APPENDIX D
Minnesota Guidestar Field Test of Non-Intrusive Technologies
Summary Findings

SUMMARY OF FINDINGS

Most devices retain a high degree of accuracy regardless of traffic volume levels, but the radar device in lane two shows a slight tendency to undercount vehicles during heavy volume time periods. Video device A shows a tendency to overcount vehicles over a wide range of volume levels. Video device B, on the other hand, shows a tendency to undercount vehicles over a wide range of volume levels. Closer inspection of the data from these two devices reveals a relationship between this miscounting and the time of day. At around sunset each day, video device B was observed to undercount vehicles and video device A to overcount. The period of miscounting extended from sunset (about 9 p.m.) to midnight each evening. Video devices A, B and C are operating with relative accuracy throughout the day but video devices A and B miscount after sunset. Video device C was unaffected by the time of day. Observations during these periods found video devices to miscount vehicles in several different ways. Sometimes both the headlight and the headlight's reflection off the pavement was counted.

On June 6, 1996 there was a very heavy rainfall with 1.25 inches failing between 4 p.m. and 5 p.m. With one exception, none of the devices were affected by the rainfall. The only exception was the radar device which undercounted during the period. The impact of rain on the radar device is difficult to identify. There was a splice in the device's cable that may have been affected by the moisture.

In 24-hour Test, some changes to the device mounting locations were made. The video cameras for video devices A, B, and C were moved from the Penn Avenue Bridge to a sidefire pole located in the freeway median 6 feet from lane one and at a height of about 40 feet. This move was requested by two of the video vendors to provide a higher mounting location. The radar device remained on the sidefire pole located 100 feet from the freeway; the passive magnetic devices remained in the conduits under the freeway; and the rest of the devices remained on the Penn Avenue Bridge.

The results from 24-hour Test are very similar to the second 24-hour test. The notable exceptions are video devices A, B, and C, which were moved from the bridge to the median pole. After the move, the amount of variation seen in the scatter plots was noticeably reduced. This is most likely due to the higher mounting location which provides the cameras with an improved view of the roadway. At a higher mounting location there is less occlusion and vehicles can be tracked within the field of view for a longer period of time. From the sidefire pole location vehicles are being detected as they travel toward the camera. When mounted on the bridge they faced traffic traveling away from the camera. One of the video vendors felt this would improve performance, another was indifferent and the third felt this would worsen performance.

CONTINUOUS TEST

In Continuous Test, most of the devices were moved to the intersection. In addition, the following three devices were added to the test: a new pulse ultrasonic (B), a second passive infrared (B), and a second passive acoustic.

The following changes were made for Continuous Test numbers 6 and 7:

1. The video cameras for video devices A, B, and C were moved to the intersection on a traffic signal pole near the trailer to observe traffic in the two northbound lanes from a height of about 33 feet.

2. The pulse ultrasonic A device was moved to the sidefire pole on the eastbound approach at a height of about 1 0 feet.

3. The pulse ultrasonic B device was mounted on the sidefire pole on the northbound approach at a height of about 18 feet.

4. The Doppler microwave A device was moved to the sidefire pole on the eastbound approach at a height of about 22 feet.

5. The Doppler microwave B device was moved to the sidefire pole on the northbound approach at a height of about 21.5 feet.

6. The passive acoustic device was moved to the sidefire pole in the median of the freeway (previously used by the video devices) at a height of about 1 0 feet.

7. A new passive acoustic device was mounted on the sidefire pole on the eastbound approach at a height of about 12 feet.

8. The passive infrared A device was moved to the sidefire pole on the northbound approach at a height of about 15 feet.

9. The passive infrared B device was moved to the sidefire pole on the eastbound approach at a height of about 15 feet.

10. The radar device was moved to a new sidefire pole located on the south side of the freeway about 35 feet from lane two at a height of about 19 feet.

The results from the devices at the intersection are not presented for Continuous Test because they could not be successfully calibrated.

At the freeway test site, the radar device operated more accurately from the new sidefire pole installed for the test. At a distance of 35 feet from lane two the pole is within the vendor's recommended range. The results for lane one improved from undercounting by about 7 percent to undercounting by about 2 percent. In lane two the improvement was from undercounting by 4 percent to undercounting by less than 1 percent.

Also at the freeway site the passive acoustic device operated more accurately from its new sidefire pole location adjacent to lane one. It improved from undercounting by about 9 percent to undercounting by about 4 percent.

In the next test several devices were successfully calibrated at the intersection. The results from devices at the intersection are as follows: the passive acoustic device was found to undercount between 1 and 15 percent, the pulse ultrasonic B device overcount between 0 and 20 percent, the passive infrared B device ranged from undercounting 3 percent to overcounting 4 percent, the video B device ranged from undercounting 16 percent to overcounting 11 percent, and the pulse ultrasonic A device overcounted between 1 0 and 60 percent. During manual observations, pulse ultrasonic A was observed to count most vehicles accurately but occasionally count one vehicle numerous times when it was stopped within the field of view.

At the freeway test site, the radar device was moved from the sidefire pole back to the Penn Avenue Bridge to observe traffic in lane one. From this new location the device consistently undercounted by less than 2 percent.

CLASSIFICATION DATA

During 24-hour Test, classification data was collected at the freeway test site. Baseline classification data is provided by the inductive loops in each lane. The inductive loops were checked against manual observations and found to have an approximate correlation. Since some obvious inaccuracies in the loop length data were observed, the loop data provides only a general guide. The loops classify vehicles based on length only. More accurate baseline classification would require an axle counter, which was not available for this test, or manual classification over the full testing period.

The method used to classify vehicles was found to vary significantly from one device to another. The active infrared device classifies vehicles by height while the rest of the devices and loops classify by length. Some devices have fixed classification definitions while others allow flexibility to create user-defined classifications. These differences made the classification data difficult to compare from one device to another. None of the devices tested counts the number of axles. The number of axles is an important parameter for placing vehicles into the 13 classes used by the Federal Highway Administration.

OBSERVATIONS AND CONCLUSIONS

The results presented are of an interim nature. Additional testing now underway will be used to provide a more detailed analysis of each device's performance.

In general, at the freeway test site the video and passive acoustic device have been found to count within 4 and 10 percent of baseline data while ultrasonic, Doppler microwave, radar, passive magnetic, and passive and active infrared have been found to count within 3 percent of baseline data. Speed measurements from the video devices at the freeway are generally within 8 percent of the

baseline data. Video and radar devices have the advantage of multiple-lane detection from a single unit.

At the intersection test site the results are more varied. The pulse ultrasonic, passive acoustic, and video devices are generally within 10 percent of baseline data while the passive infrared device is within 5 percent.

Future test plans include additional 24-hour and continuous test periods at both the intersection and freeway sites. Those devices that have only been tested at the intersection will be moved to the freeway. New mounting locations will be tried for other devices as time permits.

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