

Maryland State Highway Administration

Guidance on Maintenance of Traffic Alternative Analysis (MOTAA)

Introduction

Developing and evaluating the best combination of construction phasing/staging, project design options, temporary traffic control, transportation management strategies hand-in-hand with each other may help reduce work zone impacts. A Maintenance of Traffic Alternative Analysis (MOTAA) should compare work zone options, including staging/phasing options as well as temporary traffic control options, for each project design alternative and document maintenance of traffic constraints for each option. The analysis should address the benefits and problems for each option, and should include the design team's recommendation on the preferred type of MOT for each detailed design alternative. It is not the intent of the Maintenance of Traffic Alternative Analysis to require a detailed design of each design alternative's work zone, rather to identify and compare major potential functional faults of the work zone options.

The MOTAA may be a factor in choosing the preferred design alternative and will serve as the basis for scoping the project's work zone design. A MOTAA should be performed for any project with potential to have significant work zone impacts on safety and/or mobility, known as "significant projects". During project planning, a conceptual MOTAA should be performed to compare work zone options for each alternate retained for detailed study. When the project moves to the design office, a more detailed MOTAA may be required for the selected alternate. The preliminary Traffic Control Plan (TCP) submitted at Preliminary Investigation (PI) shall be based on the preferred work zone option determined by SHA after reviewing the MOTAA (unless further analysis is required due to project design changes).

The following is a recommended procedure for conducting a MOTAA. Other analysis procedures and techniques, such as a Kepner-Tregoe Analysis, are acceptable as long as they address all applicable work zone issues and investigate alternative/innovative design, construction and transportation management strategies.

Definitions

Detailed Design Alternative – Detailed design alternatives include all alternates retained for detailed study during the project planning process (e.g., bridge replacement in-line with existing structure or parallel to existing structure, widening 4-lane highway to 6-lane highway, grade separating an at-grade intersection, etc.).

Work Zone Option – Work zone options are maintenance of traffic concepts that address construction staging, phasing and traffic control (e.g., full closure, reversible lanes, use of temporary structures, etc.). Work zone options should be developed for each detailed design alternative.

Work Zone Constraint – A work zone constraint is a potential negative impact caused by the work zone design (e.g., increased right-of-way costs, reduced access to neighboring businesses, high utility relocations costs, etc.).

Complex Project – All urban projects and non-urban projects which involve temporary pavements, significant localized alignment modifications from phase to phase, etc. Projects which involve significant modifications to interchanges, with a high number of sub-phases, would be considered to be complex projects. Any project which involves more than simply two phases and a possible third phase to upgrade the shoulder could also be considered a complex project.

Process

A MOTAA is accomplished by examining a standard work zone cross-section throughout the project length and identifying potential impacts. This process should be completed for all phases of the work zone options selected for each detailed design alternative.

1. **Determine Work Zone Options.** Meet with the ADE-Traffic and appropriate representatives from Office of Construction, District Construction, Office of Traffic and Safety, Highway Design Division and Bridge Design (if structures are involved) to discuss construction staging and work zone options for each detailed design alternative. Select work zone options for analysis. The selection of work zone options should begin with the consideration of positive protective strategies, such as full closures, ramp closures, crossovers and detours, which would avoid or minimize worker exposure to motorized traffic. Other work zone options may include, but are not limited to, the following traffic control strategies (refer to the Work Zone Design Checklist for additional options):
 - Part-width construction
 - Lane shifts or closures
 - Reversible lanes
 - Temporary structures
 - One-lane, two-way operations
 - Widening
 - Runaround
 - Use of shoulder or median

2. **Develop Cross-Sections.** Cross-sections for each work zone option shall be developed between every interchange, on every bridge, at each merge/diverge point (ramps), and wherever overpass piers are present. Where bridge widths vary, the narrowest part of the bridge should be shown. Use the following information to develop the cross-sections:
 - a. The number of lanes required to satisfy SHA's Work Zone Lane Closure Analysis Guidelines is the starting point for this analysis. Any work zone where volume exceeds work zone capacity will require a detailed traffic analysis per the Lane Closure Analysis Guidelines.
 - b. Typically show 12 foot lanes unless a narrower lane(s) provides significant benefits in terms of mitigating maintenance of traffic constraints.
 - c. All exit and entrance ramps will be maintained with the same number of lanes during construction as pre-construction.
 - d. A minimum 1 foot clearance will be provided between lanes and barrier toes.
 - e. Show existing beam spacing on bridge decks (transverse sections).
 - f. Show bridge deck cut lines in relationship to existing beams (transverse sections).
 - g. Show a 2 foot paved shoulder where possible; and indicate locations where this is not possible.
 - h. Show existing or proposed bicycle and pedestrian facilities.

3. **Stick Drawing.** Provide a stick drawing (schematic or sketch) covering the entire project length for each work zone option. Include on each stick diagram (schematic or sketch) the following information:

- a. Arrows showing lane use, including merging and diverging ramps in relation to work areas and barriers.
 - b. All bridges.
 - c. Cross- sections between every interchange (from previous step).
 - d. Existing toe-toe bridge width; proposed final bridge toe-toe widths (if available); required toe-toe bridge widths necessary for maintenance of traffic. This may be in the form of a table if necessary.
4. **Work Zone Constraints.** Using the stick drawings and cross-sections, the following factors should be considered when looking for possible work zone constraints.
- a. Ability to meet thresholds in the Work Zone Lane Closure Analysis Guidelines.
 - b. Ability to maintain access (businesses, communities, etc.).
 - c. Ability to provide required ramp merge distances.
 - d. Right-of-way impacts.
 - e. Environmental impacts.
 - f. Bridge widths.
 - g. Significant impacts on construction duration.
 - h. Significant impacts to earthwork, retaining walls, pier clearances, profile differences, etc.
 - i. Ability to maintain existing drainage, utility and lighting systems.
 - j. Constructability and construction equipment access.
 - k. Impacts on pedestrian and bicycle facilities.
 - l. Impacts on emergency services (fire, ambulance, police, hospitals).
 - m. Safety (of traveling public and workers)
 - n. Ramp Capacity
 - o. Construction and MOT costs

Should a work zone option prove to have significant constraints, or prove impractical or otherwise not possible to construct, SHA may require an additional analysis using other construction strategies not initially identified. When major conflicts are identified, the project team should coordinate with designers to eliminate or reduce the impact during these preliminary design phases. This coordination may result in the development of new or modified work zone options, or even new project alternatives.

5. **Transportation Management Strategies.** Potential transportation management strategies, such as transportation operations and public awareness strategies, to improve mobility and safety through the work zone should also be considered as part of the analysis. Detailed strategies are not necessary. Generalizations regarding reduction in demand, increases in capacity, etc. for specific strategies can be made based on good engineering judgment and previous experience. For example, a permanent shoulder closure on a high crash segment of roadway may be feasible if an incident management plan is used that includes a tow-truck based incident response program.

Submission Requirements

The analysis shall be submitted to the project team for review. The analysis should always include a project description indicating the type of work. The following shall be included in the submission:

1. **Stick Diagrams and Cross-Sections.** Stick diagrams (schematic or sketch) for the entire project length and cross-sections shall be provided. In the stick diagram, along with each roadway schematic or sketch, the corresponding cross-sections shall be displayed on the same sheet. Each cross-section location shall have its own identifier, i.e., do not repeat section 'AA' at different locations. If a cross section is provided at the same location in several phases, to provide uniformity for easy identification among the various phases, it shall be identified with the same identifier in each phase.
2. **Work Zone Constraints Form.** This form shall be incorporated into the analysis report. The content of each box in the form should indicate if that work zone constraint will be an issue with that work zone option. Where a constraint is identified, it should be clear which phase of construction (or all phases) the constraint will be present. Constraints should be footnoted and an explanation should be provided after the form in the analysis report. The explanation should provide sufficient information for SHA to determine the magnitude of the constraint.
3. **Rolled Plans for Complex Projects.** For complex projects, SHA may require additional information in the form of a set of rolled plans showing the entire length of the project. If rolled plans are required, each construction phase with its corresponding traffic phase should be color coded. A legend shall be provided showing different colors for permanent roadway, permanent bridge, temporary roadway, temporary bridge, etc. Cross-hatching shall be shown on each construction area that is critical for the next phase. Other items to denote using colors or symbols include ramp closures, structures to be removed or demolished, color coding for traffic routing, and arrows showing direction of traffic flow.
4. **Estimate.** A best available engineering estimate should be provided for each alternative. Major cost differences between alternatives should be noted (e.g., requires additional temporary concrete barrier and temporary pavement; requires widening bridge decks; requires purchase of additional right-of-way, etc.).
5. **Summary/Recommendation.** The Maintenance of Traffic Alternative Analysis shall include a summary that includes a recommendation on the preferred work zone option for each detailed alternative, as well as the overall preferred work zone option, based upon the constraints identified. SHA will determine, based upon the analysis, the preferred work zone option.

Sample Work Zone Constraints Form and Footnotes

The following are some examples of constraint footnoted information. These are not meant to be all inclusive, nor are they intended to be an indication of verbatim responses expected. It is expected the engineering team will use judgment and provide sufficient information to allow SHA to make an informed decision when selecting between work zone options.

- **Right-of-Way Impacts** - The explanation should state the project ramifications of overcoming this constraint (e.g., buy R/W or use retaining walls). Cost and/or schedule impacts should be included.
- **Bridge Widths** - In order to provide the number of lanes required by the work zone lane closure analysis guidelines, existing structures will have to be widened (either temporarily or permanently).
- **Ability to Provide Required On-Ramp Merge Decision Sight Distance** - An existing ramp cannot provide adequate merge distance due to a physical constraint, such as a bridge pier or parapet. Costs should be provided to remove the obstruction(s). In addition, information should be provided to indicate the extent to which the merge condition will not be satisfied (i.e., how many feet).
- **Environmental Impacts** - Crossover construction will require significant amounts of fill material that could introduce stream impacts. Project cost and schedule impacts should be provided.
- **Ability to Meet Thresholds in the Work Zone Lane Closure Analysis Guidelines** - A structure on the project will not allow for the work zone lane closure analysis guidelines required number of lanes to be provided. Information should give an estimated cost to widen the structure to provide the required cross-sections.
- **Ability to Maintain Existing Drainage and Lighting Systems** - Median-mounted highway lighting will have to be removed to accommodate maintenance of traffic, or proposed alternative cross section will require temporary wedging to allow for drainage. Cost information should be provided.

Sample Work Zone Constraints Form

Factors to be Considered	Detailed Alternative 1 ⁴		Detailed Alternative 2		Detailed Alternative 3	
	Work Zone Option 1	Work Zone Option 2	Work Zone Option 1	Work Zone Option 2	Work Zone Option 1	Work Zone Option 2
Ability to Meet Thresholds in the Work Zone Lane Closure Analysis Guidelines						
Ability to Maintain Access						
Ability to Provide Required Ramp Merge Distances						
Right-of-Way Impacts						
Environmental Impacts						
Bridge Widths						
Significant Impacts for Construction Duration						
Significant Impacts to Earthwork, Retaining Walls, Pier Clearances, Profile Differences, etc.						
Ability to Maintain Existing Drainage, Utility and Lighting Systems						
Constructability and Construction Equipment Access						
Impacts on Pedestrian and Bicycle Facilities						
Impacts on Emergency Services (fire, ambulance, police, hospitals)						
Safety						
Ramp Capacity						
Estimated Total MOT Cost						

Notes:

1. Where a constraint is identified, it should be clear in which phase(s) of construction the constraint will be present.
2. Each constraint should be footnoted and an explanation should be provided after the table in the analysis report. The explanation should provide sufficient information for SHA to determine the magnitude of the constraint.
3. Additional work zone options shall be included in the constraints form as required by the number of work zone options selected for analysis by the project team. Similarly, the number of detailed alternatives examined should reflect the number of alternates retained for detailed study by the project team.
4. During project planning, Detailed Alternative 1 will always be the no-build option. Work zone options are not needed for the no-build option; however, some discussion of existing or future conditions given the no-build option may be warranted.