



Project Summary Report 0-4740-S

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Project 0-4740: Improved Quantification of High Occupancy  
Vehicle (HOV) Lane Delay Savings

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## Improved Quantification of High Occupancy Vehicle (HOV) Lane Delay Savings: Summary Report

### PROJECT SUMMARY REPORT

High occupancy vehicle (HOV) lanes are commonly evaluated using travel time studies. These studies are typically conducted infrequently and under non-incident conditions due to the cost and manpower required to conduct manual studies. A literature review did not identify any evaluations of HOV lanes under incident conditions.

Due to the high occurrence of incidents in large urban areas where HOV lanes are more likely to be implemented, travel time studies conducted under non-incident conditions underestimate the true benefit of the HOV lanes. The prevalence of incidents is seen in Houston, where in 2003, an average of only 17 percent of morning peak periods and 10 percent of afternoon peak periods were found to be incident free on a given day on any of the four HOV corridors studied.

### What We Did...

The primary focus of this research was to examine HOV lane travel time savings

for barrier-separated HOV lanes in Houston and HOV lane travel time savings for buffer-separated HOV lanes in Dallas during incident conditions. The goal of the project was to determine the additional benefit provided by HOV lanes during incident conditions. An additional task also looked at the feasibility of opening the HOV lane to mainline traffic during certain mainline incidents.

For the Houston barrier-separated analysis, researchers:

- categorized 9506 incidents in the 2003 Regional Incident Management System (RIMS) database by characteristics such as corridor and direction, cross-section location, severity, number of vehicles, time of day, day of week, etc.;
- created an incident matrix based on extent of lane blockage and duration of incident;
- developed a Travel Time Generator Software program to analyze historical automatic vehicle identification (AVI) data to compute corridor travel times;

- developed selection criteria to identify incidents for further analysis;
- analyzed a total of 341 individual incidents in four HOV lane corridors covering a range of incidents in the incident matrix; and
- quantified the dollar value of HOV lane travel time savings using an entire year of AVI data (minus holidays and two flooding events), which include both incident and non-incident conditions for 2003.

For the Dallas buffer-separated analysis, researchers:

- videotaped 569 peak period incidents on one buffer-separated HOV corridor using Dallas Traffic Management Center cameras;
- categorized these incidents by characteristics such as incident location, direction, time period, cross-section location, longitudinal direction, type of incident, duration, etc.;
- created an incident matrix based on extent of lane blockage and duration of incident;



- acquired corresponding Autoscope speed data and calculated travel times between camera locations; and
- evaluated a limited number of incidents due to unanticipated speed and travel time data limitations.

For the task that studied opening HOV lanes to all traffic during certain mainline incidents, researchers:

- performed a literature review and identified current diversion policies of various HOV operators;
- developed a matrix of 16 scenarios with four variables and analyzed the feasibility of opening HOV lanes to mainline traffic during mainline incidents for each scenario; and
- developed a decision-making tool for in-field agents on whether or not to open the HOV lanes to mainline traffic during certain mainline incidents.

## What We Found...

For the Houston barrier-separated analysis, each of the 341 incidents was analyzed to compare HOV and mainline travel times throughout the peak period, and a series of graphs were produced depicting the travel time savings. Figure 1 shows an example of the HOV and mainline travel times, while Figure 2 shows the HOV travel time savings corresponding to a single incident from the incident matrix.

Averaging data from all 341 incident evaluations showed that HOV lanes provide an additional 74 percent travel time savings during incident conditions over non-incident conditions. The maximum travel time savings during incident conditions

ranged up to 64 minutes in the morning peak period and 49.5 minutes during the afternoon peak period. An analysis of the entire year of 2003 AVI data, which include incident and non-incident conditions, estimated the benefit of Houston HOV lanes in the four corridors analyzed at approximately \$38 million per year. The Katy Freeway HOV lane showed the greatest incident and non-incident delay savings at nearly \$80,000 per day or \$20.5 million per year.

For the Dallas buffer-separated analysis, each incident was

analyzed to compare the HOV and mainline travel times. However, only a few incidents could be analyzed from each matrix cell, a total of 64 incidents. Graphs were produced showing the travel time savings for each general-purpose lane incident. Figure 3 shows an example of the HOV and mainline travel times during a typical incident.

Incidents blocking one or more of the general-purpose lanes showed a maximum additional travel time savings to HOV lane users of 10 minutes per vehicle for incidents with a lane blockage

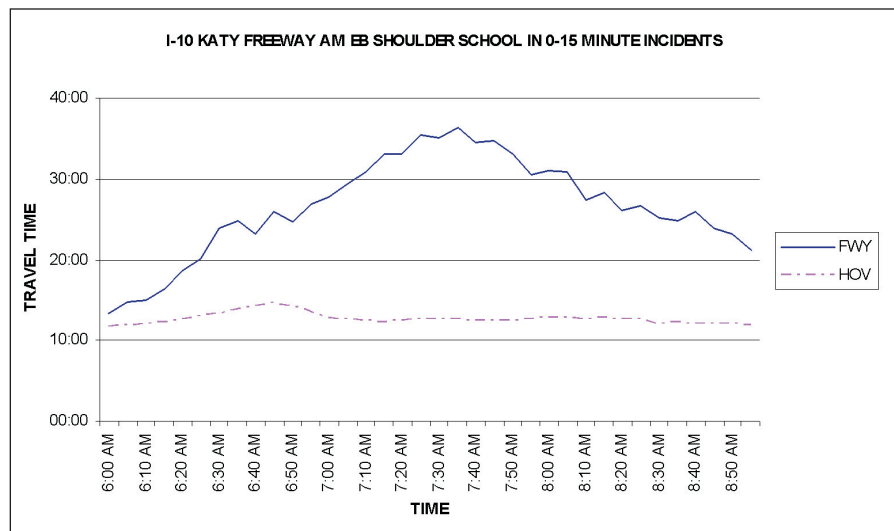


Figure 1. Mainline versus HOV Lane Travel Times.

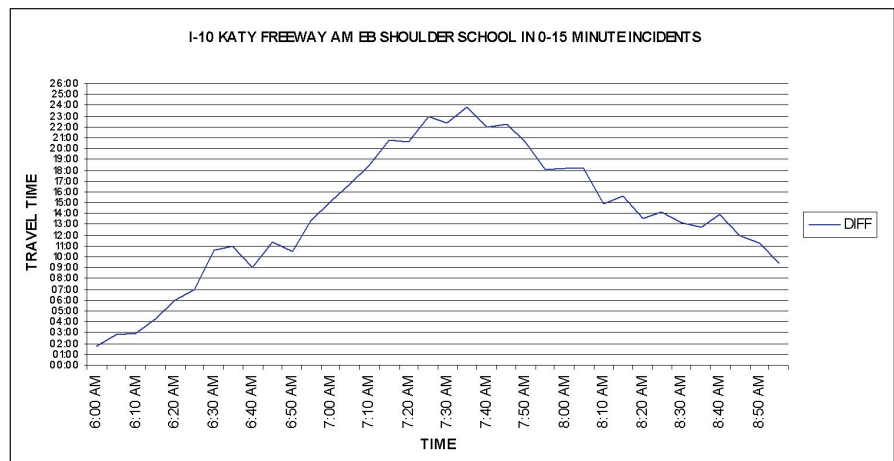


Figure 2. HOV Lane Travel Time Savings.



of nearly one hour. Shorter duration incidents produced less additional travel time savings. Incidents causing the HOV lane to be blocked, due to the incident itself or to responding emergency vehicles, resulted in HOV lane users experiencing at least as much if not more delay than that experienced by general-purpose lane users. An unanticipated result of this research was the observation that during certain mainlane incidents the HOV lane operated effectively until emergency vehicles arrived on the scene.

Of the 16 scenarios explored for opening HOV lanes to mainlane traffic during certain mainlane incidents, only four scenarios showed a positive benefit. All four of these scenarios involved a low level of HOV utilization. Without low HOV volumes, no significant capacity is available for diversion, and the corridor becomes a poor choice for carrying incident-based traffic from the general-purpose lanes. Three of these

four scenarios also involve high incident severity in the mainlanes, implying that the incident will be in place for an extended period of time. A diversion decision in the case of a low-severity incident should be made only when general-purpose lane blockage is likely to be high. In this situation, even if the incident can be cleared relatively quickly, multiple lane blockages may cause residual upstream traffic congestion for an extended period of time.

### The Researchers Recommend...

Based on the results of this research, researchers make the following recommendations:

- This research showed the additional travel time savings HOV lanes provide under incident conditions. Evaluations of HOV lanes should consider the impact of incidents in the analysis, which provides additional travel time

savings to HOV lane users over typical non-incident travel time savings.

- The combined incident matrix results from the barrier-separated analysis in Houston can be utilized as a starting point for estimating the additional travel time savings provided by barrier-separated facilities during incident conditions with given corridor characteristics.
- In Houston, where continuous AVI data are available, HOV benefits based on travel time savings should take advantage of these data as they contain both incident and non-incident speed conditions and more accurately reflect the true benefits of the HOV lanes.
- Several suggestions for incident response techniques on buffer-separated HOV lanes are offered for maintaining HOV lane operation during incident conditions including preferred placement of emergency vehicles in Report 0-4740-2, *Additional High-Occupancy Vehicle Lane Delay Savings Calculated for Incidents on IH-635 (LBJ Freeway) in Dallas, Texas*.
- Agencies that operate HOV lanes need to have procedures in place based on defensible engineering practices for opening HOV lane facilities during certain mainlane incidents.
- The qualitative tool developed by researchers may be used to assist in the evaluation of the appropriateness of diverting general-purpose lane traffic to HOV lanes during certain mainlane incidents.

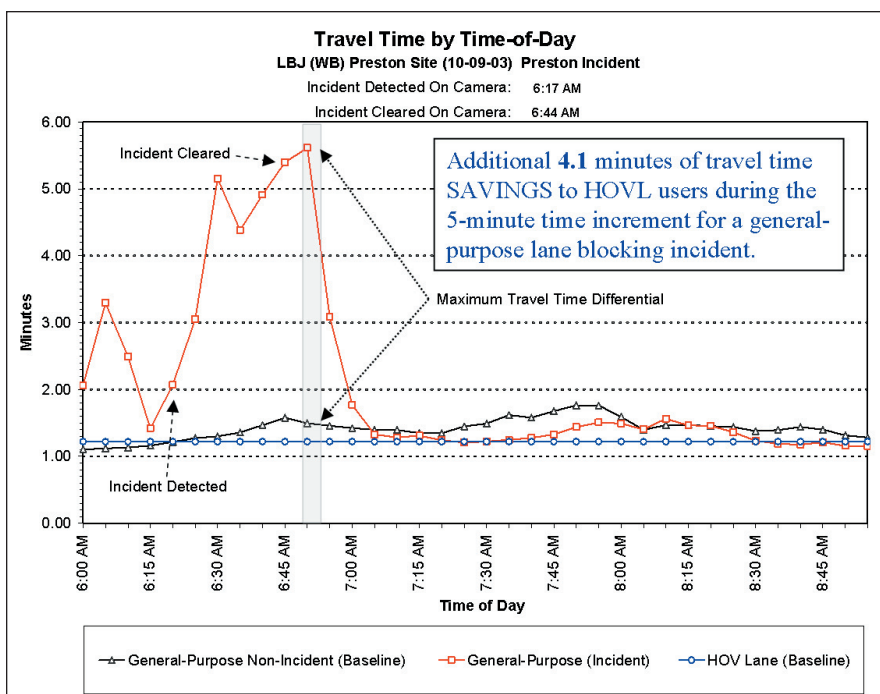


Figure 3. Additional HOV Lane Travel Time Savings.



## For More Details...

This research is documented in:

- Report 0-4740-1, *Quantification of Incident and Non-Incident Travel Time Savings for Barrier-Separated High-Occupancy Vehicle (HOV) Lanes in Houston, Texas*
- Report 0-4740-2, *The Effects of Incidents on Concurrent Flow High Occupancy Vehicle Lane Delay on IH-635 (LBJ Freeway) in Dallas, Texas*
- Report 0-4740-3, *Improved Quantification of High Occupancy Vehicle (HOV) Lane Delay Savings: Year Two Results*

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