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The Santa Monica Freeway Diamond Lanes
Volume I: Summary

Final Report
September 1977

Service and Methods Demonstration Program

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16. Abstract

The Santa Monica Freeway Diamond Lanes, a pair of concurrent-flow preferential lanes for buses and carpools linking the City of Santa Monica, California, with the Los Angeles CBD, opened on March 16, 1976 and operated amid much controversy for 21 weeks until the U.S. District Court halted the project. The Diamond Lane project marked the first time preferential lanes had been created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles.

This report summarizes the findings of the official, objective, independent evaluation of the project sponsored by the U.S. Department of Transportation as part of the UMTA Service & Methods Demonstration Program. The report addresses a broad range of project impacts in the following major areas: Traffic speeds and travel times; traffic volumes and carpool information; bus operations and ridership; safety and enforcement; energy and air quality; and public attitudes and response. Analysis shows that the project succeeded in increasing carpool ridership by 65% and the increased bus service accompanying the Diamond Lanes caused bus ridership to more than triple. Nonetheless, energy savings and air quality improvements were insignificant, freeway accidents increased significantly, non-carpoolers lost far more time than carpoolers gained, and a heated public outcry developed which has delayed the implementation of other preferential treatment projects in S. California.

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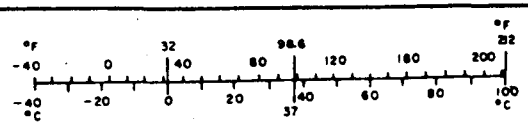
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



ACKNOWLEDGMENTS

This evaluation of the Santa Monica Freeway Diamond Lanes was prepared in the Los Altos, California offices of SYSTAN, Inc. under Contract Number DOT-TSC-1084, as part of the Service and Methods Demonstration (SMD) Program sponsored by the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation. Dr. John W. Billheimer served as SYSTAN's project manager and principal investigator. Dr. Howard Simkowitz of DOT's Transportation Systems Center (TSC) served as technical advisor on the project, while Mr. Joe Goodman of UMTA was the project manager for the SMD Program.

Many individuals contributed to the development of the Diamond Lane evaluative report. Within SYSTAN, John W. Billheimer directed the evaluation and served as principal author of the report. Robert Bullemer was responsible for data processing, wrote the Chapter 8 report on Energy and Air Quality, and contributed to the chapters dealing with freeway operations and bus ridership. Carolyn Fratessa assisted with survey design and implementation, monitored public and media response, and wrote the Chapter 9 report on What Happened Off the Freeway. Arthur W. Simpson assembled and summarized data on other preferential lane projects, while Michael Holoszyc undertook special statistical studies of accidents and bus ridership and Andrew Canfield assisted with data processing and analysis. Gail Fondahl helped to analyze and describe traffic operations, ramp delays, and survey responses, while Carole Parker organized and edited the final report.

Although SYSTAN accepts full responsibility for the data tabulations and conclusions presented in this report, the evaluation would not have been possible without the cooperation and assistance of the many local agencies participating in the project. The collection of most of the voluminous traffic data reflected in the report was accomplished by the California Department of Transportation (CALTRANS) Freeway Operations Branch under the direction of Gary Bork and the supervision of Robert Goodell. Mr. Pat Conway supervised data collection activities of the Southern California Rapid Transit District (SCRTD) and Robert Ayer performed a similar function for the Santa Monica Municipal Bus Lines (SMMBL). Donald Bass and Robert Camou of the Los Angeles City Traffic Department (LADT) assembled data on surface street conditions. Lieutenant William Russell of the California Highway Patrol (CHP) supplied the viewpoint of officers enforcing the Diamond Lane restrictions, and supervised the collection of data on accidents, enforcement, and police deployment. Each of the above individuals contributed their insights and understanding to the preparation of the final evaluation report, as did Graham Smith and Paul Satja of the Los Angeles Mayor's Office. The photographs accompanying the summary exhibits in the text are the work of Robert Goodell of CALTRANS.

PREFACE

The Santa Monica Freeway Diamond Lanes opened on March 15, 1976, and operated amid much controversy for 21 weeks until August 9, 1976 when Judge Matthew Byrne of the U.S. District Court in Los Angeles halted the project and ordered additional environmental studies prior to its continuation.

Much of the controversy at the time consisted of conflicting claims regarding the ability of the project to accomplish its stated objectives of conserving energy, improving air quality and expanding effective freeway capacity by increasing the occupancy of buses and automobiles using the freeway. Some of these objectives had been attained by the close of the demonstration, although the cost in accidents, congestion and public outrage was far greater than anyone had anticipated. Major findings on the positive side of the ledger were:

- During the last seven weeks of the project, the Santa Monica Freeway carried 1.8% fewer people in 10.1% fewer automobiles than it had carried prior to the project in the morning and evening peak periods. The entire corridor, including parallel surface streets, carried 1% more people in 5% fewer vehicles.

- The number of carpools on the freeway increased by 65% during the project.

- In response to both the Diamond Lanes and a significant increase in transit routes and service frequency, daily bus ridership between the Westside study area and the Los Angeles CBD more than tripled, increasing from 1,171 riders per day prior to the project to 3,793 riders per day during the last week of Diamond Lane operation.

- Speeds recorded by carpoolers in the Diamond Lanes were both faster and more consistent than pre-demonstration speeds. Carpoolers traveling the length of the Diamond Lanes were able to save between two and three minutes over pre-project travel times and approximately five or six minutes over travel times in other lanes.

However, certain hoped-for benefits failed to materialize during the short life of the project:

- After an initial increase, fuel consumption levels on the freeway and adjacent city streets dropped slightly during the last seven weeks of the project, falling an estimated 0.8% below pre-project levels.

- Although it is impossible to make conclusive statements regarding air quality on the basis of the limited samples taken during the life of the project, estimates of vehicle emissions made on the basis of mileage computations indicate that emissions increased early in the project and dropped to pre-project levels by the close of the demonstration.

Moreover, the positive and neutral impacts of the project were counterbalanced by the following negative considerations:

- Freeway accidents rose markedly during the project. An average of 25 accidents per week occurred during Diamond Lane operating hours, roughly 2.5 times the weekly pre-project average.

- During the Diamond Lane demonstration, freeway speeds for non-carpoolers were both slower and less predictable than they were before the demonstration. Although speeds improved as the demonstration progressed, freeway driving time for non-carpoolers traveling the full length of the Diamond Lanes over the last seven weeks of the project were slightly more than one minute longer than pre-project levels in the westbound direction during the P.M. peak and more than four minutes longer in the eastbound direction during the A.M. peak.

- Average delays at the busiest metered ramps increased between one and five minutes per car during the peak hours of morning and evening operations.

- Combining ramp delays and slower freeway speeds, measured increases in total trip times for no-carpoolers traveling eastbound on the freeway in the morning ranged from six minutes per trip at the western end of the freeway to negligible increases at on-ramps near the CBD. Corresponding increases for westbound travelers in the evening ranged from seven minutes per trip for drivers entering near the CBD to insignificant delays west of La Cienega Boulevard for drivers entering midway along the length of the project.

- Aggregate travel speeds on surface streets paralleling the freeway slowed slightly during the demonstration, dropped by about 4.5%.

- The weight of the media and public opinion were solidly against the project. Eighty-six percent of corridor drivers surveyed, including the majority of carpoolers, felt that the Diamond Lanes were either harmful or of no benefit whatsoever.

After the close of the demonstration, conditions on the freeway approximated those experienced prior to the project. Although bus service continued and bus ridership remained high, at more than two and one-half times pre-project levels, the number of carpools dropped to within 5% of the number on the freeway before the Diamond Lanes were implemented.

Thus, the Santa Monica Freeway Preferential Lane project succeeded to some degree in attracting riders to carpools and transit, and increased freeway capacity with a minimum amount of additional construction and enforcement costs. However, the project brought about a significant increase in freeway accidents; energy savings and air quality improvements were insignificant; non-carpoolers lost far more time than carpoolers gained; and a heated public outcry developed which has delayed the implementation of other preferential treatment projects in Southern California and given planners and public officials in other areas ample cause for reflection before attempting to implement similar projects.

The effect of the Diamond Lanes on Los Angeles traffic, travel patterns and travelers was a complex one that cannot be adequately summarized in concise statements such as those listed above. Both the issues and the impacts were many-faceted, admitting as many different interpretations as there were freeway drivers. Nearly everyone in Los Angeles, by virtue of their daily tussle with traffic, qualifies as a traffic expert with a narrow range of specialization. The many different governmental agencies and institutions serving these experts have somewhat broader concerns than the individual driver, but the field of vision of any governmental agency is necessarily circumscribed by the agency's jurisdiction, history, and political outlook. In Los Angeles, the different agencies and public officials involved with the Diamond Lane project had substantially different views regarding the purpose, promises, prospects and relative success of the Lanes. During the demonstration, the press was filled with reports by drivers under the pressure of the daily commute and by agencies under the pressure of the media blitz, that touched only limited aspects of the problem and were sometimes badly distorted. At times, it seemed as if the parable of the six blind men and the elephant were being reenacted by thousands of rage-blinded commuters and hundreds of one-eyed officials, reporters, and television commentators.

The authors of this evaluation cannot claim markedly better eyesight than many of the drivers and officials in Los Angeles who held strong views regarding the merits or faults of their side of the elephant. The evaluators have, however, been blessed with more time to evaluate conflicting statistics and sort though the viewpoints of drivers, agencies and officials free from the pressures of commuting, project decisions, and the media glare. Although this time provides the perspective needed for a more objective view of the elephant, the evaluator is prey to a different set of pitfalls. In time, he comes to know every aspect of the elephant intimately, from the length of his trunk to the function and chemical composition of his digestive tract. These details, in themselves, may be scarcely more enlightening than the views of a single enraged driver or harassed official. In Los Angeles, moreover, the media-created circus surrounding the project was so diverting that it was difficult at times to concentrate on the measurement of the elephant's trunk, so that the measurement process necessarily had to be extended to cover the public unroar.

Unless the evaluator is careful, a detailed description of the elephant's extremities and the surrounding clamor may be just as distorted as those of the original six blind men. In attempting to report on all sides of the elephant, the authors recognize that they have probably provided more information than any single individual wants to know about the Diamond Lanes. Accordingly, the report has been developed at several levels of detail and divided into different sections covering the major aspects of the project: traffic speeds; vehicle volumes and occupancy; bus operations and ridership; safety and enforcement; energy consumption and air quality; and what happened off the freeway. Chapter 1 summarizes each of these topics in some detail, and is itself dotted with short listings of key findings to aid the reader interested in a specific aspect of the Diamond Lane experience. In addition, an executive summary has been prepared for the reader desiring an overview of the evaluation.

The final report has been published in two volumes:

Volume I: SUMMARY -- Contains the Executive Summary and Chapter 1, a topic-by-topic condensation of the technical report.

Volume II: TECHNICAL REPORT -- Contains the Executive Summary;
Overviews of the Project, Site, and Evaluation (Chapters 2, 3 and 4);
Freeway and Bus Operations (Chapters 5 and 6);
Safety, the Environment, and Public Response (Chapters 7, 8 and 9);
Survey of Other Preferential Lane Projects (Chapter 10); and
Appendices.

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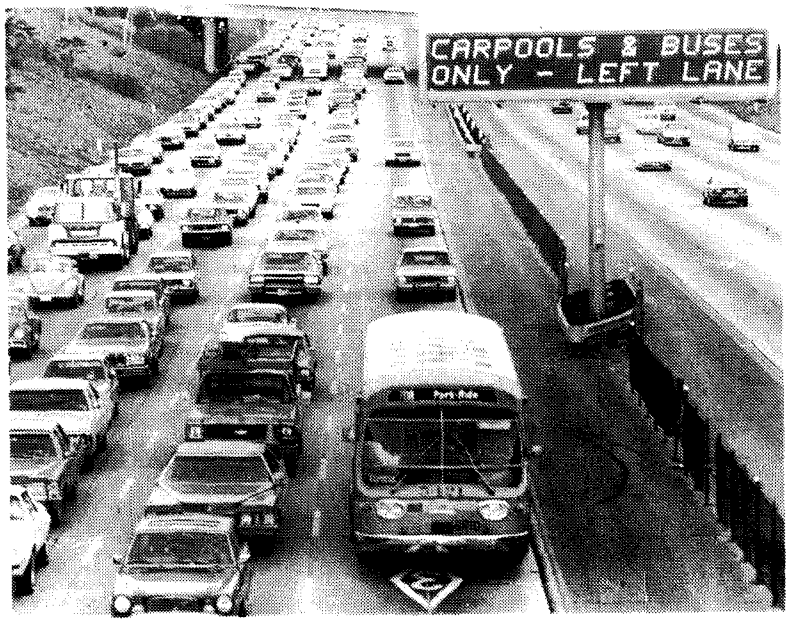
EXECUTIVE SUMMARY

INTRODUCTION

The Santa Monica Freeway, which connects the City of Santa Monica and downtown Los Angeles, is one of the most heavily-traveled freeways in the world, and is served by a variety of sophisticated traffic control devices, including metered on-ramps with preferential entry provisions at selected locations, a computerized surveillance system, and centrally-controlled electronic displays. On March 15, 1976, the California Department of Transportation (CALTRANS), acting in conjunction with the California Highway Patrol (CHP) and local bus operators, reserved the median lane in each direction of a 12-mile, eight-lane segment of the Santa Monica Freeway for the exclusive use of buses and carpools carrying three or more occupants. The reserved lanes, known locally as the Diamond Lanes, operated in each direction during the peak hours of traffic flow. No barriers separated these lanes from the remaining flow of freeway traffic. Implementation of the Diamond Lanes was accompanied by the introduction of a variety of express bus services and the opening of three new Park-and-Ride lots in Western Los Angeles.



The Santa Monica Freeway project marked the first time preferential lanes had been created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles. Although the Diamond Lanes entailed no major physical modifications or construction on the freeway itself, they generated considerable emotional reaction among freeway drivers and other residents of Los Angeles. The project neither started nor ended as scheduled. The original starting date was delayed by a combination of concerns including operational readiness, financial problems, a local dispute over the implications of nationwide labor protective agreements, and the Southern California rainy season. When the Diamond Lanes finally opened, the first day of operations was disastrous, featuring bumper-to-bumper traffic, long queues at on-ramps, a malfunctioning ramp meter, many accidents, outraged drivers, poor press notices, and derisive news commentary. As the project progressed, freeway performance improved somewhat and both bus and

carpool ridership increased, but accidents remained a serious problem and the climate of public opinion and media reaction grew more hostile. The preferential lanes operated amid much controversy for 21 weeks until August 9, 1976, when Judge Matthew Byrne of the U.S. District Court in Los Angeles halted the project and ordered additional environmental studies prior to its continuation.

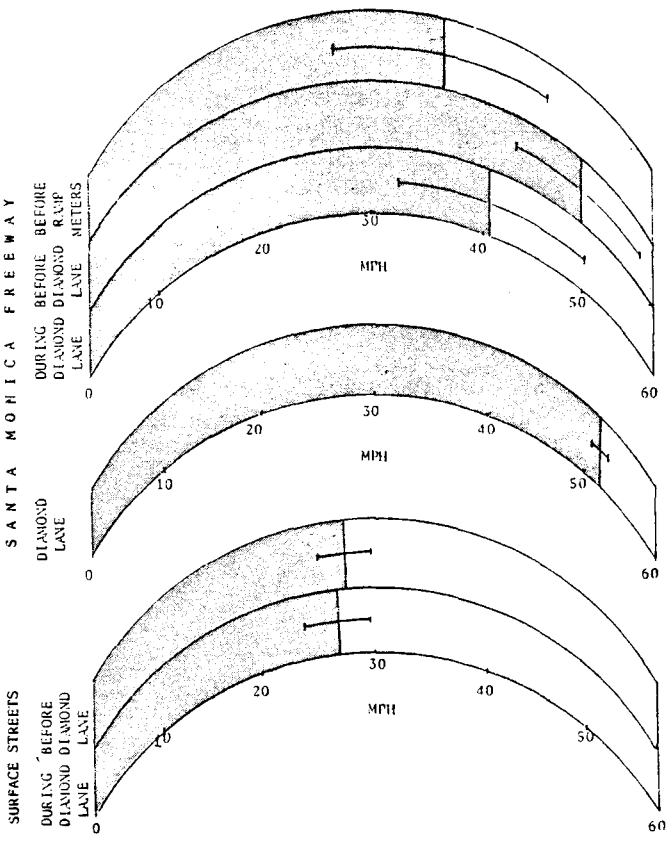
Much of the controversy surrounding the Diamond Lanes consisted of conflicting claims regarding the ability of the project to accomplish its stated objectives of conserving energy, improving air quality, and expanding effective freeway capacity by increasing the occupancy of buses and automobiles using the freeway. An independent analysis of the vast quantities of data assembled by both friends and foes of the project reveals that, although some of the stated objectives had been attained by the close of the demonstration, the cost in accidents, driver delay, and public outrage was far greater than anyone had anticipated. Major findings of the analysis are summarized below.

TRAFFIC SPEEDS AND TRAVEL TIMES

Vehicle Speeds

The dedication of the Diamond Lanes to the exclusive use of buses and high-occupancy vehicles, and the accompanying changes in ramp metering rates, had a marked impact on vehicle speeds on the Santa Monica Freeway. *The speeds of vehicles using the Diamond Lanes were significantly faster and steadier than the speeds of vehicles in the remaining non-preferential lanes, which were generally slower and less predictable than those experienced on the freeway prior to the initiation of the demonstration.* Although the speeds of non-carpoolers improved as the demonstration progressed, they never returned to meter-controlled, pre-project levels. Average freeway driving times for non-carpoolers traveling the full length of the project over the last seven weeks of the demonstration were slightly more than one minute longer than pre-project levels in the westbound direction during the evening and more than four minutes longer in the eastbound direction during the morning.

A.M. EASTBOUND TRAVEL SPEEDS



Average statistics do not provide a complete picture of travel times in adjacent lanes, since these times varied considerably during the morning and evening hours of operation. The non-carpooler entering the eastbound freeway at 6:30 A.M. found his travel time to Los Angeles increased by roughly one minute during the demonstration. By 8:00 A.M., however, the additional delays in freeway travel time approached nine minutes per trip. The difference between the average travel time measured over the full span of Diamond Lane operating hours and the actual travel times experienced by motorists during specific peak travel periods, coupled with the greater uncertainty associated with travel during Diamond Lane operations, helps to explain some of the skepticism with which freeway users viewed the average statistics reported in the press while the project was still in progress.

Speeds recorded by carpoolers in the Diamond Lanes were both faster and more consistent than pre-demonstration speeds. Carpoolers using the lanes typically traveled between two and five miles per hour faster than they had prior to the initiation of the demonstration. The Diamond Lanes provided a more pronounced advantage relative to the speeds in adjacent lanes during the demonstration, offering carpoolers and bus riders average speeds between 11 and 12 miles per hour faster than those available to general traffic.

Aggregate travel speeds on the surface streets paralleling the freeway slowed slightly during the demonstration, dropping by about 4.5% as former freeway users transferred to surface streets.

Entry Ramp Conditions

Over a period of two years prior to the Diamond Lane demonstration, traffic signals were installed on the Santa Monica Freeway on-ramps to control the number and spacing of cars entering the freeway during the peak hours. Before these ramp meters were installed, general vehicle speeds on the freeway were slightly slower than the speeds attained by non-carpoolers during the Diamond Lane demonstration. The installation of these ramp meters greatly improved traffic speeds on the freeway by limiting entering vehicles to a fixed rate of flow. Although vehicles entering the freeway spent an average of two minutes waiting at the ramp meters, this delay was more than offset by the time saved in traveling in the improved traffic conditions on the freeway itself.

Metering rates on most freeway access ramps were adjusted during the week preceding the opening of the Diamond Lanes. In some instances, these adjustments represented severe departures from pre-project conditions. The adjustments were designed to alleviate anticipated freeway congestion and, in most cases, increased the length of time motorists were required to wait in

queues before entering the freeway. As the project continued, metering rates were readjusted in response to actual traffic conditions, but these attempts to fine-tune the system did not match the sweeping changes made before opening day in either the magnitude of the adjustments or the number of ramps affected.

Once the confusion and adjustments of the first week were past, few changes in ramp delays were observed during the peak hours of travel. *Average delays at the metered ramps carrying the bulk of entering traffic increased between one and five minutes per car during the project.*

At 12 of the 30 metered entry ramps, preferential access lanes permitted buses and vehicles with two or more occupants to bypass the meter system. The bypass lanes at these selected ramps saved buses and two-person carpools between two and seven minutes per trip during the Diamond Lane demonstration.

The average increases in queue lengths at freeway on-ramps were not so pronounced as the increases in ramp waiting times. There were relatively few instances in which the Diamond Lane metering changes caused vehicle queues to extend dramatically beyond the ramp storage capacity, and speed measurements showed that the queue increases did not appear to cause additional interference with traffic on north-south feeder roads.

Total Trip Times

Measured Freeway Trip Times. Considering both ramp delays and slower freeway speeds, measured increases in average trip times for non-carpoolers traveling eastbound on the freeway in the morning were as high as six minutes per trip for those drivers starting at the western end of the freeway and traveling to the CBD. Eastbound drivers entering the freeway about midway along the length of the project experienced negligible increases in total travel times. Corresponding increases for westbound travelers in the evening were as high as seven minutes per trip for non-carpoolers entering the freeway near the CBD. Westbound drivers using ramps midway along the project's length experienced negligible additional delays.

At each of the entry ramps with a bypass lanes for buses and two-person carpools, the amount of time saved by using the ramp bypass exceeded the amount of time saved by traveling in the Diamond Lane to the Lane's end. *That is, the relative delays imposed on single-occupant automobiles at preferential on-ramps were greater than those imposed by the Diamond Lane itself.*

Perceived Trip Times. The changes in freeway travel times encountered during the Diamond Lane demonstration may also be viewed in the light of the total door-to-door commuting times perceived by drivers in the freeway corridor. The average door-to-door trip reported by a sampling of 2,800 corridor drivers

was 21 miles long, and took 37.4 minutes in the morning and 43.2 minutes in the evening. Diamond Lane carpoolers responding to a survey questionnaire reported an average savings of 1.5 minutes over pre-project travel times. Non-carpoolers reported an increase in trip times of 8.3 minutes in the morning and 9.4 minutes in the evening. These perceived increases are slightly higher than freeway measurements indicate are likely, and include a number of impossibly high reports (greater than 30 minutes) of average trip delays. Not unexpectedly, non-carpoolers appear to have overestimated the average delays accompanying the Diamond Lane demonstration, although measurements indicate that the delays encountered by a non-carpooler traveling the length of the project could have averaged as much as six to seven minutes per trip. Given the increased uncertainty accompanying travel in the non-preferential lanes, moreover, delays on any single day could have been much higher than the average figure.

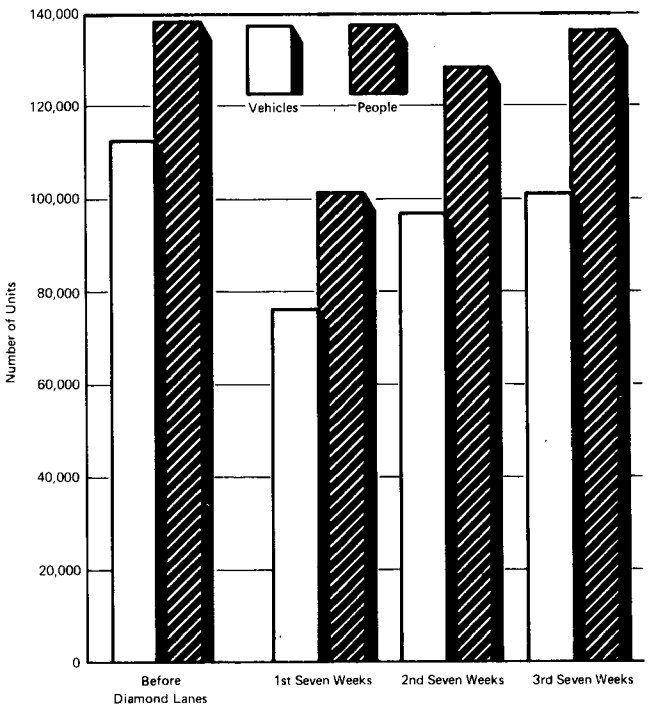
TRAFFIC VOLUMES

Freeway Traffic Volumes

The changes in travel speeds experienced during the demonstration were accompanied by significant shifts in traffic patterns. The total number of vehicles and people using the Santa Monica Freeway dropped markedly during the early weeks of the demonstration, and then rose steadily. The early decline in freeway traffic reflected a combination of carpool formation, growing bus ridership, and defection to surface streets by non-carpoolers. *By the close of the demonstration, the number of people using the easternmost segments of the freeway was within 2% of pre-project levels, while vehicle volumes had declined by 10%.* Summary Table 1 provides more detail on changes before, during and after the project as measured at observation points near the Los Angeles CBD.

VEHICLE AND PEOPLE THROUGHPUT AT CRENSHAW BOULEVARD

Santa Monica Freeway: 7 Hours, Both Directions



Measurements made at different points along the freeway reflect the same general pattern of usage depicted in Summary Table 1, although shifts in vehicle and passenger movement were less pronounced at locations farther removed from the CBD. Although directional

trends on the Santa Monica Freeway are less pronounced than on most major freeways, the greatest changes in vehicle and passenger movement during the demonstration occurred in the peak directions of travel (eastbound in the morning and westbound in the evening), where congestion was greatest in the non-preferential lanes. By the last seven weeks of the demonstration, the freeway carried an average of 9% fewer people in 17% fewer vehicles in the peak directions of travel.

SUMMARY TABLE 1

AVERAGE DAILY VEHICLE AND PASSENGER STATISTICS

SANTA MONICA FREEWAY AT CRENSHAW BOULEVARD

(Seven-Hour Peak Periods, Both Directions of Travel)

Statistic		Before Project	DURING DIAMOND LANE PROJECT			After Project
			First Seven Weeks	Second Seven Weeks	Final Seven Weeks	
Total Vehicles	Number	113,135	76,738	97,197	101,678	112,059
	% Increase (Decrease)	---	(-32%)	(-14%)	(-10%)	(-1%)
Total People	Number	138,873	101,643	128,180	136,421	140,507
	% Increase (Decrease)	---	(-27%)	(-8%)	(-2%)	1%
Bus Ridership	Number	1,171	3,092	3,569	3,810	2,916
	% Increase (Decrease)	---	164%	205%	225%	149%
Passengers/ Vehicle	Ratio	1.23	1.32	1.32	1.34	1.25
	% Increase (Decrease)	---	8%	7%	9%	2%
Three-Person Carpools	Number	3,479	4,345	4,923	5,749	3,652
	% Increase (Decrease)	---	25%	42%	65%	5%

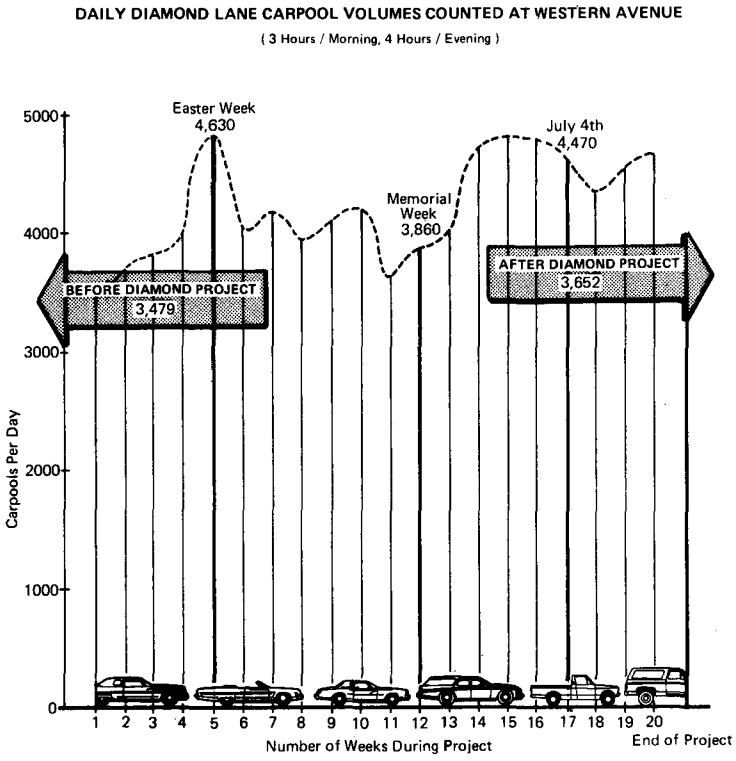
Vehicle volumes at all measuring points increased over pre-project volumes during the midday hours when the Diamond Lanes were not operational. The extent of the increase in vehicle volumes between the hours of 10:00 A.M. and 3:00 P.M. ranged between 2% and 6% over pre-project levels, indicating that drivers who had some flexibility in their choice of travel times elected to travel during the midday lull rather than face the much-publicized freeway congestion during Diamond Lane operating hours.

Prior to the project, each lane of the Santa Monica Freeway carried approximately 1,800 vehicles per hour during peak periods of flow. During the project, the Diamond Lanes carried an average of 300 vehicles per hour in the peak eastbound direction and 500 vehicles per hour in the peak westbound direction. Thus, the preferential lanes operated at between 20 and 30 percent of their vehicular capacity, and appeared relatively empty when compared

with the heavily-congested adjacent lanes. Even so, the number of people carried by the Diamond Lanes approached the number carried by the remaining lanes by the end of the project, and the unused capacity in each preferential lane supplied the Santa Monica Freeway with at least as much reserve capacity as two additional lanes operating at pre-project occupancy rates.

Carpool Formation

The number of carpools carrying three or more people on the Santa Monica Freeway increased significantly during the demonstration, rising 65% above pre-project levels by the last seven weeks of the project. The growth of carpool usage was relatively steady throughout the project, with pronounced peaks during vacation periods.



Afternoon traffic in the eastbound Diamond Lane increased markedly during the Easter holiday week, and rose steadily following Memorial Day, suggesting that much of the increased Diamond Lane usage during these vacation periods may be attributed to groups of vacationing beachgoers returning from the ocean. Although no formal data were assembled to support this observation, Diamond Lane observers noted a number of surfboard sightings during the periods in question.

The average size of the carpools using the Diamond Lanes was 3.4 people. The primary incentive for forming a carpool mentioned by most of the carpoolers surveyed (63%) was to save money. Only 25% of the carpools responding to the survey were initially formed during the Diamond Lane demonstration period, and only 30% of these carpoolers identified the Lanes as the primary incentive behind their decision to carpool. With the disappearance of the Diamond Lanes, the number of carpools on the freeway dropped to within 5% of pre-project levels, suggesting that the Lanes themselves were more of an incentive to those carpools formed during the demonstration than the survey responses indicated.

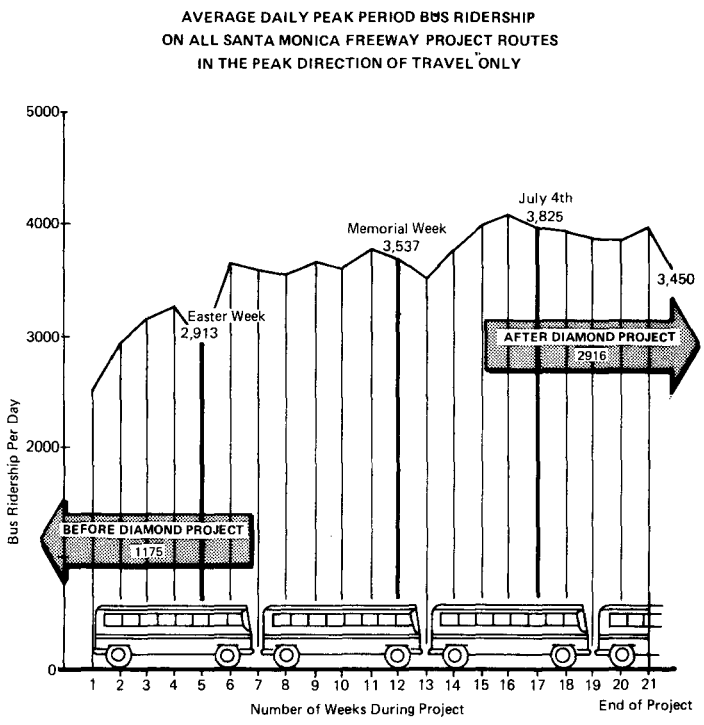
Surface Street Volumes

Traffic volumes on surface streets parallel to the freeway rose between 10% and 15% shortly after the demonstration was implemented, then appeared to subside somewhat during the summer months. Surface street vehicle occupancy rates did not change significantly during the demonstration.

Considering Santa Monica Freeway users, surface street travelers, and accounting for former Santa Monica Freeway users traveling on different freeways or during less-congested time periods, a rough comparison of vehicle and passenger movement across the entire Santa Monica Freeway corridor near the CBD indicates that *by the last seven weeks of the project, 1% more people were traveling in 5% fewer vehicles than were being used prior to the demonstration.*

BUS OPERATIONS AND RIDERSHIP

Two bus operators in the Los Angeles area participated directly in the Santa Monica Freeway Preferential Lane project by offering new services in conjunction with the opening of the Diamond Lanes: The Southern California Rapid Transit District (SCRTD), which operates 2,400 buses in the four-county Los Angeles area, and the Santa Monica Municipal Bus Lines (SMMBL), which operates about 100 buses in the Santa Monica area.



Bus service linking the Westside study area to the Los Angeles CBD improved significantly with the implementation of the demonstration. The addition of four new Diamond Lane feeder/express routes to the four already serving the Westside area more than doubled the number of Westside CBD workers living within walking distance of express bus service. In addition, three new Park-and-Ride routes were introduced to serve those Westside residents who were not within walking distance of a feeder/express route.

On the first day of the demonstration, 74 express bus trips were offered from the Westside area to the Los Angeles CBD during the morning peak, an increase of more than four times pre-project levels. Even without the Diamond Lanes, therefore, the marked

improvement in service significantly improved the travel time by bus from most sections of the study area to the CBD. In the initial stages of the demonstration, service headways on new routes were generally set so that buses were no more than 15 minutes apart. As the project progressed, headways were adjusted to reflect ridership.

The introduction of the Diamond Lanes significantly improved the on-time performance of those SCRTD routes in existence prior to project implementation, cutting two minutes off the freeway travel time of the busiest line. Diamond Lane buses also generally exhibited better on-time performance than buses using other freeways without preferential treatment and buses using surface streets.

Ridership

Daily bus ridership between the Westside study area and the Los Angeles CBD increased from 1,171 riders per day prior to the project to 3,793 riders per day during the last week of Diamond Lane operation. Bus ridership rose rapidly during the first month following implementation, and continued to grow throughout the project. While the growth patterns were essentially the same for both SCRTD and SMMBL, SMMBL carried 26% of the combined average daily ridership with only 15% of the total daily bus trips. By the close of the project, most of SMMBL's buses were fully occupied, and the average occupancy during the project was 41.1 riders per trip, an occupancy rate of 82 percent.

In the case of SCRTD, the average occupancy during the project was 19.2 riders per trip, or 38 percent of the available seating capacity. This figure was well below pre-project levels, and stemmed from the policy decision to provide as much service as possible early in the project to maximize the possibility of attracting ridership. While the policy appears to have had the desired effect, it also put a large number of near-empty buses in public view during the early stages of the project. As the project progressed, unprofitable runs were eliminated and SCRTD occupancy rates improved markedly.

In general, both the new feeder/express routes and those routes existing prior to the demonstration succeeded in attracting patronage from the ranks of automobile drivers during the project, and an overwhelming majority of the bus riders surveyed expressed satisfaction with the service. *By the close of the project, the eight feeder/express routes had come close to meeting the aggregate long-term demand predictions for patronage on these routes, carrying nearly 30 percent of the CBD-destined trips projected to be within walking distance of a bus line.* The three new Park-and-Ride routes, however, fell far short of expectations and were all discontinued by September 1.

After the close of the demonstration and a five-week SCRTD bus strike, ridership on those freeway routes remaining in service was 17 percent below the peak attained during Diamond Lane operations. Ridership declines were greatest on those routes reporting the longest door-to-door travel times. Ridership drops were lowest on the one SMMBL route which continued operating through the strike. By early 1977, however, none of the routes had succeeded in attaining the peak ridership levels attained during the demonstration.

Attempts to isolate the impact of the Diamond Lanes themselves on bus ridership are frustrated by the short, uncertain life of the project, seasonal patronage variations, the media blitz, frequent and major changes in bus service frequency, fare increases, and the five-week strike of SCRTD workers which followed the closing of the demonstration. Recognizing these uncertainties, it can be argued that the extent of the Diamond Lanes' influence can at least be bounded by surviving ridership levels. If, in the light of service cutbacks, fare increases and a five-week strike, subsequent ridership levels still managed to rise to within 17 percent of their peak during Diamond Lane operations, it would seem that this 17 percent figure represents a fair estimate of the maximum drawing power of the Diamond Lanes alone. This aggregate figure varies from line to line, and might have been greater had the life of the lanes not been continually threatened. *Nonetheless, although the Diamond Lanes and the attendant publicity helped to attract a portion of the observed increase in bus riders, it appears that improvements in bus system coverage and service frequency were responsible for the bulk of the observed patronage increases.*

Revenues and Costs

Prior to the systemwide fare increases introduced by SCRTD and SMMBL in July and August, the average Diamond Lane bus rider paid 41.3¢ per trip. After the increases, the average rider paid 61.3¢ per trip. The fare increases seemed to have little impact on the demand for service on the feeder/express routes. Demand for Park-and-Ride services appeared to be far more sensitive to fares than demand for other services, and the fare increases applied the coup de grace to the already disappointing Park-and-Ride ridership.

The average operating cost per rider over the length of the project was $3.49 for SCRTD and $1.52 for SMMBL. These 21-week averages mask a general downtrend. In the case of SCRTD, cost per rider declined from $4.00 to $2.50 as unproductive runs were eliminated over the length of the project.

The relatively high cost-per-rider figures are directly related to the low productivities of the vehicles in Diamond Lane service. SCRTD buses carried an average of 7.2 riders per vehicle-hour, while SMMBL reported productivities of 16.6 riders per

vehicle-hour. The explanation for these low productivities rests largely with the nature of the freeway express operation itself, with its long runs, lack of intermediate stops, limited backhaul potential, and the difficulty of generating more than one peak-period revenue run per bus.

POLICE DEPLOYMENT, ENFORCEMENT AND VIOLATIONS

Police Deployment

Highway patrol deployment doubled during the first weeks of the project, and gradually returned to normal (76 man-hours daily during the project operating hours) by the thirteenth project week. For the most part, the additional manpower used early in the project consisted of motorcycle units diverted from other freeways.

Enforcement

Although levels of police deployment returned to normal midway through the demonstration, enforcement activities remained considerably higher than normal throughout the life of the project. An average of 151 warnings and citations were issued daily, more than four times the estimated pre-project levels.

Enforcement of the Diamond Lane provisions was facilitated by the existence of a median strip where violators could be cited without being escorted across three or four lanes of traffic to the right shoulder of the roadway. Helicopter and roadside observers soon noted, however, that the use of the median for enforcement also interfered with the flow of traffic in other lanes. The use of the median for enforcement led to gawking and traffic slowdowns, particularly in the Number 2 lane adjacent to the Diamond Lane.

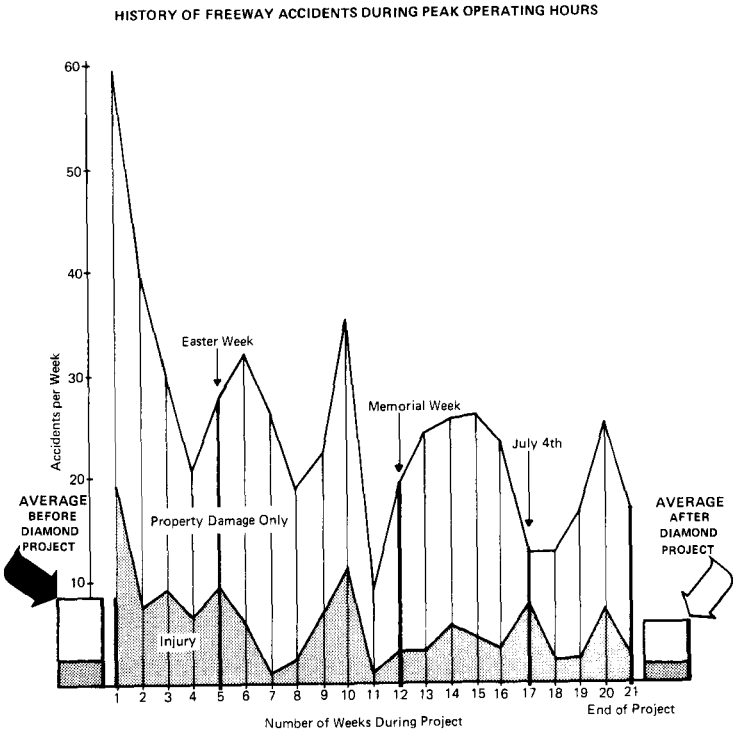
Violations

The Diamond Lane violation rate, defined as the ratio of vehicles with fewer than three occupants to the total number of vehicles in the lane, was high on the first day of the project and dropped immediately thereafter. On the opening day, 40% of all vehicles using the preferential lanes did so illegally. The violation rate then dropped rapidly, and fluctuated between 10% and 20% for the duration of the project. Most of the observed violations occurred at the fringes of the Diamond Lane operating hours.

SAFETY

Freeway Accident Patterns

One of the most disturbing aspects of the Diamond Lane project was the high incidence of freeway accidents accompanying the operation of the preferential lanes. Accidents increased markedly in the first week of the project, when 59 accidents were reported during Diamond Lane operating hours. Accident levels subsequently declined, dropping to an average of 18 accidents per week during the last month of the project, but they remained substantially higher than pre-project levels throughout the demonstration. During the 21 weeks of the demonstration, 527 accidents were reported during peak operating hours, an average of 25 accidents per week and roughly 2.5 times the pre-project average. Since accidents on the Santa Monica Freeway increased during the project while vehicle volumes decreased, the measured increases in accident levels are even more striking when expressed in terms of accidents per million vehicle-miles (accidents/MVM), a common measurement index. *Throughout the Diamond Lane project, the overall accident rate was 5.1 accidents/MVM, falling to 3.7 accidents/MVM during the last month of the demonstration. This closing rate was 2.6 times the rate of 1.40 accidents/MVM experienced during the same period in 1975.*



In addition to the absolute increases in the number of accidents occurring during project implementation, certain changes occurred in the relative pattern of accidents. The most notable of these changes was the marked increase in accidents in the Number 2 lane adjacent to the Diamond Lane. The number of accidents in this adjacent lane rose from under two accidents per week prior to the project to 14.8 accidents per week during Diamond Lane operating hours, an increase of more than 13 accidents per week. The average increase in accidents on the entire freeway during project implementation was on the order of 15 accidents per week. Thus, *a significant proportion of the overall increase in accidents was concentrated in the Number 2 lane.*

The relative incidence of rear-end accidents also increased significantly during the project, rising from 68% to 80% of all accidents, reflecting an increase in stop-and-go conditions in the non-preferential lanes -- particularly the lane adjacent to the Diamond Lane. No freeway fatalities occurred during Diamond Lane operating hours, and the relative severity of recorded accidents did not change significantly with the project.

Probable Causes of Freeway Accidents

A number of potential accident causes were postulated and analyzed in an attempt to account for the observed increase in accident levels. These included:

- Overreporting of minor accidents as a result of increased CHP presence;
- The distracting effect of CHP ticketing activities;
- Increased congestion resulting from the closing of a freeway lane to general use;
- The barrier-free operation of the Diamond Lanes at speeds well in excess of the speeds in adjacent lanes;
- The confusion, distraction and aggravation accompanying the novelty of the Diamond Lane concept; and
- Exogenous factors unrelated to the Diamond Lanes (i.e., historical citywide accident trends or a growing tendency to ignore the 55 m.p.h. speed limit).

While it is possible that each of the above factors contributed to one or more accidents during the demonstration, an analysis of these factors in the light of the accumulated accident data makes it seem unlikely that certain of the potential causes had a major influence on the accident picture. In particular, statistical analyses indicate that there is little chance that CHP reporting practices or any factors unrelated to the Diamond Lanes themselves could explain a measurable share of the accident increase.

The distracting effect of increased enforcement activities appeared to contribute somewhat to the increased accident rate. Although it is impossible to quantify the relative extent of this contribution, this factor does not seem capable of explaining a substantial share of the increase. Although the general pattern of CHP ticketing activities paralleled the overall accident pattern, and surveillance teams reported an increase in stop-and-

go conditions where tickets were being issued, the increased CHP ticketing activities do not provide a direct explanation for the remarkable increase in accidents in the Number 2 lane, and a day-by-day correlation of accident and enforcement levels during the demonstration period explains a relatively small proportion of the observed accident variation.

Although increased congestion accompanying the removal of the Diamond Lanes from general use undoubtedly contributed to the increased accident rate, it is unlikely that the accident rate would have risen substantially if the Lanes had simply been closed to all traffic. Congestion levels equivalent to those experienced during Diamond Lane operations existed on portions of the freeway prior to both the addition of an extra lane in 1967 and the introduction of ramp meters in 1974 and 1975 without causing pronounced increases in accident levels. Moreover, with the increase in carpooling and bus riding accompanying the Diamond Lanes, and the concurrent shifting of some drivers to the city streets, the total number of vehicles per hour in each of the non-preferential lanes actually dropped slightly at several locations along the freeway.

The confusion, distraction and aggravation associated with the Diamond Lanes' novelty undoubtedly helped to account for the extremely high accident levels experienced during the first two weeks of the project. Because of the shortened duration of the project, the effect of this novelty factor on accident levels during the later weeks of the demonstration can never be known with certainty. The tendency to gawk and count the heads of passing carpoolers would certainly have diminished with time, and the frustration and aggravation of single-occupant automobile drivers might also have diminished if operations in the non-preferential lanes continued to improve. It is not possible, however, to project with confidence the accident level that would have existed following a longer period of operation. After extremely heavy accident rates during the first two weeks, accident levels tended to decline over the length of the project. Although the rate of decline slowed with time, the relative number of accidents per vehicle-mile was still declining slightly when the project was terminated.

The single factor that appears to account for the largest share of the accident increase is:

- *The pronounced speed differential between the free-flowing traffic in the sparsely-occupied preferential lane and the stop-and-go traffic in congested adjacent lanes, coupled with the frequent lane changes resulting from the variety of possible origins and destinations along the length of the project.*

Under normal operating conditions, an incident-related slowdown in one lane generally results in a slowdown in all lanes. Given the reserved nature of the Diamond Lanes, however, a slowdown in the remaining lanes usually just accentuated the speed differential between the Diamond Lane and the remainder of freeway traffic, increasing the difficulty of entering and leaving the Diamond Lanes safely. Motorists attempting to enter the Diamond Lane had to enter a faster traffic stream from a slower starting speed, while motorists attempting to leave the lane had to slow and attempt to find an opening in stop-and-go traffic. This problem was exacerbated by the large variety of trip origins and destinations in the Los Angeles area, which led carpoolers to enter and leave the Diamond Lanes at many points along the freeway. Regular and occasional carpoolers responding to the driver survey cited problems merging with slower traffic in leaving the Diamond Lanes as the greatest single difficulty encountered in using the lanes, and regular carpoolers felt that the discomfort of traveling faster than vehicles in the other lanes was just as disturbing as the difficulty of merging with these vehicles. As the speed differential increased, moreover, the ability to save time by using the Diamond Lanes attracted a few violators who dodged in and out of the Lane unsafely, attempting to stay one jump ahead of the CHP.

Implications of the Accident Picture

Since the ability to travel faster in a preferential lane is the chief inducement for attracting carpoolers and bus users to that lane, the fact that this ability increased accident levels significantly on the Santa Monica Freeway raises serious questions regarding the feasibility of the barrier-free preferential lane in certain settings. These questions appear to exist whether the lane is created by reserving an existing lane, as was done on the Santa Monica Freeway, or by creating an entirely new lane, as was originally contemplated on the San Diego Freeway in Los Angeles. Conceivably, the addition of a new barrier-free preferential lane to an existing freeway could also result in increased accidents if stop-and-go traffic conditions exist in the non-preferential lane, a significant speed differential is maintained between these lanes and an underutilized preferential lane, and destinations are scattered so that carpoolers enter and exit at many points along the lane.

If the usage of a preferential lane increases with time, either because more carpools are formed or because enforcement is relaxed, the speed differential will decrease and accident levels can be expected to drop. As the speed differential drops, however, the inducement to use a preferential lane drops as well. In theory, the number of carpools should grow over time until the marginal amount of time saved by switching to a carpool exactly

balances the perceived inconvenience of making the switch. In practice, the level of accidents occurring before this equilibrium point is reached may be unacceptable to society, or the equilibrium point itself may result in an unacceptable accident rate.

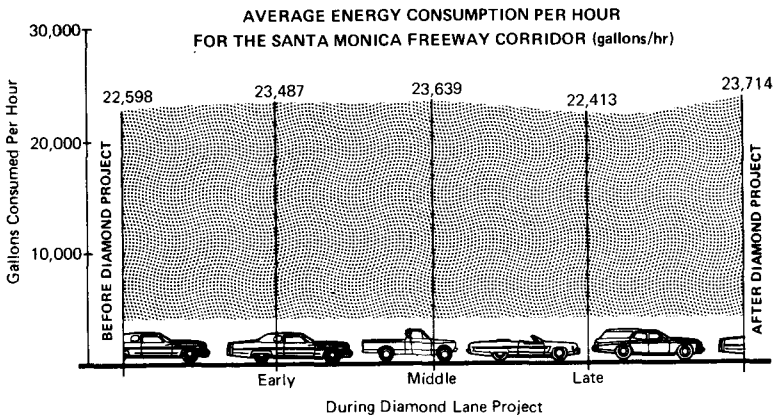
Surface Street Accidents

One of the potential side effects of the Diamond Lane project was the possibility that traffic diverted from the Santa Monica Freeway to surface streets might increase the number of accidents on those streets in the corridor surrounding the freeway. A sampling of eleven major surface routes paralleling the freeway for the first four months of the project revealed that total accidents on those streets had increased by 8.8% over the four-month period prior to the project, and increased by 5.2% over the average level experienced in a similar time period during the five years preceding 1976. *Although surface street accident levels were seen to increase slightly during the demonstration, statistical evidence linking these increases with the Diamond Lane project is inconclusive.*

ENERGY AND AIR QUALITY

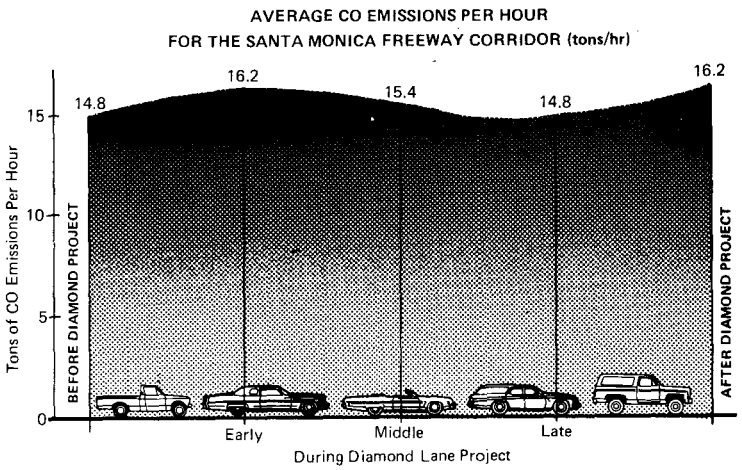
Fuel Consumption

Fuel consumption estimates based on vehicle mileage records indicate that, even allowing for increased idling time at on-ramps, gasoline consumption declined on the Santa Monica Freeway during the Diamond Lane demonstration. At the same time, fuel consumption actually increased on all parallel surface routes that were sampled. The net effect for the entire east-west corridor was a slight increase in fuel consumption of approximately 500 gallons per hour during the first fourteen weeks of the project. *By the last seven weeks of the project, the total energy consumption was 185 gallons per hour lower than the pre-project level of 22,958 gallons per hour, a savings of 0.8% over pre-project levels.*



Because of increased congestion and idling time, fuel consumption rates for non-carpoolers had increased by 6% by the close of the project. These increases were offset by the savings accompanying increases in carpool and bus usage. Each solo driver switching to a carpool or bus was estimated to save roughly eleven gallons of gasoline per week.

Air Quality



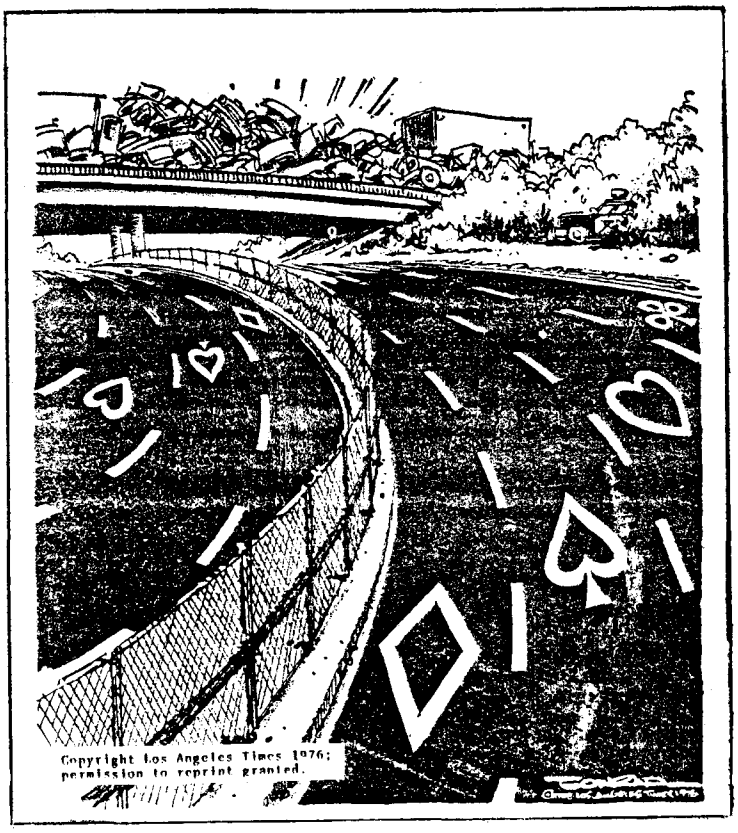
On the basis of vehicle mileage computations, corridor vehicle emissions rose early in the project and dropped to pre-project levels by the time the project closed. Measured air samples showed a general decrease in carbon monoxide concentrations during the project. In view of the small sample sizes, seasonal changes, meteorological variations, and analytic uncertainties, however, it is impossible to make conclusive statements regarding the precise impact of the Diamond Lanes on air quality.

WHAT HAPPENED OFF THE FREEWAY

Statistical summaries quoting freeway speeds, vehicle volumes, bus ridership and accident rates do not begin to convey the full picture of the Santa Monica Freeway Diamond Lane demonstration. The Diamond Lane experience was not confined between the guardrails of the Santa Monica Freeway. The demonstration quickly became a media event, generating reams of newsprint, radio and television coverage, vocal public reactions, political debate, lawsuits, banners, slogans, badges, cartoons, and at least one song. *From their implementation to their dissolution, the Diamond Lanes were never far from public view and, when in view, they were treated as an eyesore.*

Media Coverage

During the 21 weeks of Diamond Lane operation, the three major daily newspapers covering the project--the morning Los Angeles Times, the afternoon Herald-Examiner, and the Santa Monica Evening Outlook-- produced an average of nine articles and editorials per week on the Diamond Lanes. The predominant tone of the articles



was negative, and the editorials were solidly against the project. Although the operations on the freeway improved following the disastrous opening day, when the newspapers carried banner headlines proclaiming "Freeway Chaos," newspaper coverage grew steadily more hostile as the demonstration progressed. Recurring themes in the press treatment of the project were:

- The operational failure of the lanes ("A Total Flop," Times, June 11, 1976);
- The distasteful, coercive nature of the use of disincentives to encourage carpooling ("Freeway Folly," Herald-Examiner, March 11, 1976);
- Bureaucratic recalcitrance ("CALTRANS Needs Education," Valley News, April 13, 1976); and
- The credibility of the data published by the project's sponsors ("Dishonesty With Diamonds," Times, June 16, 1976).

The Diamond Lanes were also a popular subject for radio and television coverage, and provided a platform for many public figures figures seeking public exposure. As in the case of the press, the general tenor of the coverage provided by local and national radio and television stations was hostile to the project. Perhaps the most hostile and least balanced of all media coverage was provided by the radio disc jockeys, whose jibes ("you'll get home tonight if it takes all year") reached motorists while they were in the middle of their congested commuting period.

Project Promotion

Although the full extent of the public and media outcry was not anticipated by the project participants, it was recognized in advance that the Diamond Lane project was likely to generate adverse public reaction, and an extensive marketing campaign was developed with the joint aims of promoting buses and carpools and

encouraging public acceptance through a program of information and education. Given the extent of the pre-project advertising campaign, which included television and radio announcements, newspaper advertisements, the use of the changeable message signs on the freeway itself, and brochures distributed at freeway on-ramps, it is unlikely that many regular users of the Santa Monica Freeway were unaware that March 15, 1976 marked the opening of the Diamond Lanes. Although the appearance of the lanes themselves should have come as no surprise, opening day commuters did have reason to be surprised by several of the unannounced adjustments accompanying the opening of the lanes, including the tightening of ramp meter rates and the barricading of a slip ramp at the interchange of the Harbor and Santa Monica Freeways near the CBD. These unannounced adjustments undoubtedly contributed to the opening day confusion, and helped make March 15 "Mad Monday."

Following Mad Monday, the advertising campaign was drowned out by the media outcry and the project's sponsors, placed on the defensive, were able to do little to counter the tide of adverse public reaction.

Public Response

Surveys, interviews, telephone calls, newspaper polls, public hearings, and letters to newspaper editors occurring during and after the project all revealed an overwhelmingly negative public response to the Diamond Lanes. *In the most extensive survey undertaken, eighty-six percent of the corridor drivers surveyed -- including the majority of carpoolers -- felt that the Diamond Lanes were either harmful or of no benefit whatsoever.* But public response to the Diamond Lane project was not limited to such formal avenues as survey responses and letters to editors. Residents of Los Angeles managed to find unique ways of expressing their general distaste for the Diamond Lanes. On opening days, nails were spilled in the lane by a disconsolate motorist, and a "baggy bomber" used paint-filled balloons to obliterate several of the painted diamonds in the lane. On June 3, the "Citizens Against the Diamond Lane" slowed Diamond Lane users by staging a mock funeral procession in the lanes, and they later attempted to hang anti-project signs from a freeway overpass. A smaller, less vocal group of "Citizens for the Diamond Lanes" was organized and developed a newsletter to champion their cause. Entrepreneurs sold bumper stickers and badges carrying comments on the lanes, while college students offered their services as riders for a fee to drivers wishing to qualify as carpoolers, and the media reported a brisk sale of mannequins designed to gull observers into believing one driver and two dummies constituted a three-person carpool.

All of the anti-Diamond Lane activities were reported by the media, which helped to create and sustain the climate of negative public opinion. It is impossible to know whether the public outcry was generated by the negative public image, or whether the media image simply reflected public outrage. Whichever came first, both the public and the media were in full cry early in the project, and each supported the other as the attack on the lanes progressed.

Any attempt to lay the full blame for the hostile climate of public opinion on the media both oversimplifies and overstates the case. It is unlikely that the negative media reports alone could have generated such a hostile response if the reports were not reinforced by a negative impact on the lives of the public. In Los Angeles, the negative media image of the Diamond Lanes was reinforced daily for over 100,000 freeway users who found their daily commute trip lengthened by a project designed to benefit a perceptibly smaller proportion of the traveling public.

Institutional and Political Climate

Several factors contributed to the stormy political weather encountered during the Diamond Lane demonstration. These included:

- The complexity of transportation planning, financing, and decision-making in the Los Angeles area;
- The changing philosophy, policies and personnel in the State transportation agency; and
- The scheduling of the demonstration in an election year.

All of these factors combined in a setting where everyone talks about transportation conditions but few are able to do anything about them. Transportation plans have proliferated as the number of federal, state and local agencies with an interest in transportation has multiplied. Los Angeles' fragmentation of public power and authority meant that a large number of government agencies and

elected officials had some purview over the Diamond Lane project. Each decisionmaker had his own concept of project goals, and the degree of involvement and commitment to the Diamond Lanes varied greatly from agency to agency. When the media spotlight turned on the project, the public saw not a united front but a number of public agencies and elected officials pointing accusing fingers at the lead agencies, while other officials remained prudently silent. The adversary role adopted by several public agencies responsible for transportation activities hindered both the free flow of project information and the coordination of project decisions. CALTRANS, the lead agency responsible for project implementation, went from a state of flux immediately prior to the project to a state of siege during the demonstration. In the period immediately preceding the project, the agency was in a state of transition that included shifts in executive responsibility at the State level as well as sweeping layoffs locally. The shuffling of responsibilities, layoffs, and changes in management caused problems in both planning continuity and pre-project data collection. Once the project began, the new faces at CALTRANS were confronted with a new set of problems. Whereas the agency had become accustomed to public pressure over the building of freeways, the Diamond Lanes represented a new concept with a new set of aims and enough adverse side effects to lead some within the agency to question whether CALTRANS was justified in defending the project. As CALTRANS struggled to assess the operations on the freeway, deal with the hostile press, and evaluate a number of complex issues involving the project's future, an impatient press and public blistered the agency for its apparent intransigence and insensitivity to the needs of the citizens.

Public reaction and the media din were exacerbated by the frequent and public opposition of several elected and appointed City and County officials. The level of opposition ranged from responsible criticism on the part of some officials who had worked with project personnel in an attempt to make the Diamond Lanes more acceptable to their constituents to simple attempts on the part of other officials to align themselves publicly with the opposition to a clearly unpopular project. Responsible opposition and objective analysis had to clamor for a hearing alongside of simplistic arguments, emotional appeals, and self-serving electioneering. The Diamond Lanes even became a pawn in the election-year battle for the approval of funds for a rapid rail system in Los Angeles (STAMP OUT DIAMOND LANES: VOTE YES FOR RAPID TRANSIT). In the face of the opposing clamor from the media, public, and elected and appointed officials, those officials who might have favored the project found it prudent to remain silent, and little in the way of a constructive public dialogue emerged. There is little doubt that the continual public threats to the Lanes' existence led many potential carpoolers to deter any commitments to shared riding until the opposition was silenced and the project achieved a more permanent status.

The Legal End

Although the life of the Diamond Lanes was continually being threatened by the media and the public, and State and local officials had drafted terminating legislation, the demonstration was eventually done in by what at the time seemed the least likely suspect, a lawsuit in the U.S. District Court of Appeals. The lawsuit only indirectly addressed the merits of the project, focusing instead on the alleged failure of CALTRANS and UMTA to comply with the requirements of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) by filing an Environmental Impact Report on the project. On Monday, August 9, 1976, Judge Matthew Byrne ruled that Environmental Impact Reports should have been filed under both State and national environmental laws, and ordered that the freeway be returned to pre-project status by Friday, August 13, 1976.

OBSERVATIONS AND IMPLICATIONS

The Santa Monica Freeway preferential lane project succeeded to some degree in attracting riders to carpools and transit, and increased the person-moving capacity of the freeway without requiring additional levels of police deployment. However, the project brought about a significant increase in freeway accidents, non-carpoolers lost far more time than carpoolers gained, and a heated public outcry developed which has halted the implementation of other preferential treatment projects in Southern California, giving planners and public officials in other areas ample cause for reflection before attempting to implement similar projects.

The Negative Impact of Lane Removal

Whereas other preferential lane projects have constructed additional lanes or converted lanes in off-peak directions to preferential use, the Santa Monica Freeway Diamond Lane project marked the first time preferential lanes were created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles. This aspect of the project contributed to most of the negative impacts recorded during the demonstration. The removal of two lanes from general use contributed heavily to the congestion and confusion on opening day, was a slight but important factor in the increased accident rate,

and appears to have been one of the chief sources of public dissatisfaction with the project. Many freeway users felt strongly that they had paid for the lanes with their gasoline taxes and were entitled to go on using them. The lane preemption and the resulting slowdown were viewed with hostility by most corridor drivers, who appeared to perceive the preemption as a plot to force individuals out of their own cars, a plot designed by meddling bureaucrats to inconvenience many for the sake of a few. Moreover, the number of project beneficiaries were perceived to be even fewer than their numbers indicated because they traveled three-to-a-car, or rode in buses that were often half-empty, and did not fill the Diamond Lanes to capacity.

The Effect of Geographic Sprawl

Because of the scattering of trip origins and destinations throughout Los Angeles, relatively few users of the Santa Monica Freeway are destined for the CBD. The lack of a focal point for trip destinations made carpool formation relatively difficult and decreased the pool of potential riders of the CBD-directed bus service. In practice, the scattering of origins and destinations also meant that drivers were likely to want to enter and leave the Diamond Lanes at points all along their 12.5-mile length. The need to enter and leave the lanes at many different points greatly increased the possibility of accidents and made freeway operation less safe than it might have been if all drivers had exited at a common destination with provisions for safe merging.

Accidents and the Absence of Barriers

Another aspect of the Diamond Lane demonstration that contributed to the project's disappointing performance was the absence of barriers between the preferential lane and the congested adjacent lanes. Frequent vehicle shifts in and out of lanes operating at markedly different speeds contributed heavily to the increase in accidents. The problem of accidents in barrier-free operation is a serious one, and deserves further study. In other areas, and in Los Angeles itself, preferential treatment lanes separated from the general flow of traffic have been successful in improving carpool and bus ridership without increasing either accident rates or public acrimony.

The Success of Ramp Metering

One positive aspect of the Santa Monica Freeway experience which has been largely ignored was the performance of the ramp meters in allevaiting freeway congestion and smoothing traffic flow before, during and after the project. Prior to the project, the meters alone had so improved freeway traffic speeds that the Diamond Lanes suffered somewhat by comparison. The Diamond Lanes themselves offered only a marginal one- or two-minute improvement at best over the meter-controlled speeds generally available to

all traffic prior to the project. Conditions in the non-preferential lanes did not approach metered pre-project levels, although freeway speeds with both ramp meters and Diamond Lanes operating were faster than speeds when neither the meters nor the lanes were operational. Where available, moreover, carpool bypass lanes on the on-ramps offered more of a time savings to carpools than the Diamond Lanes themselves. *Thus, the ramp meters bypasses, which were safer and--surveys showed--less objectionable to the public than the Diamond Lanes, actually offered a greater time savings to carpoolers than the preferential freeway lanes, while the meters themselves improved freeway traffic flow.*

The Question of Credibility

One of the most serious controversies emerging during the demonstration turned on the question of data credibility. The sponsoring agencies were collecting data as the project progressed, and CALTRANS became the source for disseminating project statistics. As "CALTRANS' project" came under attack, so did the data it issued. Other agencies began drawing different conclusions from the CALTRANS data, and some local groups--including the press itself--began collecting and issuing their own data. The free-form use of different numbers and different reference bases during the demonstration made it difficult for the public to know who or what to believe, and led the press to question the credibility of project participants. The credibility of project foes was rarely questioned by the media.

Under the best of circumstances, there will always be some degree of ambiguity associated with traffic data. In many instances, statistics concerning the Diamond Lane project were produced under the worst of circumstances, having been hurriedly processed under rigid deadlines in the glare of publicity, and interpreted by agencies with a vested interest in attacking or defending the project. Problems encountered in the data collection and evaluation phases of the project ranged from simple human miscalculations to complex computer failures. In retrospect, the picture of the project that emerges from a more thorough examination of the data is somewhat different from that presented by both proponents and opponents of the project in the midst of the "battle of numbers" waged during the demonstration itself.

S U M M A R Y

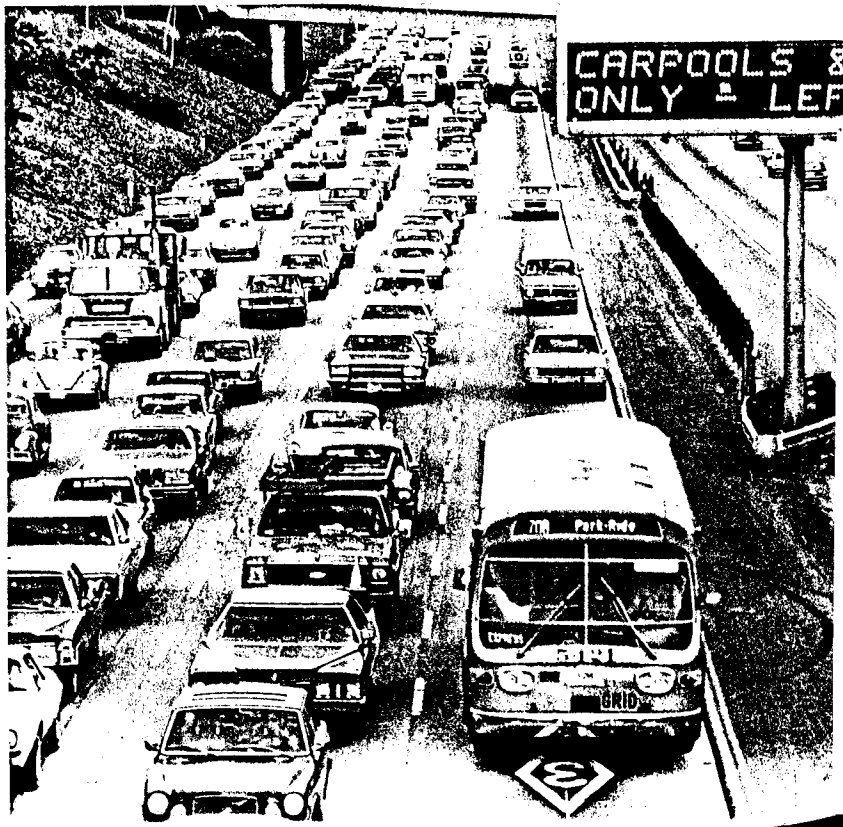
1.1 INTRODUCTION

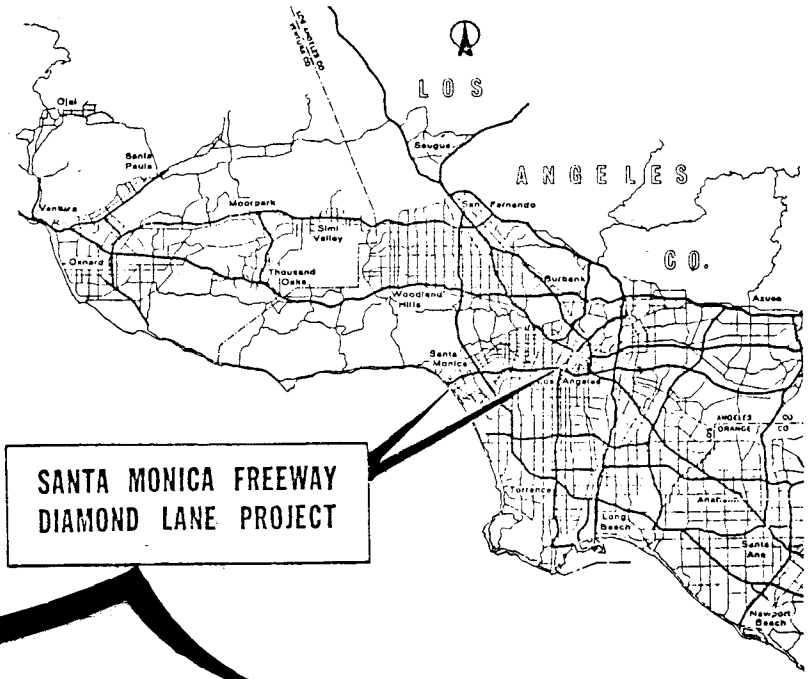
1.1.1 Project Overview

The Santa Monica Freeway, which connects the City of Santa Monica and downtown Los Angeles, is one of the most heavily-traveled freeways in the world, and is served by a variety of sophisticated traffic devices, including metered on-ramps with preferential entry provisions at selected locations for two-person carpools, a computerized surveillance system, and centrally-controlled electronic displays. On March 15, 1976, the median lane in each direction of a twelve-mile, eight-lane segment of the Santa Monica Freeway was reserved for the exclusive use of buses and carpools carrying three or more occupants. The reserved lanes, known locally as the Diamond Lanes, operated in each direction during the peak hours of traffic flow. No barriers separated these lanes from the remaining flow of freeway traffic. Implementation of the Diamond Lanes was accompanied by the introduction of a variety of express bus services and the opening of three new Park-and-Ride lots in Western Los Angeles.

The Diamond Lane project was jointly sponsored by the California Department of Transportation (CALTRANS), the Southern California Rapid Transit District (SCRTD), the Santa Monica Municipal Bus Lines (SMMBL), and the California Highway Patrol (CHP) in an effort to improve air quality, reduce energy consumption, and increase effective freeway capacity by increasing the occupancy of buses and automobiles using the freeway. Other local agencies participating in the project included the Los Angeles Police Department (LAPD), the Los Angeles Department of Traffic (LADT), the Office of the Mayor of Los Angeles, the Southern California Association of Governments (SCAG), the Los Angeles County Road Department, and Commuter Computer, a local non-profit organization providing carpool-matching service.

The Santa Monica Freeway project marked the first time preferential lanes had been created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles. Although the Diamond Lanes entailed no major modifications or construction on the freeway itself, they generated considerable physical and emotional dislocation among freeway drivers and other residents of Los Angeles. The project neither started nor ended on schedule. The original starting date was delayed, first for three months and later for an additional six months, by a combination of concerns including operational readiness, financial problems, a local dispute over the implications of nationwide labor protective agreements, and the Southern California rainy season. When the Diamond Lanes finally opened in March 1976, the first day of operations was disastrous, featuring bumper-to-bumper traffic, long queues at on-ramps, many acci-





SANTA MONICA FREEWAY
DIAMOND LANE PROJECT

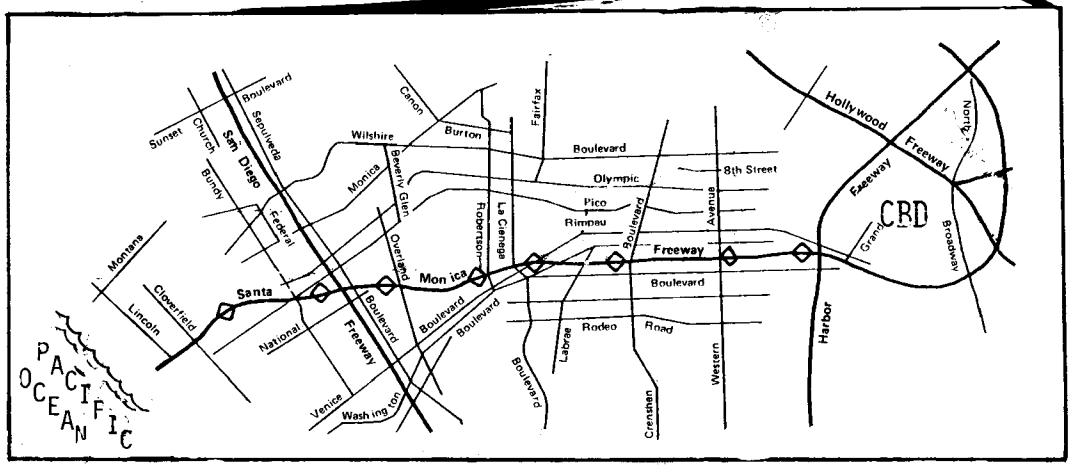


EXHIBIT 1.1
OVERVIEW OF PROJECT AREA

dents, outraged drivers, poor press notices, and derisive news commentary. As the project progressed, freeway performance improved somewhat and both bus and carpool ridership increased, but accidents remained a problem and the climate of public opinion and media reaction grew more hostile. The preferential lanes operated amid much controversy for 21 weeks until August 9, 1976, when Judge Matthew Byrne of the U.S. District Court in Los Angeles halted the project and ordered additional environmental studies prior to its continuation.

Judge Byrne's decision focused primarily upon legal requirements for environmental impact analyses and reports, and did not deal directly with the merits of the project itself. The ruling did not adversely affect either the ramp meters or the carpool bypass lanes on selected freeway on-ramps. These currently continue to operate, along with most of the express bus service introduced with the Diamond Lanes.

The dedication of an existing freeway lane to high-occupancy traffic was a controversial measure with equally controversial impacts, of interest not only in Los Angeles but throughout the United States. To ensure that the full range of these impacts would be measured and evaluated with a high degree of statistical precision, the federal Urban Mass Transportation Administration (UMTA), acting through the Transportation Systems Center (TSC), has sponsored a detailed evaluation of the Diamond Lane project as part of its Service and Methods Demonstration (SMD) Program. This report contains the results of that evaluation.

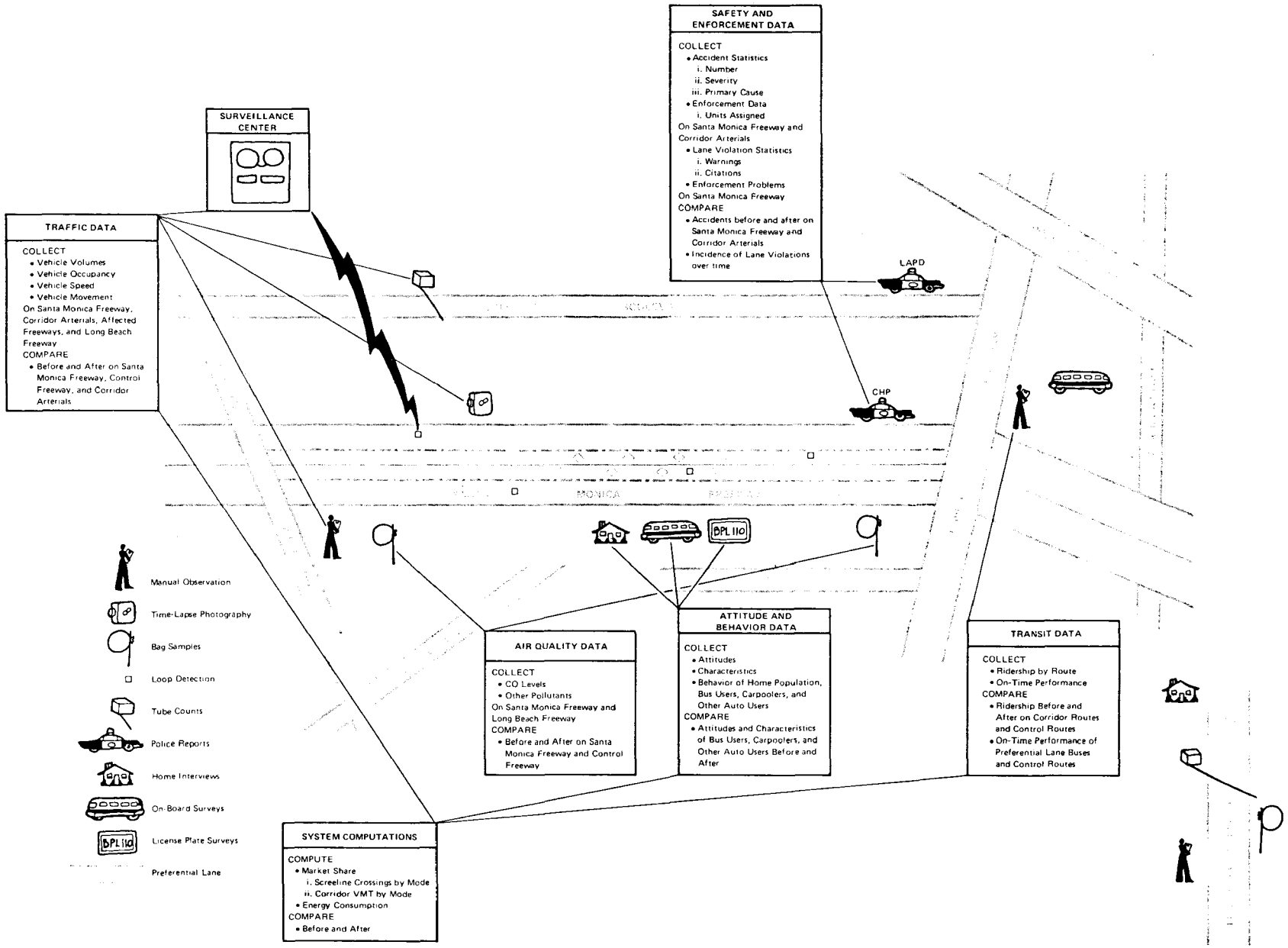
1.1.2 Evaluation Overview

1.1.2.1 The Original Evaluation Plan

Prior to the Diamond Lane demonstration, SYSTAN, Inc. prepared an evaluation plan[2] designed to address the key issues surrounding the demonstration and to provide a quantitative assessment of the full range of project impacts. Exhibit 1.2 shows each of the major categories of data to be sought, itemizes the major data elements within each category, depicts the data collection instruments to be employed, and specifies certain of the critical comparisons to be made in analyzing the collected data. The major categories of data sought in the demonstration evaluation were classified as follows:

- Traffic data;
- Transit data;
- Safety and enforcement data;
- Air quality data; and
- Attitude and behavior data.

EXHIBIT 1.2: OVERVIEW OF THE EVALUATION PROCESS



1.1.2.2 Implementing the Plan

Under the evaluation plan, data collection responsibilities were divided among the many local agencies responsible for implementing the project itself. Once the field data were collected, SYSTAN undertook an independent review and analysis of all data elements, assessed the validity and applicability of the data, developed independent summaries, performed the statistical tests and comparisons specified in the evaluation plan, analyzed the results of these comparisons, and prepared the current report. Although the report would not have been possible without the cooperation and assistance of the local agencies in assembling field data, SYSTAN assumes full responsibility for the data tabulations and conclusions presented herein.

Prior to the project and in the early stages of the Diamond Lane demonstration, the evaluation generally followed the detailed evaluation plan. Certain deviations occurred prior to the project that reflected the shifting of project responsibilities and manpower shortages within CALTRANS. As the demonstration progressed, additional adjustments in the basic evaluation plan were made to focus on questions of interest, make the best use of available manpower, respond to the need for operational decisions and public information, and capture perishable data as a hedge against the possibility that the project might be closed without warning. The sudden closing of the project in August interrupted the evaluation in midstream and necessitated a number of significant changes in the structure of the evaluation plan. One such change entailed the collection and analysis of an extensive body of data following project termination to document any lasting changes in carpool use and bus ridership, and to shed additional light on the nature and source of impacts recorded during the demonstration.

1.1.2.3 Coping With the Cut-Off

The abrupt termination of the demonstration proved to be somewhat damaging to the evaluation process, but far from fatal. Judge Byrne's decision terminated the project before a steady state had been reached, before the end of summer vacation had returned traffic conditions to a state comparable to that recorded prior to the project, and before adequate data samples had been collected in certain areas, notably the area of air quality. The termination of the project also closed off the evaluator's ability to explore new avenues of investigation suggested by the initial results of the data analysis. Nonetheless, contingency planning made it possible to conduct most of the surveys specified in the evalution plan, a considerable quantity of data was amassed during the project to shed some additional light on the effects of the Diamond Lanes themselves.

With a few exceptions, more than enough data were collected to document exactly what happened during the five months the project was in operation. The chief effect of the abrupt termination of the demonstration, and the hullabaloo surrounding the project, was to cloud the evaluators' ability to interpret the data in terms that are unambiguous and meaningful for other jurisdictions interested in the potential application of preferential lanes. The most serious analytic drawbacks stemming from the project's premature termination are listed below:

- The Threat of Termination. From the first day of the project, the possibility of termination was openly admitted by project administrators, pondered by planners, prescribed by the press, and pleaded for by most of the public. It is impossible to assess with any precision the effect that the apparently temporary nature of the project had on carpool buildup and bus ridership. Clearly, the threat of termination must have dissuaded some lone drivers from the often significant steps necessary to form a carpool, but it is impossible to gauge the precise impact of this threat in discouraging carpooling.

- Termination in Transit. The demonstration was terminated at a time when such critical measures as carpool ridership, bus patronage and speeds in the non-preferential lanes were all displaying slight but distinct upward trends. There is no way of knowing how long these trends would have continued to improve project performance before a steady state was reached. In the case of the El Monte busway, ridership continued to grow for three years before reaching a plateau. Similarly, the abrupt termination makes it impossible to know whether the accident rate would have decreased with time, and hence frustrates the analyst's ability to determine the precise extent to which the increased rate might be traced to the newness of the project and the gawking accompanying this newness.

- The Midsummer Misfit. All pre-project data reflect travel conditions during the winter, with full school and employment rosters contributing to the commuting problem. The evaluation plan called for all major measurements to be made under similar conditions, and the final round of data collection activities was originally scheduled for the winter of 1976. The midsummer termination date means that the last two months of demonstration data were taken under conditions that are not strictly comparable with the pre-project data

base. Thus, what appears to be a decline in traffic volumes on surface streets may be a natural consequence of the vacation season, rather than the result of driver decisions to return to the freeway. Similarly, late-project increases in carpoolers may be family vacationers or groups of beachgoers that would disappear with the winter months.

- The Not-Quite-Ample Sample. In some cases, the abrupt project termination cut off data collection activities before a sufficient quantity of data could be amassed to ensure the desired level of statistical significance. This was particularly true in the case of air quality measurements.

The above considerations are cited as a warning to the reader that the sudden closing of the demonstration had an effect on the evaluation which must be recognized in interpreting the analytic findings contained in this report.

1.1.3 Report Organization

1.1.3.1 Summary Chapter

Section 1 of this report has been designed to stand on its own as a summary of the Diamond Lane evaluation, and contains many illustrations and analyses treated in more detail in later sections. The remainder of Section 1 summarizes findings within each of the major data classifications. Traffic speeds and travel times are summarized in Section 1.2, while Section 1.3 addresses traffic volumes and the formation of carpools and Section 1.4 summarizes bus operations and ridership. Police deployment, law enforcement and traffic violations are discussed in Section 1.5, while Section 1.6 addresses the key issue of safety. Section 1.7 summarizes findings regarding air quality and energy consumption. Each summary subsection dealing with a major data classification is followed by a short listing of the key findings within that classification. The summary concludes with a description of what happened off the freeway (Section 1.8) and a discussion of the implications for other areas.

1.1.3.2 Overview Chapters

Following the Section 1 summary, Sections 2, 3, and 4 of the report present overviews of, respectively, the project itself, the Los Angeles setting, and the evaluation strategy. The project overview of Section 2 lists project objectives and contains a chronological history of important events in the planning and implementation of the demonstration. The site overview of Section 3 describes the Westside Los Angeles area primarily affected by

the demonstration, while the evaluation overview of Section 4 discusses evaluation strategy, implementation procedures, and the implications of the abrupt project termination on evaluation findings.

1.1.3.3 Major Evaluation Subjects

Each of the sections following the overview discussions addresses one of the major subjects identified in the evaluation plan. Section 5 chronicles the traffic conditions in the freeway corridor before, during, and after the Diamond Lane demonstration, and explores the effect of these conditions on such aspects of motorist behavior as carpool formation, route choice, and trip scheduling. Section 6 deals with bus operations and ridership, while Section 7 examines the effect of the demonstration on accident levels on and off the freeway and reports on police deployment levels, enforcement activities and the rate of Diamond Lane violations.

1.2 TRAFFIC SPEEDS AND TRAVEL TIMES

1.2.1 Summary of Operational Changes

The reservation of the Diamond Lanes for use by buses and carpools was accompanied by other changes designed to ease the traffic problems created by removing one lane in each direction from general use. These changes included the opening of a new CBD on-ramp at Flower Street for the exclusive use of buses and carpools, significant lengthening of the metering rates governing flow at selected freeway on-ramps, and the erection of a temporary barricade restricting the flow of vehicles between the Harbor and Santa Monica Freeways. Whereas the coming of the Diamond Lanes and the opening of the exclusive on-ramp were well-publicized in advance of the March 15 implementation date, the accompanying changes in metering rates and barricade placement were not so well publicized. Consequently, these accompanying changes came as a surprise to most motorists when they were introduced, and helped to contribute to the controversy, confusion, and frustrations of the early weeks of the project. By the time the project was two weeks old, it appeared that the controversial Harbor interchange barricade was creating more congestion and confusion than it alleviated, and the barrier was replaced by a metered signal on the transition roadways between the southbound Harbor Freeway and the Santa Monica Freeway. Another major change occurred on May 17, when the morning hours of Diamond Lane operation (originally scheduled from 6:00 to 10:00 A.M.) were changed to 6:30 to 9:30 A.M. Minor adjustments were made in ramp metering rates throughout the project.

Under the jurisdiction of the Los Angeles City Department of Traffic (LADT), several improvements were introduced on certain surface streets paralleling the freeway to ease the flow of traffic diverted to these parallel arterials during the Diamond Lane demonstration. These changes included signal timing adjustment, signal coordination, and the introduction of peak-hour parking prohibitions. Preferential left-turn pockets permitting buses and two-person carpools to turn left into on-ramps with preferential bypass lanes were initially installed at six locations, and subsequently opened to all traffic during the fourth week following project implementation.

1.2.2 Vehicle Speeds and Travel Times

The dedication of the Diamond Lanes to the use of buses and high-occupancy vehicles, and the accompanying changes in ramp metering rates and interchange configurations, had a marked impact on vehicle speeds on the Santa Monica Freeway. The speeds of vehicles using the Diamond Lanes were significantly faster and

steadier than the speeds of vehicles in the remaining non-preferential lanes, which were in turn generally lower than those experienced on the freeway prior to the initiation of the demonstration.

1.2.2.1 Non-Preferential Lanes

Table 1.1 records the average travel times and speeds measured in the non-preferential lanes between 6:30 and 9:30 A.M. and between 3:00 and 7:00 P.M. before, during and after the Diamond Lane project. Prior to the project, a little more than 18 minutes was required to make the westbound trip from Grand Avenue to Lincoln Boulevard. During the early weeks of the Diamond Lane project, this time increased by as much as eight to ten minutes, as the increased accident levels and congestion around the Harbor Freeway interchange slowed traffic considerably. As the project progressed, westbound freeway speeds improved noticeably until, by the last seven weeks of the project, the average travel time in the non-preferential westbound lanes during the peak period had dropped to 19.5 minutes, slightly over one minute longer than the pre-project average.

In the eastbound direction, speed runs made approximately one year prior to project initiation show average travel times of 22.7 minutes between Lincoln Boulevard and Grand Avenue. However, these speed runs were made prior to the activation of ramp meters designed to improve the flow of traffic in the eastbound direction. Following the installation of eastbound ramp meters, computer records for one week in October 1975 show that the average peak-hour eastbound travel times between Lincoln Boulevard and Grand Avenue had dropped to 15.7 minutes. These travel times rose again to 21.3 minutes during the early weeks of the Diamond Lane demonstration. By the fourteenth week of the project, this time had dropped to 18.8 minutes, but eastbound speeds did not improve further as the project progressed, and the average travel time recorded over the length of the project was 20.2 minutes. Although this represented a slight improvement over the travel times recorded prior to the initiation of ramp metering, it was roughly 4.5 minutes longer than the meter-controlled travel times experienced just before project initiation.

The travel times and speeds tabulated in Table 1.1 represent an average of measurements made over the duration of the morning and evening Diamond Lane operating hours. Since speeds and travel times varied considerably throughout the morning and evening peak, the speed of the individual motorist was heavily dependent on the hour at which he chose to travel. Exhibit 1.3 breaks down the average travel time measurements in half-hour intervals during the morning and evening peaks for two separate time periods before the Diamond Lane demonstration (before and

TABLE 1.1: AVERAGE FREEWAY TRAVEL TIMES AND SPEEDS IN NON-PREFERENTIAL LANES

Time Period	Lincoln to Grand EB 6:30-9:30 AM		Grand to Lincoln WB 3:00-7:00 PM	
	Time (Min.)	Speed (MPH)	Time (Min.)	Speed (MPH)
Before Diamond Lanes				
• Before Eastbound Ramp Metering	22.7	36.2	18.4	43.6
• After Eastbound Ramp Metering	15.7	50.6		
During Diamond Lanes				
• First Seven Weeks	21.3	39.1	25.3	32.0
• Second Seven Weeks	18.8	43.8	20.8	39.2
• Last Seven Weeks	20.5	41.1	19.5	41.9
• Average During	20.2	41.3	21.5	37.7
After Diamond Lanes	17.7	45.0	16.7	46.9

after eastbound ramp metering) and for the last seven weeks of Diamond Lane operations. The exhibit shows not only the mean travel time but also the standard deviation about the mean, a measure of the day-to-day variability encountered in traveling on the freeway.

With the installation of eastbound ramp meters in May and October 1975, that portion of the morning commute trips spent on the Santa Monica Freeway became both shorter and more predictable. The greatest time savings occurred between 7:30 and 8:30 A.M., when more than eight minutes were cut from the eastbound trip. The subsequent introduction of the Diamond Lanes in early 1976 had the opposite effect. Travel times became longer and less predictable, although the average times remained less than those experienced prior to ramp metering.

Measurements made in the westbound direction reflect similar patterns. In this case, the sample speed runs made in February and March of 1975 were made after the introduction of meters on the westbound ramps, so that the travel times during this period reflect the effects of metered control. With the introduction of the Diamond Lanes, travel times increased during each half-hour interval, and the variability of these times increased as well. As the project progressed, westbound travel times improved and grew more predictable, although neither the consistency nor the high average speeds experienced prior to the project had been attained by the last seven weeks of the project. Exhibit 1.3 also highlights the difference between the average travel time over the entire four-hour evening peak and the average travel time actually experienced by motorists during any portion of that four-hour period. Whereas the average peak period travel time during the last seven weeks of Diamond Lane operations was 19.5 minutes, the average travel time experienced by non-carpooling westbound motorists traveling during the peak half-hour between 5:30 and 6:00 P.M. was 25 minutes. The difference between the average travel time measured over the full span of Diamond Lane operating hours and the actual travel time experienced by motorists during the peak travel times, coupled with the greater uncertainty associated with travel during Diamond Lane operations, helps to explain some of the skepticism with which freeway users viewed the average statistics reported while the project was still in progress.

1.2.2.2 Preferential Lanes

Freeway sensors located in the Diamond Lanes themselves recorded an average speed of 54.3 miles per hour during the demonstration. These speeds did not vary appreciably over the life of the demonstration, either by hour or direction of travel. In general, the lanes were empty enough to provide a clear route of passage to buses and carpools. Buses and carpools did experience some delays in reaching and leaving the Diamond Lanes, causing the average speed for the total trip between Lincoln and Grand to drop below

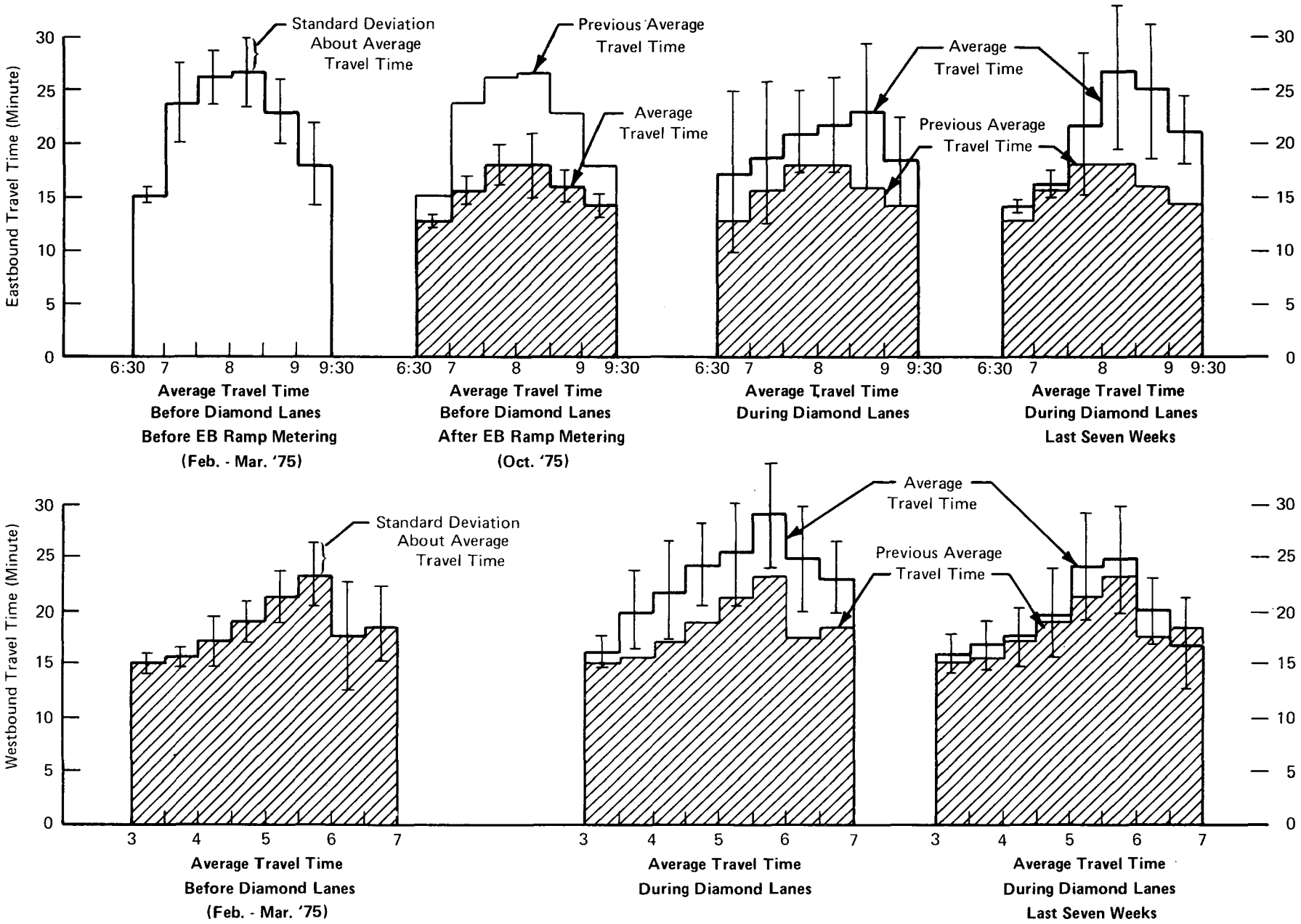


EXHIBIT 1.3

SANTA MONICA FREEWAY TRAVEL TIMES IN NON-PREFERENTIAL LANES

(Lincoln to Grand; 12.93 Miles)

54.3 miles per hour. The average speed recorded by drivers making the eastbound trip between Lincoln and Grand in the morning was 52.8 miles per hour, resulting in a trip time of 14.7 minutes. In the westbound direction, congestion at the Harbor Freeway interchange slowed carpoolers trying to reach the Diamond Lanes in the evening and added approximately one minute to the return trip from Grand to Lincoln. The average speed for the return trip was 49.4 miles per hour, resulting in a trip time of 15.6 minutes.

1.2.2.3 Surface Streets

Speed measurements on six surface street routes paralleling the Santa Monica Freeway revealed a slight drop in surface street speeds of roughly 4.5% during the Diamond Lane demonstration. In the morning, eastbound speeds on all parallel arterials dropped from 27 to 26 miles per hour while, in the evening, westbound speeds dropped from 24 to 23 miles per hour. Slower speeds on parallel surface streets were judged to be statistically significant on only one of the six routes examined, Washington Boulevard, where speeds between Lincoln and Grand dropped by 11% during the demonstration.

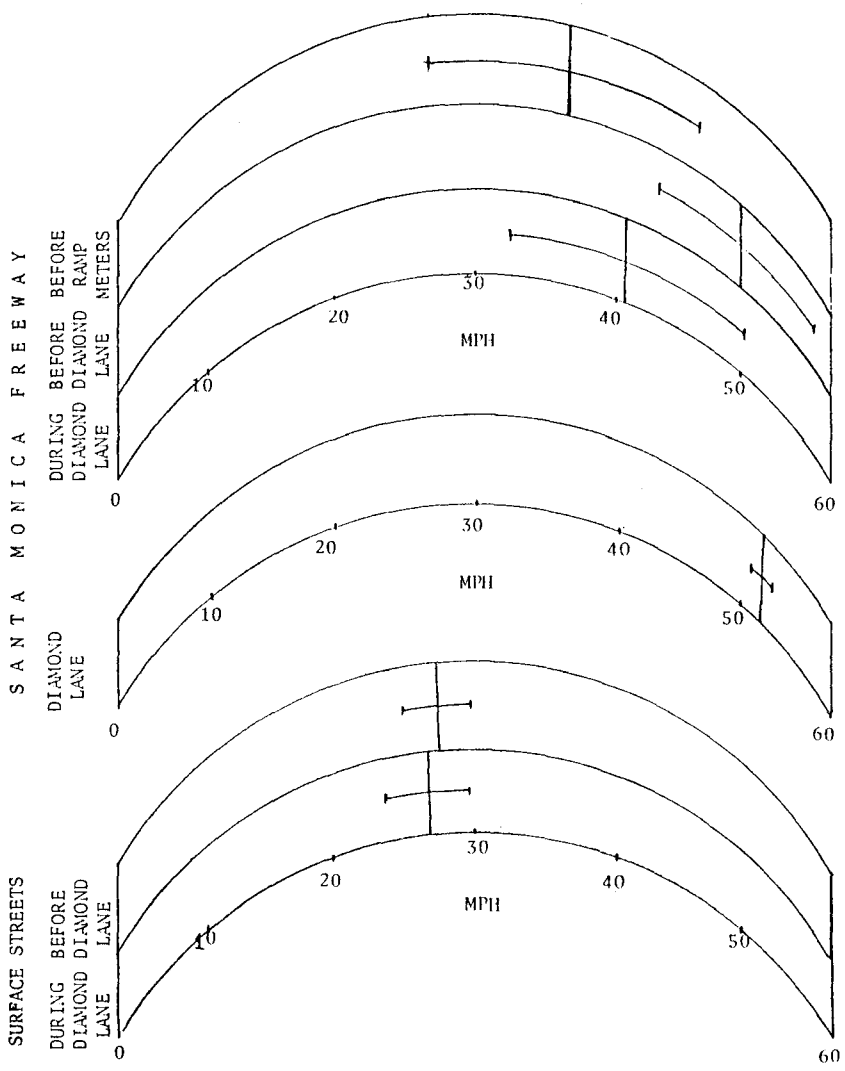
Prior to the project, there was concern that vehicles backing up from the freeway on-ramps might impede the flow of traffic on north-south surface streets perpendicular to the freeway. Speed measurements made by the LADT on six such streets in the vicinity of the freeway before and during the demonstration showed few significant changes. Average speeds for southbound traffic in the morning actually rose by 10% during the project, perhaps reflecting declines in traffic volumes as some drivers avoided the freeway and its north-south access routes.

1.2.2.4 Speed Comparisons

Exhibit 1.4 compares average travel speeds between Lincoln Boulevard and Grand Avenue for traffic on surface streets, in the Diamond Lanes and in the non-preferential lanes of the Santa Monica Freeway for the morning hours of Diamond Lane operation. Travel speeds in the non-preferential lanes are shown before the installation of ramp meters in May 1975, after the installation of these ramp meters, and before the Diamond Lane demonstration. Comparison of these speeds shows that the installation of ramp meters significantly improved general freeway speeds, which then deteriorated with the introduction of the Diamond Lanes. Even with the deterioration, however, general speeds during Diamond Lane operation were higher than those experienced prior to the installation of ramp meters. Whereas the Diamond Lane provided a substantial advantage to eastbound travelers during the demonstration, offering average speeds 11.5 miles per hour faster than those available to general traffic for the morning trip between Lincoln and Grand, the Diamond Lanes' advantage over the meter-controlled speeds generally available prior to the demonstration was far less pronounced. The lanes permitted carpoolers traveling the length of the project in morning to save only one or two minutes over pre-project travel times.

EXHIBIT 1.4

A.M. EASTBOUND TRAVEL SPEEDS



P.M. WESTBOUND TRAVEL SPEEDS

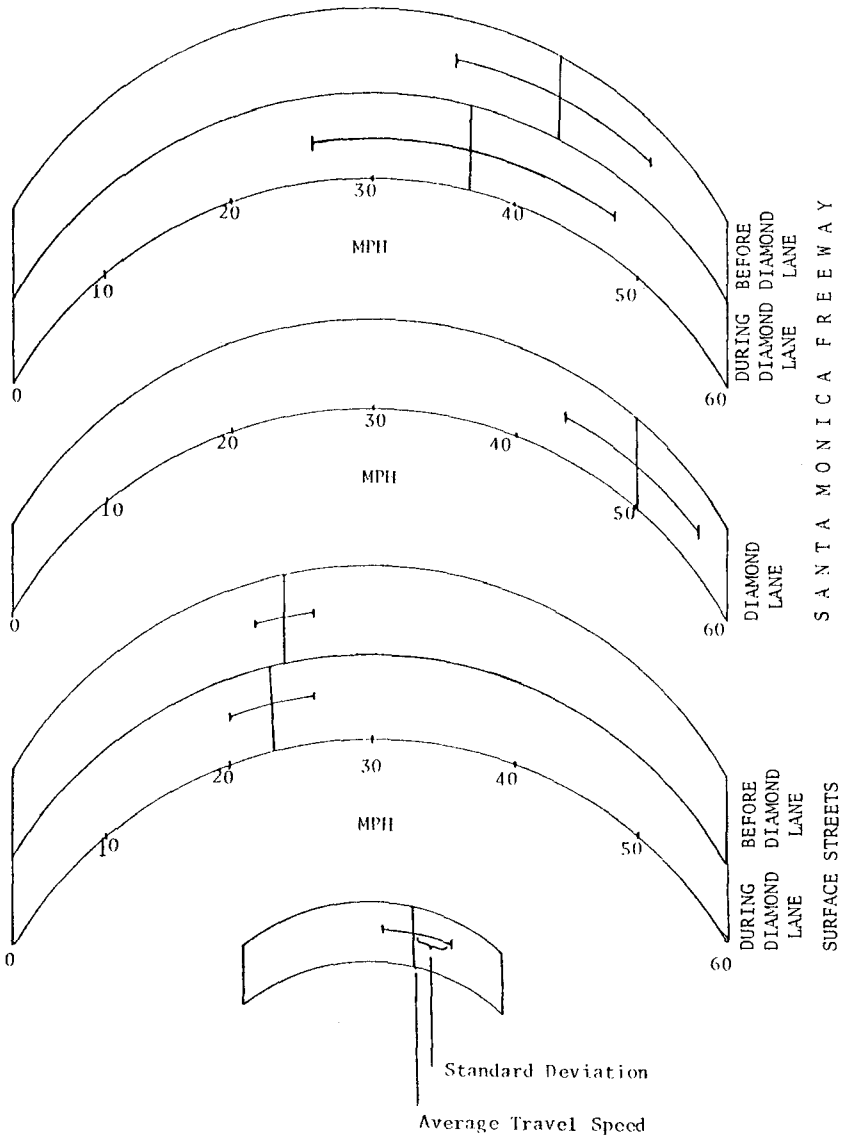


Exhibit 1.4 provides a similar comparison for westbound traffic during the evening rush hour. In the westbound direction, the Diamond Lanes offered travel at a speed 11.7 miles per hour faster than travel in the non-preferential lanes. This represented a saving of six minutes for the trip from Lincoln to Grand, and a savings of roughly three minutes over travel times experienced prior to the project. Westbound delays in the non-preferential lanes during the evening hours of Diamond Lane operation were particularly marked at the eastern end of the freeway, between Grand and Western Avenues. Several surface routes offered travel times comparable to those attainable on the freeway between Grand and Western Avenues during the evening rush hour.

1.2.3 Entry Ramp Conditions

Traffic signals installed on the Santa Monica Freeway on-ramps are used to control the number and spacing of cars entering the freeway during the peak morning and evening hours. These signals limit traffic entering the freeway from surface streets to a fixed rate of flow designed to allow the freeway to carry a maximum number of vehicles at speeds between 35 and 50 miles per hour. At the start of the Diamond Lane demonstration, the signals controlling traffic at the 30 entry ramps serving the Santa Monica Freeway within the project limits were all activated by fixed time-control devices capable of introducing a limited number of pre-selected metering rates during any 15-minute interval. The meters serving the westbound lanes of the Santa Monica Freeway had been in operation since July 1974, while those serving the eastbound lanes were introduced in May and October 1975. At 12 of the 30 metered entry ramps, preferential access lanes installed at approximately the same time as the meters permitted buses and vehicles with two or more occupants to bypass the meter system.

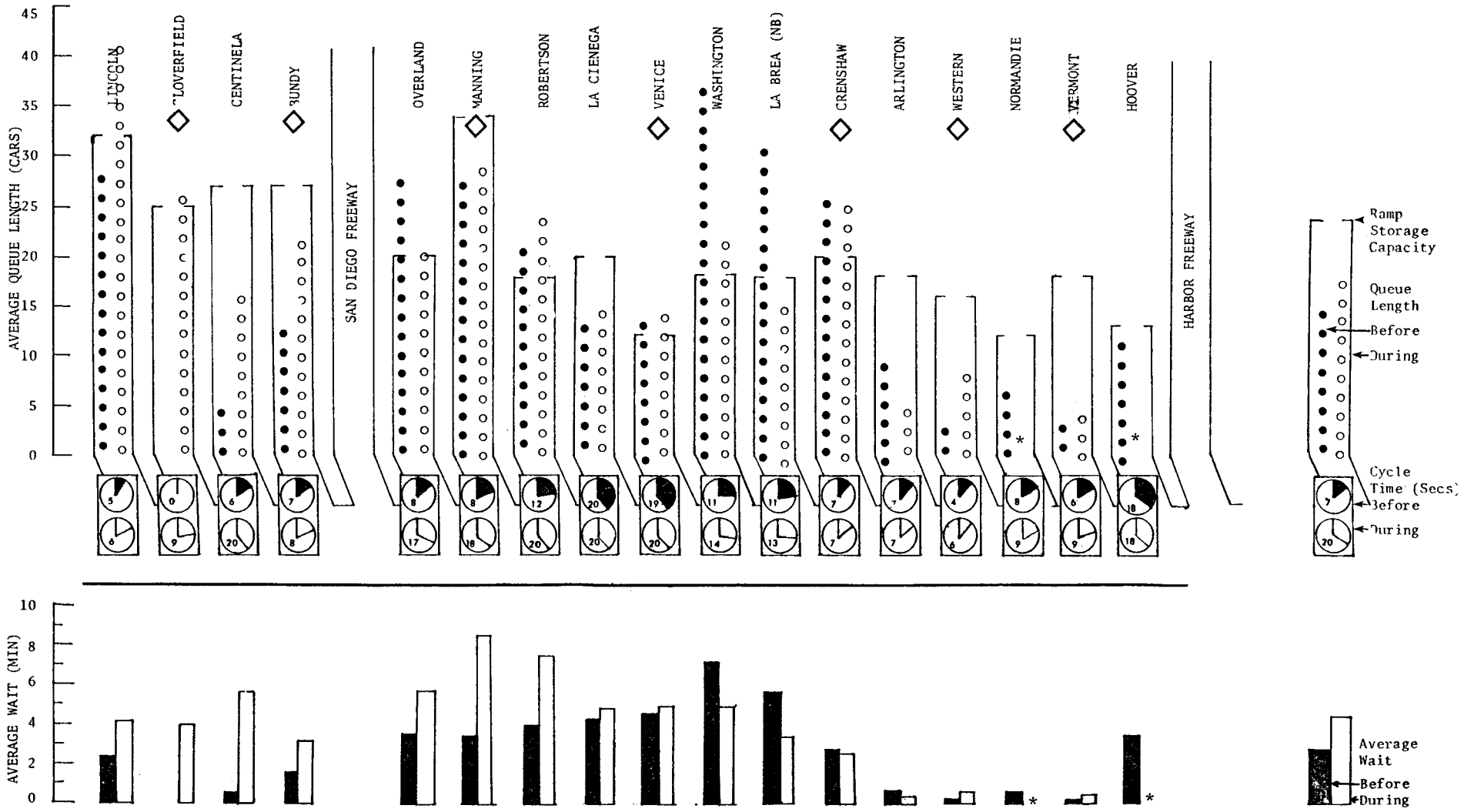
Metering rates on most freeway access ramps were adjusted during the week preceding the opening of the Diamond Lanes. In some instances, these adjustments represented severe departures from pre-project conditions. The adjustments were designed to alleviate the freeway congestion caused by the proposed Diamond Lane restrictions and, in most cases, increased the length of time motorists were required to wait in queues before entering the freeway. As the project continued, metering rates were readjusted in response to actual traffic conditions. The slight adjustments to metering rates made during the project were generally attempts to fine-tune the system, and did not match the sweeping changes made before opening day in either the magnitude of the adjustments or the number of ramps affected. In late May, the fixed-time meters at the eastbound Manning and Overland ramps were replaced with traffic-responsive signals whose timing was self-adjusted in response to the flow rates sensed by the vehicle detectors on the freeway itself. Under the heavy traffic conditions prevalent during most of the Diamond Lane operating hours, these traffic-responsive meters were set to operate in the fixed-time mode. During the off-peak hours and those early and late portions of the peak period when traffic was relatively light, however, the two traffic-responsive meters significantly reduced ramp delays.

1.2.3.1 Eastbound Ramps

Exhibit 1.5 shows the average delays, queue lengths, and metering rates experienced during the peak hour between 7:00 and 8:00 A.M. on the eastbound ramps of the Santa Monica Freeway before and during Diamond Lane operations. The metering rates displayed in the exhibit represent the duration of each red-and-green signal cycle, and consequently reflect the time each individual automobile waits at the head of a metered lane. In response to the metering changes accompanying the Diamond Lane project, statistically significant increases in total waiting times were observed at the seven on-ramps at the western end of the freeway, as well as at the Western Avenue on-ramp. The largest peak-hour increases in ramp delays were observed at Centinela (a 5.0-minute increase, 1053% over pre-project delays), Manning (a 5.2-minute increase, 152% over pre-project delays), Cloverfield (a 3.9-minute increase, where no delay had previously existed), and Robertson (a 3.7-minute increase, 92% over pre-project delays).

At five on-ramps from La Cienega eastward (La Cienega, Washington, northbound La Brea, Crenshaw, and Arlington), statistically significant decreases in waiting times were recorded. Project-related changes in metering rates at these on-ramps were minimal, so that the decreased waiting times may be traced to declining ramp volumes, which dropped on the easternmost ramps as drivers, presumably discouraged by the increased freeway travel times, began to make more use of adjacent city streets for shorter trips. Sampling rates were too light to support statistically significant statements regarding the remaining on-ramps east of La Cienega Boulevard. Once the confusion and adjustments of the first week were past, few changes in eastbound ramp delays were observed during the peak hour between 7:00 and 8:00 A.M. That is, during the hour of heaviest usage, ramp delays did not improve as the project progressed. Delays experienced over the full four-hour morning peak period were reduced somewhat at the Lincoln, Overland, and Manning on-ramps as the project progressed, however. Reductions were particularly striking at the Overland and Manning ramps, where traffic-responsive ramp meters cut delays significantly during the more lightly-traveled portions of the morning peak (before 7:00 A.M. and after 9:00 A.M.). In addition to changing ramp delays, the changing metering rates and traffic patterns on the eastbound Santa Monica Freeway also changed the lengths of the queues waiting at each eastbound on-ramp. During the peak morning hour, average queue lengths increased at every eastbound on-ramp west of La Cienega Boulevard except the Overland on-ramp, though the percentage increase in queue length was typically not so great as the percentage increase in waiting time. Prior to the project, the average peak-hour queue length had exceeded ramp capacity at six of the observed locations (Overland, Robertson, Venice, Washington, Crenshaw, and northbound La Brea). During the project, the Cloverfield and Lincoln on-ramps were added to this list, and average queue lengths on the La Brea on-ramp dropped within the ramp storage capacity. Ramp overflows occurring during the project did not appear to worsen traffic conditions on a sampling of north-south streets, where speeds remained substantially the same

EXHIBIT 1.5 : PEAK HOUR QUEUE LENGTHS EASTBOUND
(6:00 A.M. to 10:00 A.M.)



*No data available.

◇ Indicates ramp has carpool bypass lane for vehicles with two or more occupants.

before and during Diamond Lane operations. Anticipated problems at the three on-ramps (Cloverfield, Bundy, and Crenshaw) where preferential left-turn pockets were provided failed to materialize, primarily because queue lengths did not increase dramatically beyond the storage capacities of the ramps, and the turning restriction were removed on April 8.

1.2.3.2 Westbound Ramps

Exhibit 1.6 shows the queue lengths, metering rates, and average delays experienced during the peak period between 3:00 and 7:00 P.M. on the eight westbound ramps of the Santa Monica Freeway located east of La Cienega Boulevard before and during Diamond Lane operations. Statistically significant increases in peak period waiting times were observed at all of these eight ramps as a result of the metering changes and traffic shifts accompanying the project. The largest measured peak-period increases in westbound ramp delays were observed at the Vermont (a 4.0-minute increase, 147% above pre-project delays), Hoover (a 3.7-minute increase, 167% above pre-project delays), and Fairfax/Washington (a 3.0-minute increase, 164% over pre-project delays) on-ramps. Delays at two of the westbound ramps -- Hoover and La Cienega -- were monitored closely as the project progressed, and peak-period delays at these ramps decreased slightly over the length of the project. At both ramps, the time of day during which peak delays were encountered appeared to be earlier during the project than before the project.

Average ramp queues increased on six of the eight observed westbound ramps during the project, although the increase in queue lengths was not so pronounced as the increase in ramp delays. In all cases, the average queue lengths encountered during the project were no more than one car beyond ramp capacity, and the measured queue lengths did not appear to cause additional interference with traffic on north-south feeder roads. As in the case of eastbound ramps, anticipated problems failed to materialize at three on-ramps (Vermont, Western, and Crenshaw) where preferential left-turn pockets were provided, and the left-turn pockets were opened to general traffic on April 8.

1.2.4 Total Trip Times

1.2.4.1 Total Measured Freeway Trip Times (Eastbound A.M.)

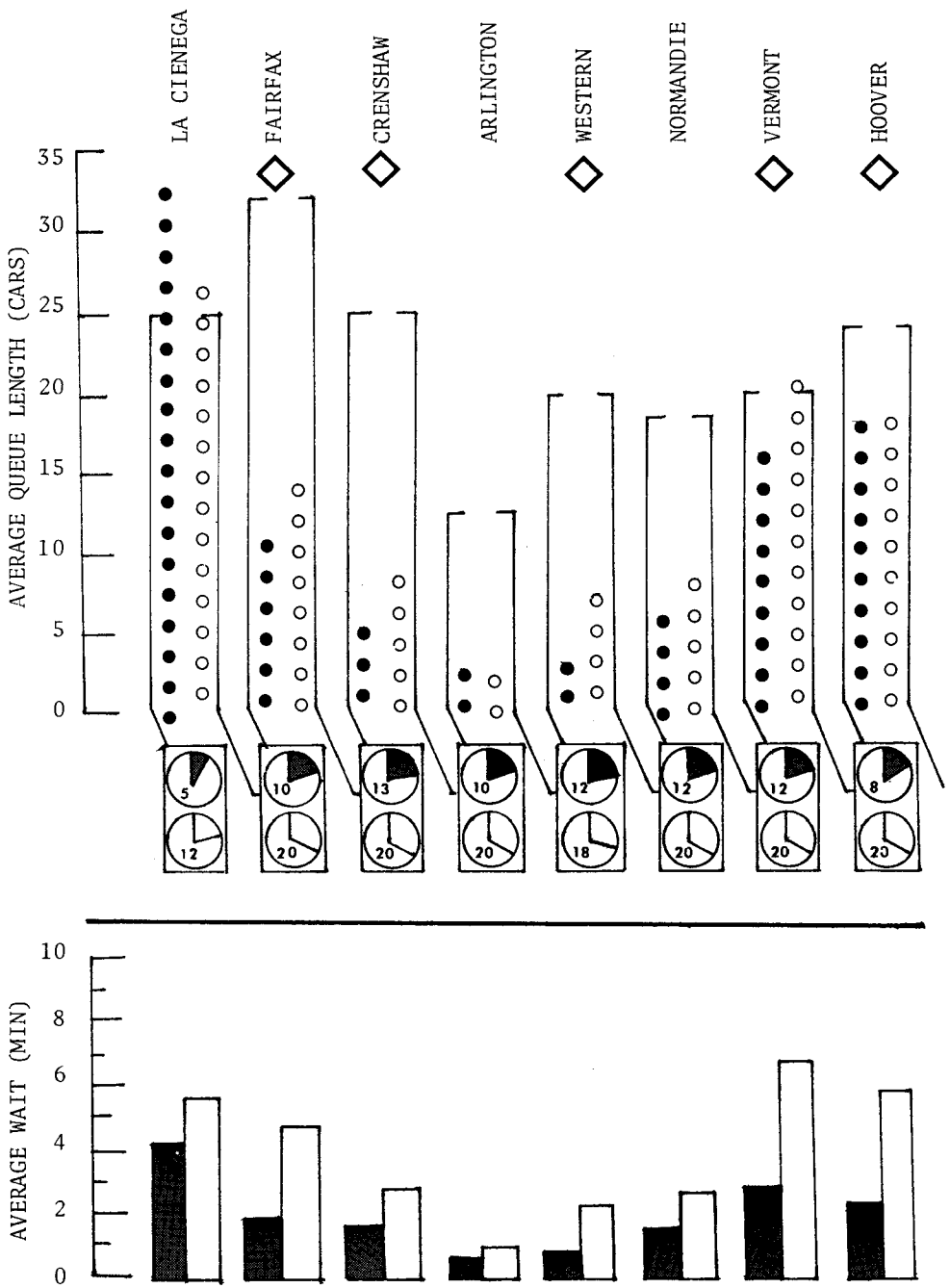
Both ramps delays and freeway driving times can be combined to develop a picture of total freeway trip times. Exhibit 1.7 combines average ramp delays and average driving times for the three-hour morning peak trip from each of 15 eastbound ramps to the CBD. Combined total freeway trip times are shown for the single driver, the two-person carpool, and the three-person carpool for the period (1) preceding ramp metering, (2) after ramp metering but before the demonstration, and (3) during the demonstration. For the single driver, total freeway trip times increased at 12 of the 15 on-ramps with the start of the demonstration. Increases ranged from as high as six minutes per trip at the western end of

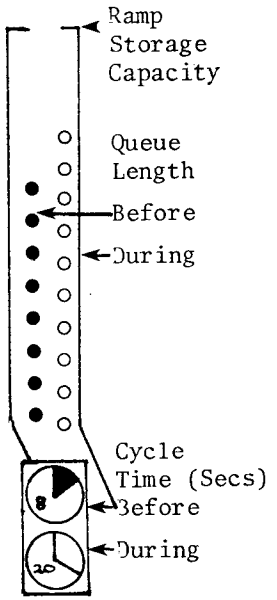
EXHIBIT 1.6

PEAK PERIOD QUEUE LENGTHS

WESTBOUND

(3:00 P.M. TO 7:00 P.M.)





◇ Indicates ramp has carpool bypass lane.

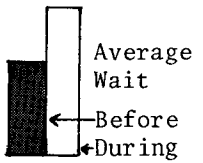
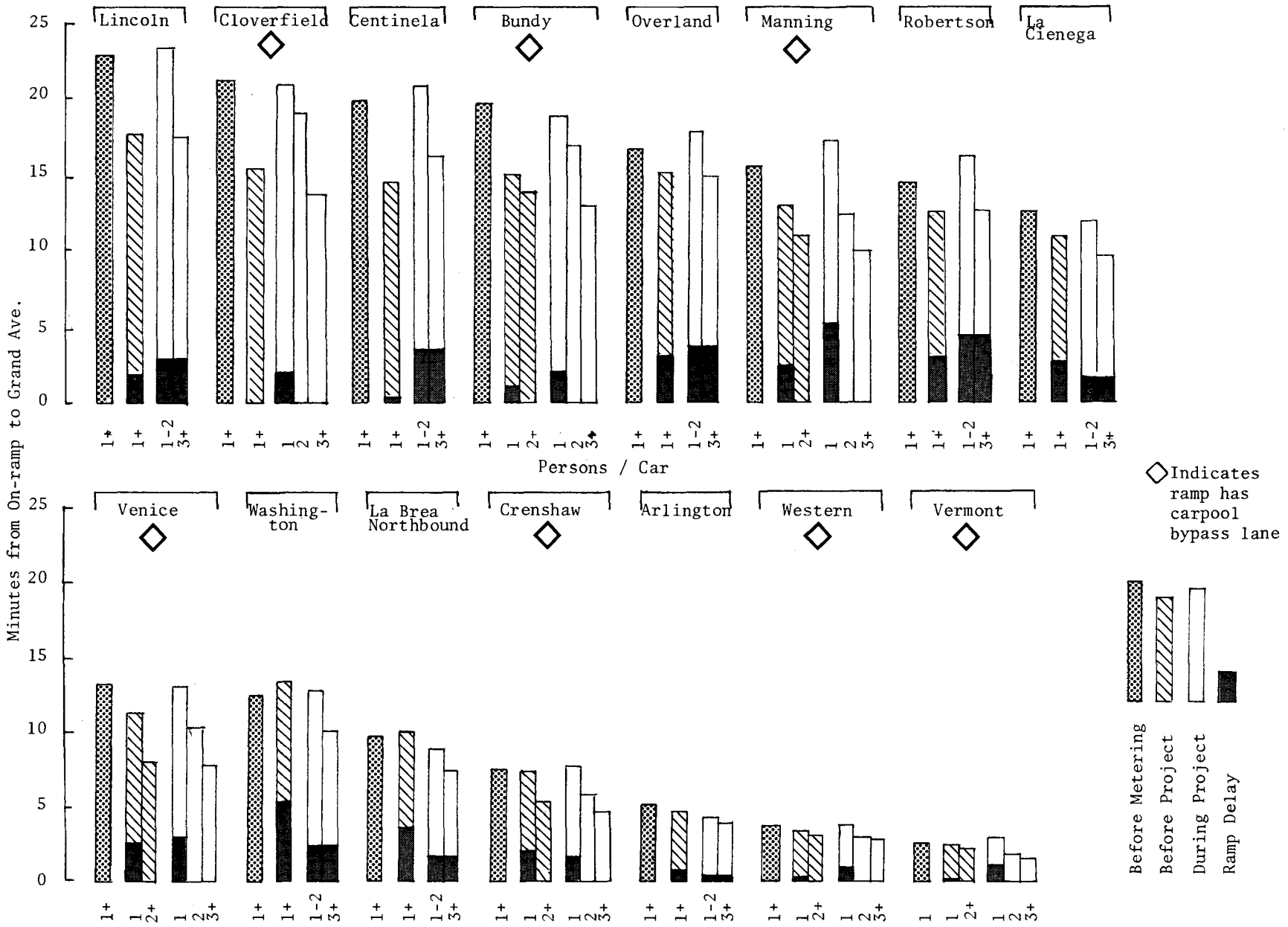


EXHIBIT 1.7: TRAVEL TIMES FROM ON-RAMP TO GRAND AVE.

EASTBOUND A.M. PEAK PERIOD



the freeway to negligible increases at on-ramps near the CBD. At three ramps (Western, northbound La Brea, and Arlington), single drivers experienced minimal decreases of less than one minute of travel time, as decreases in ramp delays outweighed driving time increases. At two of these ramps, Washington and La Brea, total trip times had increased for the single driver with the introduction of ramp metering. At all other ramps, however, ramp metering resulted in a net decrease in total trip times, even for the single driver. For the two-person carpooler able to take advantage of ramp bypasses, total trip time increased at ten of the 15 ramps shown. Increases ranged from six minutes at the western end of the freeway to minimal near the CBD, but averaged about one minute less than those measured for the single-occupant automobile.

At 13 of the 15 eastbound on-ramps, carpools with three or more passengers experienced a decrease in travel time with the initiation of the Diamond Lanes, so that travel times were less than both pre-ramp metering and pre-project travel times. Total trip savings from pre-project to project were greatest (3.4 minutes) for carpools entering at the Washington on-ramp, and averaged slightly more than one minute over all on-ramps, with larger decreases felt by those carpools traveling longer distances. No change occurred at the Robertson on-ramp, while travel time increased at Centinela, where the increased meter delay offset the advantage gained from using the Diamond Lane to travel to the CBD.

At each of the eastbound ramps with a bypass lane for carpools and buses, the amount of time saved by using the ramp bypass exceeded the amount of time saved by traveling in the Diamond Lane from the on-ramp to downtown Los Angeles. That is, the total delays imposed on single-occupant automobiles on the on-ramps were greater than those imposed by the Diamond Lane itself.

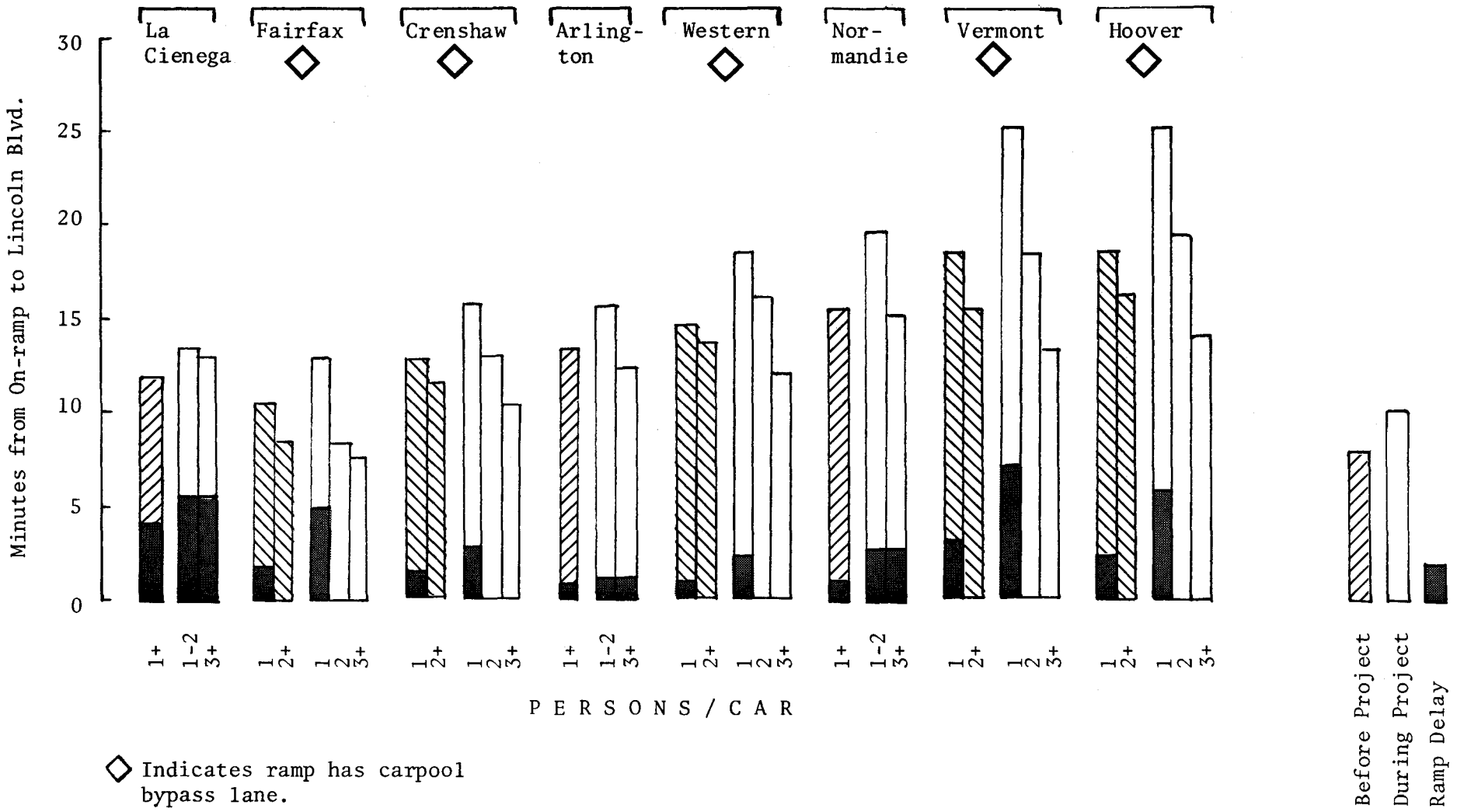
1.2.4.2 Total Measured Freeway Trip Times (Westbound P.M.)

Total freeway trip times for westbound drivers are graphed in Exhibit 1.8. The travel times combine average driving time and average ramp delay from each of eight on-ramps to Lincoln Boulevard.

Single drivers realized r increase in travel time at each of the eight on-ramps east of La Cienega Boulevard. Increases ranged from nearly seven minutes at Hoover and Vermont to 1.2 minutes at La Cienega, generally decreasing from east to west. Travel time for two-person carpools also increased at all ramps except at Fairfax, where the travel time decreased very slightly (.04 minute).

At all ramps except La Cienega, travel times decreased slightly with savings averaging 1.4 minutes for westbound carpools of three or more people. At La Cienega, where ramp delays were very high and no bypass lane existed, the travel time increased by a little over 1/2 minute.

EXHIBIT 1.8: TRAVEL TIMES FROM ON-RAMP TO LINCOLN BLVD. (WESTBOUND P.M. PEAK PERIOD)



◇ Indicates ramp has carpool bypass lane.

1.2.4.3 Perceived Trip Times

The average door-to-door trip reported by a sampling of 2,800 corridor drivers in response to the corridor driver survey was 21 miles long, and took 37.4 minutes in the morning and 43.2 minutes in the evening. These times correspond to average effective trip speeds of 34.0 miles per hour and 29.5 miles per hour, respectively, where effective trip speed is defined as the average trip length divided by the average travel time. Freeway users' trip lengths averaged 6.5 miles longer than city street users' trip lengths, and three-person carpoolers' trip lengths averaged 3.7 miles longer than non-carpoolers.

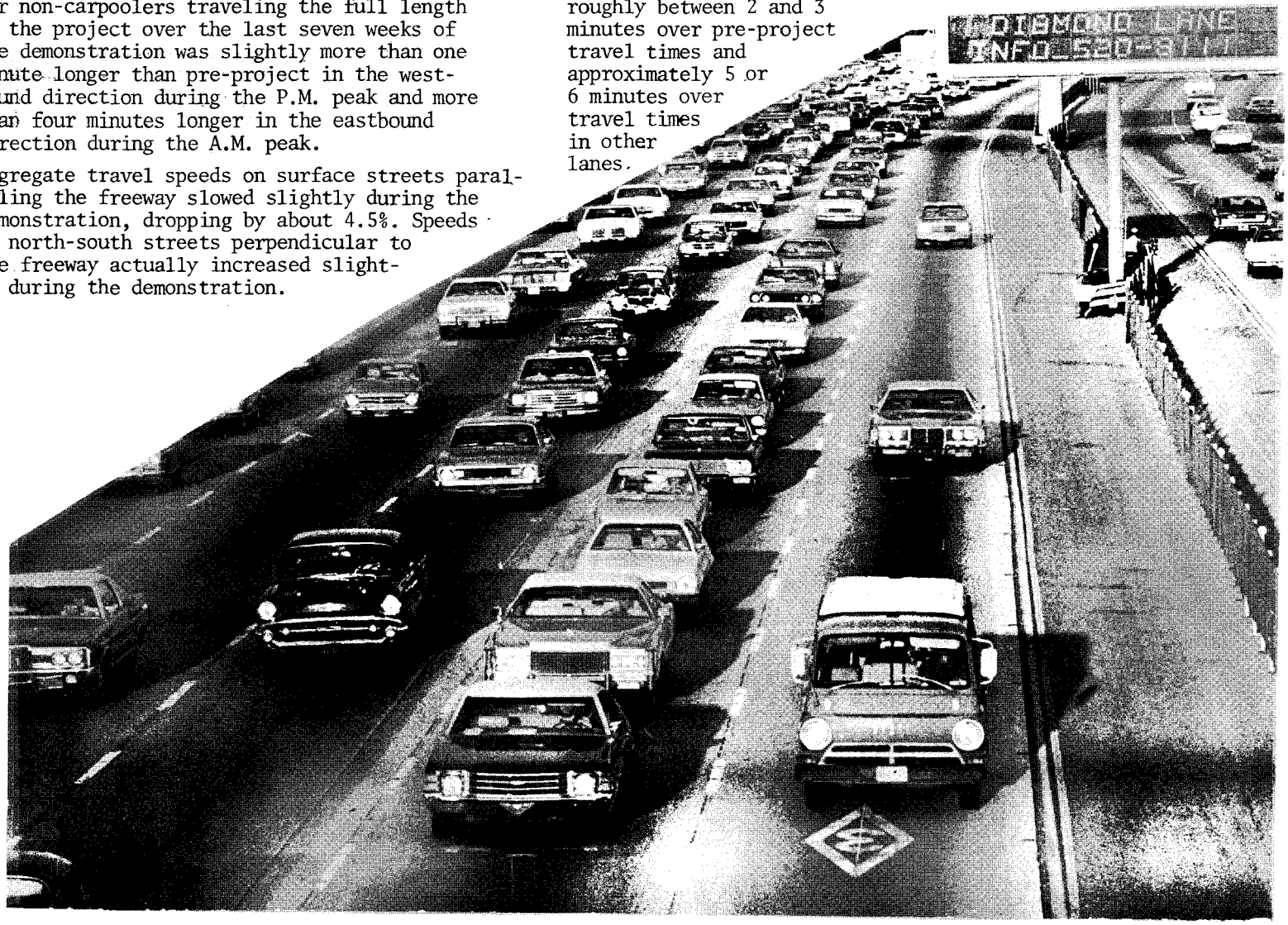
Survey respondents were asked to specify those conditions of their usual trip that changed during the operation of the Diamond Lanes. These conditions included length, starting time, and travel time for both the A.M. and P.M. trip. The average reported change in trip length was positive, but less than one mile for all groups.

The average change in trip starting time due to the Diamond Lanes was 5.0 minutes earlier in the morning and 0.8 minutes later in the evening. These figures indicate that people generally started five minutes earlier to get to work on time in the morning, but did not stay at work longer and probably could not leave work earlier in the evening. Freeway users changed their A.M. starting times more than city street users, and non-carpoolers adjusted more on the average than carpoolers. Similarly, travel times increased more for freeway users than city street users, and non-carpoolers reported much greater increases in travel times than three-person carpoolers, who reported a collective travel time decrease of 1.5 minutes per trip. This travel time savings is consistent with measured travel times before and during Diamond Lane operations.

The perceived increase in total travel time reported by non-carpoolers was 8.3 minutes. For work trips, this change is consistent with the change in starting time. The P.M. travel time increase was reported to be slightly greater than the A.M. increase, with an average of 9.4 minutes. These perceived increases are higher than freeway measurements indicate is likely, and include a number of impossibly high estimates (greater than 30 minutes) of average trip delays. Not unsurprisingly, non-carpoolers appear to have over-estimated the average delays accompanying the Diamond Lane demonstration, although measurements indicate that the delays encountered by a non-carpooler traveling the length of the project could have averaged as much as six to seven minutes per trip. Given the increased uncertainty accompanying travel in the non-preferential lanes, moreover, delays on any single day could have been much higher than this average figure.

SUMMARY OF VEHICLE SPEEDS

- During the Diamond Lane demonstration, freeway speeds for non-carpoolers were both slower and less predictable than they were before the demonstration. Although speeds improved as the demonstration progressed, freeway driving time for non-carpoolers traveling the full length of the project over the last seven weeks of the demonstration was slightly more than one minute longer than pre-project in the westbound direction during the P.M. peak and more than four minutes longer in the eastbound direction during the A.M. peak.
- Aggregate travel speeds on surface streets paralleling the freeway slowed slightly during the demonstration, dropping by about 4.5%. Speeds on north-south streets perpendicular to the freeway actually increased slightly during the demonstration.
- Speeds recorded by carpoolers in the Diamond Lanes were both faster and more consistent than pre-demonstration speeds. Carpoolers traveling the length of the Diamond Lanes were able to save roughly between 2 and 3 minutes over pre-project travel times and approximately 5 or 6 minutes over travel times in other lanes.

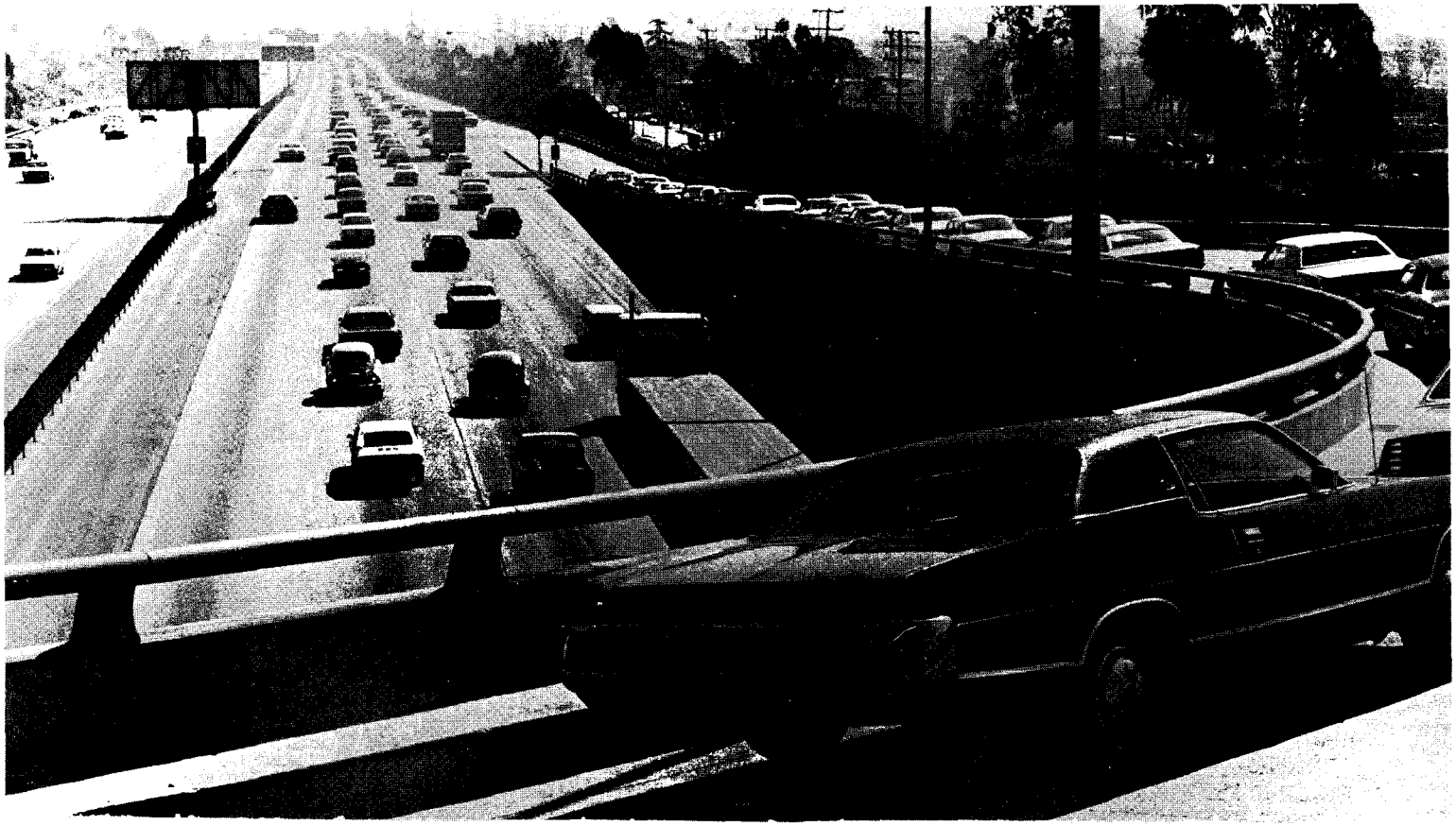


SUMMARY OF ENTRY RAMP CONDITIONS

- Metering rates on most freeway access ramps were adjusted prior to the demonstration. In most cases, these adjustments increased the length of time motorists were required to wait before entering the freeway.
- Bypass lanes at metered ramps saved buses and vehicles with two or more riders between 2 and 7 minutes per trip.
- Waiting times at the eastbound ramps most distant from the CBD increased significantly during the project, particularly between 7 and 8 A.M. During this time, increases at the 7 westernmost ramps ranged between 2 and 5 minutes per car.
- Average increases in ramp queue lengths were not so pronounced as the increases in ramp waiting times, and the increases did not appear to cause additional interference with traffic on north-south feeder roads.
- Average delays at the westbound ramps nearest the CBD were found to increase between 1 and 4 minutes per car between 3 and 7 P.M.

SUMMARY OF TOTAL TRIP STATISTICS

- Following the demonstration, the average door-to-door trip reported by a sampling of 2,800 corridor drivers was 21 miles long and took 37.4 minutes in the morning and 43.2 minutes in the evening.
- Carpooler's trip lengths averaged 3.7 miles longer than non-carpoolers.
- Carpoolers reported an average savings of 1.5 minutes over pre-project travel times with the implementation of the Diamond Lanes.
- Measured increases in total trip times for non-carpoolers traveling eastbound on the freeway in the A.M. ranged from six minutes per trip at the western end of the freeway to negligible increases at on-ramps near the CBD.
- Increases for travelers entering at various westbound ramps ranged from 7 minutes per trip near the CBD to insignificant delays west of La Cienega Boulevard.
- At each of the ramps with a bypass lane for buses and 2-passenger carpools, the amount of time saved by using the ramp bypass exceeded the amount of time saved by traveling in the Diamond Lane to the end of the project.
- Non-carpoolers reported the average perceived increase in trip times during Diamond Lane operating hours to be between 8 and 9 minutes.



1.3 TRAFFIC VOLUMES

The changes in travel speeds experienced during the Diamond Lane demonstration were accompanied by significant shifts in traffic patterns. The total number of vehicles and people using the Santa Monica Freeway dropped markedly during the early weeks of the demonstration, and then rose steadily. The early decline in freeway traffic reflected a combination of carpool formation, growing bus ridership, and diversion to surface streets by non-carpoolers. By the close of the demonstration, the number of people using the easternmost segments of the freeway was approaching pre-project levels, while vehicle volumes had declined to nearly ten percent.

1.3.1 Freeway Traffic Volumes

1.3.1.1 Total Usage

Table 1.2 lists vehicles, travelers, occupancy rates, and Diamond Lane usage measured at the Crenshaw Boulevard sensor stations and Western Avenue observation points prior to the project and in each of the three seven-weeks periods during the life of the demonstration. Prior to the start of the Diamond Lane demonstration, a combined average of 113,135 vehicles crossed the Crenshaw Boulevard sensors in all Santa Monica Freeway lanes during the seven-hour period between 6:30 A.M. and 9:30 A.M. and between

TABLE 1.2

AVERAGE DAILY VEHICLE AND PASSENGER STATISTICS

SANTA MONICA FREEWAY AT CRENSHAW BOULEVARD

(Seven-Hour Peak Periods, Both Directions of Travel)

Statistic	Before Project	First Seven Weeks	Second Seven Weeks	Final Seven Weeks	After Project
Total Vehicles	113,135	76,738	97,197	101,678	112,059
Total People	138,873	101,643	128,180	136,421	140,507
Bus Ridership*	1,171	3,092	3,569	3,810	2,916
Passengers/Vehicle (including buses)	1.23	1.32	1.32	1.34	1.25
Passengers/Vehicle (automobiles only)	1.22	1.29	1.28	1.31	1.23
Diamond Lane Carpools	--	3,879	3,955	4,497	--
Non-Diamond Lane Carpools	3,479	466	968	1,252	3,652
Total Carpools	3,479	4,345	4,923	5,749	3,652

*SCRTD and SMMBL buses only.

3:00 P.M. and 7:00 P.M. During the first seven weeks of the project, this number dropped by 32 percent to 76,738 vehicles. By the second seven-week period, the average number of vehicles had risen to within 14 percent of the pre-project level and during the last seven weeks of the project an average of 101,678 vehicles crossed the Crenshaw Boulevard sensors, 10.1 percent less than the pre-project levels. By October 1976, two months following the project, vehicle volumes had returned to within one percent of pre-project levels.

The total number of travelers, or passengers, in all vehicles (including buses) passing Crenshaw Boulevard on all freeway lanes during the seven-hour peak period was estimated to be 138,873 prior to the initiation of the Diamond Lanes. This average number dropped by 27 percent during the first seven weeks of the project to 101,643 passengers. The second seven-week period saw an average passenger level of 128,180, a level which rose to 136,421 or 1.8% below the pre-project average during the last seven-week period. Thus, during the last seven weeks of the demonstration's life, the freeway carried 1.8% fewer people in 10.1 fewer vehicles at Crenshaw Boulevard. The increase in vehicles and passenger travel over time is depicted graphically in Exhibit 1.9.

The change in vehicle occupancy rates reflects the relationship between the change in the number of vehicles and the change in the number of persons using the freeway during Diamond Lane operating hours. Prior to the project, each automobile using the freeway carried an average of 1.22 persons. By the last seven weeks of the demonstration, which roughly paralleled the summer vacation period, occupancy rates had risen to 1.31 passengers per car, a 7.4 percent increase over pre-project levels. The increase in vehicle occupancy rates is even more striking when buses and bus occupancies are introduced to the accounting system. From a pre-project occupancy rate of 1.23 passengers per vehicle, the occupancy rate including both bus and automobile passengers rose to 1.34 passengers per vehicle by the last seven weeks of the project, an increase of 8.9% over the starting rate. Following the demonstration, automobile occupancy rates dropped to 1.23 passengers per car, one percent higher than pre-project levels, while the combined bus and auto occupancy rate dropped to 1.25 passengers per vehicle, two percent higher than pre-project levels.

1.3.1.2 Volumes by Direction

Peak Directions of Travel. Exhibit 1.10 plots vehicle and passenger movement in the peak directions of travel over the three seven-week periods comprising the demonstration project. The greatest drops in vehicle and passenger movement on the freeway during the demonstration occurred in the peak directions, where congestion was greatest in the non-preferential lanes. By the last seven weeks of the demonstration, the freeway carried an average of 10% fewer people in 19% fewer vehicles in the eastbound direction between 6:30 and 9:30 A.M. Vehicle volumes in this direction took a relatively large drop immediately following implementation, falling from 25,762 vehicles to 16,287 vehicles during the first seven weeks of the project, a drop of 36.8%. Morning eastbound traffic volumes never fully recovered from this initial drop over the life of the demonstration.

EXHIBIT 1.9

VEHICLE AND PEOPLE THROUGHPUT AT CRENSHAW BOULEVARD

Santa Monica Freeway: 7 Hours, Both Directions

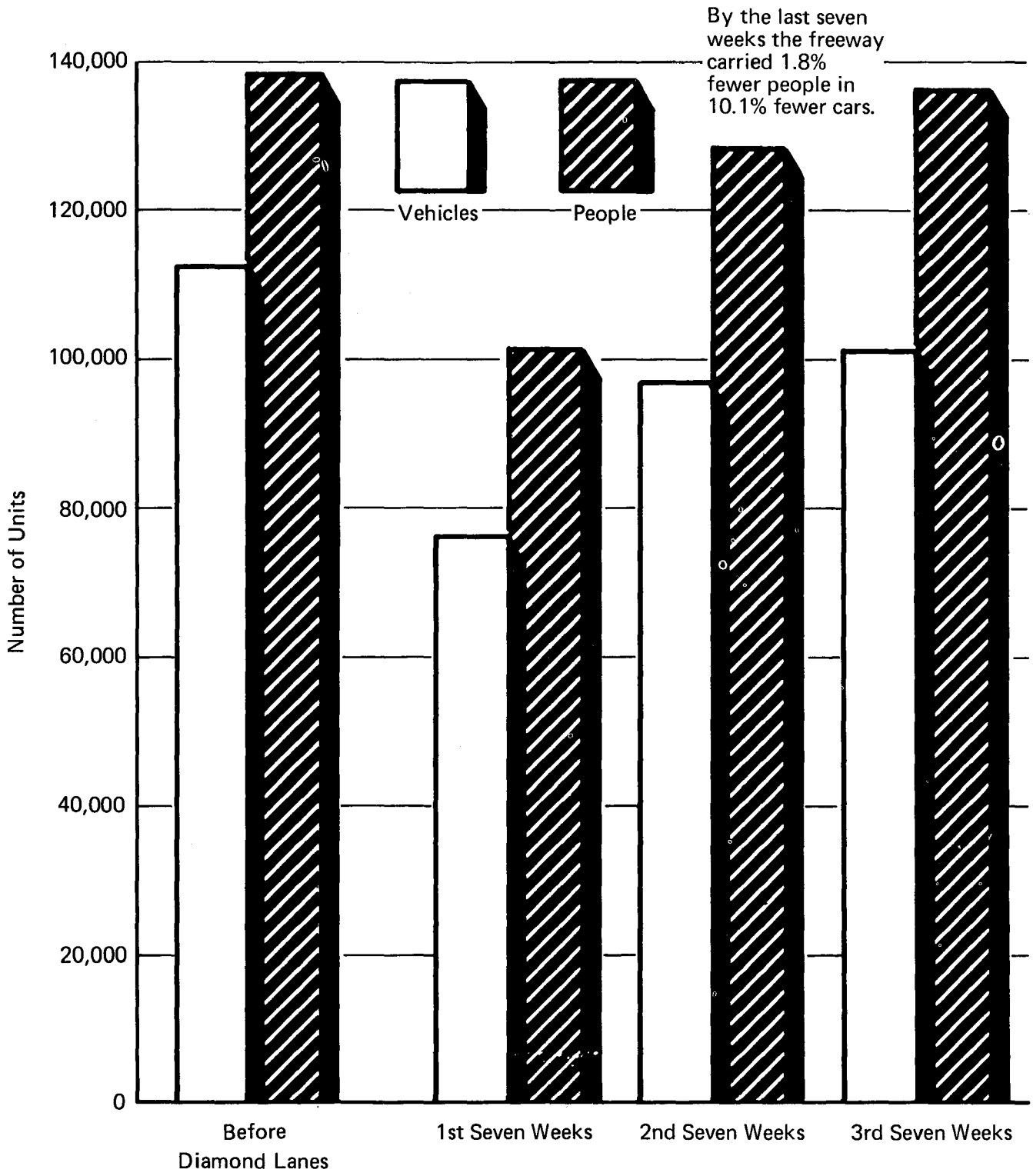
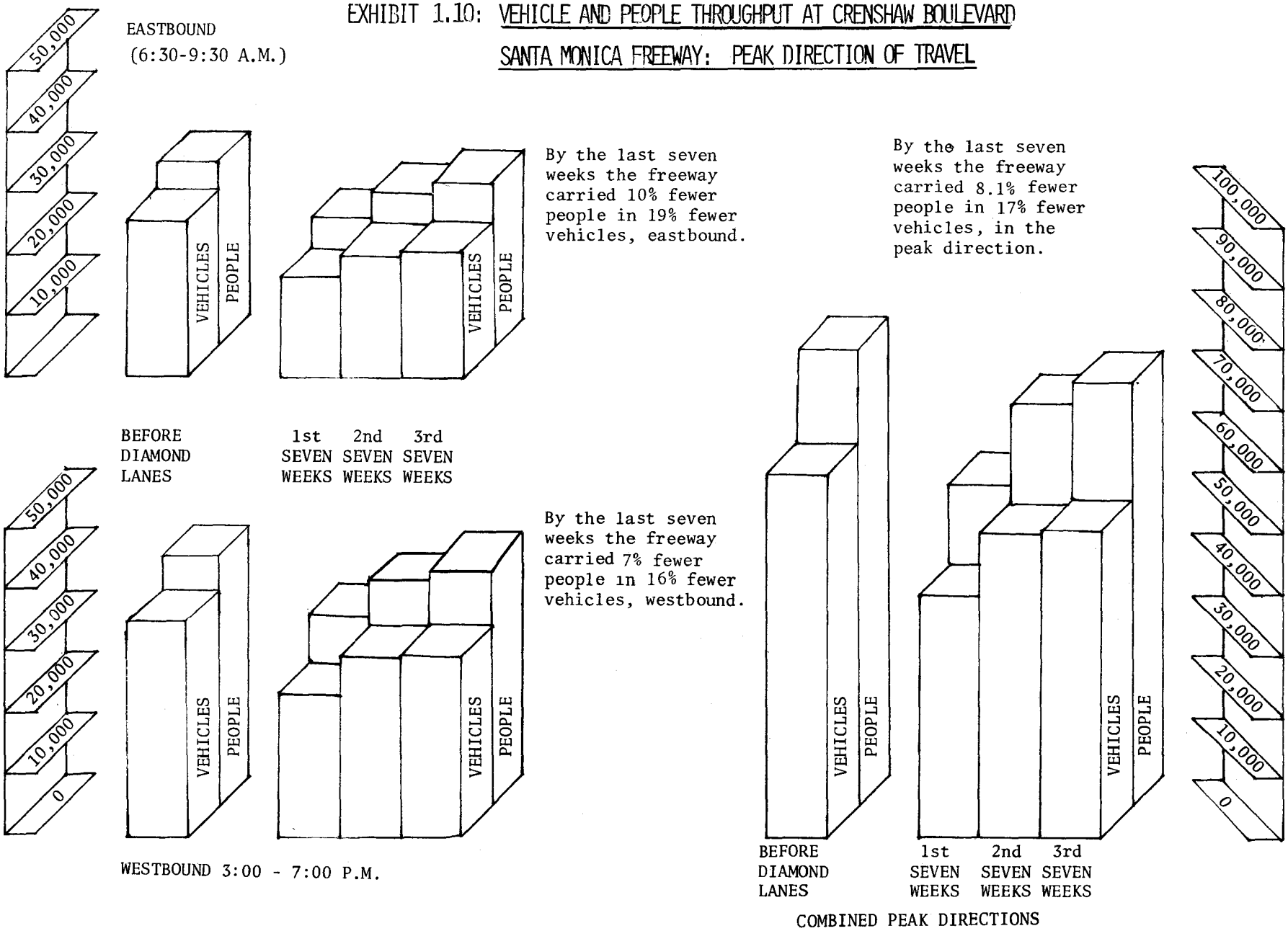


EXHIBIT 1.10: VEHICLE AND PEOPLE THROUGHPUT AT CRENSHAW BOULEVARD
SANTA MONICA FREEWAY: PEAK DIRECTION OF TRAVEL



For the westbound trip home from the CBD in the evening, the freeway carried 7% fewer people in 16% fewer vehicles during the last seven weeks than it carried prior to the demonstration. By the close of the project, occupancy rates were higher for the westbound peak direction than for any other direction of travel, averaging 1.42 passengers/vehicle when project buses were counted. When westbound and eastbound travel in the peak directions are combined, a comparison of traveler movement before and during the project shows that by the last seven weeks, the freeway was carrying 8.1% fewer people in the peak direction than it had carried prior to the project, in 19% fewer vehicles.

Reverse-Peak Directions of Travel. Directional trends on the Santa Monica Freeway are less pronounced than on most major freeways. Prior to the project, 46% of the total number of vehicles traveling during the morning peak were moving westbound, away from the CBD. In the evening, the difference in travel directions was even less pronounced, with 47.5% of the total vehicles traveling eastbound toward the CBD. Although project bus ridership in the reverse-peak direction was insignificant, the Diamond Lane project offered sufficient advantages to travelers in the reverse-peak direction to cause significant numbers of new carpools to be formed for westbound trips during the morning and eastbound trips during the evening. As a result, vehicle occupancy rates increased for reverse-peak travel as well as for peak travel. In the case of westbound traffic between 6:30 and 9:30 A.M., both vehicle and passenger levels during the last seven weeks of the demonstration exceeded pre-project averages. By the last seven weeks, the freeway carried 9.8% more passengers in 4.9% more vehicles in the westbound direction between 6:30 and 9:30 A.M. Comparable statistics for the eastbound direction between 3:00 and 7:00 P.M. show that the freeway carried 3.1% more people in 6.8% fewer vehicles in this reverse-peak direction.

1.3.1.3 Volumes by Screenline

Observations made at La Cienega Boulevard, midway along the length of the project, reflect a history of usage patterns similar to those observed at Crenshaw Boulevard, although shifts in vehicle and passenger movement were less at the La Cienega location. During the first seven weeks of the project, traffic volumes passing La Cienega Boulevard in all directions dropped to 79,057 vehicles, a decline of 13.4% from the 91,258 vehicles observed prior to the demonstration. Average vehicle volumes at Crenshaw Boulevard initially dropped by 32% with the introduction of the Diamond Lanes. By the last seven weeks of the demonstration, the Santa Monica Freeway carried 3% fewer people than were carried prior to the project at La Cienega Boulevard in 10% fewer vehicles.

Vehicle volumes measured at Cloverfield Boulevard, west of the San Diego Freeway, dropped from 54,679 vehicles to 50,041 vehicles during the first seven weeks of the project, a decline of 8.5%. By the close of the project, vehicle volumes at Clover-

field had climbed to within 5.8% of pre-project levels, and volumes in the off-peak directions actually exceeded pre-project levels. Thus, the relative amount of vehicle displacement attributable to the Diamond Lane project dropped as traffic moved away from the CBD and vehicle volumes decreased.

1.3.1.4 Volumes by Time of Day

Exhibit 1.11 traces vehicle volumes in both the eastbound and westbound directions on the Santa Monica Freeway by time of day before and during the Diamond Lane demonstration. These volumes were recorded by loop detectors located at Crenshaw Boulevard, and depict declines in vehicle volumes during the Diamond Lane operating hours. The sharp drop in vehicle volumes in both directions with the introduction of Diamond Lane restrictions is particularly striking. Similar patterns were observed at La Cienega and Cloverfield Boulevards.

Vehicle volumes at all three measuring points increased during the midday hours when the Diamond Lanes were not operational. The extent of the increase between the hours of 10:00 A.M. and 3:00 P.M. at three sensor stations is indicated in Table 1.3:

TABLE 1.3

INCREASE IN MIDDAY VEHICLE VOLUMES
ON SANTA MONICA FREEWAY
(10:00 AM to 3:00 PM)

	Additional Vehicles	% Increase
Crenshaw Boulevard	1,131	1.6
La Cienega Boulevard	2,192	3.7
Cloverfield Boulevard	1,968	6.2

Average midday traffic volumes increased during the Diamond Lane project for travel in each direction at each of the observed measuring stations. These increases suggest that certain drivers who had some flexibility in their choice of travel times elected to travel during the midday lull rather than face the much-publicized freeway congestion during Diamond Lane operating hours. To the extent that drivers were willing and able to reschedule non-work trips for such purposes as shopping and recreation to avoid the peak periods, peak-hour freeway congestion was reduced and a better-balanced, more efficient use of the freeway itself resulted as traffic moved away from the CBD and vehicle volumes decreased.

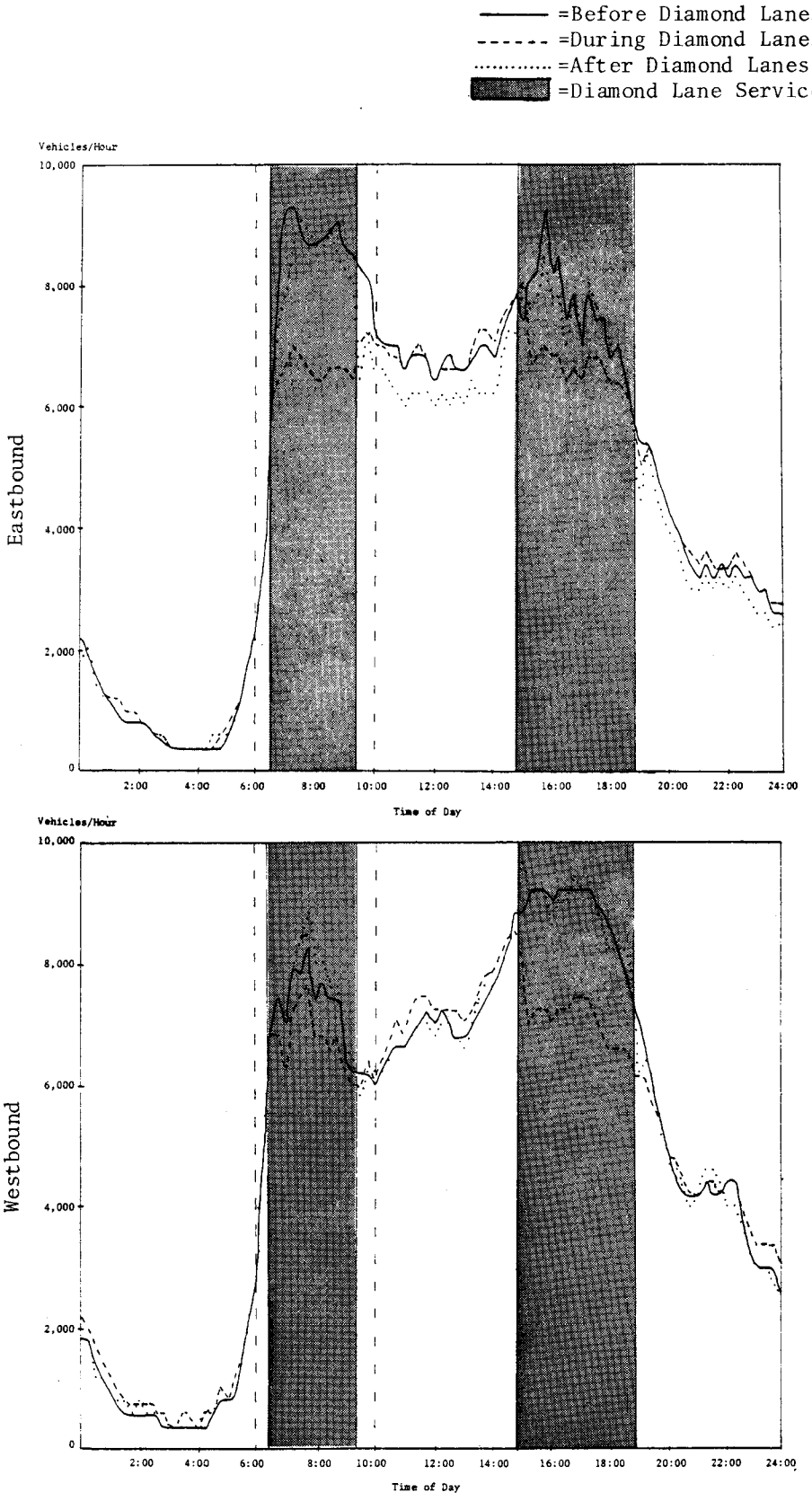


EXHIBIT 1.11

EASTBOUND AND WESTBOUND TRAFFIC PATTERNS AT CRENSHAW BLVD.

1.3.1.5 Volumes by Lane

Exhibit 1.12 depicts lane-by-lane vehicle volumes observed during the project near the Western Avenue screenline. This exhibit was constructed from time-lapse photographs made at Western Avenue, and records of total vehicle volumes obtained from sensors at Gramercy Place, one-quarter mile from the Western Avenue filming location. Prior to the project, an average of approximatly 1,800 vehicles per lane per hour passed the Western Avenue screenline in each direction. Following project implementation, vehicle flow in the Diamond Lanes dropped markedly, while the flow of eastbound vehicles in the morning increased to an average of 2,139 vehicles per hour in each non-preferential lane. Traffic flow in the westbound direction during the evening peak dropped to 1,678 vehicles per hour in the non-preferential lanes, a drop of nine percent below pre-project levels. Some portion of this drop may be attributed to the increased congestion accompanying the Diamond Lane project. It is likely, however, that the decline in vehicle throughput in the main westbound lanes at Western Avenue can be traced primarily to the increased use of the adjacent collector roadway by drivers attempting to postpone their entry to the congested freeway until the last possible moment. Exhibit 1.13 translates the vehicle volume figures depicted in Exhibit 1.12 into person-throughput per lane.

Table 1.4 summarizes the average traffic flow in the non-preferential lanes at each of the four sensor stations before and during the Diamond Lane demonstration. Under the forced-flow conditions existing at sensors closer to the Los Angeles CBD, the closing of one lane to general traffic often resulted in a decline in both speeds and per-lane traffic volumes. At Crenshaw Boulevard, average vehicle throughput in the non-preferential lanes dropped during the project, while average throughput per lane at La Cienega Boulevard rose in the eastbound lanes and dropped slightly in the westbound lanes. Under the relatively free-flow conditions existing at Cloverfield Boulevard, the constriction of traffic flow in the non-preferential lanes resulted in lower speeds, but increased the number of vehicles per lane per hour.

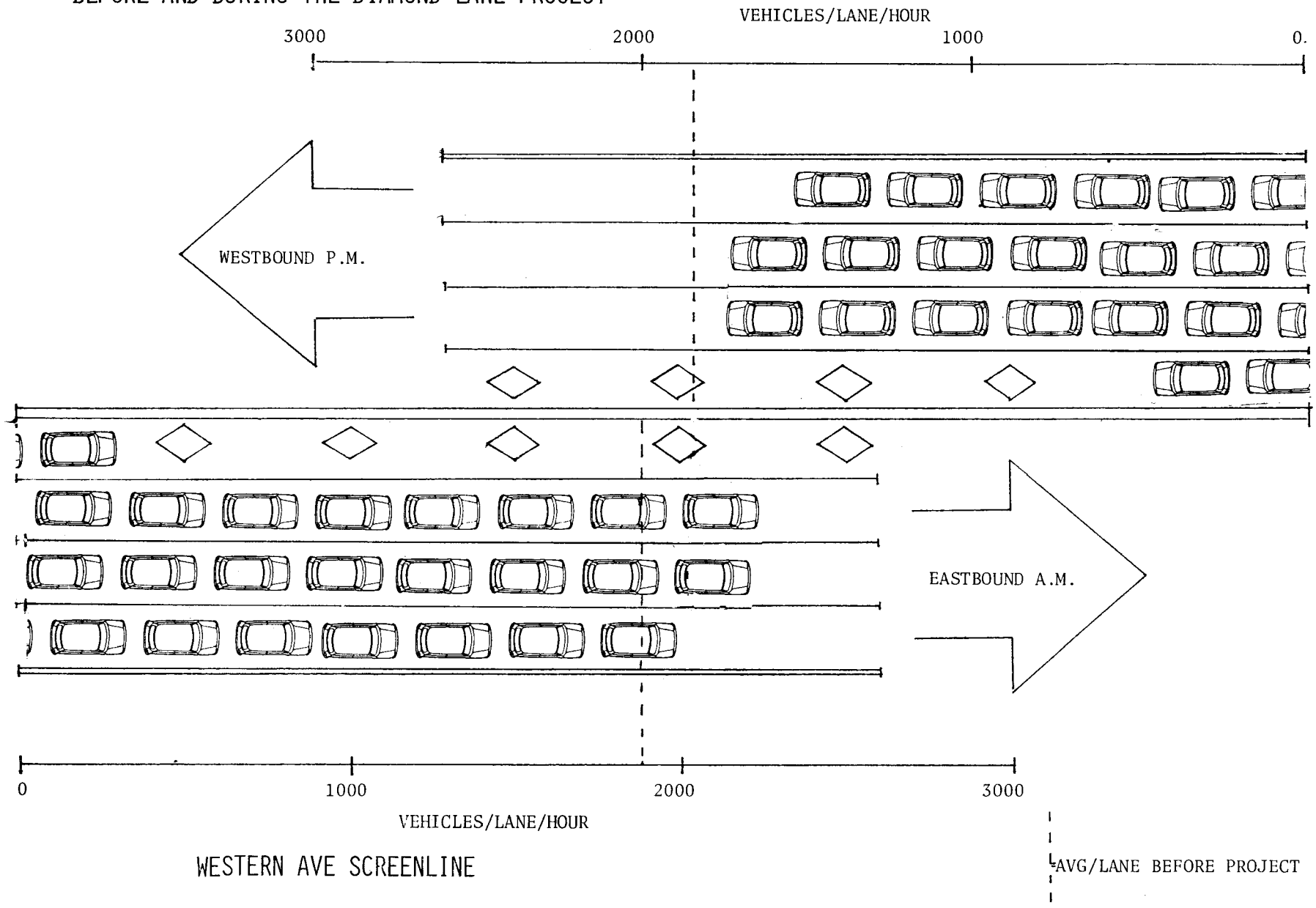
1.3.2 Carpool Formation

1.3.2.1 Evolution Over Time

The number of carpools carrying three or more people on the Santa Monica Freeway increased significantly during the Diamond Lane demonstration. Table 1.5 shows that the total number of carpools observed at Western Avenue increased by an estimated 65 percent from before the demonstration to its last seven weeks. With the disappearance of the Diamond Lanes, the number of carpools on the freeway dropped to within 5% of pre-project levels.

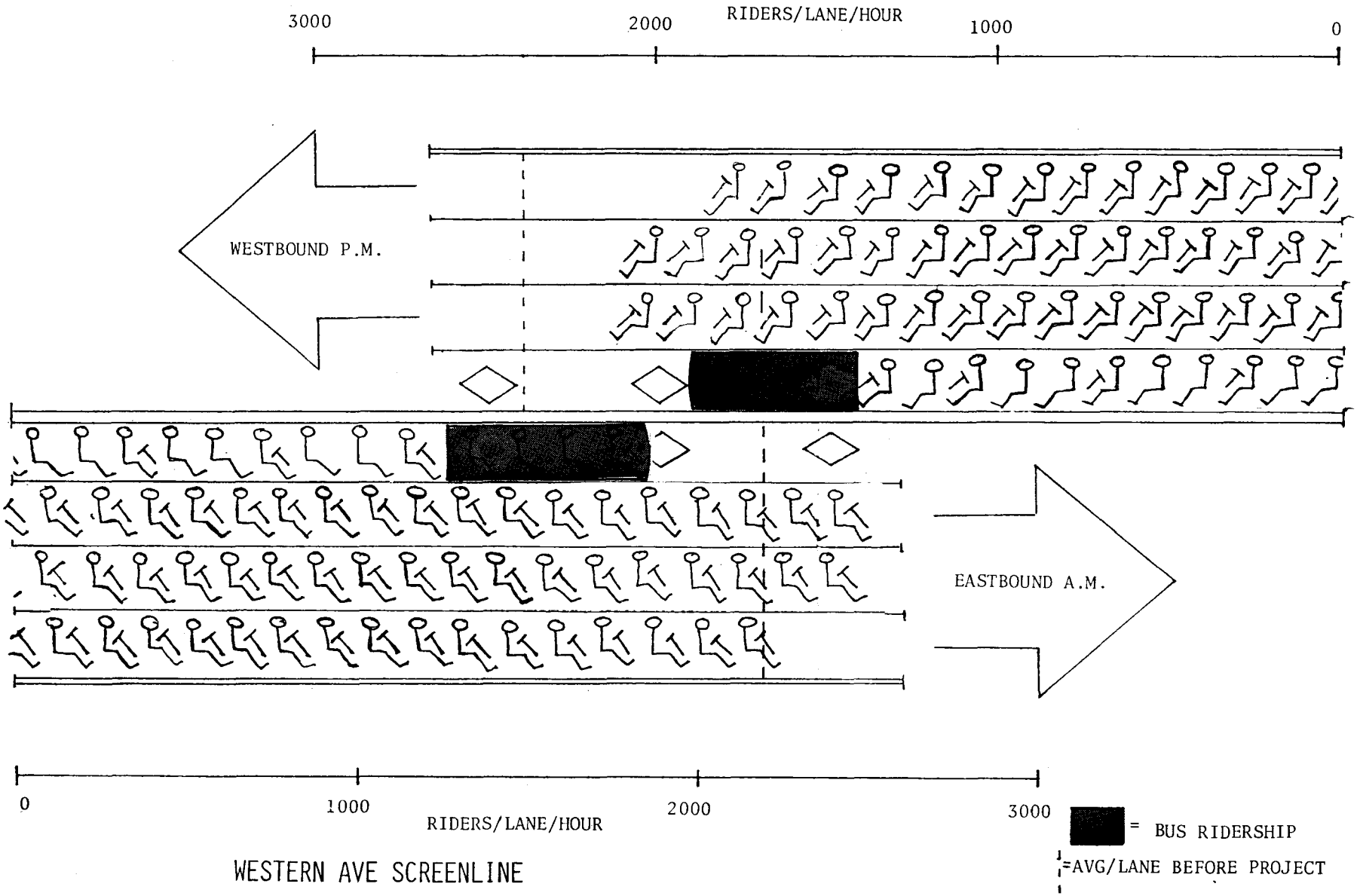
EXHIBIT 1.12

AVERAGE VEHICLES PER LANE PER HOUR
BEFORE AND DURING THE DIAMOND LANE PROJECT



WESTERN AVE SCREENLINE

EXHIBIT 1.13: AVERAGE RIDERSHIP PER LANE PER HOUR BEFORE AND DURING THE DIAMOND LANE PROJECT



WESTERN AVE SCREENLINE

TABLE 1.4

VEHICLES PER HOUR PER LANE AT SELECTED LOCATIONS

COUNTING STATION	BEFORE ◇ LANES	DURING ◇ LANES	
		NON-◇ LANES	◇ LANES
Western Avenue (4 lanes each direction)			
Eastbound/6:30-9:30 a.m.	1,870	2,139	284*
Westbound/3:00-7:00 p.m.	1,842	1,678	492
Crenshaw Boulevard (5 lanes each direction)			
Eastbound/6:30-9:30 a.m.	1,717	1,561	319
Westbound/3:00-7:00 p.m.	1,767	1,653	487
La Cienega Boulevard (4 lanes each direction)			
Eastbound/6:30-9:30 a.m.	1,726	1,831	265
Westbound/3:00-7:00 p.m.	1,856	1,848	416
Cloverfield Boulevard (4 lanes each direction)			
Eastbound/6:30-9:30 a.m.	1,167	1,236	92
Westbound/3:00-7:00 p.m.	1,093	1,320	141

* Automatic count not available; indicated figure is manual count.

TABLE 1.5

AVERAGE DAILY CARPOOLS BY SEVEN-WEEK PERIOD

(Diamond Lane Counts at Western Avenue)

	Before Project	First Seven Weeks	Second Seven Weeks	Last Seven Weeks	After Project
Diamond Lane Carpools					
Eastbound 6:30-9:30 AM	--	664	626	706	
Westbound 3:00-7:00 PM	--	1,332	1,375	1,482	---
Westbound 6:30-9:30 AM	--	516	537	617	---
Eastbound 3:00-7:00 PM	--	1,367	1,417	1,692	---
Total Diamond Lane Carpools	--	3,879	3,955	4,497	---
Non-Diamond Lane Carpools	3,479	466	968	1,252	3,652
TOTAL CARPOOLS	3,479	4,345	4,923	5,749	3,652
Percent Increase Over Before		25%	42%	65%	5%

Relative to other traffic, carpools constituted less than 3.1% of all vehicles and 8.5% of all people using the freeway prior to the project. By the last seven weeks of the project, carpools accounted for 5.7% of all vehicles and 14.3% of all people using the freeway at Crenshaw Boulevard.

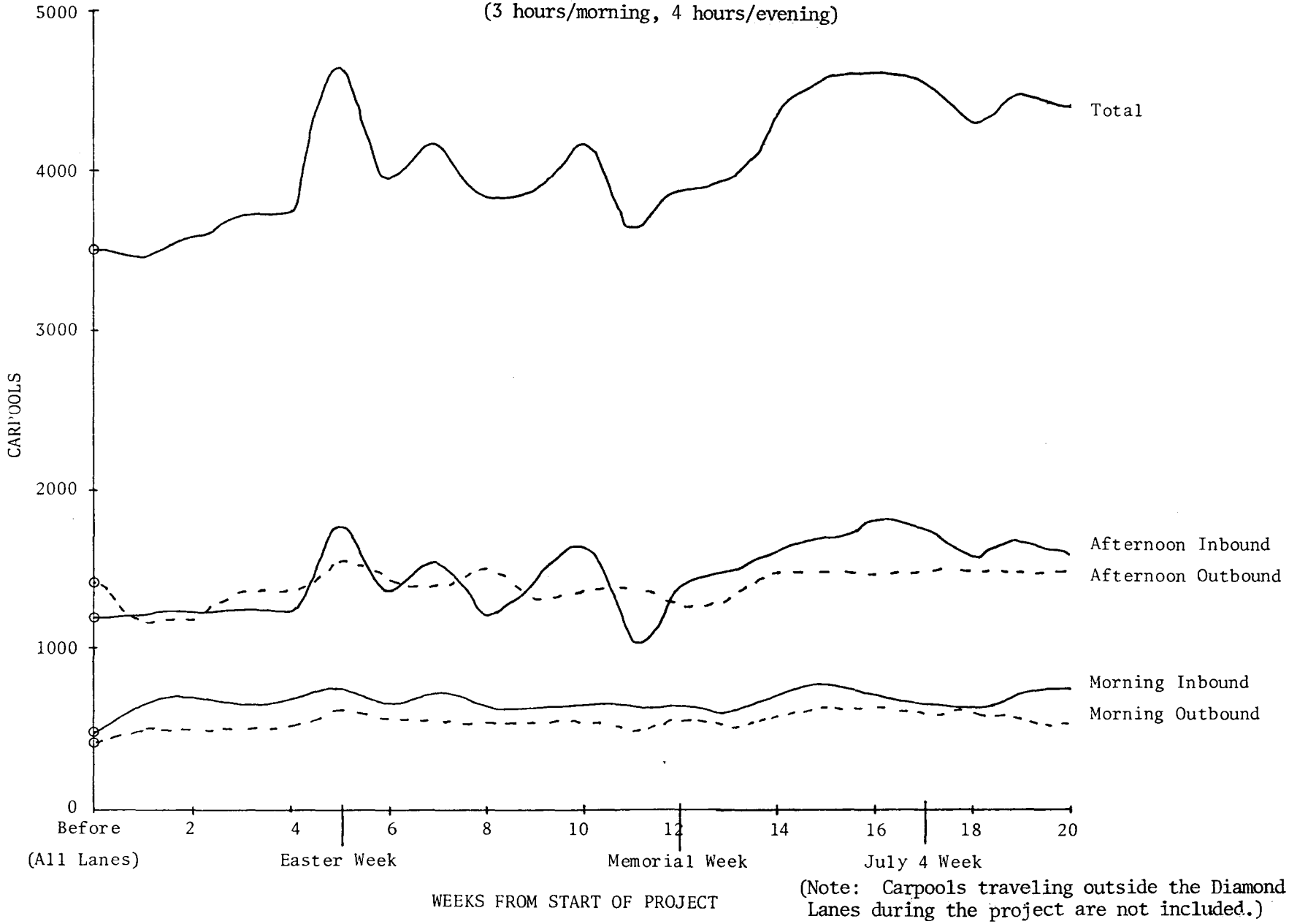
The week-by-week buildup of Diamond Lane carpools in each direction of travel is plotted in Exhibit 1.14. Except for a few variations during the afternoon, carpool ridership generally increased throughout the length of the project. These afternoon variations appeared to be related to vacation periods. Afternoon traffic in the eastbound Diamond Lane increased markedly during Easter week, which contained parochial school holidays, and rose steadily following Memorial Day. The timing and direction of these increases suggests that much of the increased Diamond Lane usage during these vacation periods may be attributed to groups of vacationing beachgoers returning from the ocean. Although no formal data were assembled to support this observation, Diamond Lane observers noted a number of surfboard sightings during the period in question.

1.3.2.2 Non-Diamond Lane Carpoolers

The percentage of three-person carpools that were not in the Diamond Lanes when the cars passed the Western Avenue observation point increased over the length of the project, rising to 22% of total freeway carpools by the last seven weeks of the demonstration. These non-Diamond Lane carpools may have been working their way into or out of the preferential lanes when they passed the observation point, or they may have avoided using the Diamond Lnae because the shortness of their trip didn't warrant changing lanes. It is also possible that they may have been discouraged by past

EXHIBIT 1.14: DAILY DIAMOND LANE CARPOOL VOLUMES COUNTED AT WESTERN AVENUE

(3 hours/morning, 4 hours/evening)



(Note: Carpools traveling outside the Diamond Lanes during the project are not included.)

used the Diamond Lanes at least once reported experiencing one or more difficulties using the lanes. The problems most frequently cited by those drivers using the lanes most often were difficulties leaving the lane to exit from the freeway, and an uncomfortable feeling generated by the speed differential between the Diamond Lane and adjacent lanes.

1.3.2.3 Carpool Characteristics

The average size of the carpools using the Diamond Lanes was approximately 3.4 people. Most three-person Santa Monica Freeway carpools (54%) were formed among co-workers; 20% were formed by friends and neighbors, and 17% by members of the same family. Only 25% of the carpools responding to the survey were initially formed during the Diamond Lane demonstration period. Of the carpools that were formed during the Diamond Lane project, 30% identified the Diamond Lanes as the primary incentive behind the decision to carpool, while 35% reported a desire to save money as the most important carpooling impetus, and 10% noted a desire to save energy and reduce pollution. Only 5% cited on-ramp bypass lanes as a factor in their decision to form a carpool.

1.3.3 Surface Street Volumes

Traffic volumes were recorded at several locations along surface streets in the Santa Monica Freeway corridor. Measurements are most complete at the Western Avenue screenline, where CALTRANS recorded volumes on seven surface streets parallel to the freeway (Olympic, Pico, Venice, Washington, Adams, Jefferson, and Rodeo). The results of these recorded volumes counts are summarized in Table 1.6.

TABLE 1.6

SUMMARY OF SURFACE STREET VEHICLE VOLUMES

MEASURED AT WESTERN AVENUE

(Totals for Seven East-West Streets)

	Eastbound 6:30-9:30 AM			Westbound 3:00-7:00 PM		
Period	Daily Totals	% Increase (Decrease)	Passengers/Car	Daily Totals	% Increase (Decrease)	Passengers/Car
Before Project	18,815	---	1.23	25,252	--	1.37
During Project						
Early Project	20,409	+8.5%	1.22	28,805	+14.1%	1.34
Mid-Project	17,953	(-4.6%)	NA	25,684	+ 1.7%	NA
Late-Project	16,778	(-10.8%)	1.24	25,470	+ 0.9%	1.38
After Project	17,199	(-8.6%)	NA	26,434	+ 4.7%	NA

Mechanical counts show that total surface street vehicles volumes at Western Avenue rose significantly, particularly during the evening hours, during the initial weeks following the initiation of the demonstration and then dropped as the demonstration progressed. It is not known whether this late-demonstration drop is due to a return of diverted automobiles to the freeway or to a natural decline in traffic with the summer months.

The general pattern characterizing observed automobile occupancy rates in both directions on the surface streets is an initial drop, followed by an increase to levels higher than pre-project levels during the summer of 1976. Tests attribute no statistical significance to either of these changes in occupancy rates.

Separate observations of surface street volumes made at different locations by the Los Angeles Department of Traffic (LADT) show volume increases early in the demonstration similar to those summarized in Table 1.6. The LADT data, however, suggests that surface street volumes did not drop during the summer months, but remained at levels between 13 and 18 percent higher than pre-project levels.

Given the inherent uncertainty in traffic volume and occupancy counts, it is difficult to draw conclusions regarding the detailed disposition of surface street traffic during the Diamond Lane project. In the aggregate, it seems clear that east-west traffic volumes on corridor surface streets increased with the initiation of the demonstration, rising on the order of 10% to 15% within the first seven weeks following March 15. What happened as the demonstration progressed is less clear. Certain sets of volume counts indicate a return to normal traffic levels, a conclusion supported by the upward shift in surface street occupancy levels and by the steady increase in freeway travel throughout the project, which could be explained by the return of non-carpoolers originally diverted to the city streets. Other volume counts argue that surface street levels continued to remain at increased levels throughout the demonstration. Even if this conflict were to be resolved, the precise effect of the Diamond Lanes on surface street traffic during the summer will always be clouded by the unknown seasonal effects of the summer months themselves on surface street traffic in the Santa Monica Freeway corridor.

1.3.4 Changes in Travel Patterns

Participants in the corridor driver survey were asked to answer several questions documenting any changes that they made in their travel patterns during the Diamond Lane demonstration. Sixty-three percent of all respondents said they had altered their travel patterns in some way at least once during the Diamond Lane project. Forty-three percent of the respondents indicated that the alteration was only temporary, generally consisting of experiments with different departure times, alternate surface street routes, or different freeway entrances that were abandoned even before the

close of the project. The remaining 20 percent reported significant daily changes in route, mode, or occupancy that lasted the length of the demonstration. Following the demonstration, the vast majority of those drivers reporting route changes reverted to their pre-project driving pattern.

Not surprisingly, the driver category reporting the greatest dislocation of normal driving patterns during the demonstration was the non-carpooler accustomed to using the Santa Monica Freeway prior to the introduction of the Diamond Lanes. Among freeway drivers traveling alone or with one other person prior to the project, 37.9 percent of those responding to the survey reported significant daily changes in their driving patterns during the Diamond Lane project. The remaining 62.1 percent either made no change at all or experimented briefly before reverting to pre-project patterns. The shifts reported by non-carpoolers responding to the survey are itemized below:

DIAMOND LANE-INSTIGATED CHANGES IN TRAVEL PATTERNS REPORTED BY NON-CARPOOLING FREEWAY USERS

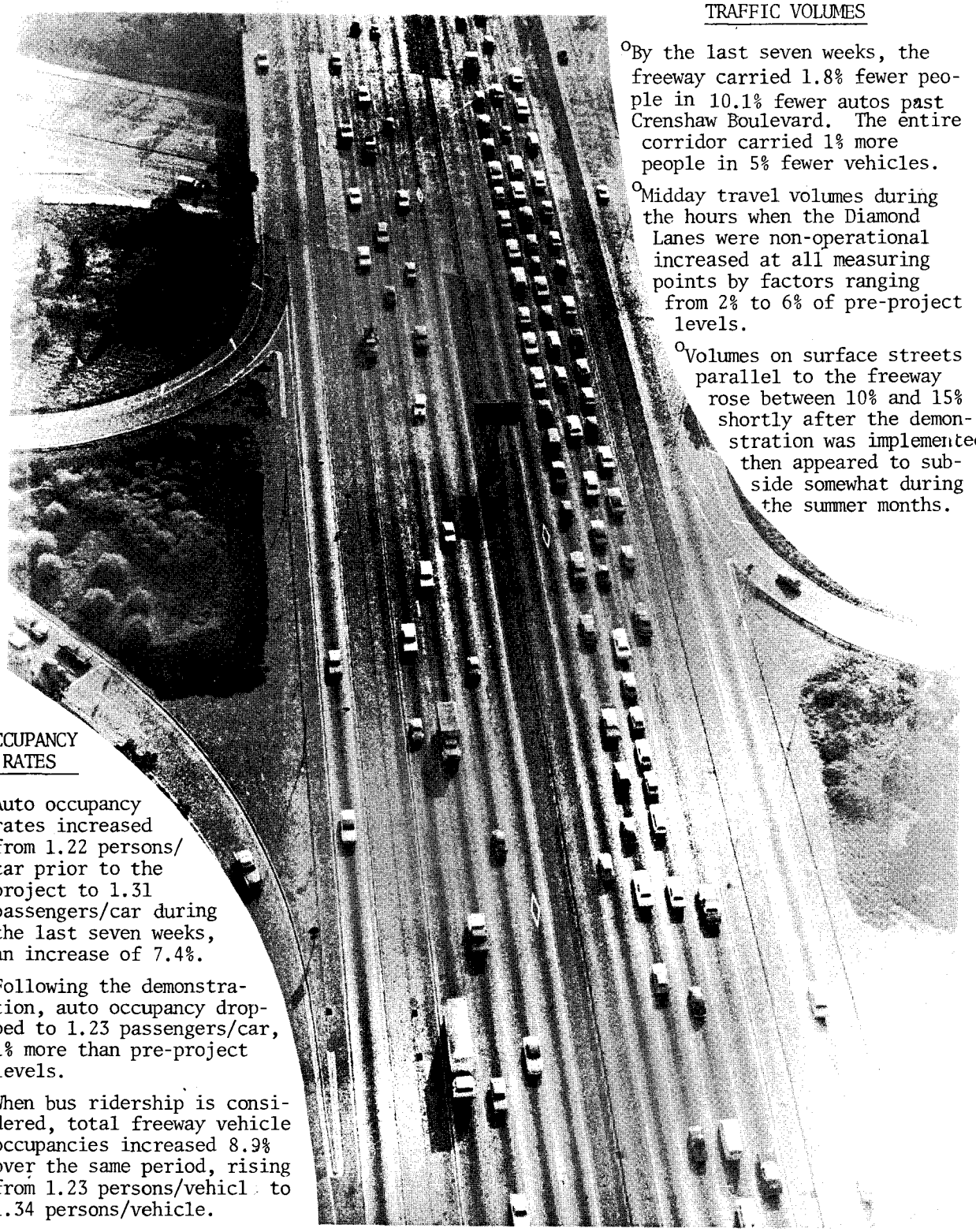
Change	% of Responses
No permanent daily change during project	62.1
Switched to 3+ carpool	1.4
Switched to bus	3.7
Switched to surface street	28.0
Switched to different freeway	4.8
Total	100.0

Not all of the 32.8% of non-carpoolers who reported leaving the freeway for either surface streets or other freeways during the project did so during both the morning and evening peaks. Some remained on the freeway for half of their daily commuting, so that the net result of the reported diversions to surface streets and other freeways would have been a 27.6% reduction in the number of non-carpoolers using the freeway during the Diamond Lane demonstration.

Considering Santa Monica Freeway users, surface street travelers, and accounting for former Santa Monica Freeway users traveling on different freeways or during less congested time periods, a rough comparison of vehicle and passenger movement across the entire Santa Monica Freeway corridor at Western Avenue indicates that by the last seven weeks of the project, 1% more people were traveling in 5% fewer vehicles than were being used prior to the demonstration.

CARPOOL FORMATION

- The number of carpools on the freeway increased by 65% during the project.
- By the last seven weeks of the project, carpools accounted for 5.7% of all vehicles and 14.3% of all people on the freeway, up from 3.7% of all vehicles and 8.5% of all people prior to the project.
- The average size of carpools using the Diamond Lanes was 3.4 people.
- Only 25% of the carpoolers surveyed initially formed their carpools during the demonstration, and only 30% of these newly-formed carpools identified the Diamond Lanes as the primary incentive behind the decision to carpool.
- Eighty-five percent of the drivers who reported using the Lane had some problem in doing so, most often a problem exiting from the Lane at the desired spot.
- With the disappearance of the Diamond Lanes, the number of freeway carpools dropped to within 5% of pre-project levels.



TRAFFIC VOLUMES

- By the last seven weeks, the freeway carried 1.8% fewer people in 10.1% fewer autos past Crenshaw Boulevard. The entire corridor carried 1% more people in 5% fewer vehicles.
- Midday travel volumes during the hours when the Diamond Lanes were non-operational increased at all measuring points by factors ranging from 2% to 6% of pre-project levels.
- Volumes on surface streets parallel to the freeway rose between 10% and 15% shortly after the demonstration was implemented, then appeared to subside somewhat during the summer months.

OCCUPANCY RATES

- Auto occupancy rates increased from 1.22 persons/car prior to the project to 1.31 passengers/car during the last seven weeks, an increase of 7.4%.
- Following the demonstration, auto occupancy dropped to 1.23 passengers/car, 1% more than pre-project levels.
- When bus ridership is considered, total freeway vehicle occupancies increased 8.9% over the same period, rising from 1.23 persons/vehicl to 1.34 persons/vehicle.
- Surface street vehicle occupancy rates did not change significantly during the demonstration.

1.4 BUS OPERATIONS AND RIDERSHIP

Two bus operators in the Los Angeles area participated directly in the Santa Monica Freeway Preferential Lane project by joining in the UMTA grant application and offering new services in conjunction with the opening of the Diamond Lanes. These two operators were the Southern California Rapid Transit District (SCRTD), which operates 2,400 buses in the four-county Los Angeles area, and the Santa Monica Municipal Bus Lines (SMMBL), which operates about 100 buses in the Santa Monica area. Although other commercial carriers, intercity lines, and charter limousine and bus services used the Diamond Lanes, detailed statistics on operations and ridership were assembled only for SCRTD and SMMBL, which were jointly responsible for providing service from the Westside study area to downtown Los Angeles.

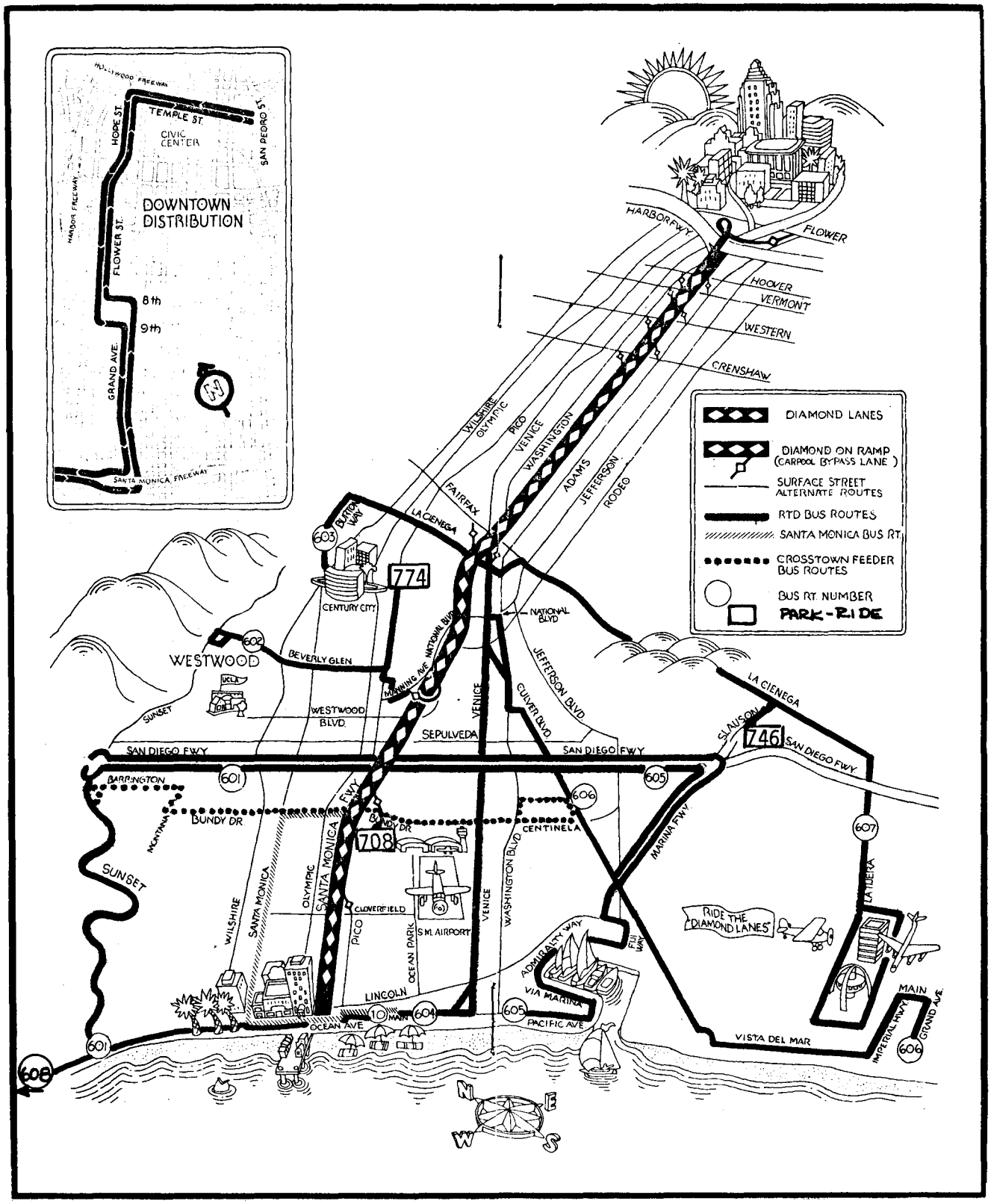
1.4.1 Bus Operations

The implementation of the Diamond Lane project was accompanied by the introduction of four new feeder/express routes linking the Westside area to the Los Angeles CBD. In addition, four bus routes operated by SCRTD prior to the Diamond Lane project were able to take advantage of the preferential lane, and three new SCRTD routes were established to serve newly-opened Park-and-Ride lots. On the opening day of the project, then, eight feeder/express routes and three Park-and-Ride routes served the Westside study area. The configuration of these routes is shown in Exhibit 1.15. All the Diamond Lane routes except SMMBL Line 10 serving downtown Santa Monica were operated by SCRTD. SMMBL also initiated a crosstown feeder service (Line 14) to provide access to the various Diamond Lane express routes.

Although many local bus routes criss-crossed Western Los Angeles prior to the implementation of the Diamond Lane project, freeway express service to the CBD was lacking in many sections of the Westside study area, and jurisdictional conflicts made it difficult to provide through service to several local municipalities. The addition of four new Diamond Lane feeder/express routes linking the Westside area to the CBD more than doubled the number of Westside CBD workers living within walking distance of express bus service.

Prior to the project, SCRTD offered 18 express bus trips every morning from the Westside study area to the CBD. On the first day of the project, the number of express bus trips offered by both SCRTD and SMMBL during the A.M. peak totaled 74, an increase of more than four times pre-project levels. Even without the Diamond Lanes, the marked improvement in service significantly improved the travel time by bus from most sections of the study area to the CBD.

EXHIBIT 1.15: DIAMOND LANE BUS LINES (3-15-76)



Source: SCRTD, modified by SYSTAN.

Service headways on new routes were made very attractive in the initial stages of the demonstration, and adjusted in response to ridership over the length of the project. At the outset of the demonstration, service levels were set by adopting a general policy that headways on all Diamond Lane lines would not be allowed to exceed a standard of fifteen minutes during the peak hour and one-half in the morning and evening. As the project continued, buses were added to those lines with heavy patronage, such as SMMBL Line 10, and removed from those lines where ridership failed to develop. The two SCRTD lines serving the Century City area (Express Line 603 and Park-and-Ride Line 774) were cancelled midway through the project for lack of ridership. At the same time, a new express service (Line 608) was introduced to serve Malibu, and service on the SCRTD Culver Boulevard line (Line 606) was extended southward to Manhattan and Hermosa Beaches. On balance, the result of the service adjustments made during the course of the project was a net decrease in the number of daily trips offered between the Westside area and the Los Angeles CBD. Whereas an average of 154 bus trips per day were offered during the peak periods at the start of the project, the process of tailoring service to ridership had led to an average of 136 trips per day by the time the court order eliminated the Diamond Lanes.

The introduction of the Diamond Lanes significantly improved the on-time performance of those SCRTD routes in existence prior to project implementation, cutting two minutes off the Freeway travel time of the busiest line. Diamond Lane buses also generally exhibited better on-time performance than buses using other freeways without preferential treatment and buses using surface streets.

SCRTD and SMMBL followed different policies in assigning equipment to Diamond Lane routes. SCRTD, which attempted to spread new and old buses evenly throughout the Los Angeles region, drew their Diamond Lane buses from the general equipment pool, so that the average age of the Diamond Lane fleet approximated the average age of the overall SCRTD fleet (estimated to be 9.7 years). SMMBL, on the other hand, followed a policy of assigning newer equipment to longer routes, so that the average age of the buses assigned to the SMMBL Diamond Lane Express was only 2.3 years. A poll of 42 SCRTD drivers revealed that the drivers were generally very happy with the Diamond Lane operation, and experienced relatively few problems entering, leaving, or driving in the Lanes. The chief complaint of the SCRTD drivers concerned the quality of some of the equipment provided for service. However, 93% of the drivers surveyed rated the operation good or excellent.

1.4.2 Ridership

Daily bus ridership between the Westside study area and the Los Angeles CBD increased from 1,171 rides per day prior to the project to 3,793 rides per day during the last week of effective Diamond Lane operation. A week-by-week breakdown of ridership on SCRTD and SMMBL routes is tabulated in Table 1.7 and graphed in Exhibit 1.16. As shown in the graph, bus ridership rose rapidly during the first month following implementation and continued to

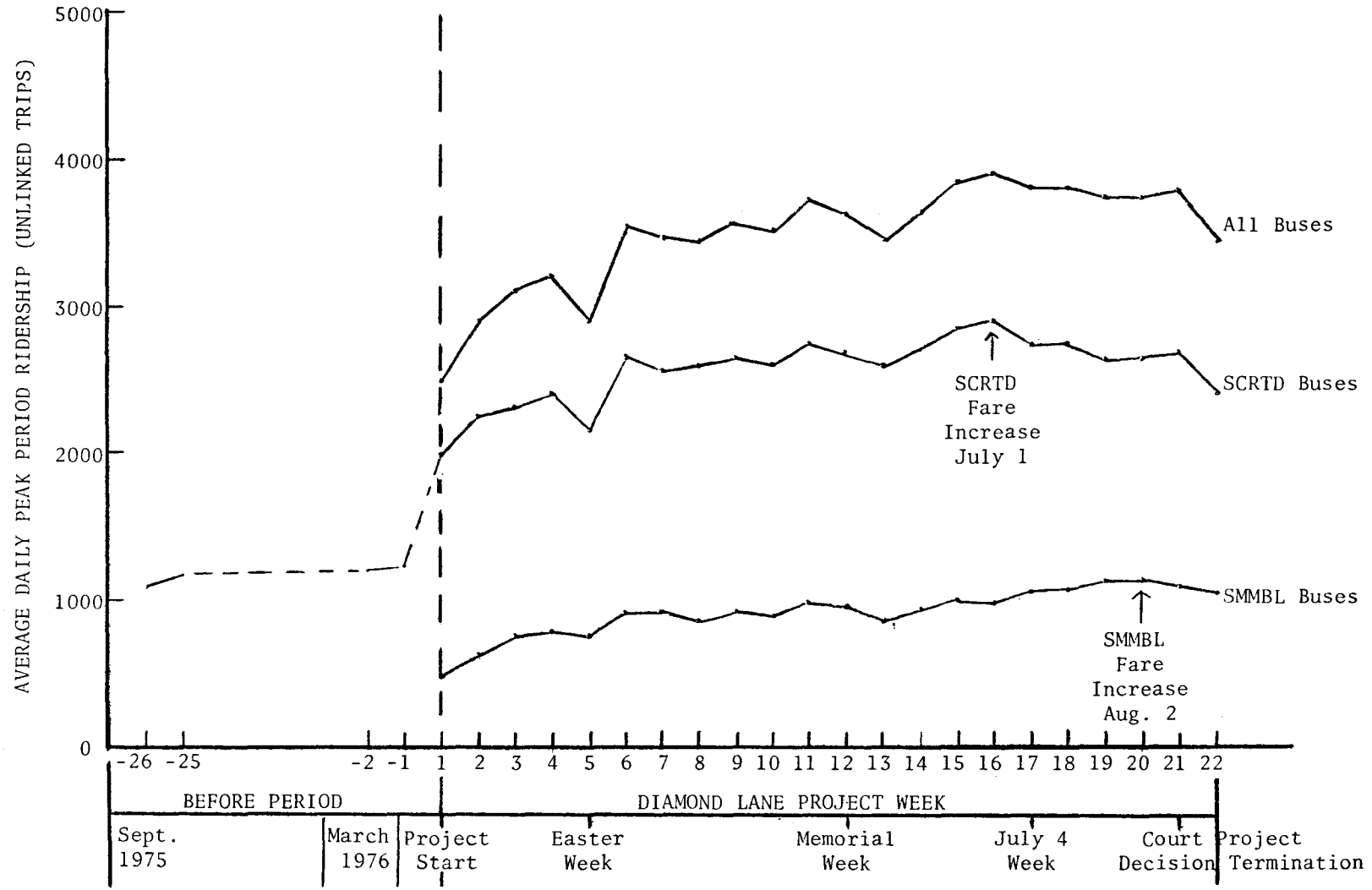
TABLE 1.7

AVERAGE DAILY PEAK PERIOD BUS RIDERSHIP

FOR ALL SANTA MONICA FREEWAY ROUTES

DIAMOND LANE PROJECT WEEK	SCRTD ROUTES		SMMBL ROUTES		ALL ROUTES	
	Average Daily Peak Period Ridership	Average Riders Per Trip	Average Daily Peak Period Ridership	Average Riders Per Trip	Average Daily Peak Period Ridership	Average Riders Per Trip
BEFORE WEEKS						
-26	1,092	30.3	No Service Prior to March 15, 1976		1,092	30.3
-25	1,171	32.5			1,171	32.5
-2	1,201	32.5			1,201	32.5
-1	1,235	32.5			1,235	32.5
SUMMARY STATISTICS FOR THE PRE-PROJECT PERIOD						
Mean	1,171	31.9	--	--	1,171	31.9
Std Deviation	62.10	1.14	--	--	62.10	1.14
Coeff Variation	.05	.04	--	--	.05	.04
Minimum	1,088	30.3	--	--	1,088	30.3
Maximum	1,235	33.15	--	--	1,235	33.15
DURING PROJECT						
1	1,999	14.6	496	29.4	2,495	16.2
2	2,253	16.3	656	34.0	2,909	18.5
3	2,318	16.7	778	37.0	3,096	19.3
4	2,422	18.4	777	37.0	3,199	20.9
5	2,160	14.6	753	35.9	2,913	17.2
6	2,642	17.6	903	43.0	3,545	20.7
7	2,578	17.2	911	43.4	3,489	20.3
8	2,579	17.3	858	40.9	3,437	20.7
9	2,653	19.8	924	44.0	3,577	23.1
10	2,635	19.7	888	42.3	3,523	22.9
11	2,765	20.6	962	45.8	3,727	23.9
12	2,692	20.1	945	45.0	3,637	23.5
13	2,601	19.6	829	39.5	3,430	22.3
14	2,714	20.4	935	44.5	3,649	23.7
15	2,851	21.4	996	47.4	3,847	25.0
16	2,892	22.1	987	47.0	3,879	25.5
17	2,748	24.8	1,077	51.3	3,825	29.0
18	2,736	24.6	1,060	48.2	3,796	28.5
19	2,633	23.7	1,132	51.5	3,765	28.3
20	2,658	23.9	1,109	50.4	3,767	28.3
21	2,718	24.5	1,075	43.0	3,793	27.9
22	2,395	21.6	1,055	42.2	3,450	25.4
SUMMARY STATISTICS FOR THE 22-WEEK PROJECT PERIOD						
Mean	2,494	19.2	870	41.1	3,364	22.2
Std Deviation	305.78	3.59	187.47	6.71	466.15	4.23
Coeff Variation	.12	.19	.22	.16	.14	.19
Maximum	3,008	25.4	1,151	53.3	3,978	29.9
Minimum	1,509	10.2	367	24.3	2,019	11.9

EXHIBIT 1.16: AVERAGE DAILY PEAK-PERIOD BUS RIDERSHIP ON ALL SANTA MONICA FREEWAY PROJECT ROUTES IN THE PEAK DIRECTION OF TRAVEL ONLY



grow throughout the project. While the growth patterns were essentially the same for both SCRTD and SMMBL, SMMBL--the smaller company--carried 26% of the combined average daily ridership with only 15% of the total daily bus trips. By the close of the project, most of SMMBL's buses were fully occupied, and the average occupancy rate during the project was 41.1 riders per trip, an occupancy rate of 82 percent.

In the case of SCRTD, the average occupancy rate experienced during the project was 19.2 riders per trip, or 38 percent of the available seating capacity. This figure was well below pre-project levels and stemmed from the policy decision to provide as much service as possible early in the project to maximize the possibility of attracting ridership. While the policy appears to have had the desired effect, it also put a large number of near-empty buses on public view in the early stages of the project. As the project progressed, unprofitable runs were eliminated and SCRTD occupancy rates improved markedly.

SCRTD's Diamond Lane bus routes can conveniently be classified in three groups:

Group 1: Old Routes in existence prior to March 15, 1976 (Lines 601, 604, 605 and 606);

Group 2: New Feeder/Express Routes started on or after March 15, 1976 (Lines 602, 603, 607 and 608);

Group 3: Park-and-Ride Routes started on March 15, 1976 (Lines 708, 746, and 774).

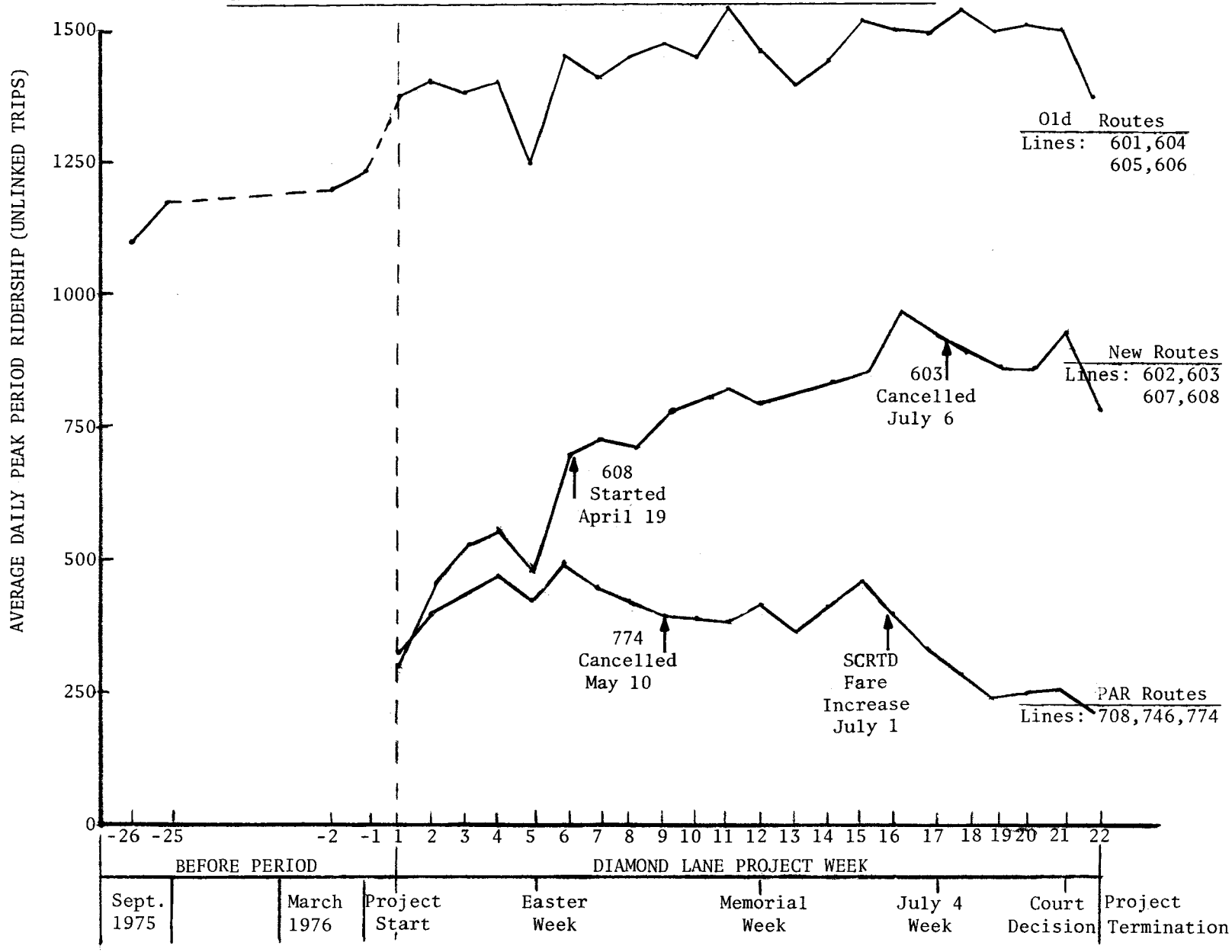
The average daily ridership in each of these groups is plotted in Exhibit 1.17. Average ridership on those old routes operating on the Freeway before the Diamond Lanes were implemented increased from 1,171 per day prior to the project to 1,428 per day during the project, an increase of 257 riders per day. At the same time, the average occupancy rate of these four lines dropped significantly, from an average of 32.5 riders per trip to 24.6 riders per trip, as the number of scheduled trips on the four routes was increased from 38 per peak period to 53 per peak period.

Ridership on all new SCRTD feeder-express routes rose sharply with the introduction of the Malibu Route 608 on April 19, and exceeded 750 riders per day every week thereafter. By the close of the project, schedule adjustments and growing ridership had increased the average occupancy on these new routes to 28.6 riders per trip, a 57% occupancy rate, which surpassed that of the group of old routes existing prior to the project.

Ridership on SCRTD's three Park-and-Ride routes averaged 394 riders per day and 11 passengers per trip, an occupancy rate of 22%. Not only was Park-and-Ride patronage well below that anticipated throughout the project, but patronage on each of the three lines declined as the project progressed. In the face of declining patron-

EXHIBIT 1.17

AVERAGE DAILY PEAK PERIOD BUS RIDERSHIP FOR DIFFERENT GROUPS OF SCRTD SANTA MONICA FREEWAY ROUTES IN THE PEAK DIRECTION OF TRAVEL ONLY



age, the operation of the Century City lot was discontinued on May 10, after seven weeks of operation, and the remaining two lots were closed on September 1, 1976, following the termination of the Diamond Lane project.

Several factors accounted for the failure of the three Park-and-Ride lots. The locations of the lots were far from ideal, and in two of three instances did not represent the first choice of SCRTD planners. In particular, the Century City lot was too close to the CBD to compete favorably with either the automobile or local multi-stop bus service, and the two-mile bus journey from the lot to the Freeway required a certain amount of backtracking away from the CBD. The excellent geographic coverage provided by the other Diamond Lane feeder-express routes supplied most Westside residents with more convenient bus service than that afforded by the Park-and-Ride lots. In fact, several ad hoc Park-and-Ride locations sprang up along other Diamond Lane routes, with the result that the number of drivers who boarded Diamond Lane buses at points removed from the officially-designated Park-and-Ride lots almost equalled the number patronizing these designated lots. The patronage of the designated lots was largely limited to residents living in the immediate vicinity.

Although the three Park-and-Ride routes fell far short of expectations, total ridership on most of the remaining Diamond Lane routes outperformed advance predictions. By the close of the project, the eight remaining feeder/express routes had come close to meeting the aggregate long-term demand predictions for patronage on these routes, carrying nearly 30% of the CBD-destined worktrips projected to be within walking distance (one-fourth mile) of a bus line. Early projections forecast a long-term average of 3,762 rides per day on these routes, as compared to 3,524 rides during the final week of the project. Although certain lines--notably the SCRTD Sunset Boulevard line (601) and the discontinued Century City feeder line (603)--failed to live up to expectations, the performance of these routes was more than offset by the ridership on such routes as SMMBL Line 10 serving Santa Monica and SCRTD Line 602 along Beverly Glen Boulevard, where ridership far exceeded advance predictions.

Although bus ridership increased appreciably as new routes and more frequent service were introduced to the Westside area, the Diamond Lane itself appears to have contributed minimally toward increasing ridership on mature, well-established routes. This judgment follows from a consideration of the performance of the one well-established SCRTD line offering comparable service before, during, and after the project. Patronage on this line, the 604 along Venice Boulevard, increased only 6.3 percent with the introduction of the Diamond Lanes, and dropped by a comparable amount with the closing of the lanes.

Further insights into the impact of the Diamond Lane itself on bus ridership are provided by Table 1.8, which compares post-project ridership levels with levels before, during and at the close of Diamond Lane operations. These insights are clouded by the five-week

TABLE 1.9: POST-PROJECT BUS RIDERSHIP BY ROUTE

LINE	AVERAGE RIDERSHIP									
	Riders Per Day					Riders Per Trip				
	Before	During	21st Week	After*	% Increase or (Decline) from 21st Wk.	Before	During	21st Week	After*	% Increase or (Decline) from 21st Wk.
OLD SCRTD ROUTES										
601	51	101	94	41	(-56%)	26	15	16	10	(-38%)
604	731	776	747	691	(-7%)	37	32	29	31	+ 7%
605	271	306	370	207	(-44%)	28	22	26	23	(-12%)
605	169	244	296	264	(-11%)	24	19	25	26	+ 4%
Subtotals Old Routes	1175	1427	1507	1203	(-20%)	32	25	26	27	+ 4%
NEW SCRTD ROUTES	--	237	347	243	(-30%)	--	20	29	27	(- 7%)
602	--	237	347	243	(-30%)	--	20	29	27	(- 7%)
607	--	321	453	345	(-24%)	--	21	30	27	(-10%)
608	--	137	143	94	(-34%)	--	23	24	16	(-34%)
Subtotals New SCRTD Routes		695	943	682	(-28%)	--	21	29	24	(-17%)
SMMBL Line 10	--	870	1075	1031	(- 4%)	--	41	43	38	(-12%)
T O T A L S	1175	2992	3525	2916	(-17%)	32	29	32	29	(- 9%)
Discontinued SCRTD Routes										
603	--	56	X	X		--	8	X	X	
708	--	207	155	X		--	15	16	X	
746	--	144	115	X		--	10	12	X	
774	--	60	X	X		--	4	X	X	

*Post-project measurements were made December 9, 1976 on SCRTD routes and March 10, 1977 on SMMBL Route 10. Comparisons of post-project ridership levels with levels recorded during Diamond Lane operations are clouded by the five-week strike which shut down all SCRTD operations between August 23 and September 28.

strike which shut down all SCRTD bus service just two weeks after the Diamond Lane closed, making it virtually impossible to separate the effects of the Diamond Lane shutdown from the effects of the strike on transit patronage in the Santa Monica corridor. Drops in average daily ridership were lowest on the one line which continued operating through the strike, SMMBL Route 10. Seven months after the close of the demonstration, average daily ridership on this line was within four percent of the peak level attained during Diamond Lane operation. In general, those lines reporting the longest average door-to-door travel times (601, 605, 607, and 608) suffered the greatest ridership decline following the closing of the Diamond Lanes.

In the aggregate, average daily ridership levels on all Santa Monica Freeway express routes still in operation in early 1977 were roughly 17 percent below the peak achieved during the last week of Diamond Lane service. Since SCRTD cut service frequencies on many freeway express routes following the strike settlement, the number of riders per bus trip is within 9 percent of the peak level achieved during Diamond Lane operations.

A number of exogeneous influences combine to frustrate attempts to isolate the impact of the Diamond Lanes themselves on bus ridership. These include the short life of the project, seasonal patronage variations, the media blitz, frequent and major changes in bus service frequency, fare increases, and a five-week strike. Recognizing these uncertainties, it can be argued that the extent of the Diamond Lane's influence can at least be bounded by surviving ridership levels. If, in the face of service cutbacks, fare increases, and a five-week strike, subsequent ridership levels still managed to rise to within 17 percent of their peak during Diamond Lane operations, it would seem that this 17 percent figure represents a fair estimate of the maximum drawing power of the Diamond Lane alone. This aggregate figure varies from line to line, and might have been greater had the life of the lanes not been continually threatened and finally cut off. Nonetheless, although the Diamond Lanes and the attendant publicity helped to attract a portion of the observed increase in bus riders, it appears that improvements in bus system coverage and service frequency were responsible for the bulk of the observed patronage increases.

A survey of Diamond Lane bus riders showed that 96% of the trips made by these riders were to and from work. Seventy-seven percent of the riders used the service regularly every weekday, while an additional 16% rode three or four days per week. Seventy-six percent of the riders surveyed had a car available for the trip but preferred to travel by bus. An additional 8 percent could have used a car, but only at some inconvenience to others, while only 16% of those responding had no alternative but to take the bus for their journey.

A further breakdown of bus riders shows that 39 percent previously drove alone in making the trip to the CBD, while 8.5 percent carpooled, 36 percent rode the bus, and the remaining 16.5 percent had not made the specific CBD trip prior to the initiation of the

Diamond Lanes. Considering only those riders who reported making the trip prior to March 15, at least 700 former drivers and 150 former carpoolers switched to riding the bus following the introduction of the new Diamond Lane services. The majority of those riders who reported using the bus prior to March 15 rode on one of the four SCRTD routes that were converted to Diamond Lane service.

One-hundred percent of the SMMBL riders surveyed were either somewhat satisfied or very satisfied with the bus service, while nearly 93 percent of SCRTD riders expressed some degree of satisfaction. Less than 5-1/2 percent of all riders surveyed said they were either "not too satisfied" or "dissatisfied" with the Diamond Lane bus service.

1.4.3 Revenues and Costs

Both SMMBL and SCRTD instituted fare increases during the course of the Diamond Lane demonstration. Fares on Diamond Lane routes varied markedly from line to line, and depended on zonal boundaries, park-ride surcharges, monthly pass policies, and elibility for discount fares offered to students, senior citizens, and the handicapped. At the start of the project, the average Diamond Lane bus rider paid 41.3¢ per trip. After the fare increase, which occurred on July 1 for SCRTD and August 2 for SMMBL, the average rider paid 61.3¢ per trip, an increase of 20¢, or 48.4% over the initial rates. The SCRTD fare increases appeared to have little impact on the demand for service on the multi-stop feeder/express routes. Demand for Park-and-Ride services appeared to be far more sensitive to fares than demand for other services, and the fare increases applied the coup de grace to the already disappointing Park-and-Ride patronage levels.

The average operating cost per rider over the length of the project was $3.49 for SCRTD and $1.52 for SMMBL. These 21-week averages mask a general downward trend. In the case of SCRTD, cost per rider declined from $4.00 to $2.50 as unproductive runs were eliminated over the length of the project.

The relatively high cost-per-rider figures are directly related to the low productivities of the vehicles in Diamond Lane service. Table 1.9 summarizes different supply and productivity factors for the various SCRTD route groupings and for SMMBL Route 10. The average productivity on all SCRTD runs was 7.2 riders per vehicle-hour, considerably lower than the systemwide average of 44.3 riders per vehicle-hour. This low productivity is not entirely a result of low vehicle occupancies. Even on SMMBL Route 10, where occupancies were relatively high, vehicle productivities averaged only 16.6 riders per vehicle-hour. The explanation of these low productivities resides largely in the nature of the Freeway express operation itself, with its long runs, lack of intermediate stops, limited backhaul potential, and the difficulty of generating more than one peak-period revenue run per bus. These factors help to account for the high per-rider costs and deficits reflected in Table 1.9.

TABLE 1.9

DIAMOND LANE TRANSIT SYSTEM PEAK PERIOD

SUPPLY AND PRODUCTIVITY MEASURES

SUPPLY FACTORS	SCRTD				SMMBL	Both SCRTD and SMMBL
	Old Routes	New Routes	P-A-R Routes	All Routes	Route 10	
Scheduled Trips per day*	58.3	36.6	37.1	132.0	21.0	153.0
Fleet Size (Buses)	27.1	16.8	14.0	58.0	9.8	67.8
Vehicle Hours per day*	149.6	120.0	79.1	348.7	52.3	401.0
Vehicle Miles per day*	2,181	1,758	949	4,888	1,046	5,934
Effective Vehicle Speed (mph)	14.6	14.8	12.4	14.1	20.0	14.8
Operating Cost per day*	$3,675	$2,958	192	$8,554	$1,268	$9,822
PRODUCTIVITY MEASURES	**SCRTD**				**SMMBL**	**Both SCRTD and SMMBL**
	Old Routes	New Routes	P-A-R Routes	All Routes	Route 10	
Riders per day**	1,428	686	380	2,494	870	3,364
Riders per vehicle hour**	9.6	5.6	5.3	7.2	16.6	8.4
Operating Cost per rider**	$2.60	$4.86	$5.02	$3.49	$1.52	$2.99
Operating Cost per vehicle hour	$24.61	$24.85	$24.51	$24.53	NA	$24.53
Operating Cost per vehicle mile	$1.68	$1.68	$1.99	$1.75	$1.21	$1.65
Average Occupancy Rate	24.6	19.0	10.9	19.2	41.1	22.2
Revenue per Rider**	$.46	$.34	$.66	$.46	$.44	$.45
Deficit per Rider**	$2.14	$4.52	$4.36	$3.03	$1.08	$2.54

* For Peak Period Operation

** Riders on the Santa Monica Freeway in the Peak Period Direction of Travel Only (the deficit does not reflect SMMBL riders in the off-peak direction)

Old Routes: 601, 604, 605, 606
New Routes: 602, 603, 607, 608
P-A-R Routes: 708, 746, 774

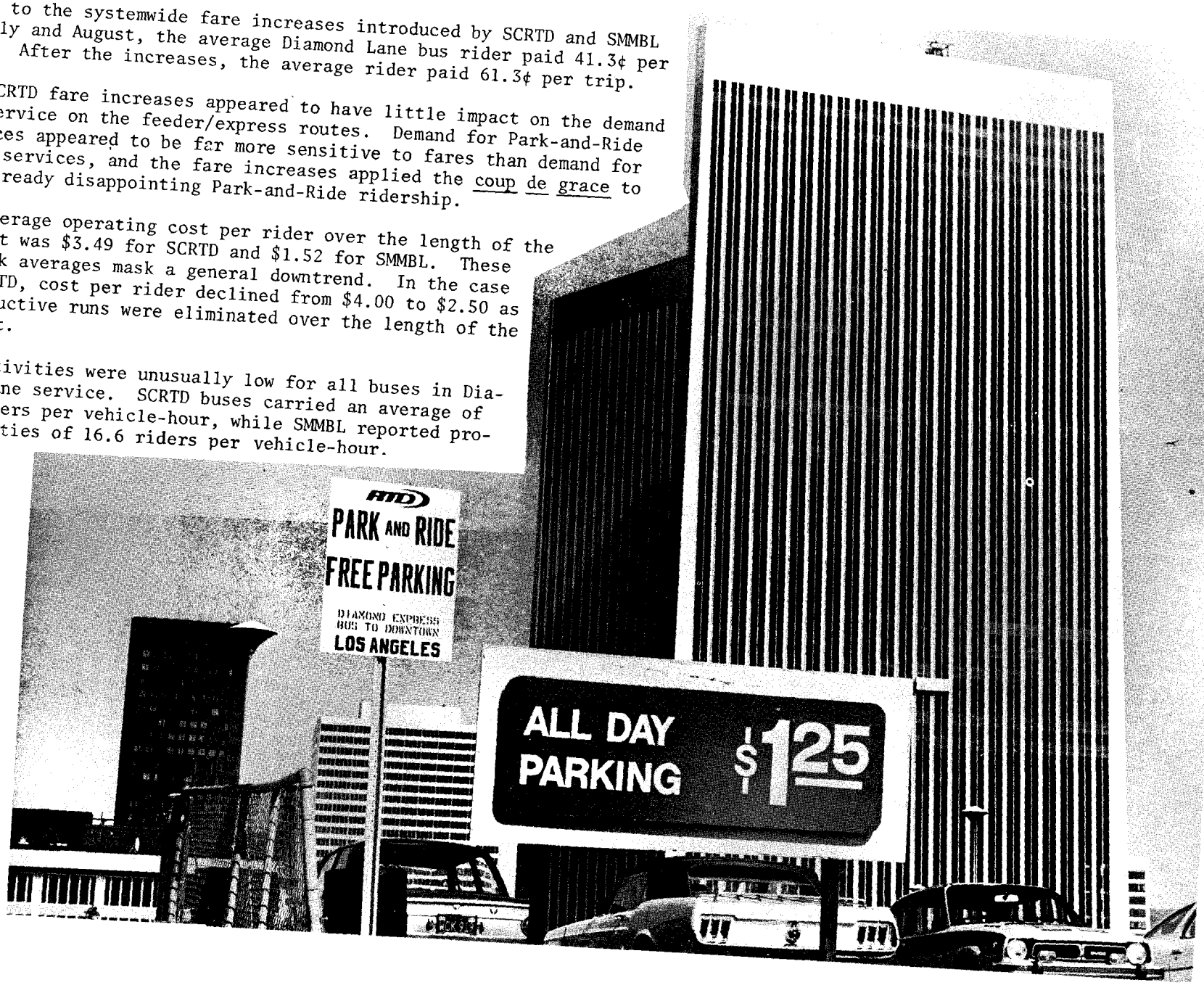
REVENUES AND COSTS

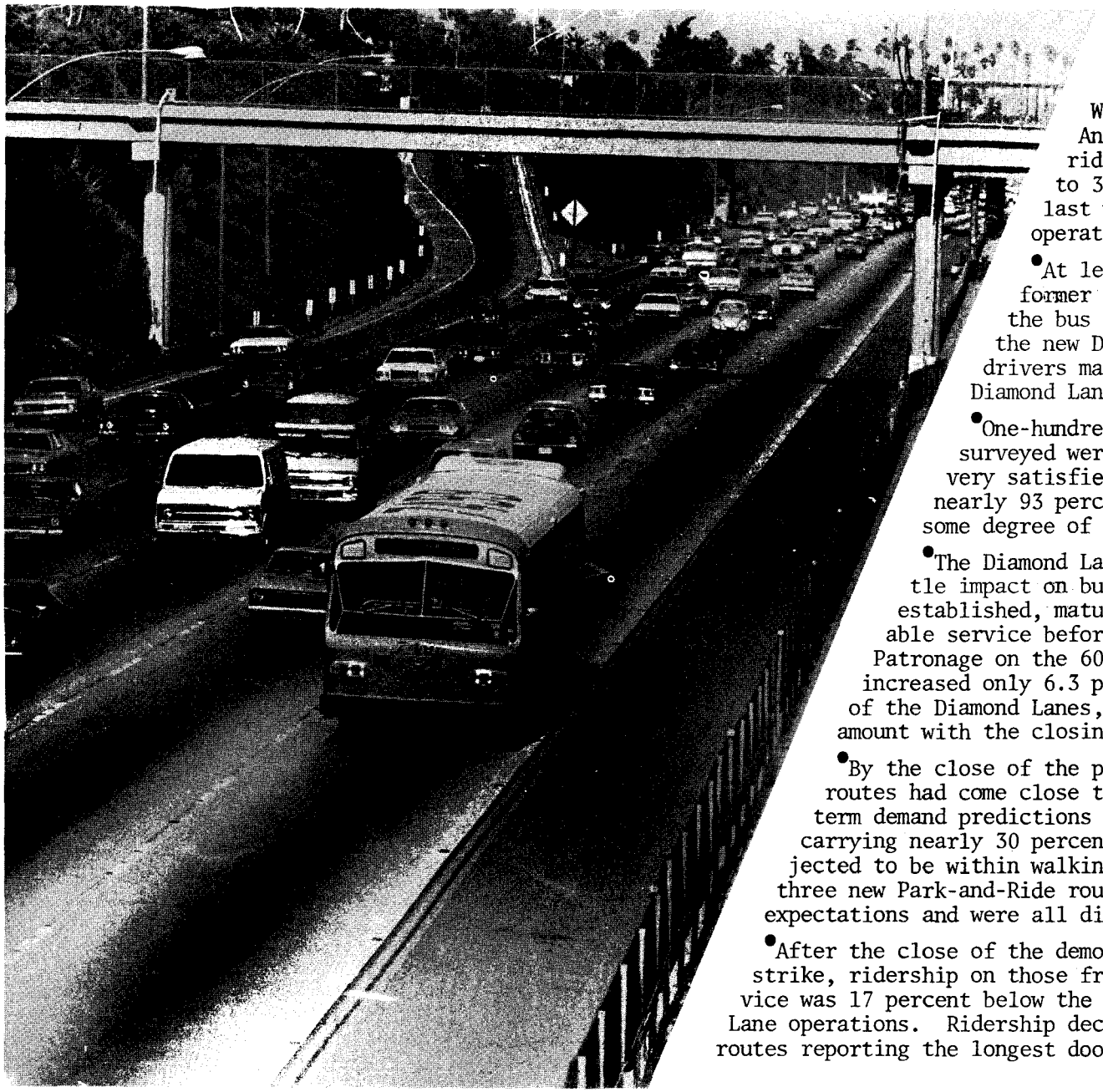
- Prior to the systemwide fare increases introduced by SCRTD and SMMBL in July and August, the average Diamond Lane bus rider paid 41.3¢ per trip. After the increases, the average rider paid 61.3¢ per trip.

- The SCRTD fare increases appeared to have little impact on the demand for service on the feeder/express routes. Demand for Park-and-Ride services appeared to be far more sensitive to fares than demand for other services, and the fare increases applied the coup de grace to the already disappointing Park-and-Ride ridership.

- The average operating cost per rider over the length of the project was $3.49 for SCRTD and $1.52 for SMMBL. These 21-week averages mask a general downtrend. In the case of SCRTD, cost per rider declined from $4.00 to $2.50 as unproductive runs were eliminated over the length of the project.

- Productivities were unusually low for all buses in Diamond Lane service. SCRTD buses carried an average of 7.2 riders per vehicle-hour, while SMMBL reported productivities of 16.6 riders per vehicle-hour.





SUMMARY OF BUS RIDERSHIP

- Daily bus ridership between the Westside study area and the Los Angeles CBD increased from 1,171 rides per day prior to the project to 3,793 rides per day during the last week of effective Diamond Lane operation.
- At least 700 former drivers and 150 former carpoolers switched to riding the bus following the introduction of the new Diamond Lane service. Converted drivers made up 57% of the ridership of Diamond Lane buses.
- One-hundred percent of the SMMBL riders surveyed were either somewhat satisfied or very satisfied with the bus service, while nearly 93 percent of SCRTD riders expressed some degree of satisfaction.
- The Diamond Lane itself appeared to have little impact on bus ridership on the one well-established, mature SCRTD line offering comparable service before, during and after the project. Patronage on the 604 line along Venice Boulevard increased only 6.3 percent with the introduction of the Diamond Lanes, and dropped by a comparable amount with the closing of the Diamond Lanes.
- By the close of the project, the eight feeder/express routes had come close to meeting the aggregate long-term demand predictions for patronage on these routes, carrying nearly 30 percent of the CBD-destined trips projected to be within walking distance of a bus line. The three new Park-and-Ride routes, however, fell far short of expectations and were all discontinued by September 1.
- After the close of the demonstration and a five-week bus strike, ridership on those freeway routes remaining in service was 17 percent below the peak attained during Diamond Lane operations. Ridership declines were greatest on those routes reporting the longest door-to-door travel times.

BUS OPERATIONS

- The addition of four new Diamond Lane feeder/express routes to the four already serving the Westside area more than doubled the number of Westside CBD workers living within walking distance of express bus service.
- Three new Park-and-Ride routes were introduced to serve those Westside residents who were not within walking distance of a feeder/express route.
- On the first day of the project, a total of 74 express bus trips were taken from the Westside area to the Los Angeles CBD during the morning peak, an increase of more than four times pre-project levels.
- Diamond Lane buses generally exhibited better on-time performance than other express and local bus services.

1.5 POLICE DEPLOYMENT, ENFORCEMENT, AND VIOLATIONS

1.5.1 Police Deployment

Prior to the implementation of the Diamond Lane project, normal deployment over the segment of the Santa Monica Freeway between Lincoln Avenue and downtown Los Angeles averaged 76.3 man-hours per day from 6:00 to 10:00 A.M. and from 3:00 to 7:00 P.M. This corresponds roughly to a deployment level of ten officers on the morning shift and nine officers on the evening shift.

During the first week of the Diamond Lane project, deployment levels rose to between 15 and 20 officers per shift, approximately double pre-project levels. For the most part, the additional manpower was diverted from other freeway portions under CHP control. To the extent possible, the additonal units consisted of motorcycles rather than patrol cars, since the added maneuverability of the motorcycle units eased the enforcement problem. Deployment levels were gradually reduced over the first twelve weeks of the project, so that the average surveillance level over these weeks was roughly 50 percent higher than normal. By the thirteenth week of the demonstration, the level of officer deployment approximated that in effect prior to the Diamond Lane project.

1.5.2 Enforcement

Although levels of police deployment returned to normal midway through the demonstration, enforcement activities remained considerably higher than normal throughout the life of the project. Over the 21 weeks of the project, CHP officers issued an estimated 5,830 citations to drivers observed using the lane illegally (in violation of Vehicle Code 21655.5). A total of 6,366 warnings were given out, with over 1,000 of these being issued on the first day of operation. An additional 3,338 citations were issued to drivers violating the two-occupant requirement on ramp bypass lanes. Citations and warnings together represent a total of 15,534 enforcement contacts for occupancy violations over the length of the project, or an average of 151 contacts per day.

On the basis of patrol man-hours, it is estimated that an average of 35 warnings and citations were issued on the Santa Monica Freeway for all violations during the peak hours of operation prior to the project. The number of citations and warnings issued daily for Diamond Lane and entry ramp violations immediately following project implementation was more than four times this estimated level. By the close of the demonstration, the number of daily enforcement contacts stemming from the illegal use of the Diamond Lane and freeway on-ramps had dropped somewhat, but remained more than twice the estimated pre-project level for all traffic violations.

Enforcement of the Diamond Lane provisions during the project was facilitated by the existence of a median strip where violators could be cited without being escorted across three or four lanes of traffic to the right shoulder of the roadway. Helicopter and roadside observers soon noted, however, that the use of the median for enforcement also interfered with the flow of traffic in other lanes. The use of the median for enforcement led to gawking and traffic slowdowns particularly in the nearby Number 2 lane. Since it was observed that black and white patrol cars stopped in the median appeared to cause more disruption than motorcycles, a June directive from the CHP suggested that, where possible, patrol cars should use the right shoulder for enforcement. As a practical matter, this often proved to be impossible during peak-hour traffic conditions.

1.5.3 Violations

1.5.3.1 Diamond Lane Violations

The Diamond Lane violation rate, defined as the ratio of vehicles with fewer than three occupants to the total number of vehicles in the lane, was high on the first day of the project and dropped to lower levels immediately thereafter. On the opening day, 40% (eastbound and westbound) of all vehicles using the preferential lanes did so illegally. The violation rate observed at the Western Avenue screenline then dropped off rapidly and fluctuated between 10% and 20% for the duration of the project, averaging 15.1% overall. The violation rate was highest (averaging 19.0%) in the westbound direction during the evening, when heavy traffic volumes increased the relative attractiveness of the Diamond Lanes for the tired, home-bound motorists on the road at that time. Violation rates were lowest (averaging 12.4%) for the eastbound trip in the morning.

Most of the observed violations occurred at the fringes of the Diamond Lane operating hours, just after the restrictions became effective at 6:30 A.M. and 3:00 P.M., or just before they were rescinded at 9:30 A.M. and 7:00 P.M. An estimated 39% of all violations occurred during the first and last quarter-hour of morning and evening operations, which represent only 14% of the seven hours of daily Diamond Lane operation.

The level of violations experienced on the Santa Monica Freeway is relatively low when compared with levels on other barrier-free preferential lane freeway projects. The violation rate on the exclusive lane operating on Interstate 95 in Miami, Florida ranged between 55 and 65 percent at the start of the project and dropped to between 35 and 40 percent after one year of operation. On Portland's Banfield Freeway, early violation rates ranged between 30 and 40 percent, dropping to 18 percent after six months of operation. During the first year of the San Francisco-Oakland Bay Bridge toll plaza bus and carpool lanes, violations

occurred at a 30 percent rate. The lower violation rate on the Santa Monica Freeway may be traced to the availability of a median strip for enforcement purposes and the cooperation of the CHP in enforcing the preferential lane restrictions from the early days of the project.

1.5.3.2 Bypass Ramp Violations

Violation rates on on-ramp bypass lanes, calculated by dividing the number of single-passenger automobiles observed using the bypass lanes illegally by the total number of automobiles using the ramps, dropped slightly during the demonstration and then soared with the termination of the Diamond Lanes. Violation rates prior to the project were 7%. During the project, these rates dropped to 5.6%, only to rise to 14.3% (double the pre-project rate) following Judge Byrne's ruling on the Diamond Lanes.

DEPLOYMENT, ENFORCEMENT AND VIOLATIONS

POLICE DEPLOYMENT

- Highway patrol deployment doubled during the first weeks of the project, and gradually returned to normal (76 man-hours daily during the seven A.M. and P.M. operating hours) by the thirteenth project week.

ENFORCEMENT

- An average of 151 warnings and citations were issued daily during the project.

RAMP BYPASS VIOLATIONS

- Violation rates in ramp bypass lanes dropped slightly during the project, but rose to more than double pre-project levels afterwards.

◆ LANE VIOLATIONS

- Approximately 15 percent of the vehicles using the ◆ Lane did so illegally. Violations occurred predominantly during the first and last quarter-hour of morning and evening operation.

1.6 SAFETY

1.6.1 Freeway Accident Statistics

1.6.1.1 Trends Over Time

One of the most worrisome aspects of the Diamond Lane project was the high incidence of freeway accidents accompanying the operation of the preferential lanes. Accidents increased markedly in the first week of the project, when 59 accidents were reported during Diamond Lane operating hours. Accident levels subsequently declined, dropping to an average of 18 accidents per week during the last month of the project, but they remained substantially higher than pre-project levels throughout the life of the demonstration. During the 21 weeks of the demonstration, 527 accidents were reported during peak operating hours, an average of 25 accidents per week. This level was more than double the rate experienced during the months immediately preceding the project, and more than two and one-half times the average rate experienced during the four years prior to 1976. Since accidents on the Santa Monica Freeway increased during the project, while vehicle volumes decreased, the observed increases in accident levels are even more striking when expressed in terms of accidents per million vehicle-miles (accidents/MVM), a common measurement index. Throughout the Diamond Lane project, the overall accident rate was 5.1 accidents/MVM, falling to 3.7 accidents/MVM during the last month of the demonstration. This closing rate was 2.6 times the rate of 1.40 accidents/MVM during the same period in 1975. Exhibit 1.18 plots a week-by-week summary of accidents during Diamond Lane operations, along with the accident levels occurring during the years 1972 through 1975, and a summary of accidents during the early 1976 weeks preceding the Diamond Lane project.

1.6.1.2 Breakdown by Severity, Time, Direction, Type, and Location

Table 1.10 compares accident levels by severity, time, direction, type, and location for three time periods: the 21 weeks of the demonstration; a comparable 21-week period in 1975; and a 12-week period following the close of the demonstration. This table shows that accidents dropped below 1975 levels following the close of the demonstration, emphasizing the role of the Diamond Lane in generating the observed accident increases.

The three major categories of freeway accident severity are (1) fatal, (2) injury, and (3) property damage only (PDO). Historically, few fatal accidents have occurred on the Santa Monica Freeway during peak operating hours -- an average of one per year during the few years between 1972 and 1976 -- and no fatalities

EXHIBIT 1.18

HISTORY OF FREEWAY ACCIDENTS DURING PEAK OPERATING HOURS

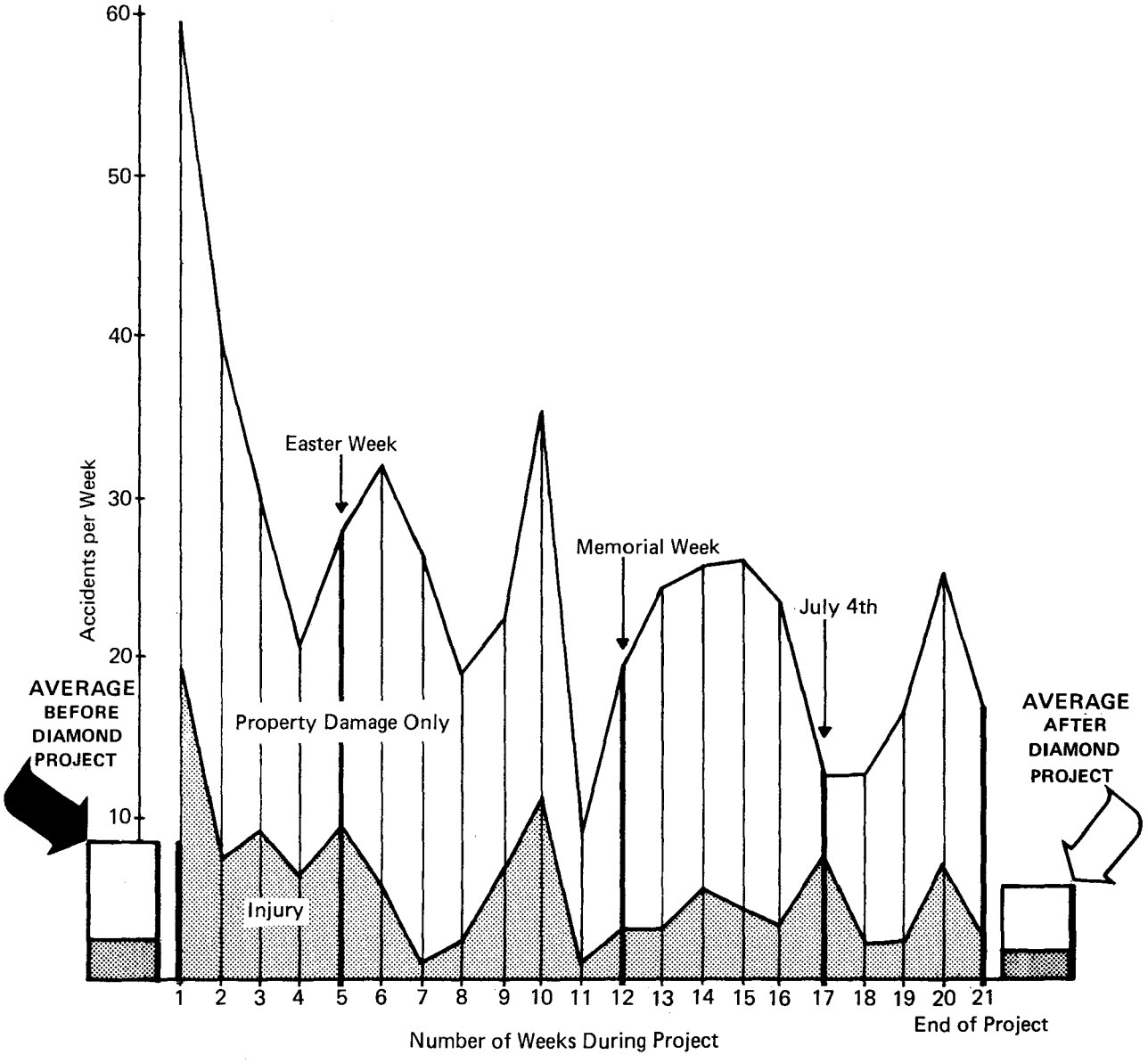


TABLE 1.10: ACCIDENT SUMMARY FOR SANTA MONICA FREEWAY BEFORE, DURING AND AFTER DIAMOND LANE OPERATION

(Monday Through Friday: 6-10 AM and 3-7 PM;
AM Hours Changed 5/17/76 to 6:30-9:30 AM)

	BEFORE		DURING			AFTER		
	3/17/75 to 8/8/75 21 Weeks 8 Hours/Day		3/15/76 to 8/6/76 21 Weeks 8 Hours/Day Before 6/17 7 Hours/Day After 6/17			8/9/76 to 10/29/76 12 Weeks 7 Hours/Day		
	Total No.	% of Total	Total No.	% of Total	% of 1975	Total No.	% of Total	% of 1975**
Total Accidents	180	100%	527	100%	293%	70	100%	78%
Accidents/Week	8.6		25.1			5.8		
Severity								
Fatality	0	0%	0	0%	0%	0	0%	0%
Injury	50	27.8%	120	22.8%	240%	22	31.4%	88%
a. Severe		3%***	1	0.8%		0	0%	
b. Other Visible		39%***	46	38.3%		10	45.5%	
c. Complaint of Pain		58%***	73	60.8%		12	54.5%	
Property Damage Only	130	72.2%	407	77.2%	313%	48	68.6%	74%
Time/Direction								
Eastbound AM	51	28.3%	108	20.5%	212%	31	44.3%	122%
Westbound AM	19	10.6%	65	12.3%	342%	8	11.4%	84%
Eastbound PM	43	23.9%	178	33.8%	414%	12	17.1%	56%
Westbound PM	67	37.2%	176	33.4%	263%	19	27.1%	57%
Eastbound	94	52.2%	286	54.3%	304%	43	61.4%	91%
Westbound	86	47.8%	241	45.7%	280%	27	38.6%	63%
Type of Collision								
Head-on	2	1.1%	2	0.4%	100%	1	1.4%	100%
Sideswipe	23	12.8%	47	8.9%	204%	11	15.7%	96%
Rear-end	122	67.8%	422	80.1%	346%	50	71.4%	82%
Broadside	12	6.7%	9	1.7%	75%	0	0%	0%
Hit Object	13	7.2%	42	8.0%	323%	7	10%	108%
Other	8	4.4%	5	0.9%	63%	1	1.4%	25%
Lane								
Median	14†	6.9%	24	4.6%	171%	4	5.7%	57%
Diamond Lane	55†	27.0%	27	5.1%	49%	12	17.1%	44%
No. 2 Lane	29††	14.2%	310	58.8%	534%	4	5.7%	14%
No. 3 Lane	29††	14.2%	51	9.7%	88%	7	10.0%	24%
No. 4 Lane	68†	33.3%	33	6.3%	49%	19	27.1%	56%
Other	9†	4.4%	82	15.6%	911%	24	34.3%	533%

*Source: Memorandum from C.P. Sweet to C.E. Forbes, CALTRANS, January 11, 1977.

**In comparing "after" data with 1975 data, 12-week, 7-hour operations during the "after" period have been factored up to 21-week, 8-hour operations to provide comparability with the 1975 base period.

***Percentages for severity of "before" injury accidents reflect peak-period statistics for a sample of 1975 accidents.

†Prior to the project, more than one location was recorded for each accident when multiple collisions occurred. Hence, the total number of lane locations adds to a total greater than the number of accidents.

††Prior to the project, accident data did not distinguish between the Number 2 lane and the Number 3 lane. A total of 58 accidents recorded in these median lanes have been split evenly between the two lanes.

occurred during the Diamond Lane project. Both injury and PDO accidents increased markedly with the implementation of the Diamond Lanes, with injury accidents increasing by a factor of 2.4 over a similar period in 1975 and by a factor of 2.5 over the average level recorded between 1972 and 1976. PDO accidents increased by a factor of 3.1 over the 1975 base period and by a factor of 2.7 over the average recorded during the few preceding years.

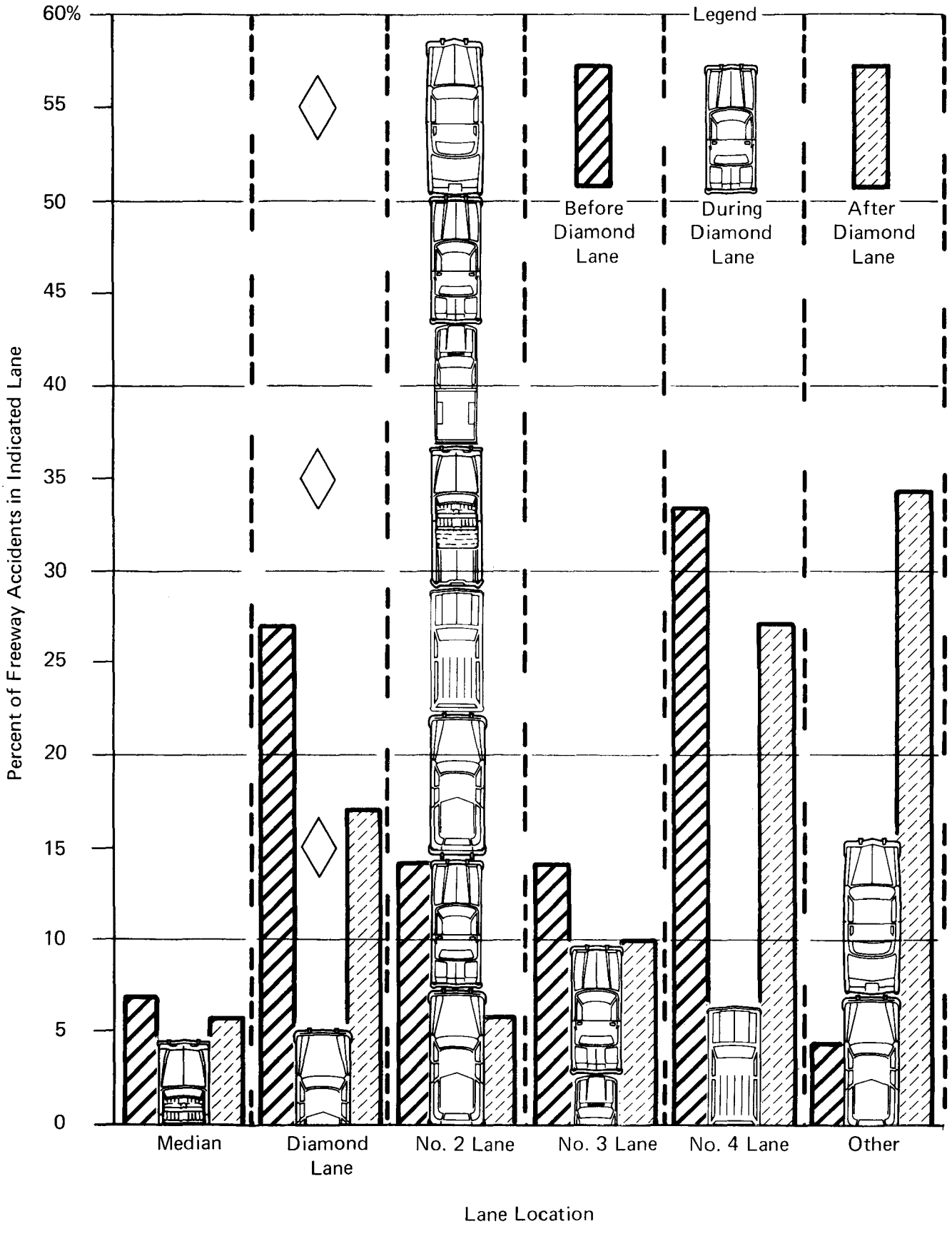
Injury accidents may be further divided into three subcategories: (a) severe; (b) visible injuries; and (c) complaint of pain. Only one severe accident (slightly less than one percent of all injury accidents) occurred during the Diamond Lane project, while 38 percent of reported injury accidents entailed other visible injuries, and 61 percent of injury accidents resulted in complaint of pain. A sampling of injury accidents occurring during 1975 shows a slightly higher incidence of severe accidents (3% of all injury accidents), but statistical tests give no basis for concluding that the Diamond Lanes affected the relative severity of injury accidents on the Santa Monica Freeway.

Almost twice as many accidents occurred during the evening peak as during the morning peak. This dominance of the evening hours coincides with pre-project experience. The greatest relative increase in accidents by time and direction occurred in the eastbound lanes during the evening rush hours. For the corresponding period in 1975, 43 accidents occurred in these lanes during the evening peak. During the evening Diamond Lane operating hours, 178 accidents occurred in this off-peak direction, an increase of 314% over pre-project levels.

Rear-end collisions accounted for 80% of the accidents recorded during Diamond Lane operating hours. During a similar time period in 1975, rear-end collisions accounted for only 68% of all freeway accidents. Thus, the relative incidence of rear-enders increased significantly during the project, reflecting an increase in stop-and-go conditions in the non-preferential lanes of the freeway.

In addition to the absolute increases in the number of accidents occurring during project implementation, certain changes occurred in the relative pattern of accidents. Perhaps the most notable of these relative changes was the marked increase in accidents in the lane adjacent to the Diamond Lane, the Number 2 lane of the Santa Monica Freeway. Exhibit 1.19 plots the relative percentage of accidents occurring in each lane before and after project implementation. During project implementation, 59% of all accidents occurring during Diamond Lane operating hours happened in the Number 2 lane. During a comparable period in 1975, the Number 2 and Number 3 lanes combined accounted for only 28.4% of all accidents, while the Number 2 lane alone accounted for only 5.7% of all accidents during the 12-week period following the close of the demonstration.

EXHIBIT 1.19
RELATIVE ACCIDENT LOCATION BY LANE
BEFORE AND AFTER PROJECT IMPLEMENTATION



In absolute terms, an average of 14.8 accidents per week occurred in the Number 2 lane during Diamond Lane operating hours. This represents an increase of more than 13 accidents per week over pre-and post-project levels. The net increase in accidents during project implementation was on the order of 15 accidents per week. Thus, a significant proportion of the overall increase in accidents was concentrated in the Number 2 lane.

Along the length of the project, most accidents occurred on those easternmost sections of the freeway near the CBD, where traffic volumes were highest. In the eastbound lanes, however, the greatest relative increases in accidents occurred west of La Cienega Boulevard. In the morning, eastbound accident increases were particularly pronounced at the point where cars from the San Diego Freeway entered the flow of traffic. The highest percentage of westbound accidents during both morning and evening hours, before and during the Diamond Lane project, occurred between the Arlington Avenue and Crenshaw Boulevard overpasses, where traffic from the collector road fed by Western, Normandie, and Hoover Avenues and the Harbor Freeway entered the flow of traffic. This location was particularly dangerous during the Diamond Lane demonstration, as one-quarter of all westbound accidents during the evening peak occurred near the spot where the two heavily-traveled collector lanes fed traffic into the Santa Monica Freeway.

1.6.2 Probable Accident Causes

A number of potential causes were identified in an attempt to account for the observed increase in accident levels. These causes stemmed from a variety of factors, including increased CHP presence, increased congestion, the mechanics of Diamond Lane operation, the novelty of the Diamond Lane concept, and exogeneous events. The most prominant of these causes were listed in the form of hypotheses and examined in the light of available data. The major hypotheses examined are listed below:

1. Hypotheses Related to CHP Presence:
   - The increased presence of the CHP on the Santa Monica Freeway meant that minor accidents which previously have gone unreported were written up during the Diamond Lane demonstration.
   - The high ticketing rate resulting from CHP enforcement of Diamond Lane occupancy rules led to gawking and slowdowns, causing additional accidents.
2. Hypothesis Related to the Removal of an Existing Lane:
   - Accidents were a direct result of increased congestion resulting from lane dedication.

3. Hypotheses Related to Diamond Lanes at Speeds Well in Excess of the Speeds in Barrier-Free Adjacent Lanes:

   - The speed differential made safe lane changes more difficult to achieve. Motorists attempting to enter the Diamond Lane had to enter a faster traffic stream from a lower starting speed, while motorists attempting to leave the lane had to slow and attempt to find an opening in slower-moving traffic.

   - The ability to save time by using the Diamond Lane attracted violators who dodged in and out of the lane unsafely, attempting to stay one step ahead of the CHP.

   - Motorists in Lane 2, accustomed to the relative absence of vehicles on their left in Lane 1, caused accidents by using the preferential lane as a safety valve to avoid rear-end collisions in their own lane.

   - The speed differential between Lane 2 and the faster adjacent lanes deluded the drivers in Lane 2 into believing they could travel faster than conditions in their lane allowed. Further, since traffic conditions were different in adjacent lanes, motorists received no cues from these lanes to indicate how conditions in their own lane were changing.

4. Hypotheses Related to Diamond Lane Novelty:

   - Driver confusion and experimentation in early weeks led to increased accident levels.

   - Movement in the preferential lane distracted drivers in the remaining lanes, causing accidents.

   - Driver aggravation with the Diamond Lane concept led to reckless, aggressive driving.

5. Hypothesis Unrelated to Diamond Lane Implementation:

   - Accidents increased naturally as a result of increasing freeway speeds and more relaxed attitudes toward energy consumption and the 55 m.p.h. speed limit.

While it is likely that each of the factors identified above contributed to one or more accidents during the demonstration, an analysis of these factors in the light of the accumulated accident data made it seem unlikely that certain of the potential causes had

a major influence on the accident picture. Among the causes which do not appear to explain a measureable share of the accident increase are:

- Overreporting of minor accidents as a result of increased CHP presence; and
- Such exogeneous factors as a general tendency to travel more or pay less attention to the 55 m.p.h. speed limit.

A correlation of accident and police deployment levels during the demonstration explain a relatively small proportion of the observed accident variation, and accident levels remained well above normal after CHP officer deployment had been reduced to pre-project levels midway through the demonstration. The sharp increase in accidents with project implementation, coupled with the return to pre-project levels immediately following the demonstration, discourages any attempts to find accident causes in citywide trends unrelated to the project itself.

Potential causes which could not be discounted but which do not appear sufficient to account for a substantial share of the accident increase include the following:

- The distracting effect of the increased CHP ticketing activities; and
- The closing of one freeway lane to general use. Although the increased density and congestion in the remaining lanes could be expected to increase accidents, it is unlikely that the accident rate would have risen substantially if the median lane had simply been closed to all traffic.

Each of the above factors undoubtedly contributed to the increased accident rate. Although it is impossible to quantify the relative extent of this contribution, neither factor seems capable of explaining a substantial share of the increase. The pattern of CHP ticketing activities appeared to parallel the overall accident pattern, increasing markedly with project implementation, and declining to a level more than double pre-project levels by the close of the demonstration. Moreover, both air surveillance teams and roadside observers reported that freeway traffic tended to bunch up in stop-and-go patterns in areas where tickets were being issued. However, the increased CHP ticketing activities do not provide a direct explanation for the remarkable increase in accidents in the Number 2 lane, and a day-by-day correlation of accident and enforcement levels during the demonstration period explains a relatively small proportion of the observed accident variation.

A rough comparison of accident locations with vehicle volumes along the freeway revealed the not unexpected finding that, in general, accidents were heaviest where vehicle volumes were heaviest. Although increased congestion accompanying the removal of

the Diamond Lanes from general use undoubtedly contributed to the increased accident rate, several arguments make it seem unlikely that this factor was a primary cause of the marked increase in accidents. Congestion levels equivalent to those experienced during Diamond Lane operations existed on portions of the Freeway prior to both the addition of an extra lane in 1967 and the introduction of ramp meters in 1974 and 1975 without causing pronounced accident levels. Moreover, with the increase in carpooling and bus riding accompanying the Diamond Lanes, and the concurrent shifting of some drivers to the city streets, the total number of vehicles per hour in each of the non-preferential lanes actually dropped slightly at several locations along the freeway.

The one potential cause which could not be discounted, and which does in fact appear to account for a large share of the accident increase is:

- The pronounced speed differential resulting from the combination of unhindered traffic in the sparsely occupied preferential lane and congested, stop-and-go conditions in the remaining lanes, coupled with the lack of barriers between lanes and the variety of possible origins and destinations along the length of the project.

It seems clear that the combination of high Diamond Lane speeds, when coupled with slow stop-and-go traffic in the non-preferential freeway lanes, contributed to the observed increase in accidents during the Diamond Lane demonstration. The exact extent of this contribution is impossible to determine, but it appears to be more important than the influence of the other postulated causes. Under normal operating conditions, an incident-related slowdown in one lane generally results in a slowdown in all lanes. Given the reserved nature of the Diamond Lane, however, a slowdown in the remaining lanes usually just accentuated the speed differential between the Diamond Lane and the remainder of freeway traffic, increasing the difficulty of entering and leaving the Diamond Lane safely. This problem was exacerbated by the large variety of trip origins and destinations in the Los Angeles area, which led carpoolers to enter and leave the Diamond Lanes at many points along the freeway. Regular and occasional carpoolers responding to the driver survey cited problems merging with slower traffic in leaving the Diamond Lanes as the greatest single difficulty encountered in using the lanes, and regular carpoolers felt that the discomfort of traveling faster than vehicles in the other lanes was just as disturbing as the difficulty of merging with these vehicles.

Attempts to verify the relative importance of unsafe lane changes as a cause of accidents during Diamond Lane operations were somewhat inconclusive. Although police records show that the absolute number of accidents which were preceded by a lane change increased markedly during Diamond Lane operations, the in-

crease in other types of accidents was just as great or greater, so that the relative percentage of accidents in which lane changes were involved did not change appreciably during the demonstration. It is not uncommon, however, for a vehicle changing lanes unsafely in congested conditions to escape unscathed while leaving a wave of braking vehicles in its wake that culminates in a rear-end collision well removed from the scene of the initial lane change. In such a case, the drivers involved in the collision are generally aware only of the proximate cause of their accident, and the accident report fails to record the lane change that initiated the chain reaction. Thus, although unsafe lane changes in and out of the Diamond Lane might seem to provide a plausible explanation for the observed increase in rear-end collisions in Lane 2, it is impossible to verify this explanation through a study of individual accident reports.

The relative percentage of accidents in which the vehicles involved were slowing, stopping, or standing still prior to collision increased from 45.5% prior to the demonstration to 58.5% during the demonstration, reflecting the increased incidence of rear-enders in the Number 2 lane and the increased level of stop-and-go traffic in all non-preferential lanes. Nearly half of the accidents (13 of 27) occuring in the Diamond Lane itself were caused by vehicles swerving into the lane to avoid trouble in their own lane, and colliding with a Diamond Lane vehicle. These 13 accidents, and at least an equal number occurring on the median strip, originated with stop-and-go conditions in the adjacent interior lane, even though they were not ascribed to that lane in the statistical summaries.

Early in the Diamond Lane demonstration, CHP officers noted that a few accidents were caused by violators dodging in and out of the preferential lane, attempting to stay one jump ahead of a ticket. Examination of the 27 accidents occurring in the Diamond Lane itself and the 24 occurring on the median shows that at least five of these 51 accidents were caused by vehicles carrying fewer than three passengers making unsafe lane changes. In three of these, the violators had been observed by the CHP prior to the accident. Further investigation of the impact of Diamond Lane violations on accidents proved impossible for two reasons:

1. In the case of minor accidents, the number of occupants of the automobiles involved is not always recorded in the accident report.

2. As noted, it is often impossible to identify the true cause of many of the reported rear-end collisions.

Because of the shortened duration of the project, the effect of Diamond Lane novelty on accident levels can never be known with certainty. The tendency to gawk and count the heads of passing carpoolers would certainly have diminished with time.

The frustration and aggravation of single-occupant auto drivers might also have diminished as operations in the non-preferential lanes continued to improve, and distracting, accident-causing "events" such as the mock funeral demonstration staged to protest the Diamond Lanes would presumably have disappeared with time. It is not possible, however, to project with confidence the accident level that would have existed following a longer period of operation. After extremely heavy accident rates during the first two weeks, accident levels tended to decline over the length of the project. Although the rate of decline slowed with time, the relative number of accidents per vehicle-mile was still declining when the project was terminated.

1.6.3 Implications of the Freeway Accident Picture

Given the nature of the most likely explanations for the increased accident rate, several occurrences could have brought about a decline in accident levels. To the extent that usage of the preferential lane increased with time, the speed differential would decrease as the preferential lane became more crowded and congestion in the non-preferential lanes was reduced by the elimination of defecting carpoolers and bus riders. The reduction of CHP enforcement levels would also work in two ways to reduce the level of accidents: First, by eliminating the distraction of the ticketing activity itself and, second, by permitting more violators to shift to the preferential lanes, thereby cutting the speed differential and easing congestion in the non-preferential lanes. To some extent, however, the elimination of either of these two accident sources tends to work against the presumed concept of the preferential lane. As the speed differential is reduced, so also is the inducement to use the lane. Moreover, any decision to relax enforcement must, by encouraging violators, run counter to the philosophy of a lane reserved for high-occupancy vehicles.

The apparent dilemma whereby reduced accidents might be achieved at the cost of lane operating efficiency highlights the delicacy of the control problem faced by planners attempting to design barricade-free preferential lanes for use in mixed traffic. On the one hand, if the preferential lane operates below capacity with a significant speed differential relative to adjacent congested lanes, accidents are almost certain to increase. If the lane is allowed to fill, however, either by allowing violators to infiltrate or by relaxing the requirements for the use of the lane (i.e., by allowing two-person carpools to use the lane), much of the inducement for using the lane vanishes. In theory, the number of carpools should grow over time until the marginal amount of time saved by switching to a carpool exactly balances the perceived inconvenience of making the switch. In practice, the level of accidents occurring before this equilibrium point is reached may be unacceptable to society, or the equilibrium point itself may result in an unacceptable accident rate.

The specter of increased accidents raises serious questions regarding the feasibility of the barrier-free preferential lane concept where drivers want to enter and leave the lanes at many points along the route. These questions appear to exist whether the lane is created by reserving an existing lane, as was done on the Santa Monica Freeway, or by creating an entirely new lane, as had been done in Portland and Miami and was originally contemplated on the San Diego Freeway in Los Angeles. The extent of the problem is difficult to assess at present, since neither Portland nor Miami has experienced an accident increase to date. In both these projects, however, enforcement activities are reduced, the influx of violators is relatively heavy, and the speed differential is not so great as in the Santa Monica Freeway project. Conceivably, however, the addition of a new preferential lane to an existing freeway could also result in increased accidents if stop-and-go traffic conditions exist in the non-preferential lanes, a significant speed differential is maintained between these lanes and an underutilized preferential lane, origins and destinations are scattered, and carpoolers are allowed to enter and exit at many points along the lane. Further investigations of the relationship between accident levels and the operation of barrier-free preferential lanes should be undertaken as soon as possible so that the risks attending these operations may be more clearly defined.

1.6.4 Surface Street Accidents

One of the potential side effects of the Diamond Lane project was the possibility that traffic diverted from the Santa Monica Freeway to surface streets might increase the number of accidents on those streets in the corridor surrounding the freeway. A sampling of eleven major surface routes paralleling the freeway for the first eighteen weeks of the project revealed that total accidents on those streets had increased by 8.8% over the 18-week period prior to the project, and increased by 5.2% over the average level experienced in a similar time period during the five years preceding 1976. Table 1.11 lists the sample corridor accidents in order of severity for the different base periods preceding Diamond Lane operation, and for the first 18 weeks of the project. This table shows that the number of injury and fatal accidents on corridor surface streets during the Diamond Lane project increased by 3.4 percent over the average level during the 18 weeks preceding the project. The primary causes of surface street accidents, which were speed, failure to yield to vehicles turning left, following too closely, and failure to observe signal lights, did not change markedly in the periods before and during the project.

Although surface street accident levels were seen to increase slightly during the demonstration, statistical evidence linking these increases with the Diamond Lane project is inconclusive. Historically, the day-to-day variability of accident levels on surface streets in the freeway corridor is great enough so that there is no assurance (at the .05 level of significance) that the observed accident increases were not a chance occurrence. The fact that accidents throughout the City of Los Angeles showed slight

TABLE 1.11

SURFACE STREET ACCIDENT SEVERITY

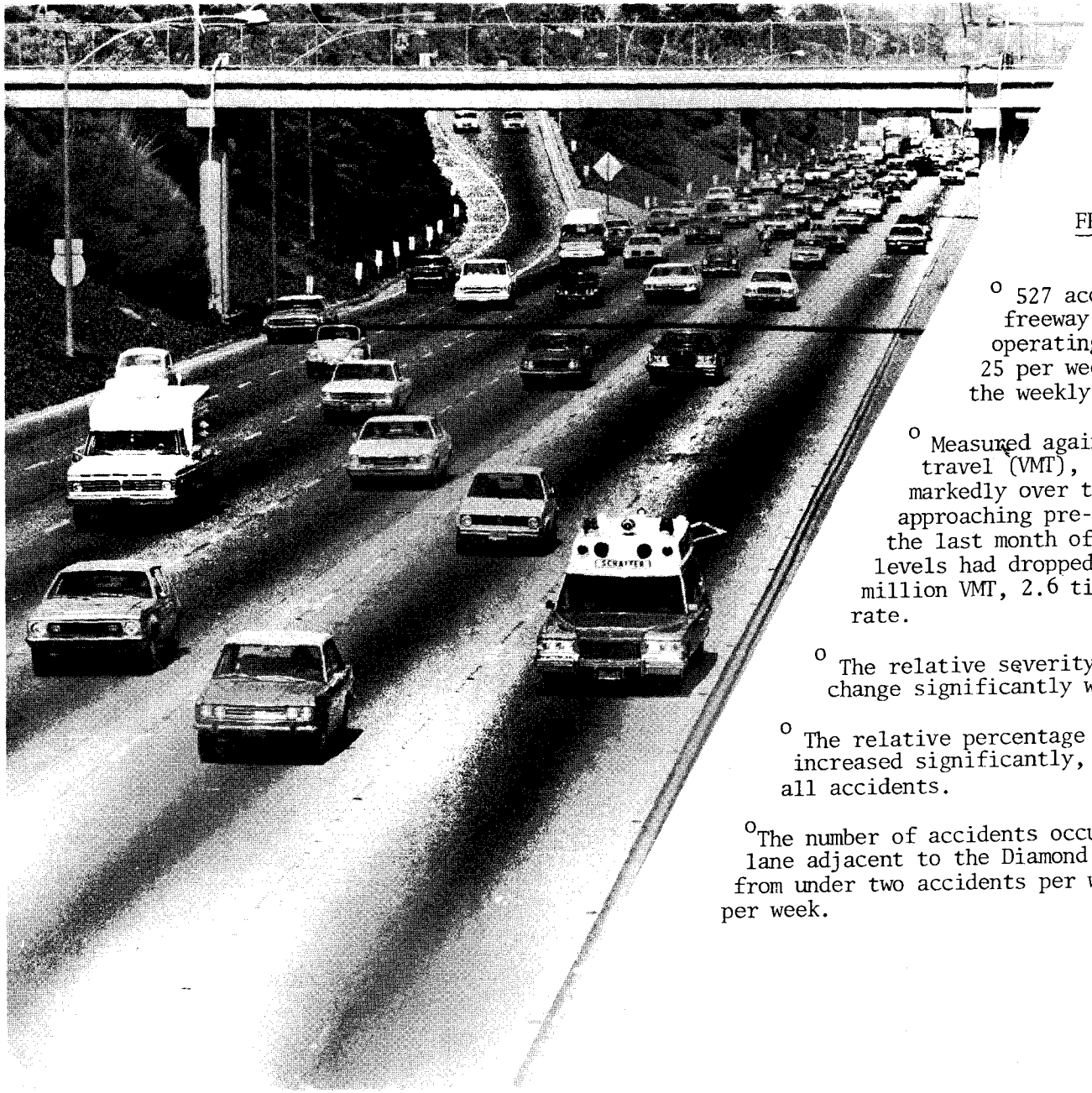
(6:00-10:00 AM and 3:00-7:00 PM on Weekdays on 11 Major East-West Routes)

Type of Accident	BEFORE PROJECT							DURING PROJECT	% CHANGE	
	Eighteen Consecutive Weeks Beginning in Mid-March						18 Weeks Prior to Project	18 Weeks* of ◆ Lane Operation	From 5-Year Average	From 18 Prior Weeks
	1971	1972	1973	1974	1975	5-Year Average				
PDO	272	258	289	235	252	261.2	261	280	+ 7.2	+ 7.3
Complaint of Pain	146	158	182	178	165	165.8	170	188	+13.4	+10.6
Visible Injury	128	142	132	103	91	119.2	99	112	- 6.0	+13.1
Serious Injury	13	24	10	14	11	14.4	12	10	-30.6	-16.7
Fatality	2	4	—	—	1	1.4	1	1	-28.6	0.0
Totals	561	586	613	530	520	562	543	591	+ 5.2	+ 8.8
Average Per Week:										
PDO Accidents	15.1	14.3	16.1	13.0	14.0	14.5	14.5	15.5	+ 6.9	+ 6.9
Injury and Fatal Accidents	16.1	18.2	18.0	16.4	14.9	16.7	15.7	17.3	+ 3.4	+ 9.9
Total Accidents	31.2	32.6	34.1	29.4	28.9	31.2	30.2	32.8	+ 5.2	+ 8.8

*At the time the analysis was performed, records were available for only 18 weeks of Diamond Lane operations.

increases during the period of Diamond Lane operation makes it still more difficult to make conclusive statements regarding the relative impact of the demonstration on surface street accidents. Since the number of vehicle-miles of travel on surface streets increased by about 9% during the early weeks of the demonstration (see Chapter 8), and averaged 3% higher than normal throughout the demonstration, the measured increase in accident levels appears to be consistent with the corresponding increases in surface street travel.

In an independent, unpublicized analysis of surface street accidents, the LADT identified larger increases in accident levels by comparing accidents occurring during the Diamond Lane demonstration with accidents occurring during the base year 1975. Comparisons of injury and fatal accidents occurring during Diamond Lane operation with the base year 1975 showed that these more serious accidents increased by 28% on a sampling of east-west surface routes and by 23% on a sampling of north-south surface routes. Since surface street accidents in Los Angeles were lower in the spring of 1975 than they were in previous years or in the months immediately before the demonstration, comparisons with this base year tend to overstate apparent increases somewhat. In the absence of further research into the subject of surface street accidents, the most enlightening conclusion that can be drawn from the separate analyses conducted to date are: serious (i.e., injury and fatal) accidents during the hours of Diamond Lane operation increased significantly (on the order of 23 to 28 percent) over 1975, a low-accident year. Less pronounced increases (on the order of 3 to 10 percent) were observed when serious accidents during the project were compared with the five-year average prior to the project, and with the four months immediately preceding project implementation. Because of the fluctuations inherent in surface street accident levels, however, no statistical significance could be attached to these less-pronounced increases.



FREEWAY ACCIDENT SUMMARY

- 527 accidents occurred on the freeway during Diamond Lane operating hours, an average of 25 per week, roughly 2.5 times the weekly pre-project average.
- Measured against vehicle-miles of travel (VMT), accident levels dropped markedly over the project, without approaching pre-project levels. By the last month of the demonstration, levels had dropped to 3.7 accidents/ million VMT, 2.6 times the pre-project rate.
- The relative severity of accidents did not change significantly with the project.
- The relative percentage of rear-end accidents increased significantly, from 68% to 80% of all accidents.
- The number of accidents occurring in the Number 2 lane adjacent to the Diamond Lane rose remarkably, from under two accidents per week to 14.8 accidents per week.

SUMMARY OF FREEWAY ACCIDENT ANALYSIS

POTENTIAL ACCIDENT CAUSES	LIKELY ROLE IN EXPLAINING ACCIDENT INCREASE
1. Increased CHP Deployment and Enforcement • Overreporting • Distracting Influence of Ticketing	• Insignificant • Probable contributor, but not a major influence
2. Congestion Resulting from Lane Removal	Probable contributor, but not a major influence in itself. Tends to exacerbate speed differential problems.
3. Pronounced Speed Differential • Unsafe Lane Changes • Weaving by Violators • Use of ◇ Lane as Safety Valve • Fosters illusion that greater speed is possible	Along with novelty, most likely explanation for significant increases. Difficult to pin down specific contribution of components, however.
4. Novelty of Diamond Lane Concept • Early Confusion • Distraction of ◇ Lane Movement • Aggravation	Undoubtedly a factor early in project. Shortness of project makes it impossible to judge whether contribution of novelty to accident rate had worn off by project termination.
5. Exogenous Explanations • Natural Increase • Citywide epidemic of carelessness	Insignificant

SURFACE STREET ACCIDENT SUMMARY

- When compared with the year 1975, a low-accident year, injury and fatal accidents on surface streets were found to rise between 23 and 28 percent during Diamond Lane operations.

- Less pronounced increases were observed when injury and fatal accidents were compared with other base periods. Accidents on a sampling of surface streets rose by 10% over the four months prior to the project and by 3% over the five-year average for the time period between mid-March and mid-July. Because of the fluctuations inherent in surface-street accident levels, however, no statistical significance could be attached to these less-pronounced increases.

1.7 ENERGY AND AIR QUALITY

1.7.1 Energy

Fuel consumption estimates were made for vehicles on the Santa Monica Freeway and a sampling of parallel city streets in the corridor before, during and after the Diamond Lane project. These estimates were based on the number of vehicle-miles traveled along sections of each corridor thoroughfare during the seven project operating hours. An allowance was also made to account for fuel consumption by traffic diverted to other freeways and time periods during the 21 weeks the Diamond Lanes were in operation.

The average energy consumption per peak-hour is tabulated in Table 1.12 for both the Santa Monica Freeway and parallel city streets before, during and after the project. This table reflects the amount of fuel consumed at cruising speeds, as well as any excess energy consumed idling at metered on-ramps or accelerating and decelerating in stop-and-go traffic. Fuel consumption levels depicted in the table were averaged over both peak periods and both directions of travel for a standard automobile that reflected the observed mix of vehicle types in the corridor.

The results tabulated in Table 1.12 indicate a reduction in fuel consumption on the Santa Monica Freeway during the Diamond Lane project. At the same time, fuel consumption actually increased on all parallel surface routes that were sampled. The net effect for the entire east-west corridor was a slight increase in fuel consumption of approximately 500 gallons per hour during the early and middle Diamond Lane periods, or the first fourteen weeks of the project. By the last seven weeks of the project, a net savings of 646 gallons per hour was recorded for the corridor itself. However, after conservatively accounting for diversions to midday hours and shifts to other freeways, the total energy consumption during the last seven weeks of the project was only 185 gallons per hour lower than the pre-project level of 22,598 gallons per hour. This represents a savings of 0.8% over pre-project levels, and may be traced primarily to the reductions in vehicle mileage recorded during the last seven weeks of the project. Although much of this reduction in mileage can be traced to the effects of the Diamond Lanes in encouraging carpool and bus ridership, some portion of the drop during the months of June and July may be due to seasonal travel fluctuations. In the absence of historical data on seasonal fluctuations in corridor traffic, it is impossible to separate the effects of the Diamond Lanes from the effects of summer vacations and beach travel on the recorded drop in energy consumption during the final seven weeks of the project.

TABLE 1.12: AVERAGE ENERGY CONSUMPTION PER HOUR (G.P.H.) FOR THE SANTA MONICA FREEWAY CORRIDOR

CORRIDOR ROUTE	BEFORE ◇	DURING DIAMOND LANE PROJECT			AFTER ◇
		EARLY ◇	MIDDLE ◇	LATE ◇	
FREEWAY LANES					
CRUISING	8543	6836	7806	7739	8367
STOP & GO	887	804	893	841	913
TOTAL	9430	7640	8699	8580	9280
SURFACE STREETS					
CRUISING	9779	10909	10307	9505	10968
STOP & GO	3388	4477	4172	3867	3466
TOTAL	13167	15385	14479	13372	14434
TOTAL CORRIDOR	22598	23025	23178	21952	23714
DIVERSION					
TO MIDDAY HOURS	0	153	153	153	0
TO OTHER FREEWAYS	0	309	309	309	0
CORRIDOR & DIVERSION	22598	23487	23639	22413	23714
PERCENT CHANGE FROM BEFORE	-	+ 3.93%	+4.61%	-0.82%	+4.94%

Another view of energy consumption in the corridor during the Diamond Lane project is afforded by Table 1.13, which charts the fuel consumption rates obtained by dividing the total energy consumption of the vehicle-miles traveled before, during, and after the project.* At the same time that total vehicle mileage in the corridor was decreasing during the project, the fuel consumption rates per vehicle-mile were increasing on every corridor route. This occurred because travel speeds were generally lower, speed changes were more frequent, and ramp delays were longer during the project. Each of these factors tended to decrease fuel consumption efficiency. Following the project, fuel consumption rates in the corridor approximated those recorded prior to Diamond Lane implementation.

TABLE 1.13

AVERAGE ENERGY CONSUMPTION RATES
IN GALLONS/1,000 VEHICLE-MILES
(Both Directions, Both Peak Periods)

	Before	During ◇ Lane			After
		Early ◇ Lane	Middle ◇ Lane	Late ◇ Lane	
All Santa Monica Freeway Lanes	58.02	58.12	59.59	58.24	58.83
Parallel City Streets	99.37	106.68	105.80	105.69	99.31
All East-West Corridor Routes	76.59	83.52	81.85	80.20	78.24
All Routes Except ◇ Lanes	76.59	84.40	82.77	81.12	78.24
Increase Over Before Period (Surface Streets and Non-Carpool Freeway Lanes)	---	7.81	6.18	4.53	1.65
Percent Increase for Non-Carpoolers	---	10.20%	8.07%	5.91%	2.15%

As shown in Table 1.13, the average energy consumption rate for non-carpoolers in the corridor increased by about 10% early in the project period. By the last seven weeks, the average non-carpooler traveling over the sample corridor routes was using 6% more gasoline

*The consumption factors shown in Table 1.13 list the energy consumption rates in gallons per 1,000 vehicle-miles. Expressed in terms of miles per gallon, automobiles on the freeway averaged about 17 miles per gallon, compared to about 12 miles per gallon on city streets.

than he had used prior to the project. For a non-carpooler traveling 20 miles daily in the corridor, this increase would have amounted to an additional half-gallon of gasoline per week. By way of comparison, it is estimated that each solo driver switching to a carpool saved an average of 1.15 gallons per one-way trip, or 11.5 gallons per week. This figure reflects information obtained in the corridor driver survey and includes an allowance to account for the extra use of automobiles left at home by carpoolers. The corresponding savings attributed to solo drivers switching to buses was 11 gallons of fuel per week. This savings is slightly lower than that attributed to carpoolers, largely because the average trip length of bus users was shorter than that of carpoolers.

By the end of the project, the estimates of total energy consumption indicate that the energy savings realized by drivers switching to buses and carpools was sufficient to offset the increases in energy consumption imposed on non-carpoolers by increased congestion and idling time. Even though the reduction in energy consumption at the time the project was terminated represents a small part (0.8%) of the total, and even though some portion of this reduction may be traced to seasonal traffic declines, energy consumption had apparently reached the marginal point at which small additional shifts to buses and carpools would have resulted in much greater savings, since the increase imposed on the non-carpooling public had already been offset.

1.7.2 Air Quality

Two different approaches were used in an attempt to assess the impacts of the Diamond Lanes on air quality in the Santa Monica Freeway corridor. In the first approach, the amount of carbon monoxide (CO) emitted by corridor vehicles during the project was computed as a function of vehicle-miles of travel, average travel speeds, and idling time at metered on-ramps. Table 1.14 summarizes the results of these computations in terms of tons of CO emitted per hour, averaged over both directions of travel and both peak periods before, during, and after the Diamond Lane project. These results parallel the energy consumption calculations based on the same vehicle mileage estimates. While the pollutant emissions declined on the freeway, they increased on all monitored surface routes during the early and middle Diamond Lane project periods. By the late Diamond Lane period, the calculated emissions on all corridor routes during the peak hours actually fell below pre-project levels. When diversions to other time periods and freeways were considered, however, total emissions during the final seven weeks of the project were roughly equal to pre-project levels. Once lane restrictions were removed, pollutant emissions rose above pre-project levels. However, these results are extremely dependent on the vehicle-miles of travel, and it is impossible to separate the effect of the Diamond Lanes from seasonal changes in traffic volumes.

TABLE 1.14

AVERAGE CO EMISSIONS PER HOUR

FOR THE SANTA MONICA FREEWAY CORRIDOR

(TONS PER HOUR)

	BEFORE ◇	DURING DIAMOND LANE PROJECT			AFTER ◇
		EARLY ◇	MIDDLE ◇	LATE ◇	
TOTAL CORRIDOR	14.8	15.8	15.0	14.4	16.2
DIVERSION	0	0.4	0.4	0.4	0
CORRIDOR & DIVERSION	14.8	16.2	15.4	14.8	16.2
PERCENT CHANGE FROM BEFORE	--	+ 9.7%	+ 4.1%	0%	+ 9.5%

In a parallel attempt to assess the effect of the Diamond Lanes on air quality, CALTRANS undertook an extensive air sampling program before, during and after the Diamond Lane project. Air quality was sampled at sites alongside the freeway and surface streets in the corridor. Because sampled air quality measurements vary not only with vehicle emissions but also with wind speed and direction and local atmospheric conditions, a good deal of uncertainty necessarily accompanies any attempt to draw conclusions on the basis of samples drawn during different seasons of the year under different meteorological conditions. The number of air quality samples drawn during the foreshortened Diamond Lane project was not large enough to support statistically significant conclusions when observations made under directly analogous meteorological conditions were sorted and compared.

In an attempt to make the most of the air quality data collected, CALTRANS developed a procedure for normalizing air quality measurements to account for (1) changes in wind speed and direction and (2) changes in local atmospheric stability. The air quality statistics resulting from this normalizing process reflect a general reduction in carbon monoxide levels at corridor measuring stations during the Diamond Lane project. With the samples normalized for aggregation, statistically significant reductions in carbon monoxide levels were recorded in the vicinity of the Western Avenue screenline on both the freeway and adjacent city streets for nearly all categories of wind direction and stability. Mixed results were obtained at the screenlines along La Cienega and Sepulveda Boulevards. Although there was a general trend toward lower carbon monoxide levels for these more westerly screenlines, measured decreases were often statistically insignificant and, in some cases, statistically significant increases in pollutant levels were recorded.

The general trend in measured air quality levels showed a decrease in carbon monoxide concentrations near corridor roadways during the Diamond Lane project. In view of the small sample sizes, seasonal changes and analytic uncertainties, however, it is impossible to make conclusive statements regarding the impact of the Diamond Lanes on air quality.

ENERGY AND AIR QUALITY

Fuel Consumption

- After an initial increase, fuel consumption levels on the freeway and adjacent city streets dropped during the last seven weeks of the project, falling an estimated 0.8% below pre-project levels.
- Because of increased congestion and idling time, fuel consumption rates for non-carpoolers had increased by 6% by the close of the project. These increases were offset by the savings accompanying increases in carpools and bus usage. Each solo driver switching to a carpool or bus was estimated to save roughly 11 gallons of gasoline per week.

Pollutant Emissions

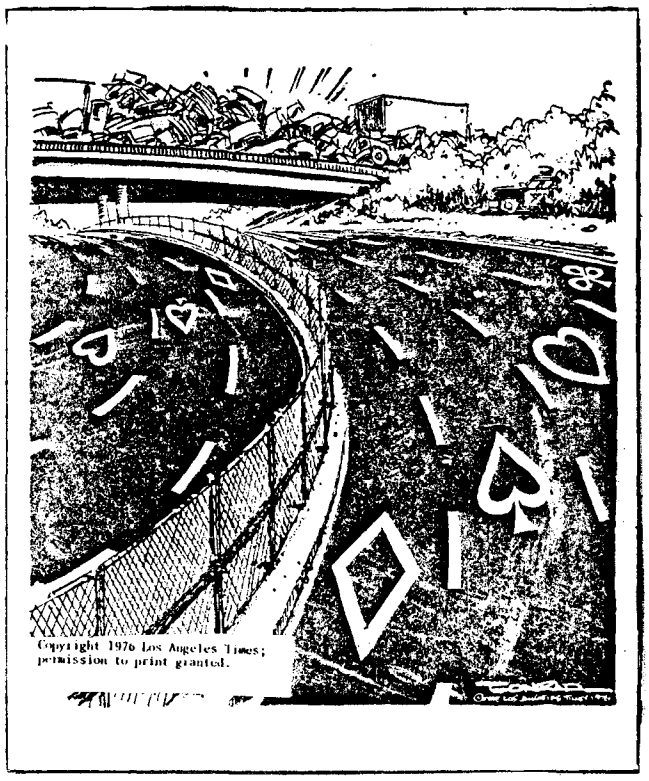
- On the basis of vehicle mileage computations, corridor vehicle emissions rose early in the project and dropped to pre-project levels by the time the project closed.
- Measured air samples showed a general decrease in carbon monoxide concentrations during the project. In view of the small sample sizes, seasonal changes, meteorological variations, and analytic uncertainties, however, it is impossible to make conclusive statements regarding the impact of the Diamond Lanes on air quality.

1.8 WHAT HAPPENED OFF THE FREEWAY

Statistical summaries quoting freeway speeds, vehicle volumes, bus ridership, and accident rates do not begin to convey the full picture of the Santa Monica Freeway Diamond Lane demonstration. The Diamond Lane experience was not confined between the guard rails of the Santa Monica Freeway. The demonstration quickly became a media event, generating reams of newsprint, radio and television coverage, vocal public reactions, political debate, lawsuits, banners, badges, slogans, cartoons, and at least one song. From their implementation to their dissolution, the Diamond Lanes were never far from public view and, when in view, they were treated as an eyesore.

1.8.1 Media Coverage

1.8.1.1 The Press



The three major daily newspapers covering the project, the morning Los Angeles Times, the afternoon Herald-Examiner, and the Santa Monica Evening Outlook, produced at least two-hundred and fifteen articles and editorials on the Diamond Lanes between January and October, 1976. The predominant tone of these articles was negative, and the editorials were solidly against the project. Although the operations on the freeway improved somewhat following the disastrous opening day, when the newspaper carried banner headlines proclaiming "Freeway Chaos" (see Exhibit 1.20), newspaper coverage grew steadily more hostile as the demonstration progressed. Exhibit 1.21 charts the editorial coverage of the project over time, from a single positive editorial before the postponed opening day in September 1975 to the negative demands for termination near the end of demonstration. Recurring themes in the press treatment of the project were:

- The operational failure of the project;
- The distasteful aspects of coercing disincentives;
- Bureaucratic recalcitrance; and
- The credibility of published data.

EXHIBIT 1.20

OPENING DAY HEADLINES

CLOSING N.Y. STOCKS

Los Angeles Times

MONDAY LATE FINAL

CHAOS ON A FREEWAY

Plot on Ford, Reagan Bared

—Story in Cols. 5-6—

New System Jams West Side Traffic

Shoe Shoos In '7000'

—SEE SPORTS MAGAZINE—

LOS ANGELES EVENING AND SUNDAY HERALD EXAMINER SUNSET

DIAMOND IS ROUGH

New Plan Ties Up Santa Monica Fwy.

Rash of Accidents, Warnings

Nutty Task Making Rangers Squirrelly

MONDAY EVENING OUTLOOK ★★★

101st Year—65th Issue | SANTA MONICA, CALIFORNIA, MARCH 15, 1976 | 28 PAGES—15¢

SM FREEWAY CHAOS

EGYPT'S ASSEMBLY VOTES TO END RUSSIAN TREATY

Summery 79 Engulfs Southland

Plot to Kill Fc Reagan Prob

Inside Highlights

Pepperdine cagers challenge UCLA dynasty in NCAA playoffs.

SM couple prepares to have baby at home.

Two groups seek fortune in Santa Monica trash.

Rebel Units Blocked In Lebanon

Diamond Lane Spurs Jams, Accidents

5 Percentage Points

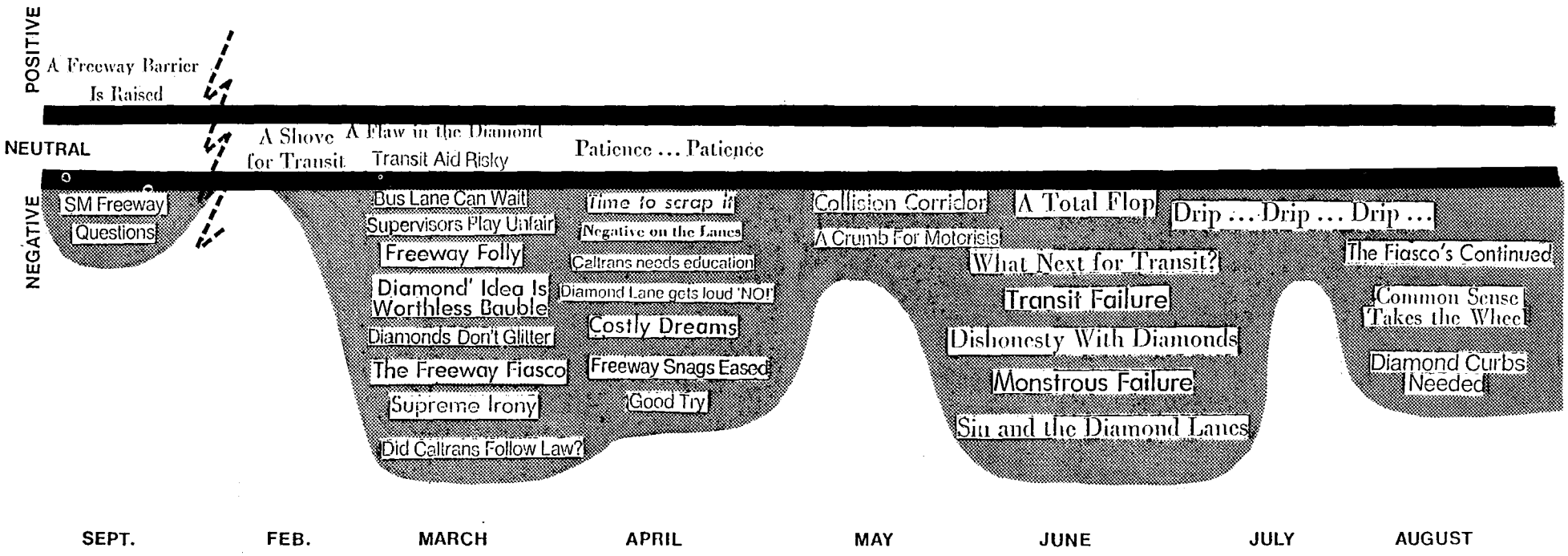
Poll Shows Carter Favored Over Ford

Revenue Sharing Defended

Vegas Hotels Struggle To Remain Open

EXHIBIT 1.21

EDITORIAL TREATMENT OF THE DIAMOND LANES



The negative image of the project reflected in the local press was mirrored by local wire service releases and the coverage provided by such State and national publications as New West, New Times, Time, Esquire, and the Wall Street Journal.

One of the most serious controversies emerging during the project turned on the question of data credibility. The sponsoring agencies were collecting data as the project progressed, and CALTRANS became the source for disseminating project statistics. As "CALTRANS' project" came under attack, so did the data it issued. Other agencies began drawing different conclusions from the CALTRANS data, and some local groups -- including the press itself -- began collecting and issuing their own data. As noted in the Los Angeles Times article of July 20 (see Appendix F), the differing figures were "...indicative of the battle of numbers that has evolved over the controversial project, hampering a true evaluation of what has been happening on the freeway and within the Santa Monica Freeway corridor."

1.8.1.2 Radio and Television

During their 22-week life, the Diamond Lanes were a popular subject for radio and television coverage, and provided a platform for many local figures seeking public exposure. Over 400 samples of this coverage were reviewed in documenting the role of the media in the Diamond Lane debate. As in the case of the press, the general tenor of the coverage provided by local and national radio and television stations was hostile to the project. Perhaps the most hostile and least balanced of all media coverage was provided by the radio disc jockeys, whose jibes ("you'll get home tonight if it takes all year") reached motorists while they were in the middle of their congested commuting period. Television news coverage commonly took the form of straightforward reports punctuated by chatty exchanges between newsteam members that helped to perpetuate such project jargon as "commuter coercion," "stubborn CALTRANS," and the view of the freeway as "the world's longest parking lot." Radio and television editorial comments followed the same negative pattern as newspaper editorials, with a few pleas for patience interspersed among many demands for termination. Interviews with project personnel and critics tended to present a wide sampling of pro- and anti-Diamond Lane viewpoints.

1.8.2 Project Promotion

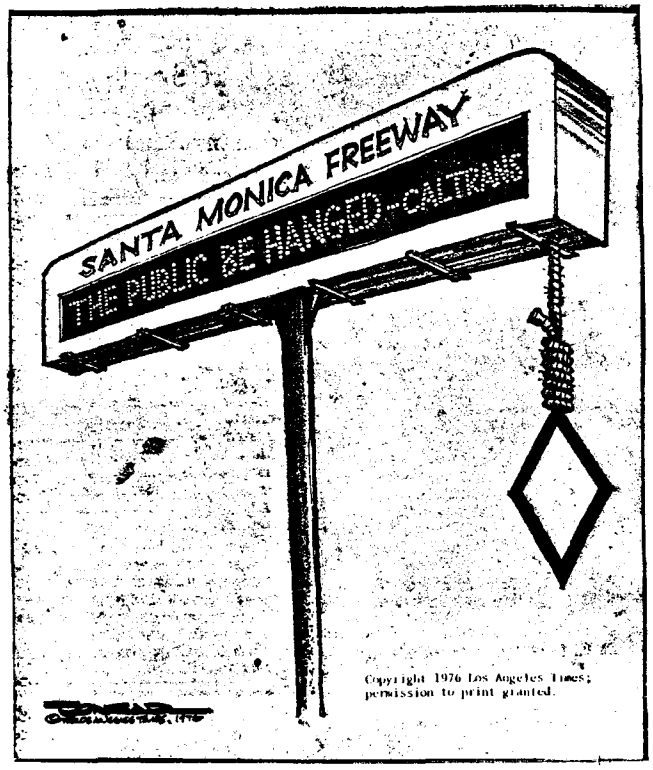
Although the full extent of the public and media outcry was not anticipated by the project participants, it was recognized in advance that the Diamond Lane project was likely to generate adverse public reaction, and a marketing campaign was developed with the joint aims of promoting buses and carpools and encouraging public acceptance through a program of information and education. The campaign was to stress the positive benefits of the project: economy, convenience, environmental improvement, energy conservation, and better utilization of existing transportation facilities. The choice of the name "Diamond Lane Express" was to provide a "memorable, meaningful, and promotable identity" for the project, and others like it.

The promotional program developed by the project team using part of the UMTA grant combined radio, television, newspapers, billboards, and handouts in a standard advertising approach to introduce the new services to the public. Following a March 1 press conference, newspaper advertisements began to appear regularly, the changeable message signs on the freeway advised commuters of the "Soon to Open" project, and 120,000 brochures were handed out by CALTRANS personnel on Santa Monica Freeway on-ramps. The brochures explained the reasons for the Diamond Lanes and how to use them, and included rules for drivers, alternate route descriptions, and bus and carpool information.

Given the extent of the media advertising campaign, the use of the changeable message signs, and the quantity of brochures handed out on the freeway, it is unlikely that many regular users of the Santa monica Freeway were unaware that March 15, 1976 marked the opening of the Diamond Lanes. Although the lanes themselves should have come as no surprise, opening day commuters did have reason to be surprised by several of the unannounced adjustments accompanying the opening of the lanes, including the tightening of ramp meter rates and the barricading of the slip ramp at the Harbor Freeway interchange. These unannounced adjustments undoubtedly contributed to the opening day confusion, and helped make March 15 "Mad Monday."

Following Mad Monday, the advertising campaign was drowned out by the media outcry and the public sponsors, placed on the defensive, were able to do little to counter the tide of adverse public reaction. Early in May, CALTRANS took a more aggressive stance in an attempt to improve the project's image, broaden the base of support for the project, and disseminate project information to a wider community of people. As part of this more aggressive marketing campaign, a program of appearances at public forums was established, downtown employers were contacted, a "Friends of the Diamond Lane" group was formed, and quick responses were generated to press coverage that was viewed as inaccurate or misleading. Unfortunately, CALTRANS' own image had suffered so much by early June that little could be done to improve the negative image of the project created by the media blasts, the public outcry, and the more disappointing aspects of the Diamond Lanes' operation.

1.8.3 Public Response



Public response to the Diamond Lane demonstration was overwhelmingly negative. It is impossible to know whether the public outcry was generated by the negative media image, or whether the media image simply reflected public outrage. Whichever came first, both the public and the media were in full cry early in the project, and each supported the other as the attack on the lanes progressed. Several mechanisms were used to monitor public reaction throughout the life of the project. These included a telephone response center, surveys of bus riders, carpoolers, and other corridor drivers, ad hoc newspaper polls, and a sampling of letters to newspaper editors.

1.8.3.1 Telephone Center

A telephone information center set up in cooperation with the Mayor's office served as a lightning rod for public opinion during the early weeks of the project. Between March 1 and April 2, 1976, the telephone center received and recorded 4,092 calls. Of these, 53% were negative, 13% were positive, 28% were information requests, and 6% were mixed. The telephone center was particularly active on the project's opening day, when over 800 calls were received, 70% of which expressed negative opinions of the project.

1.8.3.2 Demonstration Surveys

During the demonstration, bus riders were surveyed by both SCRTD and SMMBL, and a four-page survey covering travel behavior and attitudes was mailed to corridor drivers following the close of the project. Only 14% of the corridor drivers surveyed felt that the Diamond Lanes were beneficial, while 19% felt they were of no benefit and 67% felt they were harmful. Thus, 86.2% of all drivers surveyed rated the Diamond Lanes negatively, and 58% felt the same way about on-ramp bypass lanes. By way of contrast, ramp metering and express bus service received positive ratings from the majority of respondents: 62% of the drivers surveyed felt that ramp meters were either beneficial or greatly beneficial, while nearly 68% viewed express bus service positively.

Although the majority (84%) of the drivers surveyed drove alone, reaction to the Diamond Lanes was negative even among carpoolers, 69% of whom felt the lanes were either harmful or of no benefit. While 40% of all carpoolers rated the ramp bypasses negatively, the vast majority (92%) of bus riders surveyed felt that they were beneficial. Nearly 95% of all bus riders surveyed viewed the Diamond Lane service positively, expressing themselves as being either somewhat satisfied or very satisfied with the bus service offered.

1.8.3.3 Newspaper Polls

Each of the major newspapers in the Los Angeles area offered their readers a chance to express their opinion of the project. In a poll conducted two weeks after the project opened, the Herald-Examiner reported that 3,167 readers voted against the Diamond Lanes while only 57 voted for the lanes. In a poll of 1,763 readers, the Santa Monica Evening Outlook found that 87% opposed the lanes, 5% were for the lanes, and 7% suggested modifications. A third poll conducted in mid-May for the Los Angeles Times by the Marylander Research Corporation found that 42% of a sample of 400 respondents disapproved of the Diamond Lanes, while 41.5% approved and the rest had no opinion. A more extensive poll conducted for the Times after the project closed revealed that 73% of the respondents felt that the experiment was a poor way to achieve the stated objectives of energy conservation, congestion relief, and air pollution reduction, while 85% said that, if asked to vote on the issue, they would not choose to renew the project. When asked who was responsible for the project, 57% of the Times survey respondents believed it was CALTRANS, while another 31% believed it was the CALTRANS Director, Adriana Gianturco, who took office the day the project opened.

1.8.3.4 Letters to the Editor

Of 120 letters to the editors of Los Angeles area newspapers published after the opening of the Diamond Lanes, 68% were negative, while 29% were positive and 3% were neutral. Most of the

positive letters spoke of the time, money, and energy saved by carpooling or bus riding and of the need to give the project time to prove itself. Negative letters echoed many of the common themes identified in the press and reflected in survey comments. These included:

- Discrimination against fuel-saving motorcycles and two-seater cars;
- Animosity toward perceived CALTRANS intransigence;
- Concern with smog, congestion, and wasted energy caused by idling, bumper-to-bumper traffic;
- Social engineering which benefits a few while penalizing the vast majority;
- Bureaucratic bungling in taking away one-quarter of a freeway paid for with citizens' gasoline tax money;
- Coercive tactics allowing no chance for public participation in the planning process; and
- Concern for safety.

1.8.3.5 Public Hearings

On the evening of June 21, 1976, Los Angeles City Councilman Marvin Braude chaired what was advertised as "the first public hearing held on the project by government at any level" to provide a forum for public testimony. Following pro and con speeches delivered by, respectively, representatives of CALTRANS and the LADT, and other interested parties, the floor was opened to those among the estimated 250 attendees who wished to be heard. Of those wishing to speak, 46 were against the project, while 24 were for it. Pro and con speeches, which were limited to three minutes, touched on most of the concerns identified above and echoed in the survey responses.

1.8.3.6 Other Public Response

Public response to the Diamond Lane project was not limited to the formal avenues of telephone inquiries, survey responses, letters to editors, lawsuits, organized group protests, and public hearings. Residents of Los Angeles managed to find unique ways of expressing their general distaste for the Diamond Lanes. On opening day, nails were spilled in the lane by a disconsolate motorist, and a "baggy bomber" used paint-filled balloons to obliterate several of the painted diamonds in the lane. On June 3, the "Citizens Against the Diamond Lane" slowed Diamond Lane traffic by staging a mock funeral procession in the lanes, and they later attempted to hang anti-project signs from a freeway overpass. Entrepreneurs sold bumper stickers and badges carrying comments on the lanes, while college students offered their services as riders for a fee to drivers wishing to qualify as carpoolers, and the media reported a brisk sale of mannequins designed to gull observers into believing one driver and two dummies constituted a three-person carpool.

All of the anti-Diamond Lane activities were reported by the media, which helped to create and sustain the climate of negative public opinion. It is impossible to quantify the extent of the media's role in generating adverse public reactions. Telephone center monitors noted an increase in negative calls on days when critical articles appeared in the press, and noted similarities in wording between the press articles and the complaints received. But any attempt to lay the full blame for the hostile climate of public opinion on the media seems to be oversimplifying and overstating the case. In writing on the relationship of the media and public opinion recently, Washington columnist Joseph Kraft observed that:

> "One of the few things we know about public opinion is that it grows from experience. People develop views when something happens to them. The more acute the happening -- the more it makes us pay in money or blood -- the more strongly held the view...
>
> "Public opinion is the sum total of all (their) experiences. Things read in the paper or seen on television only form a part of the total. But a part that is dim unless reinforced by experience."

In Los Angeles, the negative media image of the Diamond Lanes was reinforced daily for over 100,000 freeway users who found their daily commute trip lengthened by a project designed to benefit a perceptibly smaller proportion of the traveling public.

1.8.4 Institutional and Political Climate

Several factors contributed to the stormy political weather encountered during the Diamond Lane project. These included:

- The complexity of transportation planning, financing, and decision-making in the Los Angeles area;
- The implications of the Clean Air Act;
- The changing philosophy, policies and personnel in the State transportation agency; and
- The scheduling of the demonstration in an election year.

All these factors combined in a setting where everybody talks about transportation conditions but few are able to do anything about them. Transportation plans have proliferated as the number of federal, State and local agencies with an interest in transportation has multiplied. In commenting upon the large number of government agencies with diverse interests involved in the Santa Monica Freeway preferential lane demonstration, the Southern California section of the American Institute of Planners wrote that:

> "Los Angeles' unique fragmentation of public power and authority typically requires the involvement of a myriad of government agencies and elected officials in most major public projects. Projects also typically require enormous amounts of time in order to secure the consensus needed. The Santa Monica Freeway diamond lanes were no exception. Besides numerous federal agencies (UMTA, FHWA, the Department of Labor, the EPA, to name a few), officials at virtually every level of local government at one time or another became involved in the project's design and implementation. The process took almost four years."

The number of local agencies participating in the development of transportation plans during the four years preceding the implementation of the Diamond Lane project included CALTRANS District 7, SCAG, SCRTD, and the City and County of Los Angeles. Preferential lanes on the Santa Monica Freeway were an important part of these plans. In the early planning stages, preferential freeway lanes appeared promising to planners and politicians alike as a low-cost, short-range, incremental approach to making better use of the existing road network and meeting the EPA air quality standards imposed by the Federal Clean Air Act of 1970. The development of such lanes was recommended by State Senate Bill 1221 in October 1973, proposed by a member of the County Board of Supervisors in February 1974, and moved by the City Council in March 1974. The fact that some of the impetus for the Diamond Lanes came from the Federal Clean Air Act and State Senate Bill 1221 helps to explain some of the locally-expressed feeling that the lanes were foisted off on Los Angeles by bureaucrats in Washington and Sacramento. Whatever the compelling motivation, however, the Diamond Lane plans were developed at the local level with the knowledge and consent of public officials by local agencies with transportation responsibilities and experience.

1.8.4.1 Institutional Problems

A variety of problems existed within the local agencies responsible for project implementation. The lead agency, CALTRANS, went from a state of flux immediately prior to the project to a state of siege during the demonstration. In the period immediately preceding the project, the agency was in a state of transition that extended from its headquarters in Sacramento to the working level at District 7 in Los Angeles. While the project was still in the planning stages, Secretary of Business and Transportation Donald Burns was appointed by the Governor; the Director of CALTRANS was fired; an acting director instituted a sweeping series of staff layoffs; and a new director, Adriana Gianturco, took office on the day the project began. At the local level in District 7, both the District Director and the Deputy District Director responsible for the conception and initial planning of the project left CALTRANS before the much-delayed project was finally implemented. The shuffling of responsibilities accompanying the departure of these figures and the sweeping layoffs instituted by the acting director in Sacramento also led to the shifting of responsibilities at middle management and staff levels at an awkward time, causing problems in planning continuity and pre-project data collection. Manpower shortages and shifts in responsibility led to compromises in the collection of pre-project data which later contributed to public mistrust of CALTRANS project reports.

Once the project began, the new faces at CALTRANS were confronted with a new set of problems for the agency, that of publicly evaluating and defending an innovative project from a daily media blitz. Whereas the agency had become accustomed to public

pressure over the building of freeways, the Diamond Lanes represented a new concept with a new set of aims and enough adverse side effects to lead some within the agency to question whether CALTRANS was justified in defending the project. Reports of dissension within CALTRANS were publicized in the Los Angeles Times as some agency employees, perceiving a deterioration in both freeway performance and agency credibility, wished they "...were back building freeways."* As CALTRANS struggled to assess the operations on the freeway, deal with the hostile press, and evaluate a number of complex issues involving the project's future, an impatient press and public blistered the agency for its apparent intransigence and insensitivity to the needs of the citizens.

Although none of the remaining project participants had the shakeups in key personnel experienced by CALTRANS, some were beset by other types of problems in discharging their Diamond Lane responsibilities. The second of the two delays in project initiation could be traced to uncertainties at SCRTD over the impact of federal labor restrictions imposed by Section 13(c) of the National Mass Transportation Act of 1974 and the availability of subsidy funds from the County, which was anticipating a cash shortage at the end of the fiscal year. During the Diamond Lane project, SCRTD's bid to build and operate a modern rail rapid transit system was defeated at the polls, in spite of the fact that the system was advertised as an alternative to the much maligned Diamond Lanes.

The City of Los Angeles had not voted funds to be a project participant, and acted solely in an advisory capacity until mid-August of 1975. At this time, the City Council voted to support the project, but included a recommendation that an operations management team be formed which would include representatives from the LADT and the LAPD as well as the members of the Joint Project Board. This team was formed and participated in project planning. Shortly after the project was implemented, however, the LADT publicly adopted an adversary attitude toward the project and acted unilaterally in many instances. Once the trial began, the adversary role of the LADT inhibited the free flow of surface street information from the LADT to other members of the management team and to the project evaluators.

1.8.4.2 Vocal Local Opinion

Public reaction and the media din were exacerbated by the frequent and public opposition of several elected and appointed City and County officials. The level of opposition ranged from responsible criticism on the part of some officials who had worked with project personnel in an attempt to make the Diamond Lanes more acceptable to their constituents to simple attempts on the part of other officials to align themselves publicly with the opposition to a clearly unpopular project. Responsible

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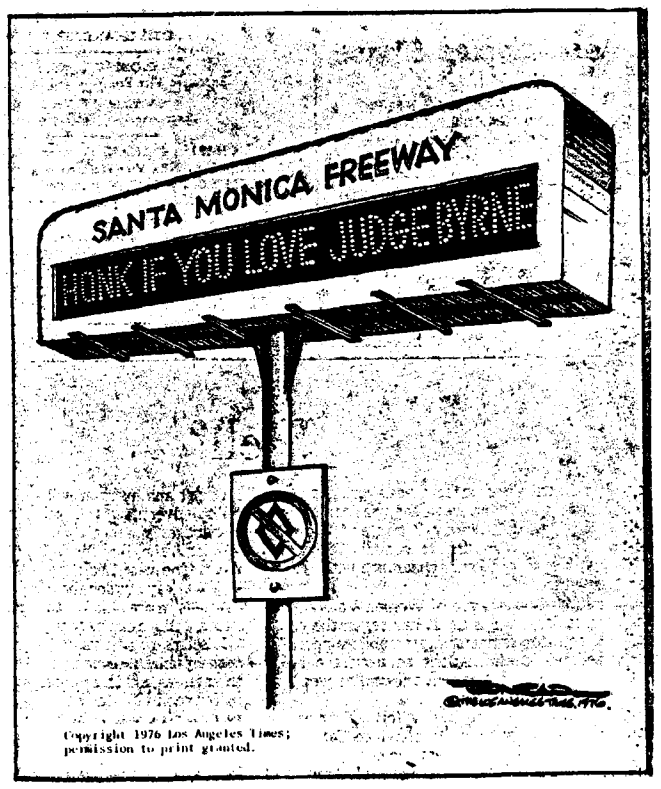
*Hebert, Ray, "Diamond Lanes Stir Dissension in Caltrans," Los Angeles Times, July 20, 1976 (complete text in Appendix F).

opposition and objective analysis had to clamor for a hearing alongside of simplistic arguments, emotional appeals, and self-serving electioneering. The Diamond Lanes even became a pawn in the election-year battle for the approval of funds for a rapid rail system in Los Angeles (STAMP OUT DIAMOND LANES: VOTE YES FOR RAPID TRANSIT). In the face of the opposing clamor from the media, public, and elected and appointed officials, those officials who might have favored the project found it prudent to remain silent, and little in the way of a constructive public dialogue emerged. The AIP background paper cites this "failure to develop a constructive dialogue" as a "major detriment to the performance of the Diamond Lanes." There is little doubt that the continual public threats to the lanes' existence led many potential carpoolers to defer any commitments to shared riding until the opposition was silenced and the project achieved a more permanent status.

1.8.5 The Legal End



Although the life of the Diamond Lanes was continually being threatened by the media and the public, and State and County officials had drafted terminating legislation, the demonstration was eventually done in by what at the time seemed the least likely suspect, a lawsuit in the U.S. District Court of Appeals. The lawsuit only indirectly addressed the merits of the project, focusing instead on the alleged failure of CALTRANS and UMTA to comply with the requirements of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) by filing an Environmental Impact Report on the project. On Monday, August 9, 1976, Judge Matthew Byrne ruled that Environmental Impact Reports should have been filed under both State and national environmental laws, ordered that the freeway be returned to pre-project status by Friday, August 13, and gave CALTRANS 180 days to file the required reports.

Judge Byrne's findings of fact refuted the defense argument that the project was exempt from the stipulations of CEQA and NEPA by virtue of its intent to further the requirements of the Clean Air Act. Since there was no EPA-approved CALTRANS Transportation

Control Plan, the controlling plan was ruled to be the EPA-promulgated plan of November 12, 1973, which did not require preferential lanes on the Santa Monica Freeway. Consequently, the project was not "an action taken pursuant to the Clean Air Act."

The Judge also found that the original plaintiff, Pacific Legal Foundation of Sacramento, had no standing in the case, so that local Councilman Zev Yaroslavsky, who had added his name to the list of plaintiffs just prior to the trial, became the injured party.

The court order did not rule upon the merits of the project or its success in meeting its goals. However, Judge Byrne was clearly concerned with the lack of coherent documentation to support the conclusion of the participating agencies that the project would have no significant impact on the environment. He found that there was no certainty that the project was not going to cause significant harm, that traffic congestion, safety, and health are environmental factors worthy of consideration, and that the testimony and exhibits submitted to support CALTRANS' claim that these factors were in fact considered were "...so ambiguous and inconsistent that it is impossible to determine exactly what procedures were followed."

1.9 IMPLICATIONS FOR OTHER AREAS

The Santa Monica Freeway preferential lane project succeeded in attracting riders to carpools and transit, and appeared to be headed toward increasing freeway capacity without requiring additional levels of police deployment. However, the project brought about a significant increase in freeway accidents, and occasioned a heated public outcry which has halted the implementation of other preferential treatment projects in Southern California, and given planners and public officials in other areas ample cause for reflection before attempting to implement similar projects.

1.9.1 General Observations

Whereas other preferential lane projects have constructed additional lanes or converted lanes in off-peak directions to preferential use, the Santa Monica Freeway Diamond Lane project marked the first time preferential lanes were created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles. This aspect of the project contributed to most of the negative impacts recorded during the demonstration. The removal of two lanes from general use contributed heavily to the congestion and confusion on opening day, was a slight but important factor in the increased accident rate, and appears to have been one of the chief sources of public dissatisfaction with the project. Many freeway users felt strongly that they had paid for the lanes with their gasoline taxes and were entitled to go on using them. The lane preemption and the resulting slowdown were viewed with hostility by most corridor drivers, who appeared to perceive the preemption as a plot to force individuals out of their own cars, a plot designed by meddling bureaucrats to inconvenience many for the sake of a few. Los Angeles City Councilman Zev Yaroslavsky expressed this point of view succinctly when he said in an interview "Why should 3,000 carpoolers

inconvenience 240,000 vehicles?"* Moreover, the number of project beneficiaries were perceived to be even fewer than their numbers indicate because they traveled three-to-a-car, or rode in buses that were often half-empty, and did not fill the Diamond Lanes to capacity.

Another aspect of the Diamond Lane demonstration that contributed to the project's disappointing performance was the absence of barriers between the preferential lane and the congested adjacent lanes. Frequent vehicle shifts in and out of lanes operating at markedly different speeds contributed heavily to the increase in accidents. The problem of accidents in barrier-free operation is a serious one and deserves further study. In other areas, and in Los Angeles itself, preferential treatment lanes separated from the general flow of traffic have been successful in improving carpool and bus ridership without increasing accident rates. In Los Angeles, the San Bernardino Busway, a preferential lane constructed by adding an eleven-mile separated lane along Route 10 east of the CBD, has operated successfully without generating either the acrimony or the accidents accompanying the Santa Monica Freeway project west of the CBD on Route 10.

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*This quote also serves to illustrate the particularly adroit feats of number-juggling that were displayed at times by both pro- and anti-forces in attacking or defending the project. The 3,000 carpools were, presumably, the number on the freeway prior to the project during the seven peak operating hours. The 240,000 vehicles represent the number using the freeway in a 24-hour day. At the close of the project, the number of individuals traveling three-to-a-car during project hours was closer to 20,000, and they were joined by an additional 4,000 bus riders. These 24,000 individuals might have been said to be inconveniening roughly 140,000 other individuals, the approximate number of non-carpoolers on the freeway during operating hours. The Councilman's point about the few inconveniencing the many need be no less valid, but it is somewhat less dramatic when more appropriate numbers are used. The free-form use of different numbers and different reference bases during the demonstration made it difficult for the public to know who or what to believe and led the press to question the credibility of project participants. The credibility of project foes was rarely questioned by the media.

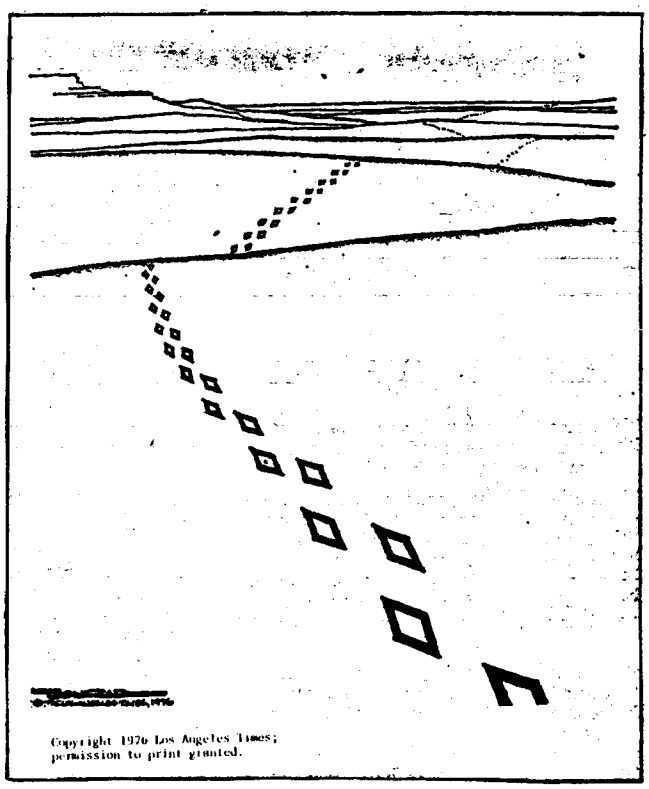
Under the best of circumstances, there will always be some degree of ambiguity associated with traffic data. In many instances, statistics concerning the Diamond Lane project were produced under the worst of circumstances, having been hurriedly processed under rigid deadlines in the glare of publicity, and interpreted by agencies with a vested interest in attacking or defending the project. Problems encountered in the data collection and evaluation phases of the project ranged from simple human miscalculations to complex computer failures. In retrospect, the picture of the project that emerges from a more thorough examination of the data is somewhat different from that presented by both proponents and opponents of the project in the midst of the "battle of numbers" waged during the demonstration itself.

1.9.2 Implications for Los Angeles

The Santa Monica Freeway Diamond Lane is gone, but the bus routes developed for the project continue, although service has been reduced and the Park-and-Ride lots were discontinued on September 1. Despite early signals after the Diamond Lane trial that CALTRANS and UMTA would appeal the decision and ask for a speedy review, there has been no follow-through on the appeal filed in October 1976. Project personnel report that the appeal has been dropped by both CALTRANS and UMTA and that environmental procedures are being reviewed. Most observers of the Santa Monica Freeway project feel that the project is dead. A CALTRANS spokesman stated that no environmental impact report will be made.

The furor over the Diamond Lanes and the resulting court decision has brought the entire high-occupancy vehicle (HOV) program in the Los Angeles area under close scrutiny. As envisioned in March 1976, the program was to have included four types of preferential lane projects: busway on a separated roadway (San Bernardino Freeway, in operation); concurrent flow on existing lanes (Santa Monica Freeway); concurrent flow on an improved median shoulder (San Diego Freeway); and bypass lanes at metered on-ramps (Harbor Freeway). The exclusive separate busway on the San Bernardino Freeway has enjoyed some success and was recently opened to carpools. Bypass lanes at selected metered ramps on the Santa Monica and other freeways have provided an incentive for carpoolers without generating either the opposition, lawsuits, or accidents accompanying the Santa Monica Freeway Diamond Lanes. The Santa Monica Freeway experience has effectively killed any future attempts to create preferential lanes by taking lanes out of general use. The outcry over the Santa Monica Freeway experience has also delayed, possibly forever, the plan to add a new reserved lane for buses and carpools by improving the median shoulder of the San Diego Freeway. Originally scheduled to open in mid-September 1976, the newly-constructed median lanes on the San Diego Freeway went unused for roughly four months while a heated public debate, fueled by the Santa Monica Freeway controversy, raged over whether the lanes should be restricted to the use of buses and carpools as originally planned. The lanes were finally opened to general traffic on January 31, 1977.

1.9.3 Implications for Other Areas



Several aspects of the Los Angeles area and the Santa Monica Freeway itself served to amplify and modify the effects of the Diamond Lanes. For the benefit of decisionmakers attempting to translate the Santa Monica Freeway experience in terms of their own geographic areas, the most important of these aspects are:

1. Los Angeles' geographic sprawl and lack of a CBD orientation;
2. Los Angeles' automobile dependence;
3. The high incomes of the area residents served by the project;
4. The fragmented division of responsibilities among State, City and County agencies; and
5. The existence of ramp metering on the Santa Monica Freeway.

Geographic Sprawl: Because of the scattering of trip origins and destinations throughout Los Angeles, relatively few users of the Santa Monica Freeway are destined for the CBD. The lack of a focal point for trip destinations made carpool formation relatively difficult and decreased the pool of potential riders of the CBD-directed bus service. In practice, the scattering of origins and destinations also meant that drivers were likely to want to enter and leave the Diamond Lanes at points all along their 12.5-mile length. The need to enter and leave the lanes at many different points greatly increased the possibility of accidents and made freeway operation less safe than it might have been if all drivers had exited at a common destination with provisions for safe merging.

Automobile Dependence and the Mystique of the Automobile: As a result of the geographic sprawl of the City, Los Angeles residents generally travel further and are more dependent on their automobiles than residents of other U.S. cities. The freeways are the City's lifelines, and it is a local observation that the combination of freeways

and sprawl means that "you can get everywhere in forty-five minutes, but you can't get anywhere in less than thirty minutes." The often noted mystique of the car culture is a real, if non-quantifiable, aspect of the local scene. Even so, there are probably few U.S. cities which would acquiesce to the removal of a busy freeway lane without some outcry.

High Incomes: Many of the most influential persons in the city lived in the project area and had ready alternatives to transit use. Their dependence on the automobile could be expected to foster resentment toward any restrictions on its use, and their political influence helped to guarantee a hearing for that resentment.

Fragmentation of Government Authority: Los Angeles' fragmentation of public power and authority meant that a large number of government agencies and elected officials had some purview over the Diamond Lane project. Each decisionmaker had his own concept of project goals, and the degree of involvement and commitment to the Diamond Lanes varied greatly from agency to agency. When the media spotlight turned on the project, the public saw not a united front but a number of public agencies and elected officials pointing accusing fingers at the lead agencies, while other officials remained prudently silent.

Ramp Metering: In operating during the demonstration, the ramp meters on the Santa Monica Freeway helped to alleviate the freeway congestion caused by lane dedication. Prior to the project, moreover, the meters alone had so improved freeway traffic speeds that the Diamond Lanes suffered somewhat by comparison. The Diamond Lanes themselves offered only a marginal one-or-two minute improvement at best over the meter-controlled speeds generally available to all eastbound traffic prior to the project. Conditions in the non-preferential lanes did not approach metered pre-project levels, although freeway speeds with both ramp meters and Diamond Lanes were faster than speeds when neither the meters nor the lanes were operational. Where available, moreover, carpool bypass lanes on the on-ramps offered more of a time savings to carpools than the Diamond Lanes themselves. Thus, the ramp meter bypasses which were safer and, surveys showed, less objectionable to the public than the Diamond Lanes, actually provided a greater incentive to carpooling than the preferential freeway lanes, while the meters themselves improved freeway traffic flow.

1.9.4 Planning and Implementation

Listed below are a number of general suggestions for planning and implementing preferential lane projects. The list was compiled from a variety of observers and participants in the wake of the Diamond Lane demonstration, and reflects their view regarding activities that were successful or might have been successful in Los Angeles. These guidelines are hardly comprehensive; nor are they intended as a compendium of implied project shortcomings. Many of the items listed were tried successfully in Los Angeles, while others were not tried at all; some might have been done better, while others were done as well as possible; some might have helped the project while others, given the particular set of circumstances surrounding the Santa Monica Freeway, might not have helped at all.

1.9.4.1 Early Planning Suggestions

- Identify all potentially adverse effects in advance. Any major new transportation measure, particularly a measure that attempts to strike a balance between incentives and disincentives, will have a negative impact on some portion of the population. Both positive and negative impacts should be assessed and documented in advance, and the gainers and losers should be identified.

  > "Negative impacts must not only be located, but dealt with."[3]

- Publicize both positive and negative impacts in advance.

  > "Until experience with and acceptance of preferential lane facilities is much more established, all projects should be preceded by a full statement of environmental (including energy) impacts. This, in turn, should be given wide public exposure, before project decisions are finalized."[4]

- Include all affected public agencies and officials in the planning process. Bridges should be built in advance between all agencies and officials with responsibility for transportation or for the interests of the public affected by the proposed project. All should have an opportunity to participate, and procedural agreements should be ratified and recorded.

- Involve the public in the planning process. Public involvement in critical decisions is a responsibility shared by participating agencies, elected officials and the media. The opportunity exists to inform the planning process with public input through elected officials, public hearings, citizen committees, forums, etc. and to keep the public apprised of project developments through informative press releases, project newsletters and other forms of communication.

- Involve the planners in the public process. Planners and public agencies should be responsive to public input during the planning stages, either by altering plans to reflect responsible criticism, or by explaining to the public why plans were not altered. In addition, all planners should be made to drive the length of the corridor before and during all preferential treatment projects. It not only gives them a street-level understanding of the project, but also avoids embarrassment when public officials inquire, with the media watching, "whether anyone responsible for the project has ever driven it?"

1.9.4.2 Pre-Implementation Suggestions

- Establish and communicate standards for project performance. The planners' hopes for the project should be communicated and, in cases where perceived disincentives are involved, at least two sets of standards should be established and publicized in advance. One set of standards should reflect conservatively-set criteria for aborting the project at any stage in its development, while another set should reflect the long-term criteria for judging project success. While it is instructive to measure short-term occurrences against long-term hopes, there is no reason to expect that long-term goals will be met early in the project, and the failure to meet such goals before the paint has dried on the pavement should not be held as due cause for pillorying project participants. On the other hand, a different set of on-going standards capable of triggering project termination needs to be set to ensure that some unforeseen negative by-product of the project, such as increased accident levels, does not grow so large in the short-term as to outweigh any possible long-term benefits.

- Develop a detailed evaluation plan and follow it. A structured statistical plan for measuring project impacts should be developed in advance, identifying precisely what is to be measured, what comparisons are to be made, and what statistical procedures are to be used to validate the comparisons. Preliminary data should be collected in accordance with this plan and summarized in advance to provide a comprehensive record of "before" conditions.

- Publicize all aspects of the project in advance at appropriate levels. The public at large needs to know when the project will be introduced, why it has been decided to introduce it now, and what the long-term hopes for the project are. The corridor driver needs to know not only when a preferential lane will be introduced, but what traffic engineering changes will accompany the lane, in the form of signal adjustments, detours, and access ramp changes.

- Provide a lightning rod for public response. On controversial projects, a central telephone center should be established shortly in advance of implementation to supply information, sample public opinion, record suggestions, and provide an outlet for public indignation.

1.9.4.3 Implementation Suggestions

- Establish a focal point for information dissemination. Project information should be distributed to the press through a single outlet, on a schedule set by the partipating agencies that allows data to be assimilated and evaluated before it is released.

- Let the demonstration run its course. So long as project standards capable of triggering project termination are not exceeded, the demonstration should be allowed to continue until its allotted time is up, and the intention to persevere should be conveyed to the public. A project whose life is continally being threatened and that is treated as tentative by participants cannot be expected to generate as many long-term commitments to carpooling and bus riding as a project that is guaranteed to be around for a specified period before being junked, modified, or accorded permanent status.

CHAPTER 1 REFERENCES

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