffic streams.
    - 3) There are potential emergency access problems in the inner lane.
    - 4) There may be problems at interchanges with traffic crossing the work zone.

2. Parallel or Adjacent Reconstruction

This approach involves a variety of lane-closure sequences. See Figure 503-2D, Parallel or Adjacent Reconstruction. The phases are as follows:

- a. The existing shoulders are widened and strengthened.
- b. Traffic is shifted to the shoulders to allow construction of the inner lanes and median reconstruction.
- c. Traffic is then shifted to the newly-constructed inner lanes to allow reconstruction of the outer lanes.
- d. After construction is completed, traffic is returned to the normal travel lanes.

An advantage of this strategy is that traffic need not cross over the median and does not operate in a two-way operation. Some of the disadvantages include the following:

- It provides a more constrained work area for the Contractor;
- Work crews are closer to moving traffic; and
- Access to the construction zone involves entry and exit from the travel lanes.

When applying this sequencing technique to a project involving a six-lane facility where, traffic is being reduced to two lanes in each direction. If closing the middle lane, it is preferable to keep the two through lanes on the same side of the construction zone, e.g., by using the shoulder, versus splitting the two lanes on either side of the construction zone.

3. Serial or Segmental Reconstruction. This strategy consists of specifying that only short segments of the facility to be under construction at one time. This also requires application of one or more of the other concepts for traffic accommodation. This concept is illustrated in Figure 503-2E, Serial or Segmental Reconstruction. An example of this application includes a mill-and-fill type resurfacing project.

The advantages of this strategy include relatively short work zones, and few if any interchanges are impacted at one time. A disadvantage of this strategy is that the overall time period that the facility is under construction can be considerably lengthened because the construction for each segment will proceed independently. Therefore, the exposure to the potentially hazardous conditions of a work zone for both the traveling public and the work force can be greater than with one of the other strategies.

4. Combination. A combination of construction sequences can be the best strategy. An example is reconstructing existing shoulders prior to the initiation of parallel construction activities. The sequence of construction may be as follows.
  - a. Phase A. Reconstruct shoulders as appropriate to allow one side of the roadway to accommodate four lanes.
  - b. Phase B. Shift traffic to the four available lanes on one side of the roadway.
  - c. Phase C. Shift traffic to the newly constructed side of the roadway using the additional reconstructed shoulder lane.

Other combination-type construction sequences involve the reconstruction of interchanges where both sequential and parallel activities may occur simultaneously. Ramps are reconstructed in a sequential arrangement, involving closure during construction with temporary detours to adjacent or alternate freeway-access points.

## **503-2.05(05) Project Scheduling [Rev. May 2023]**

Project scheduling can affect the overall success of the TMP. For example, restrictive scheduling may be required to facilitate the opening of a highway prior to a special event. In determining a construction schedule, the following should be considered.

1. Shortened/Accelerated Schedule. An accelerated schedule or early completion date may be considered when the adverse impacts of construction to motorists, businesses, and communities are anticipated to be significant. This measure can also be used to facilitate completion of the project, or a phase of the project, ahead of a special event or time of the year, for instance ahead of the beginning of the school year. Incentive/Disincentive clauses (Section 503-2.06) and Lane Rental (Section 503-4.01), and A + B bidding (Section 503-2.06(02)) may be useful in achieving early or accelerated schedules.
2. Time-of-Day or Day-of-Week Restriction. This type of restriction can be necessary if the work zone capacity cannot accommodate the expected demand during a peak traffic period or large event (e.g. the Indy 500) and when other measures are not as cost effective or are less safe for motorists and workers. For example, night work may be required to allow longer work hours than can be provided between morning and afternoon peaks and to decrease the excessive traffic delays or congestion associated with lane closures during the daytime.
3. Project Staging. Project staging or completing smaller portions of a project, one portion at a time, may be necessary to limit disruption to traffic. However, construction activity in the same area over several seasons should be discouraged.
4. Combining with Other Work. Multiple projects within a corridor may be combined, bundled, or scheduled at the same time where practical, pending available funding, to minimize impacts to the motoring public. The TMP may need to be adjusted for combing or bundling of projects.

## **503-2.06 Contract Provision Strategies [Rev. May 2023]**

### **503-2.06(01) Incentive/Disincentive Clause and Justification [Rev. May 2023]**

An incentive/disincentive clause is used to minimize the time that a facility can be affected by construction. This type of clause establishes the conditions under which the contractor is to be provided additional funds if the project is completed early, or is to be assessed damages if the project is not completed on time. Due to administrative concerns related to implementing this

concept, the use of an incentive/disincentive clause should be limited to a project that has one or more of the following characteristics:

1. high traffic volume in an urban area;
2. completion of a gap in the highway facility;
3. severe disruption in traffic or highway services;
4. significant increase in roadway user's costs;
5. significant impacts to adjacent neighborhoods or businesses;
6. replacement of a major bridge that is out of service; or
7. requirement of lengthy detours.

The Determination of Incentive/Disincentive Amount worksheet for is available from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT). INDOT has capped the amount of incentive/disincentive at the following per day:

- Urban Freeway - \$60,000
- Rural Freeway and Urban Non-Freeway - \$20,000
- Rural Non Freeway - \$10,000

Calculations are required to determine this value and cannot be assumed to be the capped amount. Exceptions to the cap require executive approval. The calculated value should be discussed with the district Construction Area Engineer. An incentive/disincentive clause request should be forwarded to the Contract Administration Division as soon as practical due to the time required for the Department to process the request.

### **503-2.06(02) A + B Bidding**

Where the impact of the worksite is significant, an A + B bidding incentive may be used to encourage the contractor to minimize the impacts described in the previous section by reducing the exposure time. A + B bidding consists of the following:

1. Part A. The total dollar amount required to complete the work. This amount is determined using the contractor's unit prices and the estimate of quantities determined by the INDOT.
2. Part B. The total dollar amount based on peak and non-peak-traffic-volume lane-closure periods, and the total contract days proposed by the contractor to complete the work. Part B is established by adding together the costs for each of the following:

$$\text{Peak-Traffic-Volume Lane-Closure Periods} = (\text{No. of Periods}) \times (\text{Cost} / \text{Lane} / \text{Period})$$

Non-Peak-Traffic-Volume Lane = (No. of Periods) x (Cost / Lane / Period); plus  
Contract Days = (No. of Days) x (Cost / Day)

The contractor is required to estimate the number of periods that the facility will be closed during peak- and non-peak-traffic-volume hours and the overall number of calendar days required to complete the contract. The cost for each of the above items is determined by INDOT and is the same for each bidder.

A + B bidding is used only for comparison purposes to determine a successful bidder. It is not used to determine payments to the contractor. A + B bidding is used in conjunction with incentive/disincentive clauses as discussed in Section 503-2.06(01). Before adding an A + B bidding special provision to a contract, the designer should coordinate its use with the Contract Administration Division and the district construction engineer.

### **503-2.06(03) Cost Evaluation**

When determining the costs of options for any interstate project or for a non-interstate project that where traffic will be maintained adjacent to the work area, e.g., lane closure, shoulder use, the designer should consider the following:

1. right-of-way cost, temporary and permanent;
2. effect on construction costs;
3. savings in construction time
4. improved quality of work
5. effect on wetlands or other environmentally sensitive areas;
6. utility impacts;
7. vehicular delay;
8. daily and total project user costs, including detour user costs if applicable;
9. crash potential;
10. worker safety and;
11. driving time.

When determining the effect of each on-site option, the designer should also consider the effect the selected option will have on an unofficial detour, i.e., a detour which a motorist selects on his or her own to avoid the construction area. See the *INDOT Detour Policy* regarding an unofficial local detour.

### **503-2.07 Traffic Impact/Queuing Analysis [Rev. May 2023]**

For any project, regardless of the extent of separation between traffic and the work area, analysis of the impact to the motorists and workers should be analyzed as follows:

1. If necessary to make the determination on whether a project will have significant work zone impacts, see Section 503-2.02, item d. It may be apparent that a project will be deemed as significant without traffic impact or queuing analysis. The analysis results for significant projects will be considered by the TMP team to formulate the overall work zone traffic management plan.

For interstate projects, the maximum queue length and daily user cost should be estimated. The results of the queuing analysis should be included with the proposed TMP and should be used to determine whether one or more of the following mitigation strategies are practical:

- restricting construction operations to off-peak traffic-volume hours or nighttime hours;
- closing a ramp;
- using a median crossover;
- using alternate routes;
- developing public relations strategies; or  
temporary widening for an extra lane or for roadway capacity.

For non-interstate projects an estimate of the delay (in minutes) during peak hours may be the most useful means to consider impacts to motorists. *Highway Capacity Software* may be used to derive this estimate. These results can be used to determine whether changes to the facility are needed such as new channelization, adjustments to signal timings, establishment of temporary restrictions, etc. At minimum LOS E performance should be provided by the TTCP.

2. To estimate user costs for comparing advantages and disadvantages of optional traffic control strategies for any interstate project and also for non-interstate projects where closure with detour or crossover/runaround strategies are not viable so will not be the strategy that is selected. There may be more than one option that will address the problem of traffic congestion during construction. The benefits and costs of each option should be compared against other factors such as constructability, construction time, construction cost, and motorists/worker safety to determine the most appropriate option. See 503-2.05(02) item 3 for additional guidance. Alternate strategies of maintaining traffic may not be available for a project. In this case, the user-cost calculations will not be required, unless otherwise noted in this section.

3. To estimate user cost as a guide for establishing an incentive/disincentive clause amount. Unless otherwise approved, INDOT has capped the amount of incentive/disincentive. See Section 503-2.06(01)
4. To estimate queue length in support of a request for an exception to the IHCP. See section 503-3.02
5. To estimate impacts of reduced lane or shoulder widths on a freeway in support of a design exception request. See Section 503-3.04(02). Impacts are in terms of reduction in capacity and any resulting queuing.
6. To estimate impacts of reduced lane or shoulder widths on a non-freeway. Impacts are in terms of reduction in capacity and corresponding LOS.
7. To estimate queue length to identify the initial location of portable transverse rumble strips when used for back of queue warning.

For projects that utilize a complete closure with detour, an analysis may be needed to select the best detour route(s) when more than one viable route is available. This analysis may involve only a simple calculation to estimate the additional travel time. The *Highway Capacity Manual* and associated *Highway Capacity Software* (HCS) may be used to estimate travel times for a variety roadway types.

For projects that utilize a crossover or runaround, a traffic impact analysis may be needed to determine the number of lanes that need to be maintained in each direction of travel to eliminate or reduce delay.

Results from a capacity analysis can be used for multiple purposes on the same project. For example, a queue estimate can help determine whether a project will have significant impacts to motorist and the strategy that will be used for temporary traffic control, then used as supporting documentation for an IHCP exception request based on that strategy, and also used to determine the location of portable rumble strips all for the same project. Conceivably the same analysis could be used for all these purposes provided the TTCP, traffic volumes and other analysis input remain the same from scoping through the various plan development stages. Often this will not be the case and the analysis will have to be updated as the plan development progresses.

### **503-2.07(01) Queue Estimating**

1. IHCP Exception Request. INDOT's Queuing Analysis Tool (QAT) is the preferred method for estimating queue for exception requests to the IHCP. QuickZone 2.0 is acceptable. QAT provides the following information:

- estimation of vehicular capacity through a work zone;
- calculation of queue length

With concurrence from the Work Zone Safety Office Vissim and Synchro may also be used to support IHCP exception requests. To facilitate processing requests that include analysis done with either of these programs the designer will meet with Work Zone Safety staff to discuss the modeling and any assumptions made, and explain the results

Regardless of the program used for the queuing analysis diversions are not be included in the primary analysis for exception requests. However, diversion estimates and their effect on the queue estimate can be submitted as a supplemental analysis should diversions be likely. This may be the case particularly in urban areas as drivers often have opportunities to divert as they become familiar with the work zone. The basis for assuming that there will be diversions and for the amount that is modeled should be provided in the supplemental analysis. Designers should confirm diversion estimates with District Technical Services. The Work Zone Safety Office, the LPA, or the MPO may also be able to provide guidance on how traffic is expected to respond to restricted conditions.

Guidance and additional information on QAT, QuickZone 2.0 and performing queuing analysis for IHCP exceptions is available on the IHCP webpage, under Interstate Congestion Policy Analysis Tool.

2. Other Uses. For other purposes aside from IHCP exception requests traffic impact analysis for freeways may also be performed with QUEWZ98, or other suitable programs. Expected diversions should be accounted for in these analyses.

Synchro, Highway Capacity Software 2016, or other computer modeling software may be used for segments with stop or signal control. In-house designers may contact District Traffic, Signal Systems for assistance with this type of analysis.

### **503-2.07(02) Detour Cost Evaluation**

To determine the daily detour user costs for a detour route, the following equations should be used:

$$\text{Detour User Cost} = ((\text{Cost in Lost Time}) + (\text{Cost in Extra Distance Traveled}))$$

$$\text{Cost of Lost Time} = (\text{No. of Vehicles Detoured}) \times (\text{Increase in Travel Time per Vehicle}) \times (\text{Value of Motorist Time}).$$



Increase in Travel Time = (Length of Detour / Average Detour Travel Speed) – (Length of Work Zone / Average Travel Speed through Work Zone)

Cost in Extra Travel Distance = (No. of Vehicles Detoured) x (Net Increase in Length of Travel) x (Vehicle Operating Expense)

Where:

The net increase in length of travel distance is the difference between the detour and non-detour distances.

The Value of Motorist Time considers not only lost wages, but also lost free time. The U.S. Department of Transportation estimates this value to be anywhere from \$9 to \$30 per hour per vehicle (varies based on local trips vs. intercity travel, personal vs. business). A value of \$16 per hour per vehicle may be used.

The Vehicle Operating Expense includes fuel, maintenance, and depreciation costs, the most recent [IRS Standard Mileage Rates](#), for example \$0.545 per mile for 2018, should be used.

In addition to the above Detour User Cost, the cost for improvements needed along the detour route must be added, e.g., repaving, pavement widening, signal improvements. Indiana law has specific reimbursement requirements for when a county road is used as an official or unofficial detour. The designer should also consider the effect the detour will have on the community and local businesses.

### **503-2.07(03) User Cost Evaluation**

The program/method used should provide the user with the expected queue length and estimated user costs based on the type of lane closure, traffic volume, time schedules, and other inputs. The program's user manual should be reviewed before performing the analysis.

1. Inputs. Typically the designer must provide the following inputs:
  - a. lane-closure configuration;
  - b. schedule of work activities, e.g., work activity and lane-constriction hours; and
  - c. traffic volume approaching the freeway segment.

The program may provide default values for the following variables:

- Cost Update Factor;
- Percentage of Trucks;
- speeds and volumes at various points on a speed-volume curve;

- Capacity of a Lane in the Work Zone;
- Maximum Acceptable Delay to the Motorist; and
- Critical Length of Queue.

To obtain meaningful results, the designer should consider revising the default values to satisfy the site location. For example, the program may assume that if a queue lasts longer than 20 min, some motorists will divert. To account for actual queues and the corresponding user costs, the designer may need to adjust the 20-min timeframe to satisfy the project situation. The designer should consult the user's manual to determine if the default values are applicable to the location under consideration.

2. Consideration in addition to Program Output. In addition to the values obtained from the program, supplemental user-cost calculations can be required where changes are expected based on existing traffic patterns and volume. Supplemental calculations for a detour are required where an exit or entrance ramp within the construction zone, including one using crossovers, will be closed and where the designer judges that the program is not properly estimating the amount of diverting mainline traffic.

Additional detour user-cost calculations should be conducted if an exit ramp is to be closed. Most or all of the traffic that will have used a ramp, if it was open, will divert from the mainline before the construction zone. Therefore, the exit-ramp volume should be deleted from the input mainline volume.

A closed entrance ramp may or may not lead to changes in the input values.

When used to compare advantages and disadvantages of traffic control strategies, the user cost for the entire duration of construction, including detour user cost and total daily user cost should be derived and considered. The daily user cost may indicate impacts to the traveling public are too significant to make the option viable – even if it is a much shorter duration.

### **503-3.0 TEMPORARY TRAFFIC CONTROL PLAN**

Highway construction disrupts the normal flow of traffic and poses safety hazards to motorists, bicyclists, pedestrians and workers. In order to alleviate potential operational and safety problems, work zone traffic control should be considered on each highway construction project. The work zone traffic control plan can range in scope from very detailed plans, incorporation of unique or recurring special provisions, to referencing the INDOT *Standard Drawings*, *Standard Specifications*, or *IMUTCD*. This section provides the necessary information to develop a well-

conceived work zone traffic control plan that minimizes the adverse effects of traffic disruption and hazards.

The initial traffic control plan should be addressed in the Engineer's report or in the project mini-scope.

### **503-3.01 Traffic Control Plan Development [Rev. May 2023]**

#### **503-3.01(01) Responsibilities [Rev. May 2023]**

It is the designer's responsibility to ensure that an adequate temporary traffic control plan (TTCP) is developed. For work that is limited in scope or of shorter duration the traffic control requirements may be fully detailed by INDOT *Standard Drawings* or *Standard Specifications*, but generally the designer needs to prepare a TTCP that will address all required temporary traffic control measures for the project that are not addressed by INDOT Standards. The designer will be responsible for the following:

1. review of the information in the Engineer's Report or, if not available, contacting the appropriate district or Central Office department, for example Traffic Design, to obtain the necessary information;
2. evaluation of the proposed design alternates, e.g., detour, crossovers, runaround, or lane closure;
3. development of the geometric design for a specially-constructed detour, e.g., crossovers, runaround, or offset alignment;
4. identification and resolution of the roadside-safety concerns within the construction zone, e.g., construction clear zone, or temporary concrete barrier;
5. selection and location of the required traffic control devices, e.g., pavement markings, barricades, barriers, or signs;
6. development and evaluation of alternate construction sequences;
7. completion of the necessary capacity and queuing analyses, if not already provided;
8. submittal of a written request to the Pavement Division regarding use of a shoulder or a portion of it for MOT with a copy of the request sent to the project manager. This request should include the construction-year AADT, percent trucks of AADT, and the approximate duration of traffic's shoulder use;
9. ensuring that the proposed traffic control plan is discussed and reviewed during the Preliminary and Final Field Check. The discussion should include worker safety.;
10. coordination with public information officials to inform the public of proposed road closure, detour route, work zone speed limit reductions, etc.;
11. revisions to the TTCP after construction has commenced if needed.

### 503-3.01(02) Content

The type and size of a project impacts the amount of information required in the TTCP. For example, a TTCP for a traffic signing project is only a listing of the appropriate INDOT *Standard Drawings*. However, for a freeway reconstruction project, the TTCP may include plan details and special provisions. In any case, the TTCP content will be determined on a project-by-project basis. The TTCP can include the following elements:

1. Construction Plan Sheets. A reconstruction project will require plans for accommodating traffic at each construction stage, e.g., specially built detour, crossovers, and staged construction. These plans can include geometric layout details, positive-protection strategies, and traffic control devices. A smaller project, e.g., partial 3R, traffic signs, signals, or a spot improvement, will rarely require this level of detail. Chapter 14 provides the INDOT plan preparation criteria, which are also applicable to a TTCP. Traffic-maintenance detail examples may be found in the Typical Applications in Chapter 6H of the *IMUTCD*.
2. Special Provisions. Special provisions are used to explain special procedures, materials, or equipment used in the TTCP that are not addressed in the INDOT *Standard Specifications*. In some cases, the TTCP may consist of only special provisions. Prior to developing a new special provision, the designer should first ensure that its requirements do not already appear in the INDOT *Standard Specifications* or Recurring Special Provisions. Chapter 19 provides the requirements for preparing a special provision.
3. Traffic Control Devices. All traffic control devices required to safely direct traffic through the work zone should be shown in the TTCP. The plan should show positive protection devices, drums, barricades, cones, tubular markers, signs, work zone or worksite speed limit assemblies, temporary pavement markings, existing pavement marking removal, warning lights, arrow boards, portable changeable message signs, temporary rumble strips or other devices required for construction. Chapter 17 provides guidance for determining plan quantities.
4. Construction Sequence and Time. The TTCP should include a proposed construction sequence.
5. Work Schedule. A special provision should identify restricted work schedules, which the contractor will be required to follow, e.g., no construction work during specified hours or days.

6. Telephone Numbers. A special provision should require the contractor to provide names and telephone numbers of the contractor's superintendent and one other responsible employee.
7. Oversized & Overweight Permits. For a restricted-lane width, the TMP team member designated in the Public Information Plan (PIP) will be responsible for notifying Motor Carrier Services Division of the Indiana Department of Revenue after the contract to advise of the width restriction to allow proper routing of oversized vehicles. For projects without a PIP, the project manager will perform this task. Additionally, restrictions related to construction activities should be entered into the CARS/511 web page: <http://intr.carsprogram.org/>. This task is performed at the district office typically by either district Communications or district Construction personnel.
8. Agreement or Legal Release. An agreement or legal release may be required before INDOT can use a local facility as a detour route. The designer should initiate this process early in the design of the work zone traffic control.
9. Media. The designer or project manager should inform the District Communications Office of a decision to include a road or ramp closure or detour as part of the TMP.
10. Pedestrians and Bicyclists. The TTCP should address the safe accommodation of pedestrians and bicyclists through the work area. Construction phasing may need to be scheduled around non-peak pedestrian-traffic times.
11. Local Businesses and Residents. At least one reasonable access should be maintained to each site of business establishment or residency. These entities should be kept informed of planned street, ramp, or driveway closures.
12. Emergency Vehicles. The TTCP should address the safe and efficient accommodation of emergency vehicles through the construction area.
13. Traffic Control Plan Checklist. A Traffic Control Plan Checklist is available from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT). This checklist should be completed after the preliminary field check and updated with each plan submission to ensure that all applicable elements for work zone traffic-control have been addressed in the TTCP.

A lack of TTCP detailing can cause significant delays and cost increases during construction.

### 503-3.01(03) Schedule [Rev. **May 2023**]

The TTCP should be developed through the phases described below before it can be incorporated into the contract and approved for letting. The following describes the schedule of the TTCP at each project phase.

1. Engineer's Report. The initial work zone traffic control strategy should be shown in the Engineer's Report. If changes are made to the recommendations in the Report, the designer should notify district Technical Services of these changes.
2. Structure Type and Size for Bridge Replacement Project or Stage 1 for Sight Distance Improvement or Small Structure Replacement or at Grade Review when applicable. At this plan development stage, the designer is responsible for contacting the appropriate district to obtain its input regarding MOT. An editable version of the Traffic Control Strategy memorandum is available for download from the Department's [Editable Documents page](#), under Traffic Maintenance (MOT). After downloading, completing the project information, and indicating the strategy that has been selected, the designer should transmit this memorandum to the district. The district will provide any feedback they have to the designer.
3. Stage 1 Review. At Stage 1 the IHCP policy should be reviewed to determine if an exception is needed.
4. Preliminary Field Check. During the Preliminary Field Check, the proposed traffic control strategy should be reviewed against actual and anticipated field conditions. Discussion and decisions should be documented in the field check minutes. The following tasks are to be performed.
  - a. Drive state highway and local detours.
  - b. Determine the environmental effects and utility impacts of a crossover or runaround.
  - c. Estimate the extent and cost of property damage caused by a crossover or runaround, including additional right-of-way requirements and costs.
  - d. Evaluate the need for scheduling work activities to avoid traffic delays during peak commuter hours or local events.
  - e. Determine the effects on project constructability, e.g. drainage considerations, ingress and egress of contractor's crew and equipment.
  - f. Review the physical and operational elements of the TTCP with other projects in the area to ensure that there are no conflicts with the proposed TTCP.
  - g. Discuss potential worker safety issues and any mitigation strategies that might be used.

At the conclusion of this phase, the preliminary geometric design, safety, and capacity analyses should be completed, and suggested plan modifications evaluated and reviewed. The designer should determine the proposed location of all traffic control elements and special design elements such as a runaround or crossovers, and should establish the proposed construction phasing. The designer should contact the district for its input, even if the proposed TTCP is already recommended in the Engineer's Report.

5. Stage 2 Review. Traffic Control Strategy selection should be finalized, and Maintenance of traffic plans should be drafted by the Stage 2 submittal the plans should be compatible with the draft IHCP exception request, if applicable. The plans should include all proposed mitigation measures related to work zone safety. It is important that the designer includes the necessary work zone safety and queue protection mitigation measures with the Stage 2 submittal. All Level One Design Exceptions for the Maintenance of Traffic should be submitted as soon as possible, but no later than with the Stage 2 Submittal.

A typical layout should be included along with details for critical points, such as intersections, ramps, or large driveways. The layout should include the width of the temporary traffic devices such as barrier wall, barrels, or other devices. It is also important to recognize and design for the complexities associated with maintaining traffic at intersections, large driveways, and ramps. These locations should be a focus of discussions with the Area Engineer and District Traffic Engineers during the field checks.

Should an exception to the IHCP be needed the draft request should be submitted with stage 2 plans, For projects with a complex TMP - those involving unusual or numerous TOP or PIP measures, many phases, or unusual traffic maneuvers, etc. - the draft should be prepared as early as possible.

6. Hearing. The plan and profile, cross-sections, construction schedule and phasing, and environmental impact reports should be completed at this stage. Preparation of the required special provisions and the permit process should be started. An estimate of the time required to re-open the facility to traffic after construction starts should be prepared.
7. Stage 3 Review. The MOT plans should be finalized, and all identified mitigation measures should be incorporated into the plans, special provisions, and estimates. Final approval of IHCP exception requests should be received by the Stage 3 submittal to ensure compatibility with the final MOT plans.
8. Final Field Check. All issues emerging from the hearing stage should be reviewed and subsequent modifications to the plans should be completed and included in the final field

check plan set. The project's physical and operational elements of the TTCP should be reviewed in the context of other projects in the area to ensure that there are no conflicts with the proposed TTCP. Examples of conflicts include detouring traffic onto a local road which is scheduled for reconstruction during the same time period, or closing a highly-traveled highway during special events or seasons. There should be coordination with the district Communications Office so that they can begin to inform the public of road closures or alternate detour routes. The TTCP should also be reviewed against changes in roadway or traffic conditions that would necessitate a change to the TTCP. For example, the condition of a detour route initially planned may have recently deteriorated; the TTCP needs to either include improvements to allow its use or utilize another route.

9. District Construction Review. As part of constructability review, the designer or project manager should submit the proposed TTCP to the district Area Engineer at each stage where TTCP details are developed. The district construction office will provide written comments or concurrence regarding the proposed TTCP to the designer, with a copy to the appropriate District Capital Program Management Director. The district Area Engineer will provide written comments or concurrence regarding the proposed TTCP to the designer. If necessary, the designer will revise the proposed TTCP until both the district construction office and district traffic office concur.
10. Final Tracing Submission. All quantity estimates should be determined and checked. The plans should be completed and all relevant special provisions should be included in the contract documents. Unofficial detour routes should not be shown in the plans or special provisions.

INDOT requires a coordinated team effort to develop and successfully implement a TTCP. Figure [503-3A](#) lists the participants involved in each phase of its development.

#### **503-3.01(04) Design Considerations [Rev. May 2023]**

The objective of the TTCP is to provide an implementation strategy that will minimize the adverse effects of traffic disruption on motorists, pedestrians, bicyclists, and workers. Consequently, the designer should consider the following design elements when developing the TTCP.

1. Geometrics. The TTCP should provide adequate facilities for a motorist to maneuver safely through the construction area, day or night. The design should avoid frequent and abrupt changes in roadway geometrics, such as lane narrowing, a lane drop, or a transition, which requires a rapid maneuver.



Where a lane merge or shift would be located in or adjacent to either a horizontal or vertical curve consideration should be given to locating the merge or shift taper outside of the curve to provide better sight distance and easier vehicle maneuvering resulting in an increased longitudinal buffer. If this is not practical for lane shifts on a multilane road where the design speed is greater than 45 mph, a taper rate of L instead of  $\frac{1}{2}$  L should be used to comply with the minimum radius for horizontal curves in construction zones. See Figures 503-3B and 503-7E for additional information.

INDOT Standards require longitudinal buffer spaces for interstate and freeway lane closures. For other roadways, where possible a longitudinal buffer space between the transition area (end of a merge or shift taper) and the work should be provided to enhance motorist and worker safety. See 503-3.04(03) for additional information.

2. Physical length of restricted cross section in the work zone and emergency pull-off areas. For projects where traffic is maintained adjacent to the work area it is desirable that the existing lane and shoulder widths be maintained. Long areas of restricted cross section place greater demand on drivers' abilities and attention and does not readily accommodate vehicle breakdowns and refuge. MOT phasing and geometrics should be developed accordingly.

Normally the length of restricted cross section at any one time should be a maximum of 5 miles. Longer restricted areas may be considered if the overall duration of the project will be significantly reduced, for example reduced from 2 construction seasons to one, or if the greater length avoids breaking a phase at a bridge or interchange. When considering areas with restricted cross sections longer than 5 miles, the traffic queue analysis, scope of work, work zone safety, roadway geometrics, environmental impacts, seasonal limitations, the impact on the time set and other factors for the project should be evaluated and included as a part of the overall TMP discussion and documentation. Specific considerations are:

- **Traffic Volume.** Longer restricted areas (phases) may be viable on segments where the volumes will be less than capacity for a single lane under construction throughout a normal day (e.g. four lane freeway segments with AADT of 30,000 or less). Speed and headway- the following distance drivers are comfortable with and so accept- vary more in a longer work zone, resulting in greater travel time delay, more tailgating, and a greater potential for rear end crashes.
- **Grade/vertical alignment.** On most interstate segments heavy vehicle travel is significant and heavy vehicle operation/speed is adversely impacted by grade. Longer restricted areas (phases) should not be considered for segments with significant grade (>2%).

The restricted cross-section area in the two travel directions may be at the same or at different reference posts or mile markers, that is they can be either staggered or directly opposite of each other.

For freeway 3R and 4R projects regardless of the length of restricted cross section or phase, outside shoulder width during construction desirably should be at least 8 ft. Consideration should be given to temporarily widening the shoulder if needed to provide this width. If adequate outside shoulder width – 8 ft or greater- cannot be provided, consideration should be given to specifying emergency pull-off areas from the outside shoulder approximately every 1 mile. Details for any widening and grading needed for the emergency pull-off areas should be included in the plans and the Pavement Design Division consulted for an appropriate pavement section.

3. Temporary Traffic Control at a Freeway Entrance Ramp. The acceleration distance is specific to the location a plan detail is required when an entrance ramp is inside or adjacent to the work area. See Figure 503-3B.
4. Corrugations for Shoulders or Rumble Stripes. An MOT plan that requires traffic to be carried on a shoulder or on the center line during construction should include information regarding corrugation installation requirements. A note should be included that reads, “Corrugations shall not be milled into the \_\_\_\_\_ shoulder/center line between Sta. \_\_\_\_\_ and Sta. \_\_\_\_\_ until after traffic is no longer temporarily using the shoulder/center line.” Existing corrugations that are along the wheel path for a distance of 2000 ft or more should be milled out and the shoulder filled in with HMA surface treatment that matches the depth of the corrugation (0.5 in.). The corrugations should be reestablished as part of the project. The need for this work should be discussed with the District as plans are being developed.
5. Road User Safety. Motorist, pedestrian, and bicyclist safety is a priority element of a TTCP and should be an integral part of each phase, i.e., planning, design, and construction.
6. Worker Safety. Worker safety should be a priority element of a TTCP and should be an integral part and consideration of each maintenance of traffic phase. The use of complete separation of workers from traffic through the use of a full road closure and detour minimizes the exposure to hazards of users to construction workers and hazards. Other work zone safety strategies should be considered where full closure and detour is not feasible. These include, but are not limited to, the use of positive protection, e.g. temporary traffic barrier, movable barrier, truck mounted attenuators, traffic law enforcement, other speed management techniques, and techniques to increase driver awareness, e.g. portable transverse rumble strips, high visibility pavement markings, and signage. When identifying the temporary traffic control and safety devices that will be included in the MOT plan, the designer should consider the effort by the Contractor and risk involved to

the road user and workers with their set up, maintenance, and removal – devices should only be specified when required or recommended by standards or policy, or when they address a specific need; simplified TTCPs should be considered for shorter duration work.

7. Highway Capacity. The TTCP should, where practical, provide the capacity necessary to maintain an acceptable level of service for the traveling public. What is considered acceptable can vary from one project to another based on the locale and existing performance (e.g. an acceptable LOS on a normally congested urban highway is probably not the same as that on a rural low volume highway). Desirably the capacity provided during construction should be as before construction but even during peak demand periods a LOS E or better should be provided. Additionally, for projects on high-speed (50 mph or greater), multi-lane, non-interstate highways, queue lengths should be estimated and if significant, mitigation measures should be considered. The IHCP defines what INDOT considers acceptable performance on interstate routes.

Maintaining an acceptable level of service may require converting a shoulder to a travel lane, eliminating on-street parking, maintaining turn lanes, constructing a temporary lane, opening additional lanes during peak traffic-volume periods, or expanding public transportation. See Section 503-4.01 for additional information on transportation operation plans. For projects on divided highways, when the LOS during any time is expected to be poorer than E, consideration should be given to including queue detection warning systems to the TTCP.

8. Temporary Traffic Control Devices. Traffic control devices should be included in the TTCP to safely direct vehicles through or around the construction zone.
9. Overhead Lighting. The design should maintain existing overhead lighting and consider the need for supplemental roadway lighting or, if not feasible, provide temporary lighting to match the existing light levels. Temporary lighting should utilize LED luminaires and may be mounted on either wood poles or portable trailers. The need for supplemental roadway lighting should also be considered for a potentially hazardous site within the work area. Separate payment should be made under the “Temporary Illumination” pay item.
10. Constructability. The construction sequence should be evaluated to identify safety, operational, or logistical problems and to facilitate the timely completion of the project. Some of the elements which should be evaluated include the following:
  - a. the maneuverability of traffic through horizontal or vertical alignments during all construction phases;
  - b. the separation of opposing traffic, workers, equipment, or other hazards;
  - c. the work area which will be used for equipment maneuverability; and

- d. access points to worksites or material-storage sites that are safe for workers and road users. Adequate acceleration and deceleration length, based on operating speed of either construction vehicles or workers vehicles as appropriate, should be provided for the ingress/egress points specified in the plans.
11. Construction Design. The availability of innovative construction options that can improve the TTCP include the following:
- a. the use of special materials such as quick-curing concrete that can support vehicular loads within hours after pouring, pre-cast bridge elements;
  - b. the use of special construction techniques such as drainage structure place by boring rather than open-cut.
  - c. the use of special designs, e.g., using a precast box structure instead of a bridge or cast-in-place box structure;
  - d. scheduling requirements which will reduce traffic disruptions, e.g., working at night and during off-peak traffic-volume hours. Nighttime work may be necessary for interstate projects in order to satisfy the IHCP. For non-interstate projects the designer should discuss use of a nighttime work schedule with District Construction before specifying as there may be disadvantages in terms of quality of work;
  - e. project phasing which will allow traffic to use the facility prior to project completion and minimizes work done under traffic; and
  - f. contractor cost incentive/disincentive for early or late completion of construction for a facility with a high AADT.
12. Economic or Business Impact. The economic impacts that a TTCP may have on road users, adjacent businesses, or residential developments should be considered as follows:
- a. vehicular travel time;
  - b. fuel consumption;
  - c. vehicular wear;
  - d. air pollution;
  - e. access to residential developments;
  - f. patron access to businesses, e.g., restaurants, gas stations, and stores;
  - g. employee or delivery access to commercial developments; and
  - h. shipments to manufacturing companies.

The TTCP should be reviewed to ensure that it does not restrict access to businesses during peak retail shopping periods. For example, a road closure should not be made in the vicinity of a regional retail mall during the period from Thanksgiving to Christmas. Coordination with local businesses, developers, or other land owners should be made early in the development of the TTCP. At least one access should be maintained to each development throughout the contract time.

13. Pedestrians and Bicyclists. The safe accommodation of pedestrians or bicyclists through the construction zone should be addressed early in project development. Locations that warrant pedestrian or bicyclist considerations include the following:
- a. where a sidewalk traverses the work zone;
  - b. where a designated school route traverses the work zone;
  - c. where significant pedestrian or bicyclist activity or evidence of such activity exists;  
or
  - d. where existing land use generates such activity, e.g., park, school, or shopping.

To meet the needs of all pedestrians at the locations listed above where sidewalk or the permanent path will be closed the TTCP should incorporate a temporary pedestrian access route. Pedestrian volume is not a prevailing consideration for the use of pedestrian maintenance of traffic. If the pedestrian access route (PAR) is closed for construction, pedestrian MOT should be maintained by providing a temporary pedestrian access route, see item 14.

The following should be considered when addressing pedestrian or bicyclist accommodation through a construction zone:

- a. providing physical separation of pedestrians and vehicles where practical;
- b. where temporary crossings are provided mid-block, parking should be prohibited for at least 50 ft on either side of the crosswalk – typically this involves adopting a temporary Official Action and adjustments to signing. For temporary mid-block crossings on high volume roadways that will be in place for longer durations pedestrian hybrid beacons (PHBs) or rectangular rapid flashing beacons (RRFBs) should be considered. Guidelines for use of PHBs are found in the IMUTCD Part 4. See Section 51-7.09 for additional criteria on PHBs and RRFBs.
- c. Temporary Traffic Barrier. Depending on vehicular traffic volumes and speeds, temporary traffic barrier should be provided to separate the PAR from vehicular traffic for the portion of the PAR that is level with the travel lanes and not protected by on-street parking;
- d. directing pedestrians or bicyclists with signs or audible information devices to a safe location such as the other side of a street, or to an alternate route when a pedestrian walkway or bicycle path is closed due to construction;
- e. staging construction operations such that if there are two walkways, they are not both out of service at the same time;
- f. phasing the construction such that temporary removal of a sidewalk will occur in the shortest practical time or is scheduled around non-peak pedestrian traffic-volume times;

- g. Temporary Traffic Barrier. Depending on vehicular traffic volumes and speeds, temporary traffic barrier should be provided to separate the PAR from vehicular traffic for the portion of the PAR that is level with the travel lanes and not protected by on-street parking;
14. Pedestrian Access Route. A temporary pedestrian access route (PAR) should be provided when sidewalks will be closed. Closures that do not include a diversion or detour should receive approval from the INDOT Technical Advisory Committee and approval documented with the project.

The temporary route may be a detour to existing sidewalk, or a temporary access path placed adjacent to the closed sidewalk, referred to as a pedestrian diversion. While a detour typically has the advantage of requiring fewer temporary devices and is less expensive, a diversion has the distinct advantage of keeping the pedestrian along their normal route. This results in a shorter, more convenient temporary PAR and requires less street crossing so reduces potential conflict with vehicles. In deciding between temporary PAR treatments, the following should be considered:

- a. the amount of cross-sectional width available for a diversion should be considered. Depending on the temporary devices used adequate width should be provided to support a minimum of a 4 ft PAR and detectable devices where required. See Figure [503-3G](#).
- b. length of a detour. Pedestrians are reluctant to veer from their normal path so excessively long detours are unlikely to be followed- pedestrians may walk in the street or attempt to walk on the closed sidewalk. Engineering judgment needs to be used in determining when a detour might be too long to be viable keeping in mind that average walking pace is between 3 and 4 mph (e.g., a detour that is 2 or 3 blocks away from the closed sidewalk might result in 10 minutes of additional walking). See Figure [503-3H](#). The ADA Technical Advisory Committee should review pedestrian detours longer than one block in each direction.
- c. the condition of existing sidewalk and curb ramps. The temporary PAR should provide the same or better level of accessibility as of the existing PAR being detoured. A detour may not be feasible or cost effective if the design elements of the sidewalk and curb ramps involved do not replicate the existing PAR that is being detoured.
- d. the amount and speed of vehicles. The greater the traffic volumes and speed on the approaches which the detour crosses, the less desirable the detour is. New marked crosswalks should not be installed for temporary PAR across uncontrolled roadways where the speed limit exceeds 40 mph, the roadway has four or more lanes, and an AADT greater than 12,000. However, if the temporary PAR uses an

existing crossing, the crossing treatments listed in Figure 51-7O should be considered.

When selecting the temporary PAR, the following hierarchy of methods should be considered, where the higher priority method cannot be used, the next method should be considered. For each method not used, documentation should be provided in the TMP or project file as to why the method was rejected.

- a. Pedestrian Diversions. For pedestrian diversions it is desirable to locate the temporary PAR between the sidewalk and right-of-way rather than between the sidewalk and the street in the buffer zone. This placement reduces the conflicts between pedestrians and vehicular or construction traffic and requires less MOT devices. However, if adequate right-of-way is not available, the street buffer zone or even a portion of the traveled way, the parking lane, shoulder, or a travel lane may be used. Where a portion of the traveled way is used, traffic barrier suitable for the speed and amount of available deflection distance should be specified if the PAR is adjacent to an open travel lane and the speed is greater than 35 mph. In addition, the following should be taken into consideration when using a portion of the traveled way.
  - 1) the LOS for reducing the traveled way should be calculated to ensure traffic will not be reduced to an unacceptable LOS, see Section 503-2.07. Signal timing may need to be adjusted to improve LOS.
  - 2) modes of transportation currently using the traveled way e.g. vehicular, horse drawn, and bicycle, should be maintained, to ensure the addition of the pedestrian movement will not cause conflicts between those modes of transportation. For example, forcing slower modes of transportation such as a horse drawn carriage into a vehicle travel lane.
  - 3) a diversion into the traveled way should not be implemented at a signalized intersection without appropriate adjustments to the signal and ensuring that truck turning movements are not impacted by the diversion.
  - 4) Traveled way diversions should not be used on high-speed, multi-lane roadways.
  - 5) Traveled way diversions at a minimum will require the placement of temporary pedestrian channelizers, temporary parallel curb ramps, and detour signage. In some cases, temporary traffic barrier will be needed.
  - 6) Temporary traffic barrier, if needed, should be indicated on the appropriate MOT plan sheet(s) and the pay item included in the estimate.
  - 7) If a diversion within the traveled way continues through a marked crosswalk, a temporary DWS will be required at the crosswalk.

Typically, temporary PARs located off of paved surfaces utilize mats that have been evaluated to be ADA compliant and are on the INDOT Qualified Product List. Aggregate, concrete, and asphalt may also be used. temporary pedestrian channelizers are needed if a natural detectable edge is not available, e.g., grass.

b. Detour. Where a diversion cannot be used and a detour will be provided, the following should be considered:

- 1) The shortest detour should be used.
- 2) Where a long detour is required, the sidewalk closure should be for no more than 3 days. A long detour is defined as being more than a city block, see Figure [503-3H](#). Long detours for a sidewalk closure should receive approval from the INDOT Technical Advisory Committee and approval documented with the project.
- 3) Adequate pedestrian detour signage and audible information devices to convey the route intended, e.g., confirmation signs, directional route changes, end detour signs, etc., see Figure [503-3H](#).
- 4) Pedestrian channelizers or other detectable barrier should be used to close the entire width of the PAR (or wider). Type 3 barricades are not detectable and should not be used to close a PAR.
- 5) Signage placed within the PAR should be detectable.
- 6) The detour may be shortened by using a temporary midblock crossing. Pedestrian Crossing warning signs should be placed at the temporary crosswalk; additional regulatory or warning devices may be needed pending traffic volume, number of lanes, presence of median, and speed limit- see Figure 51-7O. This measure may be particularly beneficial when the detour would otherwise be unusually lengthy, for instance ¼ mile or greater. Temporary midblock crossings should not be considered for roads with high traffic volumes or many travel lanes. The District Traffic Office should be consulted on use of this measure.
- 7) Review the detour at a field check to identify any improvements needed to replicate as nearly as practical the most desirable characteristics of the existing sidewalk or footpath PAR, e.g., similar surface, width, curb breaks, vertical discontinuities, etc.

c. Short-term PAR Closures can be considered, when

- 1) A diversion or detour cannot be provided,
- 2) a closure is not anticipated to last more than 72 hours, and
- 3) the closure does not fully cutoff access to a destination.



A short-term closure should include a USP that limits the closure time and approval should be obtained by the INDOT ADA Technical Advisory Committee and approval documented with the project. Where the sidewalk will be closed for ~~less than~~ no more than a work day, work zone personnel may provide assistance to pedestrians as necessary. A USP will be needed to provide instructions to the contractor if work zone personnel will be expected to assist pedestrians.

Pedestrian Maintenance of Traffic Devices. Devices that have been evaluated to be ADA compliant by the Department can be found on the Qualified Product List. See Section 503-7.07 for additional information on these devices.

- a. Temporary Curb Ramp. Temporary curb ramps should be provided where a barrier exists within the temporary PAR. How the curb ramp is oriented will be determined by the need at the site. The height of the curb should be noted as this information is needed to determine the features for the ramp, particularly the need for handrail should the height exceed 6.0 in and whether a two-stage ramp is needed to satisfy the maximum running slope requirement should a prefabricated model be used (rather than asphalt or concrete). Temporary ramp running slopes should be less than or equal to 8.33%, anything over this should come before the ADA TAC for approval. A table that lists each temporary curb ramp should be provided on the MOT plan or in the contract document. It should also identify the type needed, perpendicular or parallel.
- b. Pedestrian Channelizer. Pedestrian channelizers with detectable surfaces should be provided as a detectable edge along a temporary PAR unless another detectable edge is present, e.g., grass, curb, etc. Channelizers may also be used to separate sidewalk or the PAR from the work area and to close sidewalks. See recurring plan details 801-xxxx for details on the channelizer.
- c. Audible Information Device. Audible information devices address accessibility criteria for the visually impaired as described in Chapter 51. They provide closure notification and navigation instructions via a speaker in a housing which can be either independently or barricade mounted. They should be specified when sidewalks or curb ramps are closed for more than 3 days unless work zone personnel will be able to provide assistance to pedestrians as necessary. Guidance on the use of audible information devices for the visually impaired is provided in the *IMUTCD* Section 6G.05 and in the notes for figures 6H-28 and 6H-29. The designer should coordinate with the District Traffic Engineer if pedestrian signals will need to be covered and APS deactivated for crosswalks at signalized intersections.

INDOT has developed special provisions for temporary accessible path routes, temporary curb ramps, pedestrian channelizers, and audible information devices that should be included when any of these devices are needed.

### **503-3.02 Interstate Highways Congestion Policy [Rev. May 2023]**

INDOT's Interstate Highway Congestion Policy (IHCP) is applicable to all construction or maintenance activities that require the closure of or restrictions to one or more lanes on an Interstate highway. The policy is available from the IHCP webpage at <https://www.in.gov/indot/3383.htm>. The purpose of this policy is two-fold. First, the policy aims to schedule work activities outside of periods of peak demand for an Interstate highway to minimize road user delay and reduce the likelihood of end of queue crashes. Second, the policy aims to estimate the impacts such that appropriate mitigation measures may be taken.

When applicable, the policy should be reviewed, and queuing analysis performed during the scoping stage and confirmed early in plan development. It is preferred to develop an MOT plan that complies with the pre-approved closure and restriction schedule(s) for the segment(s) involved. However, that may not always be feasible. Exceptions to the policy will be considered on a project-by-project basis.

Prior to submitting an Interstate Highway Congestion Policy Exception Request, the designer should thoroughly research, plan, and detail the maintenance of traffic plans and provisions that provide comprehensive mitigation measures. For projects with complicated MOT schemes, preliminary coordination should be performed with the District Traffic Engineer, the INDOT Office of Work Zone Safety, and the IHCP exception approval authority to assess the appropriate solutions with regard to the IHCP.

Preliminary IHCP Review should involve initial coordination of the IHCP with the District Traffic Engineer while the maintenance of traffic is being developed and before it is finalized. IHCP exception requests should include all phases of work and not just the main phases of the work. Set-up and take down of the MOT phases (including temporary markings), temporary closure of ramps, and final pavement marking placement can often involve the need for IHCP exception approvals.

For Interstate projects that may involve the complete closure of an interstate (either one direction or both directions) will require substantially more effort to document the recommendations and to seek internal approval as well as FHWA approval. The decision for this strategy should be made early in the project development phase to allow for complete analysis and approval of this strategy.

Resources for documenting and submitting a policy exception request are available from the IHCP webpage under the heading Cover Letters and Exception Request Templates. Exception requests made during design should be submitted as soon as possible, but no later than three months prior

to Final Tracings submittal. The approved IHCP Exception should be uploaded to ERMS. The approved closure schedule and any additional conditions must be included in RSP 801-T-216, Lane Closures, and incorporated into the contract documents.

For other policy exceptions the required documentation and approval varies by type of work, e.g. contract work in progress, permit work, ITS repair, and maintenance. The policy considers certain types of activities to be emergency repairs that do not need policy exceptions.

### **503-3.03 Work Zone Traffic Capacity**

Maintaining an acceptable level of service during construction is important on all INDOT projects. The need for a traffic-capacity analysis during the development of the TMP is based on the nature of the project. This analysis should be done for projects that will have significant adverse impacts to motorists. These project types include Interstate, where the pre-approved IHCP lane closure schedules are not met or where lane widths will be reduced, and non-Interstate projects that will have significant impact to motorists. Other freeway reconstruction projects are also candidates for analysis. Maintaining an acceptable level of service during construction is important on a freeway or other high-speed rural highway.

The operational elements of a facility under construction, e.g., lane segments, ramp, intersection, should maintain a level of service which is not less than that provided by the facility prior to construction, although this is not always attainable. Achieving this may require one or more of the following actions:

1. converting a shoulder to a travel lane;
2. eliminating on-street parking during peak traffic-volume hours or at all times;
3. constructing a temporary lane;
4. opening additional lanes during peak traffic-volume periods;
5. providing public transportation;
6. constructing a jug-handle type configuration for an indirect left-turn at an intersection;
7. closing or metering ramps at an interchange;
8. providing a turnout along a long, restrictive stretch of highway construction;
9. constructing a passing blister at a T intersection;
10. providing a two-way, left-turn lane on an urban facility;
11. adjusting signal phasing and timing at an intersection;
12. providing an additional turn lane at an intersection;
13. lengthening a turn-lane storage bay;
14. adjusting acceleration or deceleration length at an interchange ramp;
15. closing an intersection;
16. restricting turns at an intersection;

17. adding pavement to accommodate separate lanes for turning movements
18. providing extra pavement width;
19. providing signal or flagger control in a one-lane, two-way operation;
20. providing public information; or
21. providing a temporary ramp connection.

#### **503-3.04 Work Zone Design Elements [Rev. May 2023]**

This section provides design criteria, which apply to temporary crossovers on a divided highway, a temporary roadway, or a runaround specifically designed for construction projects. Some of the criteria also apply to an existing roadway through a construction zone, specifically construction zone design speed, lane/shoulder width, taper rates, sight distance, vertical clearance, and pedestrian access. These criteria do not apply to a detour over existing routes.

A Level One checklist should be completed for temporary roadway, runaround, and crossovers. The checklist is available on the Department's [Editable Documents](#) page, under Design Submittal. Where the controlling design elements of the crossover, runaround, or temporary road do not vary from phase to phase, the checklist needs to be completed only once. Where the design elements vary, a checklist should be completed for each phase.

Exception requests are required for the following circumstances:

1. lane and shoulder closures/restrictions will be contrary to the approved schedules in IHCP (IHCP exception)
2. combination of lane and shoulder width will not satisfy criteria in 503-3.04(02) (Level 1),
3. vertical clearance will not meet 3R criteria. In the case of vertical clearance on an existing roadway the exception request is only needed when an existing substandard clearance will be made worse during construction, for example, through a lane shift (Level 1);
4. construction clear zone will not satisfy 503-3.05(03) (Level 2).
5. ADA requirements for pedestrian access will not be satisfied (Inquiry to ADA TAC).

Shoulder drop-offs, elevation differences, and potential crossover obstructions should be minimized. These elements along with truck edge distance, paved shoulder widths, and median widths should be reviewed and accounted for in MOT design.

#### **503-3.04(01) Construction Zone Design Speed**

The discussion of construction zone design speed in this section applies to the design of the geometric elements through the work zone. It does not replace the regulations that govern the

speed limit through the work zone and its posting requirements. Rather the posted speed limit during construction, whether reduced from the permanent speed limit or not, takes into consideration the construction zone design speed, i.e. the construction zone design speed is established and then consideration is given to whether the speed limits needs to be reduced during construction based on the design speed and other factors. Regulatory speed limits and signing are discussed in Section 503-7.01.

The construction zone design speed is to be shown on the MOT plan sheets for each phase of construction. When selecting the construction zone design speed, the posted speed limit should be considered as follows.

1. The posted speed limit of the roadway prior to construction. Drivers are reluctant to reduce speed even when in a work zone. This principle is recognized in the *IMUTCD*, Section 6C.01. Per the *IMUTCD*, the construction zone design speed should desirably match or exceed the current posted speed limit but in any case should not be more than 10 mph lower than this posted speed limit.
2. The posted speed limit of the roadway adjacent to the work zone and the speed limit of adjacent work zones. Consistency of speed limits between adjacent work zones enhances enforceability.

The designer should work with the appropriate district Traffic Engineer to establish the construction zone design speed for an INDOT route and with an LPA's representative for a local-agency route. If the operating speed (85<sup>th</sup> percentile) is significantly higher than the current posted speed limit, a higher construction-zone design speed should be considered.

If crossovers are used to maintain one lane of traffic in each direction on a rural Interstate route, the following will apply.

1. Temporary concrete barrier should be used to protect motorists and workers.
2. Unless the median shoulder is full depth, it is to be removed and replaced with a 6-ft width section with its pavement design to be requested by the designer. See Chapter 304 for guidance related to design of temporary pavement.
3. Crossover details should be as shown in the INDOT *Standard Drawings* series 801-TCCO, Temporary Construction Crossover.
4. Shoulder corrugations are to be milled into the new shoulder after traffic is crossed over to the other side of the median.

### 503-3.04(02) Lane or Shoulder Width, Lateral Offsets [Rev. May 2023]

Desirably there should not be a reduction in the width of the roadway cross section through the construction zone. However, this may not be practical for every work zone. When such a reduction is unavoidable on a non-Interstate freeway, expressway or higher volume arterial highway (AADTs > 12,000 for a two lane highway and 30,000 for facilities with 4 lanes or more), a traffic capacity analysis should be conducted as part of the Traffic Management Plan to assess potential queuing and delay issues that may occur. Depending on the outcome of the analysis, additional maintenance of traffic countermeasures may be required, such as establishing alternative routes or adjusting signal timings. The results should be shared and discussed with the TMP team.

Section 503-7.02(02) provides the minimum taper rate that should be used on an approach to a lane-width reduction. The following lane and shoulder widths should be used in a construction zone. A Level One design exception request should be submitted if the recommended combined lane and shoulder width cannot be satisfied.

1. Freeway. For a freeway, a minimum 11-ft lane width should be maintained with shoulders or barrier offsets of 2 ft or wider. At bridges and their approaches an 11-ft lane with 1-ft shoulder or barrier offset may be used when any of the following conditions are present:
  - The available cross section is at least 13 ft but less than 15 ft for one lane work zones, 24 or 25 ft for two lanes, and 35 or 36 ft for three lanes, etc. Note: if there are more than two lanes in a travel direction the inside lane(s) should be 11 ft in width at minimum.
  - A reduction in the number of lanes is not allowed by the IHCP established closure schedule.

When a lane width less than 11 ft is proposed on an Interstate, an exception to the IHCP is required. Exceptions to the IHCP will require an evaluation of traffic capacity. The analysis should take into account the width of the maintained lane(s). The IHCP contains guidance on input parameters needed to perform capacity analysis along with the pre-approved allowable interstate lane closure and restriction times. See Section 503-3.02.

If an IHCP exception is not required, but the proposed combination of lane and shoulder width does not satisfy the guidance in paragraph 1 above, a capacity analysis should be performed and submitted with the design exception request.

2. Divided Non-Freeway. For a non-Interstate divided highway, a minimum 11-ft lane width should be maintained with shoulders of 2 ft or wider. Should the available cross section be limited so that these lane and shoulder widths cannot be provided and a reduction in the

number of lanes is not viable, however, an 11 ft lane with 1 ft shoulder or a 10-ft lane with 1'- 6" shoulder can be considered.

3. Undivided Highway. A minimum 10-ft lane width and 1-ft shoulder width should be maintained.
4. Road Closure with Diversion. A runaround with 12-ft lane widths and 6-ft shoulder width should be used.
5. Median Crossover. For a one-lane, one-way operation, the lane width should be 16 ft with 5-ft shoulder widths. For a multi-lane or multi-directional operation, each lane width should be 12 ft with 5-ft shoulder widths.
6. Restricted Widths. The clear travel width is taken as the width of travel lanes plus shoulders plus appurtenance free area per direction of travel. If the available clear travel width will be less than 12 ft 4 in., the MOT plan should include advanced warning signs for the width restriction that state the available width. These signs are necessary since extended (90-day) and annual permits are issued for wide loads that do not exceed 12 ft 4 in. The signs should be located where the driver can use the information to avoid the restricted-width roadway. For state highways, these locations include approaches to the last state highway intersection in advance of the width restriction and on the approaches of intersecting highways, major local roadways, and commercial drives within the restricted-width road segment.

Advanced warning signs are detailed in the INDOT *Standard Drawings* series 801-TCSN, Traffic Control Signs.

Advance warning signs on the restricted highway should be located at approximately 2 mi and 1 mi ahead of the restriction for freeways and at 1 mi and ½ mi for non-freeways. The advance signs should incorporate the legend "WIDE LOAD RESTRICTION" with the distance indicated, sign code XW20-YWR(A).

For freeways the next warning sign should be located approaching the last interchange or the last state highway intersection prior to the restriction and should read, "LOADS OVER \_\_\_ FT WIDE MUST EXIT", sign the code XW20-YWR(B).

For non-freeways another warning sign should be provided ahead of the restriction, but downstream of the last intersection and should read "NO LOADS OVER \_\_\_ FT WIDE", sign code XW20-YWL(C).

Should the district determine that an official wide-load detour is warranted, the appropriate detour signing should be provided in advance of the detour and on the detour route to guide motorists back to the original highway at a point clear of the width restriction.

7. Barrier Offset. Offset from the edge of the temporary travel lane to barrier wall or guardrail should be a minimum of 2 feet.
8. Shoulder Break Offset. A minimum of 4 feet offset should be provided from the edge of the temporary travel lane to the shoulder break location.

### **503-3.04(03) Transition Taper Rate and Longitudinal Buffer Spaces [Rev. May 2023]**

1. Merge and shift tapers. The most important element in the transition area is the taper that provides channelization. Reference [IDM Figure 503-7D](#) and 503-7E for the types of lane tapers. An inadequate or excessively long taper length produces undesirable traffic operations, which could lead to crashes within the work area. A merging taper is used on multilane roadways when the number of traffic lanes is reduced. The length of the merging taper should be long enough for vehicles traveling side-by-side to adjust their speeds and merge into a single lane before the end of the transition.

The table in INDOT Standard Drawing [801-TCDV-03](#); provides minimum taper lengths based on speed and either the width of the lane or the shift. The standard initial merge taper length for all interstate and freeway projects will be based on 70 mph regardless of the permanently posted speed limit. This change recognizes that in urban areas operating speeds significantly exceed the posted speed limit on a regular basis. Subsequent merges will also be based on 70 mph speeds unless a variation is deemed appropriate. If a shorter merge taper length will be used it should be based on a lower prevailing operating speed at the location and the decision should be documented with a level 2 design exception. Following the same reasoning interstate and freeway shift taper lengths for a full 12 ft shift should be 420 ft. For other highways the permanently posted speed limit in advance of the construction zone should be used to determine the needed length. Should the average operating speeds be greater than 70 mph (freeways) or the posted speed limit (non-freeways) that speed should be used as the basis for the taper length.

Longer tapers should be considered when truck volumes are high. In those situations, consideration should be given to taper lengths that are based on a speed that is at least 10 mph greater than the normal posted speed of the highway, particularly for the first taper encountered since large trucks require greater distances to adjust their speed and maneuver safely. The taper should be placed well in advance of temporary traffic barriers. This practice not only provides for a safer work zone, but also helps construction traffic to safely access the work zone.



Lane shift and shoulder closure tapers should be based on the same speeds as lane merge tapers. Shoulder closure tapers should be provided for any shoulder closure and when the adjacent travel lane is closed and should be calculated as  $1/3 L$ .

2. Staggering Shifts of Multiple Lanes. Another strategy that is required for interstates and freeways and should be considered for other multi-lane highways is to offset tapers of multi lane shifts to increase the lane width through the shift movement. This is accomplished by staggering the starting point of temporary longitudinal pavement marking edge and lane lines. See Figure 503-3J for a depiction, the Standards (801-TCLC) contain the requirement for interstates and freeways. The staggered shift method provides wider lane widths. For instance, with a 40 ft stagger from the beginning point of each temporary pavement marking line to line (edge line to lane line to lane line etc.), 12' interstate lanes transition into 14' lanes entering the taper and again to 12 ft lanes after the shift. Where the lane width is to be reduced from 12' entering the shift to 11' after the shift the stagger from the beginning of temporary line to line should be 80 ft. This treatment enhances operation and safety particularly for large trucks.
3. Longitudinal Buffer Spaces. Table 6C-2 in the IMUTCD provides “Stopping Sight Distance as a Function of Speed” and should be used as minimum Longitudinal Buffer Space Lengths. Longitudinal Buffer Space is required for interstate and freeway lane closures by INDOT Standards. For other highways these buffer spaces should be provided whenever practical and shall be provided for all first merges and shifts transitioning into work zones where longer tapers described in this the preceding paragraphs are deemed necessary

#### **503-3.04(04) Sight Distance [Rev. May 2023]**

For the approach to the first physical indication of the construction zone, the sight distance available to the motorist should be based on the decision sight distance criteria but no less than the stopping sight distance criteria. Through the construction zone, stopping sight distance should be available to the motorist. Although the location of many design features are often dictated by construction operations, an element can have an optimal location. For example, a lane closure or transition should be located where the approaching motorist has decision sight distance available to the lane closure on transition.

Horizontal sight distance should be checked, i.e., calculate the middle ordinate of the horizontal curve. The percentage of trucks or other heavy vehicles should also be considered when determining the controlling sight distance. See Section 43-4.0 for additional information on horizontal sight distance.

Sight distance especially on inside of curves with TTB should be maximized by providing a wider inside shoulder. A level one design exception should be submitted if adequate sight distance cannot be provided.

Horizontal sight distance should be checked for temporary runarounds, crossovers, or other temporary roadways. A statement that a temporary runaround is in accordance with the INDOT *Standard Drawings* series 713-TCTR, Temporary Runaround, is not sufficient to verify that adequate horizontal stopping sight distance is provided.

Intersection sight distance should be checked for each public road approach and commercial drives for each MOT phase.

### **503-3.04(05) Horizontal Alignment**

The geometrics for the horizontal curvature alignment for all temporary roads should be determined using the selected construction-zone design speed. AASHTO Method 2 should be used for distributing superelevation and side friction to determine the radius and superelevation rate of the horizontal curve. In this method, superelevation is introduced only after the maximum allowable side friction has been reached. Compared to AASHTO Method 5, this approach results in no superelevation on a flatter curve, i.e., maintaining the normal crown through the curve, and a reduced rate of superelevation on a sharper curve. Figure [503-3B](#), Minimum Radius for Horizontal Curve in Construction Zone, provides the minimum radius including the radius for retention of the normal crown section for a horizontal curve through a construction zone based on AASHTO Method 2. For other horizontal-curvature elements, such as superelevation transition length, the criteria described in Chapter 43 is also applicable to a construction zone.

Where it is necessary to use the shoulder as a travel lane, the shoulder cross slope can be a concern on a horizontal curve, i.e., the slope may be in the opposite direction than the superelevated section. One or more of the following options should be considered to mitigate this problem.

1. The shoulder may be rebuilt to the proper superelevation rate based on the selected construction-zone design speed. This alternative is practical only when the adjustment to the superelevation is useful for the final alignment.
2. An advisory-speed plaque should be installed for the horizontal curve.
3. Transverse rumble strips should be installed in conjunction with item 2 above in advance of the temporary travel lane, see Figure 503-7G.

4. Trucks or other large vehicles should be prohibited from using the temporary travel lane. Such large vehicles should be detoured to other facilities.

#### **503-3.04(06) Vertical Alignment**

A sag vertical curve should be designed using the selected construction-zone design speed and the comfort criterion provided in Figure [503-3D](#), K-Value for Sag Vertical Curve. This comfort criterion is based on the comfort of change in vertical direction through a sag vertical curve due to the combined effects of gravitational and centrifugal forces. The ride through a sag vertical curve is considered comfortable when the centripetal acceleration does not exceed  $1 \text{ ft/s}^2$ .

#### **503-3.04(07) Cut or Fill Slope**

A temporary cut or fill slope should be designed to satisfy the design criteria shown in Chapter 45. However, a 3:1 fill slope can be used where there is sufficient clear-zone width available at the bottom of the slope. See Section 503-3.05(03). The use of a fill slope steeper than 3:1 may be considered, but requires the installation of a roadside barrier unless sufficient clear zone to the steeper slope is provided.

The use of a slope steeper than 3:1 for a cut depth of less than 10 ft may be acceptable under restrictive conditions, such as inadequate right of way or the presence of utilities that make regrading impractical. For a temporary road or a road used as a detour where excavation work is needed, a 3:1 cut slope is acceptable in place of the flatter slope required in Chapter 45.

The anticipated traffic volume and the length of time that the detour will be in place should be considered when determining the final cut or fill slope. Stable embankment material must be used and placed in accordance with the INDOT *Standard Specifications*. Drainage should be considered between the work zone and the traffic when establishing the phases of construction.

#### **503-3.04(08) Maximum Profile Grade**

The vertical grade should be designed using the 3R criteria for the appropriate functional classification, rural or urban environment, and construction-zone design speed.

#### **503-3.04(09) Through-Lane Cross Slope**

The 3R criteria for through-lane cross slope criteria should be used for the appropriate functional classification and rural or urban environment. If the existing shoulder is used for through traffic, a 4% cross slope will be acceptable.

#### **503-3.04(10) Vertical Clearance**

The 3R criteria for vertical clearances should be used for the appropriate functional classification and rural or urban environment. If vertical clearance for a crossover, temporary runaround or other temporary road, is not in accordance with the criteria for Level One elements, a design exception will be required. A design exception for substandard vertical clearance is also needed when substandard clearance on an existing roadway will be worsened during construction.

#### **503-3.04(11) Drainage During Construction**

See Chapter 203, the Office of Hydraulics, Bridge Management Division may be contacted for additional guidance.

#### **503-3.04(12) Temporary Crossover Pavement Design**

Pavement design for a temporary crossover, temporary widening, etc. should be obtained from the Pavement Division.

#### **503-3.04(13) Pedestrian Accessibility**

Provisions for continuity of accessible paths for pedestrians should be incorporated into the TTCP. When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities or detours must be provided. The length and duration of such detours should be minimized to the greatest extent possible. Temporary facilities must be accessible to the same extent as the existing pedestrian facility being impacted. This may include incorporating accessible pedestrian signals (APS), curb ramps, or other accessibility features.

When it is necessary to block travel at a departure curb and close a crosswalk that is disrupted by excavation, construction, or construction activity, curb ramp access to the perpendicular crosswalk must be maintained.

Other specific requirements include:

1. temporary ramps must be detectable.

2. sidewalks used as a detour must be at least 48 in. width unless the sidewalk being detoured is narrower than 48 in., in which case the detour sidewalk width must at least match that of the existing.
3. if sidewalk width is less than 60 in wide, then every 200 ft a 5 ft by 5 ft passing space must be provided.
4. curb ramp slope can be no greater than 12:1.
5. temporary signals must include the same pedestrian features included with the permanent signals.
6. curb parking is not allowed within 50 ft of a temporary mid-block crossing.
7. temporary pedestrian facilities must be firm, stable and slip-resistant.

The pedestrian access route should be reviewed to verify that signs and devices used in the TTCP can be placed without negatively impacting the available clear width. Where impacts are unavoidable, a temporary parallel route using a portion of the roadway and positive separation devices should be considered. If a temporary parallel route is not feasible a signed pedestrian detour route may be selected.

See the *Public Rights-of-Way Accessibility Guidelines* ([PROWAG](#)) and *IMUTCD* Chapter 6D for additional information.

### **503-3.05 Road User and Worker Safety**

A construction zone is a complex and potentially hazardous environment. A motorist is often exposed to an increased number of traffic control devices, narrowed lanes, pavement shifts, opposing traffic, construction personnel and equipment – both stationary and moving about the work zone. These complexities can increase the consequences of common driving mistakes such as momentary inattention. While a complete elimination of construction-zone hazards is usually impractical, a motorist's exposure to potential hazards should be reduced to the extent possible. The following sections provide roadside safety criteria which apply to the roadside elements within the construction zone. These criteria do not apply to a detour over existing routes.

#### **503-3.05(01) Positive Protection**

Positive protection is a device that contains and/or redirects a vehicle and meet the established crashworthiness evaluation criteria. A positive protection device must meet the crash testing requirements of the *AASHTO Manual for Assessing Safety Hardware* (MASH) or National Cooperative Highway Research Program (NCHRP) Report 350, as appropriate.

### 503-3.05(02) Use of Positive Protection [Rev. May 2023]

The wide range of project-specific TTCPs does not allow for a comprehensive list of all high risk situations that would warrant the use of positive protection devices. Where a full road closure and detour is not practical, designers should discuss the need for positive protection at the preliminary and final field checks. Decisions on its use should be documented in the field check minutes.

For temporary traffic barrier the consideration of shielding a hazard is similar to a permanent barrier – it should be utilized where the severity and the duration of a hazard is deemed more dangerous than the temporary barrier itself.

Additional information on positive protection can be found in the American Traffic Safety Services Association (ATSSA) publication [Work Zone Positive Protection Toolbox: Pocket Guide of MUTCD Guidance for Temporary Traffic Control](#). The National Work Zone Safety Information Clearinghouse is a library of resources on improving roadway work zone safety for all roadway users. The website and their hot topics page: <https://www.workzonesafety.org/> provide current guidance on several topics including rear end crashes, accommodating pedestrians in work zones, smarter work zones, transportation management plans, and working at night. These and additional resources for considering the use of positive protection are available from the INDOT [Designers webpage](#) under Work Zone Safety.

INDOT uses positive protection as follows.

1. Separating Two-Way Traffic.
  - a. On a interstates and other freeways, temporary traffic barrier is required by INDOT Standards to separate two-way traffic when traffic is crossed over (split or median crossover).
  - b. On an expressway, temporary traffic barrier should be used to separate two-way traffic when traffic is crossed over.
  - c. On a divided highway (non-freeway), temporary traffic barrier should be considered when traffic is crossed over. Steel barrier should may be considered for these applications, provided deflection performance is acceptable for the cross sectional width that will be available.
2. Shoulder Closure.
  - a. On a freeway or expressway, temporary traffic barrier is required by INDOT Standards to protect a shoulder closure that is longer than three days.
  - b. On a divided highway to protect work areas adjacent to public road intersections and drives.
  - c. On a rural divided highway (non-freeway or expressway), temporary traffic barrier should be considered.

- d. Channelizing devices may be used rather than temporary barrier to close a shoulder on a two-way, non-divided highway.
3. Pavement Drop-Off. See Section 503-3.05(06) for additional information on pavement drop-offs.
    - a. On a freeway or expressway, temporary traffic barrier should be used to protect continuous pavement drop-offs that are greater than 5 in. deep and within 4 ft of the travel lane.
    - b. On any highway, temporary traffic barrier should be considered to protect pavement drop-offs greater than 5 in. close to the travel lane.
  4. Phased Bridge Construction. Temporary traffic barrier should be used to protect exposed drop-offs when a bridge is constructed in phases. This applies to protection of drop-offs that occur during deck overlays provided there is adequate cross-sectional width for the open lane(s), shoulders, and shy distance to the barrier. Temporary Traffic Barrier is typically used for projects involving rigid overlays to protect workers, equipment, and newly constructed pavement.
  5. Shadow Vehicles. Truck/Trailer-Mounted Attenuators are required by INDOT standards for shadow vehicles that are positioned in the travel lanes or shoulders of interstates, freeways, and other divided highways during mobile operations. They should be considered for shadow vehicles used in mobile operations on non-divided highways.
  6. Traffic Adjacent to Work Area. Temporary traffic barrier should be considered to protect pedestrians and workers by separating traffic from the work zone where there is no lateral buffer space or traffic is operating in the adjacent lane. Vehicle speed, traffic volume, heavy vehicle percentage, availability of worker escape routes in case of vehicle intrusion are factors that can also be considered when determining what is a sufficient lateral buffer. The type of positive protection device may vary based on speed, ADT, and duration of the construction activity.
  7. Steep slopes. Temporary traffic barrier should be considered to protect slopes that are within the construction clear zone and that are steeper than 4:1. Slopes steeper than 3:1 are considered non-traversable since drivers are more likely to lose control of their vehicle, while slopes between 4:1 and 3:1 are traversable but not recoverable meaning an errant vehicle is unlikely to be able to get back to the travel lane. The designer should also take into account additional hazards such as woods, bodies of water, or the bottom of the slope when determining this need.

8. Fixed Object within the Construction Clear Zone. Impact attenuators, temporary traffic barrier, or guardrail should be considered to protect an exposed, fixed object that is within the construction clear zone. See Section 503-3.05(03) item 1.
9. Exposed Construction Elements. Impact attenuators, temporary traffic barrier, or guardrail should be considered to protect construction elements such as bridge falsework, sign foundations, excavation or rock cuts, exposed bridge piers, untreated guardrail end in a two-way, two-lane operation. Blunt ends of bridge railing or concrete barrier (permanent or temporary) within the construction clear zone should be protected.

Where positive protection is not utilized, alternative treatments to mitigate hazards to road users and workers should be considered. This may include specifying lateral buffer space into the work zone cross section, traffic law enforcement or other speed management techniques, e.g. “your speed is” devices (radar speed display signs); and techniques to increase driver awareness, e.g. portable transverse rumble strips, prominent pavement markings, and signage.

#### **503-3.05(04) Positive Protection Devices [Rev. Aug. 2020, May 2023]**

In addition to the requirements of IDM Chapter 49 and the INDOT *Standard Drawings*, this section provides additional information related to installation of positive protection devices.

1. Temporary Guardrail. A temporary guardrail installation for an interstate route project should be in accordance with the permanent installation criteria described in Chapter 49 and the INDOT *Standard Drawings*, except as shown in Figure [503-3E](#), Construction Clear Zone Width. For short-term construction, the installation of new temporary guardrail is not practical.

The following should be used to determine the temporary guardrail length at each corner of a temporary bridge in on a two-lane runaround.

- a. For a construction-zone design speed of 45 mph or lower, the minimum guardrail length is 50 ft. For a construction-zone design speed of 50 mph or higher, the minimum guardrail length is 100 ft. These lengths include transition and end treatment. Length of need calculations should be performed.
- b. A temporary guardrail run should continue until the guardrail warrant for an embankment as shown in Chapter 49 is satisfied. The anticipated operating speed, and not the construction-zone design speed, should be used to determine the guardrail warrant for an embankment. As with permanent installations, site specific constraints/concerns should be discussed in determining the length of need.



2. Temporary Traffic Barrier (TTB). A TTB provides the most effective separation between motorists and workers when traffic is maintained adjacent to the work area. It is used to separate opposing directions of traffic, to separate workers from traffic, and to keep vehicular traffic from entering work areas. The type of temporary traffic barrier selected should be based on the following:
  - a. TTB, Type 1. Type 1 is a longitudinal barrier used to separate two-way traffic. INDOT utilizes temporary concrete barrier where two-way traffic separation is required on high-speed, high-volume roadways or to separate traffic from the work area.
  - b. TTB, Type 2. Type 2 is a longitudinal barrier used to separate traffic from the work zone. It should be considered to protect motorists from an obstruction, including an elevation differential or drop-off, inside the construction clear zone. The construction-zone design speed (see section 503-3.04(01), the extent of the obstruction, and the extent of the elevation differential, should be considered.
  - c. TTB, Type 3. Type 3 is temporary concrete barrier, which is left in place upon completion of the contract and becomes the property of the INDOT. This type is used when appropriate for new roadways or added travel lane projects.
  - d. TTB, Type 4. Type 4 is a movable longitudinal barrier comprised of a system of short T-shaped concrete barrier segments, which are lifted and shifted by a compatible transfer vehicle.

Type 4 is typically used to accommodate the shifting of traffic lanes to facilitate the directional distribution traffic volume. This may be on a daily basis during peak-hour traffic volume or intermittently during certain times of the week (e.g. crossing over on the weekend and lifting the crossover before Monday morning peak hours).

Type 4 may be considered to separate workers from traffic that is running in an adjacent lane in a stationary work zone in place for a limited time (e.g. concrete patching at a number of locations along a segment) such that the barrier needs to be shifted frequently. Use of Moveable Temporary Traffic Barrier on a project, should be discussed with the District Traffic Engineer, Project Manager, and TMP Team.

The barrier layout and signage for each phase, a staging-area diagram, and the location of the barrier-transfer apparatus when it is not in use should be shown on the TTCP. The size of the barrier-moving apparatus should be estimated to be 50 ft long by 16 ft wide.

3. Anchored TTB. TTB is anchored to reduce the lateral movement of a longitudinal barrier system. In general, anchoring consists of the use of steel pins or bolts to connect the barrier to a bridge deck or road surface. The anchoring surface should be in good condition to ensure proper performance of the system, e.g. a severely deteriorated bridge deck may not retain the anchor bolts during impact.

The need to anchor should consider the maximum posted speed limit and the allowable area for deflection.

- a. TTB Type 1. Type 1 barrier is concrete and is the only type used to separate two directions of travel. Extensive in service performance history in Indiana has shown these devices have performed acceptably without anchoring. As such, TTB Type 1 should not be anchored.
- b. TTB Type 2. TTB Type 2 should be anchored when the deflection of the unanchored barrier cannot be accommodated or is not tolerable, e.g., a bridge constructed in phases, or where a pavement drop-off is closer to the back of the TTB than the crash tested deflection distance.

INDOT's unanchored temporary concrete barrier has a dynamic deflection of approximately 63 in. when tested under NCHRP Report 350 TL-3 conditions (62 mph at 25 degree angle). INDOT's anchored temporary concrete barrier dynamic deflection can be considered zero. The dynamic deflection of other temporary traffic barriers, e.g. steel or water-filled, varies on a product-by-product basis.

Significant drop offs adjacent the roadway should be evaluated on a case-by-case basis. Depending on the setback of the hazard more deflection can might be tolerated where temporary concrete barrier is placed on pavement with a work area on the other side and anchoring typically is not necessary. Barrier deflection may intrude into the work area, but there is little data related to workers being injured under these conditions.

- c. TTB Type 3. TTB Type 3 should not be anchored for the reasons described for Type 1.
  - d. TTB Type 4. TTB Type 4 should not be anchored due to its frequent movement.
4. TTB with Glare Screen. A glare screen may be used in combination with TTB Type 1 or Type 3 to eliminate headlight glare from opposing traffic in a crossover or in a two-way, two-lane operation. The traffic volume, its directional distribution, and roadway alignment should be taken into account. Additional guidance regarding consideration of a glare screen is described in Chapter 49.

5. Truck- or Trailer-Mounted Attenuator (TMA). A TMA is an energy-absorbing device used to reduce impact severity. A TMA is typically utilized to shield workers from rear-end collisions during installation of other temporary traffic barriers, for protecting work areas that move frequently such as painting, or pothole patching, and for shielding workers in short to intermediate-duration work operations such as bridge deck patching and thin deck overlays or nighttime operations that are performed with drums and no barrier wall. TMAs are required by INDOT Standards and should be specified for shadow vehicles that are used in a travel lane or a shoulder. Shadow vehicles are typically used for mobile operations with no stationary lane or shoulder closures for work activities such as pavement marking or RPM installation, pavement repair, or crack filling. The need for a TMA should be discussed at the field check(s). Additional information can be found in Recurring Special Provision (RSP) 801-T-227, Truck Mounted Attenuators and Recurring Plan Detail (RPD) 801-T-227d, Truck Mounted Attenuators (Plan Details), as well as the [\*ATSSA Field Guide for the Use and Placement of Shadow Vehicles in Work Zones\*](#).

TMA's are paid by the number of calendar days they are used. To estimate the quantity when a TMA is needed, the designer should:

- determine the work activities that will require a TMA, and
- then determine the number of TMA's that will be needed at any one time, and
- finally determine the anticipated number of work days for each TMA on the project.

To determine the anticipated number of work days, the designer should coordinate with the district Area Engineer on the contract time set for the project. Average quantities for TMA's are 60 days for road and resurfacing contracts, 45 days for bridge contracts, and 10 days for traffic and maintenance contracts.

6. Other Devices. Other devices such as mobile work zone barrier or vehicle arresting devices may be considered. These devices should be MASH or NCHRP 350 compliant, as appropriate. The use of these devices should be coordinated with the Division of Construction Management and will require the creation of a unique special provision. See Section 503-3.05(06) for additional guidance on end treatments.
7. End Treatments or Impact Attenuator. The following end treatments or impact attenuators may be used for positive protection areas.
  - a. Energy-Absorbing Terminal. The use of a construction-zone energy-absorbing terminal should be based on MASH or NCHRP 350 test levels. The TL-3 terminal should be specified for an interstate or other route with a construction-zone a permanently posted speed limit of 50 mph or higher. The TL-2 terminal should be specified for a non-interstate route with a construction-zone speed limit of 45 mph

or lower. Even if a lower temporary worksite permanent speed limit is to occasionally apply, each terminal's test level should still correspond to that for the construction-zone speed limit. The location of each terminal with its test level should be shown on the TTCP. Energy-absorbing terminals should be used where a hazard, such as the blunt end of a temporary traffic barrier, cannot be:

- 1) removed from the construction clear zone,
- 2) flared, in accordance with 503-3.05(03), outside of the construction clear zone on a smooth surface of 10:1 or flatter, or
- 3) tucked behind a permanent solid median or outside concrete barrier wall with an overlap of 100 ft.

b. Guardrail. The treatment for an exposed end of guardrail may include one or all of the following:

- 4) connection to existing barrier;
- 5) use of an acceptable end treatment according to the construction-year AADT and guidance provided in Chapter 49;
- 6) flaring of the end to a point outside the construction clear zone; or
- 7) burying of the end in the backslope. See INDOT *Standard Drawings* series 601-GRET for Guardrail End Treatment Type II details. This method may be well suited for guardrail downstream of a hazard adjacent to a cut slope.

c. Gravel Barrel Array. Due to the size of the array, a gravel-barrel array may have limited application in a work zone.

### **503-3.05(05) Design Layout**

Where practical, a temporary roadside-safety device should be designed and located as determined in Chapter 49. For example, guardrail deflection distance should be considered and the appropriate length of need provided. However, due to the limited time a motorist is exposed to a construction hazard, it is often not cost effective to satisfy the same permanent-installation criteria. The exposure time of the hazard should be evaluated when determining the need for installation of a roadside-safety appurtenance. The following provides alternatives that should be considered when designing and locating a temporary roadside-safety appurtenance within a construction zone.

1. Construction Clear Zone. The construction clear zone width as shown in Figure [503-3E](#) should be provided. However, engineering judgment should be used to determine whether exposed hazards such as non-recoverable slopes (3:1 or steeper), TTB ends, fixed objects,

or non-breakaway structures located between the construction clear zone and permanent clear zone should be protected. Criteria for consideration include work duration, size or length of hazard, AADT, posted speed limit. It is not necessary to adjust the value for clear zone width for horizontal curvature. A level 2 design exception should be prepared if construction clear zone cannot be provided.

2. Shoulder Widening. Where a temporary traffic barrier is placed adjacent to a shoulder, it is not necessary to provide extra shoulder widening.
3. Crossed-over Two-way Traffic. Where a multilane highway utilizes a crossover to provide two-way traffic on one side, the following are the minimum level of traffic separation to be provided:
  - a. Temporary concrete traffic barrier and temporary solid yellow lines are to be used on a freeway.
  - b. Temporary tubular markers and temporary double solid yellow lines are to be used on a multi-lane divided roadway that is not a freeway. A lane separator with tubular markers or delineators should be considered.
  - c. Temporary double solid yellow lines are to be used on an urban or rural multi-lane undivided roadway. A lane separator with tubular markers or delineators may be used.

Temporary asphalt divider is not to be used for separating traffic in a multilane crossover application.

4. Flare Rate. A temporary traffic barrier, should be flared beyond the traveled way to a point outside the construction clear zone. Figure [503-3C](#) provides the typical flare rate for the temporary concrete barrier based on the selected construction-zone design speed. The flare rate shown should be provided unless extenuating circumstances render it impractical, e.g., stop condition, drive, or intersection. Flare rates for temporary steel and plastic barriers should be in accordance with the manufacturer's recommendations. If a flared portion of TTB cannot be designed to end outside the construction clear zone, an acceptable construction-zone energy absorbing terminal is required.
5. Opening. An opening in the barrier should be avoided. Where an opening is necessary as may be the case in a long work zone, the barrier end should be shielded with an acceptable end treatment or flared to meet construction clear zone as required in Section 503-3.05(02).

6. Plan Details. Locations and quantities of TTB (by type), glare screens, and energy absorbing terminals, along with flare rates should be shown on the TTCP for each maintenance of traffic phase.

### **503-3.05(06) Pavement Edge Drop-Off**

A pavement edge drop-off should be avoided immediately adjacent to a lane open to traffic during a construction activity such as new pavement construction, shoulder rehabilitation, or crossover construction.

In general, for a drop-off greater than 3 in., traffic may be shifted away from the drop off. On a high speed roadway where the traffic lane adjacent the drop-off cannot be closed for an extended period of time, a full-depth rehabilitated shoulder section should be considered that will be placed to within 3 in. of the top of pavement elevation before the end of a day's work. The pavement section required to fill the shoulder drop-off to within 3 in. before exposure to adjacent traffic should be obtained from the Pavement Division Pavement Engineering Team. A unique special provision will be required to address the timeframe imposed on the contractor for bringing the shoulder paving up to the required grade. Also, drums should be placed on along the shoulder drop-off on the high side where lane width allows, spaced as shown in Figure [503-7F](#), Suggested Maximum Spacing of Channelization Devices.

For freeways and expressways, treatment alternatives provided in Figure 503-3F. For multilane divided highways, the desirable option is to close the lane adjacent to an edge drop-off. This will ensure that the edge drop-off is located outside the construction clear zone.

### **503-3.05(07) Temporary Transverse Rumble Strips [Rev. **May 2023**]**

Temporary transverse rumble strips are narrow, raised strips of rough-textured material arranged intermittently and transversely to extend across the travel lane to create audible and vibratory stimuli that increase driver awareness. Temporary transverse rumble strips are used to alert drivers to potentially unexpected conditions and to warn motorists of impending changes or unusual vehicle conditions in a work zone, such as an unexpected change in alignment or a potential stop condition. Where temporary transverse rumble strips are used in advance of conditions requiring warning, they should be supplemented with signs or PCMS.

- 1, Applications. Temporary transverse rumble strips should be considered for inclusion in the TTCP in these situations:
  1. In advance of a flagging operation or

2. In advance of an automated flagger assistance device or temporary signal; or
3. In advance of transition areas such as a lane merge, a lane shift, a lane width reduction, or a crossover; or
4. In advance of an active work area within a long work zone where work areas are separated by areas with no work, or
5. For any bridge project on a freeway where traffic is being crossed over or maintained adjacent to the work area; or
6. In advance of the back-of-queue for projects where queuing is expected. In this application they should be used in conjunction with static signage, such as BE PREPARED TO STOP signs, or similar messaging via PCMS to warn motorists about the presence of the back-of-queue.

This measure can be particularly beneficial where speeds are high (greater than 40 mph), the peak-hour volume-to-capacity ratio approaches or is greater than 1, or if stopping sight distance to the flagger or merge taper is restricted. Inclusion and application of this measure in the plans should be discussed with the district during the preliminary and final field checks.

Temporary transverse rumble strips should not be placed on sharp horizontal or vertical curves or through pedestrian crossing or on bicycle routes. They should not be placed on roadways used by bicyclists unless a minimum clear bicycle path of 4 ft is provided at each of the roadway or on each paved shoulder.

## 2. Types of Temporary Transverse Rumble Strips

- a. Temporary Portable Rumble Strips (TPRS). Temporary portable rumble strips are different from other temporary transverse rumble strips in that they are devices that stay in place under their own weight, do not attach to the pavement with adhesives or fasteners, and can be quickly installed and removed. TPRS are designed for short-term and intermediate-term stationary duration work zone applications. To include TPRS into the TTCP, the recurring special provision 801-T-209 should be included.

TPRS should not be used on freeways, expressways, and routes with a posted speed limit of 65 mph or higher. TRPS are prone to move out of position and require frequent maintenance in conditions with high-speed traffic or traffic with a high volume of large trucks.

Temporary portable rumble strips, should be specified with flagging on a two-lane highway or multilane divided highway where the regular posted speed limit is between 50 and 60 mph and one of the following conditions are met:

- 1) the flaggers will be at location for more than 4 hours such as for concrete polymeric bridge deck overlays, HMA patches, PCCP patches including PCCP rapid setting patches, or high friction surface treatments,
- 2) there is inadequate stopping sight distance to the work zone,
- 3) the flagging will be done at night,
- 4) automated flagger assistance devices will be used.

TPRS should also be specified on a multilane highway (non-freeway) where the regular posted speed limit is between 50 and 60 mph and the work will be at a location for more than one hour. TPRS may be considered under the following conditions:

- 1) with any flagging operation; or
- 2) a non-freeway lane merge; or
- 3) within a long work zone where the work area is moving from day to day.

Use of a TMA for installation and maintenance should also be specified and the TMA pay item should be incorporated the into the cost estimate.

- b. Temporary Stationary Transverse Rumble Strips, Stationary temporary transverse rumble strips (also known as temporary buzz strips) are durable pavement markings created with extruded material to a ¼ in. height. INDOT Standard Drawing series 801-TCDV and Figure [503-7G](#) illustrate the typical layout for temporary transverse rumble strips placed in advance of a lane closure.

Stationary temporary transverse rumble strips should be considered for long term stationary duration work zone applications where the timeframe of use will be two months or longer. The INDOT *Standard Specifications* require either removable or durable pavement markings.

Section 503-7.03(01) provides additional information related to rumble strips.



## 503-4.0 TRANSPORTATION OPERATIONS PLAN

The Transportation Operations Plan (TOP) is the set of strategies that will be used to minimize adverse impacts in the work zone and must be incorporated into the TMP of any project that is determined to have significant work zone impacts. TOPs may also be provided as needed for projects that are not defined as having significant work zone impacts.

The TOP includes strategies for the operations and management of the work zone and all facilities affected by the work zone, which can include transit, rail, air, and pedestrians. The proposed mitigation measures should also be included in the TOP. These strategies may include traffic incident management plans, planned special events, Intelligent Traffic System (ITS) components, maintenance or enhancement of other modes of transportation, emergency service provider access and communication, work zone law enforcement, and other related strategies. The TOP must include the proposed methodology for monitoring and measuring mobility during the active work zone phase.

### **503-4.01 TOP Development [Rev. May 2023]**

For an INDOT project, the TOP is developed by the District Traffic Office, in coordination with the Traffic Management Division and the LPA(s). For any given project, other members of the TMP Team may also be involved in the development of the TOP. Depending on the traffic mitigation measures initially identified, other offices may be involved in the development of the TOP to ensure that it is successfully planned and implemented.

The following strategies should be considered in developing an effective TOP:

1. Tow Trucks for Incident Management. The use of on-site tow trucks should be considered for a freeway work zone with limited or unavailable shoulder width. These trucks should also be considered where a crash or vehicle breakdown can seriously impact traffic flow and cause excessive backups and delays. A separate pay item for Tow Truck should be included in the cost estimate.
2. Interconnection of Traffic Signals. The addition of interconnected traffic signals should be considered where the benefit of moving traffic more efficiently through a work zone will be significantly enhanced.
3. Lane Rental by Contractor. In this application, a contractor formulates its bid around the number of hours that it expects to keep a number of lane-miles closed,

and then can earn or lose money if the actual number of hours is higher or lower than that bid. This concept has not had widespread use to date.

4. Police Patrol for Speed Control. A police patrol can be required to ensure that vehicular speeds are at or below the posted speed limit, or for other safety reasons. Because this requires a special funding mechanism and special provisions, the designer should coordinate this with the Traffic Management Division. If access from one direction of travel to the other (across the roadway) is restricted, median openings or turnarounds should be considered to facilitate enforcement. No U-turn signs should be provided for interstate median openings.
  
5. (Local) Law Enforcement Officers for Work Zone Safety. Local law enforcement officers (LEOs) authorized by the Department and hired by the contractor may be specified for a contract to enhance work zone safety. Officers can be used for a number of purposes including
  - a. queue protection;
  - b. serving as a presence behind any operation being performed adjacent to live traffic, even if the work is taking place only on the shoulder or utilizing a buffer zone;
  - c. issuing citations for violations within the work zone;
  - d. responding to an emergency within the work zone;
  - e. responding to an incident or emergency near the work zone that might affect traffic flow or safety.

Officers should not be use for the following:

- a. serving as a presence while officer's vehicle is stationed in work zone behind
- b. a temporary barrier wall;
- c. serving as presence while their vehicle is stationed on a road or ramp that has already been closed with barricades;
- d. providing flagging assistance.

LEO use should be included for contracts identified as significant in relation to work zone impacts in accordance with Section 503-2.02. For contracts identified as non-significant, District Construction will make a project-specific determination to include LEOs. The TMP team or designer may consider whether LEO presence will be beneficial and make a recommendation accordingly.

When LEOs will be used, RSPs 801-R-672, Law Enforcement Officer for Work Zone Safety, and 801-R-672A, Guidelines for Law Enforcement Officers When Working in INDOT Work Zones,

should be included in the contract documents with the appropriate pay item. LEOs are paid for on an hourly basis as noted in the RSP.

6. Ramp Closure, Short or Intermediate Term. If a shorter intermediate-term ramp closure is necessary, additional signage will be necessary to forewarn motorists. Signs should be posted on the affected ramp two weeks in advance to advise motorists of the closure date or portion of the day during which the ramp will be closed.
7. Ramp Closure, Long Term. This can be necessary to improve traffic flow on the mainline roadway. Local access and business impacts should be considered before deciding on a long-term ramp closure. The capacity of the potential detour route(s) should be also considered. Two adjacent ramps should not be closed at the same time unless necessary for safety reasons.
8. Ramp Metering. Ramp metering should be considered where it is necessary to restrict the amount of traffic entering a freeway for capacity and safety reasons. Ramp metering can be used during peak traffic volume periods or for the entire 24hr day. The potential negative impacts of ramp metering on an intersecting road should also be considered, i.e., traffic back-up.
9. Restriction of Trucks. Restricting trucks can increase a facility's capacity. However, state or local ordinances should be considered, as well as the availability and suitability of alternate routes that the restricted trucks will be required to take.
10. Reversible Lane. This should be considered where the peak traffic flow distribution is in one direction for a specified period of time. The use of such a lane can be limited in use due to the cost of providing and maintaining the daily changes required. There are also safety considerations related to change in the direction of traffic flow which should be evaluated if a reversible lane is being contemplated. Movable barrier wall is required for application of this strategy in a freeway crossover, and should be considered in a crossover on a divided non-freeway.
11. Special Materials. The use of fast-setting or precast concrete, or other special materials, should be considered where traffic restrictions should be minimized, e.g., on a ramp or in an intersection.
12. Split Lane Configurations. On a six-lane facility, where three lanes cannot be maintained in both directions, determine if three lanes can be provided in one direction with two lanes in the other direction. Similarly, on a four-lane facility, where two lanes cannot be maintained in both directions, determine if two lanes can be provided in one direction with one lane in the other direction. The afternoon

peak hour generally has a higher traffic volume than the morning peak hour, and the direction of travel with the higher number of lanes should be selected accordingly.

13. Temporary Parking Restriction. One option to increase capacity is to eliminate on-street parking to create an additional lane or to reduce traffic conflicts. However, the concerns of local businesses related to on-street parking should be addressed. The elimination can be only for during a peak traffic volume period or for the entire 24 hour day.
14. Temporary Worksite Speed Limit. A reduced regulatory speed limit may be warranted where work activity can constitute a hazard to traffic, especially for a lane closure. The *Indiana Code* permits INDOT to establish a reduced worksite speed limit without an Official Action. Section 503-7.01(02) provides the criteria for establishing speed limit signing in a work zone.
15. Traffic Signal Timing and Phasing. Traffic signal timing changes should be considered for all pre-timed traffic signals within a work zone for which capacity improvements can be gained. Adding or deleting signal phases to actuated traffic signals may be required for changes in travel patterns.
16. Trailblazer Signs for Major Travel Destinations. Trailblazer signs may be necessary to guide the motorist to a major travel destination in the area where the normal route is closed or seriously restricted, or where an alternate route to the destination will assist traffic which will otherwise travel through the work zone.
17. Turn Restrictions. These should be considered where necessary for capacity or safety reasons. The turn restrictions may occur at intersections or drives. Turn restrictions may be in place only during a peak traffic volume period or for the entire 24 hr day.

#### **503-4.02 Other Traffic Mitigation Measures [Rev. Apr. 2021, May 2023]**

One of the key components of the TOP is the proposed mitigation measures. Examples of possible mitigation measures are as follows:

1. Demand Management Strategies.
  - a. transit service improvements;
  - b. transit incentives;
  - c. shuttle services;

- d. ridesharing/carpool programs or incentives;
  - e. park and ride promotion strategies;
  - f. high-occupancy vehicle (HOV) lanes; and
  - g. variable work hours.
2. Corridor/Network Management Strategies.
- a. signal coordination improvements;
  - b. ITS, including real time work zone systems;
  - c. temporary traffic signals;
  - d. off-site intersection improvements;
  - e. bus turnouts;
  - f. vehicle height, width, and weight restrictions;
  - g. separate truck lanes;
  - h. dynamic lane closure system;
  - i. late (zipper) merges using construction signs or dynamic late (zipper merges) using PCMS; see section 503-7.01(03); and
  - j. coordination with adjacent construction sites.
3. Work Zone Safety Management Strategies.
- a. variable speed limits;
  - b. temporary traffic signals;
  - c. temporary traffic barrier;
  - d. moveable traffic barrier;
  - e. attenuators, impact and truck-mounted;
  - f. temporary transverse rumble strips;
  - g. warning lights;
  - h. ITS, like Automated Work Zone Information Systems (AWIS);
  - i. automated flagger assistance devices (AFADs)
  - j. courtesy patrol;
  - k. construction safety inspectors;
  - l. traffic monitors; and
  - m. on-site safety training;
4. Incident Management Strategies.
- a. ITS;
  - b. courtesy patrol;
  - c. emergency responders coordination;
  - d. surveillance, i.e., closed circuit cameras and loop detectors;
  - e. enhanced mile-post markers;
  - f. media coordination;
  - g. designated local detour routes;

- h. contract support for incident management;
- i. incident/emergency management coordinator;
- j. incident/emergency response plan;
- k. dedicated breakdown area or emergency pull-off area.  
See section 503-3.01(04);
- l. contingency plans;
- m. stand-by equipment; and
- n. stand-by personnel.

Not all of these strategies will be applicable to every project. Other strategies can be considered to accommodate operations on a project-by-project basis.

### **503-4.03 Traffic Monitoring Procedures for Work Zone**

The TOP should also include the proposed methodology for monitoring and measuring mobility during the various stages of the active work zone. Monitoring and measuring activities can include actions such as work zone travel-time monitoring, temporary or permanent vehicle-detection devices, and temporary or permanent video systems. The Slow Down (Delta Speed) tool on INDOT's 511 page may be used for monitoring work zone slowdowns: <https://liveview.trafficwise.org/>. The monitoring and measuring activities are integral to evaluating the effectiveness of the TOP and any adjustments over time.

### **503-4.04 Incident Management Plans**

An Incident Management Plan (IMP) that is separate from the TOP may be necessary for a project on an interstate route where the AADT exceeds 50,000. Tow Trucks and Police Patrols may be used as part of the TMP. See Section 503-4.01. Incident management strategies are discussed in Section 503-4.02;

## **503-5.0 PUBLIC INFORMATION PLANS**

The Public Information Plan (PIP) is intended to create an organized and systematic process to communicate work zone information to the traveling public and prospective stakeholders and must be incorporated into the TMP of any project that is determined to have significant work zone impacts. PIPs may also be provided as needed for projects that are not defined as having significant work zone impacts.

The PIP will include information to be communicated, communications strategies, and methods of delivery. Timing of the communications should also be considered. The communicated information should include items such as construction commencement dates and times, brief description of work, staged traffic changes, dates, and times as well as a protocol for emergency events or accidents.

The target audience should be identified and the most effective means and methods for delivery of project information to the affected groups should be addressed by the PIP. This will include listings of local newspapers with contacts, supporting businesses for posting of information, potential public meeting locations, and local business groups that can assist with publicizing work zone details. It is more appropriate to determine these specifics prior to construction activities and to establish relationships that will be beneficial during project delivery. The following potential communication methods may be considered:

- media, e.g., newspapers, TV, and radio;
- lane closure web page, INDOT TrafficWise;
- changeable message signs, both portable and associated with ITS;
- temporary motorist information signs;
- web-based motorist information campaigns, e.g., project websites and email listservs;
- social media (Facebook, Twitter, etc.)
- freight informational campaigns; and
- stakeholder updates and meetings.

Work in this section must be closely coordinated with INDOT Office of Communications staff from both Central Office and the district. The INDOT district communication representative should be an active participant in the development and implementation of the PIP.

## **503-6.0 WORK VEHICLE TRAFFIC CONTROL PLANS**

### **503-6.01 Work Vehicle Traffic Control Plan (WVTCP) Development [Rev. May 2023]**

A WVTCP is a tool the project engineer can use to plan, coordinate and control the flow of construction vehicles, equipment, and workers operating in close proximity to the motoring public within the work zone activity area with the goal of improving the safety of the workers. The development of a WVTCP provides for safe traffic control within the work zone and may address one or more of the following objectives for the Contractor:

1. provide enough work space to reduce the need to back up equipment;
2. limit access points to and from work zones;

3. provide adequate acceleration and deceleration lengths for work vehicle ingress and egress points
4. restrict the use of median crossovers on a limited-access highway;
5. establish pedestrian and worker-free areas where possible;
6. establish work zone layouts commensurate with the type of equipment being used;
7. place signs within the work zone to provide guidance for workers, equipment, and trucks;
8. design buffer spaces to protect workers from errant vehicles or work zone equipment; and
9. provide specific training to be completed by workers prior to entering the work zone, and prohibit workers from entering the work zone who have not completed the training.

The need for a WVTCP might be indicated by industry through their search of contracts that are included on the 18-month letting list. If a WVTCP is developed during the design stage, it should be included in the contract documents. Preparation of the WVTCP should include the following:

1. determine the construction sequence and choose the construction stages that require site-specific WVTCP plans;
2. draw the basic work area layout;
3. plot pedestrian and vehicle paths;
4. locate utilities, and storage and staging areas;
5. prepare necessary WVTCP notes; and
6. determine internal work zone speed limits.

Critical parts of the WVTCP, such as ingress and egress points, should be discussed with and approved by District Construction or the project engineer. The plan for communicating the provisions of the WVTCP and the overall safety plan to each worker should also be discussed at the PFC, FFC and preconstruction meeting.

## **503-6.02 Resources**

### **503-6.02(01) Occupational Safety and Health Administration Regulations**

The Occupational Safety and Health Administration (OHSA) has additional regulations for motor vehicles in the construction industry. These regulations are codified in the *Code of Federal Regulations* at [29 CFR part 1926](#), Safety and Health Regulations for Construction, Subpart O, Motor Vehicles, Sections 600-601. These regulations specify minimum standards and procedures for work zone vehicles with respect to items such as backing-up vehicles and leaving vehicles unattended at night. These regulations should be reviewed and included, as appropriate in the WVTCP.



## **503-6.02(02) Indiana Manual on Uniform Traffic Control Devices**

The *IMUTCD*, Chapter 6H, provides additional guidance regarding the placement of work vehicles in and near the work space.

## **503-7.0 TEMPORARY TRAFFIC CONTROL DEVICES**

The proper use of traffic control devices is critical to both public and worker safety and has been proven to significantly reduce accidents crashes in a construction zone. An Official Action is required before installation of a regulatory temporary traffic control device if a proposed change is made to a facility's regulatory control. An Official Action is a document generated and approved by the district that identifies the new regulation and the exact location of its applicability, ensuring the action is enforceable and can be properly adjudicated. Examples are proposed regulatory changes regarding a parking restriction, intersection control, no-passing zone, traffic signal, or a temporary speed limit. However, Indiana Statutes provide for the establishment of an enforceable reduced posted speed limit in a work zone without an Official Action. For a state-controlled facility, the designer must contact the appropriate District Traffic Engineer to obtain a copy of the approved Official Action. The Official Action must be included in the special provisions contract documents. For a locally-controlled facility, approval must be obtained from the appropriate jurisdiction.

### **503-7.01 Temporary Traffic Control Signs**

In a construction zone, a proposed regulatory sign is used to temporarily override an existing mandate or prohibition such as a reduced speed limit. A warning sign, as described in Section 503-7.01(03), is used in advance of the construction area to indicate a potentially hazardous condition. A guide sign, as described in Section 503-7.01(04), is used to inform the motorist of a detour route, destination, or point of interest.

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and *IMUTCD* Part 6 provide the INDOT criteria for the design, application, and placement of signs in a construction zone. This section provides supplemental information on the application of various highway signs. See Section 502-1.0 and the *IMUTCD* regarding permanent signs.

#### **503-7.01(01) Placement**

The uniform placement of construction signing, although desirable, is not always practical. Road geometrics or other factors often dictate a more advantageous placement. In addition to INDOT

*Standards* and Part 6 of the *IMUTCD* the following guidelines should be also considered together when determining the placement of construction signing.

1. Permanent Sign. A construction sign in close proximity to a permanent sign should be reviewed after the theoretical temporary sign location has been determined. For example, the permanent sign should not block the view of the temporary sign nor convey conflicting information. An information “overload” should also be avoided by not placing too many signs near each other.
2. Intersection. If construction signing is warranted near an intersection, the temporary sign should be considered beyond the intersection. On the intersection approach, a permanent sign provides control and directional information to the motorist. Locating a construction sign beyond the intersection will usually improve motorist comprehension of the sign.
3. Roadside Barrier. A temporary construction sign should be placed behind an existing roadside barrier if practical. This will reduce the probability that it will be impacted.
4. Spacing Between Signs. Unless otherwise stipulated herein or by INDOT *Standards* or the *IMUTCD* the minimum spacing between signs should be 100 ft regardless of construction zone design speed. Greater spacing between any two panel signs is needed, 500 ft is recommended.

### **503-7.01(02) Regulatory Signing [Rev. May 2023]**

1. Work Zone and Worksite Speed Limit Signing. A reduced speed limit for a work zone may be established in one of two ways: either as a “work zone speed limit” through official action or as a “worksite speed limit” which is authorized by the *Indiana Code*. There are two type of worksite speed limits, continuous use and intermittent.

The work zone speed limit and the continuous-use worksite speed limit are intended to protect motorists. An intermittent-use worksite speed limit is for the protection of workers and thus applies to a specific location within the work zone where work is actually occurring. The designer should consult with the district traffic office to determine which, if any, of the three speed limit types is appropriate for the work zone. Figure 503-7A provides recommended work zone and worksite speed limits for a freeway based on the type of facility and the proposed construction application. The following information should be considered during the selection and implementation of a work zone or worksite speed limit.

- a. Work Zone Speed Limit. The work zone speed limit is a temporary reduction and will be determined based on the construction-zone design speed, traffic volume, work type, geometrics, project length, etc. The work zone speed limit should not

exceed the construction-zone design speed through the construction area. Section 503-3.04(01) provides guidance on the selection of a construction-zone design speed. A work zone speed limit is established by an Official Action through the district office.

A work zone speed limit sign consists of the appropriately sized R2-1 sign and should be placed according to the *IMUTCD*. It is paid for as either Construction Sign Type A (36" x 48" series or larger) or Construction Sign Type B (24" x 30' series).

- b. **Worksite Speed Limit.** Indiana statutes permit INDOT to establish a worksite speed limit without an Official Action. They also stipulate that the worksite speed limit will be at least 10 mph below the original posted speed limit. Although an Official Action is not needed, worksite speed limits should be authorized by the District Technical Services or District Construction Office. This authorization should be provided in writing and kept in the project file.

There are two types of worksite speed limits:

- 1) **Intermittent-Use Worksite Speed Limit.** Since this type is primarily intended to protect workers, an intermittent worksite speed limit by law is only in effect where and while work is actually in progress and workers are present.

An intermittent-use worksite speed limit sign assembly consists of an R2-1-B speed limit sign, an XG20-5-B "Worksite" plaque placed above the speed limit sign, an S4-4 "When Flashing" plaque placed below the sign, and amber flashing strobe lights with one mounted at each upper corner of the regulatory sign. The beacons should be activated only while work is in progress and workers are present. The device provides for both worker and public safety without imposing unnecessary travel delays during non-working periods.

The mounting method is the contractor's option but generally the signs and strobe lights are set up on a trailer. An intermittent use worksite speed limit sign assembly is paid for as "Temporary Worksite Speed Limit Assembly, *Intermittent Use*, EACH". A work zone should have sufficient lateral width or right of way to accommodate a trailer in order for the intermittent use worksite speed limit assembly to be used.

- 2) **Continuous-Use Worksite Speed Limits.** The determination of a continuous-use worksite speed limit should be based on the same considerations as a work zone speed limit.

A continuous-use worksite speed limit sign assembly consists of an R2-1-B speed limit sign and a “Worksite” plaque mounted above the regulatory sign. A continuous-use worksite speed limit sign assembly is paid for as a Temporary Worksite Speed Limit Assembly, *Continuous Use*, EACH.

- c. Location and Spacing. When determining the location and spacing of signs, the following will apply.
  - 1) Work Zone Sign. The designer should coordinate with the District Traffic Engineer to determine the appropriate beginning and ending locations for the work zone speed limit. A work zone speed limit sign should be placed prior to the construction zone and after each interchange entrance ramp within the construction zone. The reduced speed zone should begin prior to an expected queue backup due to a lane closure, lane restriction, etc.
  - 2) Worksite Sign. The INDOT *Standard Specifications* provide the guidelines for determining the appropriate location for a worksite speed limit sign assembly.
  - 3) Distance plaque. For longer reduced work zone speed limit or continuous use worksite speed limit segments, consideration should be given to adding a supplemental plaque to the assembly below the speed limit sign noting the length of the speed limit reduction, e.g. “NEXT 5 MILES”.
  - 4) Additional normal speed limit signs should be specified to properly reestablish the normal speed limit. This aids enforcement by properly defining the speed zones.

For rural interstate applications, R2-1-B and R2-Y2-B signs for the normal speed limits should be placed approximately 500 ft downstream from the end of the worksite.

For all other applications an R2-1 or R2-1-B sign for the normal speed limit should be placed 500 ft downstream from the end of the worksite.

The additional normal speed limit sign(s) may be omitted if existing normal speed limit signs are located within sight distance. For worksite speed limits the R2-Y12 or R2-Y12-B “End Worksite Speed Limit” sign may also be provided, although not required, alongside the normal speed limit sign at the end of the worksite.

In work zones where reduced speed limits are in effect for distances of 2 miles or greater additional work zone or worksite speed limit signs should be considered. Law enforcement

recommends spacing between signs of no more than 1 mile. Additional signs should be provided downstream of and close to any entrance ramp within the reduced speed segment. For interstates and other multilane highways, consideration should be given to providing left side as well as the standard right side placement, particularly when traffic volumes and truck percentages are significant.

- d. Speed Limit Reductions Greater than 10 mph. The regulatory sign, R2-15b “Reduced Speed XX Ahead” should not be specified. Instead, the reduced speed limit warning sign XW3-5 or XW 3-5a should be specified. The details are shown on the INDOT *Standard Drawings* series 801-TCDV, Traffic Control Devices. Only one of the sign designations should be specified for the entire project. Reduced speed limit warning signs should be quantified as a construction sign of the appropriate type, similar to work zone or worksite speed limit signs.
  - e. Divided Facility. An assembly should be placed on each side of each roadway.
  - f. End Speed Limit Sign. An “End Work Zone or Worksite Speed Limit” sign should be included in the TTCP. Not applicable for intermittent worksite speed limits.
2. “Stop” or “Yield” Sign. Each individual site may warrant the use of other regulatory sign changes. For example, the installation of a “Stop” or “Yield” sign may be considered at a previously uncontrolled merge and acceleration area if the taper length is reduced during construction operations. An Official Action, as described in Section 503-7.0, should be coordinated through the District Traffic Engineer. Based on *IMUTCD* guidelines, the implementation of a “Stop Ahead” or “Yield Ahead” sign may also be considered.
  3. Selective Exclusion Sign. Where a lane shift occurs through a construction zone and the lane shift requires the use of the shoulder as a travel lane, a selective exclusion sign can be considered to assign heavy-truck traffic to lanes on the pavement proper, that is, a heavy truck is not be permitted to use the shoulder as a travel lane. Where signage is placed to restrict trucks to a lane, consideration should be given to adding a supplemental plaque to the signage assembly noting the need for compliance, e.g. Soft Shoulder. An Official Action, as described in Section 503-7.0, should be coordinated through the District Traffic Engineer.

### **503-7.01(03) Advanced Warning Signs [Rev. May 2023]**

This section provides additional information on the sequence and placement of advance warning signs. See INDOT *Standard Drawings* series 801-TCSN, Traffic Control Signs, for sign details.

A warning sign is used to alert the motorist of a potentially hazardous condition on or adjacent to the roadway. Designer should consider that the unnecessary use of this type of sign can breed motorist disrespect for signing in general. Therefore, the minimum number of warning signs necessary to warn the motorist adequately should be used.

A warning sign is used in an advance warning area, transition, or activity areas of a construction zone. The advance warning area is the first opportunity to inform a motorist regarding the safe negotiation of the upcoming construction activity. The following elements should be considered when determining the sequence and placement of advance warning signs.

1. road facility type and location;
2. traffic volume and mix;
3. posted speed limit;
4. construction activity type and location; and
5. actual or anticipated field conditions.

Warning signs for work zones that remain in the same location for no longer than 12 hours, for example work zones utilizing flaggers, should be specified as mobile and the corresponding pay item- 801-92448, “CONSTRUCTION SIGN, MOBILE” - included in the estimate

### **Sign Sequence**

Based on the factors above, the advance warning area may warrant either a single warning sign or a multiple sign sequence. An advance warning sign sequence may be classified as A, A-B, or A-B-C. Figure [503-7B](#), Advance Warning Signs, and the *IMUTCD* provide the configuration for each sequence classification. The following describes each sign sequence category and its application.

1. A Sequence. This consists of a single sign placed upstream from in advance of the nearest point of transition or restriction. The sequence should be considered for work outside a shoulder.
2. A-B Sequence. This is a two-sign configuration within the advance warning area. The B sign is placed in advance of the A sign. The sequence should be considered for the following construction activities:
  - a. work on a shoulder;
  - b. interior lane closure on a roadway with three or more lanes; or
  - c. lane closure on a minor street.

3. A-B-C Sequence. This consists of three or more signs within the advance warning area. The C sign is placed upstream from the B sign. The sequence should be considered for the following construction activities:
  - a. road closure with traffic diversion;
  - b. lane closure for one-lane, two-way traffic control; or
  - c. lane closure for a highway with four or more lanes or a freeway.

The use of a multiple advance warning sign sequence is required on a limited-access facility with a higher speed or a facility with construction activities, which present the motorist with major decision points such as a lane closure, multi-lane shift, or queue backup. Advance warning signs are spread out over a greater distance on such a facility to provide the motorist with adequate time and distance to safely negotiate the downstream construction activity. Figure [503-7B](#) provides the suggested sign placement distance for each facility type. The columns headed A, B, and C represent the distances between signs and should be used to indicate the theoretical sign locations. These distances should be used as a starting point and each sign location adjusted as necessary based on actual and anticipated field conditions, e.g., sign location relative to a crest vertical curve, or line-of-sight obstruction. Figure [503-7B](#) should be used in conjunction with the diagrams shown in the *IMUTCD* for each construction activity discussed above.

### **Construction Ahead Sign**

The XW-20-1, “Construction Ahead”, sign should identify the actual type of construction activity as specifically as possible. When the project involves only one type of work such as pavement, bridge, or utility, the XW-20-1 legend should incorporate the specific type of work, i.e., “Pavement Work”, “Bridge Work”, and “Utility Work”. Otherwise the “Road Construction Ahead” message should be used.

### **Worksite Increased Penalty Signs**

The Worksite Increased Penalty Signs inform the motorist of increased penalties for moving violations is required for all work zones that occupy or are adjacent to travel lanes for a period of one hour or more.

1. Use of Single Worksite Added Penalty Sign. The XW2-6-A “Worksite Added Penalty” sign, 78 in. x 42 in., should be specified for a rural area with sufficient right of way to accommodate the sign. It also should be specified for an urban area with a posted speed limit of 40 mph or higher, and sufficient right of way to accommodate the sign. The XW2-6 “Worksite Added Penalty” sign, 60 in. x 36 in., should be specified for an urban area with a posted speed limit of 35 mph or lower, under one of the following conditions:

- a. the existing conditions outside the edge of pavement make installation of driven posts impractical; or
  - b. the width of the right of way outside of the edge of pavement is not sufficient to accommodate the XW2-6-A sign.
2. Use of Separate Speeding and Reckless Driving Signs.
- a. Rural Area. The XW2-6a-B “Speeding” and XW2-6b-B “Reckless Diving” signs, both 48 in. x 48 in., should be specified to be used in series with each other, and should be used under the following conditions
    - 1) the project is in an area where the right-of-way width outside of the edge of pavement is not sufficient to accommodate the XW2-6 sign; or
    - 2) the project is a moving operation where construction signs are set and removed each day to accommodate the changing location of the work.
  - b. Urban Area. The XW2-6a-A “Speeding” and XW2-6b-A “Reckless Driving” signs, both 36 in. x 36 in., should be specified to be used in series with each other, and should be used under the following conditions.
    - 1) the project is in an area where the right-of-way width outside of the edge of pavement is not sufficient to accommodate the XW2-6 sign; or
    - 2) the project is a moving operation where construction signs are set and removed each day to accommodate the changing location of the work.
3. Sign Location and Quantities. The following guidelines should also be used to determine the size, location and quantity of the signs.
- a. Signs are required for each project in which traffic will travel through an active construction zone marked by “Road Construction Ahead” and “End Construction” signs.
  - b. An XW2-6-A or XW2-6 sign (where warranted) should be placed in advance of the first “Road Construction Ahead” sign for each direction of travel on the project mainline. The advance distance should be 1/2 mile on an interstate or other freeway, .500 ft on freeways or a non-freeway in a rural area, or 100 ft on a non-freeway in an urban area.



- c. XW2-6a and XW2-6b series of signs (where warranted) should be placed in advance of the first “Road Construction Ahead” sign for each direction of travel on the project mainline. The advance distance for the XW2-6a sign should be 1000 ft in a rural area or 200 ft in an urban area. The advance distance for the XW2-6b sign should be 500 ft in a rural area, or 100 ft in an urban area.
- d. Signs are not required to be placed on side roads or ramps leading into a construction zone.
- e. Signs are not required if the active construction zone is completely isolated from live traffic, i.e., a full road closure with a detour or construction along a new alignment. The location of each sign should be indicated in the same manner as other construction signs shown on the maintenance of traffic plans.
- f. When the XW2-6a and XW2-6b signs are appropriate the 36 in. x 36 in. versions should be used for urban highways, while the 48 in. x 48 in. versions, XW2-6a-B and XW2-6b-B should be specified for rural highways. The XW2-6a and XW2-6b signs which are 30 in. x 30 in. may be used on urban collectors and low volume county roads.

### **Zipper Merge Warning Signs**

Zipper merges may be used where there is a lane closure and queuing is anticipated for at least two hours a day for five days a week and with the approval of the district traffic engineer. The first two signs for this treatment should have the message “USE BOTH LANES TO MERGE POINT” and the third “MERGE POINT/TAKE TURNS”. The signs should be shown on the plans located at the A-B-C sequence described previously in this section.

The use of portable changeable message signs (PCMS) with zipper merge messages that vary based on travel conditions in the work zone (e.g. free flow, slow, or stopped traffic) may also be used. PCMSs may be preferable when queuing is intermittently occurring.

### **503-7.01(04) Guide Sign**

The applicable criteria for permanent guide signs should be reviewed in Section 502-1.0 and in the *IMUTCD*. The following supplemental information applies to the use of a guide sign in a construction zone:

1. Panel Sign. A guide sign is warranted in a construction zone or alternate route where a temporary route change is necessary. For example, a large panel sign can be considered for

a ramp or lane closure, e.g., “Ramp \_\_\_ Closed Use Ramp \_\_\_,” “Ramp \_\_\_ Closed (date)”. See the INDOT *Standard Drawings* series 801-TCSN, *Traffic Control Signs*, for information related to determining the size of a panel sign support.

2. Other Signs. Route markers, street name signs, special information signs, or directional or detour signs can also be warranted based on the particular work scheduled for the facility.

### **503-7.01(05) Portable Changeable Message Sign [Rev. May 2023]**

A portable changeable message sign (PCMS) is effective in communicating the construction-zone information to the general motoring public. Its use in a construction project should be as outlined in [INDOT Guidelines for Portable Changeable Message Signs](#).

1. PCMS Need. A PCMS should be considered for each project which involves the following challenges:
  - a. intermittent or short term, road, lane, or ramp closure;
  - b. frequent changes in traffic patterns;
  - c. at least one road with traffic volumes that will be at or over capacity during construction; or
  - d. other projects as deemed necessary by the District, the Construction Management Division, or the Work Zone Safety Office of the Traffic Management Division.

A PCMS should not be used to convey a message that can be effectively conveyed with static signing. The need for a PCMS and the selection of messages should be considered during the development of the TMP.

2. Showing PCMS on the Plans. If a PCMS is needed the following information should be provided on the plans:
  - a. The approximate location of each PCMS. Unless there are specific reasons otherwise, each PCMS is to be located as shown in the *INDOT Guidelines for PCMS*, Tables 1 and 2.
  - b. The message content for each PCMS. Each message should be selected from the standard messages shown in the *INDOT Guidelines for PCMS*, Table 7, or developed as non-standard under Section V the guidelines. The district Traffic Office or the Traffic Management Center can be consulted for assistance with message development. A Programming Information for Portable Changeable Message Sign form is available from the Department’s [Editable Documents page](#),

under Traffic Maintenance (MOT). This form should be included in the contract documents for each non-standard message on each PCMS.

- c. A pay item for Portable Changeable Message Sign and the appropriate quantity should be included in the estimate of quantities and cost estimate.
3. Traffic Management Center Control of PCMS Operations. As part of the TMP for a project on any interstate or freeway, the designer should consult with the district construction office and the appropriate traffic management center (TMC) to determine whether TMC control of the PCMS is desired. The ATMS areas have expanded to include all interstate and freeway segments in the state.
  4. The *IMUTCD* provides design and application criteria for a PCMS. The following should also be considered in specifying a PCMS.
    - a. Display. The display should provide no more than the maximum amount of information that can be read and comprehended by the motorist at a quick glance, i.e., no rolling message. A PCMS is capable of displaying three lines of eight characters each. There should not be more than two messages phased in order to provide readability and comprehension. Each message phase should be able to stand alone. For multiple messages, two signs should be used.
    - b. Location. The sign should be visible from 2500 ft under ideal day or night conditions. The first message should be legible at a minimum distance of 650 ft from each lane. PCMSs are typically placed in advance of all other advance warning signs. For more information regarding location, see the Placement Section of the *INDOT Guidelines for PCMS*.
    - c. Traffic Control Devices. A PCMS may be used as a supplement, but it should not be used as a substitute for the proper use of other traffic control devices.
    - d. Flashing Arrow Sign. A PCMS should not be used as an alternative to a flashing arrow sign. However, a PCMS may be used to simulate an arrow display in a message.

### **503-7.01(06) Flashing Arrow Sign**

A flashing arrow sign is used to supplement other traffic control devices. It is used where additional warning and directional information is required to assist direct motorists in merging and controlling traffic through or around the work activity. The *INDOT Standard Drawings*, the *INDOT Standard Specifications*, and the *IMUTCD* provide the *INDOT* criteria for the placement,

design, and application of a flashing arrow sign. A flashing arrow sign should be used on each all freeway interstate construction projects requiring a lane closure. For other roadway types, the need for a flashing arrow sign will be determined on a project-by-project basis. A flashing arrow sign can be considered for the following applications:

- work in the vicinity of a freeway entrance or exit ramp;
- median crossover on a freeway;
- interior or double-lane closure on a freeway or other roadway of four or more lanes;
- right lane closure on the far side of an intersection; or
- mobile operation on a shoulder or roadway of four or more lanes.

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and the *IMUTCD* provide the INDOT criteria for the placement, design, and application of a flashing arrow sign. The *IMUTCD* also includes application diagrams. The following provides supplemental information on the use of a flashing arrow sign.

1. Display. The following display modes are available:
  - a. Flashing Arrow or Sequential Arrow. This is used for a left or right lane shift or diversion.
  - b. Flashing Double Arrow. This is used for an interior lane closure where traffic is permitted to travel either left or right around the work activity.
2. Use and Location. The flashing arrow sign should be located at the beginning of a lane-merge taper. For a stationary activity, the sign should be located on the shoulder or in the closed lane behind a channeling or barricade device. For a mobile operation, a mounted sign should be located at the rear of the activity upstream of the maintenance vehicles. Where used in the vicinity of a ramp, median crossover, or side-road intersection, the flashing arrow sign placement should not confuse the motorist. Figure [503-7C](#) provides the recommended usages and the minimum legibility distances under ideal day or night conditions.
3. Two-Lane, Two-Way Operation (TLTWO). A flashing arrow sign should not be used to shift traffic in a TLTWO.
4. Shoulder or Roadside Activity. A flashing arrow sign should be used only in the flashing caution mode for a shoulder or roadside work activity.
5. Flagger. A flashing arrow sign should not be used if a flagger is used for traffic control at the worksite.

6. Multiple Lane Closure. Multiple flashing arrow signs should be considered for a multi-lane closure. In this situation, a flashing arrow sign should be located at the beginning of each lane-merge taper. A flashing arrow sign should not be used to laterally shift multiple lanes of traffic.
7. Traffic Control Devices. A flashing arrow sign may be used as a supplemental traffic control device, but it should not be used as a substitute for the proper use of signs, pavement markings, or lighting in a construction zone. A flashing arrow sign should not replace other required signing.

### **503-7.02 Channelizing Devices [Rev. May 2023]**

The INDOT *Standard Drawings*, the INDOT *Standard Specifications*, and the *IMUTCD* provide the INDOT criteria for the selection, application, and placement of channelization devices. The *IMUTCD* also includes application diagrams for the use of these devices.

#### **503-7.02(01) Types [Rev. May 2023]**

Channelization devices are used in a work zone to warn the motorist of work activities in or near the traveled way, to protect workers in the work zone, and to guide the motorist or pedestrian safely through and around the worksite. There are a number of channelization devices available, each having its specific application in a construction operation, e.g., crossover, runaround, lane closure, road closure, or two-lane, two-way operation. Because each project differs, the selection, application, and location of these devices should be determined on a project-by-project basis. The following channelization devices may be used in a construction zone, devices used for pedestrian MOT are described in section 503-7.07.:

1. Barricade.
  - a. Type I or Type II Barricade. INDOT does not allow the use of these types of barricades on the roadway; type II barricades may are no longer be used to close a sidewalk.
  - b. Type III Barricade. This is used to close a lane or roadway but not a sidewalk. See Section 503-7.02(04) for applications and placement guidance.
2. Drums. Drums are used in a linear series to channelize and delineate the desired travel path. They may also be used individually or in a group to mark a specific location. They can be

easily shifted moved to accommodate changing conditions within the construction zone. For a temporary lane closure during daylight hours, cones, tubular markers, or vertical panels may be used in lieu of drums.

3. Cones. Traffic cones are channelization devices used to delineate a travel path, divide opposing traffic lanes, divide traffic lanes in the same direction, or delineate a short-duration construction, maintenance, or utility activity. The INDOT *Standard Specifications* prohibit cones for interstate lane restrictions and they may not be substituted for drums or barricades in situations where those devices are required.
4. Tall Cones, or 42" Channelizers as they also known. Tall Cones may be used to delineate tangents on freeways where the effective lane width should a drum be used would be less than 10 ft. Effective lane width is the width of pavement for the lane minus the 2 ft width of the drum.

On non-freeways they may be used to delineate tapers, tangents, and separate directions of travel. They may also be used to delineate pavement drop-offs should use of drums result in less than a 10 ft effective lane width.

5. Tubular Markers. These devices are used to channel traffic, divide opposing lanes of traffic on a non-freeway, or delineate pavement drop-offs. Tubular markers have less visible area than other devices and should be used only where space restrictions do not allow for use of more visible devices.
6. Vertical Panels. These devices are used to channel traffic, delineate pavement drop-offs, and may be used in place of drums or barricades where space is limited. Vertical panels have less visible area than drums or barricades and should be used only where space restrictions do not allow for use of more visible devices.
7. Temporary Asphalt Divider. This device should not be used for separating traffic.
8. Temporary Concrete Traffic Barrier (TTB). A TCTB should not be used solely for channelization but should where positive protection is also needed. The TCTB should be located behind and in conjunction with supporting channelization devices, delineators, or pavement markings. Section 503-3.05(03) provides flare rates for the TCTB. Delineators and steady-burning lamps should also be attached to the TCTB. However, where used between lanes in a two-lane, two-way operation, experience has shown that opposing vehicular headlights wash out the lamp and the lamps cannot be safely maintained. Therefore, lamps should not be used in this situation.

9. Delineators. Delineators are supplemental devices used to indicate the roadway alignment and the intended path through the construction zone by providing retro-reflection from headlights. Delineators are used along the pavement edge in a runaround operation and are attached to the TCB or TTB.
10. Longitudinal Pavement Markings. The application of pavement markings is discussed in Section 503-7.03. Longitudinal pavement markings should be used only in combination with other primary channelization devices to delineate the desired travel path. A temporary double solid yellow line should be used in conjunction with tubular markers, vertical panels, or TCB. Markings should also be used on each undivided roadway of four or more lanes. Revisions to existing pavement markings are not required for a temporary daylight lane closure. Adjustments to existing markings or use of temporary markings is often not practical for work zones that are not of a long duration.

### **503-7.02(02) Taper Length**

The required length of tapered section delineated by channelization devices is shown on the INDOT *Standard Drawings*. Figures [503-7D](#) and [503-7E](#) provide the minimum taper requirement for each taper application in a construction zone.

### **503-7.02(03) Spacing**

As with a taper, the longitudinal spacing of channelization devices is dependent on vehicular speed. In a two-lane, two-way traffic operation, the spacing at a tapered section should be 10 ft for a 50-ft taper length, or 20 ft for a 100-ft taper length. Figure [503-7F](#) provides suggested spacing of channelization devices for other construction-zone design speeds. Unless otherwise specified in the INDOT *Standard Drawings*, the maximum spacing of drums, cones, or vertical panels should be based on Figure [503-7F](#).

### **503-7.02(04) Type III Barricade [Rev. May 2023]**

INDOT uses a Type III-A or Type III-B barricade for a road or lane closure, pedestrian channelizers are used to close a sidewalk (see section 503-7.07), type III barricades are no longer used for this purpose.

The Type III-A barricade is used where traffic is not allowed behind the barricade. Reflectorized rails are used only on the side facing traffic. The Type III-B barricade is used where traffic is

allowed behind the barricade. Reflectorized rails are required on both sides of the barricade. The following should also be considered.

1. Materials. A Type III barricade is constructed with three sections mounted on skid-type supports or on posts driven into the ground. The sections may vary from 4 to 12-ft long. A skid-mounted barricade should be used where the barricade is to be located on the traveled way or shoulder. A post-driven barricade may be used where the barricade is to be located outside of the paved portion of the roadway.
2. Complete Closure. A Type III-A barricade should extend completely across the roadway and across a roadway side slope that is 3:1 or flatter within the right of way. Should the side slope be steeper than 3:1, the barricade need only to extend 10 ft. past the edge of pavement. During non-working hours, openings are not allowed within the barrier assembly.
3. Divided Highway. Where one set of lanes of a divided facility is closed to traffic, a Type III-A barricade is required across the pavement area and on a side or median slope which is 3:1 or flatter but extends no further than to the centerline of the median. Should the side slope be steeper than 3:1, the barricade need only to extend 10 ft. past the edge of pavement. An additional barricade is required across the closed portion where the facility intersects with a local road, e.g., county road, drive. An additional barricade is required where a bridge or pipe is to be removed; see item 6, below.
4. Crossover. A Type III-B barricade should be used where a crossover on a divided facility is required because one set of lanes is closed for construction and two-way traffic is being maintained on the other set.
5. Local Traffic. If local traffic is allowed to use the facility under construction, a Type III-B barricade should be used at the beginning and end portions of the closed road. Each barricade should extend onto a side slope of 3:1 or flatter, within the right of way. An additional barricade will be required where a bridge or pipe is to be removed; see item 6, below.
6. Bridge or Pipe Removal. Where there is a possibility that a vehicle can be on a closed facility and where there is a bridge removal, pipe removal, or other hazard location, an additional Type III barricade should be provided within 150 ft of the hazard.
7. Road Closure Sign Assembly. Where a Type III barricade is used, a road closure sign assembly is required. However, such a sign assembly should not be used next to a lane closure where adjacent lanes remain open to traffic, or where a barricade is specified for closure of a lane on an undivided facility of four or more lanes, and the remaining lanes



are being used to maintain traffic. The Road Closure Sign Assembly is paid for separately from the Type III barricade as a per each item and not as a Construction Sign. When alternative messages, such as “Bridge Closed” or “Ramp Closed” are used the Road Closure Sign Assembly pay item should be used in accordance with Standard Specifications.

### **503-7.02(05) Lateral Placement- Encroachment into adjacent Travel Lane [Add. May 2023]**

If the entire width of a lane needs to be closed, e.g., concrete pavement patching, the MOT plans sheet should detail the channelizing devices in the adjacent, open lane with the near edge of the channelizing device shown at the permanent lane line between the closed and adjacent open lanes.

### **503-7.03 Temporary Pavement Markings [Rev. Nov. 2020]**

The INDOT *Standard Drawings* and the *IMUTCD* provide the INDOT criteria for the selection, application, and placement of pavement markings in a construction zone.

INDOT *Standard Specifications* section 801 requires temporary pavement markings to be placed prior to opening the lane to traffic. This includes the marking patterns of gore areas, outside edge line of deceleration and acceleration lines, narrow bridge markings, lane reduction transitions, lane lines, centerlines, and transverse markings as appropriate.

A quantity for temporary pavement markings for edge lines should be included when durable edge line pavement markings are warranted in accordance with Figure 502-2C.

For temporary markings used in conjunction with HMA pavement, the quantity should be calculated for each lift of intermediate and surface.

The width specified should be that of the existing pavement marking.

### **503-7.03(01) Types [Rev. Nov. 2020, May 2023]**

1. Paint. Quick-drying traffic paint is a low-cost, temporary pavement marking. To improve reflectivity, glass beads are required. Temporary paint is a non-removable type of temporary pavement marking and is not allowed on a final pavement surface except as follows.

If it is anticipated that the temporary markings will be in place through the winter months, temporary paint may be the most suitable choice on a final pavement surface. The decision to

use temporary paint under these conditions should be coordinated with the district Traffic Office and district Construction.

2. **Temporary Raised Pavement Markers.** In a high traffic-volume location, raised temporary pavement markers should be considered as a supplemental device to improve delineation through the construction zone. Typical locations include centerline, lane line, gore area, or where there are changes in the alignment, e.g., lane closure or lane shift. For a centerline or lane line, temporary raised pavement markers are placed at the midpoint of each gap, i.e., every 40 ft. For a taper, gore, or similar element, the raised markers should be spaced at 20 ft. Temporary raised pavement markers should be removed prior to the placing of the next pavement course.
3. **Temporary Pavement Marking Tape.** Temporary pavement marking tape is the appropriate material choice where there is a change to the traffic pattern during construction, such as a crossover switch. Temporary tape may be the most desirable option when temporary markings are needed on the final pavement surface. It can be easily and quickly installed and, if necessary, easily removed. This helps to protect the pavement surface and eliminates the potential for “ghost markings” – left over remnants of the temporary markings that are no longer in the correct position. Disadvantages of temporary tape are that it tends to move or break up under heavy traffic volume, and that it is not suitable for usage during the winter months. Temporary pavement marking tape requires more maintenance in comparison to temporary paint. INDOT uses the following temporary pavement marking tape.
  - a. **Type I.** Type I tape is a removable type of temporary pavement marking that may be used as a temporary centerline, lane line, or no-passing zone line that is placed parallel to the normal pavement marking pattern, or as a temporary transverse marking or pavement message marking. It should also be used where pavement markings are placed at an angle to the normal pavement marking pattern, e.g., taper for lane closure or lane shift. When black Type I tape is used to cover conflicting markings, the width specified should be at least 1 in. wider than the existing marking to be covered. Available widths are 6 in and 8 in. The contractor should use a type 1 tape from INDOT’s Qualified Product List, all tapes on this list have wet reflective elements.
  - b. **Type II.** Type II tape is a non-removable type of temporary pavement marking that may be used on a pavement which is expected to be removed or covered by additional pavement courses. It may be used as a centerline, lane line, or edge line that is parallel to the normal pavement markings. It may also be used as a centerline or lane line on a resurfacing overlay course.

4. Thermoplastic or Multi-Component Markings. Thermoplastic or multi-component (epoxy) markings are used in a construction zone only if the traffic volume is high, and the temporary traffic pattern will be in place for over one year. Thermoplastic or multi-component markings are non-removable types of pavement markings. Durable markings used for a temporary application are paid for with the appropriate pay item for permanent markings.
5. Temporary Transverse Rumble Strips. Transverse rumble strips are narrow, raised strips of rough-textured material arranged intermittently and transversely to extend across the travel lane to create audible and vibratory stimuli that increase driver awareness. Portable and stationary type temporary transverse rumble strips adhere to the pavement surface. The stationary type are created with extruded material or repeated passes of pavement marking tape to reach a ¼ in. height. Temporary portable rumble strips are devices that stay in place under their own weight and do not attach to the pavement with adhesives or fasteners. Figure 503-7G illustrates the typical layout for transverse rumble strips placed in advance of a lane closure. Section 503-3.05(07) provides additional information regarding applications for temporary transverse rumble strips.

### **503-7.03(02) Application**

The application of temporary pavement markings in a construction zone depends on facility type, project duration, project length, and anticipated traffic volume. The phasing of temporary traffic control during construction should be considered. The temporary pavement markings should be selected that are best suited to the anticipated conditions and are most economical for the project. The removal of a removable temporary pavement marking is included in the Temporary Pavement Marking, Removable pay item quantity.

If permanent or temporary tape type II markings must be removed as part of the planned traffic-maintenance plan, a quantity for removal of these markings is required or type I temporary black tape should be specified to cover the existing markings. Black temporary tape should be specified where the pavement will not be replaced or resurfaced. When used, black temporary tape should be at least 1 inch wider than the existing marking it will cover. If non-removable temporary pavement markings are necessary on a final surface, the temporary markings should be placed as near as possible to the location of the final permanent pavement markings.

## **503-7.04 Temporary Traffic Control Signals**

### **503-7.04(01) Location**

The use of a temporary traffic signal in a construction zone will be determined on a project-by-project basis. The warrant criteria for permanent signal installations in Section 502-3.02 should be used to help determine if a temporary traffic signal is warranted at an existing non-signalized intersection. The traffic volume expected during construction should be used for the warrant analysis. An Official Action, as described in Section 503-7.0, must be coordinated through the District Traffic Engineer. Temporary signals may be installed during construction at the following locations:

1. intersection where an existing signal must be maintained;
2. existing non-signalized intersection or drive where construction patterns and traffic volume now warrant a signal;
3. temporary haul road or other temporary access point;
4. one-lane, two-way traffic operation such as a bridge lane closure; or
5. crossroad or ramp intersection where there is an increase in traffic or there is a decrease in capacity due to the construction.

### **503-7.04(02) Application [Rev. May 2023]**

The following should be considered:

1. Existing Signals. The impacts that a construction activity has on existing signal operations should be determined, in order to maximize the level of service. For example, the designer might propose the following solution:
  - a. Recommend re-timing or re-phasing the signal to compensate for changes in traffic volume, mix, or patterns, and for changes in lane designation or intersection approach geometrics.
  - b. Physically relocating poles or adjusting signal heads to maintain compliance with the *IMUTCD*.

- c. If temporary signals will be used, the designer should coordinate the signal timing plan with the appropriate INDOT Signal Systems Engineer and show placement locations on the plans.

Section 502-3.02 and the *IMUTCD* discusses preliminary traffic signal design activities.

2. Bridge. If a lane is expected to be closed overnight, a temporary signal should be considered.
3. Temporary Signal Types. A temporary traffic signal may either be fixed or portable; the type selected should be detailed on the plans and the appropriate pay item included in the cost estimate or itemized proposal.
  - a. For a temporary traffic signal MOT strategy, the designer should consider the cost-effectiveness of portable versus fixed temporary signals. Portable signals are mounted on trailers rather than wood poles, are powered by a battery/solar panel charging system and are generally rented by the contractor. When the need for a temporary traffic signal is expected to be less than four months at any one location, or the cost to bring electric service to the location (fixed signal) is more than \$5,000, a portable signal signals will typically be less expensive.
  - b. Concurrence from the district Traffic Engineer is required prior to including the portable signal pay item into a contract. A Temporary Traffic Signal Type Determination form is available on the Department's Editable Documents page, under Traffic Maintenance (MOT). The form should be completed and submitted to the district Traffic Office as early as possible in the plan development process but at least prior to Stage 2 plan review.
  - c. Should portable signals be specified, and private drives exist within the restricted (one lane) area, Driveway Assistance Devices (DADs) may be used to control the drives. DADs display an arrow indicating the direction that traffic is flowing within the one lane operation so drivers may access the roadway when an adequate gap is available. They operate via communication with the portable signal from the same manufacturer. Multiple drives may be accommodated by DADs, at least 12 regardless of manufacturer.

DADs are experimental at this time so the Traffic Administration Office should be advised of the intent to use them on any project. Traffic Administration will request

FHWA approval for use on the project and if approved will add the location to INDOT's experimentation plan.

4. Plan Sheets. Each temporary signal installation, whether fixed or portable, should be shown on the MOT plan. The placement locations for temporary signals should conform to the IMUTCD requirements for lateral and longitudinal signal positioning. For portable signals the designer should indicate if both signal heads should be mounted overhead.

For fixed temporary signals the service point, whether existing or new, should be located on the plans. See 502-3.04(07) for the procedure in coordinating with the electric service provider and Figure 502-3GG on plan detailing.

5. Vehicle Detection. Normally, a temporary signal should include vehicle detection. The detection area for fixed temporary signals should be shown on the plans. Figure 503-7H shows typical vehicle detection for a fixed temporary signal. If a fixed temporary signal will not have vehicle detection, a unique special provision that overrides INDOT Standard Specifications which contains a requirement for detection should be included in the contract documents. The Standard Specifications allow the contractor to use either inductive loop or wireless detection for fixed temporary signals, and Microwave or Doppler for portable. Where it is determined that another type of detection is needed, a unique special provision should be included in the contract.
6. Phasing/Timing Plans for Portable Signals. If portable signals will be used, the designer should coordinate the signal phasing and timing plan with the appropriate INDOT Signal Systems Engineer, complete the Temporary Signal Timing Plan (RSP 801-T-212) and include the RSP in the contract documents. For additional information, the designer may refer to the FHWA Signal Timing Manual. Commercially available software may be used to perform signal-timing computations when the software is consistent with the Signal Timing Manual.
  - a. For consultant designs, the consultant should be prequalified in Category 10.1, Traffic Signal Design.
  - b. For simple one lane, two-way operation, the following guidance/parameters may be used:
    - 1) Vehicle detection should be provided and the method of vehicle detection (e.g. inductive loops, wireless vehicle detection, Doppler, or video) should be shown on the plans. Radar (Doppler) detection is generally specified as it is non-invasive to the pavement. When Radar (Doppler) detection is to be

used, the plans should have a callout note for the devices as they are typically mounted to the portable signal trailer or support.

- 2) The minimum green time for both phases is based on driver expectation and may be set at 15 seconds for major arterials regardless of speed and 10 seconds for minor arterials or collectors. See Table 5-1 of the FHWA *Signal Timing Manual* for lower values based on engineering judgment.
- 3) The maximum green time for each phase should be exceed the time it takes to clear a peak hour queue but should be limited to no more than 90 seconds for arterials and 40 seconds for collectors. This queue clearance time can be estimated by the equation:

$$G_q = 3 + 2n$$

where,  $G_q$  = green time to clear queue

$n$  = the number of vehicles in the queue

Establishing  $G_q$  is an iterative process. To determine the number of vehicles in queue, the peak hour volume is divided by the number of cycles per hour.

- 4) Yellow change interval should be based on the approach speed. Yellow change intervals on rural state highways may be set at 4 seconds where speed limits no greater than 45 mph and 5 seconds where speed limits are 50 mph or greater.
- 5) All red clearance phase is established by calculating the travel time from stop bar to stop bar which is the distance divided from signal to signal divided by the operating speed:

$$T \text{ for red clearance (seconds)} = \text{distance (ft)} \div [1.467 \times \text{operating speed (mph)}]$$

The average operating speed through the work zone will depend on conditions (truck volume, length of the work zone, lane width, shoulder width, offset to barriers, pavement condition, etc.) and can be estimated at 25 mph.

- c. The designer should confirm that the anticipated queue will not encroach upon adjacent intersections. If encroachment is expected additional planning will be

needed (e.g. the portable signal may need coordinated with the adjacent signal).

7. Pay Items. A supplemental description noting the location, by intersection or route number and reference post for one lane, two-way operations, should be included with the use of the fixed temporary signal or portable signal pay item. Vehicle detection is included in the cost of the pay item.

### **503-7.05 Automated Flagger Assistance Devices [Rev. May 2023]**

Automated Flagger Assistance Devices (AFADs) enhance worker safety by allowing the flagger to control traffic while standing off the road and out of harm's way. This is accomplished through use of a remote control that operates the AFAD. The flagger needs to be in a position to see both the AFAD and approaching traffic. If the work zone is short in length, one flagger can control the AFAD on both approaches, which reduces safety risk and labor costs. They are battery powered and generally trailer-mounted, but stand mounted versions are also available.

AFAD use should be considered for flagger operations on roadways where the permanently posted speed limit is 50 mph or greater. The designer should discuss the need with the district as the temporary traffic control plan is being developed. When not specified in the plans AFAD use is a contractor option by the Standard Specifications.

There are two types of AFAD, it is the contractor's option on which type will be used regardless of whether they are specified on the plans or not:

:

1. STOP/SLOW paddle. As the name implies this type utilizes the same type of sign that is used in a flagging paddle.
2. RED/YELLOW lens type. While AFADs are not traffic signals, this type makes use of red and yellow signal lenses. As with a signal, red means stop, but yellow means proceed with caution.

### **503-7.06 Illumination of Nighttime Work Zone**

#### **503-7.06(01) Types**

The following lighting devices may be used in a construction zone:

1. Hazard identification beacons, flashing warning lights;



2. steady-burning warning lights;
3. warning lights;
4. floodlights; and
5. conventional highway lighting.

### **503-7.06(02) Warrants**

Hazard-identification beacons, steady-burning electric lamps, and warning lights are used to supplement signs, barriers, or channelization devices, and emphasize specific signs, hazard areas, and the desired travel path. The lighting devices should satisfy the criteria for temporary lighting in the *IMUTCD*. Floodlights are used to illuminate the work area during a nighttime operation, e.g., flagger station, equipment crossing, and other areas requiring supplemental lighting.

For existing conventional highway lighting, the need for temporary lighting will be determined on a project-by-project basis. Existing highway illumination should be maintained unless discontinuance of the highway illumination is specifically allowed by INDOT.

Temporary lighting at a location without permanent should be considered when the work area has the following characteristics:

1. high traffic volume;
2. high traffic speed;
3. heavy queuing or congestion;
4. area with complicated traffic maneuvers, e.g., freeway crossover or intersection; and
5. any other hazardous location.

If existing light standards are to be removed or deactivated during construction, temporary lighting should be considered until permanent lighting is reinstalled.

For temporary installation in a construction zone, either LED or high-pressure sodium lamps are allowed, mounted on temporary wood posts. Portable lighting can also be considered as an option. Section 502-4.0 provides additional information related to the design of highway lighting.

### **503-7.07 ADA Compliant Temporary Pedestrian Devices [Add. May 2023]**

These devices are used to provide for all pedestrians including those with visual impairment. When existing pedestrian facilities are disrupted, closed, or relocated by a work zone, the temporary facilities should be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Where pedestrians with visual disabilities

normally use the closed sidewalk, a barrier that is detectable by a person with a visual disability traveling with the aid of a long cane shall be placed across the full width of the closed sidewalk.

#### **503-7.07(01) Temporary Accessible Pedestrian Path [Add. May 2023]**

Temporary Accessible Pedestrian Paths are needed when sidewalk is closed and pedestrians will be routed where no other sidewalk exists as may be the case with a right of way side diversion, section 503-3.01(04) 13.a. They can be made from standard construction materials – aggregate, asphalt, concrete – or prefabricated. Prefabricated paths are typically interlocking sections of plastic or rubber mat. The typical area of each prefabricated section is 2.67 sq (4 ft x 4 ft), which should be accounted for when preparing estimated quantities.

#### **503-7.07(02) Temporary Curb Ramps [Add. May 2023]**

The existing curb height should be determined at each location that will have a temporary curb ramp. A temporary curb ramp with a rise of 4 in. requires edge support and a temporary curb ramp with a rise of more than 6 in. requires handrail. The ramps may be either perpendicular or parallel to the roadway. The estimate should base the quantity of temporary curb ramp on the total number needed for the work zone, the number of each type; perpendicular or parallel; should be indicated in the plans or by unique provision.

#### **503-7.07(03) Temporary Pedestrian Channelizers [Add. May 2023]**

Temporary Pedestrian Channelizers are used to close sidewalk, rather than barriers, as well as delineate the path along a pedestrian diversion. Currently, INDOT QPL does not contain a model that also serves as type 2 temporary barrier so separate items are needed for these devices. The plan details showing temporary pedestrian channelizers should note whether it will need to redirect vehicles. If so the channelizer should also function as a type 2 temporary traffic barrier.

#### **503-7.07(04) Audible Information Devices [Add. May 2023]**

Audible Information Devices are the most desirable way to inform pedestrians with visual disabilities of sidewalk closures and the detour path that should be taken. The estimate should base the quantity of audible information devices on the total number needed for the work zone.

Roadway Type	Capacity <sup>1</sup> (pce/hr/ln)	Notes
Freeway	2,400 (70 mph)	May be further reduced in urban segments with close interchange spacing, substantial weaving/merging activity
	2,350 (65 mph)	
	2,300 (60 mph)	
	2,250 (55 mph)	
Ramp, high speed	2,200	Directional or system interchange ramp
Ramp, intermediate speed	2,000	
Ramp, low speed	1,800	Loop ramp
Non- Freeway Divided, Unsignalized	2,100	
Rural Non-Divided, unsignalized	1,700	Substandard lane or shoulder width, grades, lack of passing opportunities will reduce capacity
Urban, non-divided, signalized	800 to 1,750	Varies depending on signals, phasing, timings, turn lanes, on-street parking. Check with District Traffic Engineer or Signal Systems Engineer for estimate
Urban, non-divided, signalized	800 to 1,750	Varies depending on signals, phasing, timings, turn lanes, on-street parking. Check with District Traffic Engineer or Signal Systems Engineer for estimate
Roundabout	300 to 1,150	See NCHRP Report 672, Exhibit 4-6
All Way Stop Control	300 to 355 (4 leg)	See HCM, Chapter 20
	445 (3 leg)	

Note:

<sup>1</sup> Capacity based on LOS E/F breakpoint values.

## TYPICAL HIGHWAY CAPACITY (Unrestricted Parallel Route Used as a Detour)

Figure 503-2A (Page 1 of 2)

<b>Capacity at Two-Way Stop-Controlled Intersection</b>			
<b>Conflicting Volume (pce/hr)</b>	<b>Potential Capacity (pce/hr)</b>	<b>Scenario 1 (pce/hr)</b>	<b>Scenario 2 (pce/hr)</b>
1	1027	1029	1029
100	876	907	880
200	746	798	750
300	635	702	638
400	540	618	541
500	458	542	457
600	389	475	386
700	330	415	324
800	280	362	271
900	237	316	225
1000	200	275	186
1100	169	239	154
1200	143	207	126
1300	121	179	102
1400	102	155	82
1500	86	133	65
1600	72	115	51
1700	61	98	40
1800	51	84	30
1900	43	72	22
2000	36	61	15

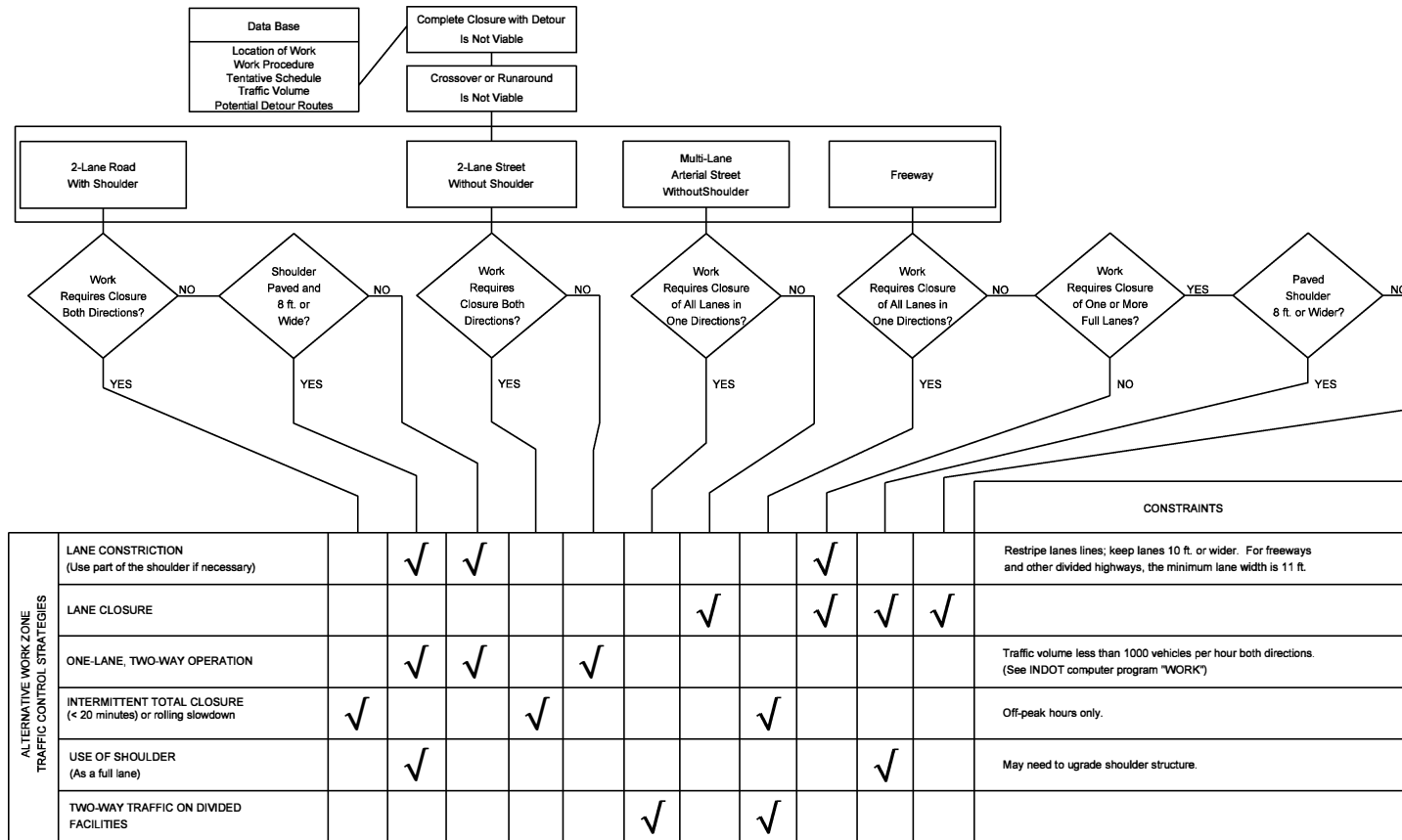
Notes:

Scenario 1: Minor road consists of a single lane in each direction and the major road consists of a shared right/thru lane and a left-turn lane in each direction. 80% of the traffic is proceeding through the intersection and 20% is turning.

Scenario 2: Minor road consists of a single lane in each direction and the major road consists of a shared right/thru lane and a left-turn lane in each direction. 50% of the traffic is proceeding through the intersection and 50% is turning.

## TYPICAL HIGHWAY CAPACITY (Unrestricted Parallel Route Used as a Detour)

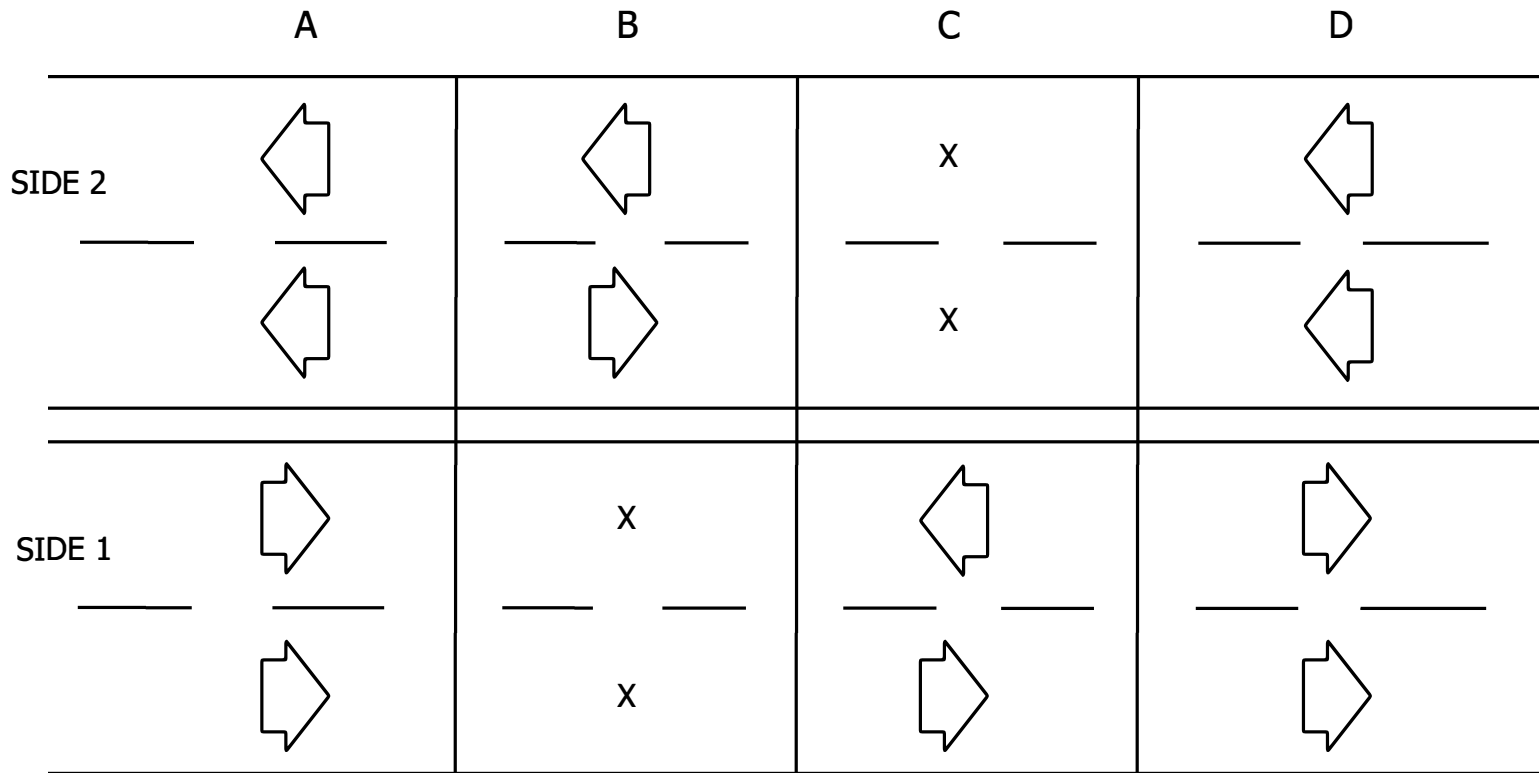
Figure 503-2A (Page 2 of 2)




√ Feasible Alternatives

## IDENTIFYING FEASIBLE WORK ZONE TRAFFIC CONTROL STRATEGIES (Traffic Maintained Adjacent to Work Area)

Figure 503-2B

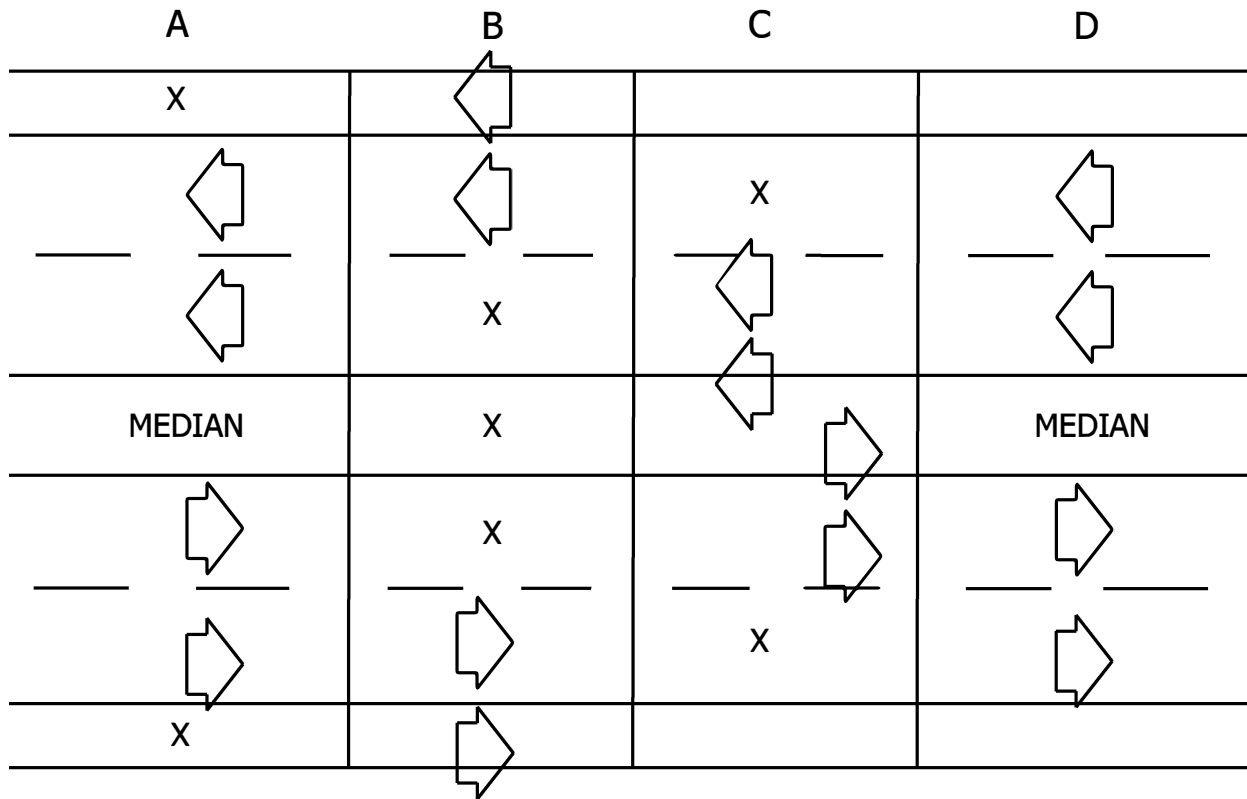


**LEGEND:**


- A = Prior to Construction
- B = During Construction of Side 1
- C = During Construction of Side 2
- D = Following Completion
- X = Construction Activity
-  = Traffic Flow

**RECONSTRUCTION BY HALVES, SIDES**

Figure 503-2C

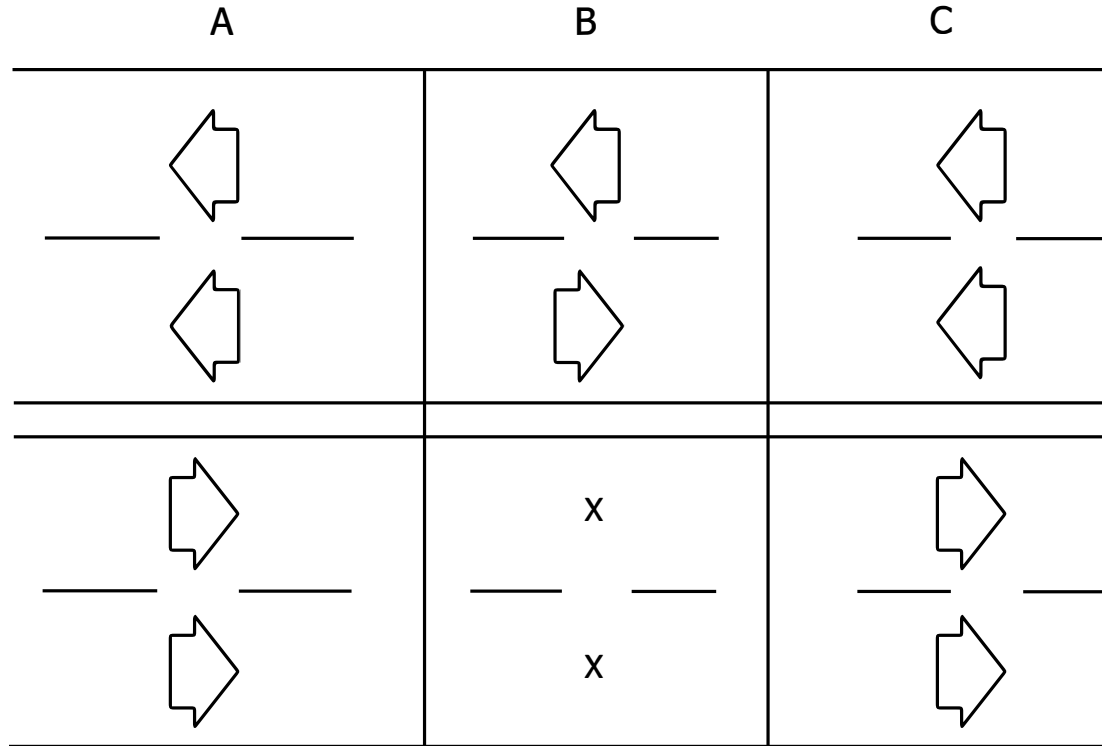


**LEGEND:**

- A = Construction of Shoulder
- B = Construction of Inner Lanes
- C = Construction of Outer Lanes
- D = Following Construction
- X = Construction Activity
-  = Traffic Flow

**PARALLELORADJACENT RECONSTRUCTION**

Figure 503-2D



**LEGEND:**

A = Prior to Construction

B = During Construction of a Segment while Maintaining Two-Way Traffic Operation

C = Completion of Construction

X = Construction Activity

 = Traffic Flow

**SERIAL OR SEGMENTAL RECONSTRUCTION**

Figure 503-2E



Participant	Project Stage				
	Project Scoping	Prelim. Field Check	Hearing	Final Field Check	Final Plan Review
Designer	X	X	X	X	X
Environmental Services	X	X	X	X	X
Consultant (if applicable)		X	X	X	X
District	X	X		X	X
Federal Highway Administration (if applicable)	X	X		X	
Communications Division (if applicable)	X		X	X	
Local Public Agency (City or Town, County, School, Fire Department)	X	X	X		X
Traffic Management <sup>1</sup> (full TMP)	X	X		X	

Note:

<sup>1</sup> Traffic Management may include any or all of the following offices as appropriate: TMD Operations, ITS Engineering, and Public Safety Operations

## PARTICIPANTS DURING TRAFFIC CONTROL PLAN DEVELOPMENT

Figure 503-3A

Construction Zone Design Speed, V (mph)	$f_{max}$ for Open Roadway Conditions	Normal Crown Section Minimum Radius, $R_{min}$ (ft), $e = -0.02$	Superelevated Section Minimum Radius, $R_{min}$ (ft), $e = +0.08$
20	0.27	110	80
25	0.23	200	140
30	0.20	340	220
35	0.18	510	320
40	0.16	770	450
45	0.15	1040	590
50	0.14	1390	760
55	0.13	1840	960

Notes:

1. Curve Radius. The radius is calculated from the equation as follows:

$$R_{min} = \frac{V^2}{15(e + f_{max})};$$

Value shown in the table for design has been rounded up to the next higher 10-ft increment.

2. Normal Crown Section. If the normal crown section is maintained through the horizontal curve, the superelevation rate is -0.02 assuming a typical cross slope of 2%. Therefore, the Rmin column with  $e = -0.02$  lists the minimum radius which can be used if retaining the normal section through the horizontal curve.
3. Other Radius. For a proposed radius or superelevation rate intermediate between the table values, the equation in Note 1 may be used to determine the proper curvature layout. For example, if the construction-zone design speed is 55 mph and the proposed curve radius is 1000 ft, the superelevation rate is determined as follows:

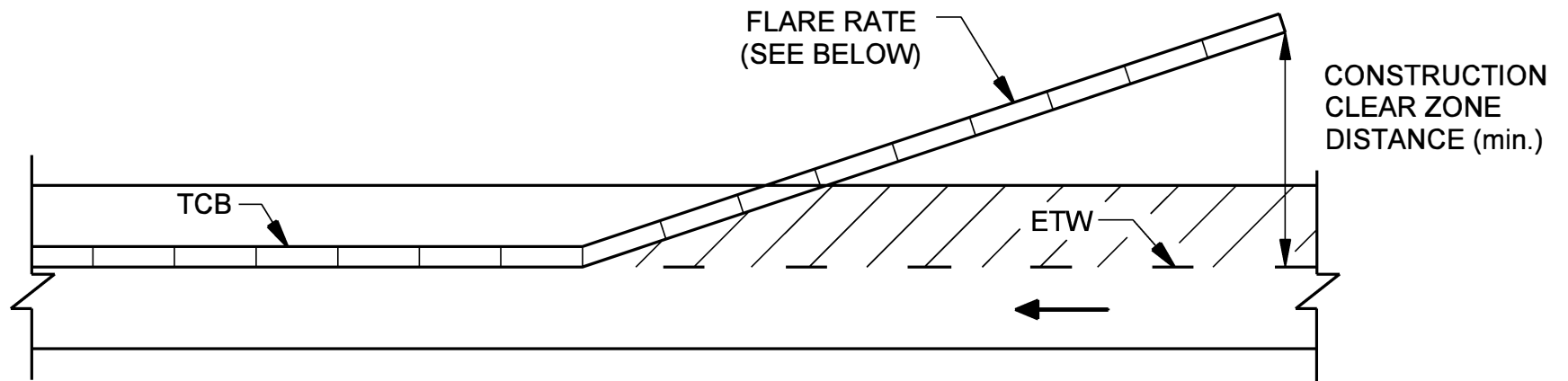
$$e = \frac{V^2}{15R} - f$$

$$e = \frac{(55)^2}{(15)(1000)} - 0.13$$

$$e = +0.07$$

## MINIMUM RADIUS FOR HORIZONTAL CURVE IN CONSTRUCTION ZONE

Figure 503-3B



Construction Zone Design Speed (mph)	Flare Rates
≤ 40	10:1
45	12:1
50	14:1
55	16:1

FLARE RATES FOR TEMPORARY CONCRETE BARRIER  
(Construction Zones)

Figure 503-3C

Construction Zone Design Speed (mph)	Calculated <i>K</i> Value $(K = \frac{V^2}{46.5})$	<i>K</i> Value Rounded for Design
20	8.6	9
25	13.4	14
30	19.4	20
35	26.3	27
40	34.4	35
45	43.5	44
50	53.8	54
55	65.1	66

$$L = \frac{AV^2}{46.5} = KA$$

Where:

L = Length of vertical curve, ft

A = Algebraic difference between grades, %

K = Horizontal distance required to effect a 1% change in gradient

V = Design speed, mph

## K VALUE FOR SAG VERTICAL CURVE (Comfort Criteria)

Figure 503-3D

<b>Speed (mph)</b>	<b>Width<sup>1</sup> (ft)</b>
30 to 40	13
45 to 50	16
55	23
60 to 70	30

Note:

- <sup>1</sup> Where the right-of-way width is restricted, the construction clear zone width in which a temporary traffic barrier is tapered may be reduced to 12 ft in a cut slope section and 18 ft in a fill slope section.

CONSTRUCTION CLEAR ZONE WIDTH (ft)

Figure 503-3E

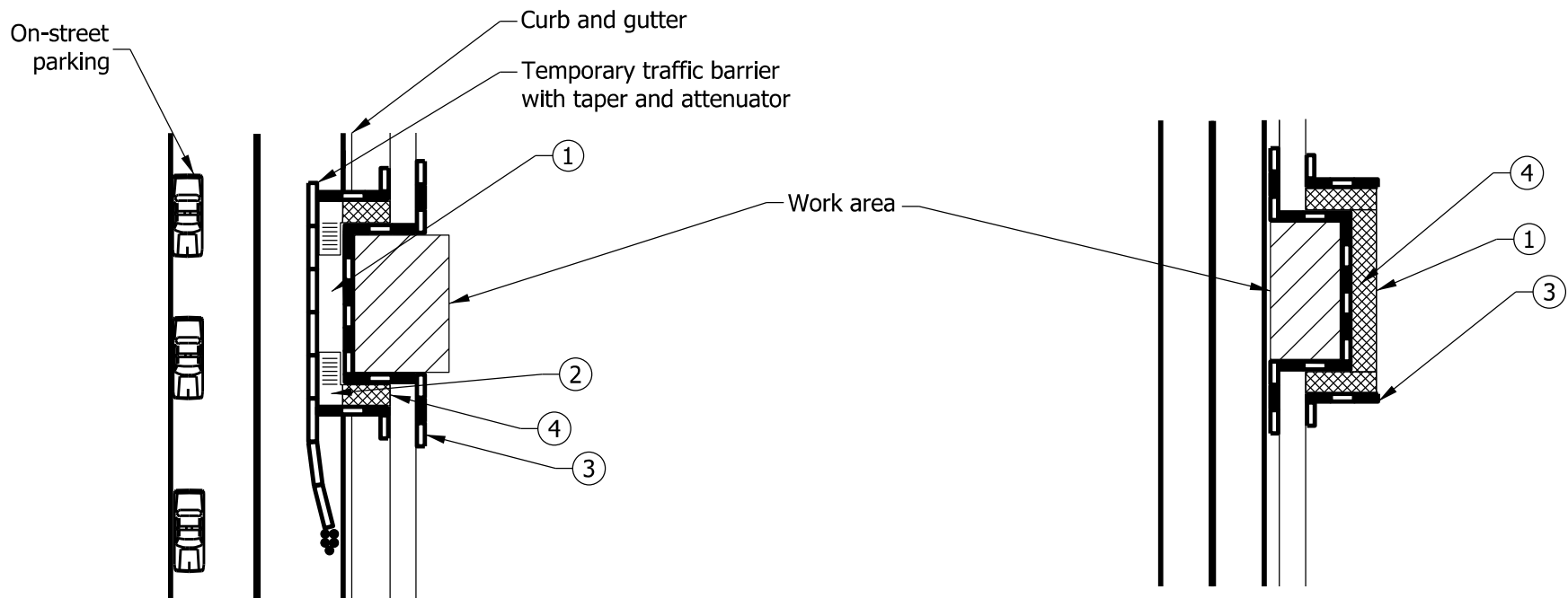
Distance of Drop-off from the Travel Lane	Drop-off Height			
	≤ 3 in.	> 3 in. to 5 in.	> 5 in. to 12 in.	> 12 in.
≤ 4 ft	No Channelizing Devices Required	Use Channelizing Devices Throughout Drop-off Condition <sup>1, 2, 4</sup>	Use Temporary Concrete Barrier <sup>3</sup>	Use Temporary Concrete Barrier
> 4 ft to 12 ft	No Channelizing Devices Required	Use Channelizing Devices Throughout Drop-off Condition <sup>1, 2, 4</sup>	Use a 3:1 Slope of Suitable Material Compacted to Non-movement	Use Temporary Concrete Barrier <sup>3</sup>
> 12 ft to 18 ft	No Channelizing Devices Required	Use Channelizing Devices Throughout Drop-off Condition <sup>1, 4</sup>	Use Channelizing Devices Throughout Drop-off Condition <sup>1, 4</sup>	Use Channelizing Devices Throughout Drop-off Condition <sup>1, 4</sup>

Notes:

- <sup>1</sup> Use Shoulder Drop-off symbol sign and plaque (W8-17 and W8-17P). The first sign should be placed approximately at the beginning of the drop-off condition and continued, when applicable, at ½ mile intervals throughout the drop-off condition.
- <sup>2</sup> May use a temporary shoulder with a mix design from the Pavement Division, or on asphalt pavements a 1:1 or flatter safety wedge.
- <sup>3</sup> May use a 3:1 slope of suitable material that is compacted to non-movement.
- <sup>4</sup> No channelizing devices are needed if the drop-off is outside the right-of-way, behind guardrail or curb, or more than 18 ft from the travel lane.
- <sup>5</sup> Figure applies to any work zone duration.

**TRAFFIC CONTROL FOR PAVEMENT DROP-OFFS  
(For Freeways and Expressways)**

Figure 503-3F



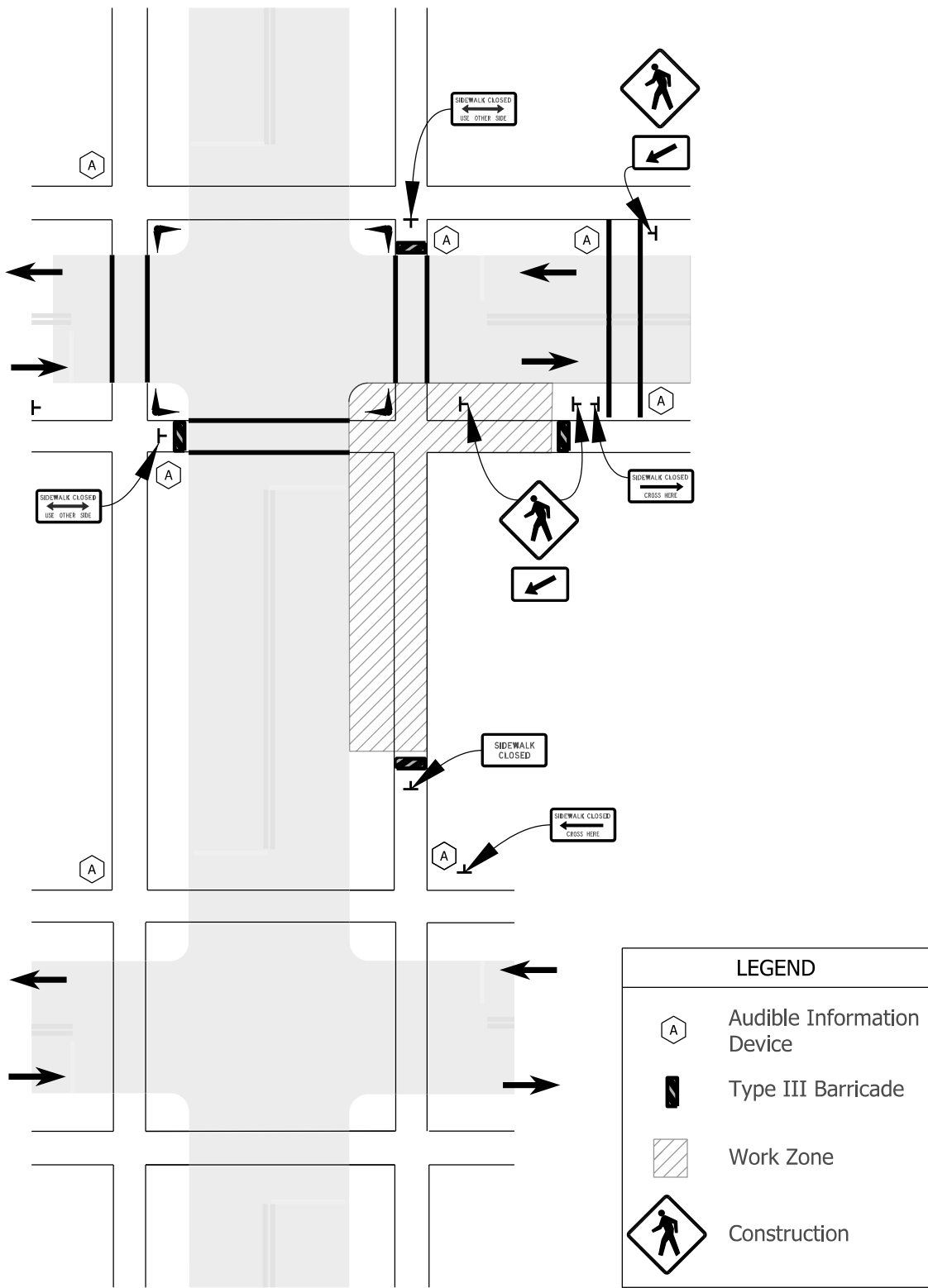
**STREET SIDE DIVERSION**

**ROW SIDE DIVERSION**

- ① Temporary pedestrian access route width of 60 in. is preferred. A 48 in. width may be used if at least one 60 in. by 60 in. passing space is provided every 200 ft.
- ② Temporary curb ramp that covers any rough, soft, or uneven ground, has a turning space of 48 in. by 48 in., an 8.00% or flatter running slope, a 2.00% or flatter cross slope, and a non-slip surface. Edge protection is required for curb heights > 4 in. and handrails are required for curb heights > 6 in.
- ③ Temporary pedestrian channelizer
- ④ Temporary accessible pedestrian path

**SIDEWALK DIVERSIONS**

Figure 503-3G



SIDEWALK DETOURS

Figure 503-3H



Existing Facility and Construction Method	Existing Posted Speed Limit				
	50 mph	55 mph	60 mph	65 mph	70 mph
4-lane Interstate with crossover to a 2-lane facility	Not Applicable	WZ 45 mph with TCB WS 45 mph	WZ 50 mph with TCB WS 50 mph	WZ 55 mph with TCB WS 55 mph	WZ 55 mph with TCB WS 55 mph
4-lane Interstate with lane closure without a crossover	Not Applicable	WS 45 mph	WZ 50 mph WS 50 mph	WZ 55 mph WS 55 mph	WZ 55 mph WS 55 mph
6-lane Interstate with crossover to a 4-lane facility with TCB	WS 40 mph	WS 45 mph	WZ 50 mph WS 50 mph	WZ 55 mph WS 55 mph	WZ 55 mph WS 55 mph
6-lane Interstate with lane closure without a crossover	WS 40 mph	WS 45 mph	WZ 50 mph WS 50 mph	WZ 55 mph WS 55 mph	WZ 55 mph WS 55 mph
Non-Interstate divided highway with crossover	Project-by-project WS 40 mph	WZ 45 mph with TTM & TDSYL	WZ 50 mph with TTM & TDSYL WS 50 mph	WZ 55 mph with TCB or TTM & TDSYL WS 55 mph	Not Applicable
Non-Interstate divided highway with lane closure without a crossover	Project-by-project WS 40 mph	WS 45 mph	WS 50 mph	WZ 55 mph WS 55 mph	Not Applicable

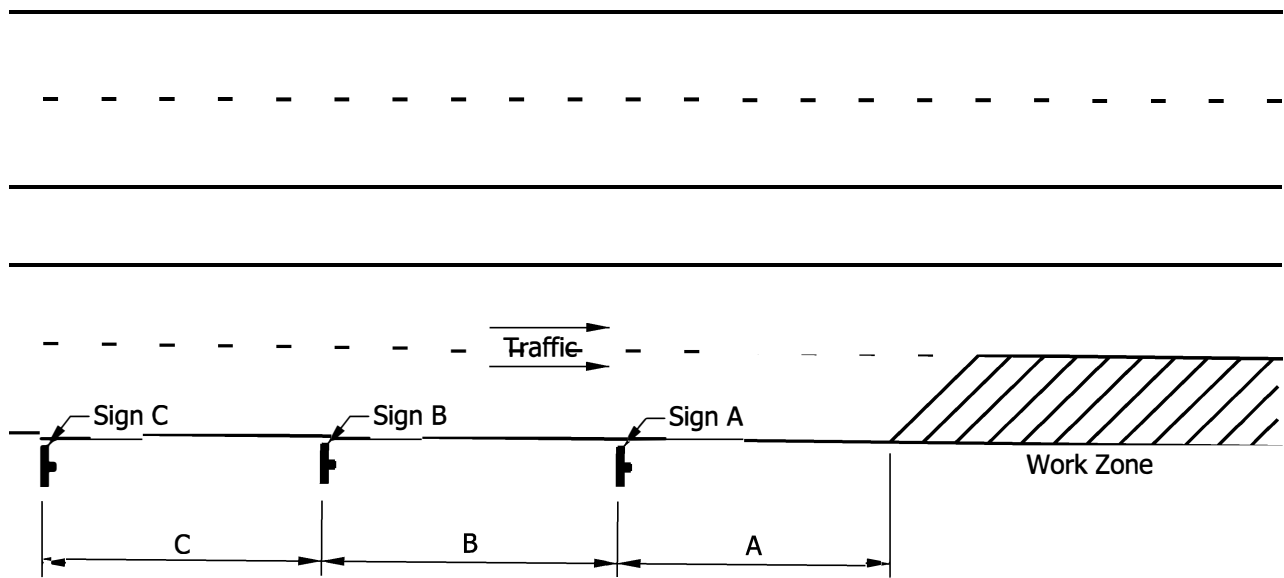
- WS = Work-Site Speed Limit (Set under IC 9-21-5-11)
- WZ = Work-Zone Speed Limit (Set by Official Action)
- TCB = Temporary Concrete Barrier
- TTM = Temporary Tubular Markers
- TDSYL = Temporary Double Solid Yellow Line

Notes:

1. Work-zone speed limits are recommended only for projects greater than ½ mile in length. For road work areas where there is no lane closure, work-zone speed limits should only be used on a case-by-case basis. See Construction Memorandum 14-06 for additional information.
2. Work-site speed limits must be at least 10 mph less than the maximum speed limit. Lower work site speed limits may be established but reductions from the normal speed limit greater than 15mph must be accomplished in two increments (e.g. from 70 mph to 55 mph and then from 55 mph to 45 mph).
3. Speed limit may vary based on circumstances and actual field conditions such as lane widths and offset distances for TCB and TTM.

## SUGGESTED TEMPORARY SPEED LIMITS FOR FREEWAYS AND EXPRESSWAYS

Figure 503-7A



Road Type	Distance Between Signs (ft)		
	A	B	C
Urban (45 mph or lower)*	200	200	200
Urban (50 mph or higher)*	350	350	350
Rural	500	500	500
Freeway/Expressway	1000	1600	2600

\* Posted Speed Limit of Facility

### NOTES:

1. Distance A is for marking the location of warning sign A upstream from the transition or point of restriction in the construction zone.
2. Distance B is the location of warning sign B upstream from the location of sign A in two and three sequence signing arrangements.
3. Distance C is the location of warning sign C upstream from sign B when three or more signs are used within the advance warning area.
4. For four or more signs, the spacing will be determined on a case-by-case basis.

## ADVANCE WARNING SIGNS

Figure 503-7B

Panel Type <sup>1</sup>	Use	Minimum Legibility Distance <sup>2</sup>
A	Allowed on facility with speed lower than 35 mp. Appropriate for use on low-speed urban facility.	½ Mile
B	Not used by INDOT. Appropriate for intermediate-speed facility, or for maintenance or mobile operation on high-speed roadway.	¾ Mile
C	Allowed on every facility. Appropriate for use on a high-speed, high-volume traffic-control project.	1 Mile

Notes:

<sup>1</sup> For panel type, see the INDOT *Standard Specifications* and *Indiana MUTCD* Figure 6F-6.

<sup>2</sup> Minimum legibility distance under ideal day or night conditions.

## SUGGESTED USE AND LOCATION OF ARROW BOARDS

Figure 503-7C

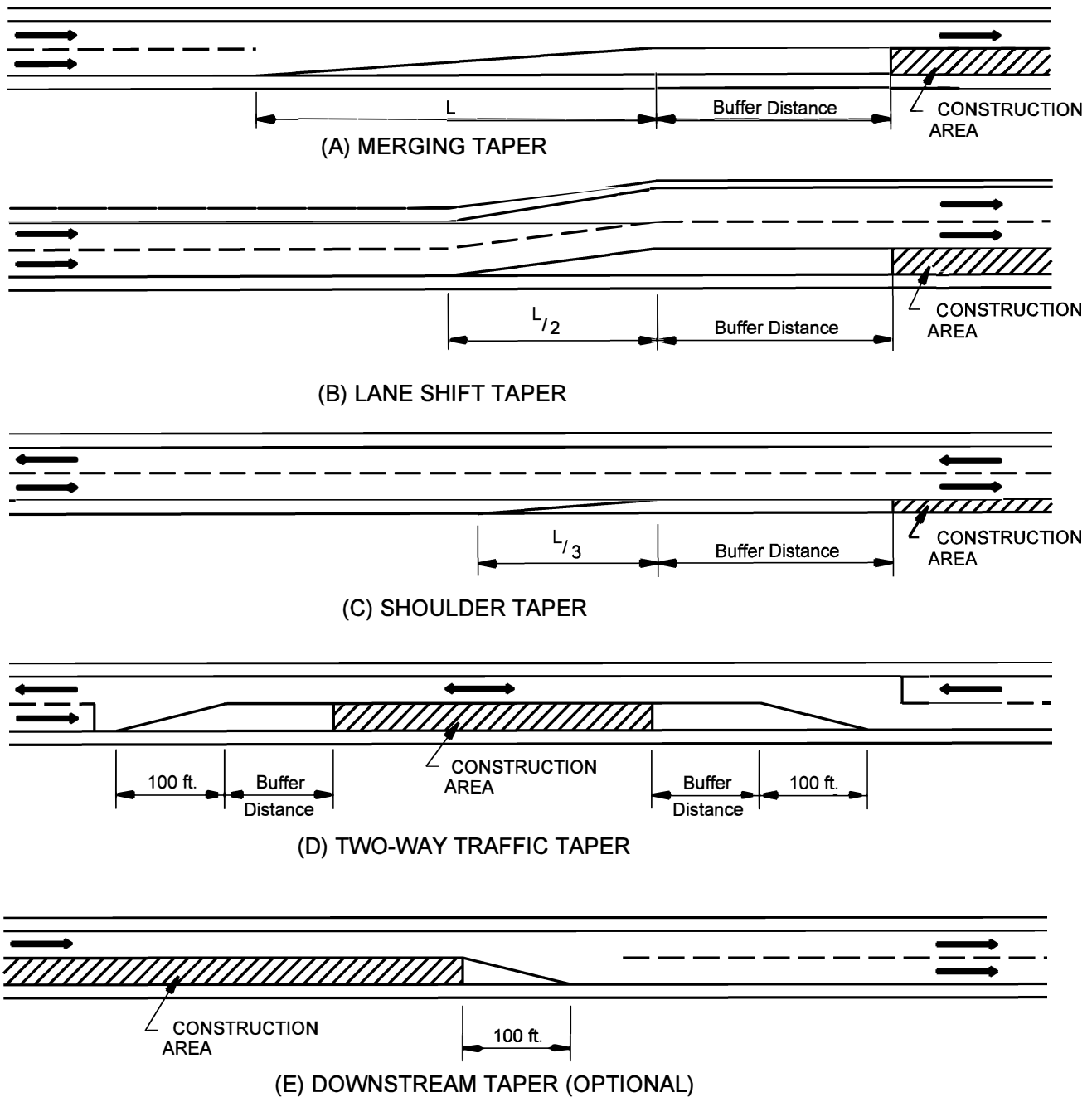
Taper Type		Length
Upstream	Merging	L (min.)
	Shifting	$\frac{1}{2}$ L (min.)
	Shoulder	$\frac{1}{3}$ L (min.)
	Two-Way Traffic	100 ft
Downstream (optional)		100 ft per Lane

Notes:

1. See the INDOT *Standard Drawings* for L.
2. Figure 503-7F illustrates the permissible taper types.
3. May be used for determining buffer-zone length.

## CONSTRUCTION ZONE TAPER LENGTH CRITERIA

Figure 503-7D



**NOTES:**

1. See INDOT *Standard Drawings* section 801 for L and buffer distances.
2. Where the work area is in or is adjacent to a curve that limits sight distance the location of the taper should be adjusted to provide adequate sight distance to the taper. This can be accomplished by adding a longitudinal buffer space adjacent to the work area. If it is not possible to adjust the taper location, L should be considered for a shift taper in or adjacent to a curve, see paragraph 1 in Section 503-3.01(04) for additional guidance.

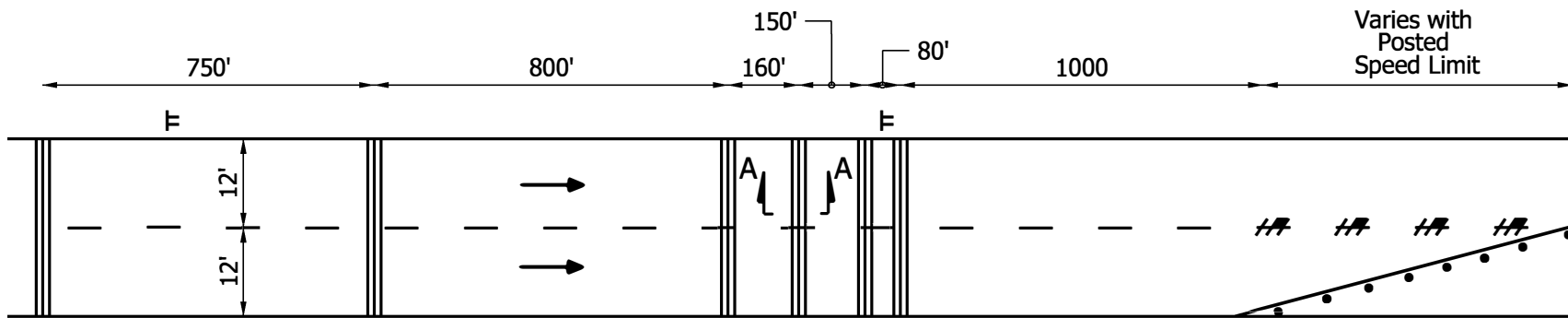
**APPLICATION OF CONSTRUCTION ZONE TAPER LENGTH CRITERIA**

Figure 503-7E

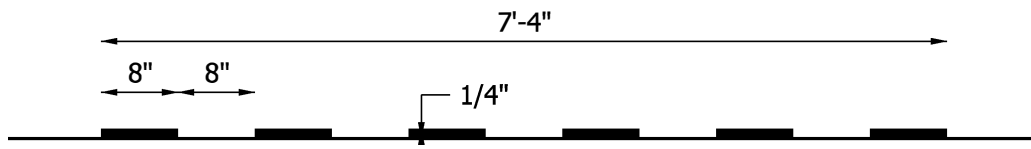
<b>Construction Zone Design Speed (mph)</b>	<b>Spacing (ft)</b>	
	<b>Tapered Section</b>	<b>Tangent Section</b>
45 or less	25	50
50 or greater	50	100

SUGGESTED MAXIMUM SPACING OF CHANNELIZATION DEVICES

Figure 503-7F



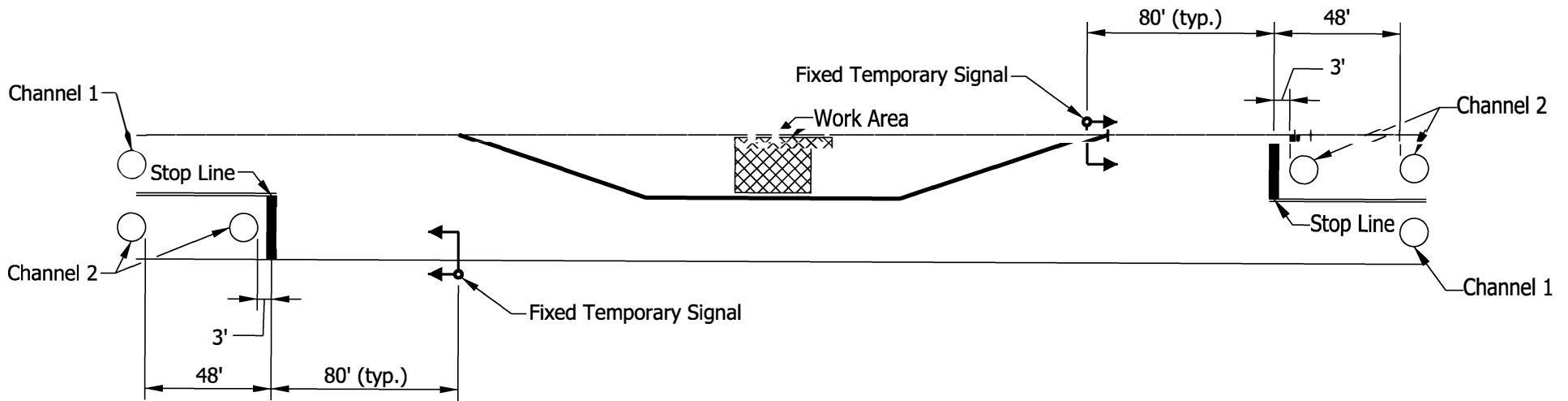
PLAN



SECTION A-A  
(TYPICAL)

### TRANSVERSE RUMBLE STRIPS

Figure 503-7G



**NOTES**

1. The designer may select another detection method with a special provision.
2. Channel 1 = Extend Only  
Channel 2 = Call and Extend
3. For portable signals, plan details for the vehicle detection are not required as microwave or Doppler vehicle detection are included with the portable signals.

**LEGEND**

○ = 6 ft diameter inductance loop or wireless vehicle detection system

**TYPICAL VEHICLE DETECTION FOR A FIXED TEMPORARY SIGNAL**

Figure 503-7H