611 TRAFFIC SIGNAL NEEDS STUDIES

A request for a traffic signal can be initiated from within ADOT, a local government, or a an individual Arizona citizen. The request can be for a new traffic signal or for modifications to an existing signal, such as the addition of left-turn phasing.

The requests will be reviewed by The Operational Traffic and Safety Engineer or designee and a determination will be made as to whether or not the request is moved to the formal study request or not. The determination will be based on whether or not the location is a potential candidate for signalization and may be based on some of or all of the following factors: potential signal spacing, traffic volumes, alternative access routes, crash history, less restrictive and/or less costly alternatives, as well as the likelihood that a signal could improve the overall operation of the intersection and the affected transportation system.
The overall objective of traffic signal control is to provide an equitable balance of safe and efficient movements of traffic and pedestrian volumes through a given intersection. Although most of the steps in conducting a traffic signal needs study are quantitative, the final determination of recommending whether traffic signal controls should be provided at a particular location involves a qualitative assessment which requires engineering judgment.

It must be remembered that one may trade one type of collision for another when a traffic signal is installed. One can expect that the number of angle collisions will be reduced; however, since traffic on the main street will now be required to stop, the probability of rear-end collisions occurring increases dramatically. Therefore, during the study, a detailed analysis should be made of the collisions which have occurred. The collision analysis should include at least three years of data to ensure that collision patterns can be differentiated from sporadic or random collision patterns of short duration.

If a location being studied satisfies one or more of the MUTCD warrant(s), less restrictive alternatives shall be considered.

Some of the less restrictive remedies that should be considered are:

A. Geometric improvements including but not limited to roundabouts, channelization, access control, cross access, and addition of turn lanes either by construction or by restriping the existing roadway cross section;

B. Remove or mitigate sight obstruction to increase intersection sight distance;

C. Street lighting if nighttime crashes are predominant; and

D. Improved signing and pavement markings to better define the intersection and its operational characteristics.

A traffic signal needs study shall be conducted to determine if a traffic signal should be provided at a particular location. The signal needs study should include a comprehensive investigation of traffic conditions and the physical characteristics of the location. Include the following data and/or analyses in the study as appropriate to the specific situation:

A. A signal warrant analysis (required)

B. A turning movement count which includes all entering traffic volumes and movement direction, AM, mid-day and PM peak hour traffic volumes and movement direction, and pedestrian volumes; the percentage of trucks and buses should be considered where appropriate. A 24-hour turning movement count should be obtained by applying factors of 1.35 and 1.20 to 12 or 16 hours, respectively, of turning movement count data collected in the field.

C. A traffic collision study including a summary by type and severity with a collision diagram.

D. A condition diagram which includes roadway geometrics, parking, driveways, sidewalks, signing, pavement markings, development of intersection quadrants, and any other features pertinent to the study.

E. A peak hour delay study

F. Approach speed limits and/or approach speeds

G. Analysis of the existing progression in a coordinated system ()

H. A capacity analysis as approved by the Regional Traffic Engineer.

I. Traffic volume projections for new roadways (see Figure 611-A)

J. Proximity to other signals, power, and maintenance facilities,

K. Consideration of life cycle costs.

L. Other data which are desirable for a more precise understanding of the operation of the intersection

M. Projections may be used to determine possible mitigation for a project (capital, development, etc.) and for preparing a location for possible future signalization.

N. However, signalization should be approved based on actual conditions based on actual counts and observations. This would typically include a signal warrant analysis per the MUTDC based on actual field conditions. Any exception would need to be approved by the operational and safety engineer**.**

O. Once a traffic signal is recommended by a study, the safety and capacity of the intersection should be considered in the design in order to maximize signal timing flexibility and reduce any impacts to the state highway system and the major travel movements. For example all minor street approaches should be laid out to avoid split phasing, have a minimum of three approach lanes and right turn

bays and for T intersections side streets should consider dual LT to reduce green time allocation for the minor street.

Figure 611-A. Traffic Volume Projections For New Roadways

On new roadways scheduled for construction, it is occasionally necessary to project signal warrants to determine whether signals should be considered for inclusion in the initial construction project. There is a simple approach to projecting signal volume warrants. The following steps provide a solid, although theoretical, basis for deciding whether or not signals should be incorporated in the design:

A. Obtain a traffic projection from the Multimodal Planning Division or from any other reliable source of data, for three years beyond the anticipated completion of construction.

B. Determine whether full warrant or 70 percent warrants are appropriate for the location.

C. Multiply the projected AADT by 5.72 percent.[1] The resultant volumes are reasonable approximations of the eighth highest hourly volumes; thus, if the calculated volumes exceed the warrant values, the location could technically be considered for signalization.

D. To fill in a "Projected Volumes" warrant sheet, multiply the projected AADT by the following factors:

High Hour	Hourly Adjustment Factor[2]
1	.0771
4	.0656
8	.0572

1. Pignataro, Louis J., Traffic Engineering, (Prentice-Hall, Englewood Cliffs), 1973, page 158.
2. Ibid.

Video recording and photography of the study location is recommended for future reference, evaluation, interpretation, and for an archive of the intersection.

When conducting a traffic signal warrant analysis, the number of lanes on each approach should normally be considered as the number of through traffic lanes, excluding left turn and right turn lanes, except at T-intersections.

For a minor street approach with one through lane plus a left-turn lane, engineering judgment would indicate that it should be considered a one-lane approach if the traffic using the left-turn lane is minor. In such a case, judgment would also indicate that only the volume of traffic in the through/right-turn lane should be considered against the volume warrants. Conversely, it would be considered as a two-lane approach if the lane split is approximately 50/50.

The ability of traffic to make right turns on red, without right-of-way assignment, may reduce the benefit realized from a traffic signal if one is installed. Therefore, the effect of right turn vehicles from minor street approaches should be considered when volume warrants are being applied. Engineering judgment should be used to determine what portion, if any, of the right turn traffic can be subtracted from the higher-volume minor street traffic count.

The following guide should be used to reduce the number of right-turning vehicles per hour on minor street approaches:

The adjusted right turn volume equals the total right turn volume minus the right turn volume experiencing a stopped-delay measurement of five seconds or less on the higher volume minor street approach:

$$\text{adjusted right turn vol.} = (\text{total right turn vol.}) - (\text{right turn vol. w/ delay of 10 secs. or less})$$

The reduction factor for the peak hour may be applied to both minor street approaches for the remaining hours of the turning movement count:

$$\text{reduction factor} = \frac{\text{(adjusted right turn volume)}}{\text{(total right turn volume)}}$$

The signal needs study should take into account all relevant factors and not just the signal warrants alone in determining the justification for a traffic signal. The fact that a location numerically meets a signal warrant does not necessarily mean that a signal is justified. For instance, a location may meet the minimum volume warrant, but, because of a heavy right-turn movement, vehicles on the minor street may experience very little delay and may not really need a traffic signal.

If a traffic signal is justified, the signal needs study should include an analysis of the need for and the location of pedestrian signals, pedestrian push-buttons, and marked crosswalks.

If a traffic signal is justified, the signal needs study should include what type of geometric improvements, if any, are required prior to installing a traffic signal.

The signal needs study should indicate who prepared and who approved the study. Typical examples of signal needs studies may be obtained from the Operational Traffic and Safety Group.

The signal needs study shall be prepared under the guidance of a registered professional engineer and shall be sealed. For installation consideration, the study shall be submitted to the Operational Traffic and Safety Group.