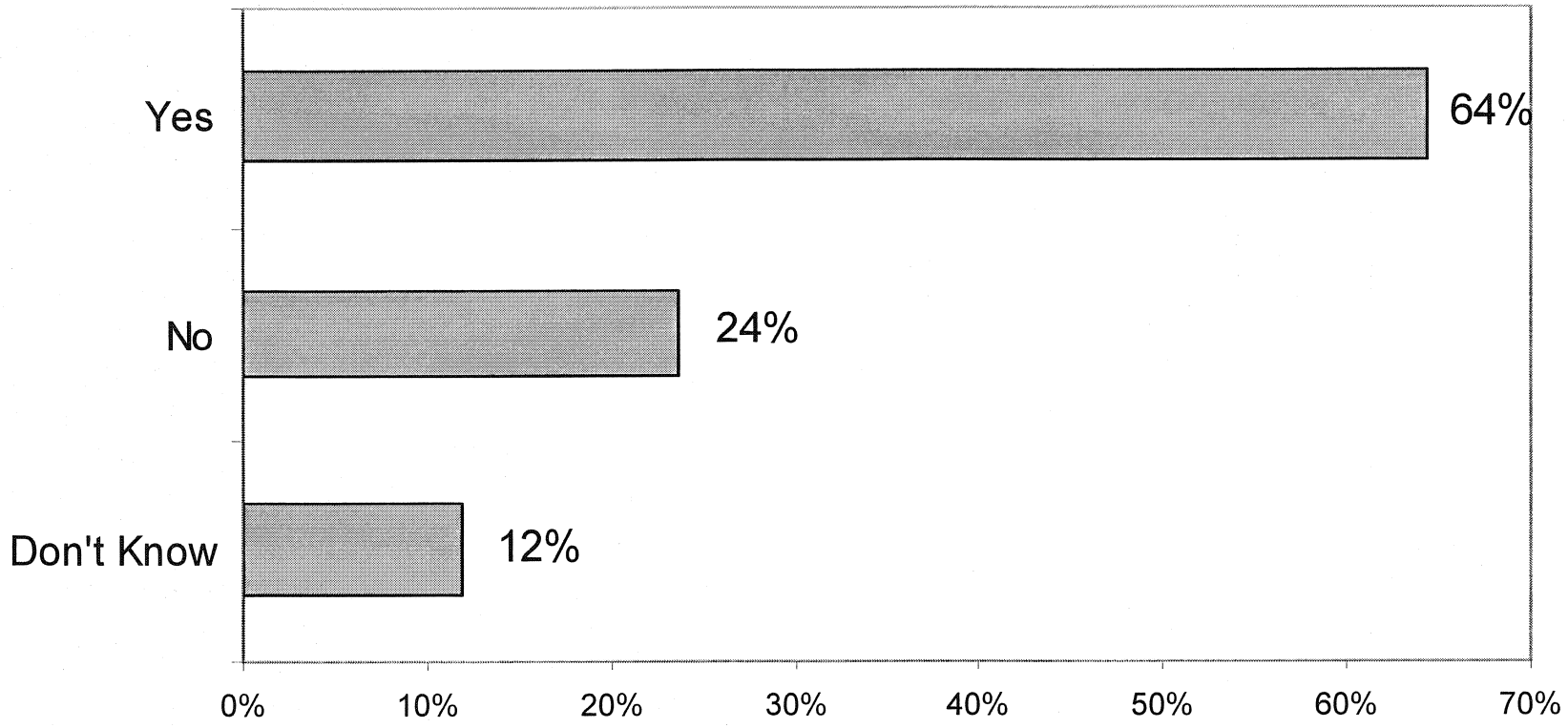
Garden Grove Freeway (State Route 22) Carpool Survey

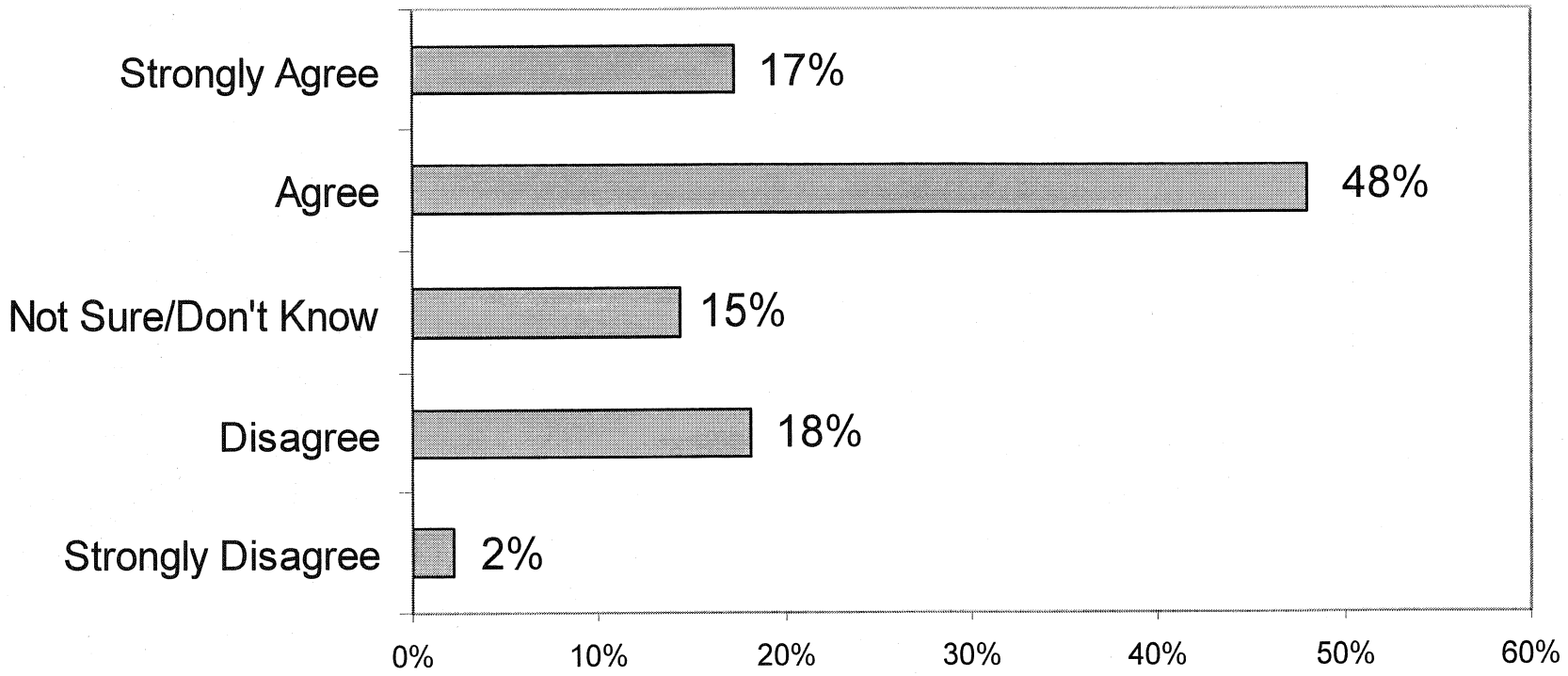
Legislative and Government Affairs/
Public Communications Committee

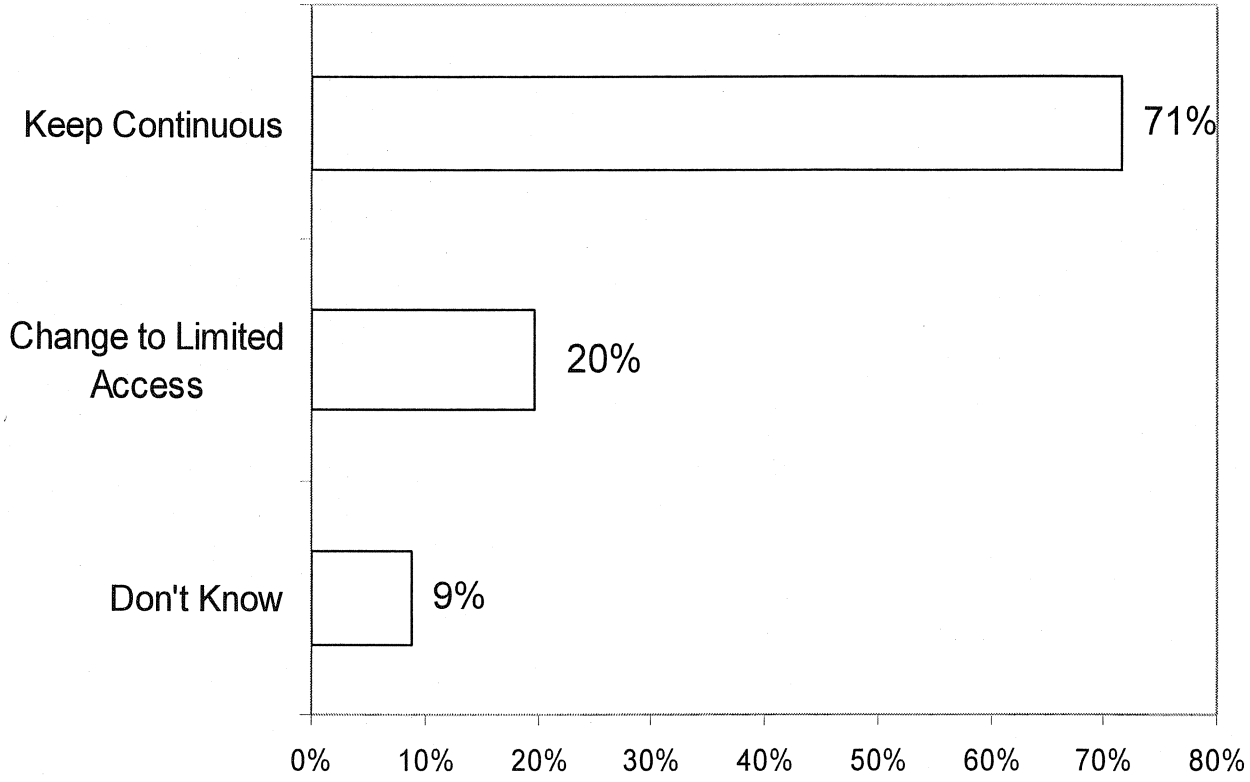
July 19, 2007

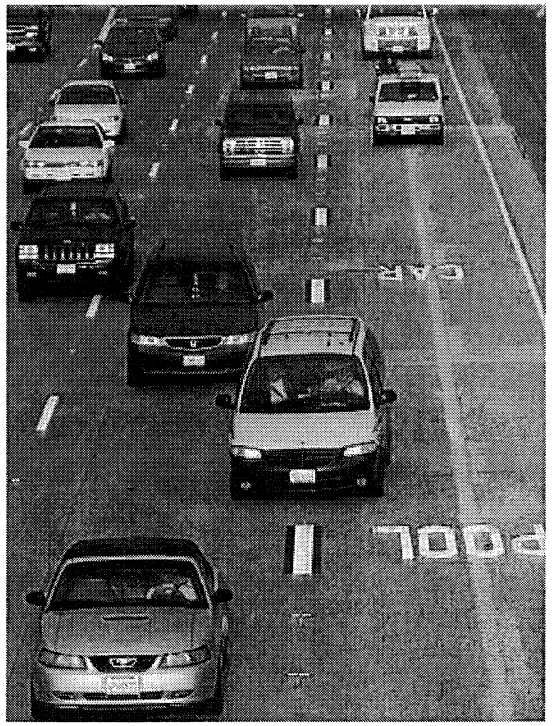
- Survey conducted between April 30 – June 13
- 1,084 households: +/- 3% accuracy at a 95% confidence level
- Sample based geographically
- Linked to origin/destination data

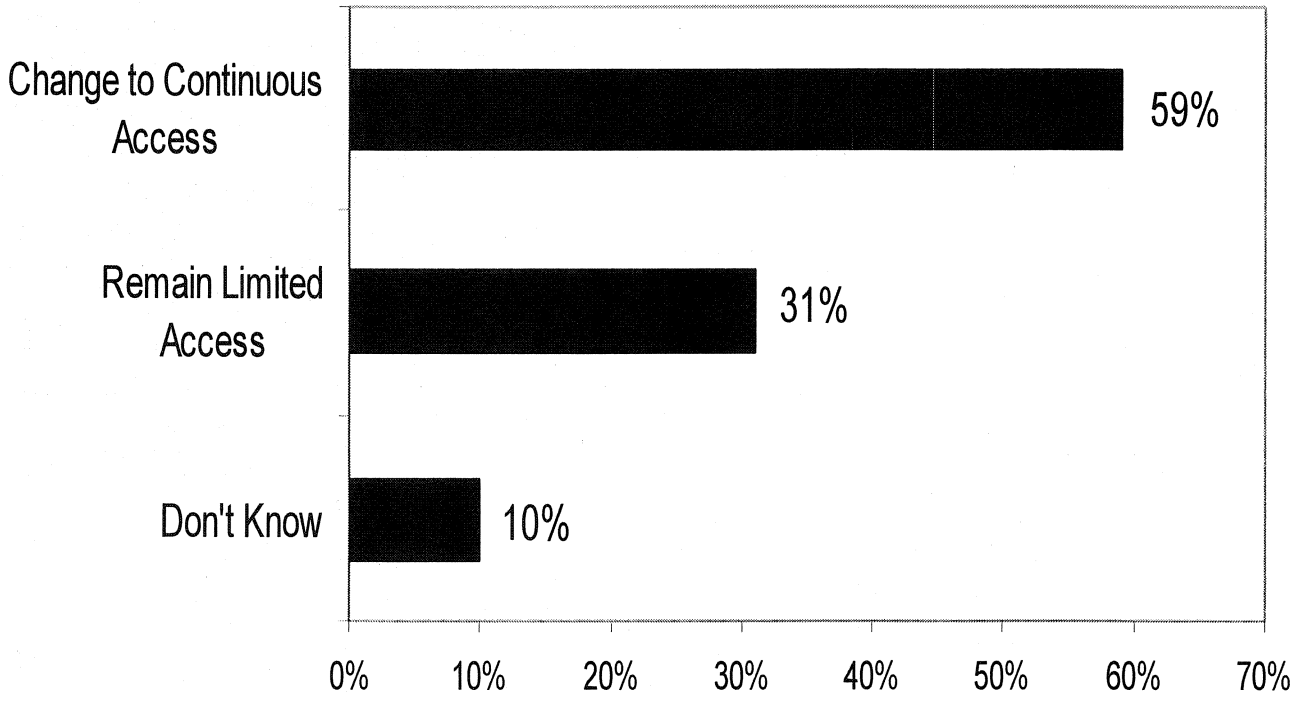
58%	Unaware HOV lanes are continuous access
64%	Believe continuous access improves safety
71%	Support continuous access on SR-22
59%	Support continuous access on other freeways
62%	Support off-peak usage of lanes by all


Yes
64%
No
24%
Don't Know
12%
0%
10%
20%
30%
40%
50%
60%
70%


Strongly Agree
17%
Agree
48%
Not Sure/Don't Know
15%
Disagree
18%
Strongly Disagree
2%
0%
10%
20%
30%
40%
50%
60%

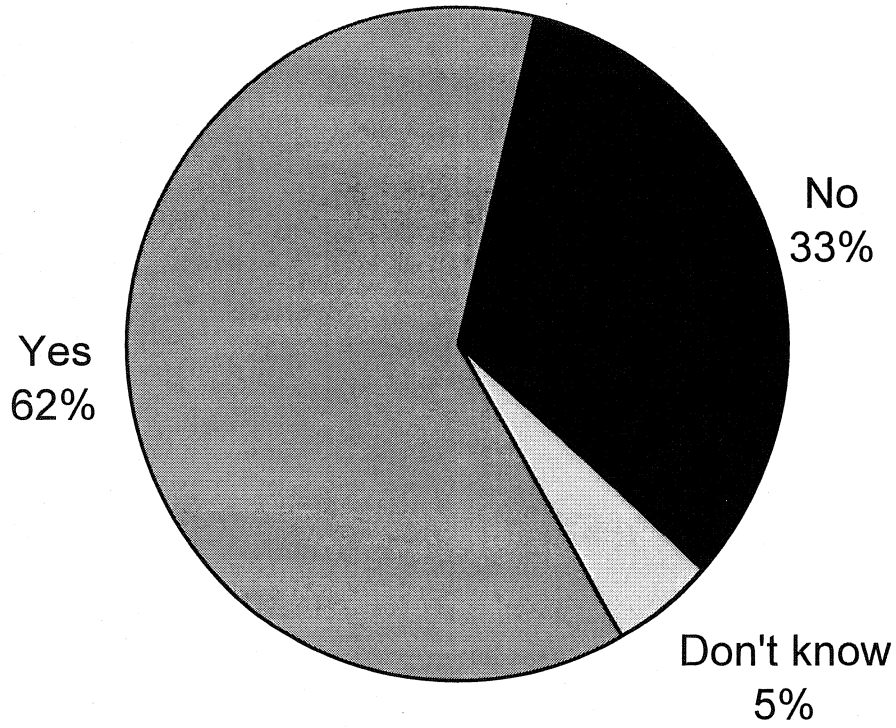

Keep Continuous
71%
Change to Limited Access
20%
Don't Know
9%
0%
10%
20%
30%
40%
50%
60%
70%
80%




Change to Continuous Access
59%
Remain Limited Access
31%
Don't Know
10%
0%
10%
20%
30%
40%
50%
60%
70%


INTERSTATE
5


INTERSTATE
405


No
33%
Yes
62%
Don't know
5%

Respondents

- Gender
- Age
- Ethnicity
- Home Ownership
- Political Orientation
- Travel Mode

Interim Results
Comparing Safety Performance of
Limited Versus Continuous Access HOV Facilities

Task Order 6601

Draft Executive Summary
July 21, 2007

Prepared for:

California Department of Transportation (Caltrans)

Prepared by

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CALIFORNIA PATH

Traffic Safety Center
Setting New Directions in Traffic Safety

Study Objective

High-Occupancy-Vehicle (HOV) lanes have been implemented in many highway segments in urban areas in California, noticeably in the highly-congested areas in Southern and Northern California metropolitan regions. The HOV facilities are aimed at elevating highway utilization effectiveness and ultimately improving overall mobility for the state transportation systems. To facilitate smooth and safe operations of traffic flows typically at relatively higher speeds within the HOV lanes, certain highway segments have utilized buffer[1] zones to separate the HOV traffic streams from the traffic in adjacent lanes ("limited access" HOV lanes).

Under the guiding principle that there is always room for improvement, a goal of the California Department of Transportation (Caltrans) is continuous evaluation and improvement of all facilities. Therefore, there are strong incentives to (a) understand the implications of HOV facilities such as the limited-access buffer zones for traffic flow and safety, and (b) establish supporting criteria and guidelines for selecting configurations to allow effective utilization of HOV facilities and to minimize the occurrence of collisions. A research team at the University of California at Berkeley was funded by Caltrans to compare traffic collision patterns between limited access HOV lanes (Southern California) and continuous access HOV lanes (Northern California). This memo briefly describes the study and the interim results from the first phase of the study which will end in August 2007.

Definitions and Background

Attachment A shows the configuration of limited and continuous access HOV lanes. Limited access HOV lanes have fixed locations of ingress and egress and are separated from other freeway lanes by pavement markings or physical barriers. Limiting access is intended to allow HOV traffic to flow freely and to be separated from congested lower speed traffic in adjoining lanes. However, concerns include possible impacts on traffic maneuvers due to (i) vehicle lane-change concentrated near ingress/egress locations and (ii) extensive vehicle lane changing between freeway ramps and HOV access points within a fixed (often short) distance. Continuous access HOV lanes allow vehicles to enter and exit at any location. In California, limited access HOV lanes are in operation 24 hours a day, 7 days a week, while continuous access HOV lanes are in operation only during peak hours (generally, Monday-Friday 5-9AM, 3-7PM). Therefore, the present comparison is limited to peak hours.

Primary research questions

- Are there differences in collision patterns (collision rates, location of collisions, type of collisions) between freeways having limited versus continuous access HOV lanes?
- Are such differences accounted for by differences in traffic volume or geometric attributes of freeway configurations (such as shoulder width)?

[1] Some facilities utilize an actual barrier between HOV and adjacent lanes. The current study is concerned only with facilities that are buffer-separated, meaning that the separation is indicated by pavement markings. The buffer can vary in width.

Data Sources

- Traffic Accident Surveillance and Analysis System (TASAS) (collisions)
- Highway Performance Monitoring System (HPMS), As-Built Plans, and Satellite maps (freeway characteristics)
- Freeway Performance Measurement System (PeMS) (traffic volume/speed differential)

Statewide HOV Collision Statistics Comparison

A general analysis was conducted using a large sample of HOV lanes which were constructed before 1999 (to allow sufficient time to observe collisions after implementation). The selected routes cover 60%+ of all the existing HOV facilities (as of 2005) (Attachment B). All collisions were used in the analysis (Fatal, Injury, and PDO).

Compared to continuous access, limited access HOV facilities had:

- A higher percentage of total collisions in the HOV and left lanes (43% in limited access versus 33% in continuous access) (Attachment C)
- A higher number of collisions per mile in the HOV and left lanes (3.6 collisions per mile in limited access versus 3.2 collisions per mile in continuous access) (Attachment D)

Detailed HOV Collision Analysis

To understand geometric factors and other features that may impact the distribution of collisions across lanes and collision rates, a detailed analysis was carried out with thirteen HOV facilities recommended by Caltrans Engineers: nine with limited access and four with continuous access HOV lanes (Attachment E). All collisions were used in the analysis (Fatal, Injury, and PDO).

Compared to continuous access, limited access HOV facilities had:

- A higher percentage of total collisions in the HOV and left lanes (40% in limited access versus 32% in continuous access) (Attachment F)
- A slightly higher number of collisions per mile in the HOV and left lanes (3.7 collisions per mile in limited access versus 3.6 collisions per mile in continuous access) (Attachment G)
- Greater severity of collisions in HOV lanes, based on comparison of two limited and two continuous access freeway segments (19.0% of collisions were injury collisions on the limited access, 8.9% were injury collisions on the continuous access). This analysis is being extended to other freeway segments.

These differences were *not* caused by higher traffic volumes or greater speed differential in limited access HOV facilities. In fact, compared to continuous access facilities, limited access facilities had *lower* volumes in HOV lanes and *less* speed differential between HOV and left lanes.

Three additional findings were noted:

First, narrower shoulder width was associated with higher collisions per mile, regardless of whether the facility was limited or continuous access (Attachment H). However, shoulder widths were on the

average similar for limited and continuous access facilities, and shoulder width did *not* account for differences in collision patterns between the two types of HOV facilities.

Second, based on an analysis of four freeway segments during peak hours (two with limited access and two with continuous access HOV lanes), collisions/million vehicle miles traveled (rates) were higher in limited versus continuous access HOV lanes. Notably, for this preliminary analysis, the limited access freeway segments had narrower shoulder widths than the continuous access segments. This analysis is being extended to other freeway segments.

Third, concentrations of collisions were observed in the vicinity of ingress/egress sections of HOV lanes, although concentrations of collisions were also observed at locations that are not adjacent to the access points along the HOV lanes with limited access.

Texas Study of Buffer Separated HOV lanes

The Texas Transportation Institute (TTI) performed a before/after study of limited ingress/egress HOV facilities in two corridors in Dallas (Cooner et al., Project Summary Report [Project 0-4434: Safety Evaluation of HOV Lane Design Elements], "Crash Data Identify Safety Issues for High-Occupancy Vehicle Lanes in Selected Texas Corridors"). The before/after comparison of corridor crash rates on IH-35E North in Dallas showed a 56% increase in injury crash rates after installation of the buffer-separated HOV lanes, while IH-635 experienced a 41 percent increase in injury crash rates after installation of the buffer-separated HOV lanes. Collision patterns for HOV and left lanes were similar to those observed in the Southern California limited access HOV lanes. The authors of the study mentioned several factors that might have contributed to the increased crash risk: speed differential between HOV and general purpose lanes, reduced width of general purpose lanes, loss of the inside shoulder, and difficulty for vehicles in the HOV lane to find gaps when entering the general purpose lanes.

Further Studies—Short Term (July and August)

Several analyses are being conducted in the short-term and will be included in a final draft of the interim report submitted by the end of August of this year (2007). These analyses include:

- Total width (shoulder + lane + buffer)
- Collision rates for four additional routes (two limited access and two continuous access)
- Statistical significance tests

Further Studies—Longer Term (Phase II beginning September 1)

Given the potential importance of these findings for the design of limited access HOV lanes, the research team expects to expand the study in second phase to further the findings from the first phase, to explore the factors that are instrumental in causing the apparent discrepancies of safety performance between limited and continuous access HOV lanes, and, most importantly, to identify

ways to improve design features of HOV facilities, whether limited or continuous access. These analyses include:

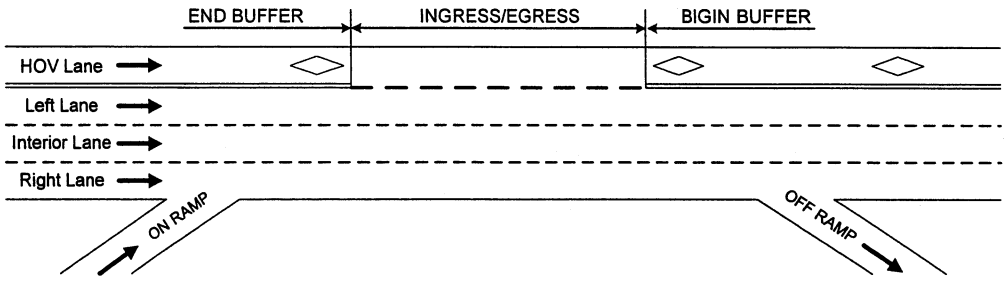
- Detailed location analysis of collisions in both limited access and continuous access HOV facilities will be conducted to determine whether the collisions are taking place at access areas or within the protected length of the HOV lanes, and also, whether collisions are taking place as a result of merging between on-off ramps and HOV access points
- Detailed analysis of the type of collisions in limited versus continuous access HOV lanes
- Detailed lane by lane analysis—this analysis will focus on the lane adjacent to the HOV lane to determine if there are benefits in this lane derived from limited access
- Expanded analyses of rates (number of collisions per VMT)
- Expanded analyses of the impact of congestion (as opposed to traffic volume)
- Analysis of optimal hours of operation for safety and capacity
- Analysis of design features that could improve both limited and continuous access facilities

Conclusion

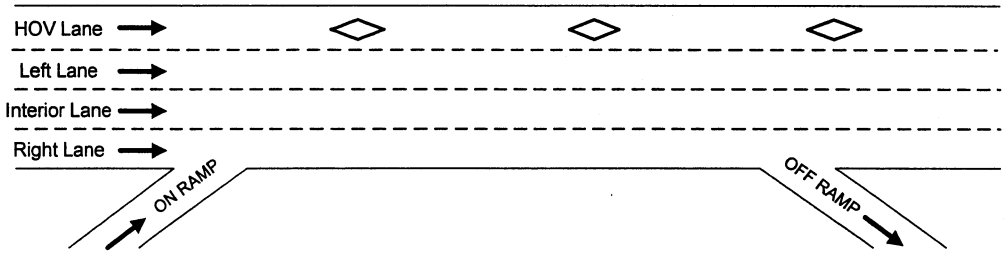
Based on locations examined so far, limited access HOV facilities appear to offer no safety advantages. In fact, at least in the locations examined, compared to continuous access HOV lanes, limited access HOV lanes have a higher proportion of collisions across lanes of the freeway, a higher number of collisions per lane mile, a higher number of collisions per vehicle miles traveled, and have collisions of greater severity. Further studies are critical to clarify these findings and to develop guidelines for improving the safety performance of both limited and continuous access HOV facilities.

Attachment A. Continuous and Limited Access HOV lanes

Limited Access (Southern California)



Continuous Access (Northern California)



Attachment B. Statewide collision comparison (HOV and left lanes)

- Collision Data
  - TASAS, 1999~2003, Weekdays (Mon. ~ Fri.)
  - Traveling Lanes Only (HOV, Left, Interior, and Right Lanes)
  - HOV Operation Hours (Peak Hours, 5~9 AM & 3~7 PM)
    - Continuous Ingress/Egress – HOV report and Inventory
    - Limited Ingress/Egress – 5 ~ 9 AM & 3 ~ 7 PM

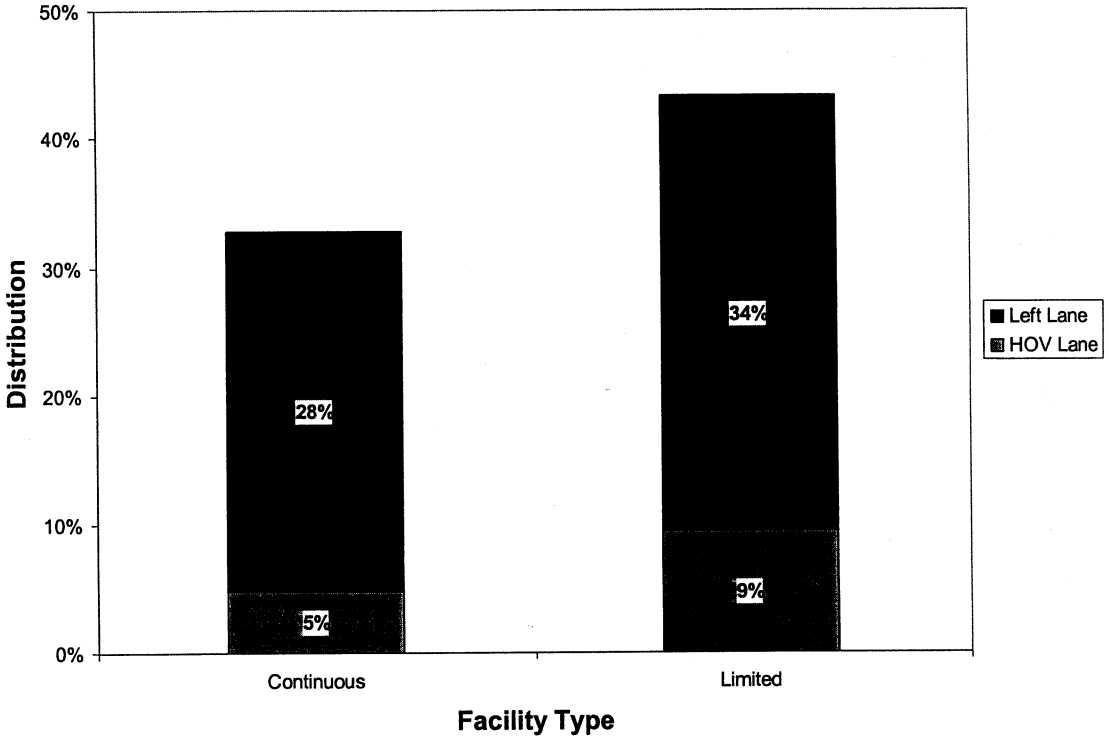
- HOV Location Data
  - HOV lanes constructed before 1999
    - HOV lanes existing before 1999 were identified to allow comparable analysis
    - Routes with unique HOV operation were excluded (HOT, Bus-Only, Elevated and etc)
  - HOV Reports (D4 & D7), HOV Inventory (as of 2005), Google Earth Aerial Photo

Study Site Summary (Statewide comparison)

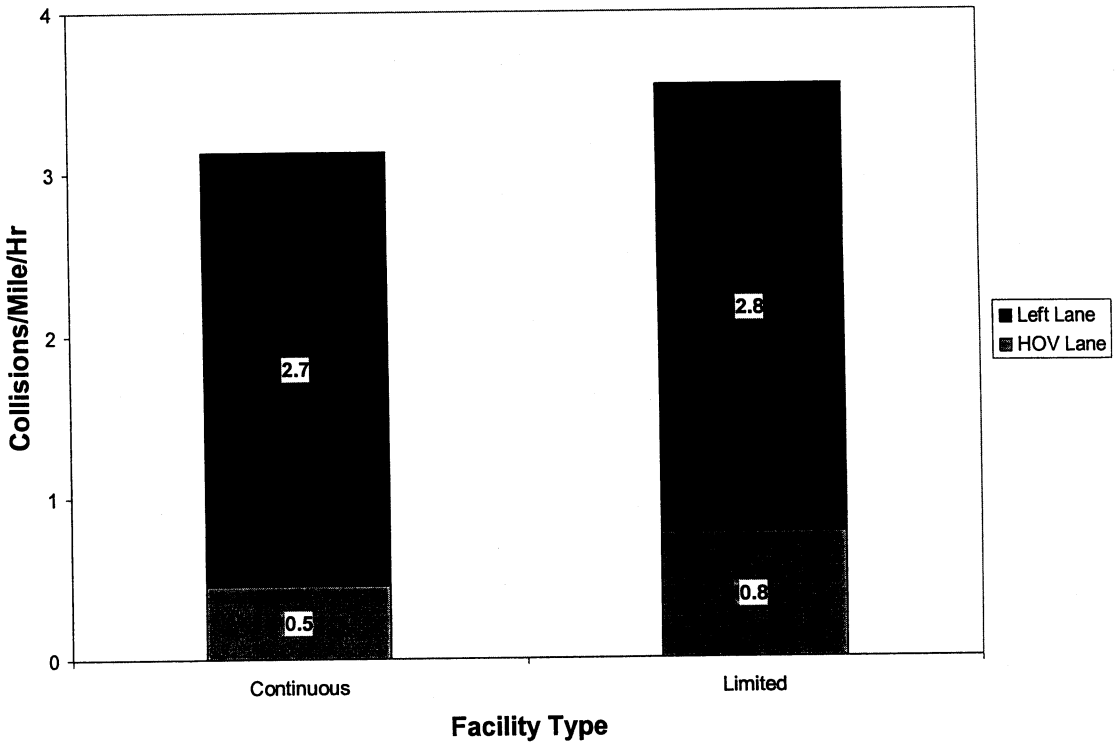
Facility Type	District	Number of Routes	Lane-Miles
Continuous	3	2	25
	4	22	253
Limited	7	24	311
	8	4	55
	12	10	179
		Total (Used for study) :	823
		Total (Entire HOV system) :	1305

□ The lane-mile calculation is based on HOV inventory as of June, 2005

Attachment C. HOV and left lane collision distribution (statewide analysis of about 60% of all HOVs in California)



Attachment D. **HOV and Left lane collisions/mile/hour (statewide analysis including about 60% of all HOVs in California)**



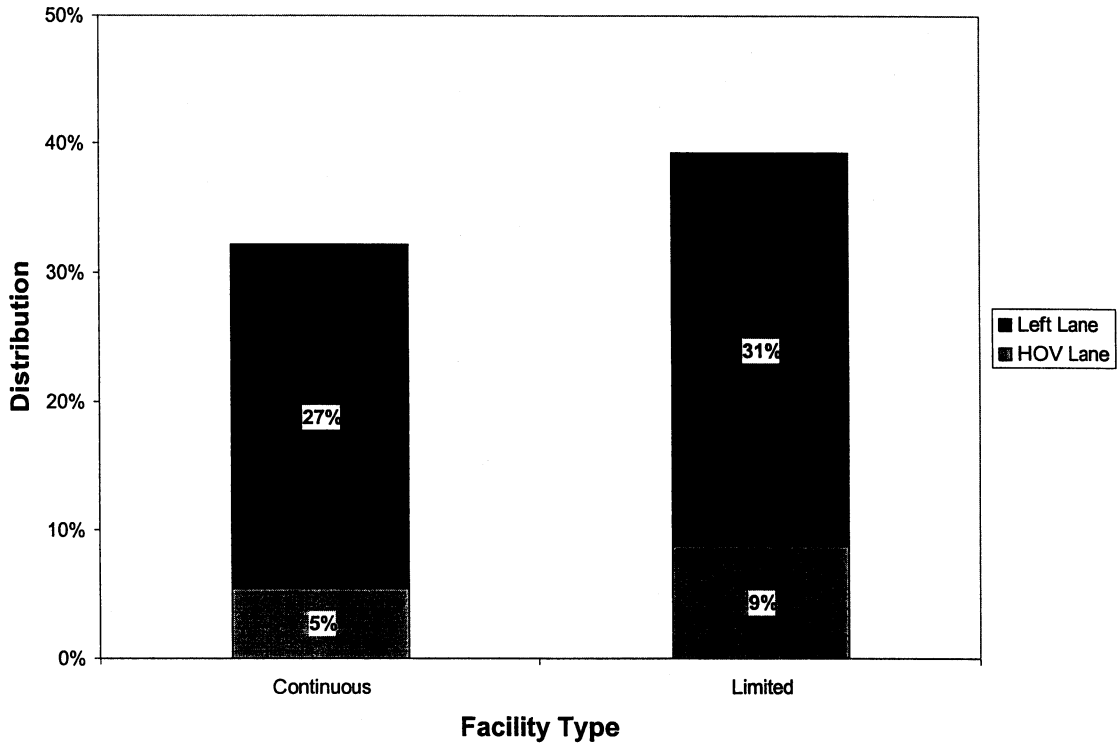
Attachment E. Detailed study routes for HOV collision analysis

- Site Selection
  - List of HOV Facilities Provided by Caltrans Advisory Group

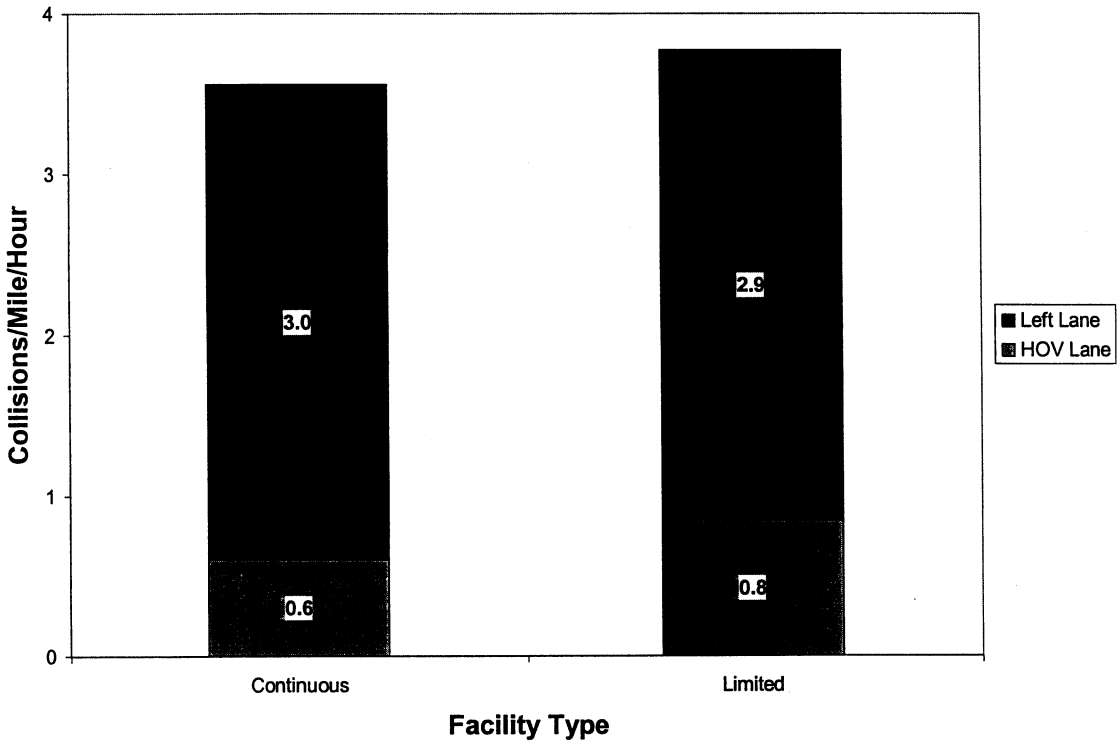
- Collision Data
  - TASAS, 1999~2003, Weekdays (Mon. ~ Fri.)
  - Traveling Lanes Only
  - HOV Operation Hours (See table below)

Facility Type	District	County	Freeway	Direction	Postmile		Length	Operation Hr.
					Start PM	End PM		
Continuous	D4	ALA/CC	I-80	E	ALA 3.373	ALA 8.036	15.029	Monday~Friday, 5~10 AM, 3~7 PM
					CC 0.000	CC10.043		
		ALA/CC	I-80	W	ALA 3.8	ALA 8.036	13.87	Monday~Friday, 5~10 AM, 3~7 PM
					CC 0.000	CC 9.76		
		ALA	I-880	N	13.51	20.876	7.366	Monday~Friday, 5~9 AM, 3~7 PM
		SCL	SR-101	S	R 26.4	39.92	13.886	Monday~Friday, 5~9 AM, 3~7 PM
Limited	D7	LA	SR-91	W	R 19.434	R 6.85	12.584	24 hours
		LA	I-105	E	R 1.164	R 16.864	15.7	24 hours
		LA	I-105	W	R 2.556	R 16.847	14.291	24 hours
		LA	I-210	E	R 24.784	R 36.407	11.932	24 hours
		LA	I-405	S	12.925	26.298	13.373	24 hours
	D12	ORA	SR-55	N	7	R 17.825	10.927	24 hours
		ORA	I-5	N	7	29	22	24 hours
		ORA	I-5	S	7	29	22	24 hours
		ORA	SR-57	S	11.083	R 22.551	11.468	24 hours

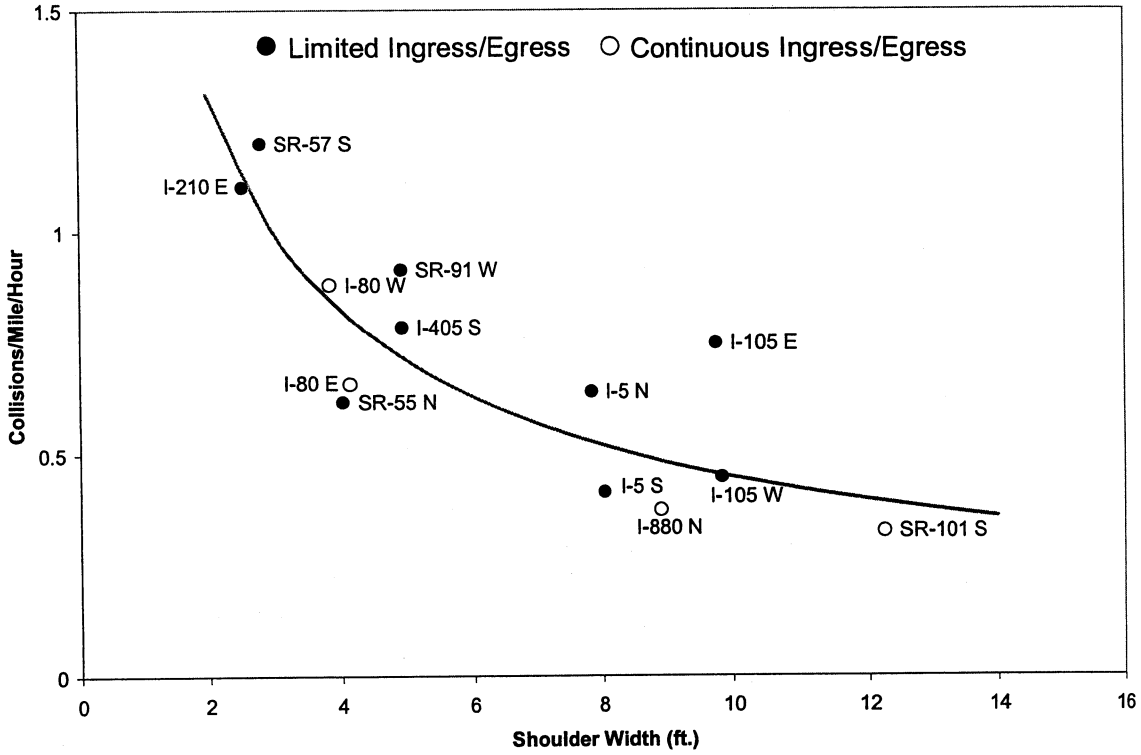
Attachment F. HOV and left lane collision distribution (detailed analysis of 13 freeway segments)



Attachment G. HOV and Left lane collisions/mile/hour (detailed analysis of 13 freeway segments)



Attachment H. Shoulder width and collisions/mile/hour relationship. Facilities with wider should width generally have fewer collisions per mile, regardless of whether the facility is a limited or continuous access facility.



OCTA
Fast Facts

Orange County Transportation Authority

The Orange County Transportation Authority (OCTA) is the county's primary transportation agency. OCTA enhances the quality of life in Orange County by delivering safer, faster and more efficient transportation solutions.

OCTA began in 1991 with the consolidation of seven separate transportation agencies. By increasing efficiency and eliminating duplicate functions, we save county taxpayers millions of dollars.

An 18-member Board of Directors governs OCTA. The Board consists of 5 county supervisors, 10 city members, 2 public members and the Caltrans District 12 Director as a non-voting member.

OCTA received the American Public Transportation Association's *2005 Outstanding Public Transportation System Achievement Award*.

OCTA Programs & Services

Measure M: OCTA administers Measure M, a package of transportation improvements promised to voters in 1990 when they approved a special half-cent sales tax. Under Measure M, 43 percent of funds go to improve freeways, 32 percent to improve streets and roads, and 25 percent for bus and rail services. The current Measure M Plan expires in 2011. On November 7, 2006, Orange County voters approved the Renewed Measure M Plan, ensuring transportation improvements for another 30 years to 2041.

Bus System: OCTA operates buses in a 798 square-mile area serving more than 3 million residents. OCTA provides local, community, rail connector, express and paratransit services.

OCTA delivers safer, faster and more efficient transportation solutions for Orange County.

Freeways: OCTA assists with planning and funding for all freeway improvements. The Garden Grove Freeway (SR-22) Improvement Project reached a milestone with the opening of new lanes east of Magnolia Street to the Costa Mesa Freeway (SR-55) in 2006 using the innovative design-build method. Construction is well underway on the Santa Ana Freeway (I-5) Gateway Project to eliminate the bottleneck through Buena Park.

Streets and Roads: OCTA administers a variety of funding programs for cities to widen streets, improve intersections, coordinate signals and rehabilitate pavement. OCTA also administers regional street and road improvement projects.

Commuter Rail: OCTA funds and supervises Metrolink rail service in Orange County. OCTA's three Metrolink lines—the Orange County Line, the Inland Empire-Orange County Line and the 91 Line—have more than 3.5 million boardings per year.

Advanced Rail Transit: The OCTA Board of Directors is studying a variety of alternatives including Bus Rapid Transit (BRT).

Motorist Services: OCTA provides emergency call boxes through the Service Authority for Freeway Emergencies (SAFE), offers emergency towing services with the Freeway Service Patrol (FSP) and removes abandoned vehicles through the Service Authority for Abandoned Vehicles (SAAV).

OCTAP: OCTA operates the Orange County Taxi Administration Program (OCTAP). OCTAP issues taxi business, driver and vehicle permits on behalf of the County and its 34 cities.

91 Express Lanes: OCTA also owns and operates the four-lane, 10-mile toll road from the Orange/Riverside County line west to the SR-55. The 91 Express Lanes save drivers time on their daily drive.

Orange County Transportation Authority 550 S. Main Street, P.O. Box 14184, Orange, CA 92863-1584 • (714) 560-OCTA • www.octa.net **02/07/07**

91 Express Lanes

Toll Schedule

Effective July 1, 2007

Eastbound

SR-55 to Riverside Co. Line

	Sun	M	Tu	W	Th	F	Sat
Midnight	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
1:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
2:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
3:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
4:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
5:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
6:00 am	$1.20	$1.90	$1.90	$1.90	$1.90	$1.90	$1.20
7:00 am	$1.20	$1.90	$1.90	$1.90	$1.90	$1.90	$1.20
8:00 am	$1.55	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90
9:00 am	$1.55	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90
10:00 am	$2.35	$1.90	$1.90	$1.90	$1.90	$1.90	$2.35
11:00 am	$2.35	$1.90	$1.90	$1.90	$1.90	$1.90	$2.35
Noon	$2.80	$1.90	$1.90	$1.90	$1.90	$2.90	$2.80
1:00 pm	$2.80	$2.65	$2.65	$2.65	$2.90	$4.80	$2.80
2:00 pm	$2.80	$3.80	$3.80	$3.80	$3.90	$9.10	$2.80
3:00 pm	$2.35	$4.10	$4.70	$4.95	$4.95	$9.25	$2.80
4:00 pm	$2.35	$6.85	$8.00	$8.50	$9.25	$9.50	$2.80
5:00 pm	$2.35	$6.65	$8.50	$8.50	$9.25	$8.00	$2.80
6:00 pm	$2.35	$4.10	$5.45	$4.95	$5.75	$4.90	$2.35
7:00 pm	$2.35	$2.90	$2.90	$2.90	$4.15	$4.55	$1.90
8:00 pm	$2.35	$1.90	$1.90	$1.90	$2.65	$4.15	$1.90
9:00 pm	$1.90	$1.90	$1.90	$1.90	$1.90	$2.65	$1.90
10:00 pm	$1.20	$1.20	$1.20	$1.20	$1.20	$1.90	$1.20
11:00 pm	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20

Toll Schedule

Effective July 1, 2007

Westbound

Riverside Co. Line to SR-55

	Sun	M	Tu	W	Th	F	Sat
Midnight	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
1:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
2:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
3:00 am	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
4:00 am	$1.20	$2.25	$2.25	$2.25	$2.25	$2.25	$1.20
5:00 am	$1.20	$3.70	$3.70	$3.70	$3.70	$3.55	$1.20
6:00 am	$1.20	$3.80	$3.80	$3.80	$3.80	$3.70	$1.20
7:00 am	$1.20	$4.20	$4.20	$4.20	$4.20	$4.10	$1.65
8:00 am	$1.65	$3.80	$3.80	$3.80	$3.80	$3.70	$1.90
9:00 am	$1.65	$3.05	$3.05	$3.05	$3.05	$3.05	$2.35
10:00 am	$2.35	$1.90	$1.90	$1.90	$1.90	$1.90	$2.35
11:00 am	$2.35	$1.90	$1.90	$1.90	$1.90	$1.90	$2.70
Noon	$2.35	$1.90	$1.90	$1.90	$1.90	$1.90	$2.70
1:00 pm	$2.70	$1.90	$1.90	$1.90	$1.90	$1.90	$2.70
2:00 pm	$2.70	$1.90	$1.90	$1.90	$1.90	$1.90	$2.70
3:00 pm	$2.70	$1.90	$1.90	$1.90	$1.90	$2.35	$2.70
4:00 pm	$2.85	$1.90	$1.90	$1.90	$1.90	$2.35	$2.85
5:00 pm	$2.85	$1.90	$1.90	$1.90	$1.90	$2.35	$2.85
6:00 pm	$2.85	$1.90	$1.90	$1.90	$1.90	$2.80	$2.35
7:00 pm	$2.35	$1.20	$1.20	$1.20	$1.20	$1.90	$1.90
8:00 pm	$2.35	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
9:00 pm	$2.35	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
10:00 pm	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
11:00 pm	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20

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