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Methodologies For Assessing The Impacts Of Highway Capacity Enhancements On Travel Behavior

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### Author

Dahlgren, Joy

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CALIFORNIA PATH PROGRAM  
INSTITUTE OF TRANSPORTATION STUDIES  
UNIVERSITY OF CALIFORNIA, BERKELEY

# **Methodologies for Assessing the Impacts of Highway Capacity Enhancements on Travel Behavior**

**Joy Dahlgren**

**California PATH Working Paper  
UCB-ITS-PWP-98-19**

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department Transportation, Federal Highway Administration.

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Report for MOU 208

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# Methodologies for Assessing the Impacts of Highway Capacity Enhancements on Travel Behavior

*Final Report*

*A Study Conducted Under MOU 208*

*Joy Dahlgren*

*California PATH*

*Institute of Transportation Studies*

*University of California, Berkeley*

*August 31, 1998*

## *Abstract*

Acceptance of ITS components that are designed to increase capacity will hinge on the extent to which additional capacity induces additional travel. This study addressed methodologies for studying the effects of capacity on travel: 1) before and after studies of travel times and volumes in corridors in which capacity had been increased, 2) surveys of users of routes on which capacity had been increased, and 3) statistical changes in county VMT as a function of freeway capacity. On I-80 in the Bay Area, the site selected for the investigation, travel times and volumes were quite variable. This suggests that a fairly high volume of data are required to draw conclusions about changes in volumes. Furthermore, construction destroyed most of the existing loop detectors, and new detectors were not connected immediately. Thus such comparisons may not be possible in the short term if researchers do not have an alternate method of obtaining a sufficient quantity of volume data. A survey was designed, but was not tested, because it was decided to survey travelers on I-80 rather than Route 85 as initially planned in order to use the survey to explain whatever differences were observed and to provide information on the extent to which the travel time savings motivated changes in job or housing location. The statistical analysis of changes in VMT based on Smog Check data did not prove feasible because the data were not available at a level of aggregation needed for such an analysis.

Key word: effects of capacity increases, induced demand, latent demand

## *Executive Summary*

The perception that increasing capacity is futile—that every increase in capacity is followed by a comparable increase in demand—may impede adoption of ITS components that are designed to increase capacity. The concept of comparing travel time changes with changes in travel patterns is simple, but making actual comparisons has proved difficult. Therefore, this study addressed methodologies for making such comparisons. The plan was to select capacity enhancing projects to be studied, identify protocols to assess the traffic inducement and redistribution impacts, select protocols to be used for studying each project, implement the protocols, analyze the results, document the results, synthesize findings and recommend next steps for the study.

Three methodologies were studied: 1) before and after studies of travel times and volumes in corridors in which capacity had been increased, 2) surveys of users of routes on which capacity had been increased, and 3) statistical changes in county VMT as a function of freeway capacity. I-80 between the Bay and Carquinez Bridges was selected for the first study because of the size of the project and its proximity to PATH. Route 85 in Santa Clara County was selected for the survey, and statewide smog check data was to be used for the third.

### **I- 80 Before and After Study**

Yearly, one-day travel time measurements and one week volume measurements for 1991 and 1994 for I-80 were obtained from Caltrans. Vehicle occupancy counts for a few days in 1996 were also obtained. It was apparent that volumes and travel times varied considerably, so that a fairly large volume of data would be required in order to make valid comparisons. We discovered that large volumes of data are no longer routinely collected. Unfortunately, the construction destroyed the old loop detectors and there was considerable delay in connecting the new detectors so that the anticipated data collection in 1997 was not performed. Ramp data are not routinely collected, and an analysis of ramp data collected in 1994 suggested that such data are not sufficiently accurate for estimating travel time.

### **Traveler Survey**

The Route 85 survey was not conducted because a marketing survey had already been done, and there was concern that travelers would be annoyed by another survey; because too much time had elapsed since the opening of the road; and because it seemed wiser to conduct such a survey on I-80, where it could be used to explain observed behavior.

### **Statistical Analysis of Changes in VMT**

The statistical analysis of changes in VMT based on Smog Check data did not prove feasible because the data were not available at a level of aggregation needed for such an analysis.

### **Further Research**

Volume data at some sites on I-80 are now being collected by PATH researchers. It and Caltrans historical travel time and loop detector data will be used to test various hypotheses regarding changes in travel behavior motivated by the capacity increases on I-80 and the reconstruction of the Cypress connector. A survey of travelers on the Cypress connector will be conducted to determine how its reconstruction and the resulting saving in travel time affected their travel.

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# *Methodologies for Assessing the Impacts of Highway Capacity Enhancements on Travel Behavior*

## **Introduction**

A possible impediment to the implementation of Intelligent Transportation Systems (ITS) that are intended to increase highway capacity is the perception that increasing capacity is futile—use will simply increase to absorb the additional capacity, and increased use will generate increased emissions, with a negative effect on the environment. But travel demand is not infinite. The demand for travel is derived from the demand to participate in activities. One's choice of the number and location of activities is of course affected by the costs of getting to the activities. Therefore, if the time cost of travel is reduced, one might participate in more activities or in more distant activities, thus increasing one's travel. There has been considerable study of this issue, such as Dowling (1994) and Dobbins, Gillen, Hansen, Huang, and Puvathingal (1993). There is considerable evidence that people are likely to change their departure time and route in response to a decrease in travel time on a particular route, but there is still a limited body of empirical research on this question of the extent to which they increase their overall travel. One reason for this is that, although the concept of comparing travel times changes with changes in travel patterns is simple, obtaining data to make such comparisons is difficult and expensive. Therefore, rather than simply assessing the effects of added capacity on travel behavior, the study addressed *methodologies or protocols* for assessing impacts.

This paper begins with a discussion of the research plan. This is followed by a description of the work that was done, the findings, and an assessment of the methodologies. The paper concludes with plans for actually applying the methodologies under MOU 355.

## **The Research Plan**

The research plan was to:

- select capacity enhancing projects to be studied
- identify protocols to assess the traffic inducement and redistribution impacts
- select protocols to be used for studying each project
- implement the protocols
- analyze the results of the protocols
- document results, synthesize findings, and recommend next steps for the study

## **Projects to Be Studied**

We developed an inventory of candidates for study from recently completed, or currently underway highway projects (Appendix A). Initial criteria for selection were time of completion, data availability, absence of confounding factors such as earthquakes and recessions, and limited alternate routes to complicate the data gathering and obscure effects.

However, it soon became clear that completion dates were difficult to predict and data collection would be more expensive in locations far from PATH headquarters. I-80 between the Carquinez and Bay Bridges was selected because the timing was right, the effects of the recession were less than in Southern California, there were limited alternate routes, and direct observations by PATH staff were feasible. A recently constructed section of Route 85 in Santa Clara County was initially selected as a site for a post-construction questionnaire of users regarding the effects of the facility on their travel.

### Protocols to Assess Traffic Inducement and Redistribution Impacts

Three protocols were studied:

1. before and after studies of travel times and volumes in corridors in which capacity had been increased, by route, mode, and time of day;
2. surveys of users of routes on which capacity had been increased; and
3. statistical changes in county VMT as a function of freeway capacity.

The first two were determined to be feasible and will be pursued under MOU 355, Developing and Using Surveillance Data for Research. The third proved not to be feasible.

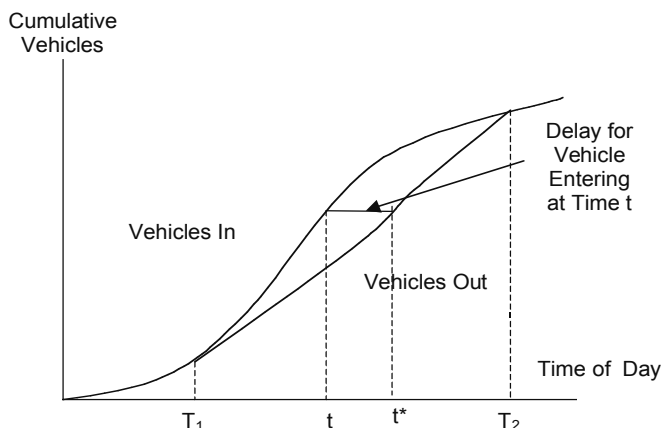
## Work Performed

### Before and After Studies

#### Methodology

The methodology was originally developed on the premise that counts at ramps and on the mainline would be available from Caltrans, that travel times could be collected, and that vehicle occupancies could be observed. The original idea was to use the volumes and travel times for each link over the peak period to construct cumulative vehicle inflow and outflow curves over the entire congested period (before the capacity enhancement). This is illustrated in Figure 1. From this and vehicle occupancy we could determine total peak period use and total delay. (It would also be possible to calculate delay directly from the volume data by

Figure 1 Vehicle Volumes and Delay



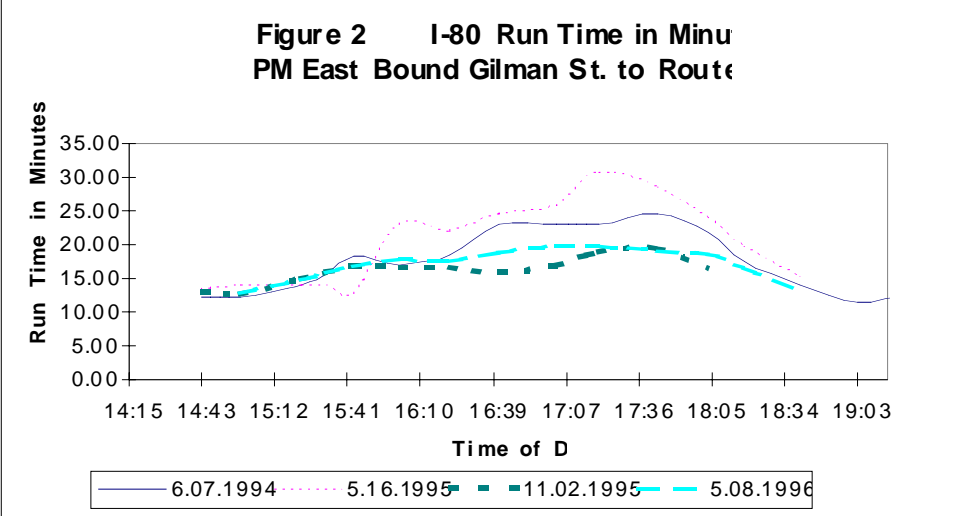
simply taking the time that vehicles enter and the time that they leave, for example  $t^*-t$ , if sufficiently accurate ramp and mainline data were available for the same days.) The area between the two curves is the total delay. Comparing “before” and “after” data we get the



total change in vehicle-delay, the change in trip start times, the change in arrival times, the change in occupancy, and the change in the number of trips. We can relate the increased number of trips (peak period increase less any overall decrease) to the actual reduction in delay.

**Data Collection**

Appendix B lists the data that was obtained and Appendix C lists the people contacted in search of data. Although a great deal of data was available, it was not of sufficient quantity or quality to carry out the analysis described above. There was historical travel time data, once or twice each year since 1994, and historical volume data for a week every three years before construction, 1991 and 1994. Examination of these data soon revealed that both travel times and volumes varied substantially between years, seasons, and days of the week, as can be seen from Figures 2 through 5. Figure 2 and 3 show comparisons of travel times on I-80 between Route 4 and Gilman on single days in 1994 through 1996. Figure 4 shows volumes by hour



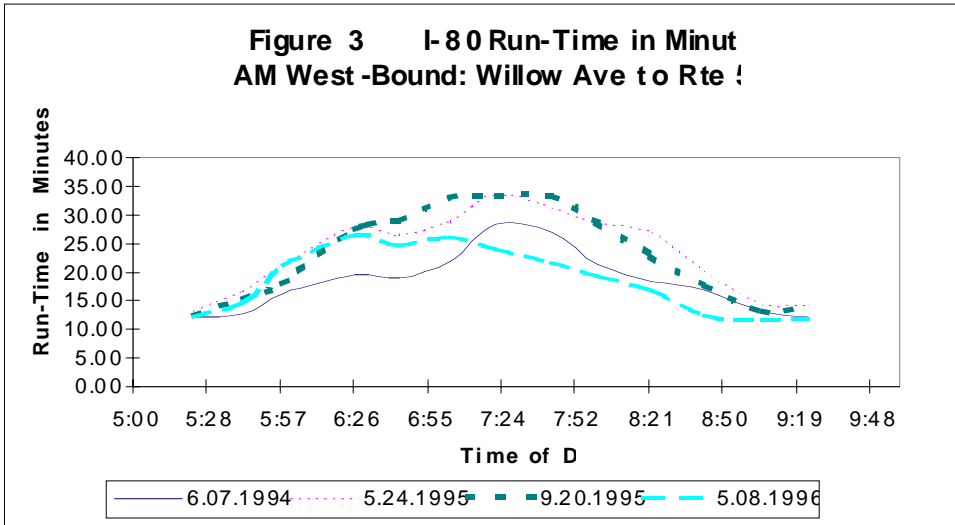
by day on I-80 at the San Pablo Dam Road for a week in 1993. Clearly some of the variation is due to downstream queues. To account for this variation, Figure 5 shows cumulative hourly traffic. However, even weekday volumes vary from day to day, as shown in Figure 6. Given this variation, it became clear that demonstration of any effect would require either a large travel time saving, the results of which could not be obscured by the variation, or a much larger sample of volumes.

Not only were there problems with variability, there also appeared to be problems with accuracy. The ramp data were not consistent with the mainline data—the sum of the total daily volume on one link plus the entering volume minus the exiting volume before the downstream link was much different than the volume on the downstream link.

We observed travel times on the primary alternate route, San Pablo Avenue, and determined that it is not a viable alternate to I-80 in most locations. However, counts done by PATH showed that the Richmond Parkway, which was completed in late 1996, diverted considerable truck traffic from I-80 between Hilltop and I-580.

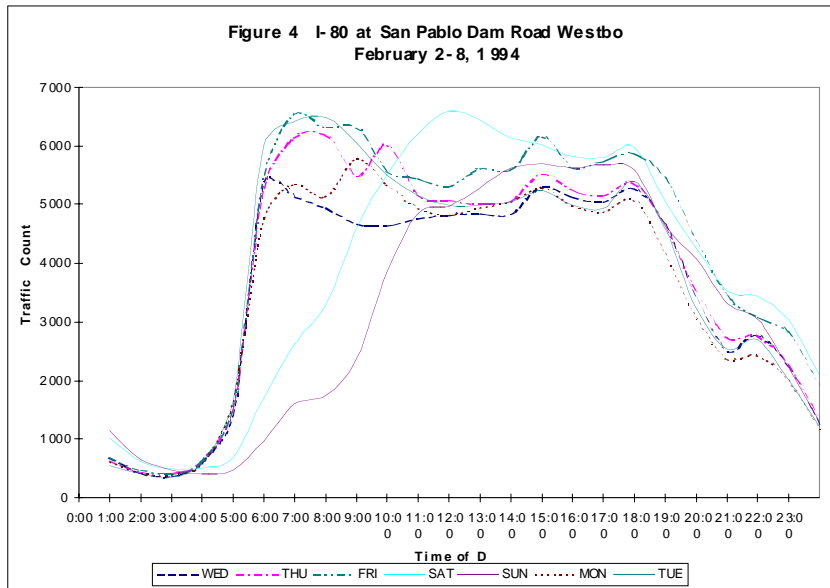
Limited data on vehicle occupancies was obtained from Caltrans and by direct observation by PATH staff. There are few vantage points where a third vehicle occupant can be observed. Even with a good vantage point, such as the pedestrian overpass at Sacramento Street in Richmond, it is difficult to see backseat occupants. Consequently, there is a high potential for error.

We investigated the effects of the carpool lane on demand for ridematching and vanpools. RIDES, the Bay Area ridesharing agency, noticed no increase in requests for carpool



matching after the opening of the first carpool lanes in December 1996. VPSI, a nationwide vanpooling agency was not able to say if there had been an increase in vanpool requests or not.

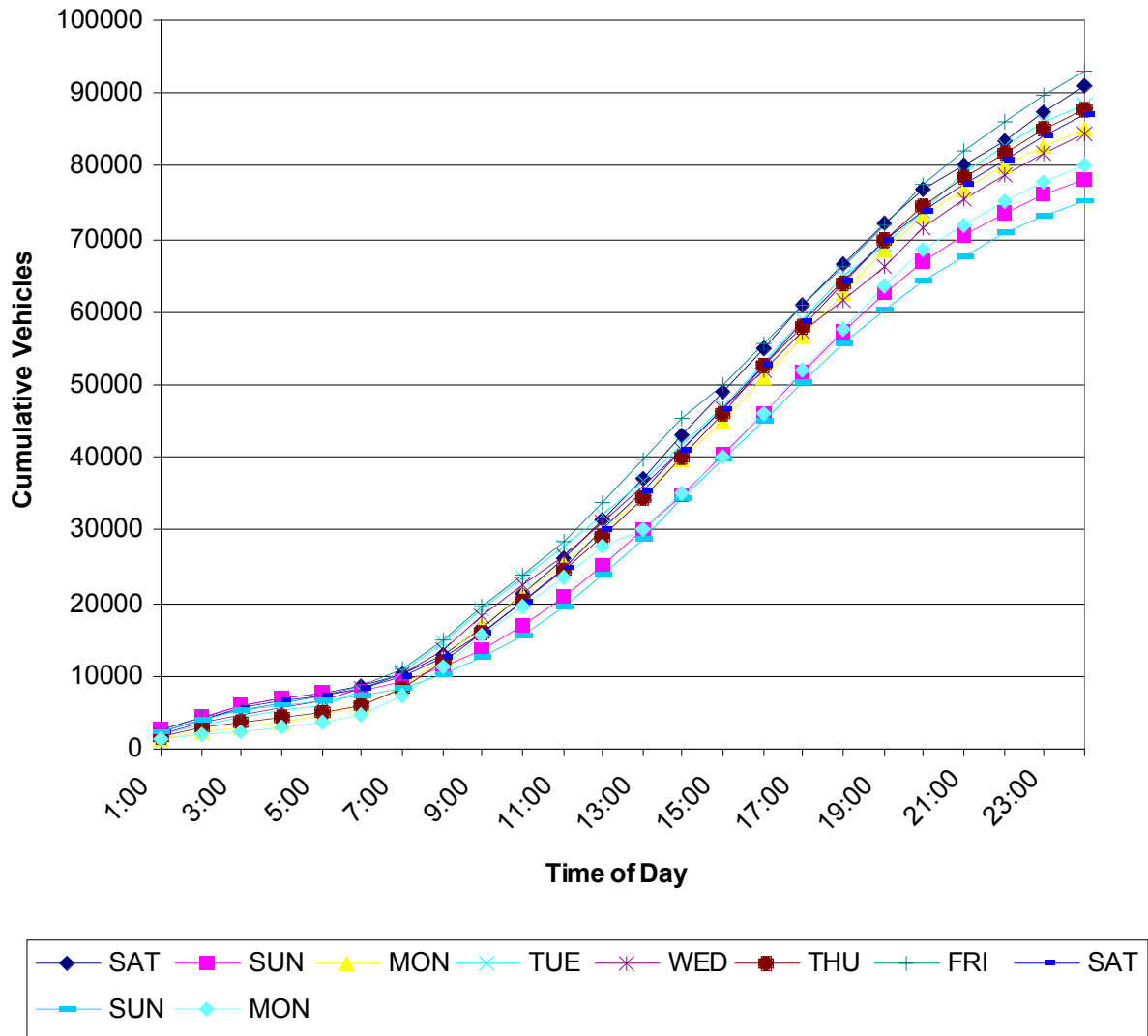
We also investigated the availability of origin and destination data for vehicles using I-80 between Route 4 and the Bay Bridge. We obtained the MTC 1990 Travel Survey Data,

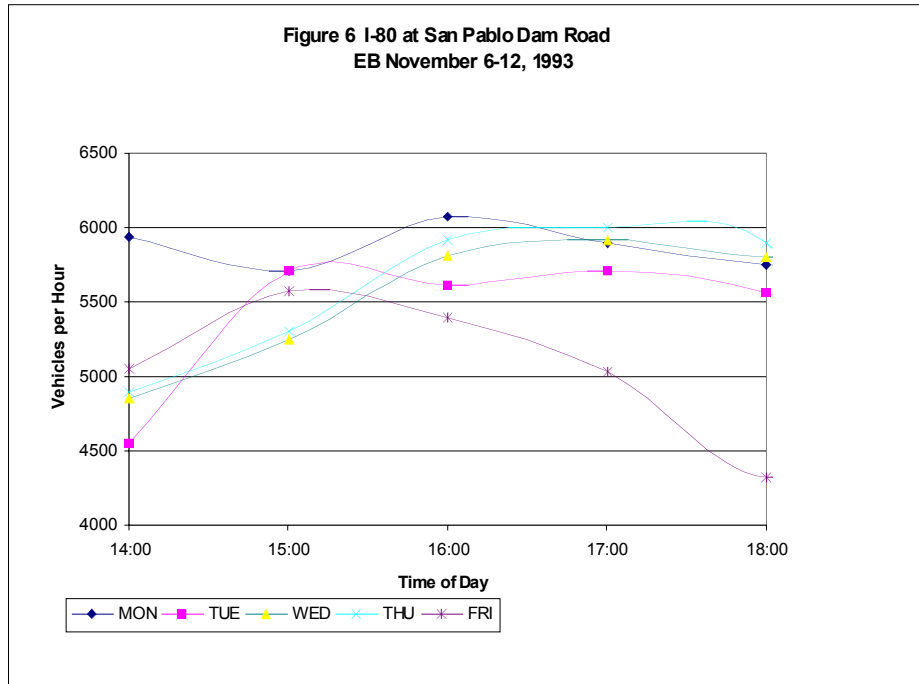


which can provide some information. We also found a study *Origin/Destination Surveys in eight Bay Area Corridors*, which shows origins and destinations of vehicles in the corridor but not origin/destination pairs. We understand the this data is available from the study author, Systan, Inc.

The volume and travel time data that were available have been entered into spreadsheets to simplify analysis when additional data become available. If surveillance is established all along I-80 between Route 4 and the Bay Bridge it may be possible to assemble a large sample of “after” data. With this, we can test the hypothesis that the travel time savings resulting from the capacity enhancements resulted in increased travel throughout the corridor, assuming, of course, that there has been a measurable reduction in travel time.

Figure 4 I-80 at San Pablo Dam Road EB Volumes November 6-12, 1993





Knowing that demonstration of any effect would require either a much larger sample of volumes and travel times or a large travel time saving, I decided to look for a larger sample of data and an capacity improvement that would have a more substantial effect on travel time. MOU 355 is intended to provide a much larger, more accurate sample of volumes, and the opening of the northbound leg of the I-880/I-80 connector—the replacement for the Cypress section of I-880—should result in substantial time savings. It will be not only less congested, but also more direct. With this much larger sample of data, I hope to be able to test the hypothesis that the time savings caused no change in travel and if the hypothesis is rejected, to estimate the magnitude of the change and its relationship to the change in travel time.

### Surveys of Users of Routes on which Capacity Has Been Increased

We planned a survey on Route 85, a new route in San Jose. We determined the process for obtaining traveler addresses from license plate observations and developed a draft questionnaire. However, a survey had already been conducted for purposes of marketing carpooling, and there was concern that travelers might be annoyed by another survey. Furthermore, by the time we were ready to survey it had been some time since the opening, and we were concerned that travelers would not remember the characteristics of their trip before the opening. Therefore, we decided to conduct a survey on I-80, where we would have complementary travel time and volume data, and where it could be conducted very shortly after the opening of the I-80/I-880 connector. This connector should have a major effect on travel time in the Albany to Bay Bridge section of I-80. This survey will be conducted as part of MOU 356.

### Statistical Changes in County VMT Compared to Changes in Highway Capacity

We had hoped to use Smog Check data gathered previously to estimate changes in VMT by Charles Lave at UC Irvine. However, the level of aggregation was not really suitable for our purposes and in the end it proved impossible to get the data in any format. Furthermore, it did not have owner's zip code or even the zip code where the smog check was done. The only location data was the county, which seemed too gross to be useful.

## Findings

### Before and After Study

The most important finding was that travel times and volumes are quite variable from day to day, so that even if the same day of the week at the same time of year is selected for observations, a relatively large sample is required to obtain reliable results.

Of equal importance was the finding that large quantities of data are not currently routinely collected. In fact, work on this project motivated another project, MOU 356, which is designed to collect large quantities of both volume and speed data, albeit in a limited area. This will allow more study of volume and speed variability.

The very construction, the effects of which we intended to observe, interrupted Caltrans regular schedule of collecting volume data every three years. The old detectors often ended up between lanes, where they could not properly sense traffic, and the new detectors were not connected to the software that interpreted the detector output and provided counts and occupancy. As a result, even the volume data that Caltrans routinely collects for a week every three years was not available in 1997.

We also found, from manipulating even the insufficient data that we accumulated, that data handling, storage and retrieval is not a trivial task. Good systems for extracting desired data from large data set are needed, if the best use is to be made of traffic data.

It is now clear that the method originally envisioned for the “before and after” study will not be practical for some time to come because accurate simultaneous ramp and mainline counts are not now available and will not be available.

### Other Methods

We did not implement the survey, so we can not yet judge its effectiveness. It appears to be feasible. By focusing directly on travelers, it is likely to tell us more about the effect of increased capacity than observations on the entire traffic stream. However, it is subject to more bias and is no better than the memories of the people answering the questionnaires.

The use of smog data was not feasible primarily because the data had been collected for another purpose and staff were not able to extract the data that would have made it usable for our purposes. Furthermore, there was not a clear link between the capacity enhancement and the vehicle data.

## Further Research

### Before and After Study

Knowing that demonstration of any effect would require either a much larger sample of volumes and travel times or a large travel time saving, I decided to look for a larger sample of data and a capacity improvement that would have a more substantial effect on travel time. MOU 355 is intended to provide a much larger, more accurate sample of volumes, and the opening of the northbound leg of the I-880/I-80 connector—the replacement for the Cypress section of I-880—should result in substantial time savings. It will be not only less congested, but also more direct. With this much larger sample of data, I hope to be able to test the hypothesis that the time savings caused no change in travel and if the hypothesis is rejected, to estimate the magnitude of the change and its relationship to the change in travel time.

Whether we attempt to do further study of the rest of the corridor will depend on how the surveillance system in the corridor develops and how significantly travel times change. If surveillance is established all along I-80 between Route 4 and the Bay it may be possible to assemble a large sample of “after” data. With this, we can test the hypothesis that the travel time savings resulting from the capacity enhancements resulted in increased travel throughout the corridor.

### **Surveys of Users**

A survey of people using the recently reconstructed I-880/I-80 connector will be conducted under MOU 356. The work plan and draft survey instrument are in Appendix D. The hypotheses to be tested are:

- 1) individual VMT is not increased
- 2) individual number of trips is not increased
- 3) departure times for trips to work are unchanged
- 4) departure times from work are unchanged
- 5) there is no change in trip chaining
- 6) there is no change in the proportion of travelers using transit or carpooling

We assume that the effects on alternate routes will be weaker but in the same direction, so that if people using the I-880/I-80 connector do not increase VMT or trips or change trip chaining or mode, people on other routes would not make these changes either.

We are not studying the trip-making characteristics of the people using the connector, only their individual demand curves for various types of trips in terms of travel time price. So we are only interested in those trips for which the travel time has changed.

Our universe will be people who used the connector during the time in which license plates are observed. Possible sources of bias are:

- observing license plates on a day with unusual travel patterns
- under-sampling of people with dirty or old cars (so the license plate can not be read)
- under-sampling of people who have recently moved (due to the registration addresses being wrong)
- under- sampling of cars with out-of-state license plates
- non-response by people who receive questionnaires but are not motivated to return them

The last is the most significant source of error and also the only one over which surveyers have any control. We will consider providing some motivation for returning the questionnaires other than simply civic responsibility.

## References

Dobbins, A., Gillen, D., Hansen, M., Huang, Y., and Puvanthingal, M., *The Air Quality Impacts of Urban Highway Capacity Expansion: Traffic Generation and Land-Use Change*, Institute of Transportation Studies, University of California at Berkeley, 1993

Dowling, R.G., *Effects of Increased Highway Capacity on Travel Behavior*, California Air Resources Board, Sacramento, CA. 1994

Shunk, G.A. *The Effects of Added Transportation Capacity, Conference Proceedings, December 16 and 17, 1991*, U.S.D.O.T and U.S.E.P.A, Washington, D.C. 1994

## Appendix A Freeway Improvements in the Revised 1994 STIP in Caltrans Districts 4, 7, 11, and 12

Alameda - Route 80 - Gilman to Contra Costa county line- add HOV lane, 1.8 miles, 1993, \$55.7 million (page 4)

Hayward - Route 238 - Industrial Parkway to Route 580 - 4 lane expressway, 5.3 miles, 1996, \$13.6 million (page 4)

Fremont - Route 880 - Santa Clara County line to Mission Blvd (Route 238) - add HOV lanes to 6 lane freeway, 2.4 miles, 1997, \$15.9 million (page 5)

Walnut Creek - Route 680 - Treat Blvd to Willow Pass Road - add 2 lanes to 6 lane freeway , 2.8 miles, 1994, \$64.6 million (page 20)

Claremont - Route 30 - Towne Ave to San Bernardino County Line - 8 lane freeway including 2 HOV lanes, 2.6 miles, 1999, \$98.7 million (page 49)

LaVerne - Route 30 - Foothill Blve to San Bernardino Co Line - 8 lane freeway including 2 HOV lanes, 5.9 miles, 1998, \$0

LaVerne - Route 30 - Foothill Blvd to Williams Ave - add 2 lanes to 2 lanes, 2.3 miles, 1996, \$3 million

Claremont - Route 30 - Williams to Towne Ave - add 2 lanes to 2 lanes, 1.1 mile, 1995, \$7 million

Castaic - Route 126 - Ventura County line to Route 5 - add 2 lanes to 2 lanes, 5.2 miles, 1996, \$23 million

Palmdale - Route 138 - 10th Street to 30th Street - add 2 lanes to 4 lanes, 3.3 miles, 1999, \$1 million

Palmdale - Route 138 - Avenue T to Longview Rd - add 2 lanes to 2 lanes, 8.8 miles, 1999, \$19 million

Los Angeles - Route 405 - Hawthorne to Culver City - add HOV lanes, 4.7 miles, 1995, \$3 million

Marin - Route 101 - North San Pedro to SF Drake - add SB HOV lanes, 3 miles, 1998, \$15.8 million

Santa Ana - Route 5 - Route 22 to Route 99, add 2 regular lanes and 2 HOV lanes to 6 lanes, 9.5 miles, 1996-9, \$255

Riverside - Route 60 - Valley Way to Route 91, add HOV lanes to 4 lanes, 4.7 miles, 1996-7, \$30 million

Riverside - Route 60 - Route 91 to Redlands Blvd, add HOV lanes to 4 lanes, 8.2 miles, 1998, \$25 million

Riverside - Route 215 - Route 60 to University Ave, add HOV lanes to 6 lanes, 3 miles, 1999, \$24 million

San Diego - Route 125 - Spring Valley - 6 lane freeway, 1.1 miles, 1996-8, \$86 million (local)

San Diego - Route 15 - route 805 to Adams St - 4 lane street to 8 lane freeway, 2 miles, 1996-7, \$81 million

Santa Rosa - Route 101 - Wilfred Ave to Route 12 - add HOV lanes to 4 lane freeway, 5.4 miles, 1997-9, \$18 million



## Appendix B Data Gathered

### From Caltrans

#### Travel times by link for one day's peak period

WB	EB
94 6/7	6/7
95 5/24, 9/20	5/16, 11/2
96 5/8	5/8

#### Volumes

##### I-80 Mainline - hourly for a week

WB	EB
<b>Bay Bridge</b>	
91	4/15-12/31
92	1/1-7/31, 10/6-12/31
93 4/19-7/25	2/25-9/30, 10/6-12/31
94 5/8-5/14, 6/5-8/14	1/1-4/2, 4/4-9/30, 10/11-12/31
95	1/1-5/1, 6/6-7/27
<b>Powell</b>	
92 3/9, 6/23, 9/10, 12/4	
93 3/16, 6/22, 9/17, 11/5, 12/3	11/5
94 2/1, 3/21, 5/3, 8/4, 9/15	2/1, 5/3, 8/4
<b>Central Avenue</b>	
90 11/1	11/30
91 2/1, 5/2, 8/1	2/1, 5/1, 8/1
93 11/5	11/5
94 2/1, 5/16, 8/4	2/1, 5/16, 8/7
<b>San Pablo Dam Road</b>	
90 11/1	11/1
91 1/31, 5/2, 8/1	1/31, 5/3, 8/3
93	
94 2/1*, 8/4*	2/3*, 8/4*

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\* Hard copy and electronic

**Hilltop Drive**

90 10/31	10/31
91 2/20, 5/1, 8/1	1/31, 5/1, 8/1
92 7/27	7/27
94 2/3*, 5/3*, 8/4*	2/3*, 5/3*, 8/4*

**Route 4**

90 10/31	10/31
91 2/20, 5/1, 8/1	1/31, 5/10, 8/1
93 11/9	11/5
94 2/3*, 5/3*, 8/4*	2/3*, 5/3*, 8/4*

I-80 Ramps - hourly for a week

WB	EB
<b>On from San Pablo Dam Road</b>	
2/7/94	2/15/94
<b>Off to San Pablo Dam Road</b>	
2/7/94	2/24/94, 3/1/94
<b>On from El Portal</b>	
2/15/94	2/15/94
<b>Off to El Portal</b>	
3/1/94, 2/24/94	2/15/94
<b>On from EB Hilltop, WB Hilltop</b>	
2/15/94          2/7/94	2/24/94, 3/1/94    6/23/94
<b>Off to Hilltop</b>	
2/7/94	2/15/94
<b>On from Appian Way</b>	
3/18/94	SB                      NB 3/23/94                3/9/94
<b>Off to Appian Way</b>	
3/15/94	6/16/94
<b>On from Pinole Valley Rd</b>	
3/15/94	3/4/94
<b>Off to Pinole Valley Rd</b>	
3/15/94	3/4/94
<b>Off to EB Route 4</b>	
	3/4/94

San Pablo Avenue - hourly for a week

SB

NB

**Rt 580 (Oakland)**

90 11/13

10/31

91 2/5, 5/6, 8/5

2/8, 5/6, 8/5

93 11/15

11/15

94 2/4, 5/5, 8/2

2/4, 5/5, 8/4

**Cutting**

90 10/31

10/31

91 2/5, 5/6, 8/14

2/5, 5/6, 8/8

93 11/16

11/16

94 2/4, 5/5, 8/2

2/4, 5/5, 8/2

95 2/8

2/8

**South of McBryde**

3/28/95

**South of RH Miller Drive**

3/28/95

3/28/95

**Miller**

2/16/95

2/8/95

San Pablo Avenue - hourly for a day

Each direction

**East of Pinole Valley Rd**

10/25/95

**East of Fifth Street (Pinole)**

10/25/95

**West of Tara Hills**

2/3/93

**East of Tara Hills**

6/22/94

**East of Alvarez Ave**

10/25/95

**West of Del Monte**

6/22/94

**East of Del Monte**

10/25/95

Vehicle Occupancies (by 15 minute interval)

**I80 Sacramento Street overcrossing WB**

9/12/95 6-10AM 11AM-2PM 3-7PM

**I80 Route 4 Junction EB**

9/14/96 7-10AM 11-2PM 3-7PM

**I80 Route 4 Junction WB**

5/23/96 6-10AM

**From City of Richmond**

Volumes by 15 minute intervals

**San Pablo Ave S/O RH Miller Dr NB**

3/28/95-4/5/95

**San Pablo Ave S/O McBryde SB**

3/28/95

**From Contra Costa County**

Volumes by Hour

**San Pablo Ave 250' E of Pinole Valley Rd EB and WB**

10/25/95

**San Pablo Ave 20' E of Fifth Ave EB and WB**

10/25/95

**San Pablo Ave 450' W of Tara Hills Dr EB and WB**

6/22/94

**San Pablo Ave 50' E of Alvarez Ave EB and WB**

10/25/95

**San Pablo Ave 300' W of Del Monte Dr EB and WB**

6/22/94

**San Pablo Ave 500' E of Tara Hills Dr EB and WB**

2/3/93

**San Pablo Ave 400' E of Del Monte Drive EB and WB**

10/25/95

**PATH**

Volumes and occupancies every 5 minutes

**I-80 at Hilltop overcrossing SB**

5/24/95 7-8AM

9/17/96 6:30-9AM

Travel time

9/17/96

**San Pablo Avenue SB from Rt 4 to Central at 6PM**

**I80 EB from Gilman to Hilltop at 3:33PM**

**I80 WB from Willow to San Pablo Dam Rd at 9:25**

11/6/96

**I-80 at Hilltop overcrossing NB**

5/25/95 4-5PM

9/17/96 4:10-6PM

## Appendix C People Contacted

### Caltrans

#### Headquarters

##### New Technology and Research Program

George Smith

Carl Shiigi

##### Traffic Operations

Jim Purcell

Joe Avis

##### Database

Jesse Bhulour

Greg Edwards

#### District 4

Jim McCrank

Albert Yee

Maximino Magbitang

Mike Church

David Seriani

Tom Tsuda

Jim Spinello

Michael Knickelbein

Doug Sibley

Rod Oto

Ron Kyutoku

#### District 7

Paul Chow

#### District 12

John Unter

Ken Kirkup

### MTC

Jeff Georgevich

Richard Lou

Chuck Purvis

Rupinder Singh

### Contra Costa County

Steve Kersivan

### City of Richmond

Gary Martin

### Department of Motor Vehicles

Chris Terwilliger

Tiffany Johnson

### RIDES for the Bay Area

Maria Thayer

**JHK**

Craig Gardner

**Systan**

John Billheimer

**UC Irvine**

Charles Lave

Anita Iannucci

## Appendix D Traveler Questionnaire

### Work Plan

**Task 1 – Develop questionnaire** Review within PATH. Test with outside people not involved in transportation

**Task 2 – Develop a plan for analyzing and presenting the results**

**Task 3 – Develop mailing list** Obtain license plate observations. Get addresses from Department of Motor Vehicles.

**Task 4 – Arrange for mailing**

**Task 5 – Process data**

**Task 6 – Analyze results**

### Draft Questionnaire

serial # (to tie with name & address)

Your help is needed in providing information that will be useful in planning future transportation improvements. In particular, you can help us learn about the effects of increased road capacity on total travel by telling us how the new connector between I-880 and I-80 ( replacing the Cypress freeway that collapsed during the 1989 earthquake) has affected your travel. Thank you for your help.

1. Do you ever use the I-880/I-80 connector?

Yes \_\_\_

No \_\_\_. If no, there is no need to complete or return this questionnaire.

2. Please provide the following information about the last trip you made using this connector.

Date of trip \_\_\_ Today's date \_\_\_\_\_

Start \_\_\_:\_\_\_ AM PM Arrive \_\_\_:\_\_\_ AM PM

Trip began at intersection of \_\_\_ and \_\_\_ in \_\_\_\_\_

street street city or area

Trip ended at intersection of \_\_\_ and \_\_\_ in \_\_\_\_\_

street street city or area

Did you carpool during this trip?

\_ Yes \_ No

Was the purpose of the main trip (please check all that apply)?

\_ work

\_ work-related

\_ school

\_ shop/errands/personal business

\_ social/recreational

About how many minutes do you think you saved by using the connector? \_\_\_\_\_

Did you stop during the trip? If so, where did you stop and how long did you stay?

Stopped at intersection of \_\_\_\_\_ and \_\_\_\_\_ in \_\_\_\_\_ for \_\_\_\_\_ minutes  
street street city or area

Stopped at intersection of \_\_\_\_\_ and \_\_\_\_\_ in \_\_\_\_\_ for \_\_\_\_\_ minutes  
street street city or area

3. If the connector had not been open, would you have made this trip (check all that apply)

- by another route: route \_\_\_\_\_
- at another time: trip start time \_\_\_\_\_
- by transit: transit route \_\_\_\_\_
- by carpool
- from another origin: location \_\_\_\_\_
- to another destination: location \_\_\_\_\_
- I would NOT have made the trip

4. How would you rate the traffic conditions for this trip before the connector opened?

- Good
- Acceptable
- Congested
- Very congested

5. Have you moved since the connector opened?

- Yes
- No

6. Would you have moved if the connector had not opened?

- Yes
- No

7. Do you expect to move in the future because the connector has saved you time?

- Yes
- No

8. Have you changed your job since the connector opened?

- Yes
- No

9. Would you have changed jobs if the connector had not opened?

- Yes
- No

10. Do you expect to change jobs in the future because the connector has saved you time?

- Yes
- No

Thank you for your help.