Traffic Control Signal Needs Study

A. General

The MUTCD states that "A traffic control signal should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection." The first question that must be answered is whether a traffic control signal is justified or is the most effective treatment option. It is the responsibility of the Engineer or agency to make this determination with serious consideration given to the following MUTCD Section 4B:

Section 4B.01 General
Section 4B.02 Basis of Installation or Removal of Traffic Control Signals
Section 4B.03 Advantages and Disadvantages of Traffic Control Signals
Section 4B.04 Alternatives to Traffic Control Signals
Section 4B.05 Adequate Roadway Capacity

B. Data Collection

The engineering study should be based upon a complete collection of site and traffic data (vehicle, pedestrian, etc) pertaining to the candidate location. Section 9-4.01 of the Mn/DOT Traffic Engineering Manual notes the studies which will be helpful in assessing and demonstrating the need for a signal as follows:

- Volume studies, including approach volumes, turning movements, and peak hour detail counts
- Pedestrian counts, including any unusual numbers of children, handicapped, and elderly
- Traffic gap studies
- Speed studies
- Crash studies
- Intersection delay studies

Procedures for completing various traffic studies are found in the ITE Manual of Traffic Engineering Studies.

MUTCD Section 4C.01 provides a detailed description of engineering study data which may be needed to conduct a warrant analysis. These include:

1. The number of vehicles entering the intersection in each hour from each approach during 12 hours of an average day. It is desirable that the hours selected contain the greatest percentage of the 24 hour traffic volume.

2. Vehicular volumes for each traffic movement from each approach, classified by vehicle type (heavy trucks, passenger cars and light trucks, public-transit vehicles, and, in some locations, bicycles), during each 15 minute period of the 2 hours in the morning and 2 hours in the afternoon during which total traffic entering the intersection is greatest.

3. Pedestrian volume counts on each crosswalk during the same periods as the vehicular counts in Item B above and during hours of highest pedestrian volume. Where young, elderly, and/or

persons with physical or visual disabilities need special consideration, the pedestrians and their crossing times may be classified by general observation.

4. Information about nearby facilities and activity centers that serve the young, elderly, and/or persons with disabilities, including requests from persons with disabilities for accessible crossing improvements at the location under study. These persons might not be adequately reflected in the pedestrian volume count if the absence of a signal restrains their mobility.

5. The posted or statutory speed limit or the 85th-percentile speed on the uncontrolled approaches to the location.

6. A condition diagram showing details of the physical layout, including such features as intersection geometrics, channelization, grades, sight-distance restrictions, transit stops and routes, parking conditions, pavement markings, roadway lighting, driveways, nearby railroad crossings, distance to nearest traffic control signals, utility poles and fixtures, and adjacent land use.

7. A collision diagram showing crash experience by type, location, direction of movement, severity, weather, time of day, date, and day of week for at least 1 year.

The following data, which are desirable for a more precise understanding of the operation of the intersection, may be obtained during the periods specified in item 2 of the preceding paragraph:

1. Vehicle-hours of stopped time delay determined separately for each approach.

2. The number and distribution of acceptable gaps in vehicular traffic on the major street for entrance from the minor street.

3. The posted or statutory speed limit or the 85th-percentile speed on controlled approaches at a point near to the intersection but unaffected by the control.

4. Pedestrian delay time for at least two 30 minute peak pedestrian delay periods of an average weekday or like periods of a Saturday or Sunday.

5. Queue length on stop-controlled approaches.

It is critical to present the above information in an organized fashion. Mn/DOT makes use of a Signal Justification Report, which contains the following information:

1. Intersection Location: Trunk highway cross-street name and county road numbers, municipality, and county. A map should be included that identifies the site.

2. Type of Work: Type of signal or beacon proposed, whether temporary or permanent.

3. Character of Site: Function and importance of roads, number of lanes, existing and proposed geometrics, channelization, grades, presence or absence of parking, bus stops and routes, posted speed limit, 85th percentile speed if markedly different, and sight distance restrictions.

4. Land Use: Present land use at the intersection, presence of any special traffic generators, proposed or likely future development.

5. Traffic Control: Existing traffic control, present and planned adjacent signals, and proposed or existing coordinated systems.

6. Actual Traffic Volumes at the Intersection: Volumes must include at least 16 hours of counts on all approaches, turning movement counts for at least a.m. and p.m. peak hours. Unusual numbers of heavy vehicles and unusual percentages of turning movements must be noted. Volumes shall have been counted within two years of the date of submission of the report.

7. Iowa DOT generated or approved volume estimates for a proposed intersection, such as found in an official TAM or SPAR report, and for which warrant estimation methods are acceptable.

8. Pedestrian counts, particularly if the intersection is a school crossing or is used by large numbers of elderly or handicapped pedestrians.

9. Crash Data: Number and general types of crashes which have occurred for a minimum of 12 months before the date of the report. If Warrant 7 for crash experience is addressed, a collision diagram must be included, showing crashes by type, location in the intersection, directions of movement, severity, date, time of day, weather, light, and roadway conditions.

10. Any special site conditions adding to the Engineer's judgment that signals are necessary.

The above information can be presented in either checklist or narrative form, so long as it is clearly and logically presented. Volumes can be presented in graph or tabular form.

Mn/DOT's Section 9-4.02.04 signal justification also provides a section on "Signal Removal Justification Criteria."

C. Warrants

MUTCD Section 4C.01 "Studies and Factors for Justifying Traffic Control Signals" states, "An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.

The investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants and other factors related to existing operation and safety at the study location:

Section 4C.01 Studies and Factors for Justifying Traffic Control Signals
Section 4C.02 Warrant 1, Eight-Hour Vehicular Volume
Section 4C.03 Warrant 2, Four-Hour Vehicular Volume
Section 4C.04 Warrant 3, Peak Hour
Section 4C.05 Warrant 4, Pedestrian Volume
Section 4C.06 Warrant 5, School Crossing
Section 4C.07 Warrant 6, Coordinated Signal System
Section 4C.08 Warrant 7, Crash Experience - modified by FHWA Interim Approval IA-19 (2/24/2017)
Section 4C.09 Warrant 8, Roadway Network

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal."

Accompanying MUTCD figures and tables for the above warrants include:

Table 4C-1 Warrant 1, Eight-Hour Vehicular Volume
Figure 4C-1 Warrant 2, Four-Hour Vehicular Volume
Figure 4C-2 Warrant 2, Four-Hour Vehicular Volume (70% Factor)
Figure 4C-3 Warrant 3, Peak Hour
Figure 4C-4 Warrant 3, Peak Hour (70% Factor)

Mn/DOT's Traffic Signal Design Manual Section 9-4.02 provides additional guidance for the following:

- Section 9-4.02.02 Warrants for Flashing Beacons at Intersections
- Section 9-4.02.03 Advance Warning Flashers Consideration