



Project Summary Report O-5002-S

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Project O-5002: Cost Effective Technologies for Advance Detection at Signalized Intersections

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Cost-Effective Technologies for Advance Detection

PROJECT SUMMARY REPORT

Numerous projects sponsored by the Texas Department of Transportation (TxDOT) have developed strategies to improve signal operations and safety at isolated signalized intersections. These strategies include Detection Control System (DC-S), Platoon Identification Algorithm (PIA), and Advance Warning of End of Green System (AWEGS). These projects have shown significant potential to TxDOT for improving safety while maintaining efficient signal operations. TxDOT has started implementing some of these strategies at various locations.

A critical component of these strategies is advance detection, which is typically located between 850 feet and 1200 feet from the intersection. Advance intersection control strategies so far have been installing inductive loops with wire-

line communication for advance detection. However, the cost of installation of these advance detectors is a significant component of the cost of installation of the advance strategies. This project investigated off-the-shelf technologies to provide advance detection in a cost-effective manner. These technologies include both detection and wireless technology.

What We Did...

Texas Transportation Institute (TTI) researchers selected detection and communication devices to be tested in this project. These devices included installing additional inductive loops, Road Runner detectors, Traficon video detectors, SAS-1 acoustic detector, and Wavetronix radar detector. Two types of wireless systems were configured. These systems included the contact closure radios and serial radios. Contact closure radio was installed to transmit the actuation

from the newly installed inductive loops at the test bed. The intersection of SH 6 and FM 185 in Waco was selected as the test bed for this project. Researchers selected this intersection because it is one of the locations where AWEGS is operational. AWEGS advance detectors served as the baseline detection system for comparing and evaluating alternative detection systems. The Waco location has the necessary hardware to log the activity of the detection systems as well as an existing phone line that was used by TTI researchers to download the data files created.

A luminaire pole was purchased and installed on the northbound approach to the intersection. The Traficon video detection camera, the SAS-1 detector, the Wavetronix detectors, and the antennas for the radios as well as the SAS-1 detector were installed on the luminaire pole. A solar power system was designed



and installed near the right-of-way line. A cabinet housing the radio equipment and the detector amplifiers was installed on the solar power system pole. Detectors and wireless systems were installed with extensive assistance from the technicians from the Waco District. Figure 1 and Figure 2 illustrate the layout at the test bed.

Data were collected for each of the detector systems installed and compared to data from the baseline system. TTI researchers developed numerous data collection applications as well as data reduction tools to facilitate the comparison with the baseline system.

What We Found...

An analysis of the data collected showed that the inductive loops using contact closure radios were very accurate in counts, vehicle classification, and speeds. The Traficon video detector was very accurate in counts and in estimating vehicle length during daytime. However, in the absence of ambient lighting, counts and vehicle lengths were not very accurate. Vehicle speeds, however, were very accurate during both daytime and nighttime. The SAS-1 detector measures vehicle speed and length and emulates a pair of contact closure actuations.

Current signal controllers can accept only contact closures. However, the SAS-1 detector's results in the contact closure format were not very accurate. The Road Runner detector did not provide satisfactory performance in any of the multiple configurations suggested by the vendor. The Wavetronix detector was found to not provide any vehicle length or identification of vehicles on a lane-by-lane basis.

Table 1 summarizes the ratings of the detection systems evaluated in this project for daytime and nighttime performance.

Researchers estimated the cost of individual systems and found that, while traditional inductive

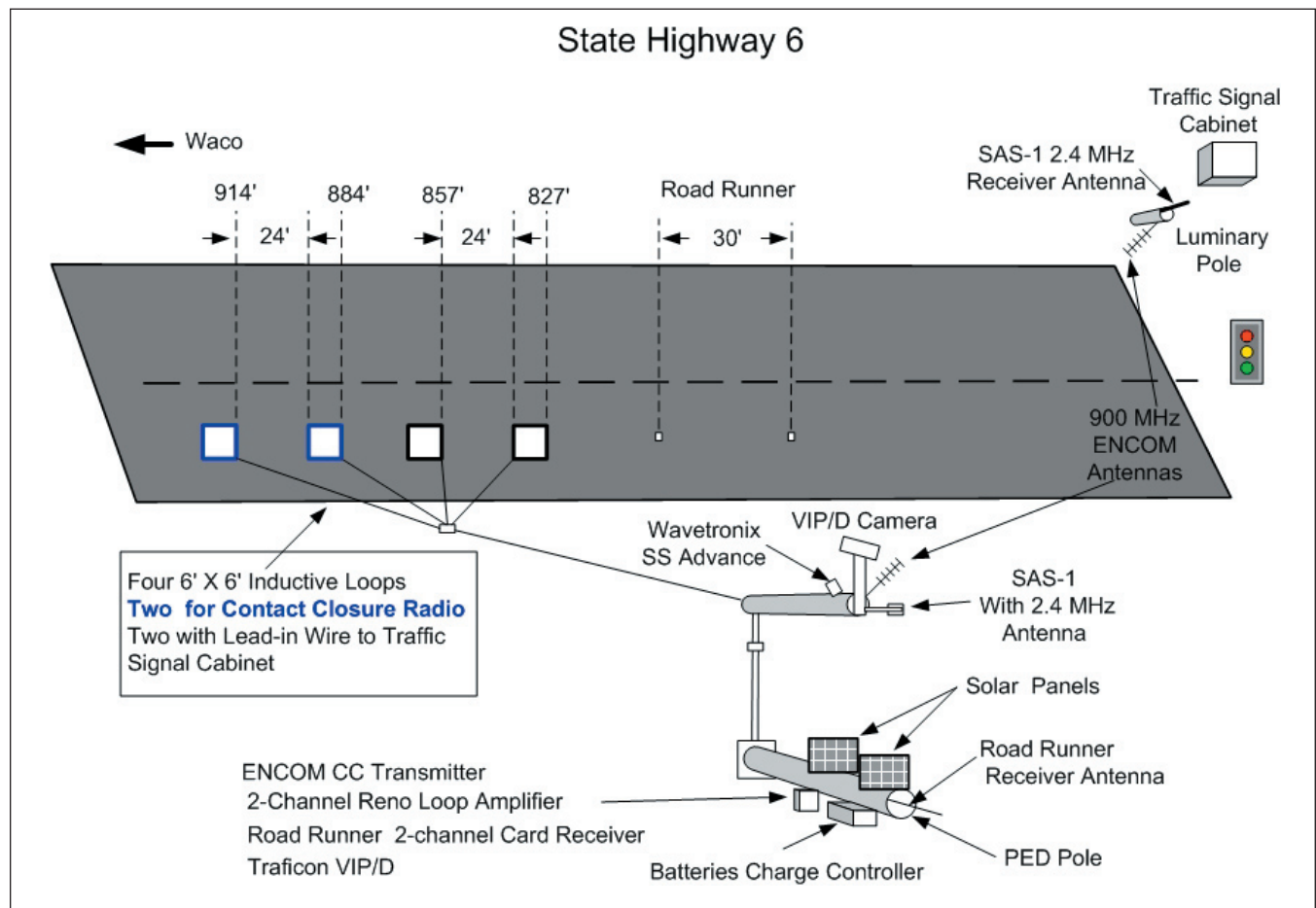


Figure 1. Layout of the Detection Systems in Waco.



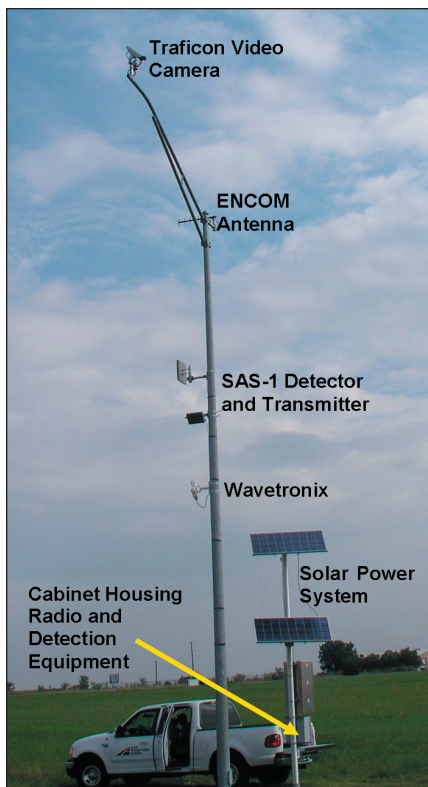


Figure 2. Detector and Communication Equipment Installed at the Test Bed.

loops cost less than alternative detection systems for a single-lane approach, the costs for all the systems were very close to each other for a two-lane approach. Alternative detection systems become cost-effective under a combination of the following conditions:

- larger number of approach lanes,
- advance detectors located greater than 1000 feet from the intersection, and
- available power at the detector station.

The Researchers Recommend...

Researchers recommend installing nighttime lighting when using Traficon video detectors. Ambient light

can significantly improve the accuracy of the detector at nighttime. Researchers also recommend requesting the makers of the SAS-1 detector to provide speeds and vehicle lengths for each vehicle. Currently this information is provided in a binned fashion. Finally, researchers recommend that engineers consider the life-cycle cost of the detection systems and not only the installation costs. Typically inductive loops have higher life-cycle costs than non-intrusive detectors. These include the costs in delays to the motorists during installation and maintenance. These factors should influence the selection of detection systems for advance detection at signalized intersections.

Table 1. Summary of Detection Systems (Daytime/Nighttime).

Systems	Counts	Classification	Speed	Total Cost		Comments
				Elect.	Solar	
Baseline—Inductive Loop Detectors (ILD)	●/●	●/●	●/●	●	●	Performs very well. With long lead-in wire, system can get expensive and can have some errors.
ILD with Contact Closure Radio	●/●	●/●	●/●	●	●	More accurate detection with lower maintenance cost due to no lead-in wire.
Road Runners	●/●	●/●	●/●	○	○	Not useful due to inaccurate performance.
Traficon—Video	●/○	●/○	●/●	●	●	Need ambient light for nighttime operations.
SAS-1—Acoustic	○/○	○/○	●/●	●	●	Evaluate the sensor when it has the capability to provide individual vehicle speed and length.
SmartSensor—Radar	N/A	N/A	N/A	○	○	Sensor does not classify by lane and also does not measure vehicle length.

● Excellent ● Good ○ Average ● Below Average ● Bad

Note: Table rates the detection systems for daytime/nighttime operations.



For More Details...

The research is documented in Report 0-5002-1, *Evaluation of Cost-Effective Technologies for Advance Detection*.

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