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CHAPTER EIGHTY-ONE

TRANSPORTATION MANAGEMENT PLANS

81-1.0 GENERAL

81-1.01 Purpose

A transportation management plan (TMP) is an overall strategy for accommodating traffic during construction. The TMP not only must address the alternatives confined to the project site, but it must also evaluate the impact traffic will have on the entire corridor. The TMP will address the proposed traffic-control plan, alternative traffic control applications, the effect traffic will have on other facilities, local concerns, cost effectiveness of various alternatives, etc. For a large project, a TMP team may be organized during the preliminary-engineering stage to study the traffic-control alternatives and their effect on the corridor.

The TMP includes the traffic-control plan (TCP). The major difference between a TMP and a TCP is that the TCP focuses on the maintenance and protection of traffic within the construction zone, and the TMP addresses project-related impacts throughout the project corridor and sometimes beyond. The designer will be responsible for incorporating the TMP objectives into the TCP. Changes made during the preparation of the TCP will affect the overall TMP. For example, a lane closure which causes a large queue on a freeway may cause traffic to divert to a nearby urban arterial. This may require signal coordination, lane widening, turn restrictions, etc., on the arterial to improve its capacity. Chapter Eighty-two discusses INDOT criteria for a TCP. If the TMP was not developed during the preliminary-engineering stage, it will be the designer's responsibility to ensure that a reasonable transportation-management strategy has been incorporated into the TCP.

81-1.02 Application

A formal transportation-management plan will most often not be required. However, the concepts discussed in this Chapter should be considered for each project. A formal TMP, including a TMP team, may be considered for a project that has one or more of the characteristics as follows:

1. the project scope of work consists of major reconstruction or new construction (e.g., 4R Interstate-route);

2. high traffic volume;

3. is in an urban or suburban area;

4. there may be significant detrimental impacts on mobility for either through or local trips in the corridor;

5. the facility's capacity will be significantly reduced (e.g., lane, ramp, or interchange closure);

6. alternate routing will be necessary (e.g., detour routing for hazardous materials);

7. there will be significant impacts on local communities and businesses (e.g., emergency vehicles, school buses);

8. timing and seasonal impacts may be significant; or

9. there will be significant grade changes.

Where a series of proposed projects are along the same corridor or along corridors of close proximity, a single TMP covering all such projects should be used. If circumstances prohibit a single TMP, the individual TMPs should be coordinated.

81-1.03 TMP Development

81-1.03(01) Procedure

Where a TMP is used, the following procedure applies.

1. TMP Determination. The Environmental Policy Team, with input from the district, the Office of Urban and Corridor Planning, and the Office of Pavement Engineering, will determine if there is a need for a TMP during the scoping process. The Environmental Policy Team will collect the initial data and conduct the initial analyses to determine whether or not a TMP will be required.

2. TMP-Team Selection. Once it has been determined that a TMP is required, the Environmental Policy Team will initially recommend who the TMP team representatives will be, based on the purpose, goals, and constraints of the TMP. Section 81-1.03(02) lists the members for a TMP-team project.

3. TMP-Team Responsibilities. Section 81-1.03(03) discusses the TMP-team responsibilities during the scoping process, project design, and construction. The expected level of traffic impacts will dictate the extent and nature of the TMP team's responsibilities.

4. Preliminary Engineering Studies Report. The Office of Environmental Services' Environmental Policy Team will incorporate the TMP recommendations into the Engineer's Report. If improvements are required to other facilities (e.g., widening of detour route), it is important that these improvements be implemented as soon as practical prior to construction of the mainline facility. Local agencies should be provided sufficient opportunity to complete their improvements before construction begins. Agreements may be necessary between the State and local agencies to determine cost sharing arrangements or approval of a local road as an alternate route.

5. Design. During the design phase, it will be the designer's responsibility to implement the recommendations of the TMP team. The designer may be required to collect additional data and conduct additional analyses, as necessary. The TMP team should be consulted if design or TCP decisions dictate a revision to the proposed TMP. During this project stage, representatives from local agencies, businesses, homeowner associations, etc., may be added to the TMP team.

6. Construction. The TMP will be implemented during construction. All significant proposed changes to the TMP by the district or the contractor must be reviewed with the TMP team prior to implementation. For a larger project, the district will appoint a TMP coordinator. A public-relations campaign may be required prior to construction. During construction, the district will be responsible for collecting data on the TMP so that the TMP team can prepare a report on the successes and failures of the TMP. See Item 7 below to determine the applicable data to be collected.

7. Final Report. Upon project completion, the TMP team will prepare a report identifying the successes and failures of the TMP. This report should discuss the following:

   a. an overall statement reflecting the usefulness of the TMP;
   b. where changes were necessary to correct oversights in the TMP;
   c. what changes were made to the original plan and if they were successful;
   d. public reaction to the TMP;
   e. the average delay time encountered (e.g., average queue length, slowdown extent);
   f. identification of the peak loading times;
   g. frequency of legitimate complaints and the nature of the complaints;
   h. types of accidents that occurred during construction;
   i. suggested improvements or changes for similar future projects; and
   j. what areas of the TMP were successfully implemented.

81-1.03(02) TMP Team

A well-balanced TMP team is an important ingredient for a successful project. The variety of disciplines represented presents an effective liaison group to meet the various needs of a TMP. Depending on the project logistics, the team composition may vary from project to project. The Office of Environmental Services' Environmental Policy Team will determine the team's composition. The TMP team may include representatives from the entities as follows:

1. Office of Traffic Engineering;
2. Office of Environmental Services, Environment Assessment Team;
3. Production Management Division;
4. district Office of Traffic;
5. district Office of Design;
6. District Construction Team;
7. Traffic Control Review Committee;
8. FHWA;
9. Local government agency;
10. Planning Division;
11. Office of Communications; and
12. others as deemed necessary (e.g., State Police, hospitals, etc.).

81-1.03(03) TMP-Team Responsibilities

The anticipated traffic impacts will dictate the extent and nature of the TMP team's responsibilities. These may include all or part of the functions as follows:

1. collecting data (e.g., traffic counts, accident history, roadway geometrics, proposed developments, operating speeds);

2. conducting analyses (e.g., capacity analyses, traffic impact studies, safety studies, queuing analysis);

3. reviewing design alternates;

4. reviewing traffic-control alternates;

5. reviewing the adequacy of alternate routes (e.g., geometrics, capacity, safety, structural);

6. reviewing on-site and off-site traffic operational improvements (e.g., signal improvements, parking restrictions);

7. reviewing construction phasing and scheduling alternates;

8. determining the cost of various options and improvements;

9. determining which options are the most cost effective;

10. coordinating with local officials and businesses;

11. coordinating funding and timing with other projects within the corridor;

12. coordinating the design with other TMP plans in the region;

13. planning for emergency responses (incident management);

14. planning rideshare and transit strategies;

15. providing recommendations for the Engineer's Report;

16. reviewing design and TMP changes made by the designer to ensure that they satisfy the TMP objectives;

17. reviewing proposed changes made by the contractor or project engineer during construction; and

18. evaluating and preparing a report on the successes and failures of the TMP after construction.

81-1.04 Public-Relations Information

For a TMP to be successful, it often requires public involvement and revision of its traveling habits. The following discusses how the public can become informed and involved in the TMP.

1. Public-Relations Campaign. It is important that the public be informed initially and be kept informed in a timely manner to ensure that the TMP will work. The elements of a public-relations campaign to be considered where significant impacts to traffic are expected are as follows:

    a. information provided to news media;
    b. television advertisements;
    c. radio advertisements;
    d. brochures to be passed out to motorists at key locations;
    e. information given to motorists at rest area or welcome centers; or
    f. contacting local businesses with large numbers of affected employees or customers.

2. Car and Van Pooling. Car and van pooling campaigns may be considered where it may be expected to reduce the number of vehicles through a work zone and where it appears practical to expect a successful campaign.

3. Charter Bus. A charter bus may be considered where it could be expected to draw a large number of users along a corridor and where it can be shown to be more cost effective than other alternatives.

4. Transit Incentives. Transit incentives provided to transit customers and companies may be considered where it can be shown to be more cost effective than other alternatives.

81-2.0 TRAFFIC-CONTROL MANAGEMENT

81-2.01 Terminology

The following definitions are used to define the time required for construction, maintenance, or utility work.

1. Mobile Work Zone. A work site that is continuously being moved during the period while work is actively in progress.

2. Short-Duration Work Zone. A work site that occupies a location for up to 1 hour.

3. Short-Term Stationary Work Zone. A work site that requires traffic control in the same location and where the activity lasts from 1 to 12 hours.

4. Intermediate-Term Stationary Work Zone. A work site that requires traffic control in the same location and occupies a location from overnight to 3 days.

5. Long-Term Stationary Work Zone. A work site that requires traffic control in the same location and where the activity lasts longer than 3 days.

81-2.02 Work-Zone Type

The work zone types that may be considered in a TMP are described below. A work site which is completely off the roadway and does not disrupt traffic is not addressed, as it will not have a major effect on traffic.

1. 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 lane constriction is shown in Figure 81-2A. 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 may be required. Where this application is applied for a long-term work zone, the current lane markings must be obliterated to avoid motorist confusion. Section 82-3.02 discusses the minimum lane width that must be provided.

2. Lane Closure. This work-zone type closes one or more normal traffic lanes. A lane-closure example is shown in Figure 81-2B. 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. Upgrading or replacement of existing pavement or placement of temporary pavement may be necessary.

3. One-Lane, Two-Way Operation. This work-zone type involves utilizing one lane for both directions of traffic. Figure 81-2C illustrates a one-lane, two-way operation work zone. Flaggers or signals are used to coordinate the two directions of traffic. Signing alone may be sufficient for a short-term work zone on a very low-volume, 2-lane road. This work-zone type is applicable only for a low-volume road or for a short-term. INDOT has developed a computer program, WORK, which determines the expected delays and queue lengths for this work-zone type.

4. Runaround. This work-zone type involves the total closure of the roadway (one or both directions) where work is being performed and the traffic is rerouted to a temporary roadway constructed within the highway right-of-way. A runaround example is shown in Figure 81-2D. This application may require the purchase of temporary right of way and requires extensive preparation of the temporary roadway.

5. Intermittent 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. This application is illustrated in Figure 81-2E. After a specific time, depending on traffic volume, the roadway is re-opened and all vehicles can travel through the area. This application is appropriate only on a low-volume roadway or at times of very low volume (e.g., Sunday morning).

6. Use of Shoulder or Median. This work-zone type involves using the shoulder or the median as a temporary traffic lane. Figure 81-2F illustrates an example. 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.

7. Crossover. This work-zone type involves routing all or a portion of one direction of the traffic stream across the median to the opposite traffic lanes. This application can also incorporate the use of the shoulder or a lane constriction to maintain the same number of lanes. Examples of crossovers are shown in Figure 81-2G. Section 82-3.0 discusses the geometric design criteria that should be used to develop a crossover. Item 8 below addresses two-way traffic on a divided facility.

8. Two-Way Traffic on Divided Facility. This work-zone type involves transferring traffic from a divided facility to two-way operations on one roadway. This application requires consideration in the planning, design, and construction phases. This application should be used only if one or more conditions can be applied as follows:

   a. an alternate suitable detour is unavailable or is not cost effective;
   b. the use of temporary lanes or shoulders are impractical;
   c. construction cannot reasonably occur with one lane open;
   d. construction time will be significantly reduced using this option;
   e. all safety issues can be reasonably addressed; or
   f. pavement and shoulder structures can be reasonably upgraded.

   A crossover as discussed in Item 7 above will be required for this application. Section 82-6.02 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 83-3.0 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 bidirectional traffic and may facilitate emergency access.

9. Detour. This work-zone type involves total closure of the roadway (one or both directions) where work is being performed and rerouting the traffic to existing alternate facilities. This application is desirable where there is unused capacity on a road running parallel to the closed roadway. In addition to maintaining an official detour, INDOT may be required to repair a county highway being used as an unofficial detour, per current detour policy.

81-2.03 Work-Zone Traffic-Control Strategy

Selection of the appropriate work-zone type represents one of the most significant elements of a control strategy. Other elements of a control strategy that should be considered include length of the work zone, time of work, number of lanes, widths of lanes, traffic speeds, or right of way. Considering these and other factors, reasonable alternates can be narrowed to a select few for further review. Only a small number of feasible work-one alternates will emerge for a particular project and, only one may be practical. Identification of these alternates at an early stage in the planning process can significantly reduce the analysis effort necessary.

Figure 81-2H provides 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. However, every work zone location will have a wide variation of conditions and that an all-inclusive selection matrix is not practical.

In using Figure 81-2H, 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 may impose additional constraints regarding the types of control strategies that can 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 lengths and number of traffic lanes that must remain open.

81-3.0 TRANSPORTATION-MANAGEMENT-PLAN STRATEGIES

In addition to the traffic-control strategies discussed in Section 81-2.0, the following provides brief summaries of the strategies that may be considered during the development of a TMP. These strategies must be reviewed and adjusted to meet each project location and situation. The strategies discussed below are not all-inclusive, and that other options may be applicable for the location under consideration.

81-3.01 Construction Phasing

How a project is constructed can greatly impact the traffic flow through the work area. The following discusses the basic construction phases for freeway reconstruction.

81-3.01(01) 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. This basic concept is illustrated in Figure

81-3A, Reconstruction by Halves or Sides. For a 6-lane facility, traffic is restricted to two lanes in each direction. This may 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 the 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 may be considered. Some advantages and disadvantages of this strategy include the following.

1. Advantages.

    a. It provides an effective work area.
    b. Workers are well-separated from the traffic stream.
    c. Work-site access can be arranged with minimal interference from the general traffic flow.

2. Disadvantages.

    a. Crossovers are required.
    b. There is a need for positive separation of the traffic streams.
    c. There are potential emergency access problems in the inner lane.
    d. There may be problems at interchanges with traffic crossing the work zone.

81-3.01(02) Parallel or Adjacent Reconstruction

This approach involves a variety of lane-closure sequences. A typical sequence of this approach is as follows, which is also illustrated in Figure 81-3B, Parallel or Adjacent Reconstruction.

1. The existing shoulders are widened and strengthened.

2. Traffic is shifted to the shoulders to allow construction of the inner lanes and median reconstruction.

3. Traffic is then shifted to the newly-constructed inner lanes to allow reconstruction of the outer lanes.

4. 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:

1. it provides a more constrained work area for the contractor;

2. work crews are closer to moving traffic; and
3. access to the construction zone involves entry and exit from the travel lanes.

A 6-lane facility is reduced to 2 lanes in each direction and the above sequence is used. 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.

81-3.01(03) Serial or Segmental Reconstruction

This strategy consists of permitting only short segments of the facility to be under construction at one time. This also requires one or more of the other concepts for traffic accommodation. An example of this application may include a bridge-deck replacement where each segment can be completed within a 12-hour time period. This concept is illustrated in Figure 81-3C, Serial or Segmental Reconstruction.

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 may be lengthened considerably 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 may be substantially greater than will be with one of the other strategies.

81-3.01(04) Complete Closure

Complete closure of the facility or closure of one direction of travel may be an effective strategy. This strategy may also be effective for only 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). Some of the advantages and disadvantages of this strategy include the following.

1. <u>Advantages</u>.

    a. Increases the safety for construction workers.
    b. Provides cost and time savings.
    c. Reduces the overall travel impacts to the public due to reduced construction time.

2. <u>Disadvantages</u>.

    a. Potentially significant short-term travel impacts to the public.
    b. Potential increase in traffic congestion on other routes.
    c. May need to construct a detour or runaround.

d. Potential adverse impact on businesses due to trip suppression (not enough traffic).
e. Potential adverse impact to businesses on alternate routes (too much traffic).

81-3.01(05) Combinations

A combination of construction sequences may be the best strategy. An example is reconstructing existing shoulders prior to the initiation of parallel construction activities. The sequence of construction can be as follows.

1. Phase A. Reconstruct shoulders as appropriate to allow one side of the roadway to accommodate four lanes.

2. Phase B. Shift traffic to the four available lanes on one side of the roadway.

3. 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.

81-3.02 On-Site Strategies

81-3.02(01) Traffic-Control Devices

The following traffic-control devices applications may be considered when developing a TMP.

1. Changeable-Message Sign. This device may be used where a static sign message is not sufficient to handle the changing conditions of a work zone (e.g., lane closure, ramp closure, advise motorists of conditions for which they must possibly react).

2. Additional-Information Panel Sign. This may be used to give the motorist additional information about a work zone. The message should be pertinent to the likely conditions the motorist will encounter.

3. Traffic-Signals Interconnection. Consider interconnecting traffic signals where the benefit of moving traffic through a work zone more efficiently will be enhanced by adding interconnection between the traffic signals on the system.

4. Traffic-Signal Timing. Traffic-signal timing changes should be considered for all traffic signals within a work zone for which capacity improvements can be gained. Adding or deleting signal phases may be required for changes in travel patterns.

5. Highway-Advisory Radio. Consider using highway-advisory radio where changing work-zone conditions make it important to give the motorist a longer, more accurate message than can be obtained through the use of signs or other means. This option requires additional information and signing to alert motorists.

6. Temporary Work-Site Speed-Limit Sign. A reduced regulatory speed limit may be warranted where work activity may constitute a hazard to traffic, especially for a lane closure. The *Indiana Statutes* permit INDOT to establish a reduced work-site speed limit without an Official Action. Section 83-2.03 provides the criteria for establishing speed-limit signing in a construction zone.

7. Flashing-Arrow Sign. A flashing-arrow sign is used to supplement conventional traffic control devices. It is warranted where additional warning or directional information is required to assist in merging and controlling traffic through and around the work activity. Section 83-2.07 provides additional guidance for the use of a flashing-arrow sign.

81-3.02(02) Capacity

Each construction site will affect the capacity of the existing facility. The extent that the roadway is occupied for work and safety purposes will determine the number of strategies required to compensate for the loss of capacity. Some of the following capacity strategies may be considered when developing a TMP.

1. 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 on-street parking for local businesses must be addressed. The elimination can be for only during a peak traffic-volume period or for the entire 24-h day.

2. Restriction of Trucks. Restriction of trucks may increase the facility's capacity. However, consideration must be given to State or local ordinances, and the availability and suitability of alternate routes that the restricted trucks would be required to take.

3. Turn Restrictions. Turn restrictions should be considered where it may be necessary for capacity or safety reasons. The turn restrictions may be at intersections or drives. Turn restrictions can be for only during a peak traffic-volume period or for the entire 24-h day.

4. Reversible or Contra-Flow Lane. Consider the use of a reversible or contra-flow lane where the peak-traffic flow distribution is in one direction for a specified period of time. The use of such a lane may be limited in use due to the cost of providing and maintaining the daily changes required. There also may be safety considerations which will need to be evaluated if such a lane is contemplated.

5. High-Occupancy Vehicle (HOV) Lane. An HOV lane may be considered where a dedicated lane for high-occupancy vehicles is available and it is desired to discourage use of single-occupancy vehicles. The use of an HOV lane can be during a peak traffic-volume period or for the entire 24-h day. Due to the lack of driver familiarity with this type of lane, it is unlikely that its use will be appropriate.

6. Ramp Metering. Ramp metering may be considered where it is necessary to restrict the amount of traffic entering a freeway for capacity and safety reasons. Ramp metering may be used during peak traffic-volume period or for the entire 24-h day. The impact of ramp metering on an intersecting road will also need to be considered (e.g., traffic backup).

7. 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.

81-3.02(03) Other On-Site Considerations

In addition to the above strategies, the following other on-site strategies may be considered in developing a TMP.

1. Ramp Closure (Short or Intermediate Term). This may be necessary for construction purposes. If a closure is required, additional signage will be necessary to forewarn the motorist. Signs should be posted on the affected ramp two weeks in advance to advise the motorist of the closure date or portion of the day during which the ramp will be closed.

2. Ramp Closure (Long Term). This may be necessary to construct or to improve traffic flow on the mainline. Local access and business impacts should be considered before deciding on a long-term ramp closure. Also consider the user costs for a detour route and the capacity and safety impact of the detour route. Two adjacent ramps should not be closed at the same time unless necessary for safety reasons.

3. Incident Management. Consider the use of on-site tow trucks for a freeway work zone with limited to unavailable shoulder width. They should also be considered where an accident or breakdown would seriously impact traffic flow and cause significant backups and delays.

4. Special Materials. Examine the use of fast-setting or precast concrete, or other special materials where traffic restrictions must be minimized (e.g., ramp, intersection).

5. 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-kilometers closed and, then, can earn or lose money if the actual number is higher or lower than that bid. This concept has not yet had widespread use.

6. Police Patrol for Speed Control. A police patrol may 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 will need to coordinate this with the Highway Operations Division.

7. Incentive/Disincentive. Consider adding an incentive/disincentive provision to minimize the time that a facility may be affected by construction. Section 81-3.05 discusses the types of work for which an incentive/disincentive provision should be considered.

8. A + B Bidding. If the impact of the construction on traffic is significant, the designer should consider the A + B bidding incentive. Section 81-3.06 provides information on A + B bidding.

81-3.03 Off-Site Strategies

Where construction will significantly impact the traffic flow away from the work zone, the following off-site strategies may be considered in the TMP.

1. Capacity Improvement. Additional improvements on the alternate route may be necessary for capacity reasons to handle the expected diversion of traffic. Examples of capacity improvement include prohibiting or restricting parking, turn restrictions, and truck restrictions, all as described in.81-3.02(01), additional pavement width, or adding a turn lane.

2. Trailblazing to Attraction or Point of Interest. Trailblazing may be necessary to guide the motorist to an attraction or point of interest where the normal route is closed or seriously restricted, or where an alternate route to the attraction or point of interest would assist traffic which would otherwise travel through the work zone.

81-3.04 Scheduling

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. Short Schedule. A schedule to minimize construction activities and disruption to traffic may be required if motorist user costs are expected to be excessive. However, a short schedule may increase the cost of the project.

2. Longer Schedule. A longer schedule of construction activities may be cost effective if it does not significantly increase the adverse impact to the motorist. The contractor may offer to provide a lower price for a longer schedule.

3. Time-of-Day or Day-of-Week Restriction. This type of restriction may be necessary if the work-zone capacity cannot accommodate the expected demand during a peak traffic period and other measures are not as cost effective. 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.

4. Project Staging. Project staging or completing smaller portions of 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.

5. Combining with Other Work. Projects within a corridor may be combined or scheduled at the same time where practical, pending available funding, to minimize impacts to the motoring public.

81-3.05 Incentive/Disincentive Justification

Incentive/disincentive is used to minimize the time that a facility may be affected by construction. The contractor is provided additional funds if the project is completed early or is assessed damages if the project is not completed on time. Due to administrative concerns of implementing this concept, limit incentive/disincentive to a project that has one or more of the characteristics as follows:

1. high traffic volume occurs in an urban area;
2. it completes a gap in the highway facility;
3. it severely disrupts traffic or highway services;
4. it significantly increases road user's costs;
5. it significantly impacts adjacent neighborhoods or businesses;
6. it replaces a major bridge that is out of service; or

7. it includes lengthy detours.

Figure 81-3D consists of the Department's worksheet for determining the appropriate incentive/disincentive amount. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/. An incentive/disincentive justification request should be forwarded to the Contract Administration Division's Office of Contracting as soon as practical due to the time required for the Central Office to process the request.

81-3.06 A + B Bidding

Where the impact of the work site is significant, an A + B bidding incentive may be used to encourage the contractor to minimize these impacts by reducing the exposure time. A + B bidding consists of two parts as follows.

1. Part A. The total dollar amount required to complete the work.

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 A is determined using the contractor's unit prices and the estimate of quantities determined by the Department. Part B is established by adding together the costs for each of the following:

1. peak-traffic-volume lane-closure periods = (no. of periods) x (cost / lane / period);
2. non-peak-traffic-volume lane = (no. of periods) x (cost / lane / period); plus
3. 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 the Department 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 as discussed in Section 81-3.05. Before adding an A + B bidding special provision to a contract, the designer should coordinate its use with the Highway Operations Division and the district construction engineer.

81-4.0 COST-EFFECTIVE ANALYSES

81-4.01 General

There may be more than one option that will address the problem of traffic congestion during construction. To determine the most appropriate option, the user will need to compare the benefits and costs of each to determine the most appropriate option. Chapter Fifty provides information on economic analyses relative to benefit/cost analysis and safety-cost analysis. The user should review Chapter Fifty in conjunction with the following to determine which option will be the most cost effective.

A project may not have alternate methods of maintaining traffic. The user-cost calculations will not be required. However, for a project with incentive/disincentive, the user costs must still be determined.

There are computer programs available which the designer may use to determine the cost effectiveness of the various options and alternates. For a freeway, INDOT uses the QUEWZ program. The Department's application of this program is further described in Section 81-4.03.

81-4.02 Cost Evaluation

81-4.02(01) On-Site

If determining the costs of on-site options (e.g., runaround, lane closure, shoulder use), the designer should consider the following:

1. right-of-way cost (temporary and permanent);
2. additional construction costs;
3. effect on wetlands;
4. vehicular delay;
5. user costs (including detour user costs);
6. accident potential; and
7. driving time.

If determining the effect of each on-site option, the designer also should 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). The designer should see the *INDOT Detour Policy* regarding any unofficial local detours.

81-4.02(02) Detour

For an official detour or unofficial detour, the designer must determine the total cost of the detour. To determine the daily detour user costs, use the following equations.

1. Detour User Cost = (Cost in Lost Time) + (Cost in Extra Distance Traveled).

2. Cost of Lost Time = (No. of vehicles detoured) x (increase in travel time per vehicle, h) x (value of motorist's time)

3. Increase in travel time = (length of detour, km / average detour travel speed, km/h) – (length of construction zone, km / average travel speed through construction zone, km/h)

4. Cost in Extra Travel Distance = (net increase in length of travel, km) 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 not only considers lost wages but also lost free time. A value from $10 to $15 per hour is used.

   The vehicular operating expense includes fuel, maintenance, and depreciation costs, and is set at $0.15 / km.

In addition to the above detour user costs, the designer must add the cost for improvements needed to the detour route (e.g., repaving, pavement widening, signal improvements). The designer should also consider the effect the detour will have on the community and local businesses.

81-4.03 QUEWZ Program

The Department uses the computer program QUEWZ for a freeway project to determine the queue length and user costs that are associated with work-zone lane closures. Based on the type of lane closure, traffic volume, time schedules, etc., the program will provide the user with the expected queue length and estimated user costs. The Office of Environmental Services' Environment Assessment Team may use this program during the preliminary-engineering stage to compare the various options. The designer may use this program to ensure that the proposed traffic-control plan is still cost effective. The program user should review the user's manual to determine how to use the program.

81-4.03(01) Inputs

The user must provide inputs into the program as follows:

1. lane-closure configurations;
2. the schedule of work activities (e.g., work activity hours, lane-constriction hours); and
3. the traffic volume approaching the freeway segment.

The program provides default values for the following:

1. cost update factor;
2. percentage of trucks;
3. speeds and volumes at various points on a speed-volume curve;
4. capacity of a lane in the work zone;
5. maximum acceptable delay to the motorist; and
6. 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 assumes 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 time frame to satisfy the project situation. The designer should review the user's manual to determine if the default values are applicable to the location under consideration.

81-4.03(02) Outputs

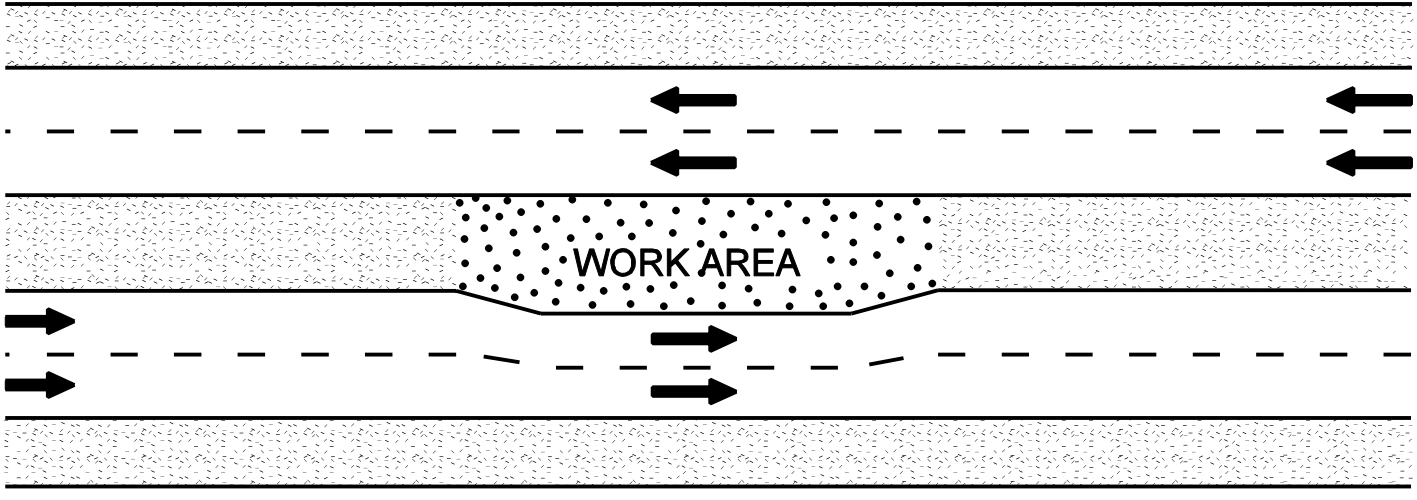
QUEWZ has two output options: road-user cost and lane-closure schedule. The road-user-cost output option analyzes a specified lane-closure configuration and schedule of work activities, and provides estimates of traffic volume, capacity, speed, queue length, diverted traffic, and additional road user costs for each hour affected by the lane closure. The lane-closure-schedule option summarizes the hours of the day during which a given number of lanes can be closed without causing excessive queuing.

In addition to the values obtained from the program, supplemental user-cost calculations may 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 that using crossovers) will be closed and where the designer judges that the QUEWZ program is not properly estimating the full amount of diverting mainline traffic.

Additional detour user-cost calculations should be conducted if an exit ramp is to be closed. Experience has shown that most or all of the traffic that would have used a ramp if it was open will

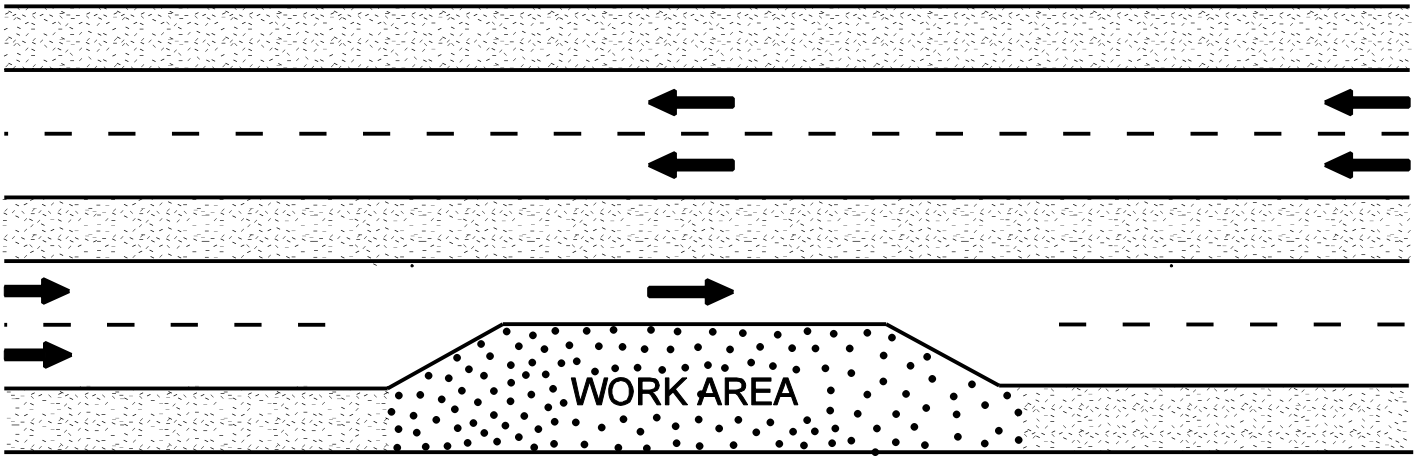
divert from the mainline before the construction zone. Therefore, the exit-ramp volume should be deleted from the input mainline volume before using QUEWZ.

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



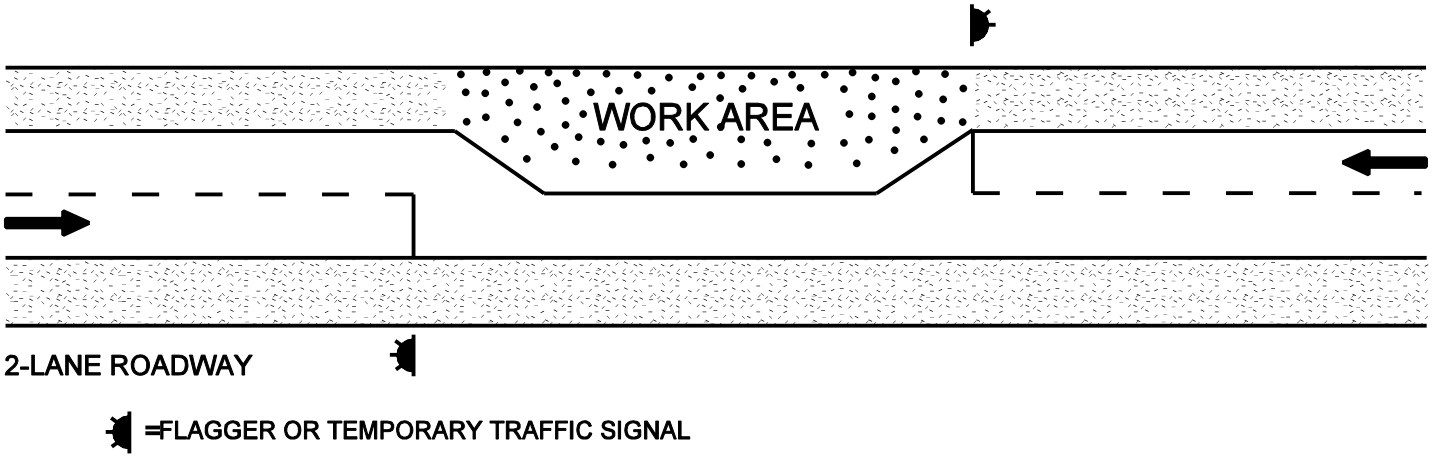
LANE CONSTRUCTION WORK ZONE

Figure 81-2A



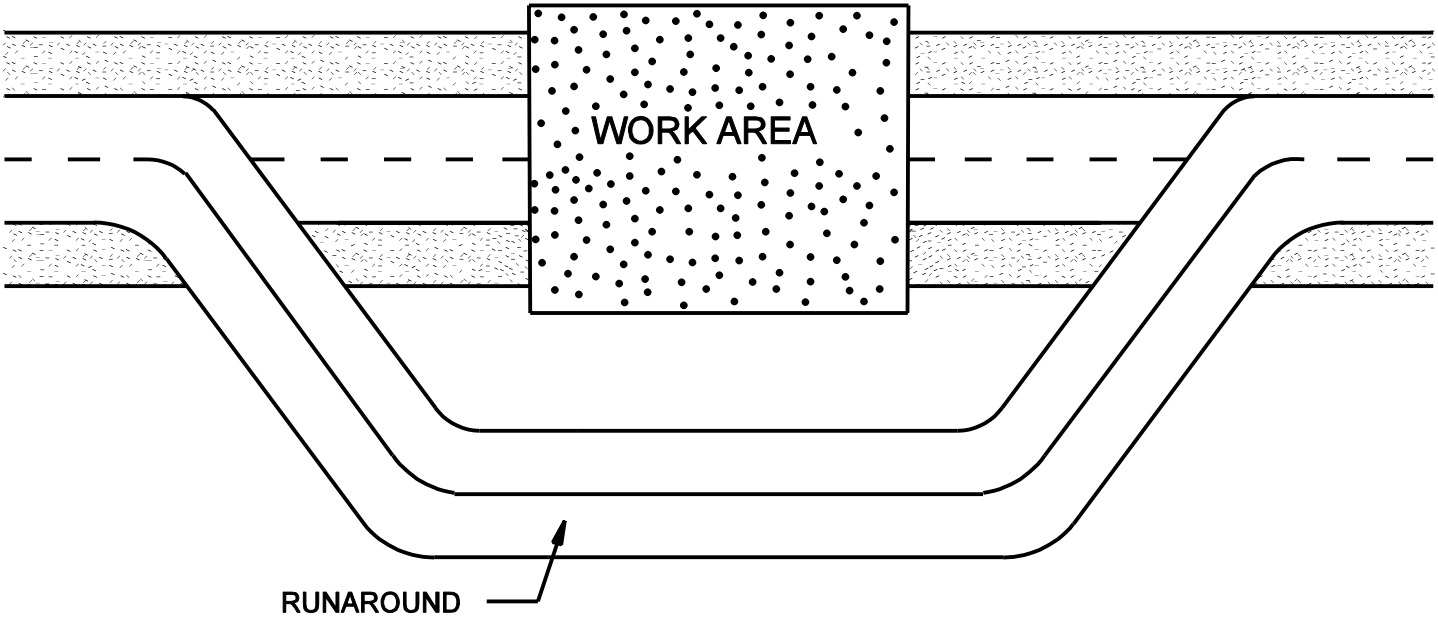
LANE CLOSURE WORK ZONE

Figure 81-2B



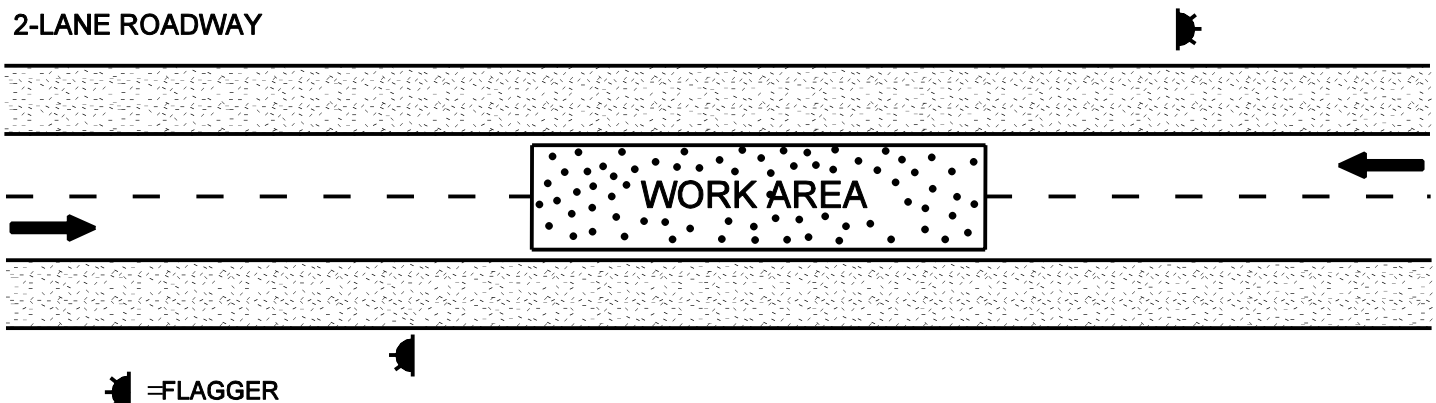
ONE-LANE, TWO-WAY WORK ZONE

Figure 81-2C



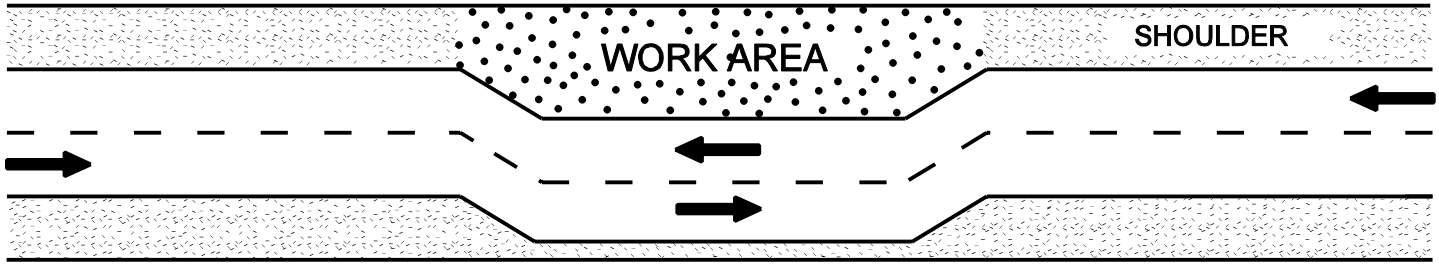
RUNAROUND WORK ZONE

Figure 81-2D



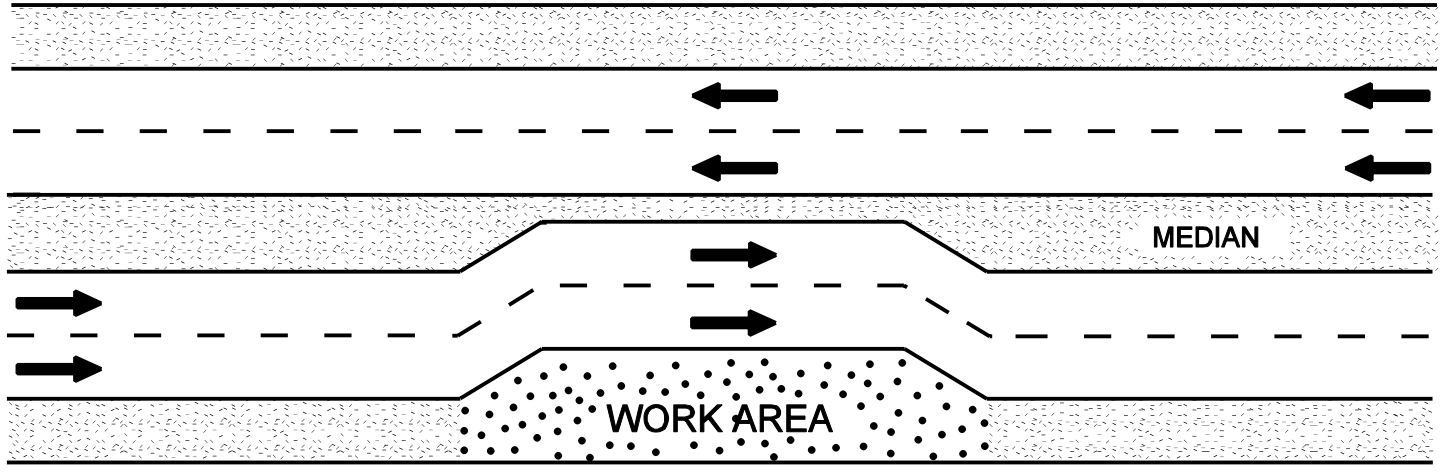
INTERMITTENT CLOSURE

Figure 81-2E



2-LANE DIVIDED ROADWAY

A

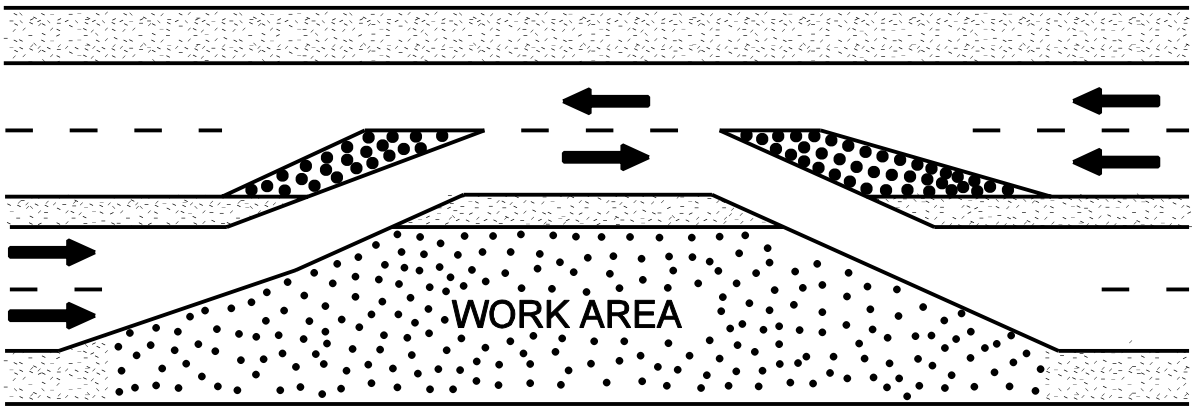


4-LANE DIVIDED ROADWAY

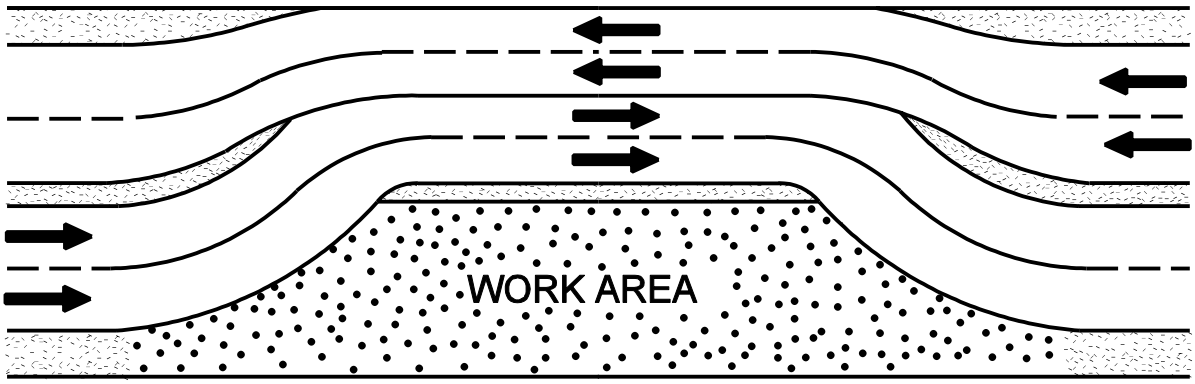
B

SHOULDER OR MEDIAN USE WORK ZONES

Figure 81-2F

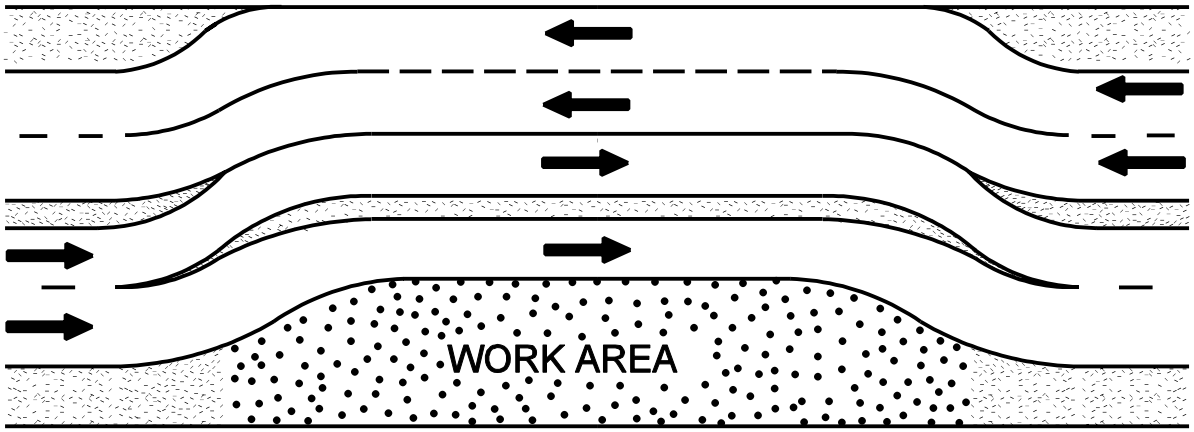


A



4-LANE DIVIDED ROADWAY

B

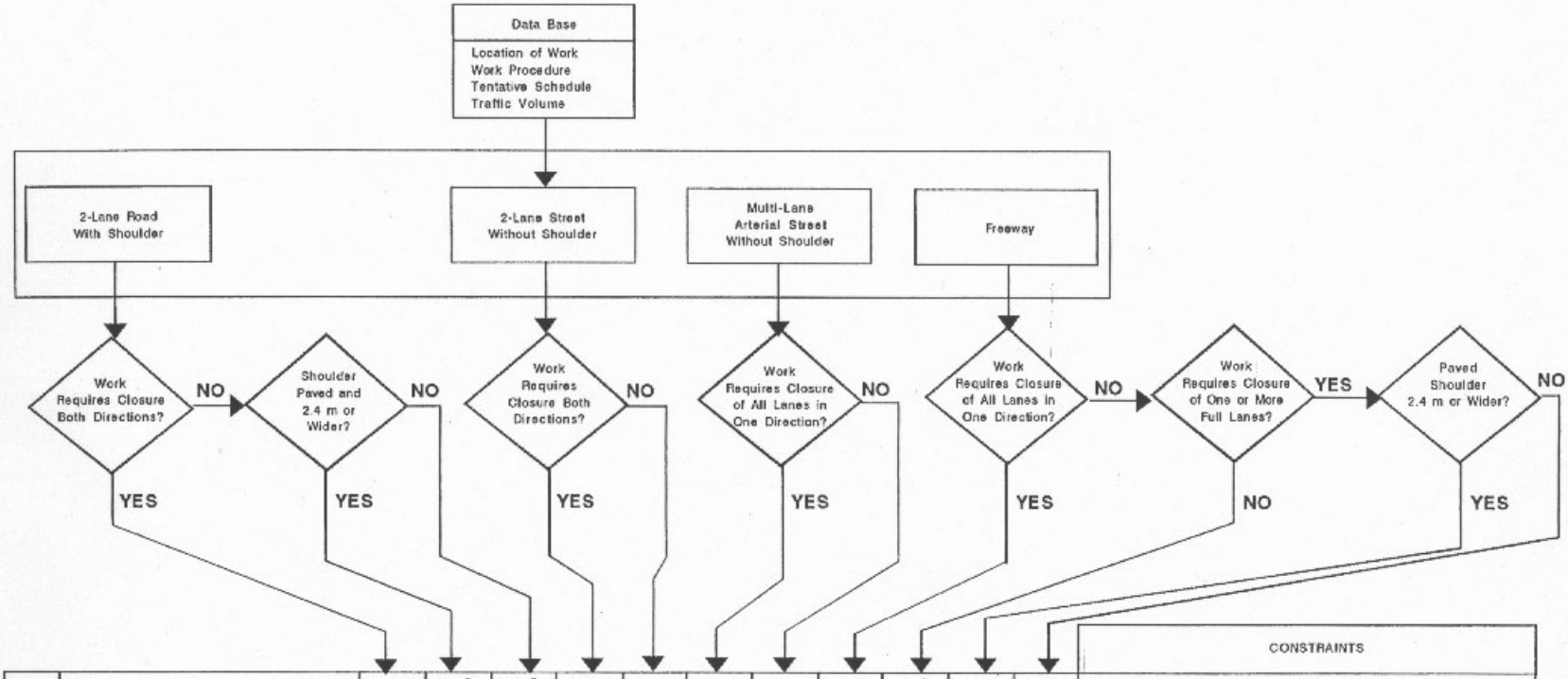


4-LANE DIVIDED ROADWAY

C

CROSSOVER WORK ZOMES

Figure 81-2G

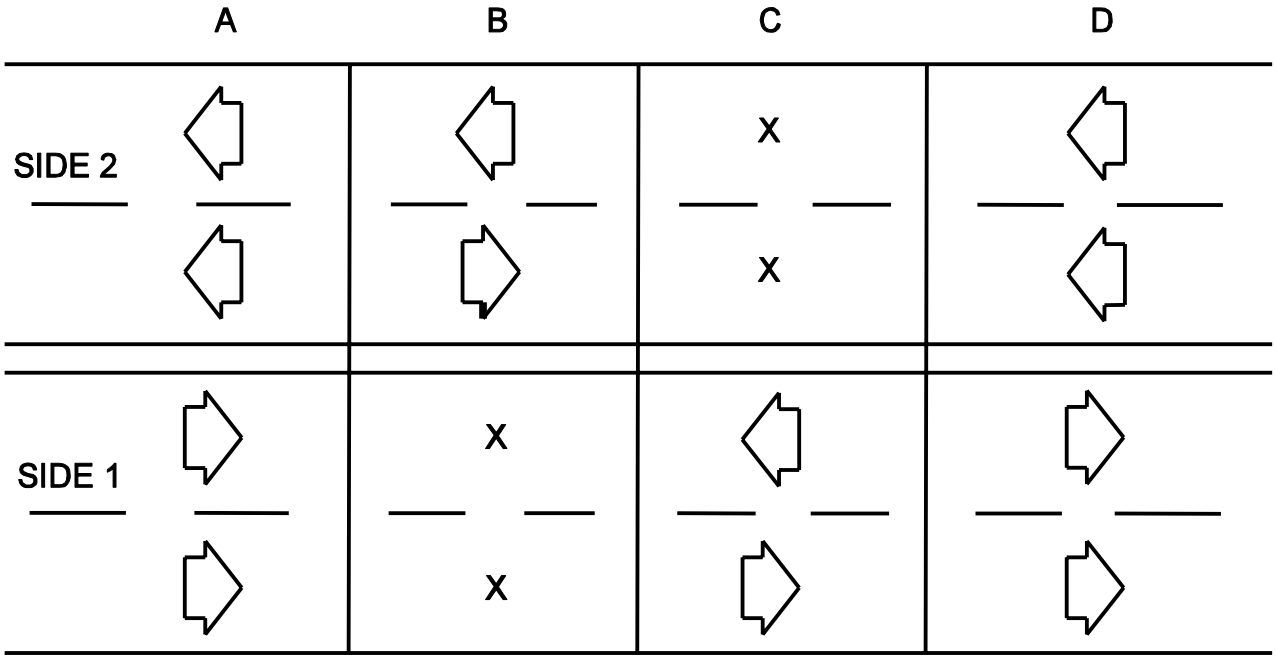


ALTERNATIVE WORK ZONE TYPES												CONSTRAINTS
LANE CONSTRICTION (Use part of the shoulder if necessary)		√	√						√			Restripe lane lines; keep lanes 3.0 m or wider. For freeways and other divided highways, the minimum lane width is 3.3 m.
LANE CLOSURE							√		√	√	√	
ONE-LANE, TWO-WAY OPERATION		√	√		√							Traffic volume less than 1000 vehicles per hour both directions. (See INDOT computer program "WORK")
RUNAROUND	√		√					√				Sufficient right-of-way available.
INTERMITTENT TOTAL CLOSURE	√			√				√				Off-peak hours only.
USE OF SHOULDER (As a full lane)		√								√		May need to upgrade shoulder structure.
CROSSOVER						√		√				
TWO-WAY TRAFFIC ON DIVIDED FACILITIES						√		√				
DETOUR TO EXISTING ROAD	√		√	√	√	√	√	√		√	√	Reasonable detour route(s) available. Maintain local access.

√ Feasible Alternatives

CHART FOR IDENTIFICATION OF FEASIBLE WORK ZONE TYPES

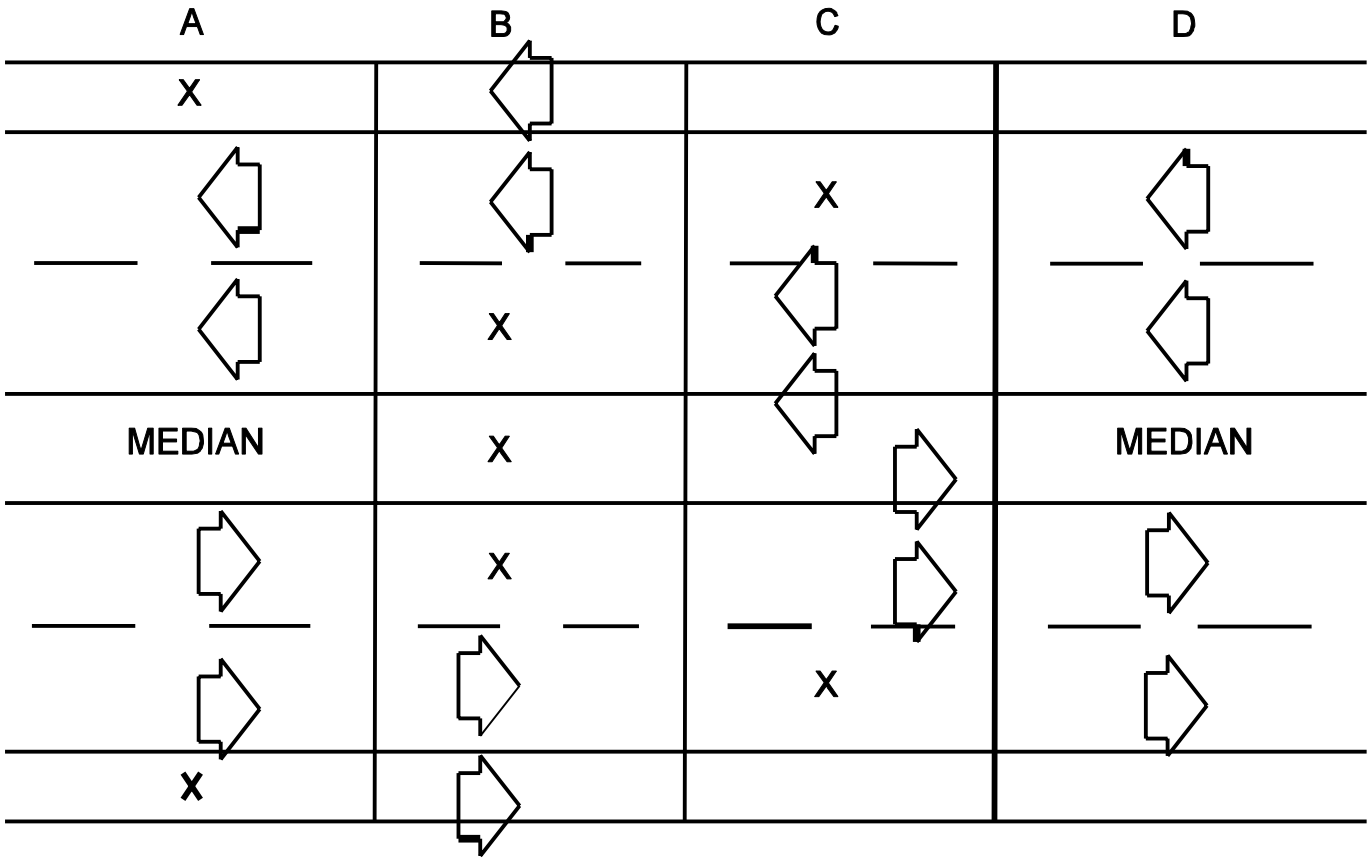
Figure 81-2H



A = Prior Construction
B = During Construction of Side 1
C = During construction of Side 2
D = Following Compleation
X = Construction Activity
⇦ = Traffic Flow

RECONSTRUCTION BY HALVES (SIDES)

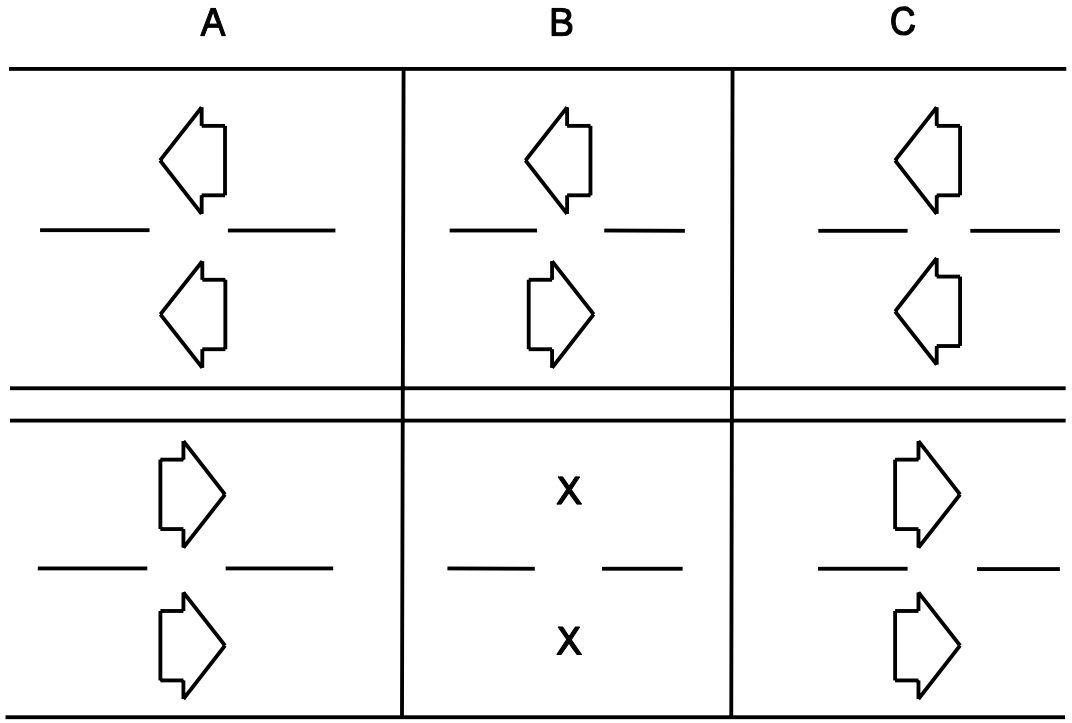
Figure 81-3A



A = Construction of Shoulder
B = Construction of Inner Lanes
C = Construction of Outer Lanes
D = Following Construction
X = Construction Activity
⇦ = Trafic Flow

PARALLEL/ ADJACENT RECONSTRUCTION

Figure 81-3B



A = Prior to Construction
B = During Construction of a Segment While Maintaining Two-Way Traffic Operation
C = Completion of Construction
X = Construction Activity
⇦ = Trafic Flow

SERIAL/SEGMENTAL RECONSTRUCTION

Figure 81-3C

INCENTIVE / DISINCENTIVE (I/D) AMOUNT DETERMINATION
Metric-Units Project

I. PROJECT CHARACTERISTICS

Route Contract No. Project No.
Des. No. District:
National Highway System (NHS) Route? ☐ Yes ☐ No
Location:
Estimated Start Date of Work:
Estimated Completion Date Without I/D:
Estimated Contract Amount: $
* Estimated Local-Traffic AADT: Trucks %
* Estimated Through-Traffic AADT: Trucks %
** Length of Local-Traffic Detour: km
** Length of Through-Traffic Detour: km

* Use best judgment for breakdown of traffic.
** Use official detour for through traffic.

II. I/D CONSIDERATIONS

Contract restrictions (e.g., utility adjustments, R/W acquisitions, permits, environmental constraints, closure times, special fabrication requirements):

Reasons for proposing I/D:

Critical construction elements:

Estimated Completion Date With I/D:
Estimated I/D Amount: $ per day
Proposed I/D Time: Calendar Days

Maximum I/D Adjustments = (I/D Amount) x (I/D Time):

$ x days = $

User Vehicle Costs (UVC):	$0.15 / km / veh (Autos & Trucks)
User Time Value (UTV):	$5.00 / h / veh
Local Design Speed:	km/h
Through Design Speed:	km/h
Traffic Adjustment Factor (TAF):	Suggested Value 0.35 (TAF normal range is 0.30 to 0.45)

NOTE: Use either of the following analyses depending on the type of project (road closure-detoured or through-traffic project). Various computer programs are available such as QUEWZ for estimating queue lengths and user costs that can be used in lieu of the following for freeway work-zone lane closures. Contact the Highway Operations Division's Traffic Control Team for details.

A. <u>User Costs for Closure-Detoured Project</u>

Local Traffic:

Vehicle Costs = (UVC) (AADT) (Local-Detour Length)
($0.15) ( ) (km) = $

User Costs = (UTV) (AADT) (Local-Detour Length) (1/Design Speed)
($5.00) ( ) (km) (1/) = $

Local-Road User Costs (LRUC) = (Vehicle Costs + User Costs)
$ + $ = $

Through Traffic:

Vehicle Costs = (UVC) (AADT) (Through-Detour Length)
($0.15) ( ) (km) = $

User Costs = (UTV) (AADT) (Through-Detour Length) (1/Design Speed)
($5.00) ( ) (km) (1/) = $
Through-Road User Costs (TRUC) = (Vehicle Costs + User Costs)
$ + $ = $

Site RUC = LRUC + TRUC
$ + $ = $

B. Disruption Costs for Through-Traffic Project

NOTE: The following analysis provides delay cost for through traffic only. If the project includes ramp or intersection closures, the analysis from Part A above can be added to the through-traffic disruption costs or other factors commensurate upon the scope of the particular project.

Vehicle Costs = (UVC) (AADT) (TAF)
($0.15) ( ) ( ) = $

User Costs = (UTV) (AADT) (TAF)
($5.00) ( ) ( ) = $

Traffic Disruption Costs = (Vehicle Costs + User Costs)
$ + $ = $

C. General Comments

D. Other Factors to Consider. Is the route on or near one or more of the following?

School: ☐ Yes ☐ No
Hospital: ☐ Yes ☐ No
Emergency Route: ☐ Yes ☐No
Hazardous-Materials Route: ☐ Yes ☐ No
Special or Seasonal Event: ☐ Yes ☐ No
Local Business: ☐ Yes ☐No

III. SUMMARY

Recommended Maximum I/D Time: Calendar Days
Recommended I/D Date:
Recommended Maximum I/D Amount: $ per Day
Is I/D amount > 5% of contract amount? ☐ Yes ☐ No

NOTE: If the I/D amount per day is greater than the Site RUC or Traffic User Costs, I/D is not justified.

IV. APPROVALS

A. Non-NHS Project

Prepared By: Date

Recommended By: _____ Date _____
Field Construction Engineer, Construction Mgmt.. Div.

If I/D ≤ 5% of contract amount,

Approved By: _____ Date _____
Director, Construction Management Division

If I/D > 5% of contract amount,

Approved By: _____ Date _____
Chief Highway Engineer

Received By: _____ Date _____
Contracting Office Manager, Contract Administration Division

B. <u>NHS Project</u>

Prepared By: Date

Recommended By: _____ Date _____
Field Construction Engineer, Construction Mgmt.. Div.

Approved By: _____ Date _____
Chief Highway Engineer

Received By: _____ Date _____
Contracting Office Manager, Contract Administration Division

NHS Exemption: ☐Yes ☐ No
If No, this document must be submitted to FHWA for approval.

Approved By: _____ Date _____
Federal Highway Administration