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16. Abstract This report describes a 15-month project conducted for the Texas Department of Transportation (TxDOT) to evaluate various considerations for inclusion into the traffic signal warranting procedure. Researchers conducted several research tasks including surveys of TxDOT, other state DOTs, and city engineers. Analyses were also conducted to investigate the feasibility of incorporating heavy vehicle factors into the warranting analysis procedure. Other considerations that were addressed include accident severity and exceptions to the warrants similar to the emergency-traffic signal. The project developed guidelines for conducting traffic signal warrant analyses. Adoption of the guidelines by TxDOT will provide clarification of the language that makes up the warrants. Additionally, the guidelines will help improve the consistency with which the warrants are used.			
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Project Summary Report 3991-S

Project 7-3991: Evaluation of Potential Traffic Signal Warrant Considerations

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## Traffic Signal Warrants

Traffic signals are a highly visible and important element of the roadway transportation network. They are often seen by the public and elected officials as a cure-all for operational and safety problems at intersections. At other times, signals are viewed as a hindrance to movement, as exemplified by the commonly used name "stop lights." The reality is that the traffic signal represents one of the most restrictive forms of right-of-way control at an intersection. Traffic signals should not be installed unless the advantages to be gained from the signal will outweigh the disadvantages.

In order to ensure that the advantages outweigh the disadvantages, that there is sufficient justification for a traffic signal, and to provide some consistency in the application of traffic signals, a series of warrants has been developed to define the *minimum* conditions under which further consideration of a traffic signal is appropriate. Simply meeting the warranting criteria does not mean that a signal is justified at a given location. There are many factors that impact the effectiveness of a signal, and all should be evaluated before a decision to install a signal is made. However, failure to meet any of the warranting criteria indicates that a traffic signal should not be installed, as there should be a better way of addressing the problems or needs at that location. Furthermore, if an existing traffic signal no longer meets any of the warrants, the Texas MUTCD states that it should not continue to operate.

The research addressed in this TxDOT project had, as its origin, a fatal accident involving a school bus and another vehicle. As a result of this accident, a government official requested that TxDOT consider the inclusion of school buses and fatal accidents in the warranting process.

The research objectives for this project were to

1. determine if, and possibly how, heavy vehicle considerations can be incorporated into existing traffic signal warrants or as part of a new warrant;
2. coordinate research efforts with the NCHRP Project 17-16 *Accident Warrant for Traffic Signals* research team with respect to accident severity issues, to provide an initial assessment of accident severity issues, and to provide an update to Project 17-16 at the termination of this project;
3. identify concerns about emergency signal installations at locations not clearly defined in the MUTCD; and
4. develop an additional document that will be used by engineers throughout the department to provide more consistency in the warranting analysis procedures.

**What We Did...**

The researchers performed a literature review of the relevant material and administered a statewide and nationwide survey of transportation agencies regarding traffic signal warranting practices. Using highway capacity analyses techniques, the researchers analyzed the sensitivity of warranting vehicle volume thresholds when heavy vehicles are considered. These activities and the subsequent findings are documented in Report 3991-1, *Evaluation of Potential Traffic Signal Warrant Considerations*.

In its role of maintaining the MUTCD, the FHWA is responsible for responding to questions and requests regarding the MUTCD as described in Section 1A-6 of the 1988 National MUTCD. FHWA has been fulfilling this responsibility since the early 1970s, and there have been numerous previous interpretations related to traffic signal warrants. The researchers combined these official interpretations and the results of the activities associated with Report 3991-1 into a document designed to provide more consistency in the warranting analysis procedures throughout the state. This document is Report 3991-2, *Guidelines for Conducting a Traffic Signal Warrant Analysis*.

## What We Found...

We learned that the Minimum Volume Warrant (warrant 1) is the most commonly used warrant to justify signalization. During the time period from 1995 to 1997, TxDOT used this warrant 28 percent of the time. Other state DOTs and cities used this warrant 44 and 36 percent of the time, respectively. Additional warrant usage is documented in Report 3991-1.

A section of the survey addressed the adequacy of the current traffic signal warrants. Slightly over half of the responding engineers feel that the current warrants do not need to be modified. Furthermore, most feel that no new warrants are needed. The main concerns conveyed through the comments were that more stringent criteria are needed for the volume based warrants, and that the Accident Experience Warrant needs to be modified.

For the volume levels contained in the current signal warrants, heavy vehicles do not impact intersection operations significantly. The analyses are shown in Report 3991-1.

The National Cooperative Highway Research Agency (NCHRP) has been funding Project 17-16, *Accident Warrant for Traffic Signals*. The objectives of this project are to develop an improved accident warrant for traffic signals and to provide a model(s) to estimate the safety impacts of installing or removing traffic signals. The project completion date is estimated to be June 2001.

Specific emergency signal concerns related to this project dealt with non-signalized intersections at hazardous chemical plants (common along the Gulf Coast), industrial parks, and military bases where the cargo is sometimes unknown but potentially hazardous. The engineers who returned surveys were split on this issue. About half felt that considerations may be necessary for other conditions, while the other half felt that emergency signals are meant to provide travel time benefits to emergency vehicles and, as such, no further provisions should be considered. Additionally, some engineers expressed concerns that at locations such as chemical plants, industrial parks, and military bases, if volumes do not meet warrants such as the Peak Hour Volume Warrant, then consideration of these locations would be adding exceptions to the warrants and increasing the complexity in terms of application.

## Researchers Recommend...

The results of this project show that there is no need to account for heavy vehicles when conducting traffic signal analyses. At the threshold volumes of the warrants, heavy vehicle percentages up to 20 percent do not significantly affect the warranting results. Heavy vehicles do have a significant impact at higher volumes, but the volumes are so high that the intersection would have met one or more warrants based on passenger cars alone.

Those districts that are conducting counts for warranting analyses by obtaining axle counts and dividing by two are effectively lowering the warrant volume thresholds. Many complaints were received from the districts indicating that the current volume thresholds were too easily satisfied. This procedure for determining vehicle counts should be discontinued as funds are available to update the counting equipment to include equipment that can count and classify. An alternative that may be viable until updated equipment can be purchased is to perform manual counts.

No changes should be made to the way accidents are evaluated in terms of warranting criteria until NCHRP Project 17-16 is completed and reviewed.

Sound engineering judgement is a prerequisite for any transportation official conducting signal warrant analyses. Additional requirements include a thorough knowledge of the warranting procedures as well as interpretations of the language of the warrants. As such, an additional document has been developed as part of this project that addresses many of the issues that have typically been left to interpretation. This document is titled, *Guidelines for Conducting a Traffic Signal Warrant Analysis*. It is available through the internet at the following address:  
<http://transops.tamu.edu/documents/Report3991-2.pdf>.

## For More Details...

The research is documented in the following two Reports:

- TTI Report 3991-1: *Evaluation of Potential Traffic Signal Warrant Considerations*
- TTI Report 3991-2: *Guidelines for Conducting a Traffic Signal Warrant Analysis*

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### TxDOT Implementation Status 2000

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This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the U.S. Department of Transportation, Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the TxDOT or the FHWA. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. This report was prepared by Paul J. Carlson, P.E. (TX-85402).