HOV EVALUATION AND MONITORING

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16. ABSTRACT

This report presents and summarizes the baseline data collected in fulfillment of the requirements for the Washington State Department of Transportation grant "HOV Lane Evaluation and Monitoring." This report provides the information necessary to analyze HOV lane performance and development. Data collection results and analysis are presented, followed by conclusions and recommendations.

The data contained herein were collected during the first year of the high occupancy vehicle lane (HOV) monitoring project (July 1992-June 1993). The data collection methodology is described in the final report, "HOV Monitoring and Evaluation Tool." Included in this report are the following primary and secondary measures of HOV lane performance: (1) average vehicle occupancy data, (2) travel time data, (3) public opinion survey results, (4) transit ridership data, (5) enforcement, compliance, and adjudication data, and (7) accident data. Data collection issues and their implications for data availability are discussed.

It is important to note that this report does not evaluate the HOV lane system in the Puget Sound region. Rather, it is a compilation of the data necessary to conduct a meaningful evaluation. Although an analysis of public opinion, transit ridership, enforcement and accident data is provided, the report's primary purpose is to simply present the data and discuss issues associated with its use,-not to provide an extensive analysis.

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HOV Lane Evaluation and Monitoring

HOV EVALUATION AND MONITORING

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DISCLAIMER

TABLE OF CONTENTS

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ABSTRACT

This report presents and summarizes the baseline data collected in fulfillment of the requirements for the Washington State Department of Transportation grant "HOV Lane Evaluation and Monitoring." This report provides the information necessary to analyze HOV lane performance and development. Data collection results and analysis are presented, followed by conclusions and recommendations.

The data contained herein were collected during Phase I of the high occupancy vehicle lane (HOV) monitoring project (July 1992-June 1993). The data collection methodology is described in detail in the companion report, "HOV Monitoring and Evaluation Tool" (1) Included in this report are the following primary and secondary measures of HOV lane performance: (1) vehicle occupancy data, (2) travel time data, (3) public opinion survey results, (4) transit ridership data, (5) enforcement, compliance, and adjudication data, and (7) accident data. Data collection issues and their implications for data availability are also discussed.

It is important to note that this report does not evaluate the HOV lane system in the Puget Sound region. Rather, it is a compilation of the data necessary to conduct a meaningful evaluation. Although an analysis of public opinion, transit ridership, enforcement and accident data is provided, the report's primary purpose is to simply present the data and discuss issues associated with its use, not to provide an extensive analysis.

EXECUTIVE SUMMARY

This is the first in a series of annual data reports for the High Occupancy Vehicle Lane (HOV) Monitoring and Evaluation project, sponsored by the Washington State Department of Transportation (WSDOT) and the Federal Highway Administration (FHWA). The purpose of this project is to collect data on the usage of the HOV lane system in the Puget Sound region and to make those data available to a wide audience of transportation planners and authorities. Completion of the HOV lane system is a high priority for WSDOT. However, it is useful to understand the strengths and weaknesses of the current HOV lane system before incurring the significant costs of constructing new HOV lanes. The companion report, *HOV Monitoring and Evaluation Tool* (**1**), describes the data collection methodology in detail.

This report is not an evaluation of the HOV lane system in the Puget Sound region; rather it is a compilation of the data necessary to conduct a meaningful evaluation. However, some of the data included in this report will need to be studied more closely before making substantive recommendations on existing HOV lane policy. Data are primarily presented in raw form; interpretation and relationships to other data are provided when appropriate. The key elements of this data collection effort are (1) that it gathers a wide range of information about the HOV lane system from throughout the Puget Sound region and (2) that the collection effort is sustained over time. These elements will allow WSDOT planners to assess the changes in travel behavior that an HOV lane system is designed to induce, particularly where HOV lanes do not currently exist. Analysis of the types of data outlined below will enable WSDOT to evaluate the performance of the HOV lane system in terms of the objectives described in the 1992 Washington State Freeway HOV System Policy report. HOV systems serve the following objectives:

- *Improve the capability of congested freeway corridors to move more people by increasing the number of people per vehicle.*
- *Provide travel time savings and a more reliable trip time to high occupancy vehicles that use the facilities.*
- *Provide safe travel options for high occupancy vehicles without unduly affecting the safety of freeway general-purpose mainlines.*

Measures of effectiveness used to determine the impact of the HOV system include the following:

- *person throughput,*
- *vehicle occupancy,*
- *comparative and absolute general-purpose (GP) and HOV lane travel times,*
- *travel time reliability, and*
- *accident rates.* (3)

The time period covered by this report is July 1992 through June 1993. This was the first full year of data collection under a methodology developed for the HOV Monitoring and Evaluation Tool project. Future updates of these data are planned to be provided quarterly.

Measures of Effectiveness

HOV lanes are intended to reduce average travel time and to increase travel time reliability for carpoolers and other ridesharers. HOV lanes are expected to provide a relatively uncongested lane for users. For these reasons, HOV lanes are expected to encourage transit use. These expected reductions in both travel time and congestion must be measured to determine whether HOV lanes are cost-effective. The data collected in this study focus on the following measures:

- vehicle occupancy (and mode choice)
- travel time
- HOV violations
- HOV lane safety
- transit ridership
- public opinion

Vehicle occupancy, travel time, and public opinion are the three types of primary data collected by this project. Secondary sources are used to assess accidents, enforcement and violations, and transit ridership along bus routes that use HOV lanes. Although traffic volumes and person throughput may be estimated from vehicle occupancy data, it is not the intent of this report to estimate these, or accident rates as related to traffic flows. Traffic volumes are better measured using volume data from inductance loop detectors; person throughput can be then estimated by multiplying these and by occupancy data percentages; analysis of accident rates depends on the traffic volume data available as well. Inductance loop data are not collected as a part of this project.

Vehicle Occupancy and Travel Time Data

Vehicle occupancy provides a profile of commute patterns, congestion, and the average number of passengers traveling along commute routes during peak commute hours. Because occupancy data are collected for HOV lanes, violation rates may be calculated for peak-hour commute times by determining the number of single occupant vehicles (SOVs) using the HOV lane. Rather than calculating average vehicle occupancy (AVO), average car occupancy (ACO) is derived from the data collected. Travel times are collected to estimate the speed and flow of traffic in the HOV and GP lanes. Over time, these observations may be used to measure the absolute and relative travel time savings for HOV lanes. Raw data on vehicle occupancy and travel time are presented at the end of the report. Data collection and their implications for the data available are discussed. A regression analysis of vehicle occupancy data was performed, and these results are discussed as well.

Public Perception of HOV Lanes

Public support for HOV lanes was measured by mail-out surveys sent to drivers of both HOV and SOV vehicles identified in the field by traffic observers. Overall, the public supports HOV lanes and HOV lane construction. This is true for people who rideshare on a regular basis as well as for those who drive alone. Public opinion data are presented to show overall results and to determine differences in opinion between the two groups. The mail-out surveys were designed to elicit area drivers' perceptions of the attractiveness, efficacy, safety, and violations of HOV lanes.

Secondary Data

Secondary data include information on enforcement of HOV violations, accident information, and effects on transit ridership. Violation information is provided by the HERO program (see Chapter 5), the Washington State Patrol (WSP), and local district courts. Taken together, these sources provide information about reports from citizens on HOV violations on area highways, tickets and warnings issued by state troopers, and the number of paid tickets and the outcomes of contested tickets in the courts. Accident information is collected by the WSDOT Traffic Data Office. While this data report focuses on the frequency of accidents in HOV lanes, data on a wide variety of conditions for all accidents occurring on freeway segments containing HOV lanes are available. Transit ridership information is collected from the three local transit agencies that operate routes on HOV lanes: Metro (King County Department of Metropolitan Services), Community Transit (Snohomish County), and Pierce Transit (Pierce County). These data focus on changes in ridership over time for routes that travel along freeway segments that contain HOV lanes.

Recommendations

1. Focus a greater proportion of mainline counts on HOV lanes. The number of successful counts affects the amount of quality data available, and in turn the validity of ACO figures. Increasing the number of counts for HOV lanes to match the number of GP lanes at a site would improve the integrity of the HOV data, and the number of counts between HOV and GP lanes could then be more reliably compared.

2. Prioritize observations at locations that ensure the best use of resources. Safe locations that provide the best visibility over varying conditions, as well as ease of access and scheduling are obviously preferred. Therefore, a directory of sites that includes site diagrams and a matrix of characteristics affecting data collection should be maintained. The question of whether counter-flow traffic patterns should be continued or eliminated at existing locations, or expanded at additional locations should be explored, as well as whether or not to maintain ramp data collection.

3. Collect vehicle occupancy data on the I-5 express lanes. Because express lanes contain both HOV and GP lanes, "before" data for this corridor may be useful in areas where express lane expansion is planned, and would allow planners to monitor the express lanes' performance.

4. Use short travel time study sections for data collection. To decrease the likelihood of observed vehicles having changed lanes or exited the corridor, distances

between sites should be short (for example, under 3 kilometers), and chosen to limit the number of intervening access/egress ramps.

5. Conduct more data collection sessions per travel time study section. Although there are a number of factors that reduce the likelihood of obtaining reliable license plate matches, one way to compensate is to increase the number of data collection sessions, thereby increasing the volume of license plates collected.

6. Limit travel time data collection to special studies. Effective collection of travel time data requires a great deal of coordination between observers to ensure that they begin and end at the same time, as well as corridor sections that facilitate license plate matches. Even when effectively collected, travel time data can vary so much that routinely gathering data to establish an "overall" travel time statistic for a length of corridor would not be very useful. An example of a special study is suggested below.

7. As a special study, conduct travel time observations using the express lanes. Not only do the express lanes have GP and HOV designations, they also constitute a "captive audience" in that vehicles may not exit for longer distances. As a result, it may be easier to obtain the matches necessary for reliable travel time data.

8. Formalize a relationship to collect enforcement data and outcome data annually from the Office of the Administrator of the Courts. These data were difficult to obtain, given that tracking HOV violation rates and enforcement outcomes is a low priority for this agency and staff were reluctant to devote any time to the task. If a relationship between WSDOT and this office were formalized for annual data reporting, it would be much easier to gather this information.

9. Conduct a special study of repeat offenders. Data on this subject may be available from district courts. Cross-referencing HERO data with violation outcome data may shed some light on the extent to which violators change their behavior after receiving a ticket.

10. Conduct a special study on highway corridors characterized by chronic violation problems. Bellevue and Redmond appear to have high violation rates; these jurisdictions also have the highest number of outstanding violations among the court districts studied. Follow-up conversations with WSP officials and court clerks and judges may shed light on this trend.

11. Investigate the accident rates for HOV lanes on the right side of the road compared to HOV lanes on the left side of the road to determine which configuration is safer. Safety analysis of each configuration should be factored into future HOV lane planning.

12. Collect accident data on an annual or semi-annual basis, unless special studies are required. Preparing and analyzing accident data is very time-intensive, and the value of quarterly data reports may not be commensurate with the costs of preparation. Accident data from the Transportation Data Office lags three months behind the current date, making up-to-date analysis difficult.

CHAPTER ONE: INTRODUCTION AND RESEARCH APPROACH

PURPOSE AND PRODUCTS

The purpose of this project is to provide a comprehensive set of data for the HOV lane system in the Puget Sound area. This data will be primarily used by transportation planners and authorities to evaluate the performance of the HOV lane system and to plan future HOV facilities. This report is the first in a series of annual data reports that will allow parties to track changes in the performance of the HOV lane system over time. This report also contains recommendations for future HOV lane policy and evaluation efforts. Quarterly updates will be published to highlight specific items of interest or concern, but will be brief in their treatment of those issues. Information concerning the data collection method is available in the companion report, *HOV Monitoring and Evaluation Tool* (1).

MEASURES OF EFFECTIVENESS

HOV lanes are intended to reduce average travel time and to increase travel time reliability for carpoolers and other ridesharers. HOV lanes are expected to provide a relatively uncongested lane for users. For these reasons, HOV lanes are expected to encourage transit use. These expected reductions in both travel time and congestion must be measured to determine whether HOV lanes are cost-effective. The data collection efforts have focused on the following measures:

- **Vehicle Occupancy/Mode Choice.** Vehicle occupancy is recorded by human observers in the field at 41 sites in the Puget Sound area. Data are collected from HOV lanes, general purpose lanes, and access/egress ramps. Bus occupancy data are obtained from the region's transit agencies. Mode choice data can be derived from vehicle occupancy. These data are supplemented by transit ridership data and survey results from this project and from other agencies.

- **HOV Violations.** Data from ACO observations, the number of HOV violation tickets and warnings issued, adjudication results, and information from the HERO program indicate the frequency of HOV violations and the enforceability of current restrictions (see Chapter 5 for information on the HERO program). Survey results provide information about perceptions of violations by the region's commuters.

- **Safety.** The state accident database is used to analyze the safety of the HOV lane system. Public opinion survey results provide information about commuter perceptions of HOV lane safety. These data measure the level of concern about safety and its impact on mode choice.

- **Travel Time.** Travel time data measure the effectiveness of HOV lanes in reducing commute times and improving reliability. A license plate matching method has been developed and used to measure and compare travel times on HOV lanes and general purpose lanes. Multiple counts at specific sites and roadway segments measure the travel time reliability function of HOV lanes.

- **Public Opinion.** Public opinion data indicate the HOV program's perceived importance and effectiveness, as well as ways in which it may be modified to appeal to more of the region's drivers. Public opinion is measured by analyzing survey results from randomly selected commuters observed on freeways during peak commute periods along routes that contain HOV lanes.

These categories of measures of effectiveness provide a valid basis for evaluating the performance of the current HOV lane system. They also address WSDOT's information needs for determining where and when to construct new HOV facilities. WSDOT's *HOV Lane Minimum Threshold Policy* states four preconditions for HOV lane construction:

1. Facility demand exceeds capacity for more than one hour each day,
2. Evidence exists that an HOV lane will move more people per hour during peak periods than the per-lane average of the adjacent general purpose lanes,
3. There is local support for HOV lane construction, or
4. An HOV lane segment improves continuity by linking other HOV lane corridors identified in the *Year 2000 HOV Core Lane System* (3).

The ACO and public perception data available from this study will provide WSDOT with some of the information necessary to evaluate minimum threshold requirements for new HOV lane construction. These data will also be useful in decisions concerning lane configuration, occupancy requirement policies, and general purpose lane conversion.

The data published in this report will be readily available to WSDOT officials and planners, as well as to other interested jurisdictions. Analysis of much of the data requires specialized computer programs designed for this project, in addition to the Statistical Package for Social Sciences (SPSS) statistical analysis program.

DATA COLLECTION

As stated before, extensive documentation of the data collection method used for this project is provided in the companion report *HOV Monitoring and Evaluation Tool* (1). However, a brief explanation of the data collection process is in order.

This study employs human observers to collect data pertaining to vehicle occupancy and travel time, as well as the information necessary to send out public opinion surveys. Traffic observers count the occupants in each vehicle in a given lane as it passes beneath a highway overpass or through an access ramp. Travel time data are collected by matching license plate numbers at two points along a roadway. Observers also collect license plate numbers of both HOVs and SOVs to generate comparable samples for the public opinion survey. These observers enter data onto personal computers (observers originally used Toshiba T1000 laptops, and now use smaller, more reliable Hewlett-Packard HP-95 palmtop computers) and hard-copy forms when necessary. Data are collected on the major interstate and state highways in the region: I-5, I-90, I-405, and SR-520 between the peak commute hours of 6:00 a.m. to 9:00 a.m., and 3:00 p.m. to 6:00 p.m. (three hours each). Other state highways were added to this list in the third quarter of 1993. These highways include SR-16, SR-167, SR-410, and SR-512. No data regarding express lane traffic on the I-5 North and I-5 Downtown corridors were collected. I-405 was divided into three separate observation corridors, and observation sites were added to I-5 in Everett and Tacoma at this time as well. Table 1.1 indicates the data collection quarters and their corresponding dates for this study. Table A2 indicates the beginning dates of study for the data collection sites.

Table 1.1: Data Collection Period, by Quarter

Quarter of Study	Dates
Q3/92	July 6, 1992 - October 2, 1992
Q4/92	October 5, 1992 - January 1, 1993
Q1/93	January 4, 1993 - April 2, 1993
Q2/93	April 4, 1993 - July 2, 1993

The success of occupancy and travel time data was affected by the type of observation performed, and the collection method used. The objective was to conduct as many observations for a wide distribution of sites, with a goal of ten counts per quarter per site. To make the best use of resources, data collection focused on the direction in which peak period traffic was expected to flow. Scheduling was affected by the type of data being gathered, the number of observers, logistical considerations, weather, and the success of prior observations. The success of the observations was affected by the type of observation performed. Data collection was further affected by such factors as the site's geographic characteristics, weather and light conditions, observer performance, and data quality management.

Occupancy and travel time data presented in this report are from **48** sites studied during the first phase of data collection (41 sites are for occupancy and 21 are for travel time data collection). As recommended in the *HOV Monitoring and Evaluation Tool* final report, only vehicle occupancy data are now being collected. Travel time data collection was discontinued as of August, 1993, except for special studies (1). For ease of data management and to increase the number of data collection sites, the I-405 corridor has been divided into three corridors: I-405 South, I-405 Central, and I-405 North (1). Data collected from these new sites (e.g., Newport Way, Front Street, 142nd, SR-900 and the "outlying sites") will not be considered in this initial report, but will be added in future reports.

REPORT ORGANIZATION

Chapter 1 introduces the report. Chapter 2 discusses the available vehicle occupancy data. Chapter 3 analyzes these ACO data. Chapter 4 discusses the available travel time data. Chapter 5 provides comprehensive information from the public opinion survey. Secondary data sources pertaining to enforcement, compliance, and adjudication; accidents; and transit ridership are presented in Chapter 6. Chapter 7 contains conclusions and recommendations. The appendices contain vehicle occupancy and travel time data, as well as relevant supplemental information.

CHAPTER TWO: BASELINE VEHICLE OCCUPANCY DATA

Vehicle occupancy data are an empirical measure of commuter mode choice. This measure can also be used to evaluate the effect of HOV lanes on commute corridors in terms of person-carrying capacity. Vehicle occupancy data indicate the proportion of vehicles of a certain occupancy or mode at a given freeway location during the weekday peak commute. Observers record the vehicle occupancy and mode at mainline and ramp locations, using a program that time-stamps each observation. Average car occupancy (ACO) is then calculated from these observations using the formula in Figure 2.1. Note that only passenger vehicles are considered in the calculation of this number. To calculate *average vehicle occupancy* (AVO), the formula in figure 2.2 is recommended, but with reservations. The weighting factors of ten and forty occupants (for vanpools and public transit buses, respectively) vary by site, time of day, direction of travel, and quarter, however, and are likely to overestimate AVO. For this reason, ACO rather than AVO is used in the remainder of this report. In the future, AVO may be completed after acquiring the average vanpool and bus loadings for each location from the appropriate transit agencies.

Figure 2.1: Calculation of Average Car Occupancy

From the data collected in this study, average car occupancy (ACO) is calculated using the following formula:

$$ACO = \frac{(1\times SOV)+(2\times DOV)+(3\times TOV)+(4.1\times FOV)}{SOV+DOV+TOV+FOV}$$

where

- ***SOV*** is the number of single-occupancy vehicles observed,
- ***DOV*** is the number of double-occupancy vehicles observed,
- ***TOV*** is the number of triple-occupancy vehicles observed, and
- ***FOV*** is the number of four- or greater- occupancy vehicles observed.

Note: Vanpools, buses, other transit vehicles, motorcycles and tractor semi-trailers are not considered.

Figure 2.2: Calculation of Average Vehicle Occupancy

From the data collected in this study, average vehicle occupancy (AVO) is calculated using the following formula:

$$AVO = \frac{(1 \times SOV) + (2 \times DOV) + (3 \times TOV) + (4.1 \times FOV) + (\underline{10} \times VAN) + (\underline{40} \times PT)}{SOV + DOV + TOV + FOV + VAN + PT}$$

where

- ***SOV*** is the number of single-occupancy vehicles observed,
- ***DOV*** is the number of double-occupancy vehicles observed,
- ***TOV*** is the number of triple-occupancy vehicles observed, and
- ***FOV*** is the number of four- or greater- occupancy vehicles observed.
- ***VAN*** is the number of vanpools.
- ***PT*** is the number of public transit busses.

Note: Other transit vehicles, motorcycles and tractor semi-trailers are not considered.

Occupancy data in this report are presented in tables according to the following characteristics:

- corridor of study
- observation site
- morning or PM peak period
- traffic flow direction
- mainline (GP or HOV) or access ramp location.

Data indicate the number of vehicles observed by type of occupancy, the total number of vehicles, the ACO, and the number of counts successfully conducted for each quarter of the study. Data about mainline locations include the number of lanes so that the average counts per lane can be estimated for comparing general purpose (GP) lane with HOV lane data. The figures in these tables are work-week and commute period aggregates (thereby assuming that the daily ACO does not vary significantly).

Although they may be disaggregated according to the day of the week, by hour of commute, or by lane of traffic if desired, some locations may not have a sufficient number of observation sessions to make this possible. Occupancy data may also be aggregated to determine the overall ACO for multiple sites of a corridor, for both GP and HOV lanes, all access/egress ramps, and for simultaneous directions of traffic flow (within the limits of the data and aggregation program). Because loop inductance data gathered from these sites are more representative of corridor traffic volumes, the data presented herein should only be used to generate estimates of the distribution of vehicle mode and occupancy (e.g., proportions of SOVs). Occupancy data presented in this report should *not* be used to compute traffic volumes.

For Phase I of this project, vehicle occupancy data were collected from 41 sites, each having either mainline or access ramp locations, or a combination thereof, amounting to 14 mainline and 26 access/egress ramp locations (see Table B1). Data are available beginning with the third quarter of 1992, and ending with the second quarter of 1993 (see Table 1.1 for the quarters and their calendar equivalents). Preceding the data for each site is a diagram of all the sites in a given corridor, followed by a lane diagram of the site that indicates the traffic flow direction and type (mainline or ramp) (Appendix B). Comments made by observers while they were collecting occupancy data can be found in Appendix C. These comments pertain to the weather and traffic conditions in which the data were collected.

OCCUPANCY DATA AVAILABLE

To provide statistically significant data, a minimum of ten 30-minute counts per quarter per site for each peak commutee period are necessary (2). Under optimum conditions, five to six counts are conducted per three-hour session. Although collection was designed with this in mind, significance of results are affected by the availability of data collected, as well as by the variation of each peak period at each site. The availability of data for these sites therefore depends on the number of observation sessions scheduled, and on the number of counts successfully performed for a given quarter (for a description of factors likely to render data unusable, please refer to *HOV Monitoring and Evaluation Tool*). These conditions are in turn affected by a number of factors, including the direction of traffic flow, the weather, geographic characteristics of the site location, and the success of scheduling efforts. Because of the large number of locations involved, counts were prioritized in favor of sites thought to capture the more typical traffic patterns. Additional locations were scouted and scheduled as the project progressed. Scheduling was also affected by the availability of transportation for observers. Data for some tables are incomplete. In the majority of cases in which data are insufficient, it is because of the fact that no counts had been scheduled during that time. In other cases, only one or two counts were completed, and the available data files were not usable (see *HOV Monitoring and Evaluation Tool* for a discussion of causes (1)). In addition, data may be unavailable for specific lanes of traffic at certain mainline locations due to the number of lanes relative to the number of counts conducted at those sites.

Scheduling

Determining which sites to use was a process that developed over time, partially as a result of learning which locations were better for observations, as well as a response to WSDOT requests for new information. During the first two quarters of data collection, emphasis was placed on scheduling observations according to expected commute patterns: i.e., inbound Seattle CBD traffic during the morning commute, and outbound traffic during the evening commute. In areas where this pattern was less clear, such as the CBD traffic on the downtown I-5 corridor and the suburb-to-suburb traffic on the I-405 corridor, collection efforts were expanded to include the less obvious reverse traffic flows as well. Although most sites had been identified by the summer of 1992, it took months of observation before these counter traffic patterns could be discerned and observations scheduled accordingly. Scheduling success was also affected by whether student observers had transportation; because more than one observer typically relied on a single vehicle, if that vehicle was not available, the counts for the affected observers were cancelled. Whenever possible, canceled observations were rescheduled.

Visibility

The ability to see into passing vehicles--and thus to observe the number of occupants accurately--is affected by the positions of the observer, the traffic, and the light source (1). Because visibility can be greatly affected by weather conditions, the usefulness of sites typically remains unknown until the weather and light conditions change. Overpasses are generally undesireable because the further away one sits from traffic, naturally the more difficult it is to see into passing vehicles. Yet they provide the best combination of visibility and safety in comparison to street level sites, which do not allow one to see all lanes of traffic. As weather and light availability changes, a site on an overpass that provides a good view into the interiors of vehicles in the summer may be rendered useless in the winter because streetlights are absent or located such that the light they provide is insufficient to see into passing vehicles. Under such circumstances, data collection was limited to daylight hours. The result is that for a number of locations, data during the fall and winter quarters (Q4/92 and Q1/93 respectively) are not available. Darkness during the winter months forced morning counts to begin after 7:30 a.m., and evening counts to end at before 5:00 p.m.--an hour to an hour and a half later (or earlier) than scheduled. Therefore, instead of the expected five to six counts per session, only three to four counts per session were successfully performed during the fall and winter quarters, if at all. Another issue was whether traffic was approaching or going away from observers; this also affected observer performance (4).

Mainline Observations

Mainline data include both HOV and GP observations; these were collected by observing a different lane for each 30-minute count; ramp data were collected by observing the same ramp throughout the session. The number of lanes at each mainline location is shown in the site diagram, and displayed under the tables' location heading ("GP lanes" or "HOV lanes"). Although the observers themselves collected data separately for each individual lane, the analysis program and tables distinguish only between HOV and GP lanes (thereby combining the data for individual GP lanes). As a result, the number of counts performed for GP lanes effectively outnumber those for HOV lanes, which makes a direct comparison between the two types of lanes difficult. To compare HOV lane with GP lane observations, the number of HOV and GP lanes must be taken into consideration. This can be done by dividing the number of quarterly counts by the number of each type of lane to obtain the average number of counts per lane.

Data availability for mainline locations are affected by a number of factors. Although mainline data are preferable to data collected at access/egress ramps, they are more difficult to obtain because they require the use of overpasses, which are more difficult to locate because overpasses occur less frequently than access/egress ramps, and those with characteristics favorable for observing vehicles (such as adequate lighting, lower height, etc. (1)) are even rarer. During the winter months, observations were scheduled to obtain mainline data from at least one overpass per corridor; access ramp data was collected to supplement them. As a result, data tend to be more readily available from ramp locations during the winter months.

Data also may be unavailable for individual lanes of sertain mainline locations because the number of lanes is greater than the number of possible counts per session. During a three-hour session, observers are able to conduct up to a maximum of six half-hour counts. When observers are faced with more lanes of traffic than the conditions of the session allow, it is inevitable that at least one lane may be missed for any given session; during the fall and winter quarters, this number rises to include at least to two lanes. This limitation was counteracted by specifying the lane at which a session was to begin, and then rotating the order of the lanes so that each lane was observed at least once per session.

Ramp Observations

There are almost twice as many ramp sites as there are mainline sites. Because access/egress ramps are more numerous and typically have better lighting than overpasses, they are ideal locations for observing vehicle occupancy. An important feature of access/egress ramps (particularly on-ramps) is that data are likely to vary greatly. This is due to the lower volume of vehicles they carry, which means that there is a greater chance for random variation. Ramp locations were therefore studied to supplement mainline data as well as to determine whether some of their data could be used as "proxies" for data gathered on the mainlines. A result is that some locations were only counted during the winter months. Both on- and off-ramps were used. In cases where ramps had metered GP and HOV bypass lanes, vehicles were recorded regardless of the lane, thereby combining the data for these locations.

ACO SITES

I-5 North Corridor (Fig. B1)

The I-5 North corridor is 9.4 kilometers long, beginning at NE Northgate Way (North of SR-520), and continuing to 236th Street SW. This was one of two corridors (the other being I-5 South) where observations were successfully scheduled and obtained regularly throughout the year for all locations. Four evenly spaced sites were used with well-lighted locations: 236th Avenue SW, N 175th Street, N 145th Street and Northgate. For all sites, morning southbound and evening northbound traffic was measured using on- and off- ramp locations, respectively Of these, only N 145th Street was used for mainline data collection. Data are only unavailable for the second quarter of 1993 (Q2/93) at 236th Avenue SW (Table B3) because observations were not scheduled.

I-5 Downtown Corridor (Fig. B6)

This corridor begins at Roanoke Street and ends at S. 144th Street, a distance of 18.9 kilometers, including I-90 and ending before the I-405 and SR-520 interchange. Conducting observations in this corridor was difficult because both directions of traffic had to be examined for each commute period (there was no obvious directional flow). Additionally, because of the irregular layout of the access/egress ramps, it was impossible to conduct observations in the same manner as was possible at suburban locations with traditional cloverleaf or diamond patterns. Because there was no single set of locations that could satisfy collection requirements, a greater number of sites had to be used. Six ACO sites--Lakeview Boulevard E , Roanoke Street, S. Holgate Street, Albro Place, Madison Street, and S. 144th Street--were used for mainline observations. Seven sites--Lakeview Boulevard E, Corson Avenue S, Stewart Street, S Michigan Street, Olive Street, Madison Street and Howell/Yale Sts.-were used for ramp data collection.

The majority of observations were conducted around three clusters of ramps: one set north of the downtown central business district (CBD), a second set at the CBD, and third set south of the CBD. *North of the CBD*, observations were performed at Lakeview Boulevard E, but were then replaced by observations at Roanoke Street (which was found to be a better site because it was closer to street level) during the first quarter of 1993 (Q1/93). Data are unavailable for Roanoke until Q2/93 because the retrieval program cannot distinguish between the two sites for Q1/93, however.

At the CBD, locations at Olive Street(northbound, evening on-ramp) and Howell/Yale Sts. (southbound, evening on-ramp) provided for "outbound" traffic; Madison (northbound, morning off-ramp) and Stewart Street(southbound, morning off-ramp) provided for "inbound" traffic data. Morning counts at Olive Street and Howell/Yale Sts., northbound, did not begin until later in the year. Mainline data collection at Madison Street was a special study begun at the request of WSDOT District 1 during the Q2/93; ramp data collection began in the fourth quarter of 1992 (Q4/92). Stewart Street was not added until Q4/92.

South of the CBD, counting at S Holgate Street was changed to counting at Albro Place because of the unfavorable characteristics of the site--there was a sidewalk on only one side of the overpass, and at the time, the HOV lane ended about 200 yards before the overpass, making it difficult to determine vehicle occupancies in that lane. Observations were suspended because of construction at the following sites: at S Holgate Street and Corson Avenue S beginning Q1/93, and at S Michigan Street beginning Q2/93. Mainline evening counts were discontinued at S 144th. Street.

<u>I-5 South Corridor</u> (Fig. B18)

The corridor begins south of the I-405 interchange, beginning at S 188th Street and continuing south to S 272nd Street, for a distance of 8.9 kilometers. Data collected during the morning commutes were for northbound traffic (on-ramps only); afternoons data were collected from only southbound traffic (off-ramps only). From a total of seven occupancy sites, one (S 216th Street.) was used exclusively for mainline observations; the remainder (S 188th Sreet, S 200th Street, SR-516--Kent/DesMoines Road, SR-516--Kent ramp, SR-516--DesMoines ramp, and S 272nd Street) were used to collect ramp data. The ramp locations at SR-516 were treated as if they were three different sites.

An instance of missing observations where sessions had been conducted was at the HOV lane of S 216th Street in the morning northbound lanes (Table B48; Q4/92). Of the two counts completed for that lane, the data were found to not be usable. No observations were scheduled at SR-516--DesMoines ramp (Table B52) for Q2/93.

<u>SR-520 Corridor</u> **(Fig. B24)**

This corridor is 7.9 kilometers in length from the Hunt's Point pedestrian bridge to the 148th Avenue overpass. From a total of seven ACO sites, two are used exclusively for mainline observations (Yarrow Point and 148th Avenue); the rest are used for ramp data collection (Hunt's Point., SR-908, 124th Avenue, and 148th Avenue--Bellevue and 148th Avenue--Redmond ramps). These sites are all located east of Lake Washington; to date, data have not been collected on the Seattle side of the lake. Similar to SR-516 on the I-5 South corridor, 148th Avenue NE was treated as if it were three separate sites. Data are collected for morning westbound (on-ramps) and evening eastbound (off-ramps) traffic only.

Data collected for this corridor were not usable for the following locations: Hunt's Point, Q4/92 (Table B55); 148th Avenue NE, Q4/92 (Table B62); and 148th Avenue - Redmond ramp, Q1/93 (Table B65). No observations were scheduled for the remaining locations where data were absent.

<u>I-90 Corridor</u> **(Fig. B30)**

This corridor spans Lake Washington from 23rd Avenue S in Seattle, to Bellevue Way, SE , in Bellevue (between I-5 and I-405), for a total of 8.5 kilometers. This corridor consists of four ACO sites. Island Crest Way is used for both mainline and ramp observations, and 60th Avenue SE, E Mercer Way and Bellevue Way SE are ramp sites only.

Island Crest Way was reported to be a poor vantage point in the mornings due to water sprinklers and landscaping (4). Morning counts at this location were temporarily postponed during Q1/93 and Q2/93 (Table B70) because of the freeway landscaping project that was underway (which turned the location into a "sea of mud" following rain storms (4)). Data collected at the Island Crest Way on ramp were not usable for Q1/93 (Table B72).

Observations at the E Mercer Way on-ramp were not scheduled for Q2/93 (Table B74); observations at the off-ramp were not begun until Q1/93 (Table B75) because of construction. Again, observations were scheduled for morning westbound traffic and evening eastbound traffic only.

Newport Way and Front Street in Issaquah were added during the third quarter of 1993 (Q3/93), and are not included in this report.

I-405 Corridor (Fig. B35 and Fig. B40)

This corridor is unique in a number of ways. Before it was broken up in the third quarter of 1993, it stretched from Tukwila Parkway (at Southcenter) to SR-908 (north of 520, by Kirkland) for a total of 27.9 kilometers, and had more sites than any other corridor (except I-5 Downtown, which has nine sites). The corridor was in a number of "activity zones," which meant that morning and evening data on both northbound and southbound traffic had to be collected. Although a large amount of data was obtained, there were so many locations that observations were not performed as often as desired. As a result, bad data affected a larger proportion of the observation quarters. To improve collection efforts, and in anticipation of more sites along this corridor, I-405 was divided into three sections, as described below.

I-405 South Corridor **(Fig. B35)**

This section begins at Tukwila Parkway and ends at 112th Avenue SE (Lake Washington Boulevard), for a total of 13.7 kilometers. It is the most complex section because it runs through the suburban centers of Tukwila (where it merges with I-5) and Renton (to Bellevue). Traffic here flows in multiple directions, traveling to and from both I-5 and I-90 towards Seattle, Tukwila, Renton and Bellevue in the morning, and returning in the evening. Although there were only four sites in this corridor, observations were conducted to measure both morning northbound and southbound, and evening southbound and northbound traffic (similar to the I-5 Downtown Corridor). During the period covered in this report, two sites (Tukwila Parkway and 112th Avenue SE) were used solely for mainline observations; three (SR-167, S Park Dr. and 112th Avenue SE) were used for ramp data collection (as of Q3/93, ramp data are being collected from 112th Avenue SE as well).

Data collected at Tukwila Parkway were unavailable for Q3/92 of the morning northbound commute (Table B78), Q3/92 and Q4/92 of the evening northbound commute (Table B79) because of bad data and the low number of counts performed. Counter-flow traffic data (morning southbound and evening northbound) were not collected during the winter months because of generally poor visibility and because it was not a high priority (Tables B79 and B80).

Ramp data for SR-167, were unusable for Q4/92 of the evening northbound commute (Table B83); all other quarters where data are missing is because counts were not scheduled. This ramp was not a healthy counting location because vehicle exhaust tended to accumulate here.

S Park Drive provides access to the Renton Boeing Plant, and so traffic patterns tend to be different here; peak periods run from 6:00 morning-7:30 AM, and from 2:00 evening-4:00 evening--traffic is gone by 5:00 evening (4). Data for northbound on-ramp traffic were not usable for the morning, Q4/92 and Q1/93 (Table B86), or evening, Q3/92 and Q4/92 (Table B87) commutes, nor were they usable for Q3/92 and Q4/92 of the evening southbound commute (Table B89). During the period covered by this study, there had been ramp construction at S Park Drive, which may have restricted the number of counts.

At 112th Avenue SE, Q4/92 data were not usable for the GP lanes during the morning northbound commute (Table B94); Q3/92 data were not usable for either GP or HOV lanes of the morning southbound commute (Table B96). Both the evening northbound, and morning southbound, locations were counter flow commutes, and thus observations were not begun until 1993. At all other locations where data are absent, observations were not scheduled.

__I-405 Central Corridor__ **(Fig. B40)**

This 2.2-kilometer long section of I-405 centers around downtown Bellevue from SE 8th Street to NE 12th Street, between I-90 and SR-520. Of the two active ACO sites, NE 12th Street is used for mainline observations and ramp observations are conducted at SE 8th Street.

Data for SE 8th Street were not usable for Q3/92 of the evening northbound commute (Table B103), or for Q4/92 of the morning outbound commute (Table B100). Both sets of data are from counter-flow commutes. Traffic for the morning southbound commute was so light (as demonstrated by Q3/92 data) that on-ramp observations here were discontinued (Table B100).

Observations at NE 8th Street were abandoned after a few trial counts during the third quarter of 1992, although additional counts were performed during the first quarter of 1993. NE 8th Street was a poor site for observations because the northbound on-ramp was too far away, and the traffic there moved too fast for observers to determine occupancy reliably. Although the southbound off-ramp was well-lighted, two lanes of traffic exit at the same time and move too fast to count (4).

During the winter months, it was generally too dark to see the number of occupants when conducting mainline observations at NE 12th Street because the lighting was inadequate (4). Morning northbound (Table B108) and southbound (Table B110) commutes were not scheduled; data collected for the evening northbound commute during the two counts of Q1/1993 were not usable (Table B109).

I-405 North Corridor (Fig. B40)

At present, there is only one site in this corridor at SR-908, 6.4 kilometers north of NE 12th Street. Mainline counts were not begun until Q3/93, consequently they are not displayed. Both ramp and mainline counts are primarily conducted from the pedestrian bridge located here. Winter observations were difficult at the overpass because of poor lighting on the pedestrian bridge; better-lighted ramp locations at this site (such as the southbound on-ramp, which does not have a Jersey barrier) were not very safe for observations (4). No observations were scheduled for the morning southbound commute during Q2/93 (Table B112).

CONCLUSIONS AND RECOMMENDATIONS

Occupancy data were successfully collected from most of the study sites. Where data are unavailable, it is because an insufficient number of counts were scheduled or successfully completed. This happened for a number of reasons, including poor siting, inclement weather, poor visibility, having more sites than observers, and discontinuing data collection at some sites. The impact of having too few successful counts per quarter was that when bad data rendered the counts unusable, data for the entire quarter were lost. Observation sessions were consistently more numerous for ramp than for mainline locations. This was because of the greater number of ramp locations and the better visibility they offered. There were also proportionally more successful observations for GP lanes as a whole than for HOV lanes as a whole.

Factors not directly explored in this chapter include observer performance, and observer and data management, and are treated in greater detail elsewhere (**1**). Because observers are unsupervised in the field, they are trusted to begin and end observations on time, and to observe and record vehicle occupancies accurately. While data quality was verified by checking individual files for "gross errors" such as misnamed files and repeats, in the future, quality will be verified by statistically comparing current site data with site data collected from previous observations (see *HOV Monitoring and Evaluation Tool* (**1**)). As this project progresses, data will become increasingly accurate because of this method and the more stable average that will emerge as the volume of data increases. With this in mind, the following changes are in order:

1. Focus a greater proportion of mainline counts on HOV lanes. The number of successful counts affects the amount of quality data available, and in turn the validity of ACO figures. Increasing the number of counts for HOV lanes to match the number of GP lanes at a site would improve the integrity of the HOV data, and the number of counts between HOV and GP lanes could then be more reliably compared.

2. Prioritize observations at locations that ensure the best use of resources. Safe locations that provide the best visibility over varying conditions, as well as ease of access and scheduling are obviously preferred. Therefore, a directory of sites that includes site diagrams and a matrix of characteristics affecting data collection should be maintained. The question of whether

counter-flow traffic patterns should be continued or eliminated at existing locations, or expanded at additional locations should be explored, as well as whether or not to maintain ramp data collection.

3. Collect vehicle occupancy data on the I-5 express lanes. Because express lanes contain both HOV and GP lanes, "before" data for this corridor may be useful in areas where express lane expansion is planned, and would allow planners to monitor the express lanes' performance.

The occupancy data presented in this report provide valuable information in two areas: (1) the operation and performance of HOV lanes as compared to GP lanes, and (2) commuter mode choice in the greater Seattle area. Additionally, as the HOV lane system expands, areas where "before" data are now being collected will serve as baseline reference points in assessing the impact of HOV facilities on commuter mode choice. However, a caveat is in order: because loop data are more representative of traffic volumes in these corridors, the data included in this report should be used only to indicate the percentages of mode and vehicle occupancy in the corridors studied. The following chapter, "Average Vehicle Occupancy Data Analysis," provides a treatment of these raw data and potential sampling bias.

CHAPTER THREE: AVERAGE VEHICLE OCCUPANCY DATA ANALYSIS

The average vehicle occupancy (ACO) data presented in this report are raw numbers. They are based on actual observations conducted between July, 1992 and June, 1993; they are not corrected for sample bias. The process for sampling time of the year, day of the week, time of day, lanes (or ramps), and locations, was designed to provide overall ACO figures that can be compared from year to year. The sample size is large enough that statistical variation is small, which allows for fairly accurate determination of the ACO at one location for a particular peak period in a given quarter. However, because ACO varies by time of the year, day of the week, time of day, lane (or ramp), and location, comparisons involving small subsamples (such as one location for a particular time period in a given quarter) must take these variations into account.

An example will illustrate the variations that must be considered. For instance, if one were interested in determining changes in the evening peak ACO in the north-bound general purpose lanes at 145th NE on I-5 from the last quarter of 1992 to the first quarter of 1993, one would have to take into account the number of observations in each of the following categories:

- day of the week
- time period during the evening peak
- the particular general purpose lane in which vehicles were observed.

If it turned out that ACO was always higher on Fridays (because of families or other groups traveling out of town together for the weekend for example), having a larger sample of Friday observations in the second quarter could lead to the misleading conclusion that ACO was increasing. Despite the controls in the sampling methodology, it is not always possible to sample in a way that is free of potential misinterpretation of the raw data.

This section of the report deals with this issue. The data from Phase I of the study have been analyzed to determine differences according to time of year, day of week, time of day, lane (or ramp), and location. Knowledge of these differences may be used to adjust for sampling bias (See Appendix D for an explanation and examples).

ANALYSIS METHODOLOGY

ACO observation data for the entire year were converted to a new format for analysis using SPSS. ACO was calculated for each 15-minute period at each location for each lane (or ramp) during each quarter. Each ACO was then stored in a data file with its associated location, quarter, lane (or ramp), and time period identifiers. The SPSS data file contained 6,783 entries: 2,540 for observations in lanes and 4,243 for observations on ramps. Next, two separate files were created: one for freeway lanes, and one for ramps. ACO figures based on fewer than 50 observations were deleted, and locations with fewer than 20 observations were also deleted. This reduction in the number of cases eliminated anomalous figures and reduced variability, but maintained enough observations to conduct the analysis.

Following this reduction, there were 2,145 observations in the lane data file and 3,634 observations in the ramp data file. Multiple regression was the general method for determining the influence of various factors on ACO. ACO was treated as the dependent variable and various combinations of other information were used to determine the influence of factors such as location, time of day, day of the week, lane (or ramp), and time of year. The regression coefficients indicate the strength and direction of the influence of the factors of interest.

For instance, if the lane in which an observation was made is indicated by a dummy variable taking the value of 0 or 1 (depending on whether the observation was or was not in the lane), the regression coefficient for that dummy variable can be used to assess that lane's influence on its ACO. For example, if the coefficient for the dummy variable indicating lane 2 were .07, and the coefficient for lane 3 was .12, we could conclude that the ACO is .05 higher in lane 3 than in lane 2 for the sample included in the regression. Furthermore, we could assess whether or not this difference is universal, or whether it is true only at some locations by comparing the regression coefficients for the total sample with the regression coefficients at each location. The differences in patterns of coefficients indicate how locations vary. The regression coefficients for the overall analysis are shown in Table D1. Table D2 contains information on the trends for each location for lanes. Table D3 contains similar information for ramps.

Differences in time of the year, day of the week, time of day, lane (or ramp), and location, were analyzed. Results are described in the following section.

TIME OF THE YEAR

Multiple regression was performed on all data using location, lane (or ramp), day of the week, and time of day, as well as dummy variables indicating the quarter in which an observation was made. By separating out the influences of all relevant variables, the independent influence of time of year can be assessed.

Using the third quarter of 1992 as a baseline, the relative influence of the other quarters can be seen in Table D1. From these data, one can see that summer ACO (Q3/92) is higher than during the rest of the year. The coefficients for Q4/92 and Q1/93 do not differ significantly. However, the coefficient for Q2/93 is significantly higher than that of the Q4/'92 and Q1/93. The general pattern is that ACO is lowest in the fall and winter, rises somewhat in spring, and reaches its highest level during the summer. One explanation is the increasing number of non-commute trips taken during the spring and summer. However, it is possible that ACO patterns observed during this single year reflect some longer term trend that will not become apparent until data from additional years are collected and analyzed.

A separate analysis was conducted by location (which includes geographical location, peak period, and direction of travel). Separate regressions were performed on the data from each unique location. Tables D2 and D3 show the locations where the quarterly ACO pattern differed significantly from the overall quarterly pattern. There are no consistent patterns by corridor. However, some of the local differences may have to do with the types of destinations at each locale. For instance, a shopping mall near a given ramp may be associated with a higher ACO during the fall quarter because of holiday shoppers traveling together.

LANE ANALYSIS

Lanes were classified by type: (1) HOV, (2) outer, (3) center, and (4) inner. The ACO in HOV lanes was obviously different from the general purpose lanes; consequently the analysis concentrated on detecting differences among the general purpose lanes. The coefficient for the HOV lane was slightly more than 1.00 higher than the other lanes. On average, there is one more person in vehicles in the HOV lanes than in the general purpose lanes.

The coefficients for inner and center lanes did not differ significantly. However, the coefficient for the outer lane was significantly lower than that for each of the two other lane types. One possible explanation for this is that people traveling by themselves tend to make shorter trips than people traveling together, and are therefore more likely to travel in the outer lane.

When each location was subjected to the lane analysis, some unique differences among lanes emerged. Table D2 shows the locations whose patterns differed significantly from the norm and the nature of those differences. The major variations from the general pattern tended to occur in the outer lane. The ACO in the outer lane in the downtown portion of I-5 tended to be higher than in other locations. With a relatively high carpooling rate in vehicles going to the Seattle CBD, exiting carpools would tend to predominate in the outer lanes.

TIME OF DAY

ACO is clearly higher during the evening peak than during the morning peak. ACO data are presented and analyzed separately for each peak period. As such, this analysis concentrates on the variations within each peak period.

An overall multiple regression was performed using dummy variables for each 15-minute period in separate analyses for each peak period. Figures D1 through D4 show the adjustment factors (based on the regression) for each 15-minute interval for each peak period. Ramps and lanes are analyzed separately. In addition, a regression was performed on the adjustment factors to determine the general patterns. Both types of data are depicted in the figures.

Data for the morning peak (for both ramps and lanes) indicate a tendency for ACO to rise during the entire peak period, with a slight tendency for ACO to be higher in the very early part of the morning peak. The rise is statistically significant for both ramps and lanes. The most likely explanations for this rise are as follow:

- Commuters who want to drive by themselves tend to leave earliest to avoid traffic.
- Commuting carpoolers can leave later and still take advantage of HOV facilities.
- Toward the end of the morning peak period, non-work trips begin to influence ACO.

There is a general tendency for ACO to fall during the evening peak. However, the evening peak pattern is clearly U-shaped, and this "U" is statistically significant. During the entire evening peak, non-commuters (which tend to travel in higher occupancy vehicles) are prevalent (compared with the morning peak). However, during the peak of the peak, commuters (primarily in SOVs) reduce non-commuters' influence on ACO.

Separate analyses were conducted for each unique location. Tables D2 and D3 show those locations whose peak period patterns differed significantly from the norm. These tables also indicate how they differed. Local variations in shopping destinations probably account for most of the differences. Because the number of observations for each time period at each location is small, these variations from the overall pattern should be interpreted with caution. Additional data will allow researchers to determine whether the variations are significantly different.

DAY OF THE WEEK

Table D1 shows overall differences in ACO by day of the week. Except for an anomalous coefficient for Wednesday in the ramp data, a regular pattern emerges. ACO is lowest on Monday and increases throughout the week. The coefficient for Friday is significantly higher than that of all other days of the week. The rising trend during the week is statistically significant.

Some differences from the overall pattern were observed in the analysis by location. Tables D2 and D3 show those locations where the weekly pattern differed significantly from the norm. The only detectable general pattern in locational differences is the frequency of low coefficients for the end of the week in the North and South I-5 corridors. Apparently, the non-commute trip destinations that tend to raise the ACO toward the end of the week do not predominate.

LOCATIONS

Tables D1 and D2 show the locations where the ACO was significantly higher or lower than the average, taking into account all other variables, such as the presence of HOV lanes, time of day, quarter, and day of the week. There were also the following trends:

- ACO tended to be higher than regional averages in the I-5 corridor (with the exception of evening northbound traffic at 145th, morning southbound traffic at Madison, and the morning southbound off ramp at Roanoke).
- ACO tended to fall below regional averages on SR-520 and I-405 lanes (with the exception of the evening southbound lanes on I-405 at Southcenter).
- ACO varied widely on all ramps outer the I-5 corridor.

The wide variation in ramp data is probably related to shopping destinations near those ramps.

CONCLUSIONS

Many factors affect ACO. Therefore, it is important to design a sampling frame that reduces the influence of these factors. However, because it is impossible to perfectly sample all time periods, days of the week, lanes, and ramps at each location for the whole year, it is important to take these factors into account when analyzing changes in ACO.

After one year of data collection, we are beginning to have some confidence in our understanding of these differences, but additional data will be important in confirming the analyses presented herein. Because these analyses are based on only one year's worth of data, caution should be exercised in applying them. However, if one is conducting such detailed analysis, it is better to apply these correction factors than to use the raw data without adjustments.

CHAPTER FOUR: BASELINE TRAVEL TIME DATA

Travel time data measure the time savings that HOV lanes provide over GP lanes. One commonly accepted standard for HOV lanes is that they must offer a time savings of at least one minute per mile. Another policy in Washington state guides decisions about occupancy requirements. According to the *Washington State Freeway HOV System Policy*, "HOV lane vehicles should maintain or exceed an average speed of 45 mph [sic] or greater at least 90% of the times they use that lane during the peak hour (measured for a six-month period)" (3). Travel time data collected in this project provide average vehicle speeds, which will allow users to apply the above time savings criteria in comparing HOV and GP lanes, and lane performance criteria in evaluating HOV lanes. Study sections were specifically chosen to bound the HOV lanes' beginning and end points along given corridors. For the average traffic speed of GP lanes, vehicles traveling in the fast (leftmost general purpose) lane were observed, and their license plates numbers were tracked. To determine HOV lanes' average traffic speed, the identification numbers of Metro buses traveling in the HOV lane were recorded. Average vehicle speeds were calculated from the time differences between matches of these identification numbers recorded at beginning and end points of given study sections. (See *HOV Monitoring and Evaluation Tool* for a complete explanation.)

While observations on all of the corridors were scheduled to capture regular commute traffic flows, observations on the Downtown I-5 and I-405 corridors captured reverse commute traffic flows as well.

Travel time data are organized along the following parameters:

- corridor of study
- beginning and end site (study section)
- morning or evening peak period
- traffic flow direction

The data presented in the tables indicate, in 15-minute intervals, the average vehicle speed observed in HOV and GP lanes during the morning and evening peak periods by quarter (in miles per hour). Because GP lane traffic speeds were drawn from fast lane observations, they may sometimes exceed the speed limit (due to the lane's use as a passing lane). Because their number varies over the length of each study section, the number of GP lanes is not included.

From July 1992, to July 1993, travel time data were collected from 23 sites (mainly overpasses), organized into 26 study sections. Of these, only two locations, S 260th on I-5 South, and 35th Avenue S on I-90, were at street level. Data are available from Q3/92 through Q2/93 (see Table A2). Corridor diagrams that indicate the study sections precede the data; these are followed by diagrams for each site (Appendix E). Comments made by observers as they collected travel time data refer to aspects of data collection, traffic, and weather conditions; they are contained in Appendix F.

TRAVEL TIME DATA AVAILABLE

As indicated in the *HOV Monitoring and Evaluation Tool* final report, travel time data are difficult to obtain and expensive to produce for a number of reasons. Reliable data collection is hampered by a slow learning curve and the high amount of coordination required to schedule observations and ensure that collection periods match. In addition, factors associated with traffic patterns (such as vehicles changing lanes) can greatly reduce reliable data collection. Although a large number of travel time sessions were conducted in all of the corridors, it was difficult to obtain matches during all peak-period times for all quarters. Consequently, quarterly average vehicle speeds are not consistently available for all given peak-period intervals.

In addition to the same weather-related problems experienced in ACO data collection (see above), travel time data are highly dependent on the number of successful licence plate matches, which in turn is affected by several critical factors. First, gathering travel time data requires greater accuracy and faster reaction time than is required for gathering occupancy data. Therefore, this process is even more sensitive to conditions that reduce visibility. Second, gathering travel time data requires a "startup" period of at least 15 to 30 minutes, during which the vehicles observed at the beginning data point of a study section must travel to the specified endpoint before they can be observed and recorded. Third, the same license plates of passing vehicles must be recorded at each end of the study section, and for the same lane of traffic. Because vehicles rarely stay in the same lane, the likelihood that a vehicle has changed lanes or exited the freeway increases with the length of the study section. Fourth, observers cannot end and begin a session every half hour as they can when collecting ACO data; while observers take breaks, these add to the likelihood that a vehicle recorded by one observer will not be recorded by the other Finally, average vehicle speeds can vary greatly from quarter to quarter.

Visibility

Rather than viewing and recording the number of persons in a vehicle with a single digit, as is done in the case of occupancy data collection, observers must be able to discern and record strings of license plate characters. Each character is smaller than the size of a business card (7 cm high by 2.5 cm wide), and vehicles can be traveling anywhere from 24 to 105 kilometers per hour. Complicating this is the fact that the license plate numbers are usually read from overpasses, thereby placing the observer from six to 11 meters above the traffic flow. Poor visibility because of weather and lighting only compounds the problem by restricting the length of the sessions. Additionally, some observers found that they performed the task best when traffic was approaching them, while others collected data best from vehicles moving away from them. Where these observers were limited by sites to record license plates from traffic that was moving the wrong direction, less than optimal observer performance occurred.

Observation Session Length

Data are typically unavailable for the beginning period of the count because of the fact that the vehicles observed at the point of origin are not recorded at the end point until at least 15 minutes later-assuming that the observers even begin at the same time. This assumption is often not the case. Because two or more observers normally rely on a single vehicle for transportation to and from the sites, one observer has to drop off the other(s) before continuing on to the end site. Depending on the length of the corridor, this can add approximately 15 to 45 minutes to the start time of the session before matches can be expected (this also holds for session end times). If, as in the cases of I-5 and I-405, multiple travel time sessions were performed over long distances, the start-up time is greater.

Study Section Length

Successful matches depend upon the plates of the same vehicles being recorded in the same lanes at both ends of a study section. The distance from the beginning to the end site of a study section, therefore, directly influences the number of successful matches because vehicles rarely remain in the same lane. As the distance between observation sites increases, the likelihood that the same vehicle will be recorded decreases because it is more likely to have changed lanes, or to have exited the corridor altogether, depending on the availability of access/egress ramps. Furthermore, because GP vehicle speeds were derived from fast lane observations, the number of successful matches may have been reduced because of the fast lane's use as a passing lane. For a list of the study sections and their respective lengths, see Table E2.

TRAVEL TIME SITES

I-5 North Corridor (Fig. E1)

The I-5 North corridor waa total of 8.2 kilometers long. It had three observation sites and consisted of two study sections from which data were collected:

- 236th Street SW to NE 117th Street for morning inbound traffic
- NE 117th Street to NE 185th Street for evening outbound traffic

236th Street SW was selected because it was the northernmost site at which HOV lanes operate; it was kept for this reason despite the fact that N 185th was later determined to be a better location (4). Both 236th Street SW and 117th Ave NE have sidewalks on the north side only; consequently, observers had to count vehicles coming toward them in the morning, and going away from them in the evening (Figures E2 and E4).

For 236th Street SW to 117th St. NE (Table E3), fewer data are available for the morning commute because the study section is longer (see Table E2). Observations for both the winter (Q4/92) and spring quarters (Q1/93) were affected by inclement weather and a shorter daylight cycle, as indicated by the lack of data for the early morning (Table E3) and late evening (Table E4). For Q1/93, data are unavailable because only one count was performed for each section, and no reliable matches were made.

I-5 Downtown Corridor (Fig. E5)

This was the second longest corridor at 18.8 kilometers long. It had four sites organized into six study sections:

- between Lakeview Boulevard E and S Holgate Street
- between Lakeview Boulevard E and Albro Place
- between Lakeview Boulevard E and S 144th Street
- between S Holgate Street and Albro Place

- between S Holgate Street and S 144th Street
- between Albro Place and S 144th Street

Regarding the individual sites, Lakeview Boulevard E was chosen to be the northernmost site of this corridor because it was also being used for vehicle occupancy collection (the HOV lane actually begins further south, at Mercer). Although Lakeview Boulevard E was discontinued for occupancy counts, it continued to be used for travel times through Q2/93 (Tables E5 through E9). S Holgate Street was a difficult site to collect data from because it was uncomfortable for observers to sit at and had poor visibility (Figure E7). The one sidewalk it had was on the north side. The overpass was situated on a steep hill that placed the observer in an awkward sitting position. Southbound traffic was 6 meters lower than northbound traffic, and in the morning sun, license plates were difficult to see because of the shadow cast by the overpass (4). Visibility was good at Albro Place in both directions, but observers complained of the diesel fumes that collected there (Figure E8) (4). S 144th Street was the best location because it had wide sidewalks on both sides of the overpass (Figure E9).

Except for a few study sections where the distances between sites were short, travel time data for this corridor are sparse. Data are again less available for the winter quarters, as well as for the longer study sections (such as Lakeview Boulevard E and Albro Place). Although HOV lane observations were successfully performed for each of the above study sections, no reliable matches were obtained from any of the data collected.

For the morning southbound commute from Lakeview Boulevard E to S Holgate Street, no data were successfully collected during Q1/93 (Table E5), for the evening southbound commute, no data were successfully collected during Q4/92 (Table E6). On Lakeview Boulevard E and Albro Place, one count each was successfully performed and matched during Q3/92 and Q4/92 of the morning southbound commute (Table E7); for the evening southbound commute, two successful counts were reliably matched for Q3/92, and one count for Q4/92 (Table E8) At the same study section for the morning northbound commute, data were successfully collected and reliable matches obtained for Q3/92 only (Table E15). and E16). Of the one successful count performed at Lakeview Boulevard E and S 144th Street for the evening, southbound commute, one match was made (Table E9); no reliable matches were found from the single count performed for the morning northbound commute (Table E20). (Table E10) (Table E11). For the morning northbound commute at S 144th Street to Lakeview Boulevard E, no reliable matches were obtained from the one successful count performed during Q3/92 (Table E20).

For the S. Holgate Street to Albro Place study section, data were collected successfully for the morning southbound commute during Q3/92 and Q4/92 only (Table E12). For S Holgate Street and S 144th Street, data were only collected and matched for evening, southbound traffic during Q3/92 and Q4/92 (Table E14); no data were successfully collected for the morning, northbound commutes (Table E21). For the Albro to Holgate study section, no data were successfully collected for the morning northbound commute during Q2/93 (Table E17); data were only successfully collected for the evening northbound commute during Q2/93 (Table E18).

<u>I-5 South Corridor</u> (Fig. E10)

The I-5 South corridor was one of the project's more successful travel time data collection sites. This corridor was 8.9 kilometers long, had three sites, and consisted of two study sections from which data were collected:

- S 178th Street to S 216th Street for evening outbound traffic
- S 260th Street to S 216th Street for morning inbound traffic

Although there is a good amount of data for the morning commute for S 260th Street to S 216th Street (Table E24), S 260th Street was a difficult and unsafe location at which to collect data. The site is located on the median dividing the northbound and southbound lanes, rather than on an overpass (Figure E13). To reach this site, observers parked on the underpass and scrambled up a steep dirt hill and around a chain link fence while carrying a folding chair and a laptop computer (4). In rain, the hill became very muddy and slippery (4).

Summer data for S 178th Street to S 216th Street are available later in the day than for any of the other travel time study sections. Data were collected until 7:15 p.m. to take advantage of the longer period of available daylight during that period (Table E23). Visibility for this corridor was adequate at all of the sites.

SR-520 Corridor (Fig. E14)

The SR-520 corridor was 7.9 kilometers long, from Hunt's Point to 148th Avenue NE, and includes SR-908. This corridor was divided into three study sections, and data collected for morning inbound and evening outbound traffic:

- Hunt's Point and SR-908
- Hunt's Point and 148th Avenue NE
- 148th Avenue NE and SR-908

The location at Hunt's Point was a pedestrian overpass four blocks west of the vehicle overpass (Figure E15). It was particularly good for collecting data because observers could see well both directions and traffic was always almost stopped, which made it easy to record license plates (4). The only distinguishing feature of 148th Avenue NE (Figure E17) was that it carried a great deal of road traffic, and observers reported that the occupants of passing vehicles often stared at them (4).

Although the study sections on this corridor were generally better than those in other areas, HOV lane data were very limited because the only HOV lane was an outer lane running from SR-908 to Hunt's Point for westbound traffic (sites 41 and 43 on Figure

E14). Data on "reverse flow" traffic were briefly collected; evening sessions were conducted on the west bound traffic from Hunt's Point to SR-908 for Q3/92 and then were discontinued due to the insufficient number of matches for the HOV lane (Table E26). Data were not collected from the 148th Avenue NE to Hunt's Point section for morning westbound traffic until Q4/92 (Table E27). Data for evening eastbound traffic are missing for the winter quarters (Q4/92 and Q1/93), despite a relatively high number of sessions that were performed.

I-90 Corridor (Fig. E18)

The I-90 corridor was 7.7 kilometers long and consisted of two study sections from which data were collected:

- E Mercer Way to 35th Avenue S for morning westbound traffic
- 23rd Avenue S to E Mercer Way for evening eastbound traffic

The neighborhood around 23rd Avenue S was not considered safe, especially in the dark for women, so male observers were preferred; this affected scheduling accordingly (4). Furthermore, observers had to stand to see the traffic because of the 1.2 metre-high wall (Figure E19). Observers relied on either of two locations for observations at 35th Avenue S: they sat on the retaining wall on the overpass, or on the bicycle path that is on the same level as the lanes, looking across traffic (Figure E20). Getting to this site was time-consuming because of the winding roads on Mercer Island; consequently, counts tended to begin later than usual--especially if there was a "drop-off" involved (4). The retaining wall position, although less comfortable, offered better visibility. Visibility from E Mercer Way was adequate, although the location is heavily landscaped (observers were often sitting in bark mulch) (Figure E21).

Travel time data collection was successful for this corridor as well, except for two quarters for which data are unavailable--both had to do with data collected during the winter months. For 23rd Avenue S to E Mercer Way, data are unavailable because no matches were obtained from the four sessions for Q1/93 (Table E32); the same problem occurred for E Mercer Way to 35th Avenue S during Q4/92 (Table E33).

I-405 Corridor (Fig. E23)

This corridor was the longest of the six corridors--27.5 kilometers, with ten study sections (also the most of any corridor). Because of the complexity of traffic patterns (see ACO data collection, pp. __-__), observations were conducted to capture both regular and reverse traffic flows at the following locations:

- Tukwila Parkway and Benson Road S
- Tukwila Parkway and 112th Ave SE
- Tukwila Parkway and NE 12th Street
- Tukwila Parkway and SR-908
- Benson Road S and 112th Ave SE
- Benson Road S and NE 12th Street
- Benson Road S and SR-908
- 112th Ave SE and NE 12th Street
- 112th Ave SE and SR-908
- NE 12th Street and SR-908

This was the least successful corridor for collecting travel time data for a number of reasons. The root problem was that, unlike the corridor for the occupancy data, I-405 was not segmented into South, Central, and North corridors because the study sections spanned the corridor's entire length. First, observation sessions were spread too thin. An average of only one to two counts were successfully performed for each applicable parameter (site, commute period, traffic direction). Second, most study sections were too long to obtain matches reliably. All but one were longer than five kilometers (Table E2), and had numerous access/egress ramps in between (Figure E23), thereby increasing the likelihood that observed vehicles would have changed lanes, or exited the corridor alltogether.

HOV data for the longer study sections are unavailable for similar reasons, and because the HOV lanes are neither continuous nor do they remain on the same side of the corridor. Inside HOV lanes begin at Tukwila Parkway and end at Benson Road S; yet from NE Park Drive to 112th Avenue SE, HOV lanes are on the outside. There were no HOV lanes in the central and northern portions of the corridor during the time of this study. During Q2/93, data were only collected between the shorter study sections: Tukwila Parkway to Benson Road S (Tables E34, E35, E41 and E42); Benson Road S to 112th Ave SE (E43, E44, E50 and E51); 112th Ave SE to NE 12th Street (Tables E52, E53, E60 and E61); and NE 12th Street to SR-908 (Tables E62, E63, E68 and E69).

Tukwila Parkway, 112th Avenue SE/Lake Washington, and NE 12th Street were average sites for collecting data (Figures E24, E26 and E27, respectively). Benson Road had good visibility and a wide sidewalk on the west--the sidewalk on the east side was very narrow (Figure E25). It was suggested that observers use the southern rather than the northern sidewalk because the northern sidewalk was almost level with street traffic, and as such, was less safe. Observers recording travel time data from the pedestrian bridge at SR-908 during the winter had the same difficulties as they had experienced with occupancy data collection efforts (p.23) (Figure E28).

CONCLUSIONS AND RECOMMENDATIONS

Although the effort to collect reliable travel time data was very educational, the usefulness of the travel time data presented in this report is very limited. Although the data can generally be used to compare HOV lane performance to GP lane performance, and to identify areas of congestion, a number of factors render data interpretation difficult.

Vehicle speeds can only be compared by time of commute for the quarter in which they occurred. The data are presented as average speeds, only individual study sections may be used; the data cannot be aggregated to examine the differences between HOV and GP lanes corridor-wide. The speeds indicated for areas tend to vary widely from quarter to quarter, therefore yearly averages are unreliable. The standard deviation for each time period must first be established to determine the number of observations required for statistically meaningful information. This means that additional data will be necessary before reliable generalizations regarding vehicle speeds (and times) can be made.

It was much more difficult and complex to collect travel time data than it was to collect vehicle occupancy data. Observers must not only be more accurate and have better visibility, they must also coordinate their efforts more carefully. Although observer absences and lateness are not discussed in this report, they further confounded the matching process, as did errors in data quality. Even with good data, matches were difficult to obtain because of normal traffic behavior (e.g. lane changes), especially over long distances. Intervening access/egress ramps in study sections only compounded this problem. However, more data was available for study sections having high numbers of successful counts. This suggests that the number of reliable matches can be increased by having greater numbers of successful sessions. Despite the obstacles that made it difficult to collect the travel time data, the experience gained in this study indicates that travel time data may be collected successfully under some conditions. The greatest amount of travel time data was gathered at study sections characterized by good visibility, short length, and high numbers of successful observations. If manual travel time observations are re-established, the following recommended actions should make the data collection effort more successful:

1. Use short travel time study sections. To decrease the likelihood of observed vehicles having changed lanes or exited the corridor, distances

between sites should be short (for example, under 3 kilometers), and chosen to limit the number of intervening access/egress ramps.

2. <u>Conduct more travel time data collection sessions per study section</u>. Although there are a number of factors that reduce the likelihood of obtaining reliable license plate matches, one way to compensate is to increase the number of data collection sessions, thereby increasing the volume of license plates collected.

3. <u>Limit travel time data collection to special studies</u>. Effective collection of travel time data requires a great deal of coordination between observers to ensure that they begin and end at the same time, as well as corridor sections that facilitate license plate matches. Even when effectively collected, travel time data can vary so much that routinely gathering data to establish an "overall" travel time statistic for a length of corridor would not be very useful. An example of a special study is suggested below.

4. <u>As a special study, conduct travel time observations using the express lanes</u>. Not only do the express lanes have GP and HOV designations, they also constitute a "captive audience" in that vehicles may not exit for longer distances. As a result, it may be easier to obtain the matches necessary for reliable travel time data.

The travel time data available in this report confirm that travel time data collection is most successful when it is limited to special studies of short lengths of corridor. Even in the future, as technological improvements make it possible to collect travel time data without the use of human observers (such as video imaging), the success of the data collection will be affected by the distance between sites, accuracy, and the number of observations.

CHAPTER FIVE: PUBLIC OPINION SURVEY

The research methodology used to collect the data described in this chapter is detailed in the companion report, *HOV Monitoring and Evaluation Tool* (1). Users of these data should be aware that the sample used in this survey is not intended to represent the actual driving population. Rather, this portion of the project attempts to generate comparable samples of single occupant drivers and carpoolers to measure differences in their attitudes about HOV lane use and effectiveness. The sample generated for this survey, however, is made up of two-thirds SOVs and only one-third HOVs. This may be because drivers identified as HOVs may have been carpooling as a special circumstance when observers recorded their commute mode in the field. Only 48 percent of the drivers identified in the field as HOVs actually rideshare on a regular basis. Eighteen percent of drivers identified as SOVs rideshare on a regular basis. This underscores the uncertainty of correctly linking commute mode on any given day to overall mode choice. It is also important to note that this survey is intended to measure only attitudes about HOV lane effectiveness, not the underlying reasons behind individuals' choices to drive alone or to rideshare.

Three supplemental pieces of information are recorded with each returned survey. First, the postage date is entered to measure changes in opinions over time. Second, data entry staff record the highway corridor and commute mode in which traffic counters observed survey respondents. Third, data entry staff assign each survey a document number which makes it easier to retrieve from storage the phone numbers and addresses of respondents who have indicated their willingness to answer follow-up questions.

As of June 1993, surveys were mailed to 5,444 vehicle owners as identified by traffic observers in the field. Drivers of vehicles identified as HOVs received 2,450 surveys; 846 returned them, for a response rate of 34 percent. Drivers of vehicles identified as SOVs received 2,994 of the surveys; 882 returned them, for a response rate of 29 percent. The response rate for the entire survey population was 32 percent.

In addition to providing results from all survey questions on the questionnaire, this section contains several examples of how to use the survey data in conjunction with other data gathered for this project. The purpose of this project is to develop a wide ranging source of data that will allow analysts to evaluate the performance of the HOV lane system. Therefore, illustrative examples that demonstrate how to combine the disparate sources of data are provided, rather than a comprehensive analysis. Subsequent quarterly reports will contain additional examples of noteworthy trends and changes from the baseline data.

The bulk of the survey data is presented in aggregate form, treating SOV drivers the same as carpoolers. However, opinion data are presented by splitting these two groups. A copy of the public opinion survey is contained in Appendix G.

SURVEY RESULTS

Figure 5.1 displays the number of surveys returned each month for the period between November 1992 and June 1993. The large increases in February and March 1993 can be attributed to the correction of a data processing error with the Department of Licensing's main computer. The Department of Licensing provides this project with the names and addresses of registered vehicle owners corresponding to the license plate numbers recorded in the field by traffic observers. Because the Department of Licensing's computer was down, few surveys were sent in December 1992, and January 1993. To make up for the backlog, twice as many surveys as normal were sent during February and March, 1993. The target number for mailing surveys is approximately 1,000 per month, or 250 per week.

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Figure 5.1: Survey Return Date

FIGURE 5.1 BOX TEXT: The number of responses in January is atypically low. Since few surveys were sent out during this period, respondents must have been returning surveys sent to them before January. The holiday season may be a poor time to send out surveys as well.

Figure 5.2 shows the breakdown of observed commute corridors and travel modes. During Phase I of the study, the region's highways were divided into six corridors:

1. I-5 north of NE Northgate Way (I-5 North)
2. I-5 between NE Northgate Way and Southcenter (I-5 Central)
3. I-5 south of Southcenter (I-5 South)
4. SR-520
5. I-90
6. I-405

After June 1993, I-405 was subdivided into three discrete corridors (North, Central, and South), and an additional corridor was created to contain outlying sites such as SR-512, SR-410, and SR-16. Subsequent data reports will contain separate information on these corridors.

Figure 5.2: Observed Commute Corridor and Mode.

FIGURE 5.2 BOX TEXT: I-90 and SR-520 have fewer responses, which reflects the fact that fewer traffic counts were conducted on those corridors.

Figure 5.1: Survey Return Date

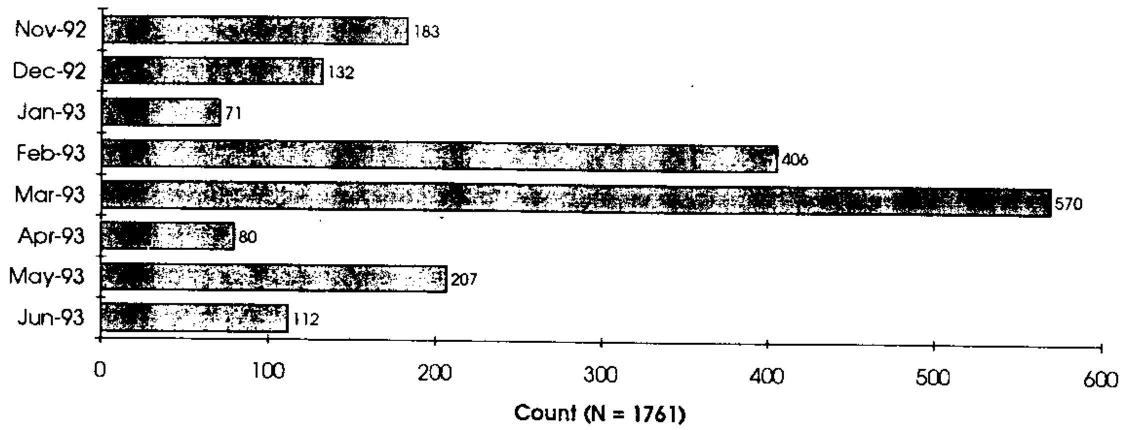
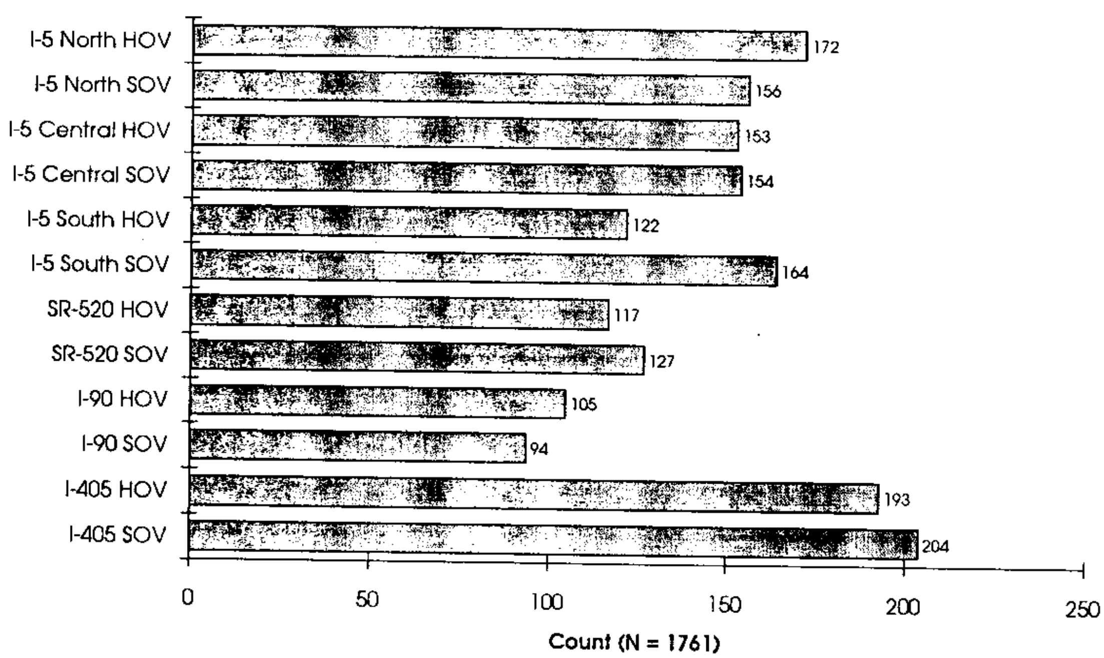


Figure 5.2: Observed Commute Corridor and Mode



Traveler Demographics

To better acquaint users of these data with the survey population, demographic data are presented before sections relating to driving patterns and opinions on HOV lane effectiveness. This does not correspond with the order of the questions as they appear on the survey, but it will facilitate interpretation of following sections.

Figure 5.3 depicts the gender of survey respondents. It is impossible to ensure that the actual driver of the auto observed in the field will respond to the survey if more than one person in the house commutes to work. Therefore, we ask that the survey be filled out by the person in the house who commutes most often.

Figure 5.3: Gender of Respondents.

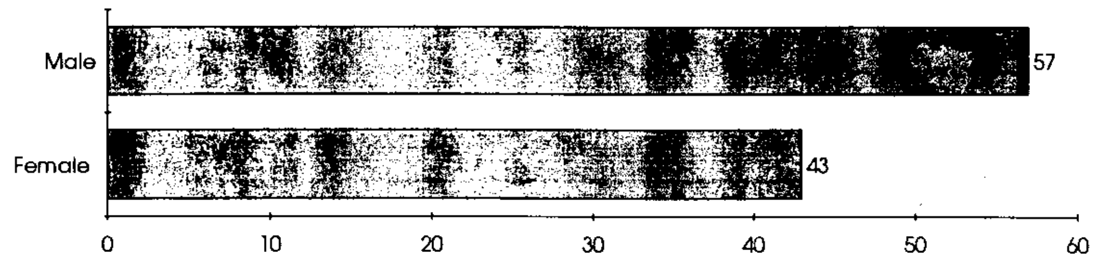
FIGURE 5.3 BOX TEXT: The number of female respondents supports data that show that women participate in the work force at a high rate.

Figure 5.4 shows the age distribution of respondents.

Figure 5.4: Age of Respondents.

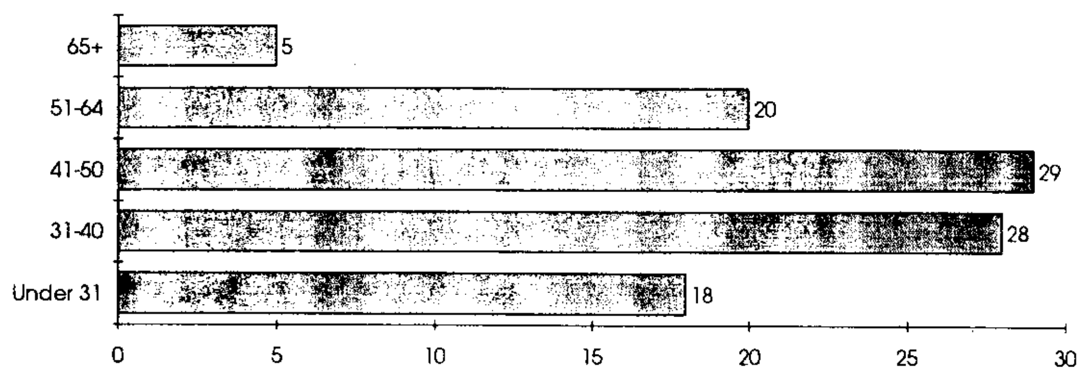
FIGURE 5.4 BOX TEXT: Almost 100 respondents are age 65 years or older. Unless there is a great discrepancy between the drivers actually observed in the field and the people who end up receiving surveys, this information supports data showing that many drivers on the road during peak hours are not commuters. It also indicates that people over age 65 years are still participating in the work force.

Figure 5.3: Gender of Respondents



Percentage (N = 1748)

Figure 5.4: Age of Respondents



Percentage (N = 1745)

Figure 5.5 provides information on the educational level of respondents.

Figure 5.5: Education Level of Respondents

FIGURE 5.5 BOX TEXT: 69 percent of survey respondents have a college degree or post-graduate education. People with a relatively high level of education may be more inclined to respond to surveys than are those with less education. This may also have implications for the population-wide level of support for HOV lanes if more educated people are predisposed to favor HOV lanes.

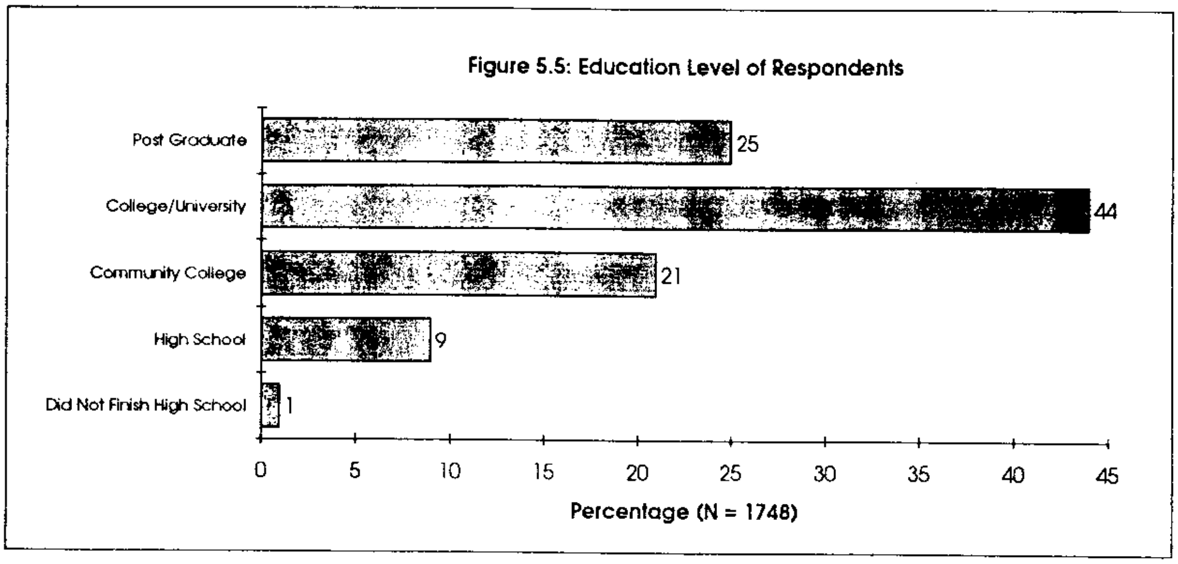


Figure 5.5: Education Level of Respondents
Post Graduate
College/University
Community College
High School
Did Not Finish High School
25
44
21
9
1
0
5
10
15
20
25
30
35
40
45
Percentage (N = 1748)

The public opinion survey asks respondents to provide information on their domestic conditions, including the number of people living in the household, the number working outside the home, and the number of vehicles owned by residents. Table 5.1 shows the most common clusters of domestic conditions for survey respondents.

TABLE 5.1 BOX TEXT: Households with two wage earners are the most frequent. None of the cases described contain an instance where there are fewer vehicles at a household than people who work outside the home. In fact, only twelve percent of respondents who regularly rideshare live in households where there are fewer vehicles than people who work outside the house.

Table 5.1: Domestic Conditions of Respondents

Domestic Conditions	Number	Percentage
2 people living in house No people under 15 years of age 2 people working outside house 2 vehicles	**355**	**20.2**
1 person living in house No people under 15 years of age 1 person working outside house 1 vehicle	**133**	**7.6**
3 people living in house 1 person under 15 years of age 2 people working outside house 2 vehicles	**111**	**6.2**
2 people living in house No people under 15 years of age 2 people working outside house 3 vehicles	**110**	**6.2**
4 people living in house 2 people under 15 years of age 2 people working outside house 2 vehicles	**107**	**6.1**
2 people living in house No people under 15 years of age 1 person working outside house 2 vehicles	**96**	**5.5**
3-4 people living in house 1 person under 15 years of age 3 people working outside house 3 vehicles	**89**	**5.1**
4-5 people living in house 2-3 people under 15 years of age 1 person working outside house 2 vehicles	**83**	**4.7**
Other/No response	**677**	**38.4**
Total	**1,761**	**100.0**

Figure 5.6 shows the normal commute routes for survey respondents. Originally, the commute route was determined by the highway corridor in which motorists were observed. This designation could then be used to measure sub-regional differences in opinion about HOV lanes. However, many respondents were observed in locations outside their normal commute routes or had commute routes that included more than one traffic observation corridor. To best analyze sub-regional differences in opinion, the commute route information is broken down into categories containing complete information on the commute route and other travel during peak hours. Twelve major commute routes, defined as having more than 60 respondents, emerged. Data for all 12 routes are shown in Figure 5.6.

Figure 5.6: Normal Commute Route.

FIGURE 5.6 BOX TEXT: This chart may be misleading in that the I-5 Central corridor has only seven percent of the surveyed commuters regularly using that corridor. However, by adding all routes that have I-5 Central as part of the regular commute route, it becomes clear that corridor is used by thirty percent of this sample's commuters.

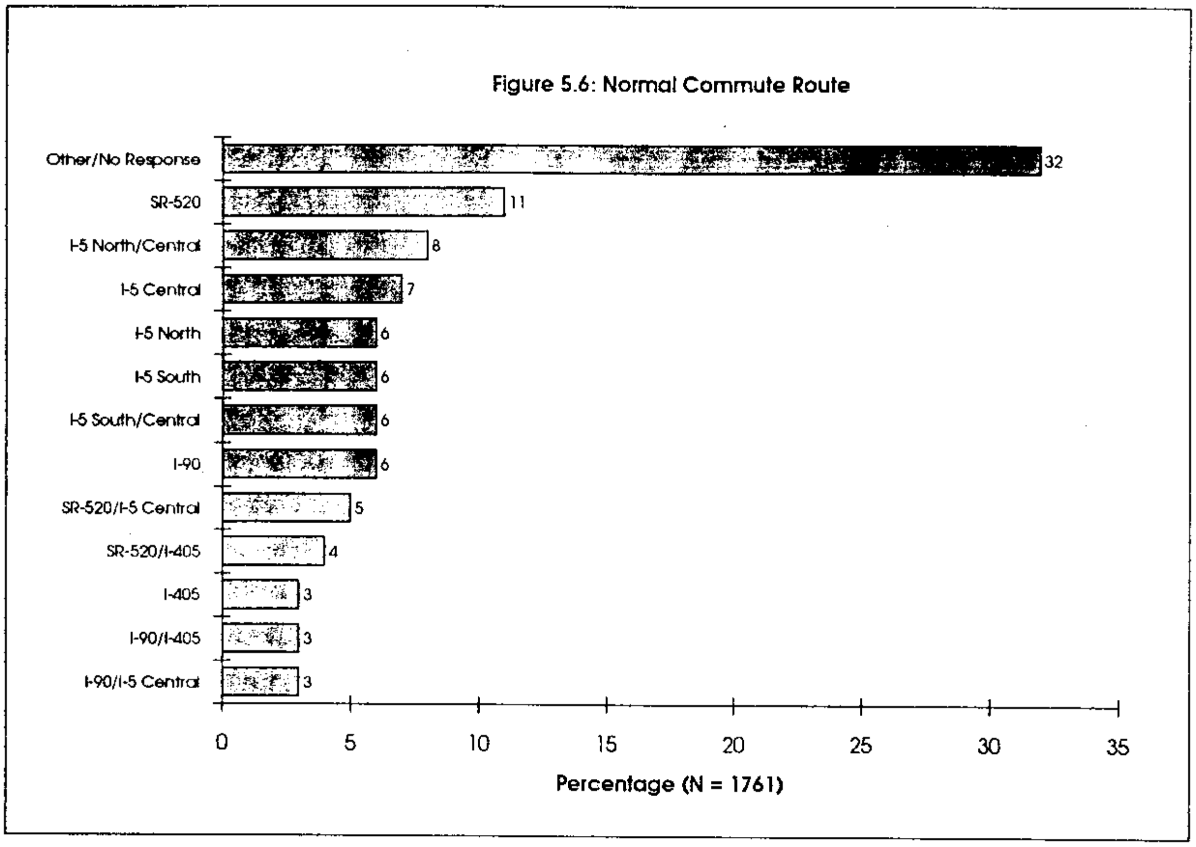


Figure 5.6: Normal Commute Route
Other/No Response
SR-520
I-5 North/Central
I-5 Central
I-5 North
I-5 South
I-5 South/Central
I-90
SR-520/I-5 Central
SR-520/I-405
I-405
I-90/I-405
I-90/I-5 Central
32
11
8
7
6
6
6
6
5
4
3
3
3
0
5
10
15
20
25
30
35
Percentage (N = 1761)

Traveler Commute Trip

Figure 5.7 shows the actual commute modes of survey respondents. For the purposes of later data analysis, the 2 Person Carpool, 3+ Person Carpool, Bus, Vanpool, and Motorcycle responses are combined into a "Rideshare" category. Motorcycles are added to the Rideshare category because these vehicles are allowed to use HOV lanes.

Figure 5.7: Commute Mode

FIGURE 5.7 BOX TEXT: Again, despite attempts to generate comparable samples of HOV and SOV drivers, SOVs far outweigh those who rideshare. Ten percent of respondents cited a commute mode other than driving alone or carpooling. This underscores the frequency with which special circumstances alter individuals' travel behavior.

Figures 5.8 and 5.9 provide information on past use of HOV lanes. Respondents are asked to indicate which HOV lanes they have used and their driving mode while using them. The total of the percentages exceeds 100 because respondents are asked to indicate all options that apply to their past use of HOV lanes -- individual drivers may have used HOV lanes in more than one mode and in more than one highway corridor.

Figure 5.8: Past Use of HOV Lanes: Travel Mode

FIGURE 5.8 BOX TEXT: The high number of respondents who report having used HOV lanes in 2-Person and 3+-Person carpools suggests that HOV lanes may be popular during the work week when employees must commute together for special circumstances. It is also possible that families use HOV lanes occasionally for weekend traveling. Thirty-two percent of respondents claim to have used HOV lanes on a bus, while only five percent say they commute by bus regularly (Figure 5.6).

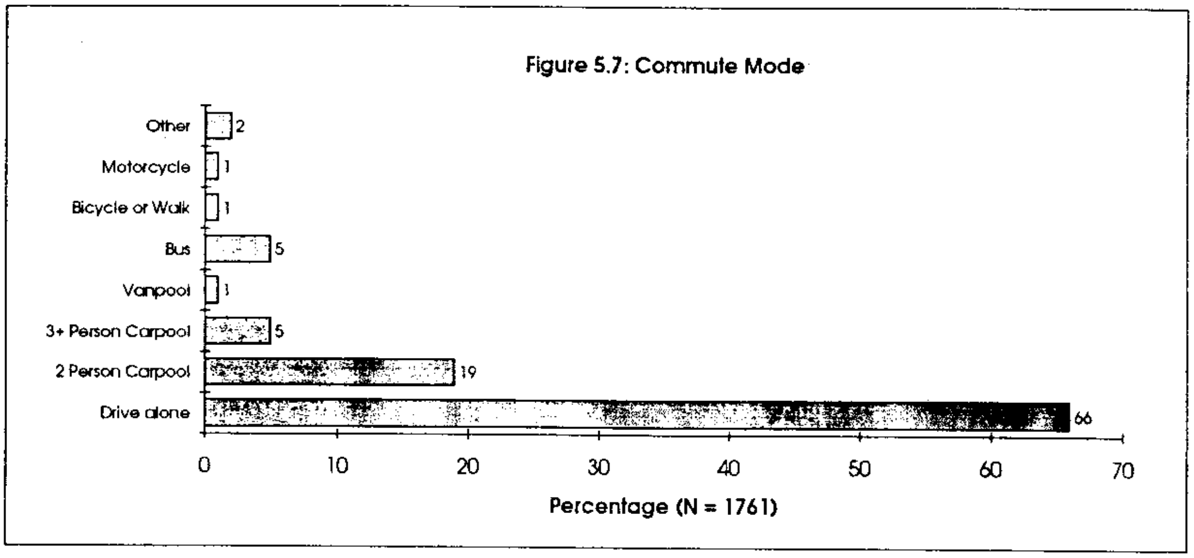


Figure 5.7: Commute Mode
Other
Motorcycle
Bicycle or Walk
Bus
Vanpool
3+ Person Carpool
2 Person Carpool
Drive alone
2
1
1
5
1
5
19
66
0
10
20
30
40
50
60
70
Percentage (N = 1761)

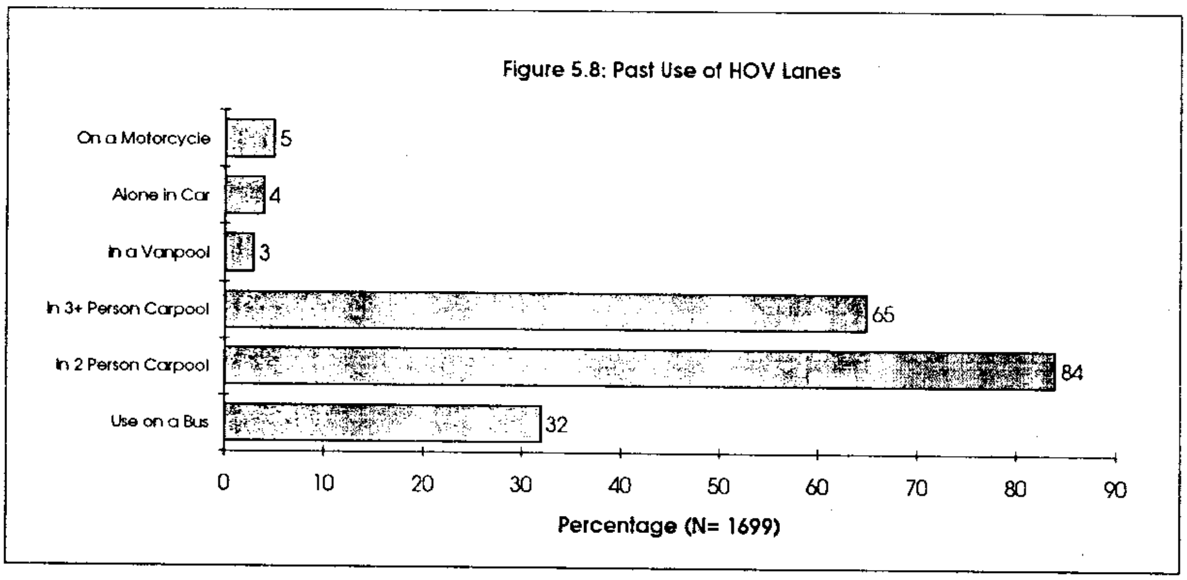


Figure 5.8: Past Use of HOV Lanes
On a Motorcycle
Alone in Car
In a Vanpool
In 3+ Person Carpool
In 2 Person Carpool
Use on a Bus
5
4
3
65
84
32
0
10
20
30
40
50
60
70
80
90
Percentage (N= 1699)

Figure 5.9: Past Use of HOV Lanes

FIGURE 5.9 BOX TEXT: The high frequency of drivers who have used HOV lanes on I-405 may be explained by the fact that I-405 drivers received more surveys than did drivers on any other highway corridor. I-405 traffic volumes are also heavy throughout the week, which may induce more HOV lane use. Central I-5 has a surprisingly low total, possibly because the HOV lane underneath the Convention Center had been designated as a 3+ HOV lane until September, 1993.

Figures 5.10 and 5.11 show the number of respondents who qualified for HOV lane use, but chose not to use the lanes, and the reasons for this choice. Data for Figure 5.11 represent single instances in which respondents chose not to use HOV lanes. Respondents are asked to check all conditions that have kept them from using HOV lanes when they have been to eligible use them. These questions have been modified as of February 1994, to cover peak periods only.

Figure 5.10: Qualification for HOV Lane Use and Outcome

FIGURE 5.10 BOX TEXT: This figure shows that a significant number of drivers chose not to use HOV lanes even when they met vehicle occupancy requirements. This may be because the question is universal, asking whether drivers ever qualify to use HOV lanes, as opposed to whether they qualify during peak hours.

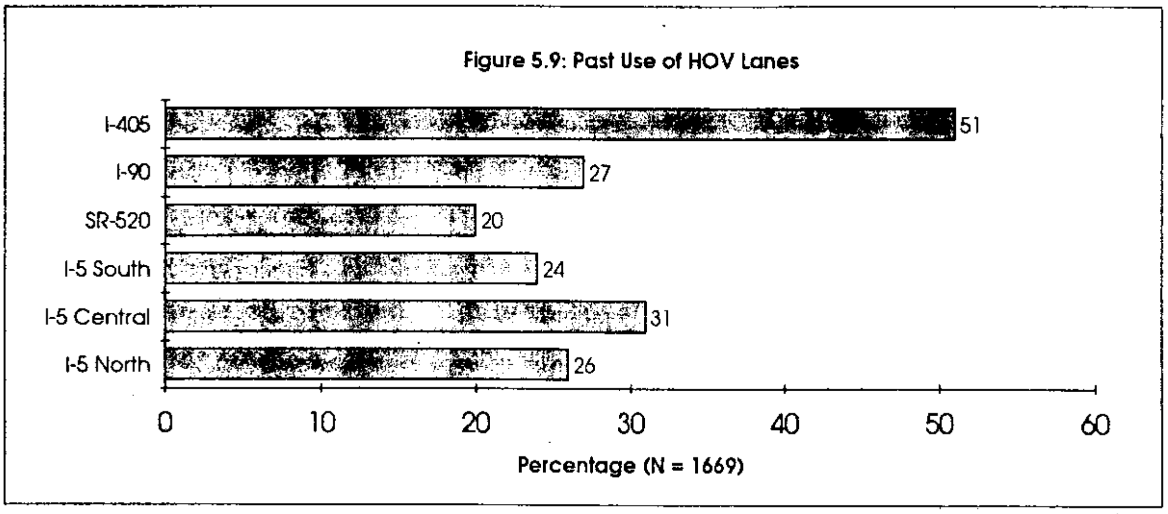


Figure 5.9: Past Use of HOV Lanes

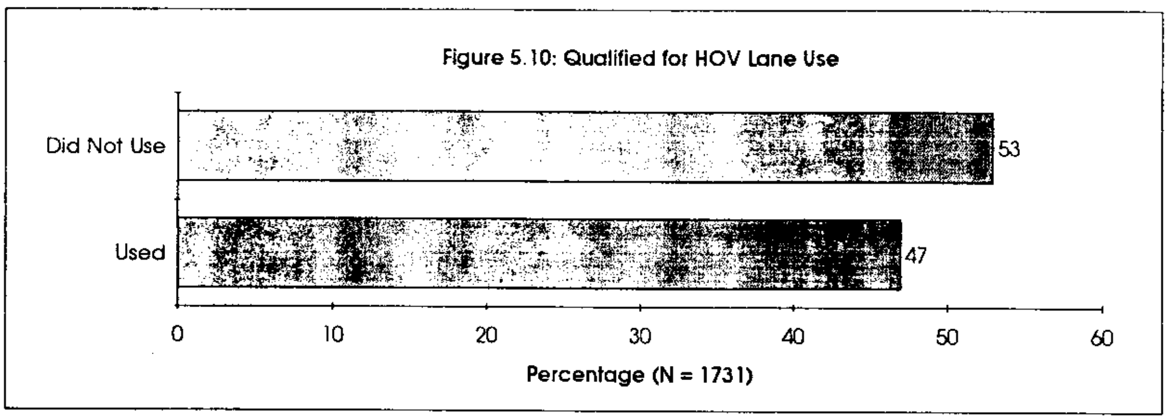


Figure 5.10: Qualified for HOV Lane Use

Figure 5.11: Reason HOV Lanes Not Used

FIGURE 5.11 BOX TEXT: Selection of "All traffic moves fast enough" predominates because this question was not limited to the peak-hour commute period. Some HOV lanes, such as the lane on I-5 southbound at Southcenter Hill, were built to alleviate congestion bottlenecks during commute hours. As the HOV lane system is completed, it will be interesting to track opinion on this question over time to see whether the travel time savings provided by longer HOV lanes attract more carpoolers.

Traveler Opinions

Figure 5.12 shows combined HOV and SOV responses for a set of options to improve the attractiveness of using HOV lanes. Because respondents are asked to check three of seven options, the number of responses exceeds the number of overall survey responses.

Figure 5.12: Options to Improve HOV Lane Usage.

FIGURE 5.12 BOX TEXT: Except for the HOV lane on SR-520, all HOV lanes on freeways in the Puget Sound area are now designated as 2+. This was not the case during the 1992-93 data collection period. Completing the HOV lane system is an attractive option because motorists may feel that substantial travel time savings will only be possible when they can use a single HOV lane throughout their trip. Enforcement and safety concerns appear to outweigh transportation demand management measures such as employer subsidies for ridesharing and additional Park & Ride lots. This may be because respondents are unsure of the effectiveness of these measures, compared to the readily identifiable benefits attributable to increased enforcement and safety.

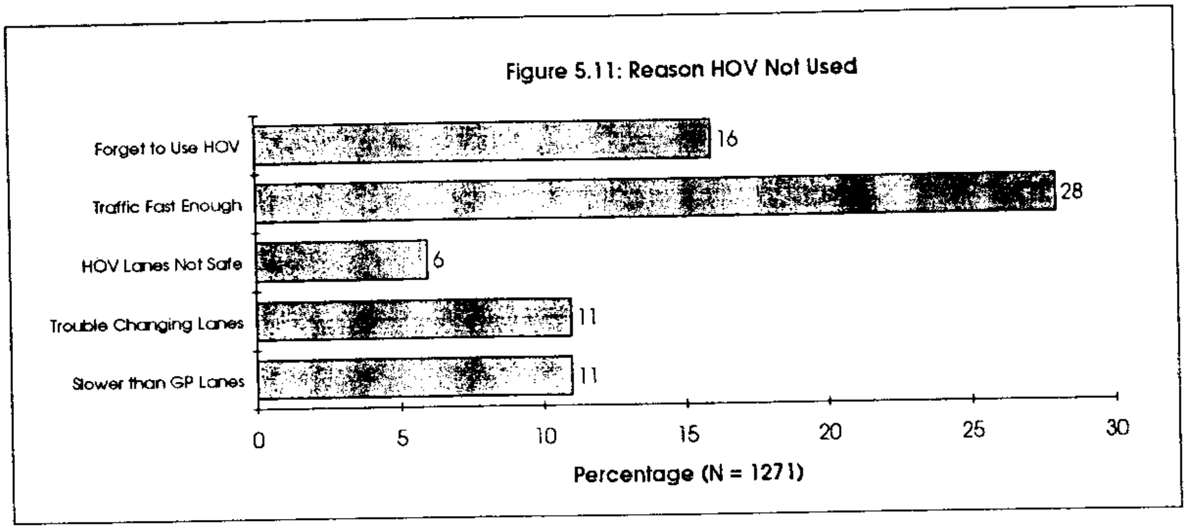


Figure 5.11: Reason HOV Not Used
Forget to Use HOV
Traffic Fast Enough
HOV Lanes Not Safe
Trouble Changing Lanes
Slower than GP Lanes
16
28
6
11
11
0
5
10
15
20
25
30
Percentage (N = 1271)

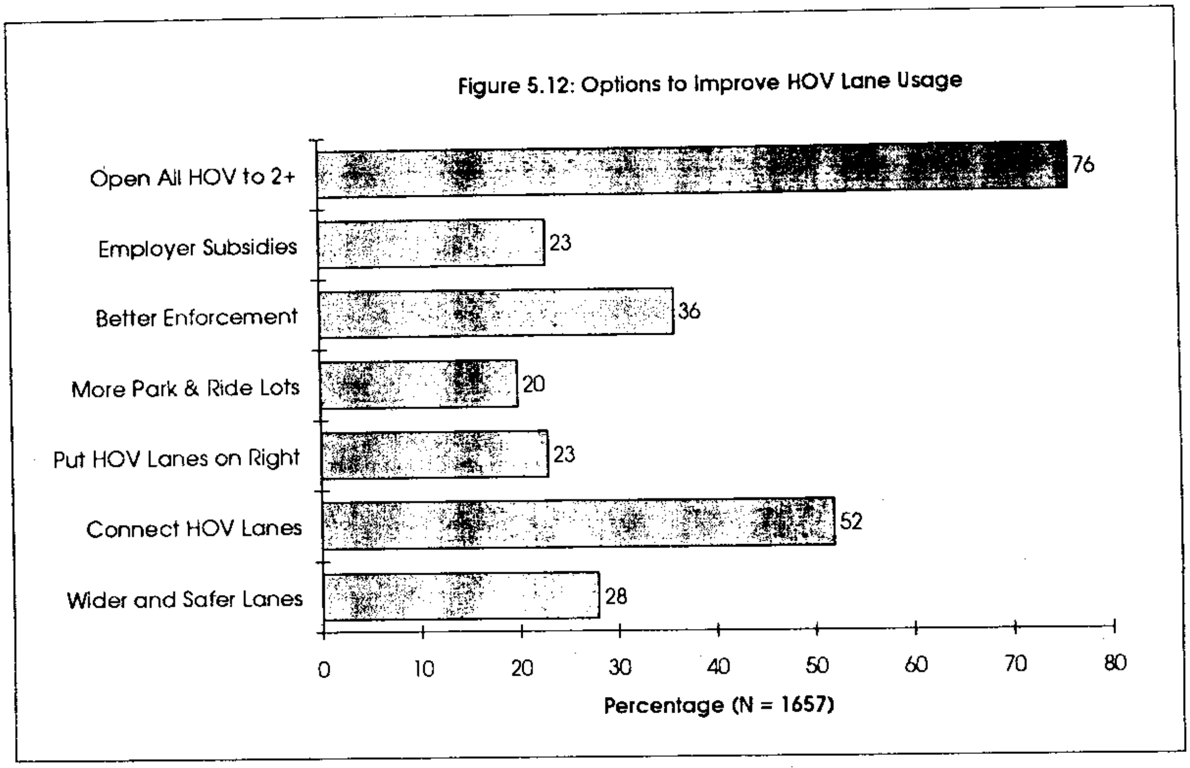


Figure 5.12: Options to Improve HOV Lane Usage
Open All HOV to 2+
Employer Subsidies
Better Enforcement
More Park & Ride Lots
Put HOV Lanes on Right
Connect HOV Lanes
Wider and Safer Lanes
76
23
36
20
23
52
28
0
10
20
30
40
50
60
70
80
Percentage (N = 1657)

The data presented in Figure 5.12 are broken down by commute mode in Figures 5.13 through 5.19. The number of responses for Figures 5.13 through 5.19 is 1,101 SOV and 556 HOV, for a total of 1,657. A p-value, representing statistical significance, is also provided for each question. A p-value of .05 or less represents statistically significant differences of opinion between HOV and SOV groups.

Options to Improve HOV Lane Usage

For Figures 5.13 through 5.19, the number of responses is 556 for HOVs and 1101 for SOVs.

Figure 5.13: Wider and Safer Lanes

FIGURE 5.13 BOX TEXT: Carpoolers have more experience using HOV lanes than do SOV drivers. This may explain HOV drivers greater support for wider and safer lanes. However, making HOV lanes safer does not appear to be a high priority for either the HOV group or the SOV group.

Figure 5.14: Connect Existing HOV Lanes With Other HOV Lanes

FIGURE 5.14 BOX TEXT: Drivers in both groups support this option. Finishing the HOV lane system would benefit people who already carpool, as well as providing a more compelling incentive for SOV drivers to start ridesharing.

Figure 5.15: Place HOV Lanes on the Right Side of the Freeway Instead of the Left Side

FIGURE 5.15 BOX TEXT: HOV lanes on the right appear to exacerbate merging problems for entering traffic during the peak hours. Support for this option may be because of the perception that HOV traffic travels too fast when the lanes are on the left side or that merging across the entire freeway is too difficult to justify HOV lane use.

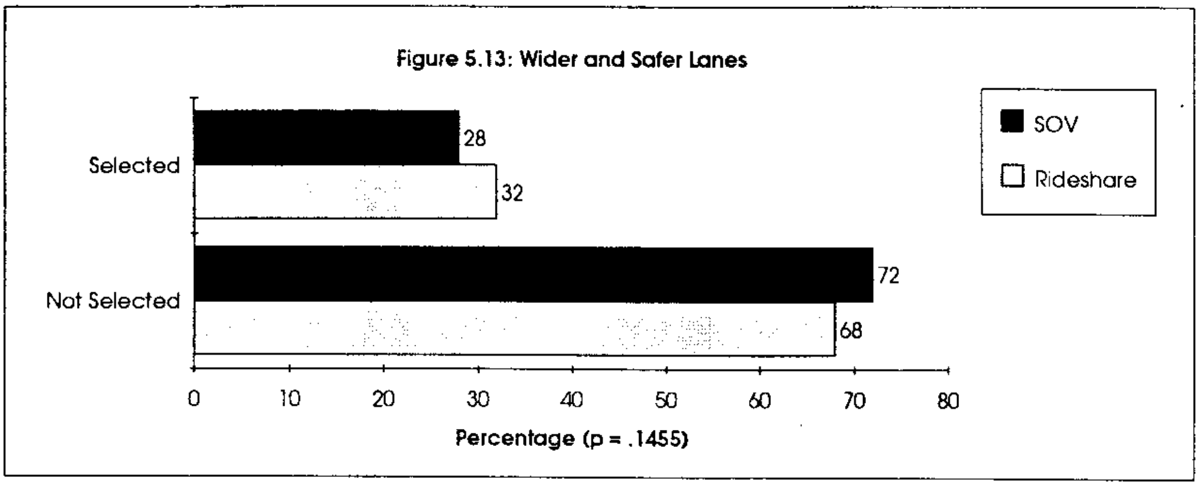


Figure 5.13: Wider and Safer Lanes
SOV
Rideshare
Selected
Not Selected
28
32
72
68
0
10
20
30
40
50
60
70
80
Percentage (p = .1455)

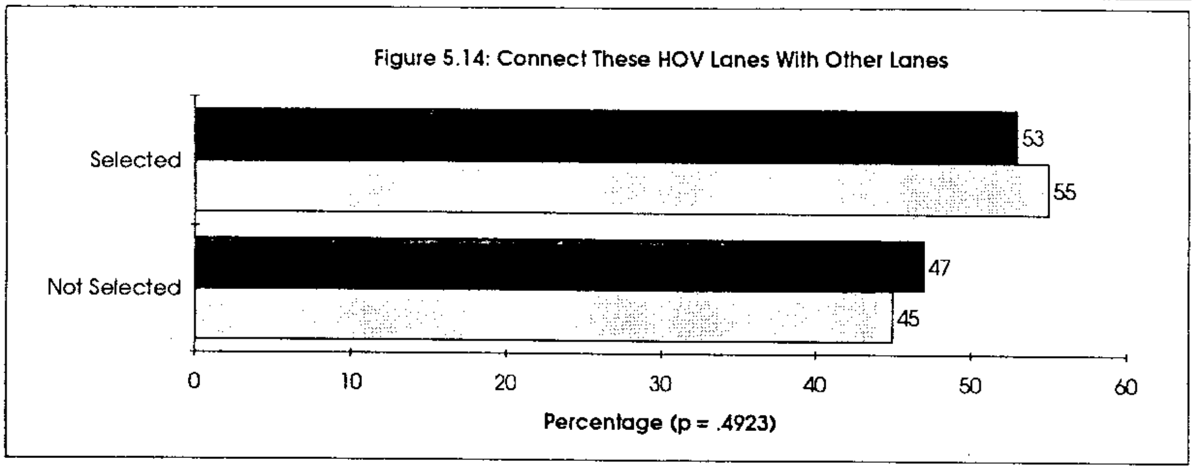


Figure 5.14: Connect These HOV Lanes With Other Lanes
Selected
Not Selected
53
55
47
45
0
10
20
30
40
50
60
Percentage (p = .4923)

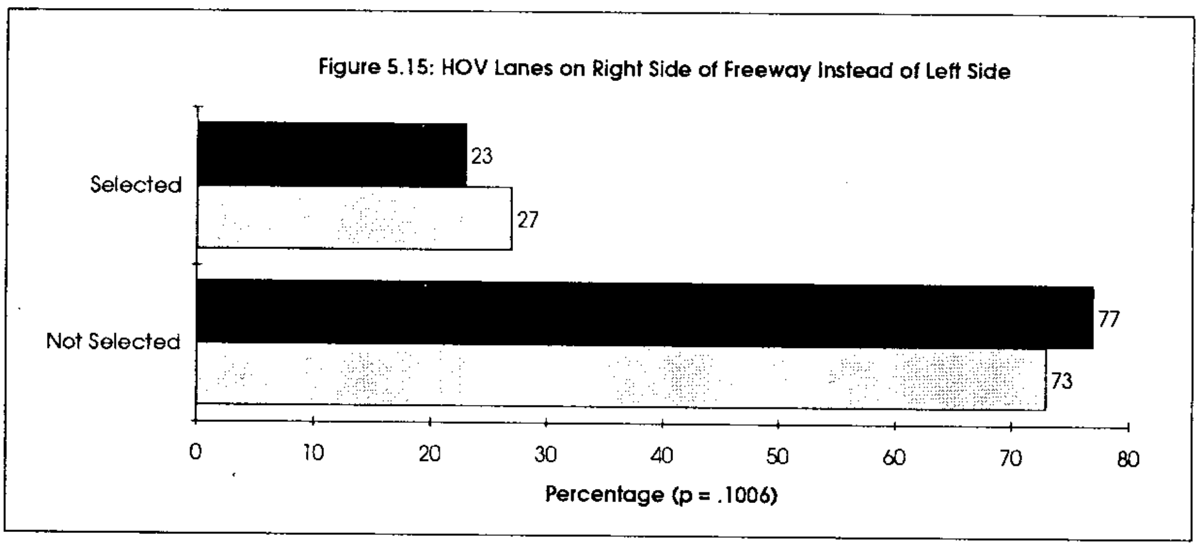


Figure 5.15: HOV Lanes on Right Side of Freeway Instead of Left Side
Selected
Not Selected
23
27
77
73
0
10
20
30
40
50
60
70
80
Percentage (p = .1006)

Table 5.2 breaks down support for HOV lanes on the right side of the freeway by commute route. Of interest here is whether commuters who drive on routes with outside HOV lanes support that configuration more than other drivers do. The mixed results are depicted in Table 5.2. Drivers who regularly use SR-520 support HOV lanes on the right side much more than do other drivers. Drivers who regularly use I-405 (which features HOV lanes on both the right and left sides of the highway) do not support the proposal to build new HOV lanes on the right. Also interesting is the difference in opinion between drivers on I-5 North and I-5 South. While both groups usually use highways with HOV lanes only on the left, I-5 South commuters support HOV lane construction on the right side of the freeway almost twice as much as do I-5 North drivers.

Table 5.2: Support for HOV Lanes on the Outside by Commute Route
(HOV and SOV groups combined, p=.007)

Commute Route	Percent Selected	Percent Not Selected	Total
I-5 North	17	83	112
I-5 Central	18	82	122
I-5 North/I-5 Central	18	82	153
I-5 South	32	68	114
I-5 South/Central	32	68	102
I-90	24	76	124
I-405	19	81	59
I-90/I-405	16	84	55
I-90/I-5 Central	16	84	51
SR-520	30	70	189
SR-520/I-5 Central	32	68	91
SR-520/I-405	23	77	64
Other/No Response	26	74	525
Total	**25**	**75**	**1761**

Figure 5.16: Adding Park & Ride Lots Near Freeway Entrances and Exits

FIGURE 5.16 BOX TEXT: SOV drivers are more supportive of this option than are their ridesharing counterparts. Park & Ride lots may not be considered as a place to assemble carpools as much as they are considered a place to catch the bus.

Figure 5.17: Better Police Enforcement Against Violators

FIGURE 5.17 BOX TEXT: All drivers appear sensitive to violations when they see people abusing a special privilege--moving ahead while other drivers remain in bumper-to-bumper traffic. The p-value of .10 shows some difference in opinion between HOV and SOV drivers, but not a strong one.

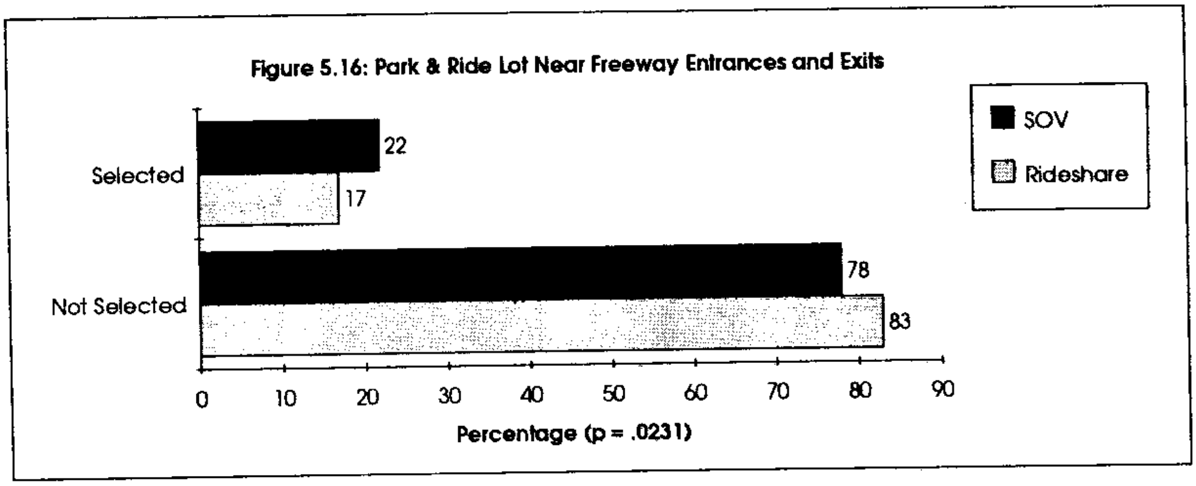


Figure 5.16: Park & Ride Lot Near Freeway Entrances and Exits
SOV
Rideshare
Selected
22
17
Not Selected
78
83
0
10
20
30
40
50
60
70
80
90
Percentage (p = .0231)

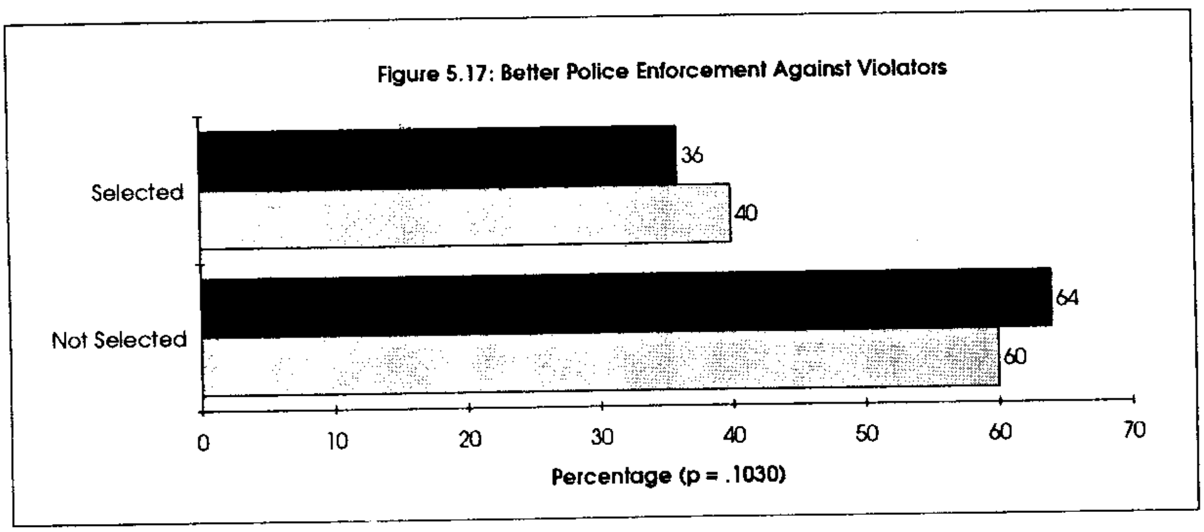


Figure 5.17: Better Police Enforcement Against Violators
Selected
36
40
Not Selected
64
60
0
10
20
30
40
50
60
70
Percentage (p = .1030)

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Figure 5.18: Employer Subsidies for Bus Passes or Parking for Carpoolers

FIGURE 5.18 BOX TEXT: People who rideshare as opposed to SOV drivers may find this option more effective because they would benefit from such subsidies. The low frequency of selection of this option among both groups may indicate that drivers do not feel that rideshare inducements are very effective.

Figure 5.19: Open All HOV Lanes to 2-Person Carpools

FIGURE 5.19 BOX TEXT: A clear majority of all motorists supports this option. However, 24 percent of ridesharers do not. Part of the reason HOV drivers withhold support for this option is that they may feel that opening all HOV lanes to 2+ carpools may create congestion in currently uncongested carpool lanes.

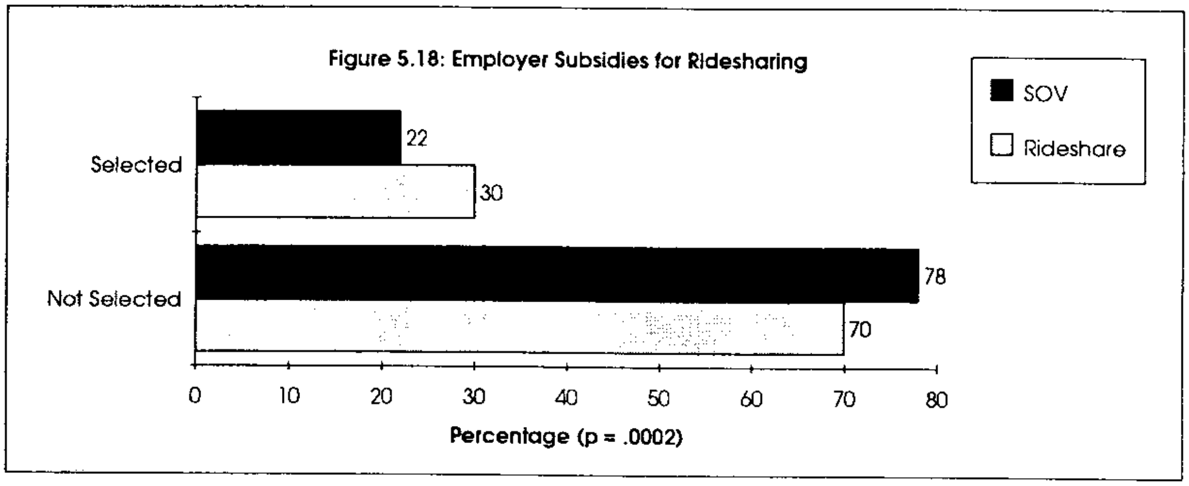
Figure 5.18: Employer Subsidies for Ridesharing
SOV
Rideshare
Selected
22
30
Not Selected
78
70
0
10
20
30
40
50
60
70
80
Percentage (p = .0002)

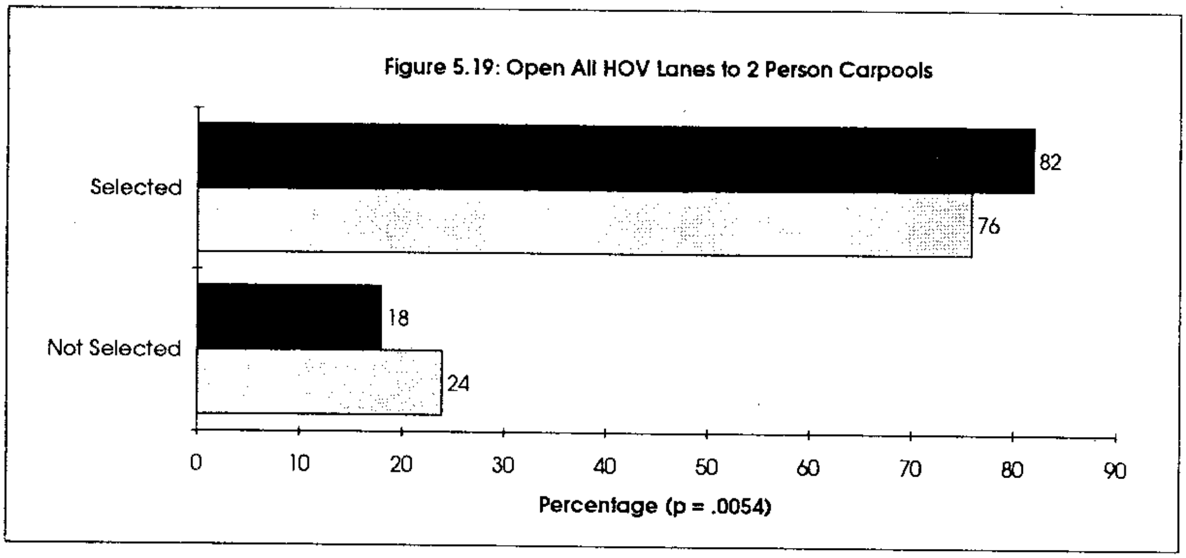
Figure 5.19: Open All HOV Lanes to 2 Person Carpools
Selected
82
76
Not Selected
18
24
0
10
20
30
40
50
60
70
80
90
Percentage (p = .0054)

Figures 5.20 through 5.32 present data for questions regarding motorists' opinions on a variety of issues regarding HOV lane use and effectiveness. The responses are broken down by normal commute mode and by the degree to which respondents agree with individual assertions. Sample sizes for both HOV and SOV groups are provided for each question. The exact wording of each question is provided in the figure titles.

It is important to note that in most cases, both HOV and SOV drivers tend to share the same basic opinions on issues relating to HOV lane effectiveness. When both groups tend to agree in general, the differences in opinion among HOV and SOV drivers are frequently based on the degree of support for or opposition to a particular issue. The most notable exception to this trend is when an issue concerns mode choice and the impact of HOV lanes on congestion reduction.

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Figure 5.20: HOV Lanes Are a Good Idea

FIGURE 5.20 BOX TEXT: 87 percent of all drivers either support or strongly support HOV lanes. While SOV drivers do not reap much benefit from HOV lanes, they may support them as a step toward the reduction of traffic congestion and air pollution.

Figure 5.21: Vehicles Dart in and Out of HOV Lanes Too Often for the Lanes to be Safe.

FIGURE 5.21 BOX TEXT: While the opinions of both HOV and SOV drivers are basically similar on this issue, some differences exist. HOV drivers may feel safer on HOV lanes because they have more experience driving on them. These drivers may also be unwilling to express something negative about HOV lanes.

Figure 5.20: HOV Lanes Are a Good Idea

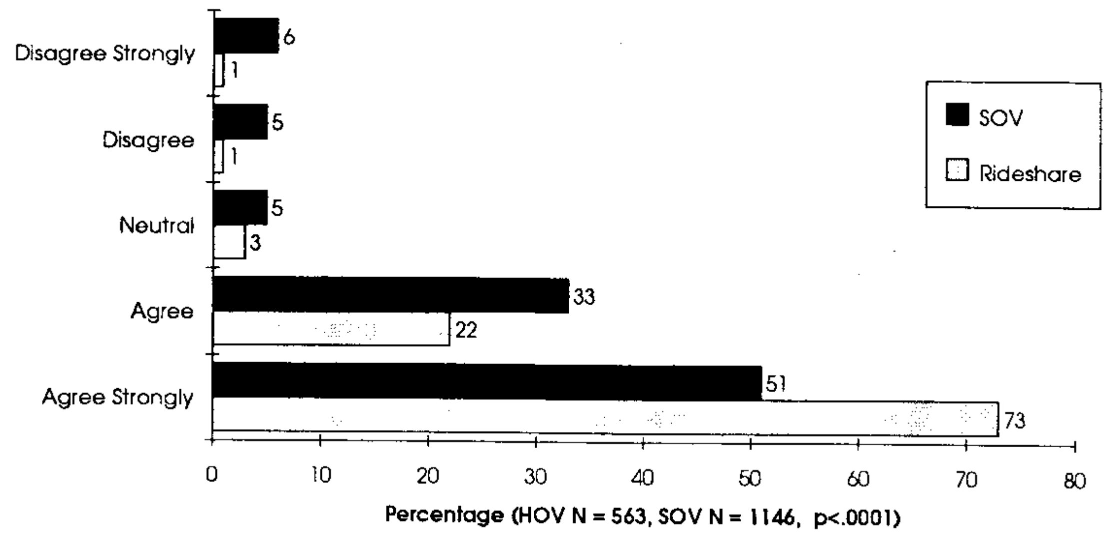

Figure 5.21: Vehicles Dart In and Out of HOV Lanes Too Often for the Lanes to be Safe

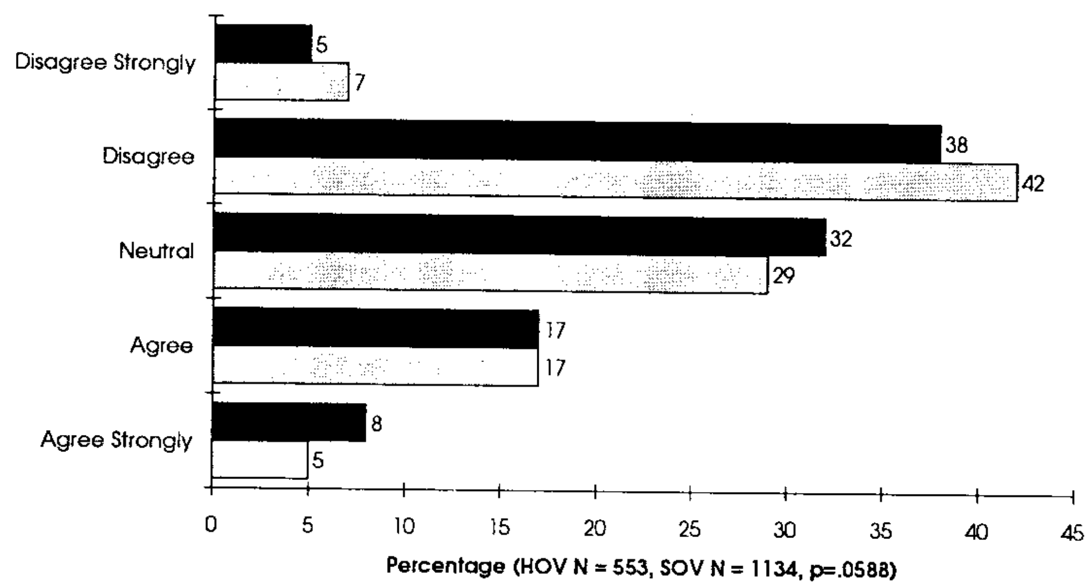

Figure 5.22: HOV Lanes Help Save All Commuters a Lot of Time.

FIGURE 5.22 BOX TEXT: The significant difference of opinion on the travel time issue may exist because SOV drivers frequently sit in traffic at bottlenecks while drivers in HOV lanes move by quickly. Similarly, HOV drivers may feel an inflated sense of contribution to congestion reduction by virtue of their carpooling. The intensity of the question, "saving ALL commuters A LOT of time," may reduce support of this key measure of HOV lane effectiveness. While there are significant differences in opinion on this issue, 47 percent of SOV drivers support the proposition.

Figure 5.23: Constructing HOV Lanes is Unfair to Taxpayers Who Choose to Drive Alone

FIGURE 5.23 BOX TEXT: This chart shows the extent to which proprietary interest shapes opinion. HOV drivers see mode choice as just that--a choice. While a majority of SOV drivers disagree with the proposition, 17 percent see no benefit to themselves resulting from HOV lane construction.

Figure 5.22: HOV Help Lanes Save All Commuters a Lot of Time

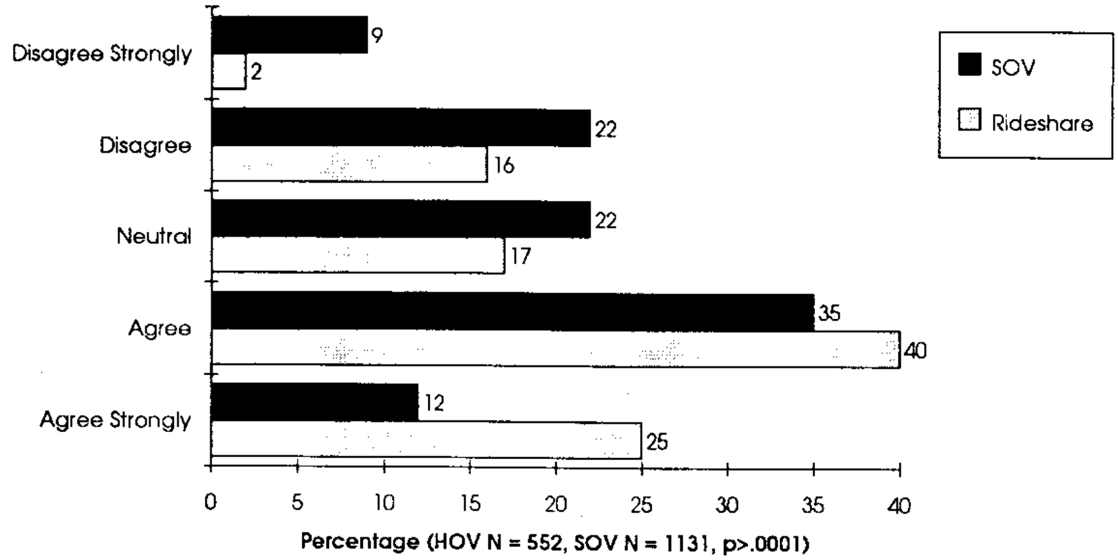

Figure 5.23: Constructing HOV Lanes is Unfair to Taxpayers Who Choose to Drive Alone

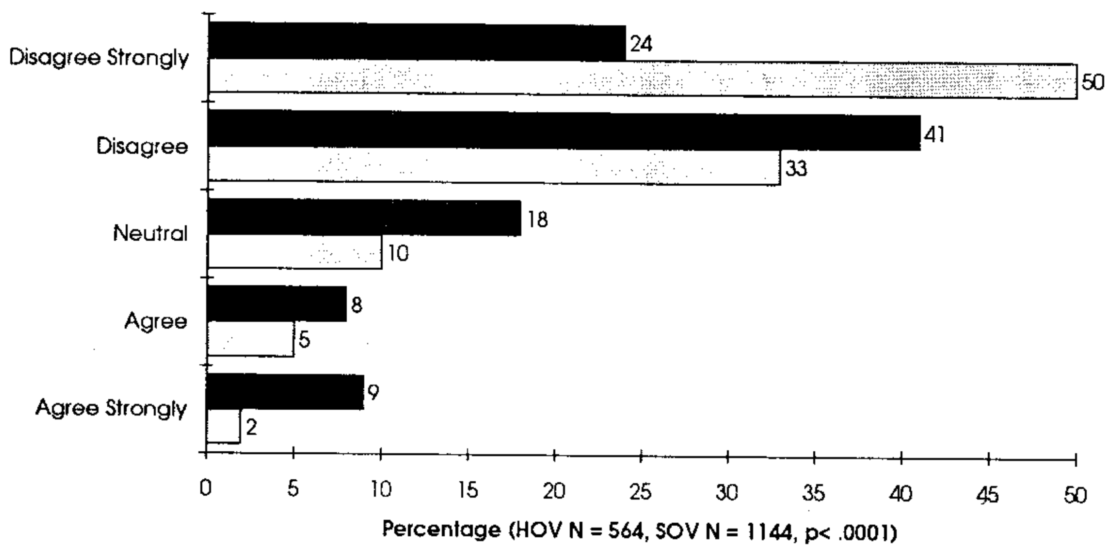

Figure 5.24: Existing HOV Lanes are Being Adequately Used.

FIGURE 5.24 BOX TEXT: Some HOV drivers may feel that HOV lanes are either at capacity or are approaching that point. However, SOV drivers tend to pay attention to long gaps between moving cars in HOV lanes while they are stuck in traffic. Overall, 52 percent of respondents disagree that HOV lanes are adequately used; 22 percent are neutral on this point.

Figure 5.25: HOV Violators Commit a Serious Traffic Violation.

FIGURE 5.25 BOX TEXT: These results suggest that SOV drivers place a lower priority on HOV lane enforcement than do HOV drivers. Even so, both groups appear to resent the fact that HOV lane violators are unwilling to sit in traffic like everyone else. Drivers may feel that HOV violators create safety hazards as well.

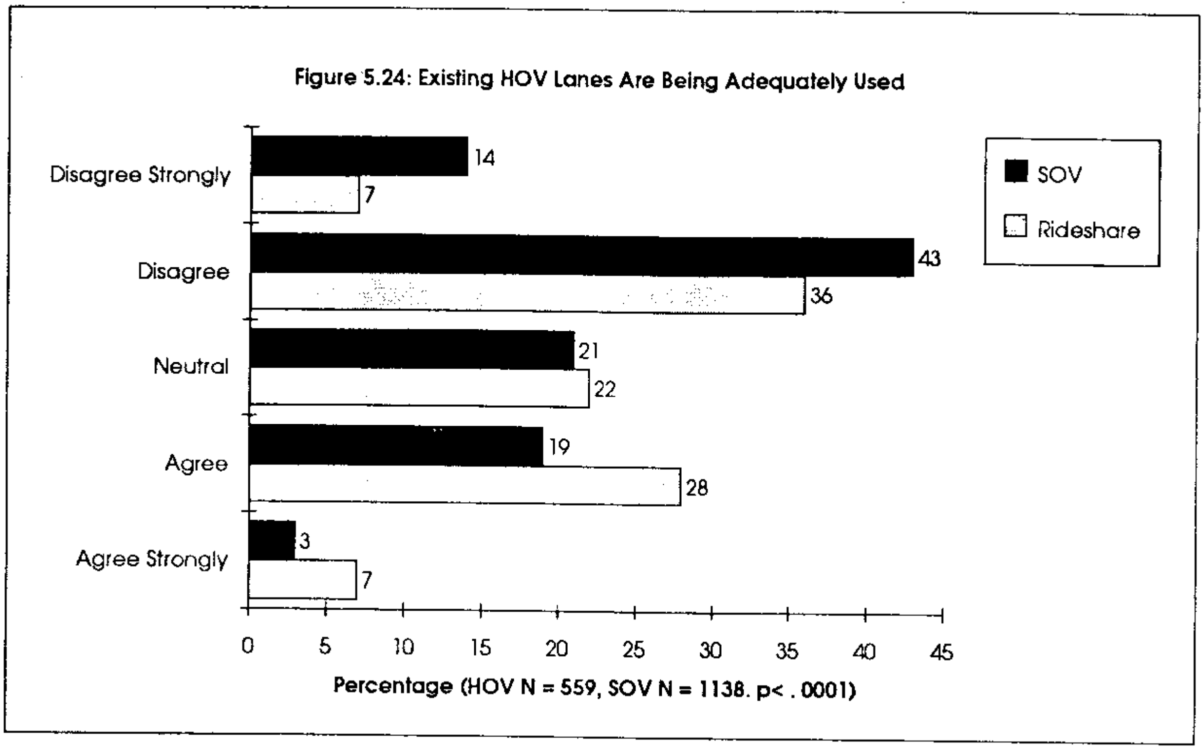
Figure 5.24: Existing HOV Lanes Are Being Adequately Used
Disagree Strongly
Disagree
Neutral
Agree
Agree Strongly
14
7
43
36
21
22
19
28
3
7
SOV
Rideshare
0
5
10
15
20
25
30
35
40
45
Percentage (HOV N = 559, SOV N = 1138. p< . 0001)

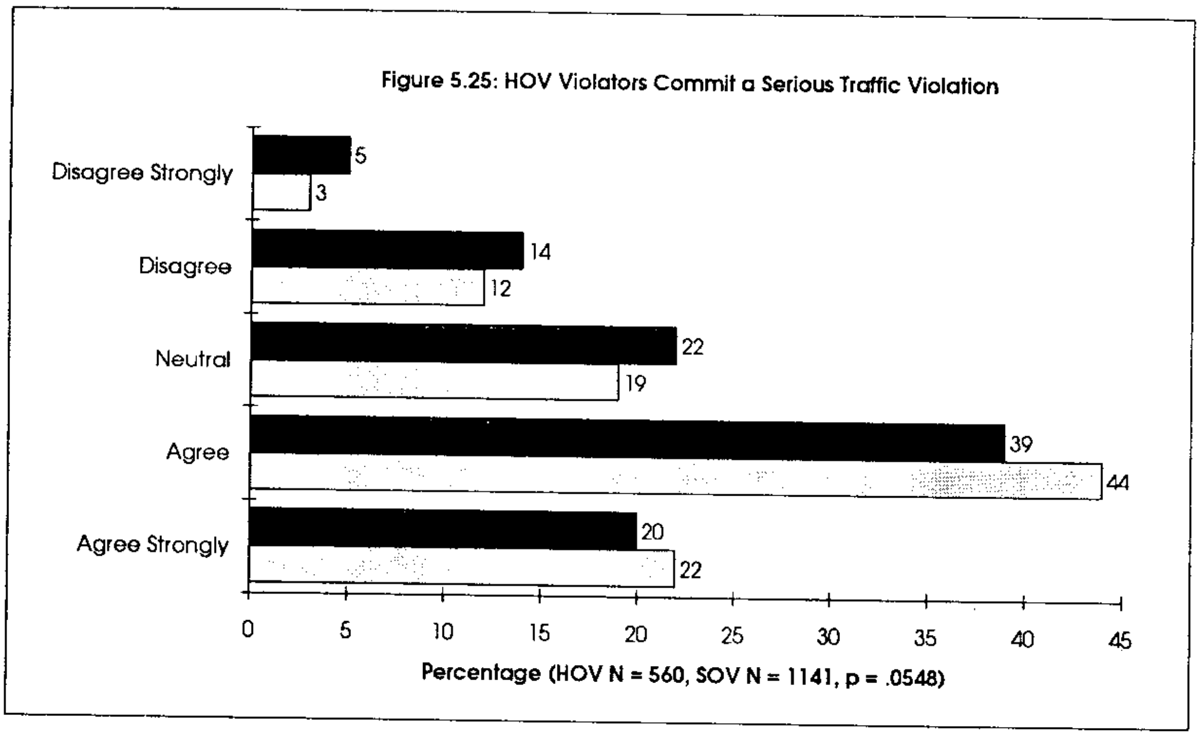
Figure 5.25: HOV Violators Commit a Serious Traffic Violation
Disagree Strongly
Disagree
Neutral
Agree
Agree Strongly
5
3
14
12
22
19
39
44
20
22
0
5
10
15
20
25
30
35
40
45
Percentage (HOV N = 560, SOV N = 1141, p = .0548)

Figure 5.26: HOV Violations are Common During the Commute Hours.

FIGURE 5.26 BOX TEXT: There are no clear differences in opinion on this issue. While there are many HOV violators during peak commute hours, some of those identified as violators are actually parents driving with small children. A number of survey respondents wrote in comments questioning whether children ought to be counted in determining vehicle occupancy. Overall, 59 percent of respondents agreed that violations are common during commute hours. This may explain why better enforcement was selected as a viable policy option for increasing the attractiveness of HOV lanes (Figure 5.12).

Figure 5.27: Many More People Would Carpool if the HOV Lanes Were More Widespread.

FIGURE 5.27 BOX TEXT: The high number of neutral responses, coupled with a low number of strongly agree and disagree responses, suggests some ambivalence among the population as a whole. SOV drivers may support the proposition less than do HOV drivers because they may see individual circumstances that rule out ridesharing, no matter how extensive the HOV lane network may be.

Figure 5.26: HOV Violations Are Common During the Commute Hours

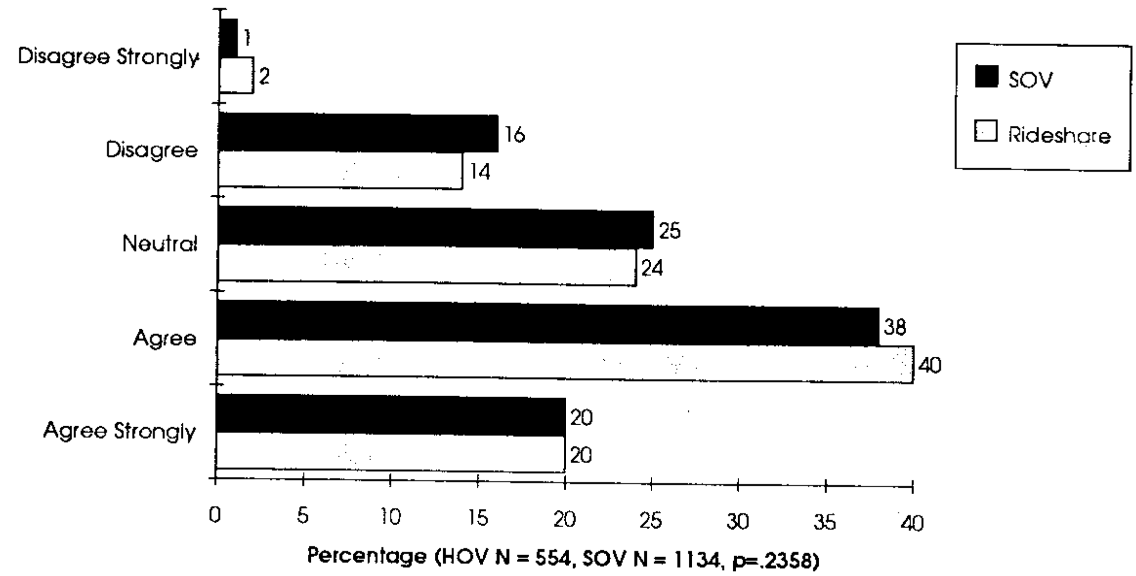

Figure 5.27: Many More People Would Carpool if HOV Lanes Were More Widespread

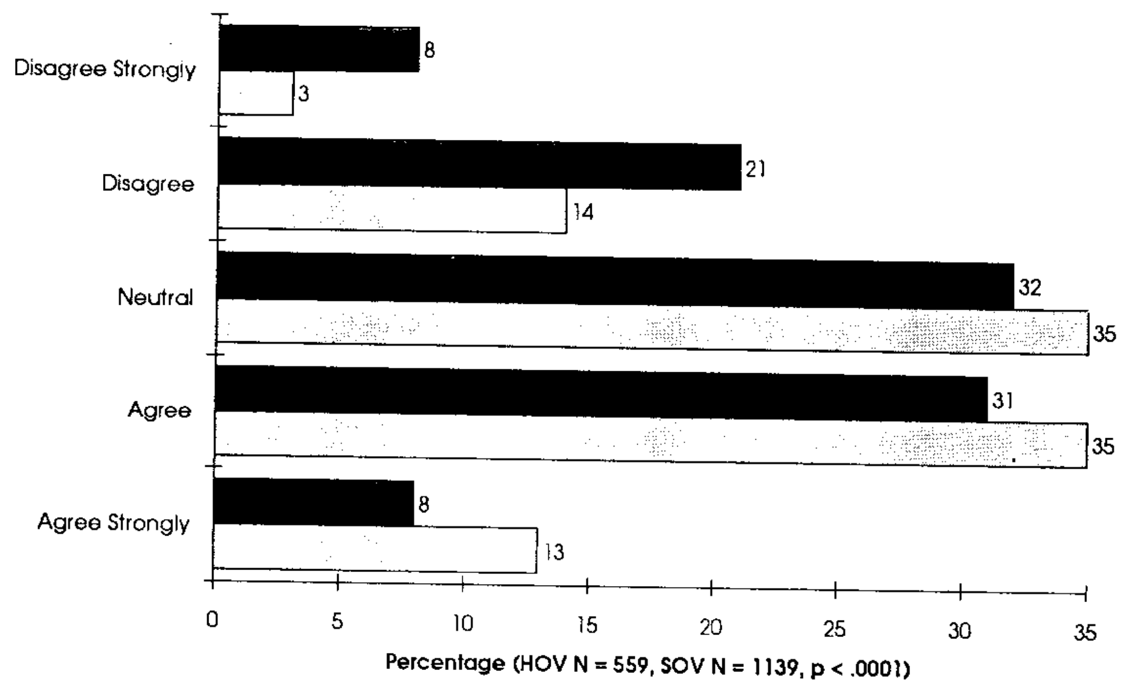

Figure 5.28: HOV Lanes Should be Opened to All Traffic.

FIGURE 5.28 BOX TEXT: 75 percent of all respondents disagree with this proposition. This means that a majority of all drivers think HOV lanes have some justification as a tool for reducing congestion and air pollution.

Figure 5.29: HOV Lanes are Convenient to Use.

FIGURE 5.29 BOX TEXT: Clear majorities of both groups find HOV lanes easy to use. The stronger support from the HOV group may be explained by the fact that those drivers are very familiar with HOV lane merges and with driving next to the median.

85

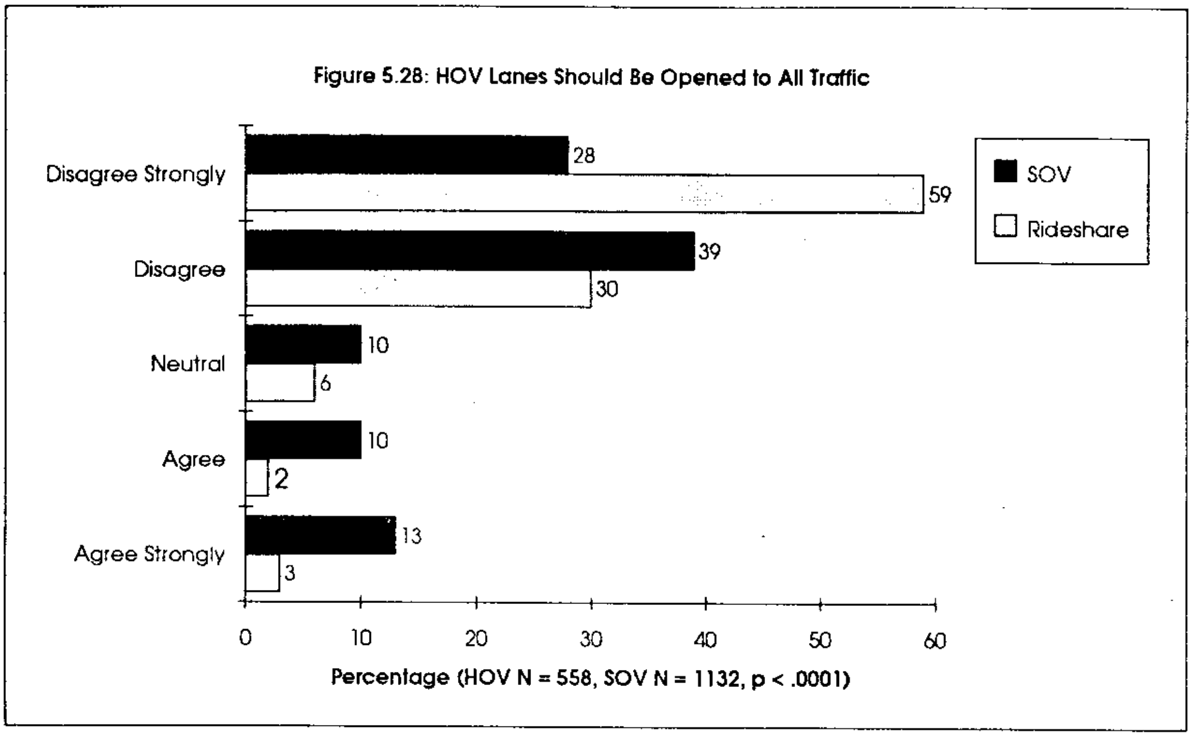
Figure 5.28: HOV Lanes Should Be Opened to All Traffic
Disagree Strongly
Disagree
Neutral
Agree
Agree Strongly
28
59
39
30
10
6
10
2
13
3
SOV
Rideshare
0
10
20
30
40
50
60
Percentage (HOV N = 558, SOV N = 1132, p < .0001)

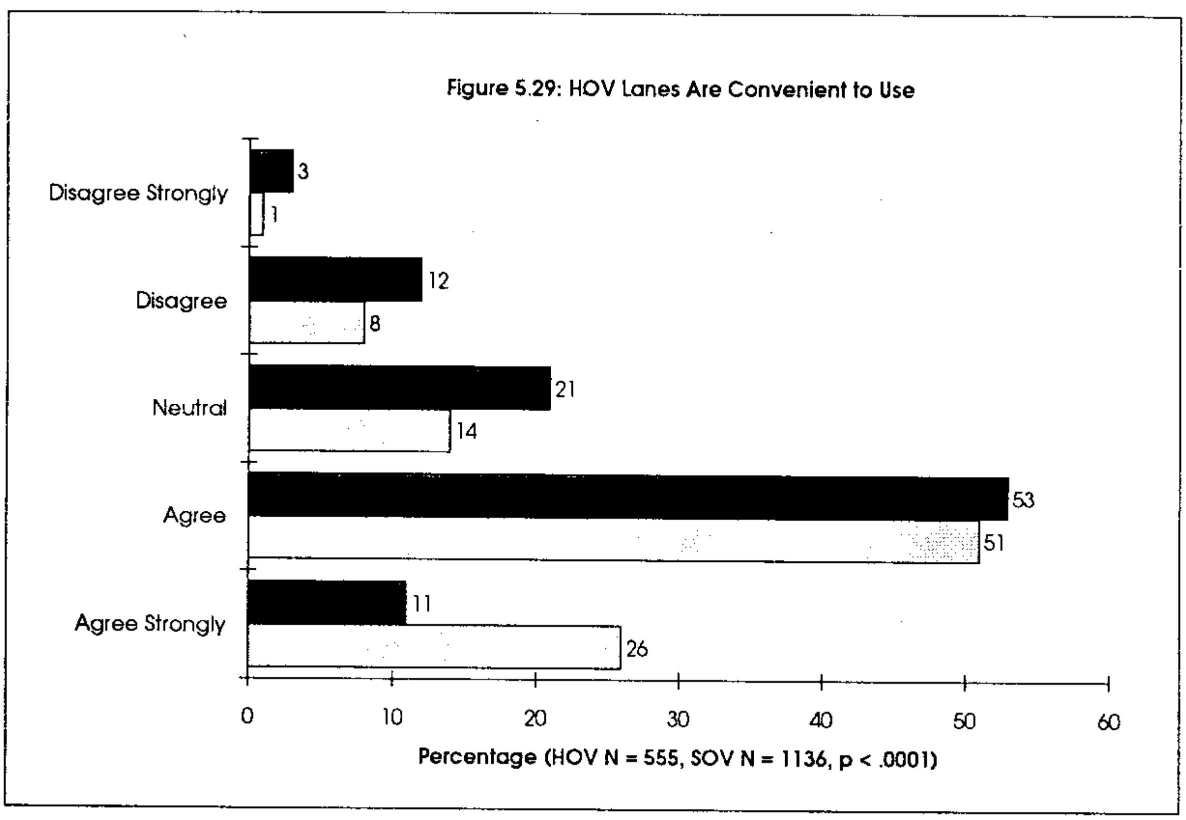
Figure 5.29: HOV Lanes Are Convenient to Use
Disagree Strongly
Disagree
Neutral
Agree
Agree Strongly
3
1
12
8
21
14
53
51
11
26
0
10
20
30
40
50
60
Percentage (HOV N = 555, SOV N = 1136, p < .0001)

Figure 5.30: HOV Lane Construction Should Continue, in General.

FIGURE 5.30 BOX TEXT: While the differences in opinion are significant, only 12 percent of SOV drivers do not feel that HOV lane construction should continue. The high level of agreement is consistent with results from Figure 12B; the region's drivers favor completion of the HOV system over other methods of making HOV lane use more attractive.

Figure 5.31: HOV Lanes Should be Enforced with Police Who Observe Violators and Mail Tickets to the Owner of the Auto.

FIGURE 5.31 BOX TEXT: Sixty-one percent of SOV drivers, who would presumably be most affected by this method of enforcement, support the proposition. While there is clear support for this method of HOV lane enforcement among all drivers, many commuters may feel uncomfortable with its intrusiveness.

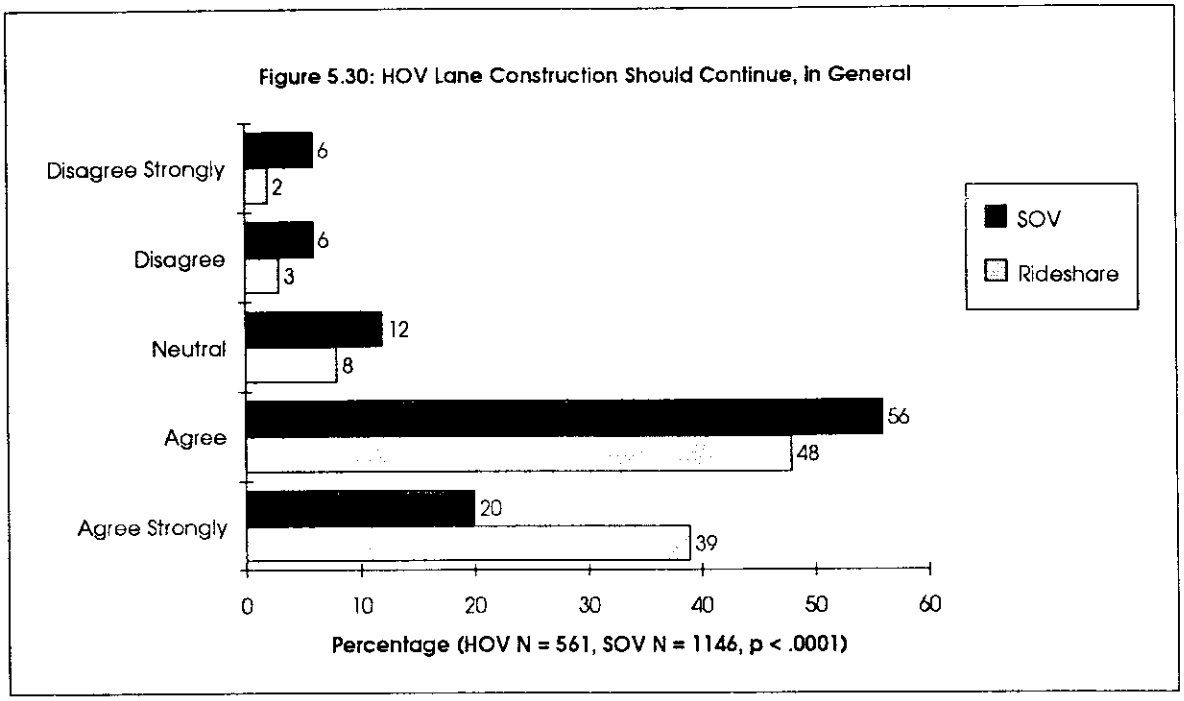
Figure 5.30: HOV Lane Construction Should Continue, In General
Disagree Strongly
6
2
Disagree
6
3
Neutral
12
8
Agree
56
48
Agree Strongly
20
39
0
10
20
30
40
50
60
Percentage (HOV N = 561, SOV N = 1146, p < .0001)
SOV
Rideshare

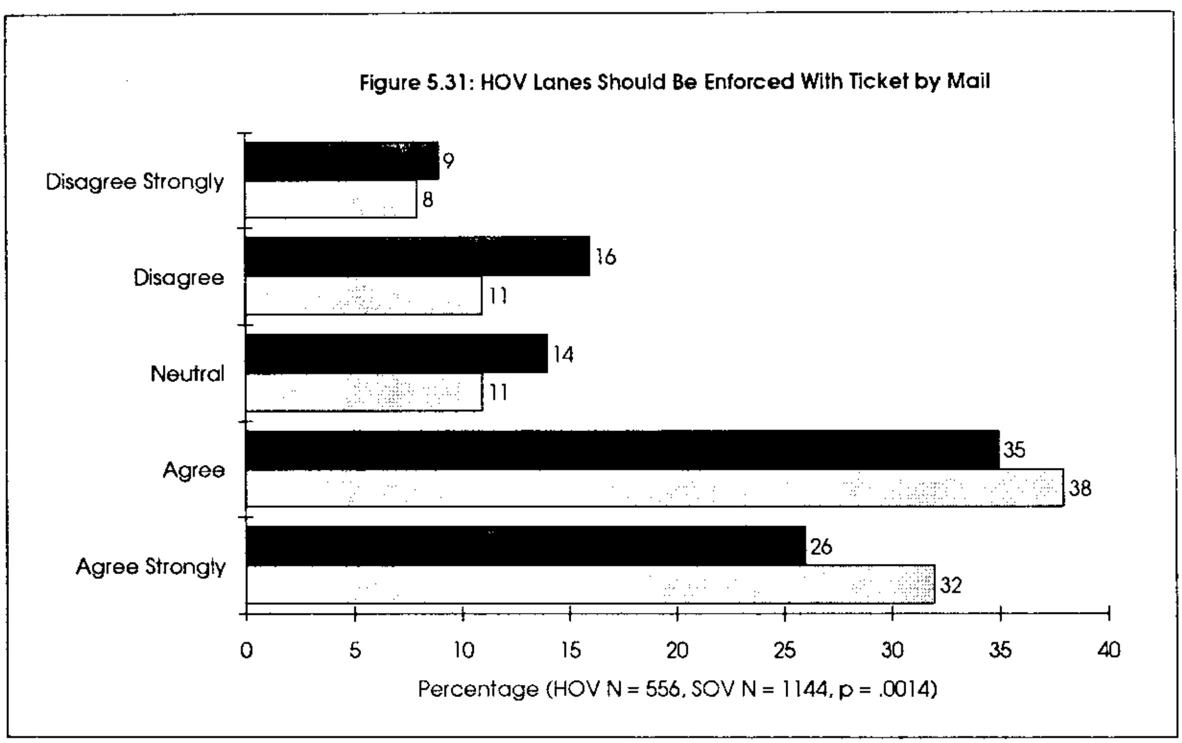
Figure 5.31: HOV Lanes Should Be Enforced With Ticket by Mail
Disagree Strongly
9
8
Disagree
16
11
Neutral
14
11
Agree
35
38
Agree Strongly
26
32
0
5
10
15
20
25
30
35
40
Percentage (HOV N = 556, SOV N = 1144, p = .0014)

Figure 5.32: 2-Person Carpools Should Be Allowed to Use All HOV Lanes.

FIGURE 5.32 BOX TEXT: While overall support for this policy change is overwhelming, support among HOV drivers is even stronger. Because SR-520 is the only remaining 3+ HOV lane under observation for this study, this question was omitted when a new batch of surveys was printed.

Figure 5.33 provides data on the percentage of respondents who gave their address or telephone number for follow-up questions. Figure 5.34 shows the percentage of respondents who provided written comments on the survey.

Figure 5.33: Respondents Providing Address or Telephone Information

Figure 5.34: Respondents Providing Written Comments

FIGURE 5.33 AND FIGURE 5.34 BOX TEXT: There may be some correlation between the quantity of written comments, the willingness to participate in follow-up interviews, and the relatively high educational attainment among the survey respondents. However, there is a low correlation between education and the likelihood of providing written comments (alpha=.17).

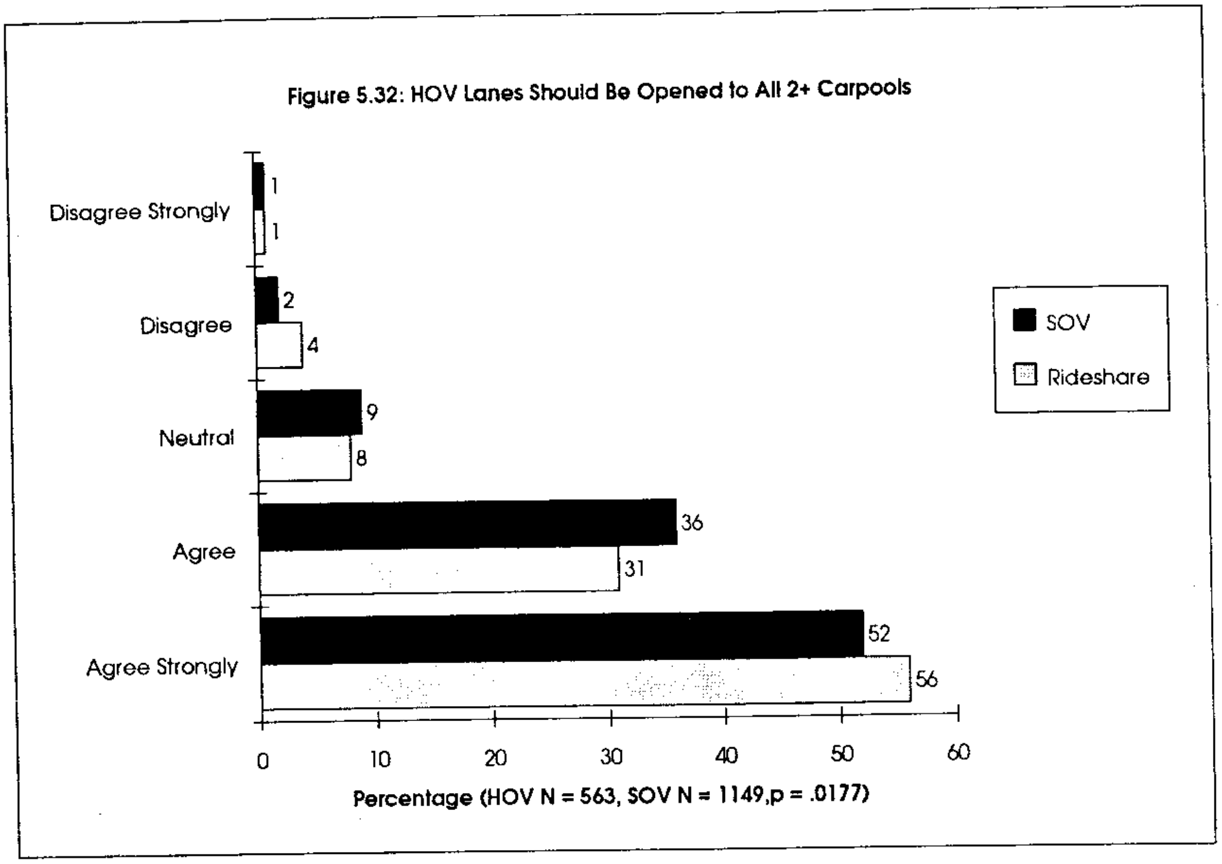
Figure 5.32: HOV Lanes Should Be Opened to All 2+ Carpools
Disagree Strongly
1
1
Disagree
2
4
Neutral
9
8
Agree
36
31
Agree Strongly
52
56
SOV
Rideshare
0
10
20
30
40
50
60
Percentage (HOV N = 563, SOV N = 1149,p = .0177)

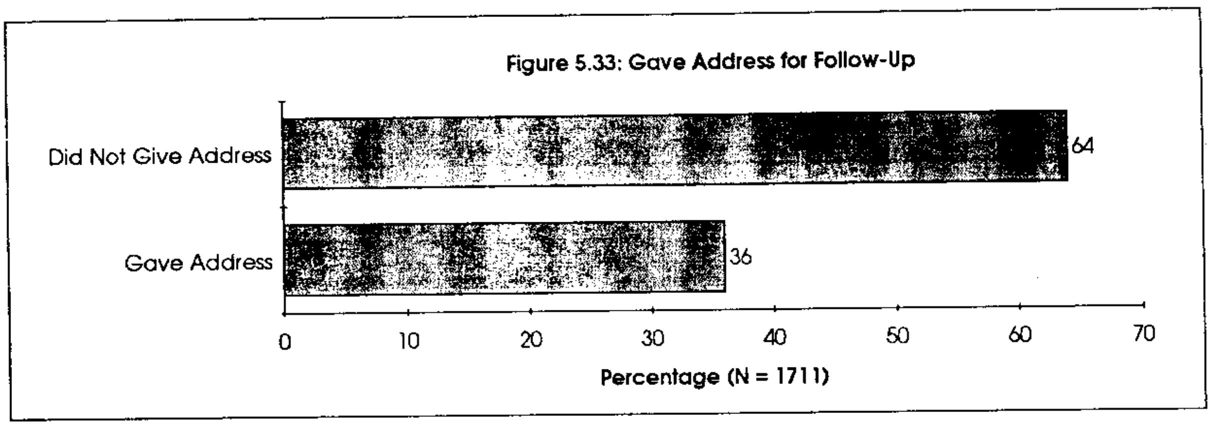
Figure 5.33: Gave Address for Follow-Up
Did Not Give Address
64
Gave Address
36
0
10
20
30
40
50
60
70
Percentage (N = 1711)

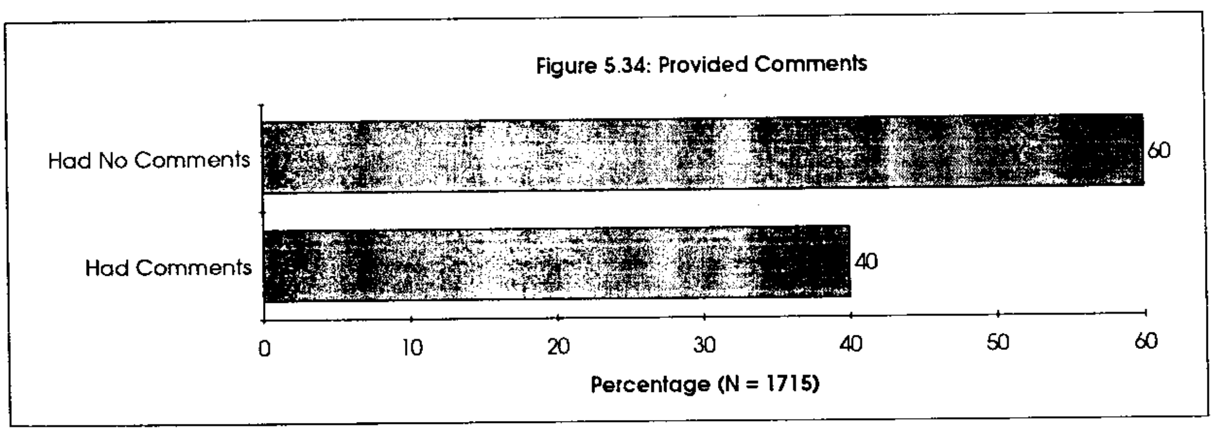
Figure 5.34: Provided Comments
Had No Comments
60
Had Comments
40
0
10
20
30
40
50
60
Percentage (N = 1715)

SUMMARY OF PUBLIC OPINION SURVEY RESULTS

There is strong public support for HOV lanes in general, and for future HOV lane construction. Although there are differences of opinion on many issues between SOV drivers and those who rideshare, these differences do not undermine general support for HOV lanes among the entire survey population.

One sentiment evident throughout the survey was that while the public supports HOV lanes, many people feel that the lanes are underused. The results from questions 5.13 through 5.19 should assist planners in selecting the HOV lane policies that will make the lanes more attractive to the public. Beginning in the third quarter of 1993 two new questions were added to the survey. One asked respondents about the level to which they felt HOV lanes should be opened to all traffic during non-commute hours. The other asked about the level to which they supported converting existing general purpose lanes to HOV lanes. Results from these survey questions should be valuable in assessing the desirability of these policy options. Future analyses will focus on changes in public opinion over time.

CHAPTER SIX: SECONDARY DATA SOURCES

BUS RIDERSHIP ON HOV LANES

One goal of adding HOV lanes is to increase the use of public transit by people who normally drive alone along routes where those HOV lanes are. Currently, Metro, Community Transit, and Pierce Transit all have bus routes that use HOV lanes. It is assumed that public transit becomes more attractive to commuters as congestion increases travel times and erodes travel time reliability. Data from Metro, Community Transit, and Pierce Transit provide the basis for measuring HOV lane effectiveness in this area.

Results from the public opinion survey show that 5 percent of respondents regularly commute by bus and that 32 percent have ridden on a bus that used the HOV lane. Overall, survey respondents do not appear to support incentives to increase bus ridership on HOV lanes as much as they support options that make HOV lanes more attractive to auto users (Figure 5.8). One reason that public transit improvements are not favored as much as other methods of making HOV lane use more attractive may be that the sample generated for this study consists primarily of auto users.

Metro Transit Ridership

Metro uses a statistical sampling to measure ridership. Passenger counters are placed on a portion of the buses on each of Metro's runs. These passenger counters tally riders throughout the day. The passenger count samples generate a measure called the average daily maximum load. The average daily maximum load is then projected to the rest of the runs on the route. This measure is multiplied by the number of daily runs on that route and by the number of service days to generate a ridership estimate for a given period of time. Table 6.1 shows weekday Metro ridership figures for 1991 and 1992.

Metro measures average daily maximum load for three trimesters of the year: Spring (February 15 through June 5), Summer (June 6 through August 28), and

Fall/Winter (August 29 through February 12). These divisions allow analysis of seasonal changes in transit ridership. However, dividing the year in this way complicates the analysis of monthly ridership estimates. First, the divisions of the year are unequal. Using the average daily maximum load to determine monthly totals would inflate some monthly totals and depress others. Second, the accuracy of this measure is based partly on aggregation of the numbers. Disaggregation would reduce the accuracy of the estimation method. As an overall estimate of total ridership, the Metro model appears to be accurate.

Two major problems complicate analysis of Metro's use of HOV lanes. First, safety considerations inhibit use of HOV lanes by Metro buses. A merge to the right into slower traffic is inherently dangerous for a bus driver. A safety guideline requires that Metro drivers begin to merge out of an HOV lane at least 2.5 kilometers before reaching a designated exit ramp. Because most HOV lanes in the Seattle area are so short, the difficulty of merging into an HOV lane and merging out of it soon thereafter reduce the benefit of using the lanes. The net result is that many Metro buses do not use the HOV lanes along their routes. Thus, the travel time savings associated with HOV lane use are mitigated by safety concerns. The exception is when an HOV lane is located on the right side of the freeway, as along SR-520 and the Sunset to Coal Creek section of I-405. As the HOV lane system is completed, it is expected that Metro buses will use HOV lanes more frequently because the problem of merging into slower traffic will be reduced, and travel time savings will increase.

Another problem is that drivers on some routes are instructed to use an HOV lane for either the inbound or the outbound portion of their trip only. These problems do not affect analysis of HOV lane use by Community Transit or Pierce Transit because the routes for both of these transit agencies are so long that HOV lanes provide significant travel time savings while posing fewer safety problems associated with merges into slower traffic.

The data in Table 6.1 show Metro ridership for all routes that use area highway segments containing HOV lanes. Because not all Metro buses use HOV lanes, the figures overestimate true HOV lane ridership. Sifting out the routes that actually use HOV lanes from the ones that do not to generate a true ridership figure would not be worth the effort, because HOV lane use is such a small factor in Metro's route guidelines. One policy option for HOV lane planners is to build special exit ramps for HOV lanes on the inside of the freeway (commonly called "direct access/egress ramps"). This option would likely increase Metro's use of HOV lanes in the future.

Table 6.1: Average Daily Ridership for Metro Routes Along HOV Lanes

Route	Fall 91	Summer 91	Spring 91	Fall 92	Summer 92	Spring 92
I-5 SB						
236th SW to Express lanes	456	501	488	442	433	443
Tukwila to SR-516	1717	2018	2878	1774	1684	1869
I-5 NB						
Lake City Wy. to NE 195th	883	857	1047	734	810	799
SW 272nd to 200th	1699	2092	2207	1788	1735	1752
SR-520						
108th NE to 76th NE	5365	4814	5291	5323	4843	5295
I-90						
WB S Bellevue to Rainier Ave	1670	1634	1731	1636	1635	1682
I-405						
NB Sunset to Coal Creek	1573	1404	1474	1392	1394	1523
SB Coal Creek to Sunset	1432	1169	1293	1346	1378	1443
Total	14,795	14,489	16,409	14,435	13,912	14,806

TABLE 6.1 BOX TEXT: Metro ridership on routes that use HOV lanes or travel next to such lanes is highest in the spring, lower in fall, and lowest in summer. This trend generally holds for Community Transit and Pierce Transit routes as well. Metro's 1991 ridership is higher, in general, than 1992.

Community Transit Ridership

Community Transit supplied this project with ridership data for routes that use HOV lanes. These data cover the period between 1985 and June 1993. Community Transit buses have two destinations in Seattle: the central business district (11 routes) and the University District (six routes). These routes use the northbound and southbound HOV lanes in the I-5 North corridor and on the Express Lanes. Figure 6.1 compares 1993 ridership with average ridership from 1990 through 1992 to the central business district (CBD). Figure 6.2 shows the same ridership comparison for Community Transit routes running to the University District. Figures 6.1 and 6.2 show only the past three years of average total monthly ridership because the annual growth in Community Transit ridership along these routes would artificially inflate the difference between 1993 values and those of previous years. The increase in annual ridership to the CBD has averaged about 10 percent and the increase in annual ridership to the University District has averaged about seven percent. Ridership to the CBD in 1992 fell by more than 11,000 riders from 1991 levels, while ridership to the University District grew by more than 94,000 riders for the same time period. The increase to the University District was partially because of implementation of the U-Pass program (which makes bus passes available to UW faculty, staff, and students at greatly reduced rates). Monthly ridership in both figures are adjusted to include only weekday, non-holiday service.

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Figure 6.1: Community Transit Average Daily CBD Ridership 1991-1993

Figure 6.2: Community Transit Average Daily UW Ridership 1991-1993

FIGURE 6.1 & 6.2 BOX TEXT: Ridership to the CBD is more stable throughout the year than to the University District. Downtown employees probably have a more constant demand for transit over the year than do students.

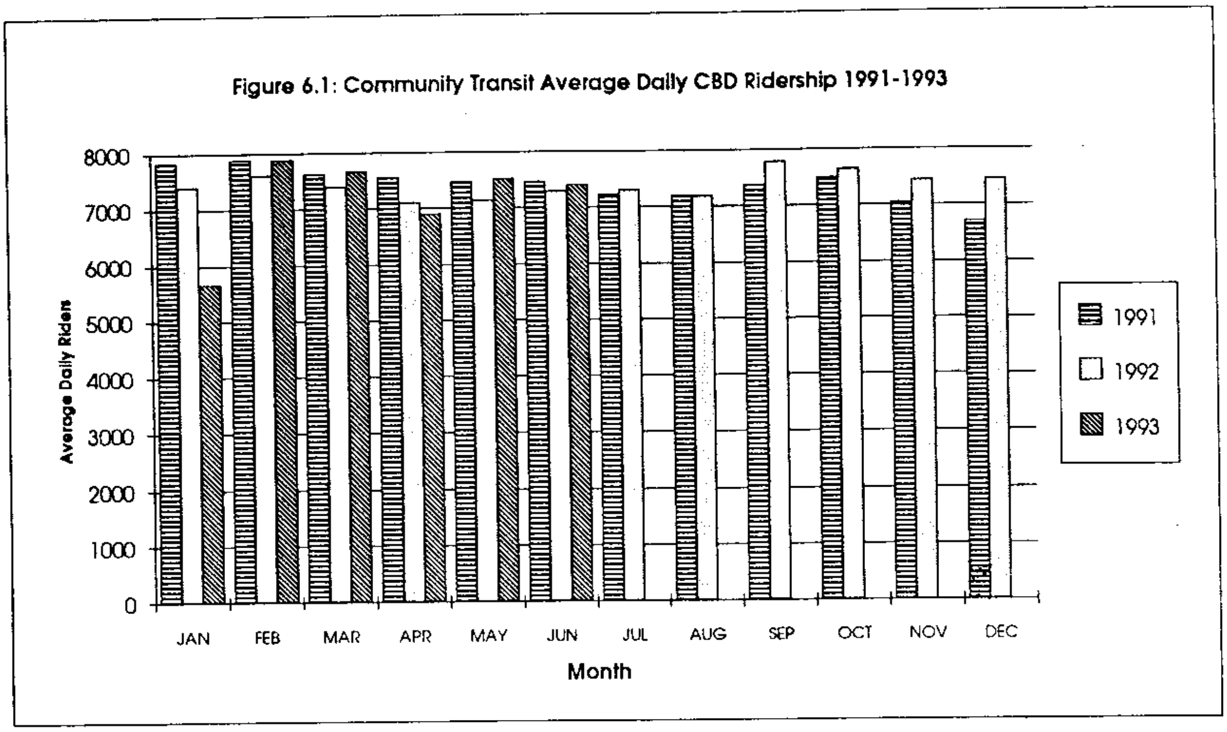
Figure 6.1: Community Transit Average Daily CBD Ridership 1991-1993
8000
7000
6000
5000
4000
3000
2000
1000
0
Average Daily Riders
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
1991
1992
1993

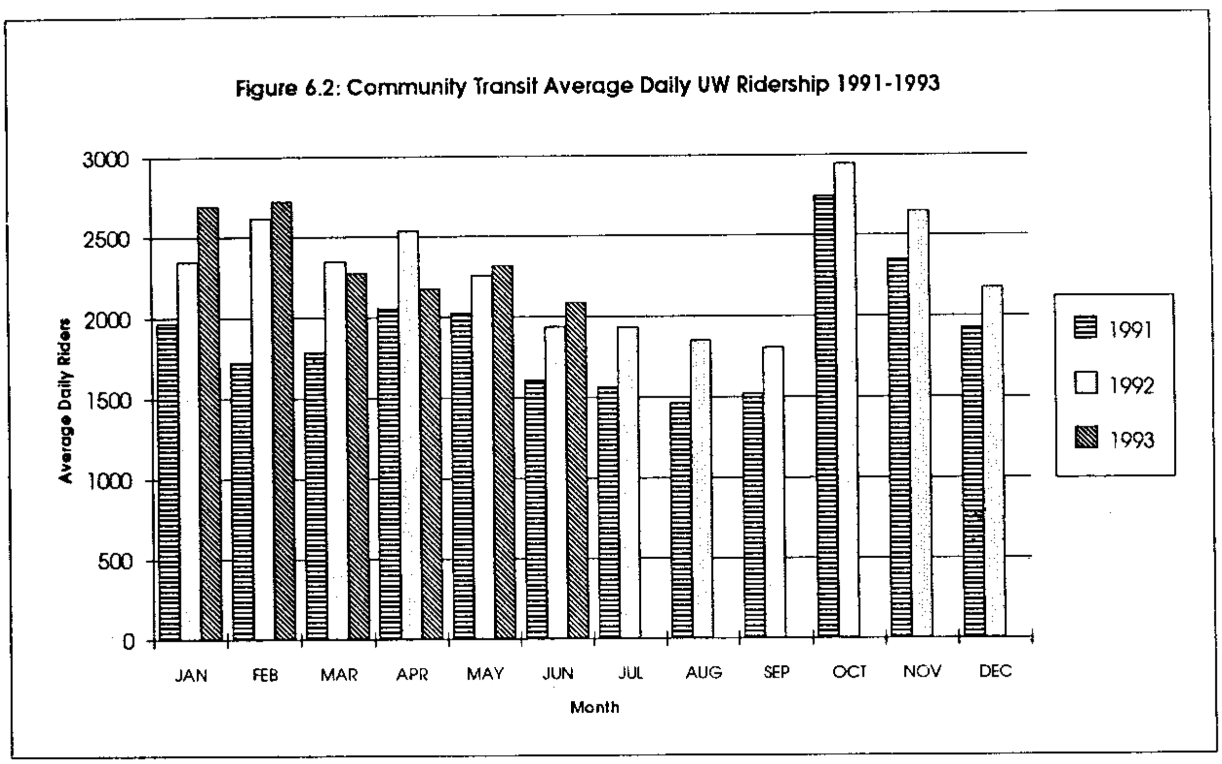
Figure 6.2: Community Transit Average Daily UW Ridership 1991-1993
3000
2500
2000
1500
1000
500
0
Average Daily Riders
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
1991
1992
1993

Pierce Transit Ridership

Pierce Transit's Seattle Express program operates five transit routes to Seattle. This service started in September 1990. Figure 6.3 shows 1993 Seattle Express total monthly ridership compared to average monthly totals for 1991 and 1992. Ridership on Seattle Express buses has grown steadily. 1992 ridership was 12 percent higher than 1991. 1993 ridership through June was 8 percent higher than 1992 ridership for the same period. The monthly ridership levels shown in Figure 6.4 include only weekday, non-holiday service.

Figure 6.3: Pierce Transit Seattle Express Average Daily Ridership

FIGURE 6.3 BOX TEXT: Ridership peaks in October, as with the Metro and Community Transit data. The relatively constant level of service suggests that the Seattle Express has a high proportion of daily riders.

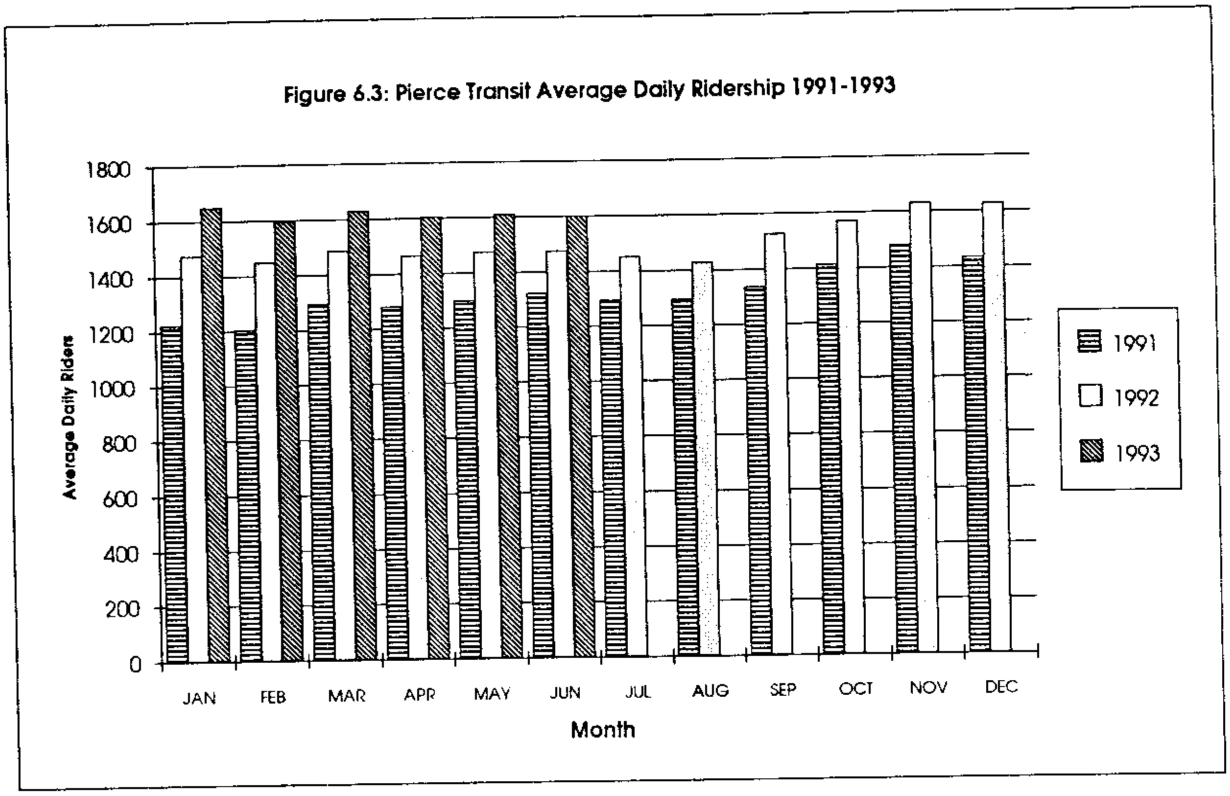
Figure 6.3: Pierce Transit Average Daily Ridership 1991-1993
Average Daily Riders
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
1991
1992
1993

ENFORCEMENT, COMPLIANCE, AND ADJUDICATION

Two measures of HOV lane effectiveness are (1) the violation rate of HOV lane restrictions, and (2) the outcomes of enforcement actions. We are interested in identifying trends in the number, locations, and outcomes of HOV violations. The average vehicle occupancy data collected by traffic observers provides some insight into violation rates, but we have collected data from other agencies to supplement this information, such as information from the Washington State Patrol and from the HERO program, which is run by Metro. To measure HOV violation outcomes, we gathered data from district courts in counties that have HOV lanes. The Washington State Office of the Administrator of the Courts supplied the data pertaining to the district courts.

In addition to these measures of HOV violations, the public opinion survey devotes three questions to motorists' perceptions of compliance and enforcement of HOV restrictions. Survey respondents ranked improving enforcement as their third highest priority for making HOV lanes more attractive, behind opening all lanes to 2+ carpools and connecting HOV lanes by finishing the HOV lane system (Figure 5.12). About 60 percent of both HOV and SOV drivers agree that HOV violations are common during peak commute hours. In addition, about 60 percent of both groups agree that HOV violators commit a serious traffic violation. To better enforce HOV lane restrictions, 70 percent of HOV drivers and 61 percent of SOV drivers support a ticket-by-mail program. Commute route information available in the public opinion survey allows comparison of localized public opinion with the number of citations given in a particular corridor.

The HERO Program

The HERO program is a service provided by Metro that encourages motorists to report HOV violators they observe on area highways. The HERO program encourages travelers to call in and report HOV lane violators at the telephone number 764-HERO. The HERO program office collects the license plates of alleged HOV violators and sends that information to the Department of Licensing for the name and address of the vehicle's registered owner. HERO staff then send a brochure to the alleged violator, providing information on HOV lane policy and restrictions. Following a second report, the violator receives a letter from WSDOT, issued by the HERO office, that explains that the person's auto was observed violating HOV lane restrictions. If a third violation is observed, the vehicle owner receives a letter from the Washington State Patrol (WSP), also issued by the HERO office. The HERO program does not issue tickets because the State Patrol must actually observe the violation. HERO reports repeat violators to the WSP for possible enforcement action. Figure 6.4 shows annual violation report rates for the HERO program.

Figure 6.4: HERO Program Actions 1990-1993

FIGURE 6.4 BOX TEXT: HERO staff suggest that one reason for the abrupt drop in violation reports for 1993 is that occupancy restrictions for almost all HOV lanes were changed to 2+, from a 3+ designation. Reported violation rates appear to fall in the winter months, possibly because poorer light conditions during this time makes it more difficult to see the number of occupants in nearby cars, or to see the vehicle license plate.

Washington State Patrol

The Washington State Patrol has primary responsibility for enforcing HOV lane restrictions on state highways. While the WSP catches only a fraction of HOV violators on any single day, repeat violators have a significant chance of eventually getting caught. For 1992 the WSP reported 7,783 contacts with HOV violators, and issued 3,790 tickets. The numbers are remarkably similar for 1993 (see Table 6.2). Figure 6.6 breaks down those enforcement actions by type.

Table 6.2: Washington State Patrol HOV Enforcement Actions, 1992-1993

Type of Action	Arrest Citations	Verbal Warnings	Written Warnings	Accident Citations	Other	**Total**
1992	3,790	3,717	248	7	21	7,783
1993	3,655	3,389	259	5	33	7,341

TABLE 6.2 BOX TEXT: WSP troopers issued only 3,790 tickets out of 7,783 contacts with HOV violators in 1992. The proportion of tickets issued was almost exactly the same in 1993. Troopers have the discretion to ticket offenders or to give verbal or written warnings as they see fit. WSP policy is to enforce HOV restrictions, and many other traffic violations, at the lowest possible level. This often results in verbal warnings for first-time violators and for those who have not been stopped for other violations, such as speeding.

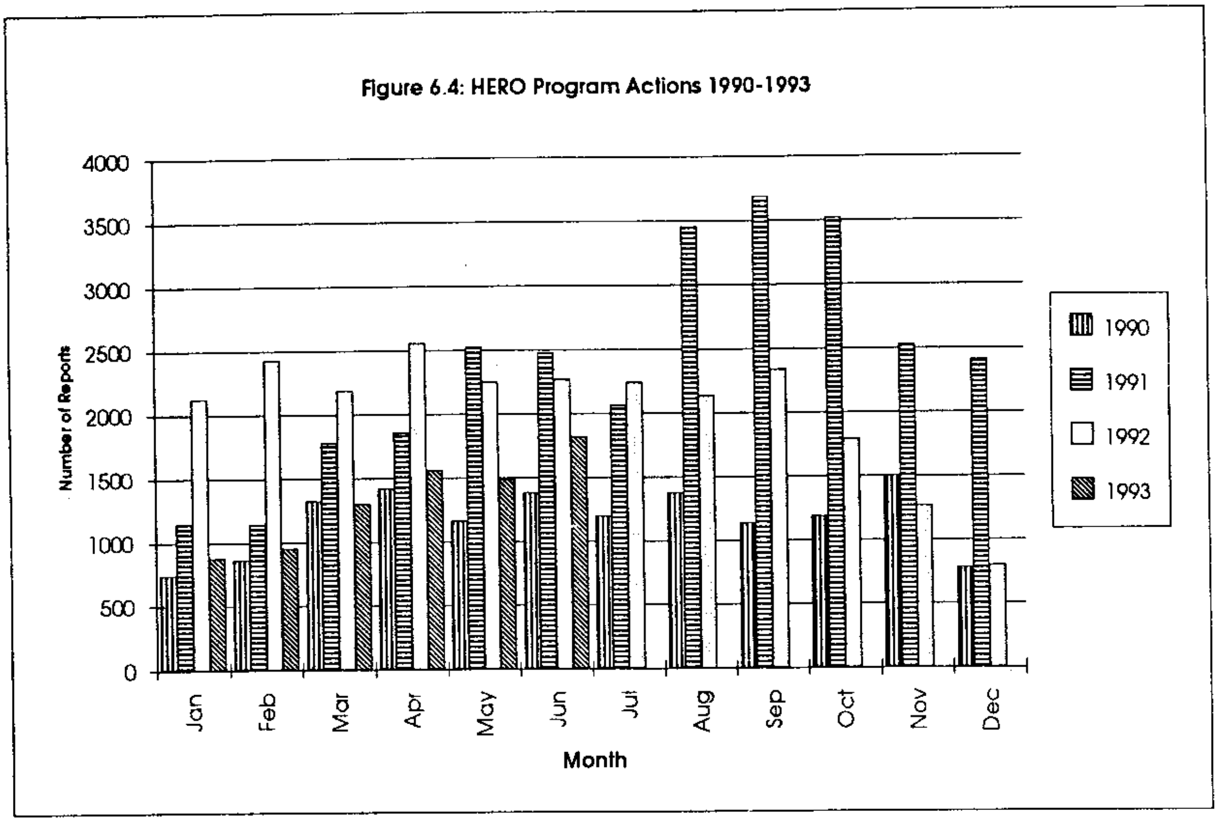
Figure 6.4: HERO Program Actions 1990-1993
4000
3500
3000
2500
2000
1500
1000
500
0
Number of Reports
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
1990
1991
1992
1993

Adjudication Data

While reports of violations and the number of warnings and tickets issued provides useful insight into HOV violation rates, it is also useful to know what happens once HOV violators are ticketed. State troopers refer HOV violators to district courts in the region in which they were ticketed. Those district courts send information on the outcomes of all court cases to the Office of the Administrator of the Courts, in Olympia, for central storage and analysis. That office supplied this project with data on outcomes for all infractions involving HOV lanes between 1991 and June 1993. Figure 6.5 shows the number of cases processed for that time period, broken down by infraction type. The outcomes are as follow:

- Paid. Violator paid fine, no court action required.
- Committed. Violator contested ticket in court and lost, or the violator failed to appear. Failure to appear in court results in an additional fine.
- Not Committed. Court found violator not guilty.
- Dismissed. Court waived charges.
- Dismissed with Prejudice. Infraction dismissed, but court reserved right to enforce the infraction in the future.
- Dismissed Without Prejudice. Infraction dismissed, and court waived the right to enforce the infraction in the future.
- Amended. Violator found guilty of a different or lesser charge.
- Change of Venue. Charges against violator transferred to a different jurisdiction.
- Pending. Case not concluded as of June 1993.

Figure 6.5 shows the outcomes for HOV violations for 1991 through June 1993. Four categories (Dismissed with Prejudice, Dismissed Without Prejudice, Amended, and Change of Venue) were omitted because there were fewer than five in each.

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Figure 6.5: HOV Violation Adjudication Outcomes 1990-1993

FIGURE 6.5 BOX TEXT: Two clear trends merit attention. First, the courts appear to be enforcing violations more stringently in 1992 and 1993 than in 1991. The number of dismissals dropped markedly in both 1992 and 1993 from the 1991 peak. Second, the number of findings against violators increased from 41 percent in 1991 to 51 percent in 1992 and 48 percent in 1993. One possible explanation for these trends is that judges allow a grace period for enforcement of new traffic restrictions to allow motorists to adjust to the new rules. Many HOV lane segments were added in 1990 and 1991, perhaps this caused some motorists to change their driving behavior. In addition, WSDOT made a presentation on the purposes and goals of the HOV lane system to a meeting of area judges in 1991. This presentation may have led to more strict enforcement of HOV lane restrictions.

Figure 6.6 provides information on seasonal variation in HOV lane enforcement outcomes. The data are averaged by month, from January 1991 through June 1993.

Figure 6.6: Average Caseload and Paid Tickets 1990-1993

FIGURE 6.6 BOX TEXT: District courts try most cases within 90 days of the citation. This may explain the high number of cases tried in January and February and the low number of cases tried in November and December: the courts may schedule hearings for traffic violations into the next year in an attempt to clear backlogs. District courts also frequently grant waivers to defendants extending the period between citation and a court appearance. This reduces the precision of evaluating changes in violation rates over time. Even so, these data do not fit well with the HERO data provided in Figure 6.4, except that violation rates appear to peak in October. One possible explanation for the difference between HERO violation reports and monthly average court caseloads may be that visibility problems suppress the number of violations reported on the HERO hotline.

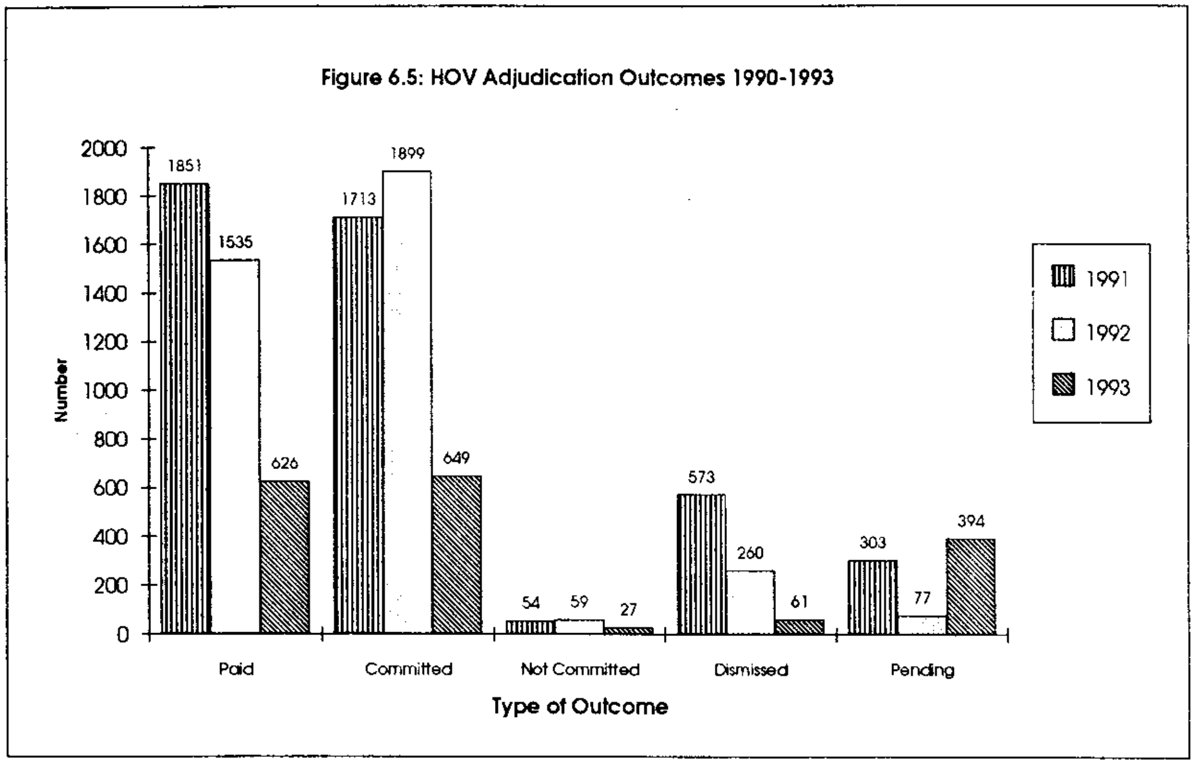
Figure 6.5: HOV Adjudication Outcomes 1990-1993
Number
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1851
1535
626
1713
1899
649
54
59
27
573
260
61
303
77
394
Paid
Committed
Not Committed
Dismissed
Pending
Type of Outcome
1991
1992
1993

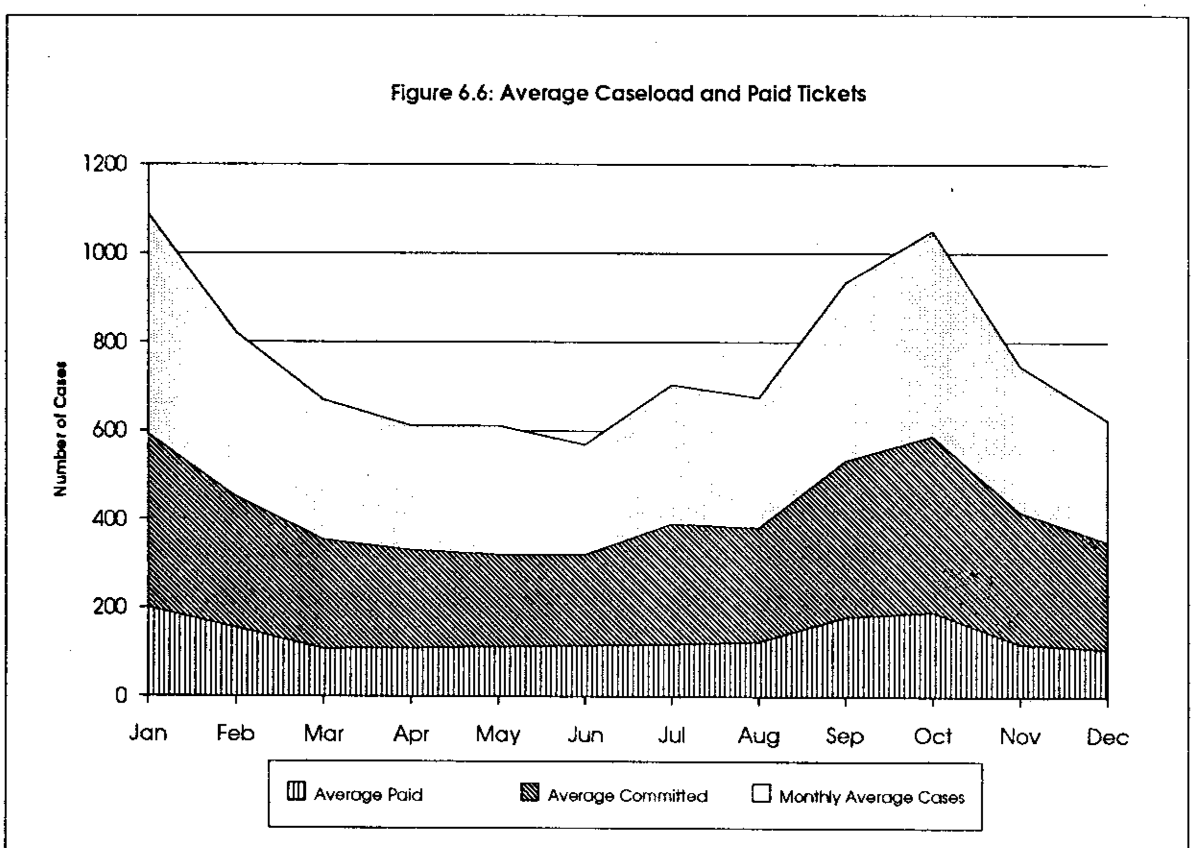
Figure 6.6: Average Caseload and Paid Tickets
Number of Cases
1200
1000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Average Paid
Average Committed
Monthly Average Cases

The outcome data are also broken down by court district in Table 6.3. Figures shown are percentages of all tickets issued in each district. The total number of cases in each district is provided in the column labeled "Total".

Table 6.3: HOV Violation Outcomes by District

District Court	Paid	Committed	Not Committed	Dismissed	Pending	Total
King County: Aukeen	51	32	10	4	3	395
King County: Northeast	31	45	2	9	13	692
King County: Shoreline	39	48	1	7	5	1452
King County: Southwest	40	45	1	6	8	973
Bellevue	15	66	1	8	10	1635
Federal Way	50	39	2	4	5	551
Issaquah	42	36	7	6	9	214
Redmond	43	39	1	9	8	2265
Seattle	55	23	1	16	5	1868
Other*	42	28	0	17	13	47
Total Cases	4012	4261	140	894	774	1009 2

*Includes Everett, Pierce County, and Sea-Tac District Courts.

TABLE 6.3 BOX TEXT: Violations appear concentrated in areas with the most HOV lanes: Shoreline, Bellevue, Redmond, and Seattle. Drivers ticketed in Bellevue contest their tickets more frequently than do drivers in any other area. Drivers ticketed in Seattle tend to pay the fines without contest most often. The convenience of appearing in court or underlying opinions about the legitimacy of HOV lane restrictions may guide those decisions. The large number of pending cases for Bellevue and northeast King County are fairly evenly distributed.

ADJUDICATION DATA RECOMMENDATIONS

1. Formalize a relationship to collect enforcement data and outcome data annually from the Office of the Administrator of the Courts. These data were difficult to obtain, given that tracking HOV violation rates and enforcement outcomes is a low priority for this agency. If a relationship between WSDOT and this office were formalized for annual data reporting, it would be much easier to gather this information.

2. Conduct a special study of repeat offenders. Data on this subject may be available from district courts. Cross-referencing HERO data with violation outcome data may shed some light on the extent to which violators change their behavior after receiving a ticket.

3. Conduct a special study on highway corridors characterized by chronic violation problems. For instance, according to our ACO data, the HOV lanes on I-405 (where SR-167 merges with I-405) appear to have a very high violation rate. We believe this is so because the traffic observation point is very close to where the highways merge, with a general purpose lane merging into an HOV lane on I-405. One way to assess the observed violation rate would be to observe traffic at that spot and at another spot 1/4 mile downstream simultaneously. Bellevue and Redmond appear to have high violation rates; these jurisdictions also have the highest number of outstanding violations among the court districts studied. Follow-up conversations with WSP officials and court clerks and judges may shed light on this trend.

ACCIDENT INFORMATION

WSDOT policy relating to the safety of HOV lanes stipulates that HOV lanes should provide safe travel options to HOVs without having a negative impact on the safety of general purpose lanes. HOV lane safety is therefore a key determinant of HOV lane effectiveness. If drivers do not feel safe on HOV lanes, it is likely that fewer drivers will use those lanes. While the public opinion survey measures *perceptions* of HOV lane safety, an effective evaluation also requires analysis of actual accident rates. Safety impacts of opening HOV lanes and accident trends over time are most relevant. In addition, a safety comparison among different HOV lane configurations and policies would be useful for planning purposes.

This section contains information on the HOV lanes under observation for this study (see Appendix I for a listing of all HOV lanes in the Puget Sound area). Each data set features information on all accidents occurring on each highway segment containing an HOV lane, plus the contiguous two miles of highway before and after the HOV lane. The additional highway sections were added to assess the safety impact of HOV lanes both up and downstream of the HOV lane itself. Accident data for the previous two years before an HOV lane was opened is also included to assess the safety impact of constructing and opening the HOV lane.

An HOV accident is defined as an accident that occurred following an HOV lane's opening date, between the milepost markers associated with that HOV lane, and in the lane designated as the HOV lane (inside/outside). Also included in this definition are accidents occurring on the shoulder next to the HOV lane. Shoulder accidents are included because a vehicle must be in or pass through the HOV lane to be involved in a shoulder accident. The accident data included in this report are current through July 31, 1992 for each HOV lane segment.

Data Collection and Analysis

Accident data are supplied by the WSDOT Transportation Data Office. WSP and local law enforcement personnel enter data relevant to each highway accident on a standard form containing information about 90 different factors. These forms are forwarded to WSDOT. Information about 28 of the variables are of interest to this study, and are available to users of these data. The 28 variables selected are the following:

1. Year
2. Month
3. Day of month
4. Day of week
5. Hour of day
6. Minute of hour
7. State route number
8. Milepost (location of accident)
9. Type of area in which accident occurred (construction area, spur, new highway, etc.)
10. Precision of estimated accident location
11. Accident severity
12. Number of injuries
13. Number of fatalities
14. Number of vehicles involved
15. Roadway surface conditions
16. Weather conditions
17. Light conditions
18. Impact location (accident location on roadway)
19. Collision type
20. Proximity of first driver's residence

21. Proximity of second driver's residence

22. Proximity of third driver's residence

23. First driver's primary cause for accident

24. First driver's secondary cause for accident

25. Second driver's primary cause for accident

26. Second driver's secondary cause for accident

27. Third driver's primary cause for accident and

28. Third driver's secondary cause for accident

Beginning in 1988, the Transportation Data Office included a code on the accident data entry form to indicate whether an accident occurred in an HOV lane. This will be useful in studying HOV accidents for time periods after that date. However, because this study focuses on accidents occurring well before that date, the code was not much help.

Accident data for each HOV lane are organized to correspond to the traffic observation corridors described earlier. HOV accidents as a proportion of total accidents for each highway segment are presented in figures 6.8 through 6.22. Vital statistics such as the opening date, location, lane miles, HOV lane location, occupancy requirements of each HOV lane, and HOV accidents as a percentage of all accidents, are included with each figure. Lane location numbers indicate the position of the HOV lane relative to the right shoulder of the roadway -- higher lane numbers are on the inside, or left shoulder. Lower numbers are on the outside, closer to the right shoulder. Any changes in the lane configuration or occupancy requirements are noted with the date of such changes. Where appropriate, data from the public opinion survey are provided to show how specific groups of drivers feel about safety on a particular HOV lane segment relative to the frequency of HOV accidents on that corridor.

Users of these data should be aware of two factors. First, each HOV lane opened at a different time of year. To ensure consistency across different HOV lane segments, accident data for the full first year included in each figure are provided. Second, the accident data for all locations are current through July 31, 1993. To adjust for partial coverage of 1993, the number of accidents is projected through the end of the year for each highway segment. To project the number of accidents, the average proportion of all accidents occurring between August 1 and December 31 for the three years prior to 1993 were computed for each HOV lane segment (HOV and general purpose accidents were factored separately). That proportion was then multiplied by the number of accidents occurring in each highway segment before August 1, 1993. The product was then added to the number of recorded accidents to produce projected year-end totals.

Finally, the accident data presented here are raw numbers. The data do not represent an accident rate because accident frequencies must be compared to traffic volumes to determine absolute rates. Therefore, while an HOV lane may represent 5 percent of all accidents in a given highway segment, only one-fifth as many vehicles may use that HOV lane as use general purpose lanes. Subsequent users of these data must compare relative lane volumes to derive a valid HOV lane safety evaluation.

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I-5 North of Lake City Way

Figure 6.7: I-5 Southbound 212th SW to Express Lane Entrance
Opened: August 29, 1983
Extended (from 236th SW to 212th SW): May 25, 1993
Milepost Location: 172.7 to 179.8
Lane Location: Lane 5 of 5 (172.7 to 174.1), lane 4 of 4 (174.1 to 179.8)
Lane Length: 11.43 kilometers
Occupancy Designation: 2+ (changed from 3+ August 8, 1991)
Proportion HOV Accidents: 286 of 3,569 (8%)

Table 6.4: HOV Accidents by Year: I-5 SB 212th SW to Express Lane Entrance

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Number	12	32	22	24	25	31	33	35	21	29	22

FIGURE 6.7 BOX TEXT: The reduction of the occupancy requirement from 3+ to 2+ in 1991 did not result in a large increase in HOV lane accidents (21 in 1991, 29 in 1992, and 22 in 1993). Likewise, the HOV lane did not appear to have had a negative safety impact north of its location. Accidents in the 3.2 kilometers preceding (north) of the HOV lane accounted for only 2.9 percent of all accidents in the corridor. However, accident rates were high immediately following (south) of the HOV lane, accounting for 24 percent of the total. This may be because the two left lanes merge into the express lanes, and when the express lanes are closed to southbound traffic, significant backups occur because of merging. This congestion may account for the high downstream accident rates, but these accidents are not necessarily related to the presence of the HOV lane. Finally, in 1983 accidents in the general purpose lanes rose considerably over 1982 totals. HOV lane construction was a significant factor in this increase: 111 of the 247 accidents in 1983 were construction-related.

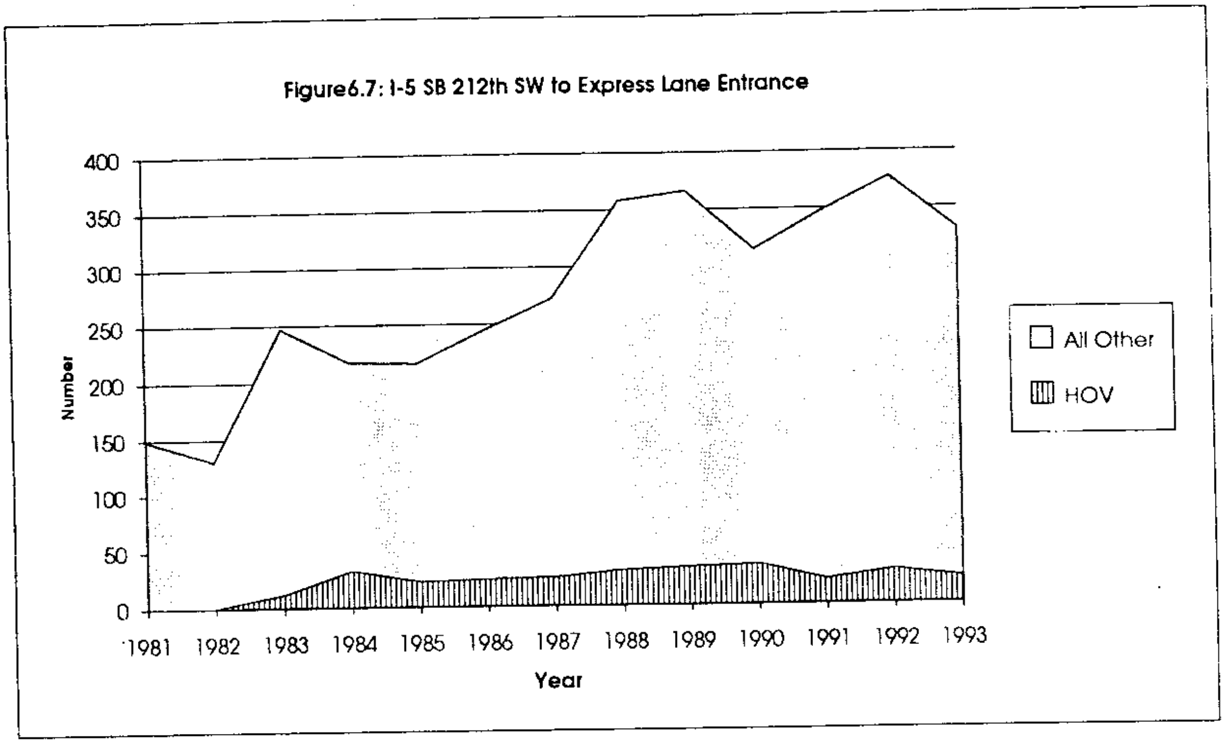
Figure6.7: I-5 SB 212th SW to Express Lane Entrance
400
350
300
250
200
150
100
50
0
Number
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.8: I-5 Northbound Express Lane Entrance to 185th NE
Opened: August 29, 1983
Milepost Location: 172.4 to 176.7
Lane Location: Lane 5 of 5 (172.4 to 174.3), lane 4 of 4 (174.3 to 176.7)
Lane Length: 6.92 kilometers
Occupancy Designation: 2+ (changed from 3+ July 28, 1991)
Proportion HOV Accidents: 293 of 2,977 (9.8%)

Table 6.5: HOV Accidents by Year: I-5 NB Express Lane Entrance to NE 185th

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Number	7	23	24	27	27	29	34	31	31	33	27

FIGURE 6.8 BOX TEXT: The change from a 3+ occupancy requirement to 2+ did not increase HOV accidents significantly (31 in 1990, 31 in 1991, 33 in 1992, and 27 in 1993). However, general purpose lane and access ramp accidents grew immediately after the reduction of the occupancy requirement, and later fell below the original 1991 level (236 in 1991, 290 in 1992, and 213 in 1993). Almost one-half of all accidents occurred in the 3.22 kilometers preceding and following the HOV lane. There is no clear trend of a high accident frequency at the merge point at the end of the HOV lane.

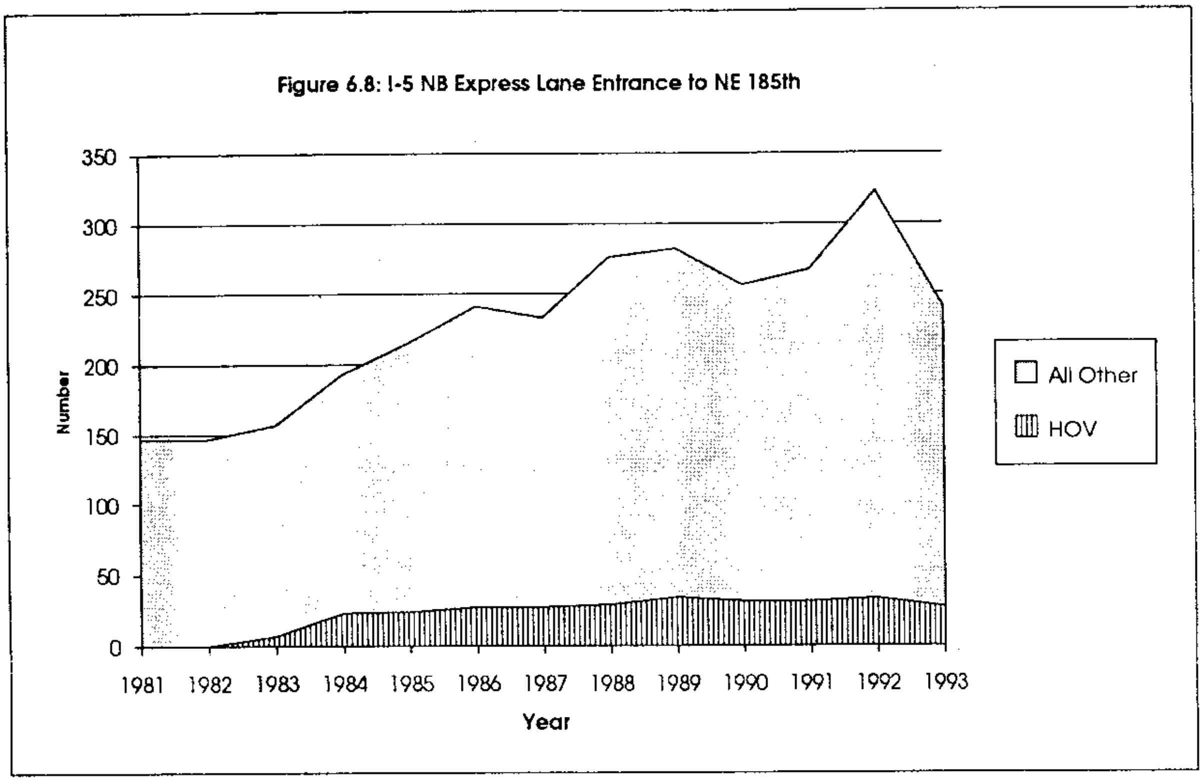

Figure 6.8: I-5 NB Express Lane Entrance to NE 185th
350
300
250
200
150
100
50
0
Number
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

I-5 between Lake City Way and Southcenter

Figure 6.9: I-5 Southbound Mercer to Yesler
Opened: April 1991
Milepost Location: 165.2 to 166.4
Lane Location: Lane 4 of 4
Lane Length: 1.93 kilometers
Occupancy Designation: 2+ (changed from 3+ August 1993)
Proportion HOV Accidents: 115 of 2,303 (5%)

Table 6.6: HOV Accidents by Year: I-5 SB Mercer to Yesler

Year	1991	1992	1993
Number	28	38	49

FIGURE 6.9 BOX TEXT: The change from a 3+ occupancy requirement to 2+ appears to have had a significant impact on HOV accidents on this HOV lane segment (28 in 1991, 38 in 1992, and 49 in 1993). However, general purpose lane accidents were projected to fall from 531 in 1992 to 351 in 1993. There is a high frequency of accidents in the 0.16 kilometers immediately preceding the end of the HOV lane. This suggests that vehicles merging from the HOV lane and vehicles entering the mainline from the Express Lanes produce a negative safety impact (3.5 percent of all accidents in the corridor occurred between mileposts 166.3 and 166.4).

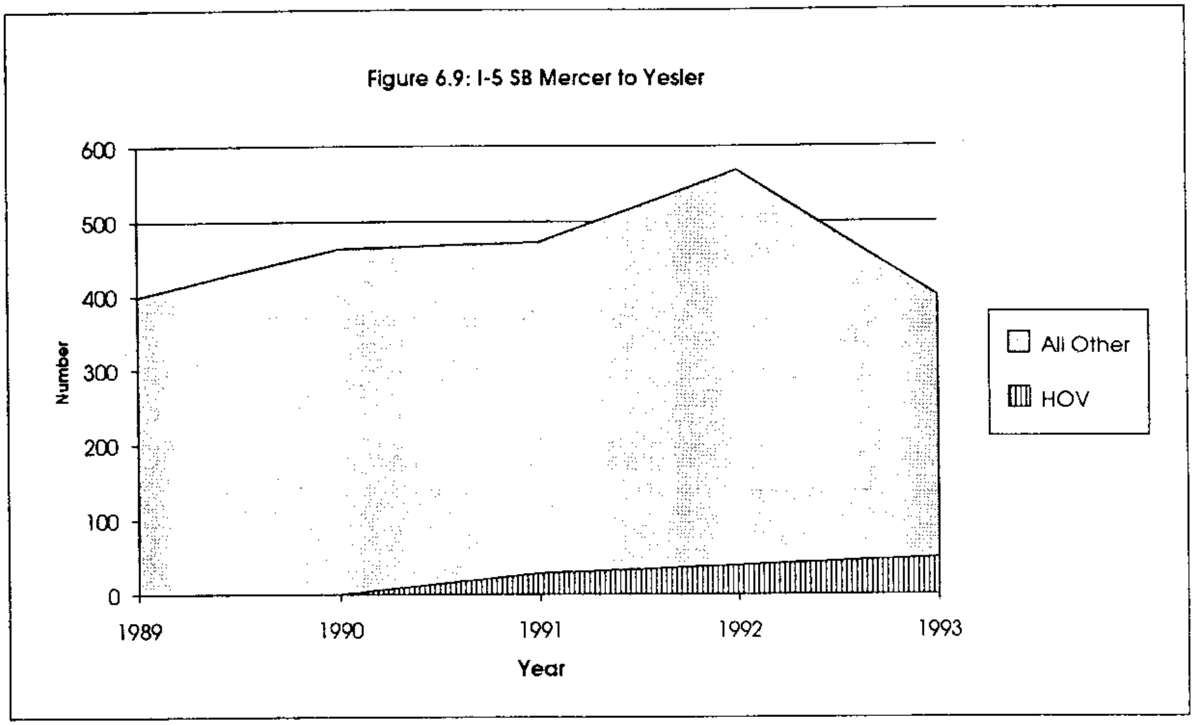
Figure 6.9: I-5 SB Mercer to Yesler
600
500
400
300
200
100
0
Number
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.10: I-5 Northbound Boeing Access Road to Steele Street
Opened: December, 1991
Milepost Location: 158.1 to 160.4
Lane Location: Lane 5 of 5
Lane Length: 3.7 kilometers
Occupancy Designation: 2+ (changed from 3+ December 14, 1992)
Proportion HOV Accidents: 12 of 1,107 (1.2%)

Table 6.7: HOV Accidents by Year: I-5 NB Boeing Access Road to Steele Street

Year	1992	1993
Number	6	6

FIGURE 6.10 BOX TEXT: The occupancy requirement change from 3+ to 2+ appears to have had no impact on either HOV accidents or on overall accident rates. The 3.22-kilometer highway section preceding the HOV lane accounted for 21 percent of all accidents measured, and the 3.22-kilometer section following the HOV lane accounted for 58.5 percent. There was no apparent increase in accidents because of the merge at the end of the HOV lane.

Figure 6.11: I-5 Southbound Foster Road to I-405 Entrance
Opened: 1990
Milepost Location: 154.6 to 155.3
Lane Location: Lane 7 of 7
Lane Length: 1.29 kilometers
Occupancy Designation: 2+
Proportion HOV Accidents: 4 of 584 (0.7%)

Table 6.8: HOV Accidents by Year: I-5 SB Foster Road to I-405 Entrance

Year	1992	1993
Number	2	2

FIGURE 6.11 BOX TEXT: Because this HOV lane is so short and feeds directly into I-405, it is not suitable for use by drivers continuing south on I-5. The majority of all accidents for this highway section occur in the 3.22 kilometers preceding the HOV lane (58 percent) and following the HOV lane (31 percent). This HOV lane also falls between the traffic observation sites, so ACO data are unavailable.

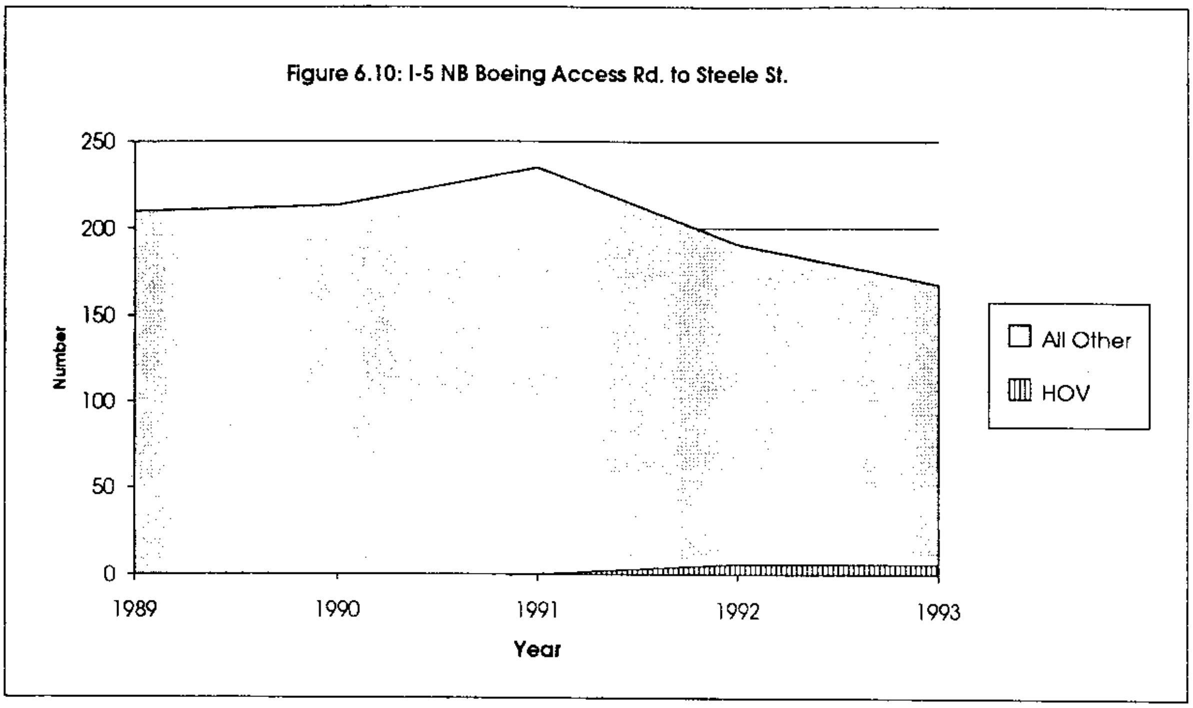
Figure 6.10: I-5 NB Boeing Access Rd. to Steele St.
250
200
150
100
50
0
Number
1989
1990
1991
1992
1993
Year
All Other
HOV

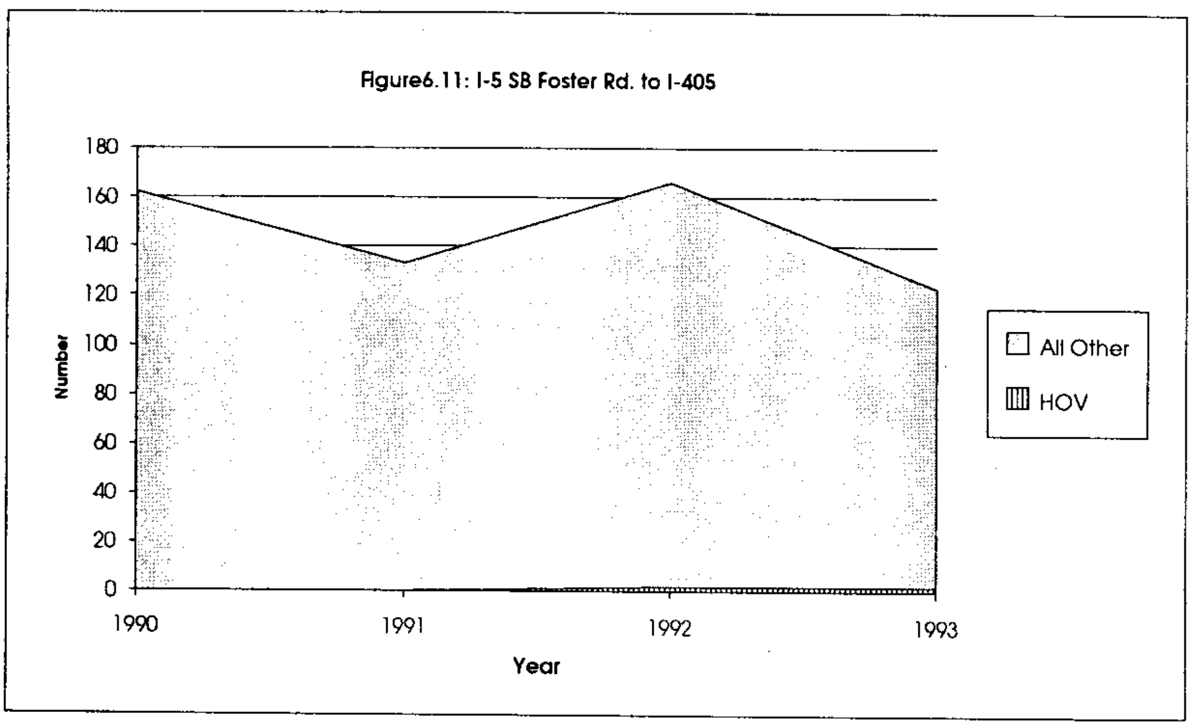
Figure6.11: I-5 SB Foster Rd. to I-405
180
160
140
120
100
80
60
40
20
0
Number
1990
1991
1992
1993
Year
All Other
HOV

I-5 South of Southcenter

Figure 6.12: I-5 Southbound Tukwila to SR-516
Opened: August 19, 1991
Milepost Location: 149.4 to 154.46
Lane Location: Lane 5 of 5
Lane Length: 7.99 kilometers
Occupancy Designation: 2+ (changed from 3+ December 7, 1992)
Proportion HOV Accidents: 89 of 1,240 (6.7%)

Table 6.9: HOV Accidents by Year: I-5 Southbound Tukwila to SR-516

Year	1991	1992	1993
Number	13	34	42

FIGURE 6.12 BOX TEXT: The change from 3+ to 2+ may have been the cause for an increase in HOV accidents (34 in 1992, 42 projected for 1993). However, general purpose lane and access ramp accidents fell significantly after the change in the occupancy requirement (260 in 1992, 191 projected for 1993). There has been no increase in accidents at the end of the HOV lane because WSDOT added a right-side exit-only lane, negating the need for HOV lane users to merge back into the contiguous general purpose lane. HOV lane construction was not a significant factor in causing general purpose lane accidents. Construction accounted for only 39 of 545 accidents in 1990-91.

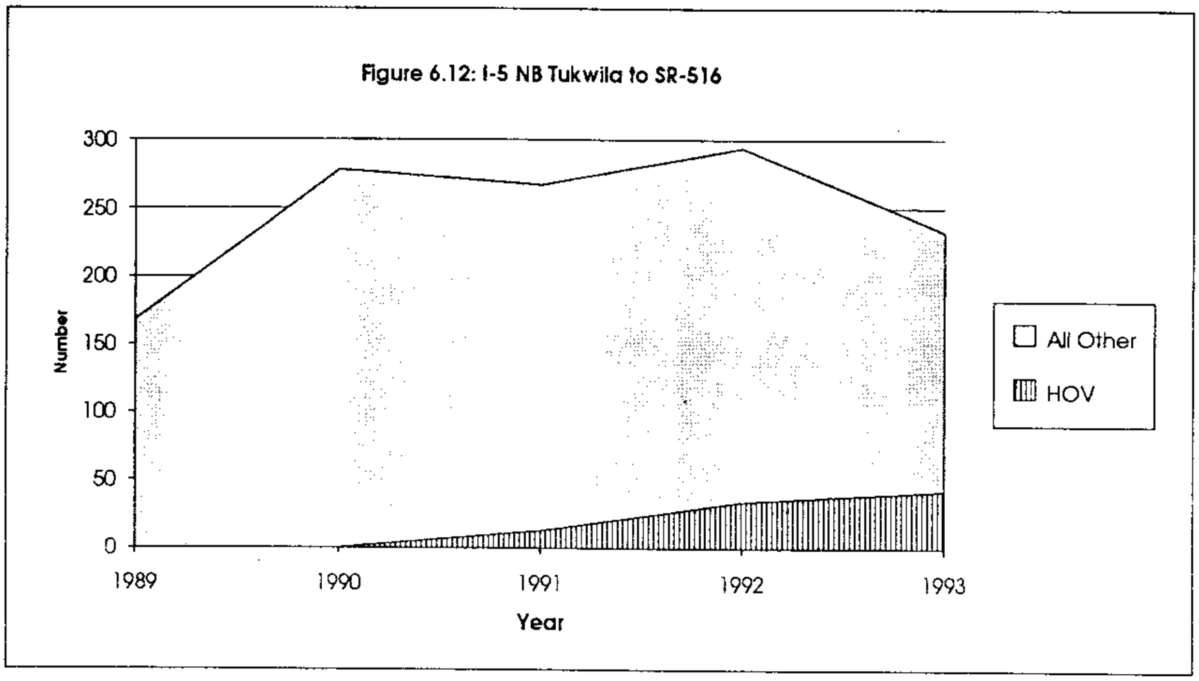
Figure 6.12: I-5 NB Tukwila to SR-516
300
250
200
150
100
50
0
Number
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.13: I-5 Northbound S 272nd to S 200th
Opened: August 19, 1991
Milepost Location: 149.6 to 150.9
Lane Location: Lane 5 of 5
Lane Miles: 2.09 kilometers
Occupancy Designation: 2+ (changed from 3+ December 21, 1992)
Proportion HOV Accidents: 10 of 543 (1.8)

Table 6.10: HOV Accidents by Year: I-5 Northbound S 272nd to S 200th

Year	1991	1992	1993
Number	1	7	2

FIGURE 6.13 BOX TEXT: The change in occupancy restrictions from 3+ to 2+ did not result in an increase in either HOV or general purpose lane accidents. Most of the accidents analyzed for this corridor occurred either before the HOV lane (43 percent) or after the HOV lane (37 percent). The merge to general purpose lanes at the end of the HOV lane does not appear to have resulted in a significant increase in accidents.

The public opinion survey reveals a disparity between perceptions of HOV lane safety among drivers who regularly use this portion of I-5 during peak hours, about HOV lane safety and actual accident frequencies. The survey asks respondents to indicate the extent to which they agree or disagree with the following statement: "Vehicles dart in and out of HOV lanes too often for the lanes to be safe." In general, only 22 percent of HOV drivers and 25 percent of SOV drivers agreed with the statement. Drivers who usually use the I-5 South corridor, however, perceived aggressive driving to be more of a problem than did other drivers: 35 percent of HOV drivers and 33 percent of SOV drivers felt the proposition to be true. The differences in opinion were significant only for the SOV group ($p = 0.01$ for SOVs, $p = 0.41$ for HOVs). I-5 South drivers held these opinions despite the fact that HOV accidents for the southbound section of the corridor were about average for the entire region, and HOV accident frequencies for the northbound section were among the lowest recorded.

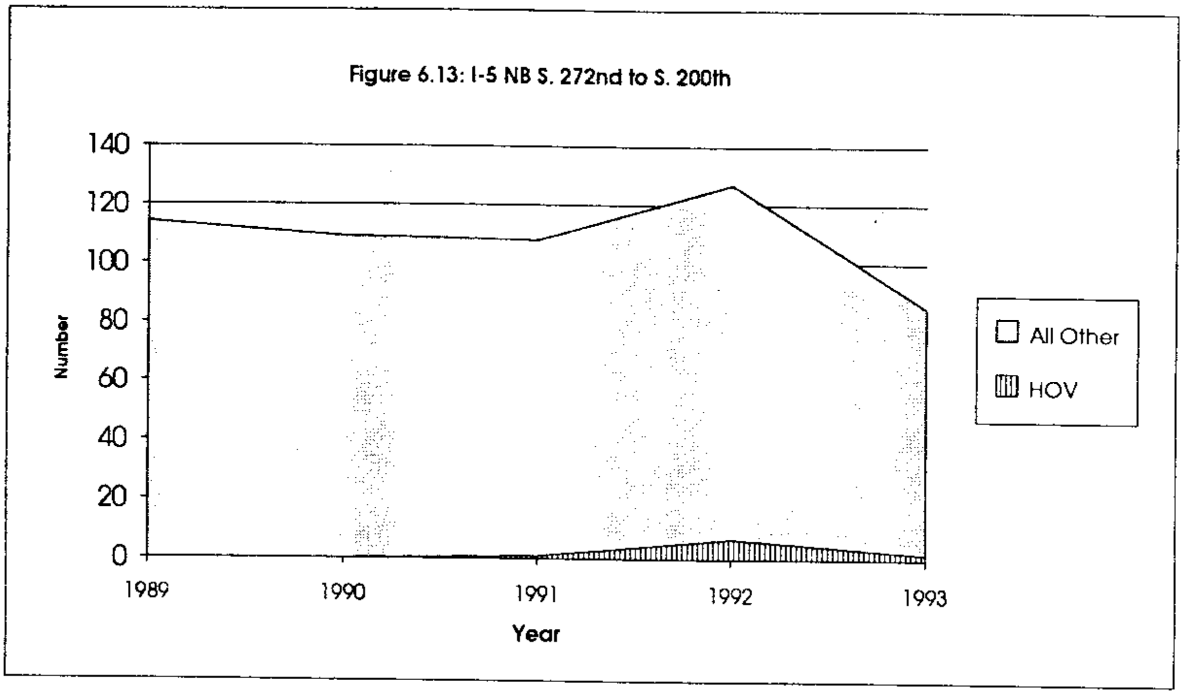
Figure 6.13: I-5 NB S. 272nd to S. 200th
140
120
100
80
60
40
20
0
Number
1989
1990
1991
1992
1993
Year
All Other
HOV

SR-520

Figure 6.14: SR-520 Westbound 108th NE to 76th NE
Opened: 1973
Milepost Location: 4.23 to 6.38
Lane Location: Lane 1 of 3
Lane Length: 3.46 kilometers
Occupancy Designation: 3+
Proportion HOV accidents: 315 of 2,268 (13.9%)

Table 6.11: HOV Accidents by Year: SR-520 Westbound 108th NE to 76th NE

Year	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Number	22	25	17	31	31	37	36
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	
Number	25	23	20	9	21	18	

FIGURE 6.14 BOX TEXT: This HOV lane is located on the right-hand side of the highway, in part because Metro operates Flyer bus stops just off the right shoulder. The high number of merges through the HOV lane by vehicles entering the highway and slowdowns because of merging Metro buses may explain why the HOV accidents account for a high percentage of all accidents. There is no significant problem created by the merge at the end of the HOV lane. (Only 1.23 percent of all accidents occurred in the 0.16 kilometers before the end of the HOV lane).

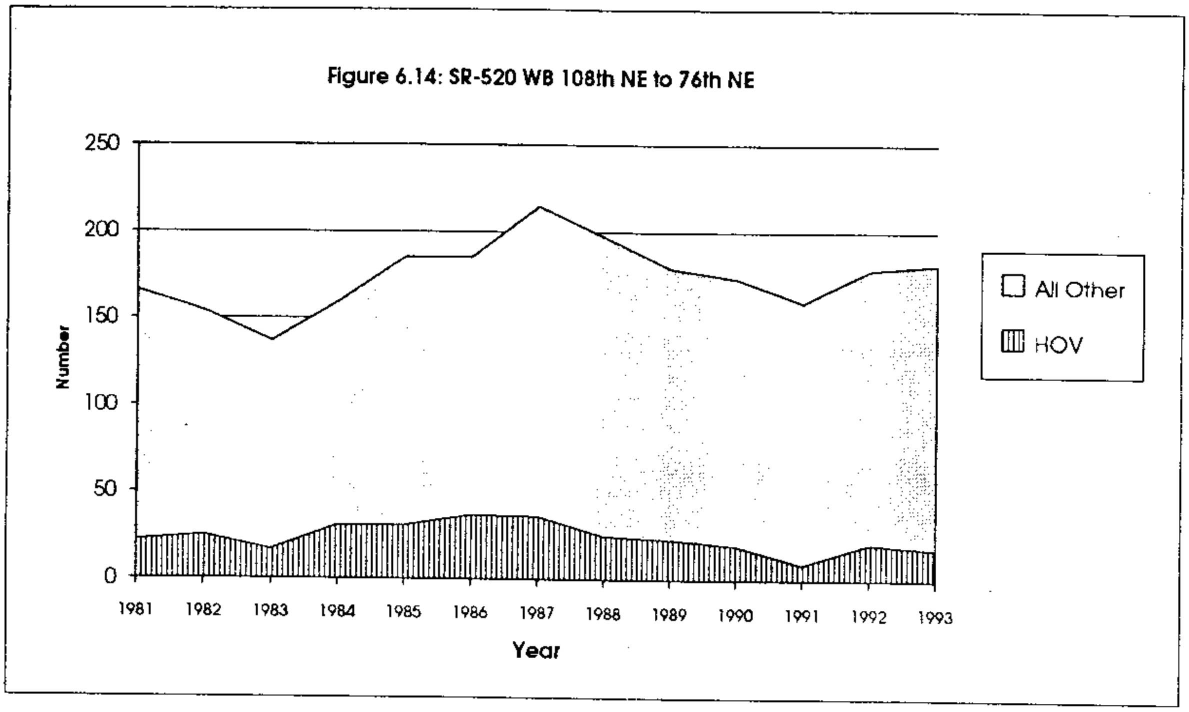
Figure 6.14: SR-520 WB 108th NE to 76th NE
250
200
150
100
50
0
Number
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

Public opinion data show a disparity between perceived levels of HOV lane safety and actual accident rates on SR-520. HOV and SOV drivers who usually use SR-520 during peak hours generally reflect overall attitudes about HOV lane safety. HOV drivers on SR-520 did not express more support for making HOV lanes wider and safer than did other HOV drivers . Thirty-four percent of SR-520 drivers selected this option for making HOV lanes a more attractive commuting option, compared to a 32 percent overall average for HOV drivers. In addition, HOV drivers on SR-520 did feel more strongly that drivers dart in and out of HOV lanes too often for the lanes to be safe than did their counterparts traveling other highway corridors. Twenty-four percent of HOV drivers on SR-520 agreed with the proposition, while 25 percent of all HOV drivers agreed. SOV drivers who usually drive on SR-520 during peak hours also reflected overall attitudes about HOV lane safety.

While drivers on SR-520 appear to feel safe in their HOV lane, that particular lane has one of the highest accident frequencies of any corridor under observation (14 percent). One possible explanation for the mismatch between perceived safety and the relatively high frequency of HOV accidents on SR-520 may be that because the HOV lane is on the right-hand side of the highway, drivers have become accustomed to traffic merging through that lane to get into the general purpose lanes. It is interesting to note that drivers who usually use SR-520 did not select moving HOV lanes from the right side of the freeway to the left side (where they appear to be safer) with any greater frequency than did other drivers.

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I-90

Figure 6.15: I-90 Westbound Mercer Island to Rainier Avenue

Opened: June 4, 1989
Milepost Location: 3.49 to 8.54
Lane Location: Lane 4 of 4 (changed from lane 1 of 4 in February 1992)
Center roadway not in use by westbound traffic at this time.
Lane Length: 8.13 kilometers
Occupancy Designation: 2+ (changed from 3+ February 1992)
Proportion HOV Accidents: 76 of 569 (13.4%)

Table 6.12: HOV Accidents by Year: I-90 WB Mercer Island to Rainier Avenue

Year	1989	1990	1991	1992	1993
Number	14	19	14	14	15

FIGURE 6.15 BOX TEXT: The change in occupancy requirements from 3+ to 2+ and the reconfiguration of the roadway does not appear to have had a negative impact on HOV lane safety. However, accident levels for the general purpose lanes rose somewhat after the reconfiguration (74 in 1992, 98 projected for 1993). The merge at the end of the HOV lane appears to reduce safety for all motorists (13 percent of all accidents occurred between the 0.16 kilometer preceding the end of the HOV lane and the 0.16 kilometer following the end of the lane).

Figure 6.15: I-90 WB Mercer Island to Rainier Ave.

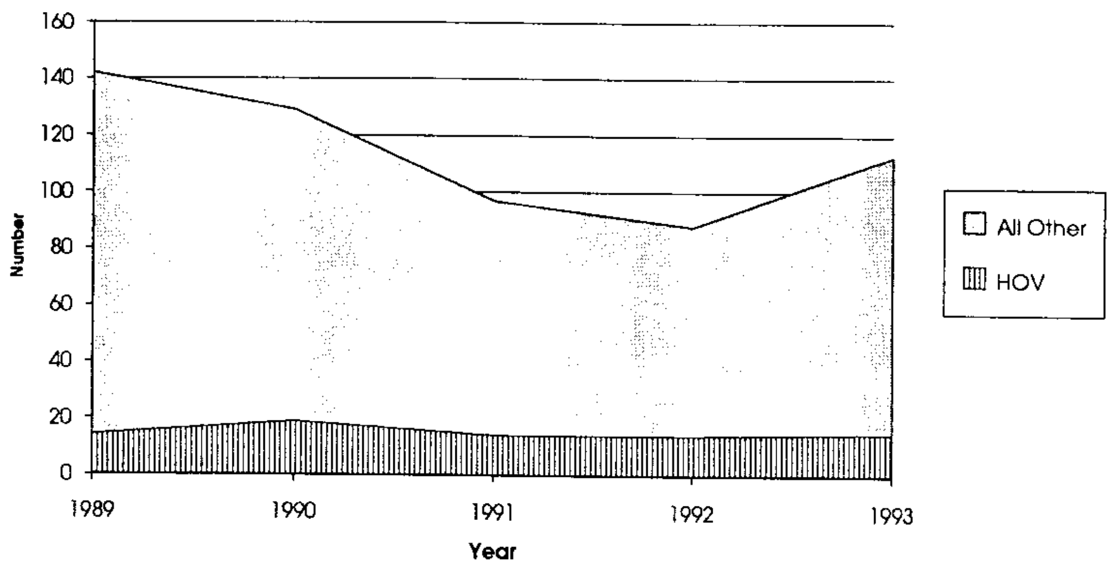


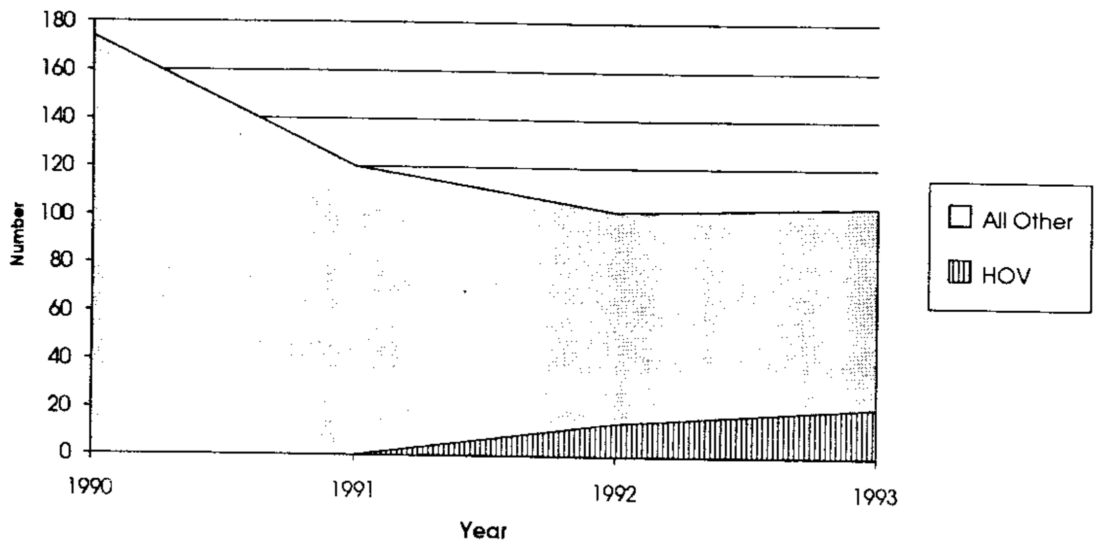
Figure 6.16: I-90 Eastbound 5th Avenue to Rainier Avenue
Opened: February 17, 1992
Milepost Location: 1.98 to 3.49
Lane Location: Lane 4 of 4
Lane Length: 2.43 kilometers
Occupancy Designation: 2+
Proportion HOV Accidents: 35 of 500 (7%)

Table 6.13: HOV Accidents by Year: I-90 EB 5th Avenue to Rainier Avenue

Year	1992	1993
Number	14	21

FIGURE 6.16 BOX TEXT: The number of accidents in the general purpose lanes and access/egress ramps has declined steadily, while HOV accidents increased between 1992 and 1993. Because this HOV lane begins very near the origin of the highway, only 0.4 percent of all accidents occurred before the beginning of the HOV lane. Accidents in the 3.22-kilometer segment after the HOV lane ends, however, accounted for 72 percent of the total for the corridor.

Figure 6.16: I-90 EB 5th Ave. to Ranier Ave.



This data report does not include information on the center reversible HOV lanes opened on I-90 (from milepost 6.00 to 9.92). This is because data collected on accidents on these lanes have been inconsistent, and because coders at the Transportation Data Office had not developed a consistent coding process for these accidents until recently. The figures supplied by the Transportation Data Office show that five HOV accidents have occurred in the westbound HOV lane configuration and that five have occurred in the eastbound configuration since the reversible HOV lanes opened in 1989 (the section open to both directions of traffic was restricted to the area from Rainier Avenue to 5th Avenue until January 1994). An update on the accident rates for these HOV lanes will be published in forthcoming reports.

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I-405

Figure 6.17: I-405 Southbound Coal Creek to Sunset
Opened: 1986
Milepost Location: 5.02 to 10.47
Lane Location: Lane 1 of 3
Lane Length: 8.81 kilometers
Occupancy Designation: 2+
Proportion HOV Accidents: 137 of 1610 (8.5%)

Table 6.14: HOV Accidents by Year: I-405 SB Coal Creek to Sunset

Year	1986	1987	1988	1989	1990	1991	1992	1993
Number	13	18	27	15	24	14	16	10

FIGURE 6.17 BOX TEXT: The rise in general purpose lane accidents in 1985 appears to be related to construction of the HOV lane, which is located on the outside. Traffic entering the highway would have to merge through and drive next to the construction area. HOV accidents have fallen each year: from a peak of 27 in 1988, to 14 in 1991, to 16 in 1992, and 10 projected for 1993. While this is one of the longer HOV lane segments in the area, the percentage of accidents occurring in the 3.22 kilometers before and after the HOV lane is very high (15 percent before and 55 percent after the HOV lane).

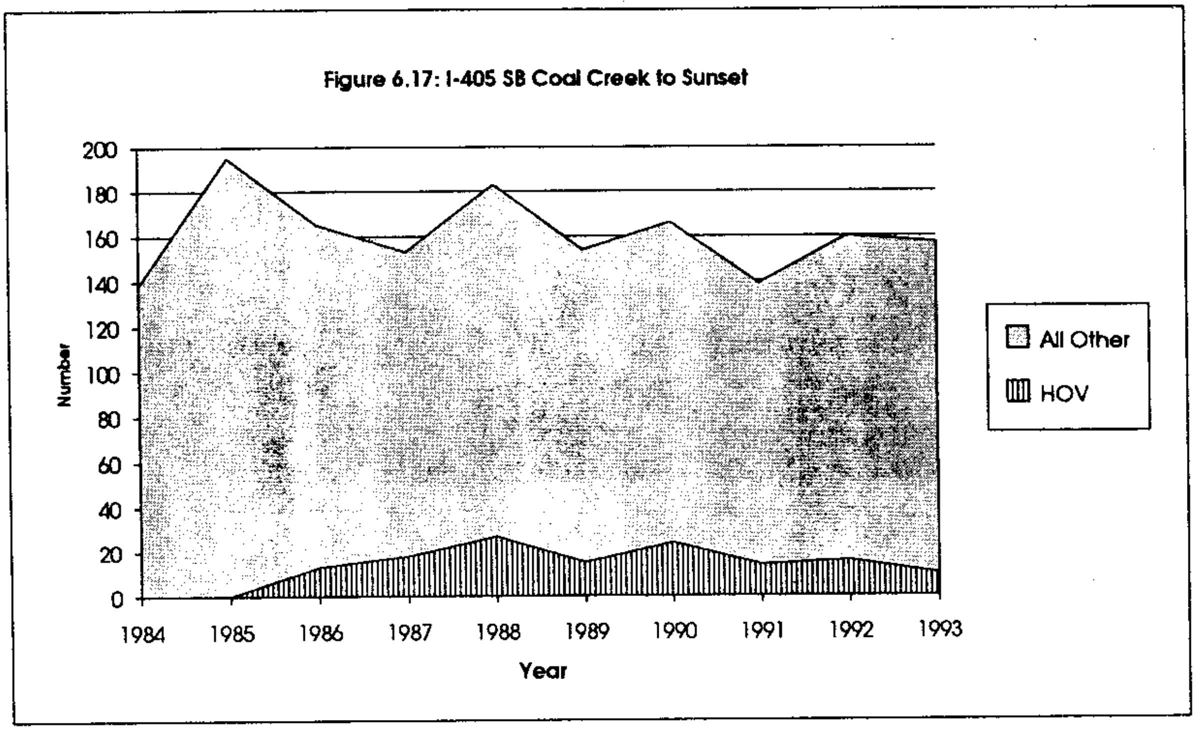

Figure 6.17: I-405 SB Coal Creek to Sunset
Number
200
180
160
140
120
100
80
60
40
20
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.18: I-405 Southbound Tukwila to South Renton
Opened: December 1, 1990
Milepost Location: 0.32 to 2.98
Lane Location: Lane 3 of 3
Lane Length: 4.28 kilometers
Occupancy Designation: 2+
Proportion HOV Accidents: 22 of 1,064 (2%)

Table 6.15: HOV Accidents by Year: I-405 SB Tukwila to South Renton

Year	1990	1991	1992	1993
Number	1	9	6	6

FIGURE 6.18 BOX TEXT: General purpose lane and access ramp accidents fell each year after the opening of the HOV lane, except for 1992. Nine percent of all accidents occurred in the 0.53 kilometer following the end of the HOV lane, where I-405 begins. The 3.22-kilometer stretch preceding the HOV lane accounts for 46 percent of all accidents. Because the HOV lane becomes an exit-only ramp to I-5 northbound, there is no merge problem with this lane.

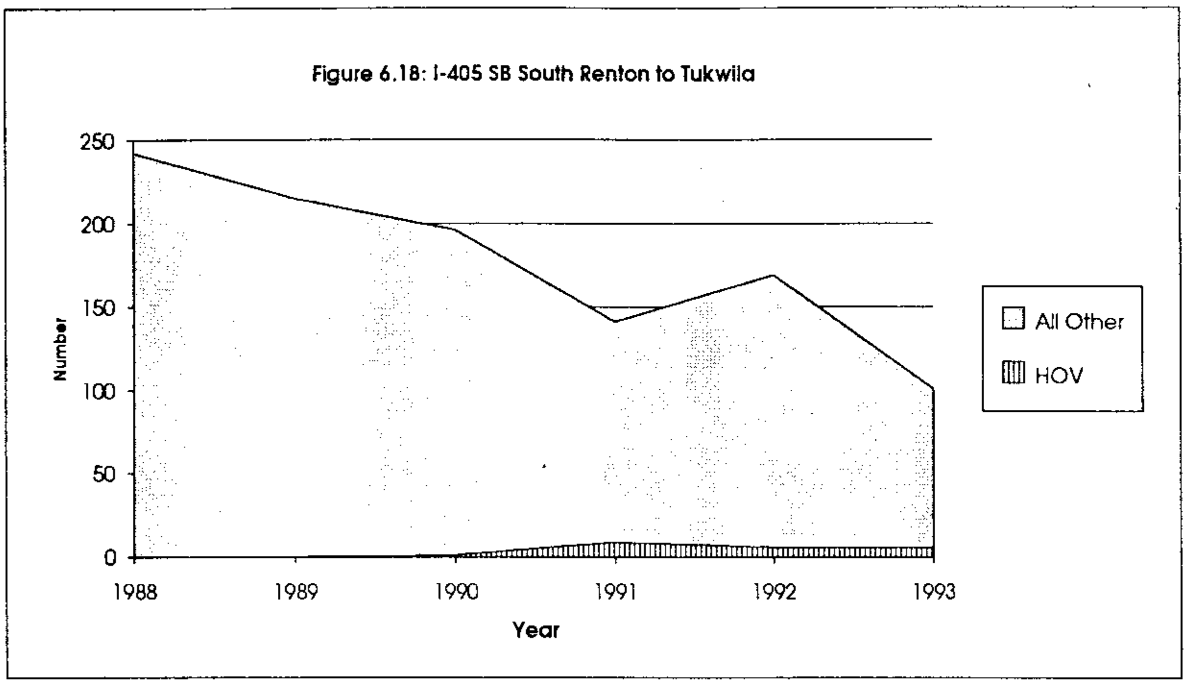
Figure 6.18: I-405 SB South Renton to Tukwila
250
200
150
100
50
0
Number
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.19: I-405 Northbound Tukwila to South Renton
Opened: November 26, 1990
Milepost Location: 0.09 to 2.76
Lane Location: Lane 3 of 3
Lane Length: 4.3 kilometers
Occupancy Designation: 2+
Proportion HOV Accidents: 47 of 1295 (3.6%)

Table 6.16: HOV Accidents by Year: I-405 NB Tukwila to South Renton

Year	1990	1991	1992	1993
Number	2	14	18	13

FIGURE 6.19 BOX TEXT: Accident patterns for this highway segment closely resemble those of the southbound segment. However, accident totals are higher for both general purpose lanes and HOV lanes. While the 0.16 kilometer stretch preceding the HOV lane accounts for only 0.5 percent of all accidents in the corridor, the 3.22-kilometer stretch following the HOV lane accounts for 33 percent of them. There does not appear to be any significant problem with the merge at the end of the HOV lane. HOV lane construction was a significant cause of accidents in 1989 and 1990. Accident records show that 135 of 253 accidents were construction-related in 1989, and construction was a factor in 93 of the 204 accidents in 1990.

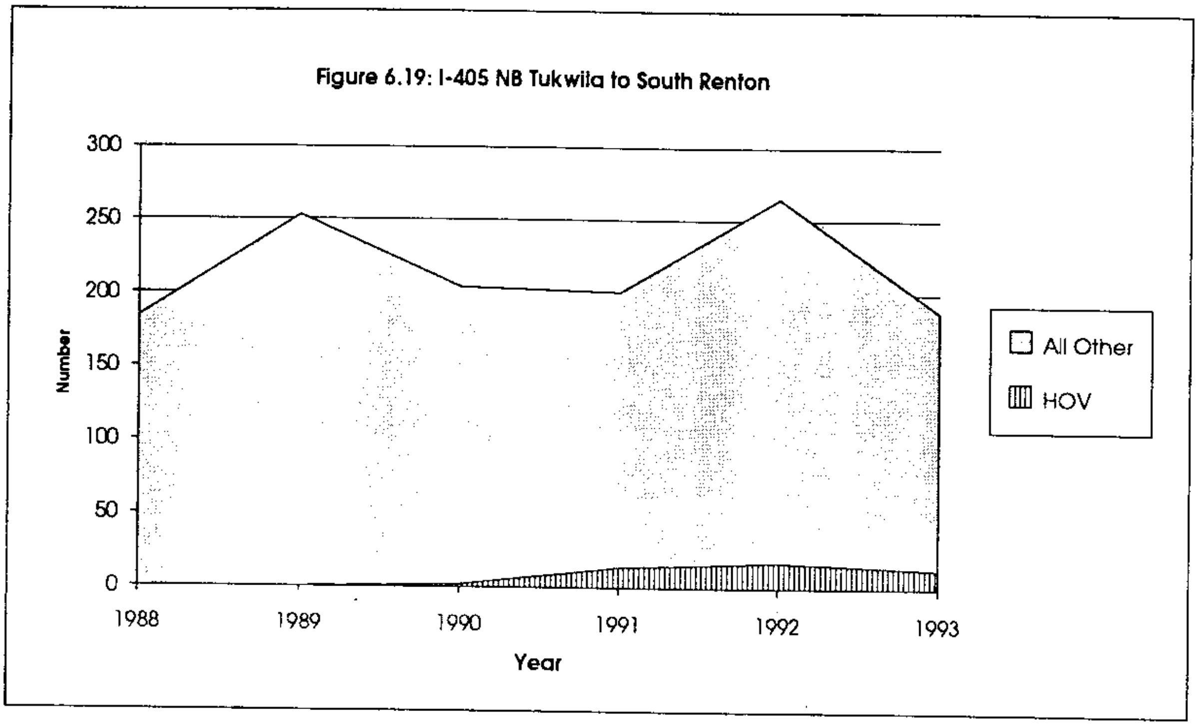
Figure 6.19: I-405 NB Tukwila to South Renton
300
250
200
150
100
50
0
Number
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

Figure 6.20: I-405 Northbound Sunset to Coal Creek
Opened: 1986
Milepost Location: 4.62 to 10.56
Lane Location: Lane 1 of 3
Lane Length: 9.56 kilometers
Occupancy Designation: 2+
Proportion HOV: 178 of 1764 (10.1%)

Table 6.17: HOV Accidents by Year: I-405 NB Sunset to Coal Creek

Year	1986	1987	1988	1989	1990	1991	1992	1993
Number	32	28	17	20	27	18	20	16

FIGURE 6.20 BOX TEXT: Accident trends for this corridor also resemble those of the southbound HOV lane. In 1985, HOV lane construction and location on the outside appear to have increased general purpose lane accidents during the time that the HOV lane was under construction. HOV lane accidents peaked in the lane's first year of operation, which suggests that drivers had difficulty adjusting to the new highway configuration. Accidents occurring just before the HOV lane accounted for 37 percent of the total, while 14 percent of all accidents occurred just following the HOV lane. This HOV lane feeds onto I-90, so there is no forced merge from the HOV lane unless travelers wish to continue north on I-405 in general purpose lanes.

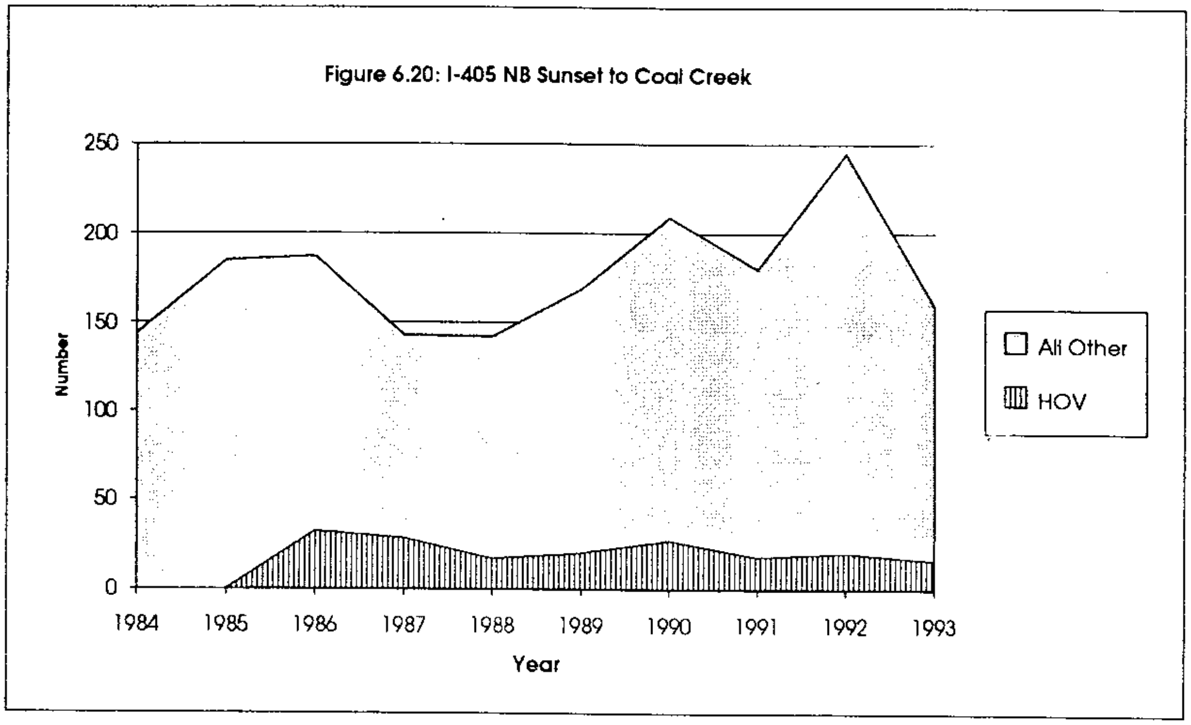
Figure 6.20: I-405 NB Sunset to Coal Creek
250
200
150
100
50
0
Number
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
All Other
HOV

ACCIDENT DATA CONCLUSIONS AND RECOMMENDATIONS

Accident patterns are erratic throughout the region, which makes it hard to generalize about accident trends. However, some summary observations appear valid.

First, HOV lanes located on the outside, or right hand side, of the highway experience more accidents than do HOV lanes located on the inside (see SR-520 and I-405 north and southbound from Sunset to Coal Creek). The problem of merging traffic entering the highway through the HOV lane onto the general purpose lanes probably accounts for much of this phenomenon. One factor that may account for lower accident levels in HOV lanes on the inside of the highway may be that vehicles that experience accidents while merging across the general purpose lanes on their way to the HOV lane are not counted as HOV accidents. However, valid conclusions about the relative safety of inside or outside depend on traffic volumes. Because traffic volumes are probably greater for HOV lanes on the outside, it is difficult to say that those lanes are less safe than inside HOV.

Second, reducing occupancy requirements does not appear to significantly worsen accident rates for either HOV or general purpose lanes. In two cases, reducing occupancy requirements was associated with an increased number of accidents: I-5 southbound from Mercer to Yesler, and I-5 southbound from Tukwila to SR-516. In the case of I-5 from Mercer to Yesler, HOV accidents increased significantly. However, in other areas, reducing occupancy requirements did not appear to result in significant safety problems.

1. Investigate the accident rates for HOV lanes on the right side of the road compared to HOV lanes on the left side of the road to determine which configuration is safer. Safety analysis of each configuration should be factored into future HOV lane planning.

2. Collect accident data on an annual or semi-annual basis, unless special studies are required. Preparing and analyzing accident data is very time-intensive, and the value of quarterly data reports may not be commensurate with the costs of preparation. Accident data from the Transportation Data Office lags three months behind the current date, making up-to-date analysis difficult.

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CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

This report represents a compilation of the data necessary to evaluate the Puget Sound area's HOV lane system. The data contained herein encompass vehicle occupancy, travel time, public opinion, transit ridership, violation and adjudication, and accident information. This report does not include volume information which are available from inductance loop detectors. Inductance loop data are needed to evaluate person throughput and accident rate information; such calculations would complement the data in this report, and together would allow for a valid evaluation of the HOV lane system.

Because this is a report of baseline data, most of the recommendations pertain to improvement of the data collection methodology. Future reports, which will highlight changes in HOV lane performance over time, will contain more substantive recommendations.

AVERAGE VEHICLE OCCUPANCY CONCLUSIONS AND RECOMMENDATIONS

Occupancy data were successfully collected from all but a few of the study sites. Where data are missing, their absence is due to an insufficient number of counts or the fact that no counts were scheduled. This happened for a number of reasons, including poor siting, inclement weather, poor visibility, having more sites than observers, and dropping some sites from the data collection menu. The impact of having too few successful counts per quarter was that when bad data rendered the counts unusable, data for the entire quarter were lost. Observations were consistently more numerous for ramp than for mainline locations, and there were more observations for GP lanes than for HOV lanes.

Factors not directly explored in this report include observer performance, and observer and data management. Because observers are unsupervised in the field, they are trusted to begin and end observations on time, and to observe and record vehicle occupancies accurately. While data quality was verified by checking individual files for "gross errors" such as misnamed files and repeats (see *HOV Monitoring and Evaluation Tool* (1)), in the future quality will be validated by comparing current site data with data collected from previous observations at the same location. As this project progresses, data will become increasingly accurate. With this in mind, the following changes are in order:

Recommendations

1. Focus a greater proportion of mainline ACO counts on HOV lanes. The number of successful counts affects the amount of quality data available, and in turn the validity of ACO figures. Increasing counts on HOV lanes in proportion to the number of GP lanes at a site would increase the validity of HOV figures, and the number of counts between HOV and GP lanes would be more evenly balanced.

2. Prioritize observations at locations that ensure the best use of resources. Safe locations that provide the best visibility over varying conditions, as well as ease of access and scheduling are obviously preferred. The question of whether counter-flow traffic patterns should be continued at existing locations or expanded at additional locations should be explored.

3. Evaluate the appropriateness of collecting vehicle occupancy data on the I-5 express lanes. Because the express lanes contain both HOV and GP lanes, "before" data for this corridor may be useful in areas where express lane expansion is planned, and would allow planners to monitor the express lanes' performance.

The occupancy data presented in this report provide valuable information in two areas: (1) the operation and performance of HOV lanes as compared to GP lanes, and (2) commuter mode choice in the greater Seattle area. Additionally, as the HOV lane system expands, areas where "before" data are now being collected will serve as baseline reference points in assessing the impact of HOV facilities on commuter mode choice. However, a caveat is in order: because loop data are more representative of traffic volumes in these corridors, the data included in this report should be used only to indicate the percentages of mode and vehicle occupancy in the corridors studied.

ACO ANALYSIS CONCLUSIONS

Many factors affect ACO. Therefore, it is important to design a sampling frame that reduces the influence of these factors. However, because it is impossible to perfectly sample all time periods, days of the week, lanes, and ramps at each location for the whole year, it is important to take these factors into account when analyzing changes in ACO.

After one year of data collection, we are beginning to have some confidence in our understanding of these differences, but additional data will be important in confirming the analyses presented herein. Because these analyses are based on only one year's worth of data, caution should be exercised in applying them. However, if one is conducting such detailed analysis, it is better to apply correction factors (see Chapter 3) than to use the raw data without adjustments.

TRAVEL TIME DATA CONCLUSIONS AND RECOMMENDATIONS

The usefulness of the travel time data presented in this report is very limited. Although the data can generally be used to compare HOV lane performance to GP lane performance, and to identify areas of congestion, a number of factors render data interpretation difficult. Vehicle speeds can only be compared by time of commute for the quarter in which they occurred. Because the data are presented as average speeds, only individual study sections may be used; the data cannot be aggregated to examine the differences between HOV and GP lanes corridor-wide. Because the speeds indicated for areas tend to vary widely from quarter to quarter, yearly averages are unreliable. To determine the number of observations required for statistically meaningful information, the standard deviation for each time period must be established. Additional data will be necessary before reliable generalizations regarding vehicle speeds can be made.

It was much more difficult and complex to collect travel time data than it was to collect vehicle occupancy data. Observers must not only be more accurate and have better visibility, they must also coordinate their efforts more carefully. Although observer absences and lateness are not discussed in this report, they further confounded the matching process, as did errors in data quality. Even with good data, matches were difficult to obtain because of normal traffic behavior (e.g. lane changes), especially over long distances. Despite the obstacles that made it difficult to collect the travel time data, the experience gained in this study indicates that travel time collection may be collected successfully under some conditions. The greatest amount of travel time data was gathered at study sections characterized by good visibility, short length, and high numbers of observations.

Recommendations

1. Use short study sections. Distances between sites should be kept to under 3 kilometers, and should be chosen to limit the number of intervening access/egress ramps.

2. Conduct observations using the express lanes. Not only do the express lanes have GP and HOV designations, they also constitute a "captive audience" in that vehicles may not exit for longer distances. As a result, it may be easier to obtain the necessary matches.

3. Data collection along the I-405 corridor should cover shorter distances and use fewer locations. For example, efforts might be more successful if observations were limited to two study sections (Tukwila Parkway and Benson Road S; 112th Avenue SE and NE 12th Street) for morning northbound and evening southbound commutes.

The travel time data in this report confirm that travel time data collection is most successful when it is limited to special studies. Even in the future, as technological improvements make it possible to collect travel time data without the use of human observers, the success of the data collection will be affected by the distance between sites, accuracy, and the number of observations.

PUBLIC OPINION SURVEY CONCLUSIONS

There is strong public support for HOV lanes in general, and for future HOV lane construction. Although there are differences of opinion on many issues between SOV drivers and HOV travelers, these differences do not undermine general support for HOV lanes among the entire survey population.

One theme evident throughout the survey was that while the public supports HOV lanes, many people feel that the lanes are underused. The results from questions 5.13 through 5.19 (see Chapter 5) should assist planners in selecting the HOV lane policies that will make the lanes more attractive to the public. Beginning in the third quarter of 1993 two new questions were added to the survey. One asked respondents about the level to which they felt HOV lanes should be opened to all traffic during non-commute hours. The other asked about the level to which they supported converting existing general purpose lanes to HOV lanes. Results from these survey questions should be valuable in assessing the desirability of these policy options.

ENFORCEMENT DATA CONCLUSIONS AND RECOMMENDATIONS

The ACO data, violation data from WSP, HERO program data, and outcome data from the district courts provide a comprehensive picture of the extent of HOV violations in the Puget Sound area. Violation rates would be the most appropriate measure for evaluation purposes because they combine the number of cars using an HOV lane with the frequency of violations. Identification of the HOV lanes with the highest violation rates would provide valuable information to WSP troopers for their enforcement efforts. The ACO data presented in Appendix B provides an indication of violation rates (the number of SOVs observed in HOV lanes). Both WSP troopers and district court judges exercise a great deal of discretion in enforcing HOV lane violations. If WSDOT or other public officials desire to increase enforcement of HOV lane restrictions, consultation with these groups is in order.

Recommendations

1. Formalize a relationship to collect enforcement data and outcome data annually from the Office of the Administrator of the Courts. These data were difficult to obtain, given that tracking HOV violation rates and enforcement outcomes is a low priority for this agency. If a relationship between WSDOT and this office were formalized for annual data reporting, it would be much easier to gather this information.

2. Conduct a special study of repeat offenders. Data on this subject may be available from district courts. Cross-referencing HERO data with violation outcome data may shed some light on the extent to which violators change their behavior after receiving a ticket.

3. Conduct a special study on highway corridors characterized by chronic violation problems. For instance, according to our ACO data, the HOV lanes on I-405 (where SR-167 merges with I-405) appear to have a very high violation rate. We believe that this is so because the traffic observation point is very close to where the highways merge, with a general purpose lane merging into an HOV lane on I-405. One way to assess the observed violation rate would be to observe traffic at that spot and at another spot one-quarter mile downstream simultaneously. Bellevue and Redmond appear to have high violation rates; these jurisdictions also have the highest number of outstanding violations among the court districts studied. Follow-up conversations with WSP officials and court clerks and judges may shed light on this trend.

ACCIDENT DATA CONCLUSIONS AND RECOMMENDATIONS

Accident patterns are erratic throughout the region, which makes it hard to generalize about accident trends. However, some summary observations appear valid.

First, HOV lanes located on the outside, or right hand side, of the highway experience more accidents than do HOV lanes located on the inside (see SR-520 and I-405 north and southbound from Sunset to Coal Creek). The problem of merging traffic entering the highway through the HOV lane onto the general purpose lanes probably accounts for much of this phenomenon. One factor that may account for lower accident levels in HOV lanes on the inside of the highway may be that vehicles that experience accidents while merging across the general purpose lanes on their way to the HOV lane are not counted as HOV accidents. However, valid conclusions about the relative safety of inside or outside depend on traffic volumes. Because traffic volumes are probably greater for outside HOV lanes, it is difficult to say that those lanes are less safe than inside HOV lanes.

Second, reducing occupancy requirements does not appear to significantly worsen accident rates for either HOV or general purpose lanes. In two cases, reducing occupancy requirements was associated with an increased number of accidents: I-5 southbound from Mercer to Yesler, and I-5 southbound from Tukwila to SR-516. In the case of I-5 from Mercer to Yesler, HOV accidents increased significantly. However, in other areas, reducing occupancy requirements did not appear to cause significant safety problems.

Recommendations

1. Investigate the accident rates for HOV lanes on the right side of the road compared to HOV lanes on the left side of the road to determine which configuration is safer. Safety analysis of each configuration should be factored into future HOV lane planning.

2. Collect accident data on an annual or semi-annual basis, unless special studies are required. Preparing and analyzing accident data is very time-intensive, and the value of quarterly data reports may not be commensurate with the costs of preparation. Accident data from the Transportation Data Office lags three months behind the current date, making up-to-date analysis difficult.

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- Community Transit, for transit ridership data,
- Pierce Transit, for transit ridership data,
- the Washington State Administrator of the Courts, for adjudication data,
- the Washington State Department of Transportation, Traffic Data Office for accident data, and
- the Washington State Patrol, for violation and accident data.

The authors also express their appreciation to TRAC staff, including Duane Wright, Ron Porter, Amy O'Brien, and Stephanie MacLachlan for their assistance in formatting the numerous tables and diagrams, as well as editing the body of this report. Eldon L. Jacobson, WSDOT--Advanced Technology Branch, and Barbara Miller, former Observations Manager, were valuable resources. Barbara also put in long hours scouting sites during this project's startup phase, and she assembled many of the lane diagrams. Our thanks also to Pat Purvis for his assistance as Observations Manager. Finally, this report is dedicated to the traffic observers. Their many hours spent counting cars in all kinds of weather, provided much of the data, without which this report would not have been possible.

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4. Personal communication, Barbara Miller (HOV Monitoring and Evaluation Observations Manager, July, 1992 - June, 1993), November 24, 1993.

APPENDIX A

ACO AND TRAVEL TIME OBSERVATION SITES

Table A1. All Observation Sites, July 1992 - July 1993

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
11 = SW 236th St	21a = Lakeview Blvd. 21b = Roanoke	31 = S 178th St
12 = N 185th St	22 = Holgate St	32 = S 188th/Orilla Rd
13 = N 175th St	23 = Michigan St.	33 = S 200th St
14 = N 145th St	24 = Corson Ave. S.	34 = S 216th St
15 = N 117th St	25 = Albro Pl	35 = SR-516 -Kent/Des Moines Rd
16 = Northgate Wy	26 = S 144th St	36 = SR-516 -Kent Ramp
	27 = Olive St	37 = SR-516 -Des Moines Ramp
	28 = Howell & Yale	38 = S 260th St
	29 = Madison St	39 = S 272nd St
	20 = Stewart St	
SR 520 (corridor 4)	**I-90 (corridor 5)**	**I-405 South (corridor 6)**
41 = Hunt's Point	51 = 23rd Ave S	61 = Tukwila Pkwy
42 = Yarrow Point	52 = 35th Ave S	62 = SR-167 -Renton
43 = Sr-908 -Bellevue/Kirkland	53 = 60th Ave SE/W Mercer Wy	63 = Benson Rd S
44 = 124th Ave NE	54 = Island Crest Wy	64 = S Park Dr
45 = 148th Ave NE	55 = East Mercer Wy	65 = 112th Ave SE/Lake Wash. Bvd
46 = 148th -Redmond Ramp	56 = Bellevue Wy	
47 = 148th -Bellevue Ramp		
I-405 Central (corridor 7)	**I-405 South (corridor 8)**	**Outlying Locations**
71 = SE 8th St.	81 = SR 908 -Kirkland/Redmond	
72 = NE 8th St		
73 = NE 12th St		

Table A2. Observation Sites: Beginning Date of Study

Corridor	Location	Q3/92	Q4/92	Q1/93	Q2/93	Q3/93
I-5 North						
	236th St. SW	7/28/92				
	NE 185th St.	7/1/92				
	NE 175th St.	6/22/92				
	NE 145th St.	6/22/92				
	NE 117th St.	6/25/92				
	NE Northgate Wy.	6/25/92				
I-5	Downtown					
	Lakeview Blvd. E	7/1/92				
	Roanoke St.			4/7/93		
	S Holgate St.	6/23/92				
	Michigan St.	6/26/92				
	Corson Ave. S	6/23/92				
	Albro Pl.	6/26/92				
	S 144th St.	7/9/92				
	Olive St.		9/22/92			
	Howell/Yale Sts.		9/29/92			
	Madison St.		12/18/92			
	Stewart St.		12/28/92			
I-5 South						
	S 178th St.	7/2/92				
	S 188th St./ Orilla Rd.	6/23/92				
	S 200th St.	7/31/92				
	S 216th St.	6/23/92				
	SR 516 -Kent/DesMoines Ramp	7/7/92				
	SR 516 -Kent Ramp	7/29/92				
	SR 516 -DesMoines Ramp	8/5/92				
	S 260th St.	7/14/92				
	S 272nd St.	6/23/92				
SR-520						
	Hunt's Point	7/7/92				
	Yarrow Point	6/24/92				
	SR-908 -Bellevue/ Kirkland	6/24/92				
	124th Ave NE.	6/24/92				
	148th Ave NE.	7/27/92				
	148th Ave NE/ Redmond Ramp	7/9/92				
	148th Ave NE/ Bellevue Ramp	7/13/92				
I-90						
	23rd Ave S	6/29/92				
	35th Ave S	6/29/92				

The column headings Q3/92 through Q3/93 appear under the spanning heading "Quarter/Beginning Date".

	60th Ave SE/ W Mercer Wy.	6/29/92				
	Island Crest Wy.	6/24/92				
	E Mercer Wy.	7/2/92				
	Bellevue Wy.	7/28/92				
	Newport Wy.					8/2/93
	Front St.					8/16/93
	142nd					9/21/93
	SR 900					9/21/93
I-405	**South**					
	Tukwila Pkwy.	6/25/92				
	SR-167	6/30/92				
	Benson Rd.	8/3/92				
	S Park Dr.	7/10/92				
	112th Ave SE	6/22/92				
I-405	**Central**					
	SE 8th St.	7/10/92				
	NE 8th St.	8/17/92				
	NE 12th St.	7/22/92				
I-405	**North**					
	SR-908	7/8/92				
Outlying	**Sites**					
	I-5N @ 112th SE-Everett					8/9/93
	I-5S @ Fife					8/26/93
	I-5S @ Tacoma Mall					9/20/93
	SR-16 @ Tacoma Narrows Br.					8/12/93
	SR-512 @ Ainsworth					9/22/93
	SR-410 @ Valley Ave.					9/21/93
	SR-167 @ 37th NW -Auburn					9/27/93
	SR-167 @ S 208th -Kent					8/3/93

TABLE A3. Phase II Observation Sites

July, 1993--June, 1994

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
11 = SW. 236th St.	21 = Roanoke St.	31
12	22 = S Holgate St.	32
13 = NE 175th St.	23 = Michigan St.	33 = S 200th St.
14 = NE 145th St.	24 = Corson Ave. S	34 = S 216th St.
15	25 = Albro Pl.	35 = SR 516 --Kent / DesMoines Rd.
16 = NE Northgate Wy.	26	36 = SR 516 --Kent Ramp
	27 = Olive St.	37 = SR 516 --DesMoines Ramp
	28 = Howell & Yale	38
	29 = Madison St.	39 = S 272nd St.
	20 = Stewart St.	
SR-520 (corridor 4)	**I-90 (corridor 5)**	**I-405 South (corridor 6)**
41 = Hunt's Point	51	61 = Tukwila Pkwy. --Southcenter
42 = Yarrow Point	52	62 = SR-167 -Renton
43 = SR-908 -Bellevue/Kirkland	53 = 60th Ave SE/W. Mercer Wy.	63
44 = 124th Ave NE.	54 = Island Crest Wy.	64 = S Park Dr.
45 = 148th Ave NE.	55 = E Mercer Wy.	65 = 112th Ave SE /Lake Washington
46 = 148th -Redmond Ramp	56 = Bellevue Wy.	
47 = 148th -Bellevue Ramp	57 = Newport Wy. --Issaquah	
	58 = Front St. --Issaquah	
	59 = 142nd Ave.	
	50 = SR-900	
I-405 Central (corridor 7)	**I-405 North (corridor 8)**	**Outlying Locations (corridor 9)**
71 = SE 8th St. -Bellevue	81 = SR-908 --Kirkland/Redmond	91 = I-5N @ 112th SE --Everett
72 = NE 8th St.		92 = I-5S @ Fife
73 = NE 12th St.		93 = I-5S @ Tacoma Mall
		94 = SR-16 @ Tacoma Narrows Br.
		95 = SR-512 @ Ainsworth/Steele
		96 = SR-410 @ Valley Ave --Sumner
		97 = SR-167 @ 37th NW --Auburn
		98 = SR-167 @ S 208th --Kent

*Site numbers with no designation indicate discontinued sites.

APPENDIX B

ACO DATA

TABLE B1. Phase I Vehicle Occupancy Mainline and Ramp Observation Sites

July, 1992--June, 1993

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
11 = SW. 236th St.	21a = Lakeview Blvd.	
	21b = Roanoke St.	32 = S 188th St. / Orilla Rd.
13 = NE 175th St.	22 = S Holgate St.	33 = S 200th St.
14 = NE 145th St.	23 = Michigan St.	34 = S 216th St.
	24 = Corson Ave. S	35 = SR 516 --Kent / DesMoines Rd.
16 = NE Northgate Wy.	25 = Albro Pl.	36 = SR 516 --Kent Ramp
	26 = S 144th St	37 = SR 516 --DesMoines Ramp
	27 = Olive St.	
	28 = Howell & Yale	39 = S 272nd St.
	29 = Madison St.	
	20 = Stewart St.	

SR-520 (corridor 4)	I-90 (corridor 5)	I-405 South (corridor 6)
41 = Hunt's Point		61 = Tukwila Pkwy. --Southcenter
42 = Yarrow Point		62 = SR-167 --Renton
43 = SR-908 --Bellevue / Kirkland	53 = 60th Ave. SE / W. Mercer Wy.	
44 = 124th Ave NE.	54 = Island Crest Wy.	64 = S Park Dr.
45 = 148th Ave NE.	55 = E Mercer Wy.	65 = 112th Ave SE /Lake Washington
46 = 148th --Redmond Ramp	56 = Bellevue Wy.	
47 = 148th --Bellevue Ramp		

I-405 Central (corridor 7)	I-405 North (corridor 8)	Outlying Locations (corridor 9)
71 = SE 8th St. --Bellevue	81 = SR-908 --Kirkland / Redmond	
72 = NE 8th St.		
73 = NE 12th St.		

TABLE B2. Phase I Vehicle Occupancy Mainline Observation Sites

July, 1992--June, 1993

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
	21a = Roanoke St.	
	21b = Lakeview Blvd.	
	22 = S Holgate St.	
14 = NE 145th St.		34 = S 216th St.
	25 = Albro Pl.	
	26 = S 144th St.	
	29 = Madison St.	
SR-520 (corridor 4)	**I-90 (corridor 5)**	**I-405 South (corridor 6)**
		61 = Tukwila Pkwy. --Southcenter
42 = Yarrow Point		
	54 = Island Crest Wy.	
45 = 148th Ave NE.		65 = 112th Ave SE / Lake Washington
I-405 Central (corridor 7)	**I-405 North (corridor 8)**	**Outlying Locations (corridor 9)**
	81 = SR-908	
73 = NE 12th St.		

TABLE B3. Phase I Vehicle Occupancy Ramp Observation Sites

July, 1992--June, 1993

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
11 = SW. 236th St.	21a = Roanoke St.	
	21b = Lakeview Blvd.	32 = S 188th St.
13 = NE 175th St.		33 = S 200th St.
14 = NE 145th St.	23 = Michigan St.	
	24 = Corson Ave. S	35 = SR 516 --Kent/DesMoinse Rd.
16 = NE Northgate Wy.		36 = SR 516 --Kent Ramp
		37 = SR 516 --DesMoines Ramp
	27 = Olive St.	
	28 = Howell & Yale	39 = S 272nd St.
	29 = Madison St.	
	20 = Stewart St.	
SR-520 (corridor 4)	**I-90 (corridor 5)**	**I-405 South (corridor 6)**
41 = Hunt's Point		
		62 = SR-167 -Renton
43 = SR-908 -Bellevue/Kirkland	53 = 60th Ave SE/W. Mercer Wy.	
44 = 124th Ave NE.	54 = Island Crest Wy.	64 = S Park Dr.
	55 = E Mercer Wy.	65 = 112th Ave SE /Lake Washington
46 = 148th -Redmond Ramp	56 = Bellevue Wy.	
47 = 148th -Bellevue Ramp		
I-405 Central (corridor 7)	**I-405 North (corridor 8)**	**Outlying Locations (corridor 9)**
71 = SE 8th St. -Bellevue	81 = SR-908 --Kirkland/Redmond	
72 = NE 8th St.		

Figure B1. Vehicle Occupancy (ACO) Sites
I-5 North (Corridor #1)

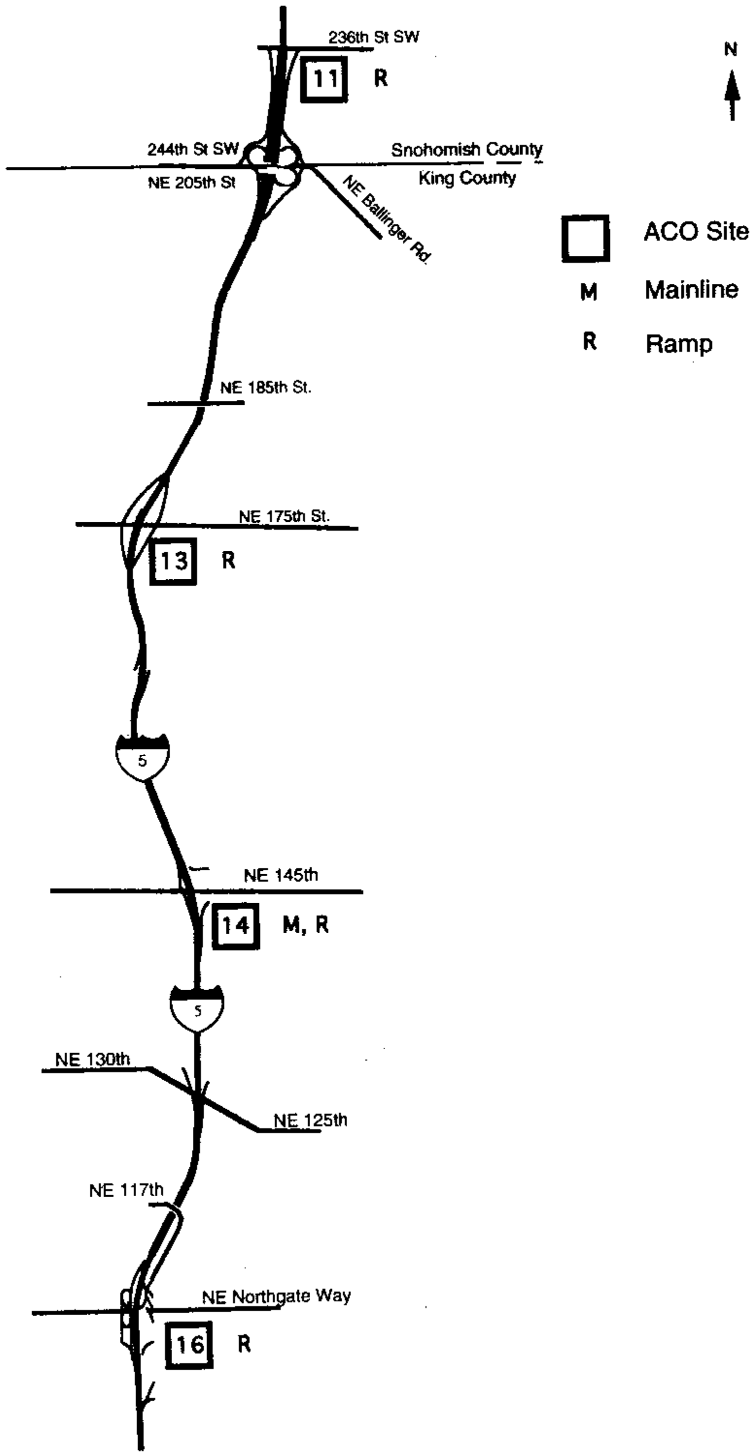


Figure B2. I-5 NORTH - 236th Street SW — SITE #11

ACO on/ramp SB-am
ACO off/ramp NB-pm

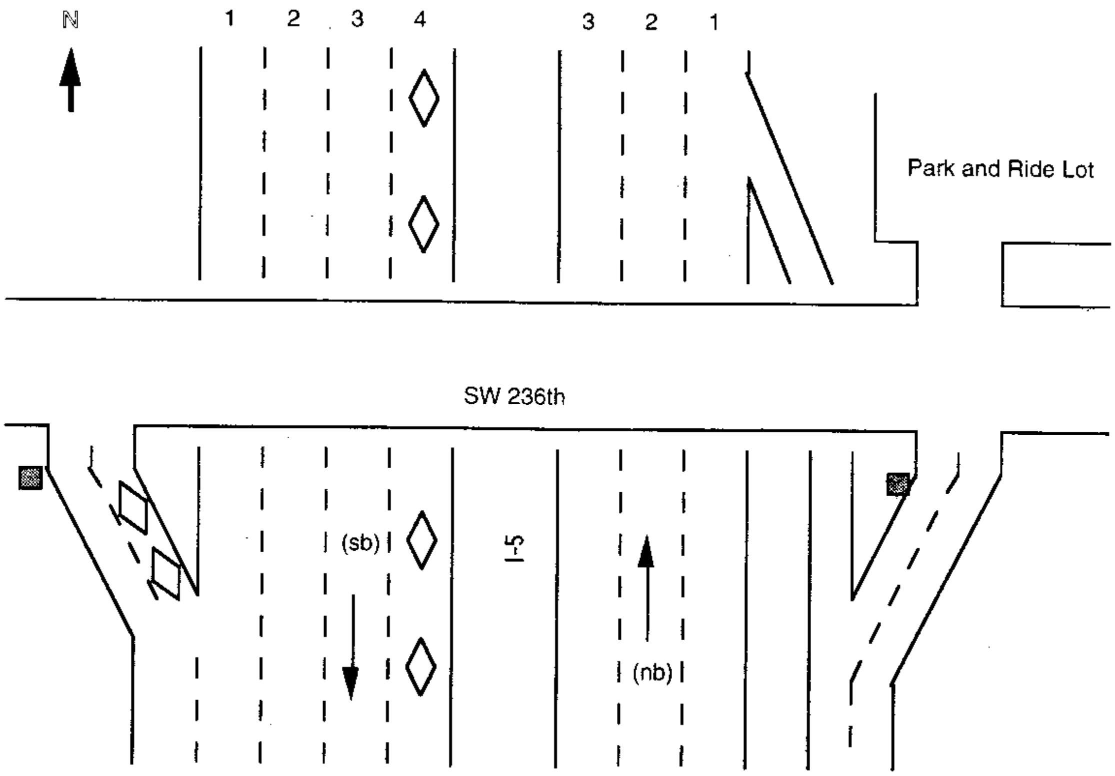


Table B2. North I-5 236th St. SW a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2929	554	103	32	6	16	20	27	8	28	**3723**	**1.24**	**12**
	Q4/92	3200	962	69	11	15	39	7	27	2	15	**4347**	**1.27**	**14**
	Q1/93	1447	440	78	17	9	18	7	17	1	13	**2047**	**1.33**	**6**
	Q2/93	2146	500	75	29	11	24	6	32	2	16	**2841**	**1.27**	**9**
														41

Table B3. North I-5 236th St. SW p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	5485	1456	256	107	45	28	2	74	2	71	**7526**	**1.32**	**14**
	Q4/92	1867	311	39	15	20	6	2	26	1	10	**2297**	**1.20**	**4**
	Q1/93	7875	1603	227	49	60	37	9	126	6	32	**10024**	**1.23**	**20**
	Q2/93	No observations*										--		
														38

Figure B3. I-5 NORTH - North 175th Street — SITE #13

■ ACO on/ramp SB-am
■ ACO off/ramp NB-pm

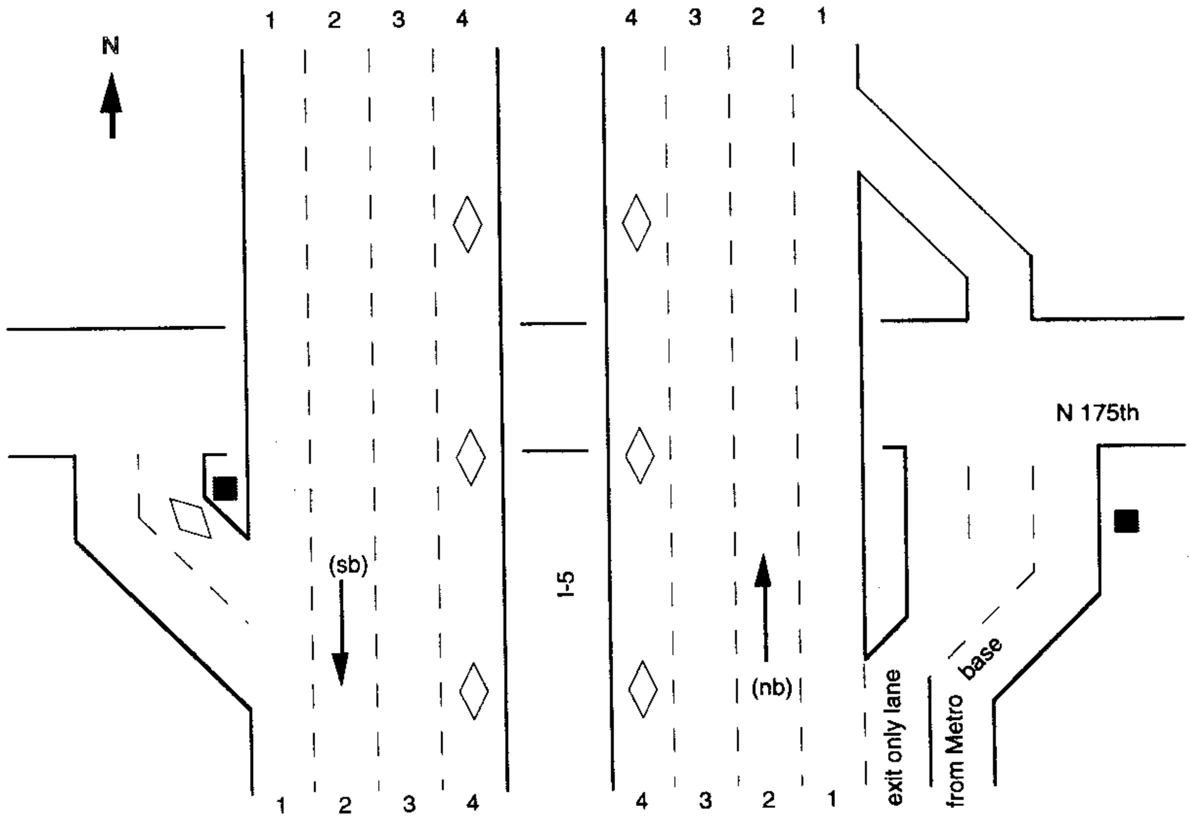


Table B4. North I-5 NE 175th St. a.m. southbound

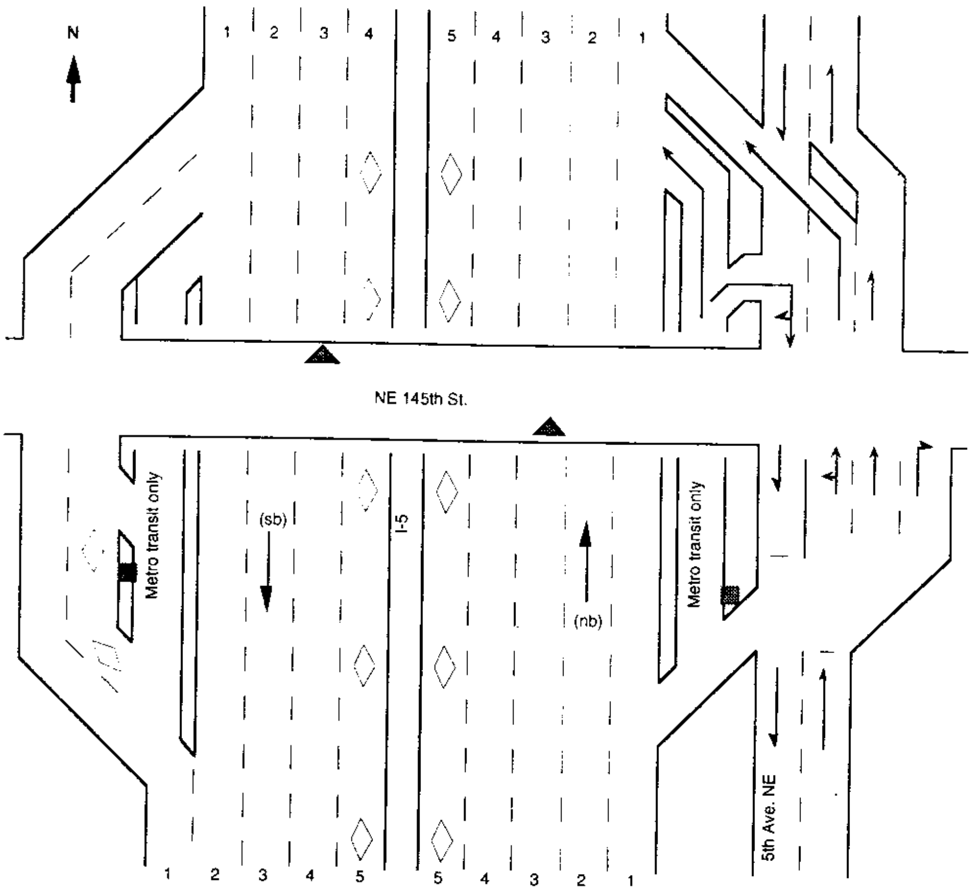
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	8033	1572	223	49	9	81	1	120	69	59	**10216**	**1.22**	**26**
	Q4/92	6170	1167	72	19	6	63	2	74	48	34	**7655**	**1.18**	**17**
	Q1/93	1724	221	23	2	2	15	2	22	10	6	**2027**	**1.14**	**4**
	Q2/93	1224	292	54	15	4	15	0	21	10	4	**1657**	**1.28**	**5**
														52

Table B5. North I-5 NE 175th St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	9367	1662	308	136	13	62	9	101	33	64	**11755**	**1.24**	**18**
	Q4/92	5466	714	62	19	14	35	5	75	24	12	**6426**	**1.14**	**13**
	Q1/93	14713	1865	183	63	19	89	13	126	40	36	**17147**	**1.14**	**30**
	Q2/93	4928	758	90	41	8	33	2	73	10	23	**5966**	**1.18**	**9**
														70

Figure B6. I-5 NORTH - Northeast 145th Street **SITE #14**

▲ ACO mainline SB-am & NB-pm
■ ACO on/ramp SB-am
■ ACO off/ramp NB-pm



Note: To count on the southbound entrance ramp in the morning, walk across the overpass from the substation. On the west end and south side of the overpass, there is a sidewalk leading half a block down the ramp to a bus shelter. You can sit by the concrete wall to count traffic to your left. You will also need to count the buses using the transit-only lane to your right.

To count on the northbound exit ramp in the afternoon, walk across the street from the substation so you are on the west side of 5th NE and the south side of N 145th. You have to walk down the grassy strip about a block, so that you count only the traffic exiting from the freeway, and the traffic from 5th NE which merges at this point.

Table B6. North I-5 NE 145th St. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV	Q3/92	12	654	105	33	4	18	18	2	0	28	**874**	**2.21**	**2**
lanes	Q4/92	72	842	94	7	9	43	2	15	0	27	**1111**	**2.04**	**3**
1	Q1/93	14	1180	71	11	10	55	6	3	0	28	**1378**	**2.06**	**2**
	Q2/93	44	1865	173	54	6	97	3	18	1	53	**2314**	**2.12**	**4**
														11
GP	Q3/92	5354	379	36	8	0	16	4	67	105	12	**5981**	**1.08**	**7**
lanes	Q4/92	4042	255	31	5	2	6	0	61	58	2	**4462**	**1.08**	**5**
3	Q1/93	6229	356	12	1	1	4	1	89	130	6	**6829**	**1.06**	**7**
	Q2/93	11174	680	41	14	6	15	8	228	234	20	**12420**	**1.07**	**15**
														34

Table B7. North I-5 NE 145th St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV	Q3/92	18	652	121	32	10	33	3	1	1	37	**908**	**2.21**	**2**
lanes	Q4/92	7	841	37	6	6	34	5	5	2	13	**956**	**2.05**	**2**
1	Q1/93	2	624	61	17	3	30	0	3	0	10	**750**	**2.14**	**1**
	Q2/93	25	1109	141	51	17	37	4	18	0	45	**1447**	**2.17**	**2**
														7
GP	Q3/92	4187	649	80	40	1	7	2	83	76	12	**5137**	**1.19**	**11**
lanes	Q4/92	4036	396	33	15	1	6	2	78	61	5	**4633**	**1.11**	**7**
4	Q1/93	4968	648	32	3	3	11	2	70	96	5	**5838**	**1.13**	**10**
	Q2/93	8752	939	51	17	7	11	3	1165	152	8	**11105**	**1.11**	**16**
														44

Table B8. North I-5 NE 145th St. a.m. southbound

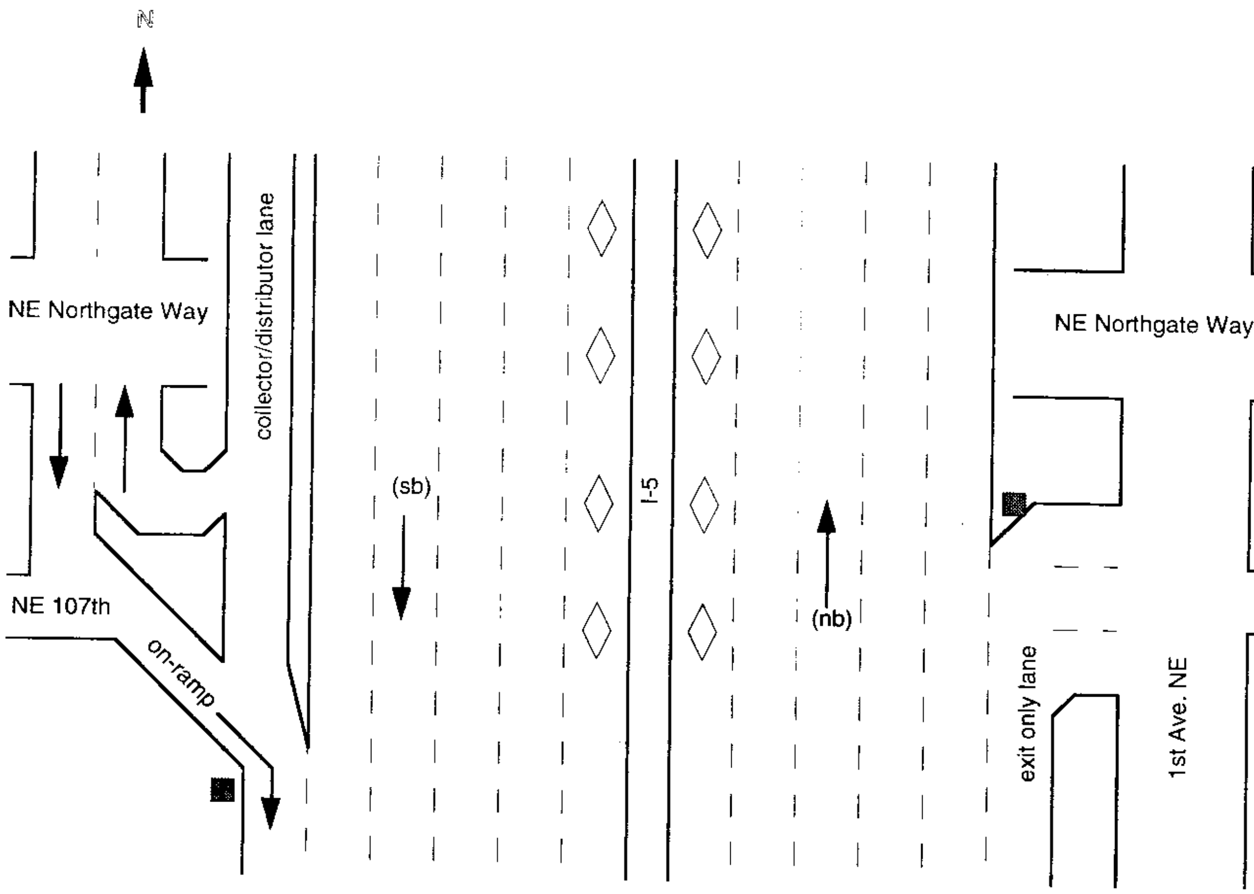
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On	Q3/92	10190	1307	185	66	17	52	13	120	43	56	**12049**	**1.16**	**17**
ramp	Q4/92	7178	885	98	36	6	57	10	59	39	12	**8379**	**1.15**	**14**
	Q1/93	5050	571	56	26	9	30	12	54	14	6	**6328**	**1.12**	**8**
	Q2/93	8761	1049	73	22	3	45	5	123	37	29	**10147**	**1.13**	**12**
														51

Table B9. North I-5 NE 145th St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off	Q3/92	4779	896	170	79	14	2	2	56	14	43	**6055**	**1.25**	**12**
ramp	Q4/92	6332	1048	108	27	11	17	7	73	18	16	**7657**	**1.18**	**14**
	Q1/93	9256	1586	193	70	11	34	13	1948	19	23	**13153**	**1.20**	**23**
	Q2/93	2059	465	47	16	0	18	1	17	4	8	**2635**	**1.24**	**5**
														54

Figure B5. I-5 NORTH - NE Northgate Way — SITE #16

■ **ACO on/ramp SB-am**
■ **ACO off/ramp NB-pm**



Note: Counting the southbound on/ramp traffic means you have to count all the cars on the collector/distributor lane. To do this, walk down the ramp until the c/d lane merges into one, and sit behind the jersey barrier for safety.

Table B10. North I-5 Northgate a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2807	569	85	20	11	7	8	62	18	19	**3606**	**1.23**	**13**
	Q4/92	2386	362	44	18	1	3	9	46	4	6	**2879**	**1.18**	**13**
	Q1/93	2040	294	25	5	5	5	9	41	7	9	**2440**	**1.15**	**8**
	Q2/93	1339	182	25	10	0	1	6	408	10	5	**1986**	**1.17**	**11**
														45

Table B11. North I-5 Northgate p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	3998	1161	240	112	5	9	4	36	19	32	**5616**	**1.36**	**14**
	Q4/92	5038	1124	179	58	1	22	5	117	17	9	**6570**	**1.26**	**14**
	Q1/93	4475	931	88	43	6	17	2	42	10	9	**5623**	**1.22**	**14**
	Q2/93	3329	775	71	24	1	9	6	24	20	16	**4244**	**1.24**	**10**
														52

Figure B6. Vehicle Occupancy (ACO) Sites
I-5 Downtown (Corridor #2N)

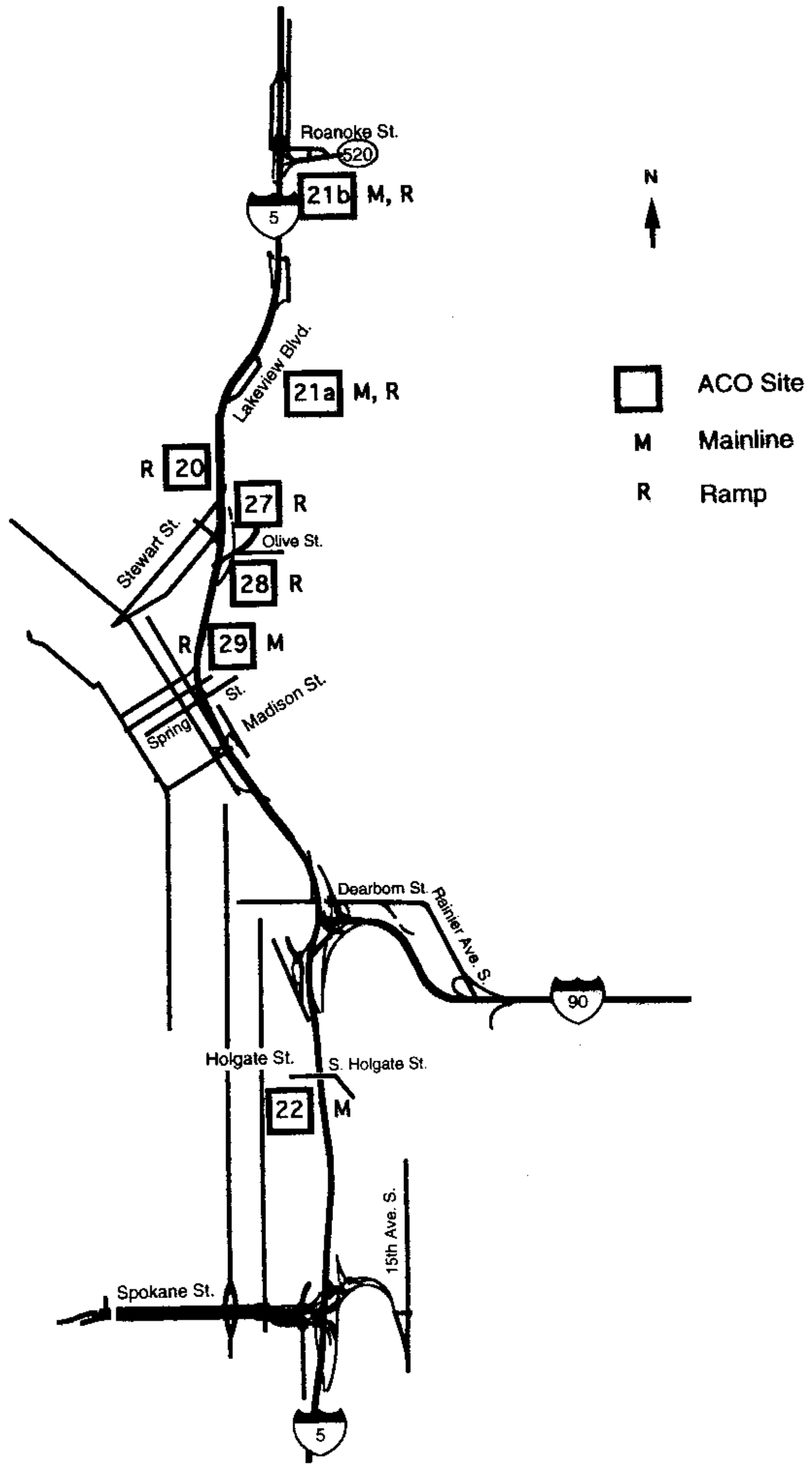


Figure B6. Vehicle Occupancy (ACO) Sites (cont.)
I-5 Downtown (Corridor #2S)

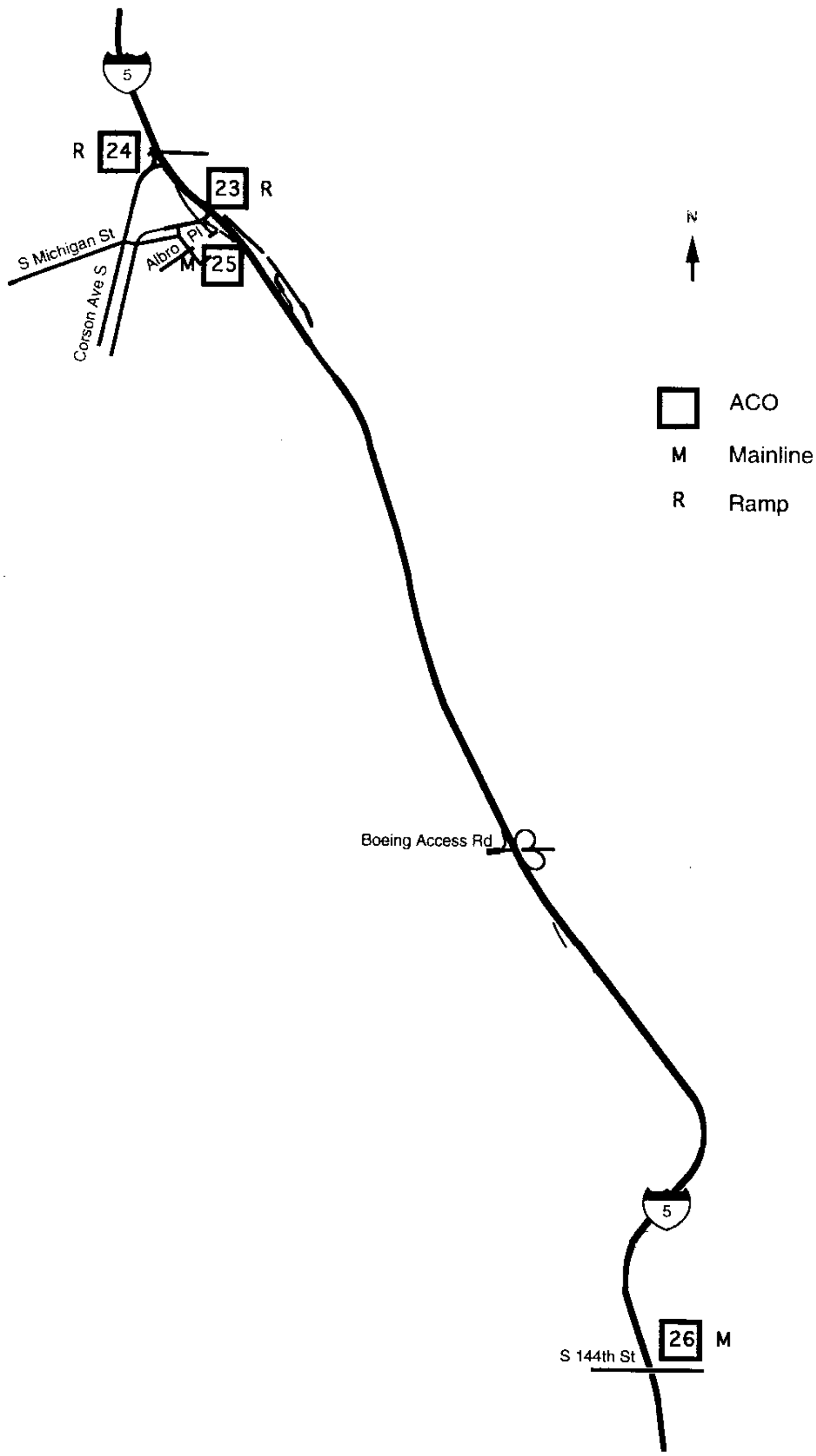


Figure B7. I-5 DOWNTOWN - Lakeview Boulevard — SITE #21a

ACO mainline SB pm
ACO mainline NB am
ACO off/ramp SB-am
ACO off/ramp NB-pm

(no diagram available at this time)

Table B12. Downtown I-5 Lakeview Blvd. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	576	209	11	4	0	0	0	10	41	8	**859**	**1.30**	**1**
lanes	Q4/92	No observations*										--		
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														1

Table B13. Downtown I-5 Lakeview Blvd. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	1004	202	19	3	2	20	2	46	53	4	**1355**	**1.20**	**4**
lanes	Q4/92	No observations*										--		
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														4

Table B14. Downtown I-5 Lakeview Blvd. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	3428	609	49	19	4	33	13	43	41	30	**4269**	**1.19**	**6**
lanes	Q4/92	2427	228	1	0	4	8	3	11	35	1	**2718**	**1.09**	**4**
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														10

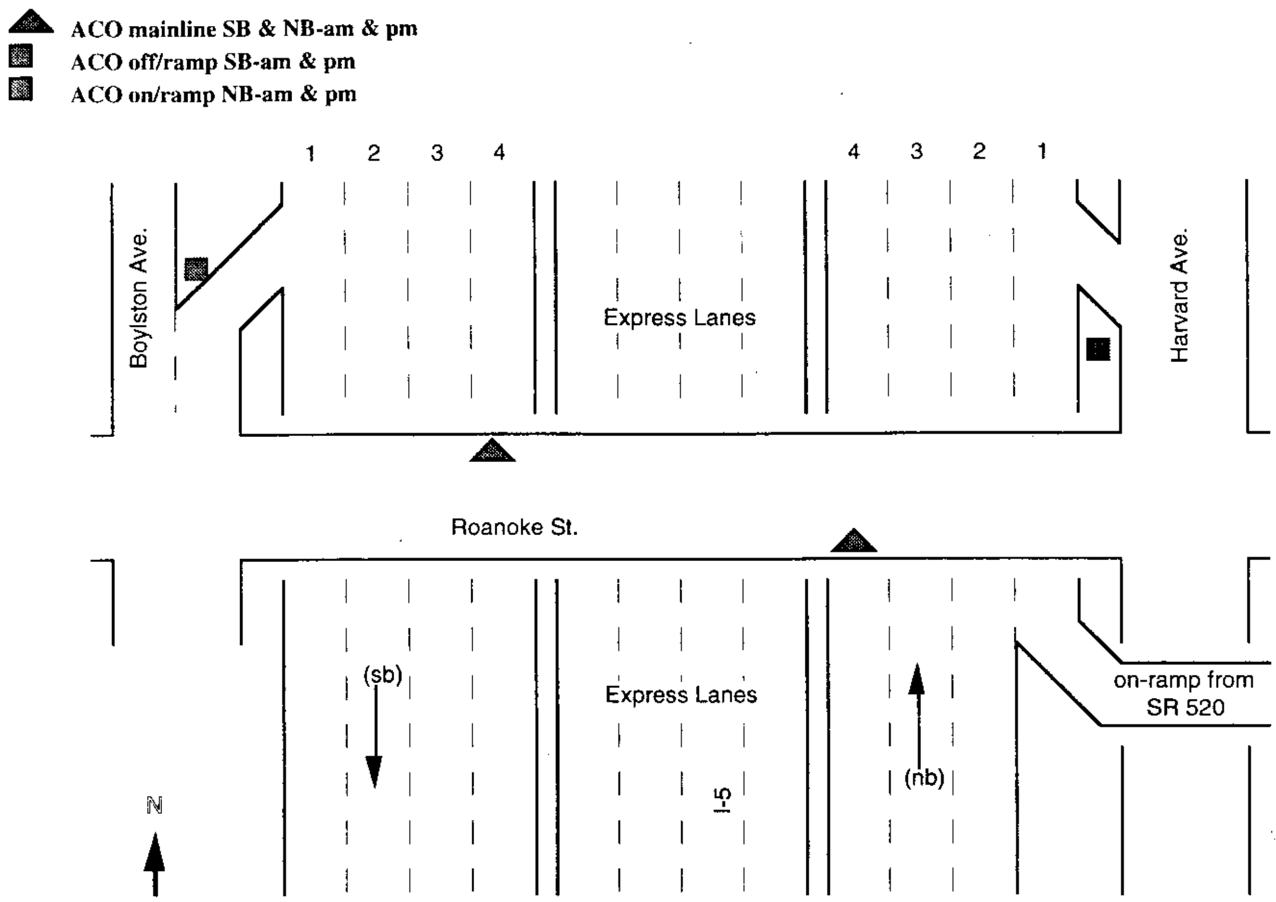
Table B15. Downtown I-5 Lakeview Blvd. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off	Q3/92	6922	614	46	9	1	0	5	106	48	30	**7781**	**1.10**	**17**
ramp	Q4/92	1708	377	43	8	1	0	1	28	12	5	**2183**	**1.23**	**3**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														20

Table B16. Downtown I-5 Lakeview Blvd. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On	Q3/92	7244	1440	188	29	2	0	5	54	20	29	**9011**	**1.21**	**14**
ramp	Q4/92	3510	403	23	7	0	0	0	56	8	13	**4020**	**1.12**	**7**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														21

Figure B8. I-5 DOWNTOWN - Roanoke Boulevard **SITE #21b**



Note: Do not count the express lanes at all in this location. The off/ramp southbound merges with traffic on Boylston Avenue East. You have to sit someplace where you can see clearly only the ramp traffic.

Table B18. Downtown I-5 Roanoke Blvd. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	9057	864	58	9	7	23	14	177	201	10	**10420**	**1.10**	**17**
	Q2/93	1987	195	17	2	0	5	3	41	32	6	**2288**	**1.11**	**4**
														21

Table B19. Downtown I-5 Roanoke Blvd. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	No observations*										--		
	Q2/93	2562	871	61	3	4	47	21	1530	74	19	**5192**	**1.29**	**9**
														9

Table B20. Downtown I-5 Roanoke Blvd. a.m. northbound

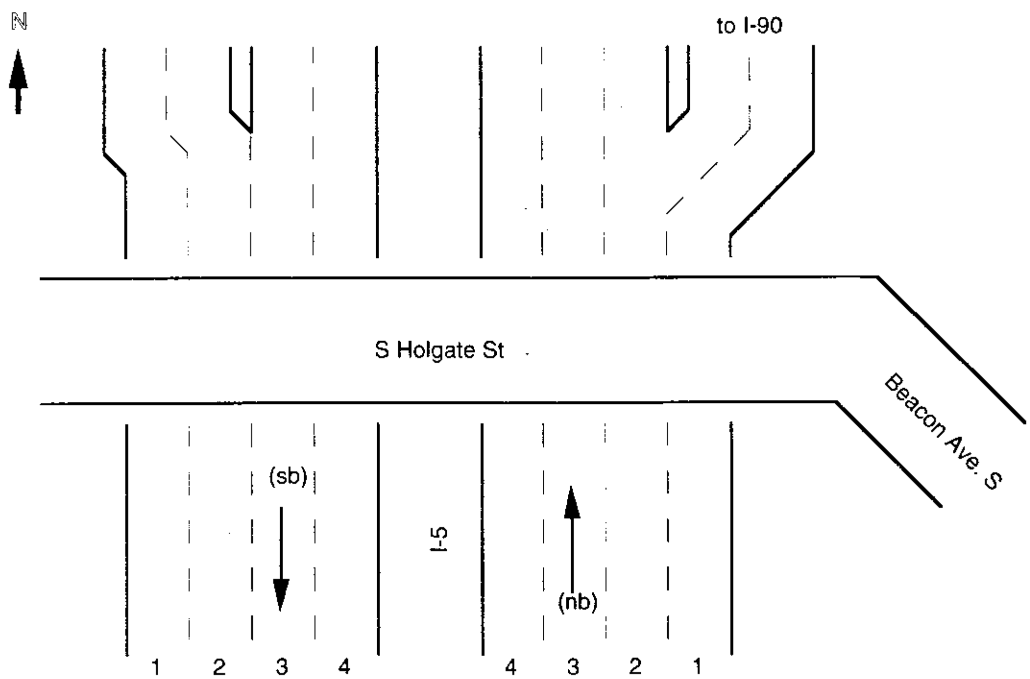
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	664	61	7	2	0	4	0	19	19	4	**780**	**1.11**	**2**
	Q2/93	1814	344	12	6	0	34	15	113	169	11	**2518**	**1.18**	**5**
														7

Table B21. Downtown I-5 Roanoke Blvd. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	7645	1951	104	20	5	19	13	2061	152	39	**12009**	**1.23**	**16**
	Q2/93	8018	1749	126	18	7	19	17	152	152	33	**10291**	**1.21**	**14**
														30

Figure B9. I-5 DOWNTOWN - S. Holgate Street — SITE #22

ACO Mainline SB & NB-am & pm



Note: There is a sidewalk only on the north side of Holgate over the freeway, so counting northbound travel times must be done with traffic moving away from you. The southbound lanes are on a considerably lower level than the northbound lanes, and are consequently somewhat harder to see.

Table B22. Downtown I-5 S. Holgate St. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	4751	625	23	5	14	41	8	90	126	11	**5694**	**1.13**	**8**
lanes	Q4/92	3292	312	19	7	2	58	10	95	111	7	**3913**	**1.10**	**6**
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														14

Table B23. Downtown I-5 S. Holgate St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	12011	3874	529	87	16	30	43	252	371	103	**17316**	**1.32**	**24**
lanes	Q4/92	7108	1689	144	61	17	12	21	182	194	30	**9458**	**1.24**	**16**
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														40

Table B24. Downtown I-5 S. Holgate St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	2436	436	33	21	8	4	7	73	103	13	**3134**	**1.19**	**6**
lanes	Q4/92	1246	310	28	4	13	10	34	78	70	11	**1804**	**1.24**	**4**
4	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														10

Table B25. Downtown I-5 S. Holgate St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 4	Q3/92	2762	602	64	25	7	7	6	55	81	37	**3646**	**1.24**	**5**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														5

Figure B10. I-5 DOWNTOWN - Michigan St. SITE #23

- ACO onramp NB-am
- ACO onramp NB-pm

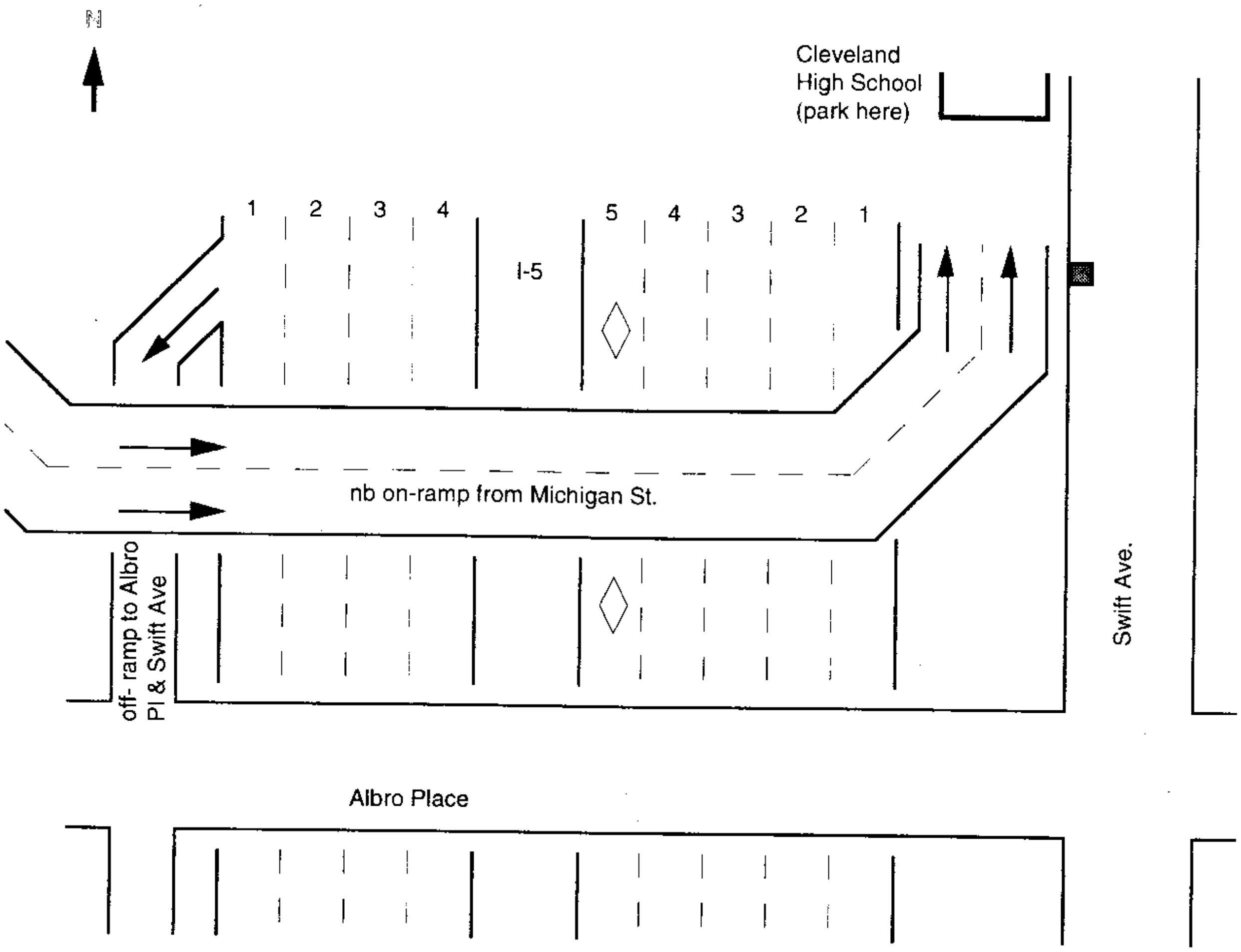


Table B26. Downtown I-5 Michigan St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2037	414	62	14	3	5	23	152	152	18	**2880**	**1.23**	**8**
	Q4/92	2096	299	41	17	18	12	8	48	56	7	**2602**	**1.18**	**10**
	Q1/93	1264	336	41	13	5	4	0	17	14	2	**1696**	**1.28**	**4**
	Q2/93	No observations*										--		
														22

Table B27. Downtown I-5 Michigan St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	5550	654	100	37	20	22	9	67	116	41	**6616**	**1.15**	**15**
	Q4/92	2096	299	41	17	18	12	8	48	56	7	**2602**	**1.18**	**7**
	Q1/93	1264	336	41	13	5	4	0	17	14	2	**1696**	**1.28**	**4**
	Q2/93	No observations*										--		
														26

Figure B11. I-5 DOWNTOWN - Corson Avenue S. SITE #24

■ ACO offramp SB-am
■ ACO offramp SB-pm

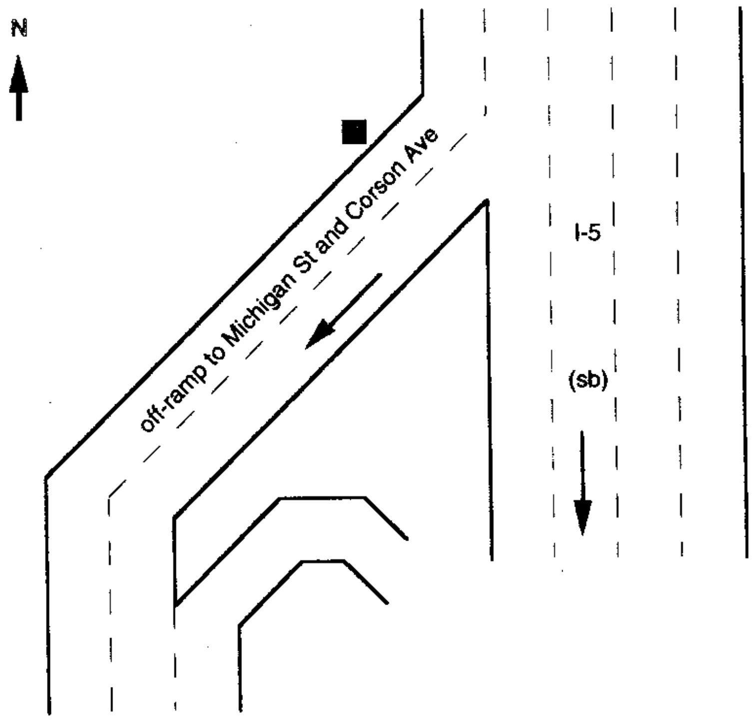


Table B28. Downtown I-5 Corson Ave. S. a.m. southbound

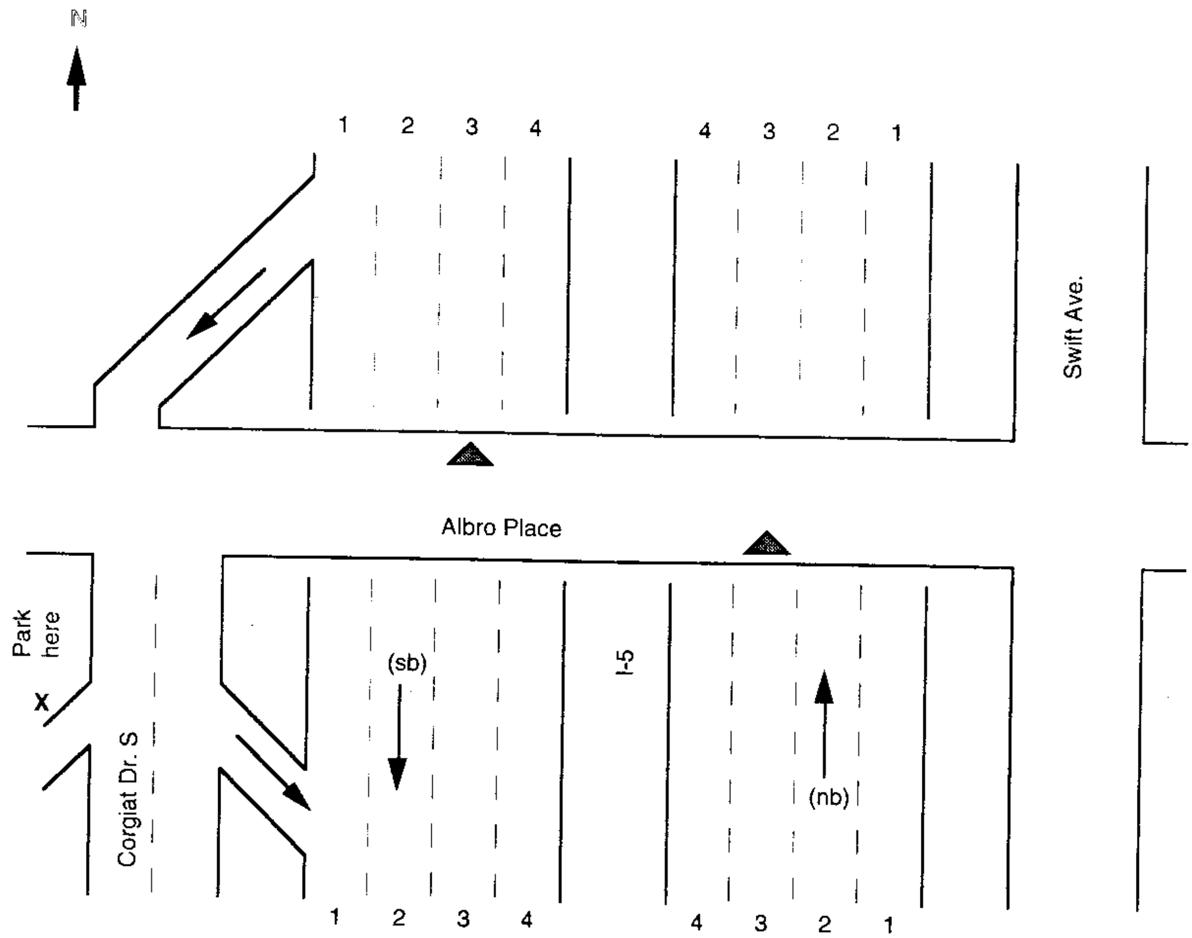
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	2332	198	22	5	1	9	4	43	112	12	**2738**	**1.10**	**8**
	Q4/92	1060	44	1	0	0	3	2	31	29	3	**1173**	**1.04**	**2**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														10

Table B29. Downtown I-5 Corson Ave. S. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	1610	359	35	28	6	5	29	41	119	19	**2251**	**1.25**	**9**
	Q4/92	808	185	27	17	2	2	17	68	41	4	**1171**	**1.28**	**4**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														13

Figure B12. I-5 DOWNTOWN - Albro Place — SITE #25

ACO mainline SB & NB-am & pm



Note: The HOV lanes northbound currently end about a hundred yards south of this overpass. The newly-opened southbound HOV lanes end about a hundred yards to the north of this overpass.

Table B30. Downtown I-5 Albro Pl. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	2475	505	3	1	1	40	5	100	114	1	3245	1.17	6
	Q2/93	2436	369	30	11	2	16	8	69	108	5	3054	1.16	4
														10

Table B31. Downtown I-5 Albro Pl. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	No observations*										--		
	Q2/93	7014	1863	256	101	12	55	24	216	287	13	9841	1.29	21
														21

Table B32. Downtown I-5 Albro Pl. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	No observations*										--		
lanes	Q4/92	No observations*										--		
4	Q1/93	No observations*										--		
	Q2/93	1939	333	66	9	1	28	1	62	65	15	**2519**	**1.21**	**4**
														4

Table B33. Downtown I-5 Albro Pl. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP	Q3/92	1853	448	65	47	8	13	11	49	49	9	**2552**	**1.30**	**3**
lanes	Q4/92	No observations*										--		
4	Q1/93	2380	606	11	2	0	42	4	80	113	3	**3241**	**1.21**	**5**
	Q2/93	7126	2479	151	62	14	98	11	171	224	22	**10358**	**1.30**	**14**
														22

Figure B13. I-5 DOWNTOWN - South 144th St. SITE #26

▲ACO Mainline NB am & SB pm

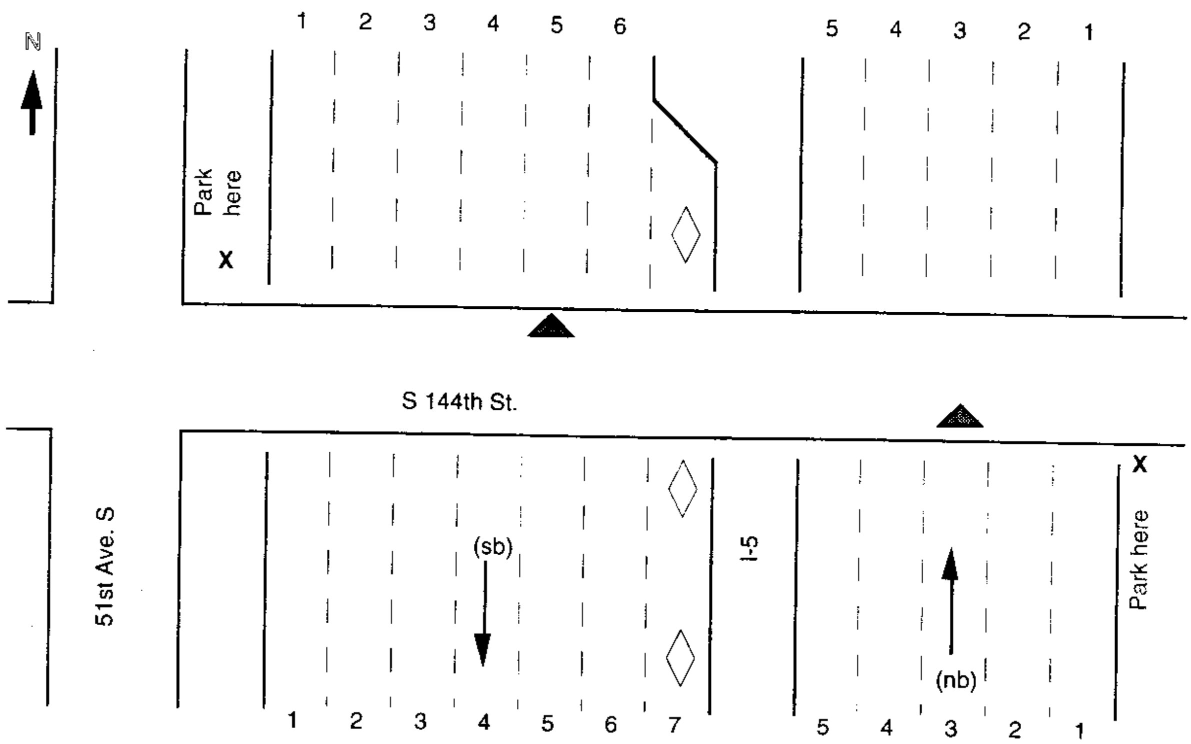


Table B34. Downtown I-5 S 144th St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 5	Q3/92	6015	1039	127	36	10	38	13	263	361	54	7956	**1.20**	**16**
	Q4/92	270	14	1	0	1	1	0	5	14	2	308	**1.06**	**1**
	Q1/93	1987	168	14	2	3	8	6	74	109	2	2373	**1.09**	**3**
	Q2/93	No observations*										--		
														20

Table B35. Downtown I-5 S 144th St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 6	Q3/92	5246	1212	246	99	16	47	12	158	253	44	7333	**1.30**	**14**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														14

Figure B14. I-5 DOWNTOWN - Olive Street SITE #27

■ ACO on/ramp NB-am & pm

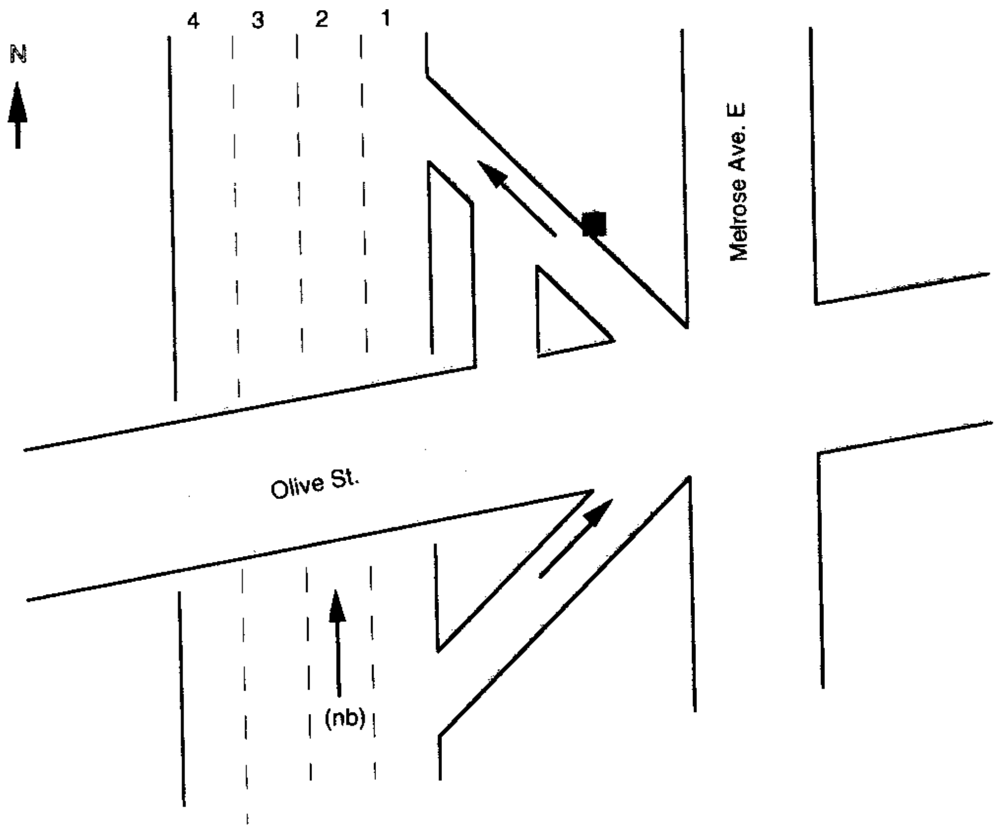


Table B36. Downtown I-5 Olive Way a.m. northbound

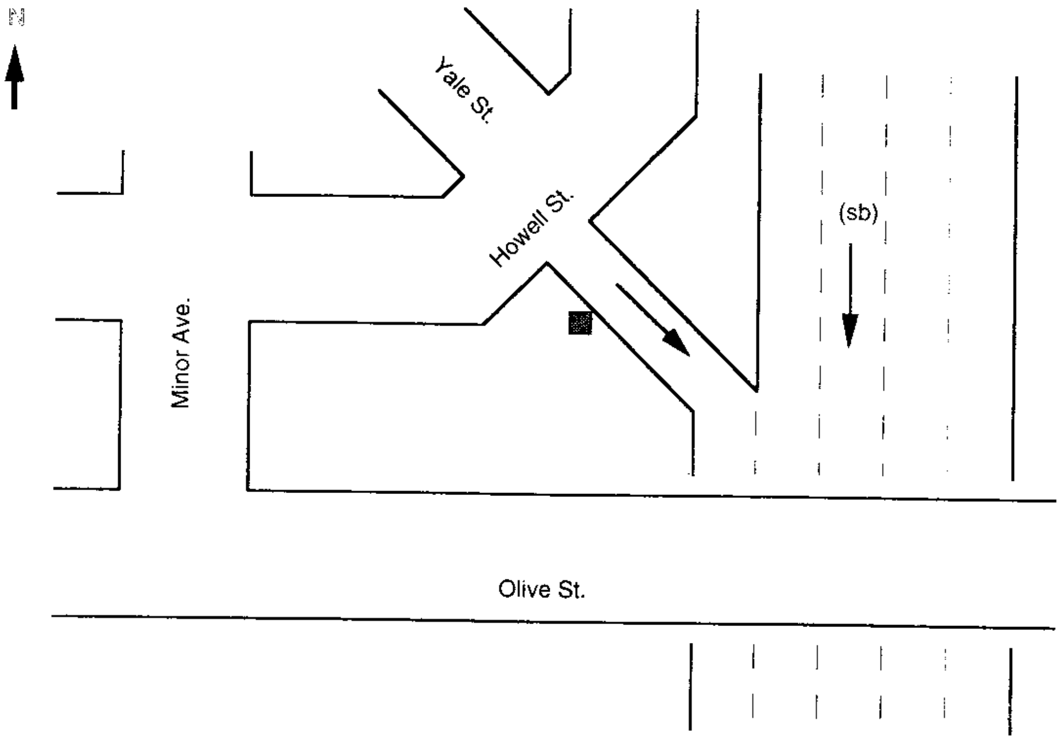
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	No observations*										--		
	Q4/92	2258	500	32	4	1	3	5	24	6	0	**2833**	**1.21**	**4**
	Q1/93	4006	522	45	15	9	520	33	36	12	12	**5210**	**1.14**	**19**
	Q2/93	1051	111	14	8	0	122	11	11	5	8	**1341**	**1.14**	**5**
														28

Table B37. Downtown I-5 Olive Way p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2041	441	72	21	1	51	4	14	3	12	**2660**	**1.25**	**4**
	Q4/92	1522	299	21	5	1	44	4	14	2	3	**1915**	**1.19**	**3**
	Q1/93	8443	1649	195	76	2	335	15	626	11	31	**11383**	**1.22**	**21**
	Q2/93	3407	766	138	54	0	123	4	668	2	21	**5183**	**1.28**	**10**
														38

Figure B15. I-5 DOWNTOWN - Howell/Yale Streets SITE #28

▩ ACO on/ramp SB-am & pm



Note: It is okay to park in the loading zone, as long as you try to stay away from the docks and out of the way as much as possible. It is a good idea to leave a big note on your dashboard that you are counting at the ramp, in case your car needs to be moved.

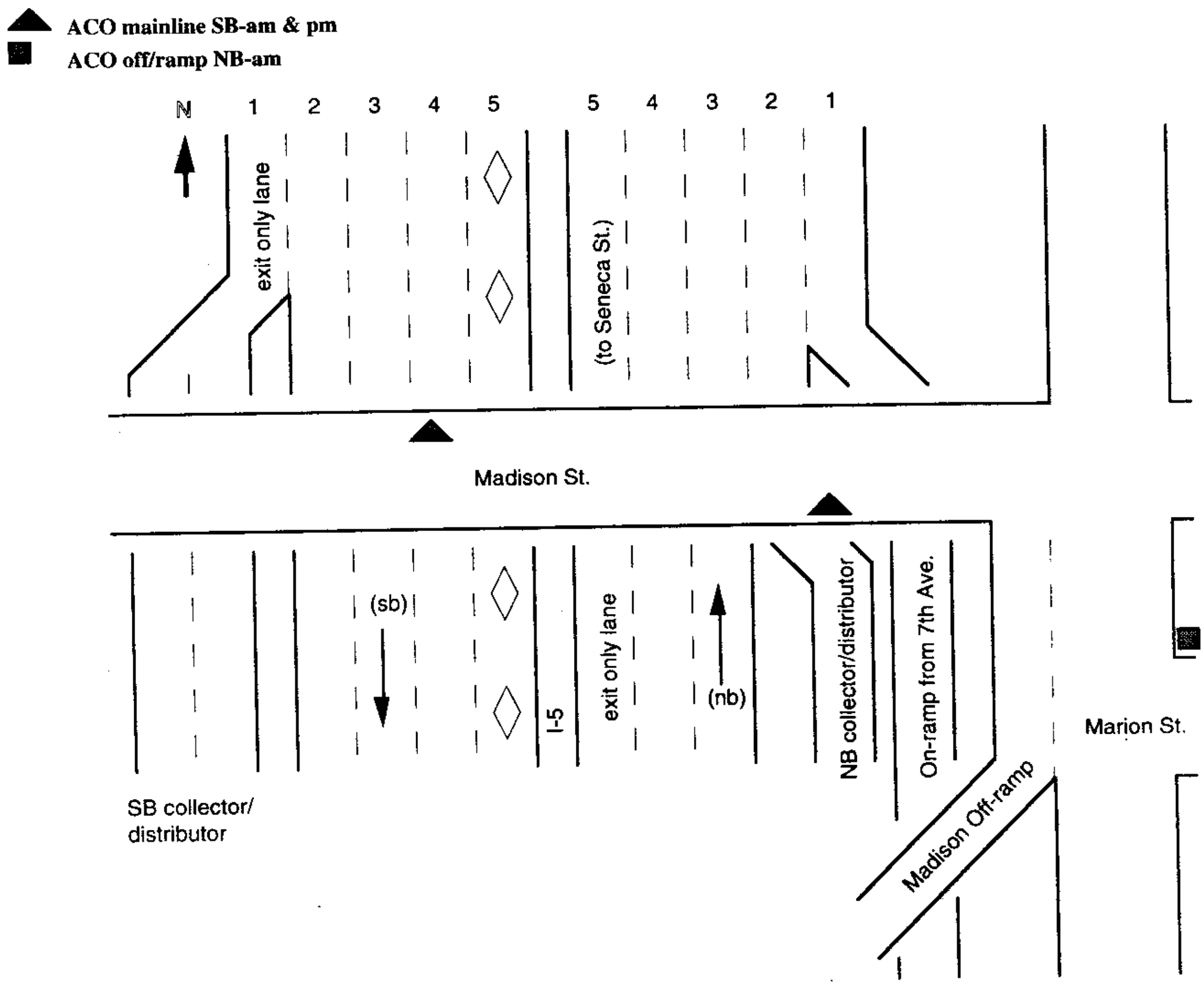
Table B38. Downtown I-5 Howell/Yale Sts. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	1099	123	8	0	1	147	4	36	15	0	**1433**	**1.11**	**4**
	Q2/93	1510	211	34	17	0	173	7	42	19	8	**2021**	**1.19**	**5**
														9

Table B39. Downtown I-5 Howell/Yale Sts. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1967	409	54	21	2	3	7	16	2	9	**2490**	**1.24**	**3**
	Q4/92	4757	1158	162	69	4	6	22	48	9	15	**6250**	**1.28**	**11**
	Q1/93	12106	2555	290	124	16	7	64	824	19	30	**16034**	**1.23**	**25**
	Q2/93	5017	1229	152	87	8	17	15	78	8	33	**6644**	**1.28**	**10**
														49

Figure B16. I-5 DOWNTOWN - Madison Street — SITE #29



Note: Count the collector/distributor lanes at this location as lanes #1 and #2 in each direction (this is different than most other sites with collector/distributor lanes). When counting the off/ramp northbound, be sure to include only the traffic coming off the freeway, and not traffic merging from 7th Avenue.

Table B40. Downtown I-5 Madison St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	1658	404	35	4	1	5	2	24	5	0	**2138**	**1.23**	**4**
	Q1/93	11762	2251	207	36	8	19	31	114	22	12	**14461**	**1.20**	**19**
	Q2/93	4855	983	93	17	6	7	15	72	19	8	**6075**	**1.21**	**8**
														31

Table B41. Downtown I-5 Madison St. a.m. southbound

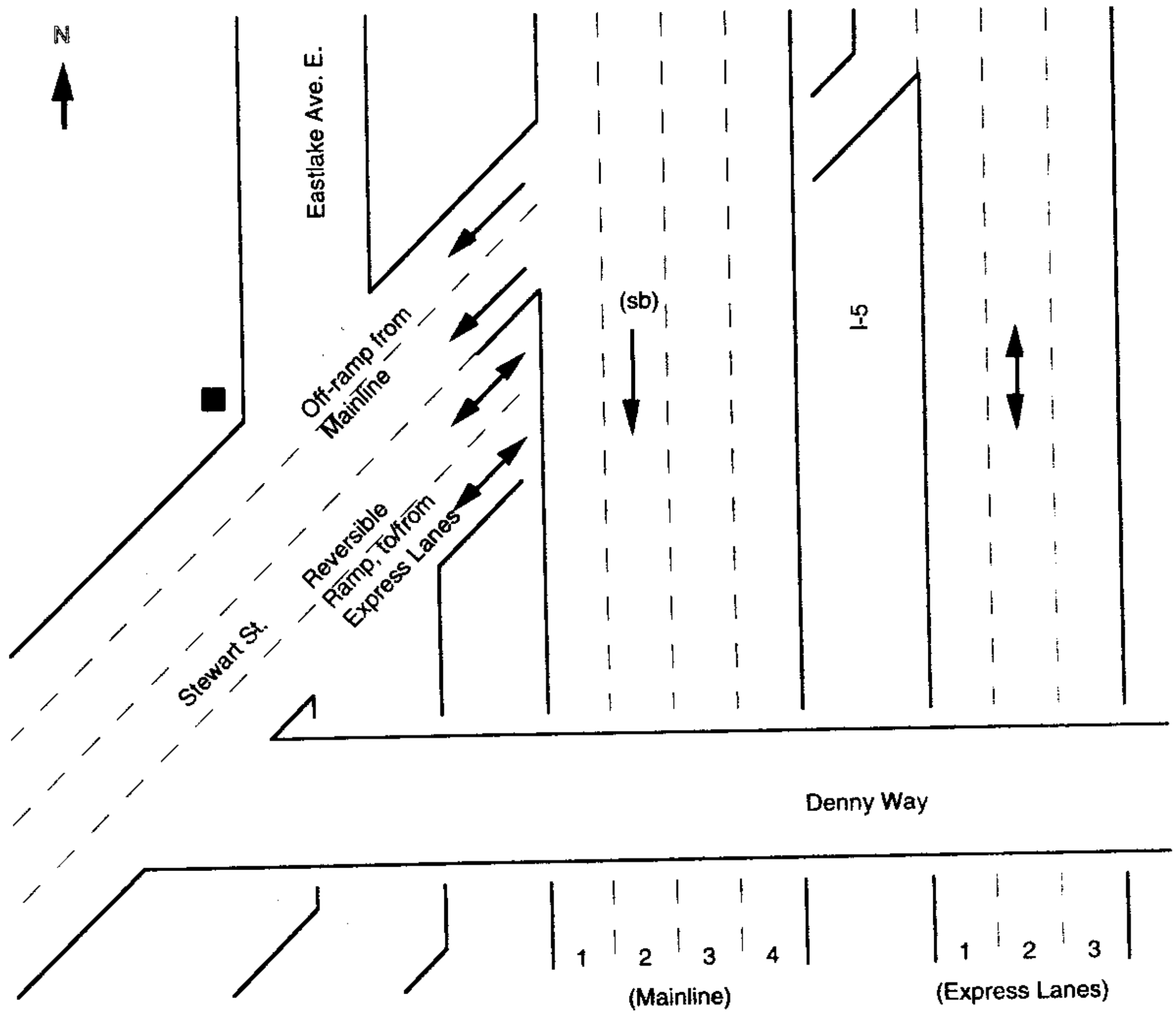
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	6	16	42	31	2	14	8	1	0	7	**127**	**3.10**	**6**
														6
GP lanes 4	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	12624	1053	92	36	13	206	40	300	336	19	**14719**	**1.10**	**21**
														21

Table B42. Downtown I-5 Madison St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	245	858	192	30	52	13	22	76	2	64	**1154**	**2.01**	**6**
														6
GP lanes 4	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	12456	2932	77	4	14	61	22	1107	358	28	**17059**	**1.20**	**24**
														24

Figure B17. I-5 DOWNTOWN - Stewart Street SITE #30

■ACO off/ramp SB-am & pm



Note: The best place to sit is on the triangular island directly across the street from the ramp traffic as it goes through the stoplight at Eastlake Avenue. The two lanes to the north at the stoplight are traffic from the mainline, and the two lanes to the south at the stoplight are traffic from the express lanes. Do not count the express lane off/ramp traffic. Count both mainline off/ramp lanes at the same time.

Table B43. Downtown I-5 Stewart St. a.m southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	491	73	10	4	2	25	2	5	2	0	614	1.18	3
	Q1/93	9399	1146	66	11	4	429	4	127	28	13	11227	1.12	29
	Q2/93	5571	502	44	20	2	264	6	515	10	12	6946	1.11	17
														49

Figure B18. Vehicle Occupancy (ACO) Sites
I-5 South (Corridor #3)

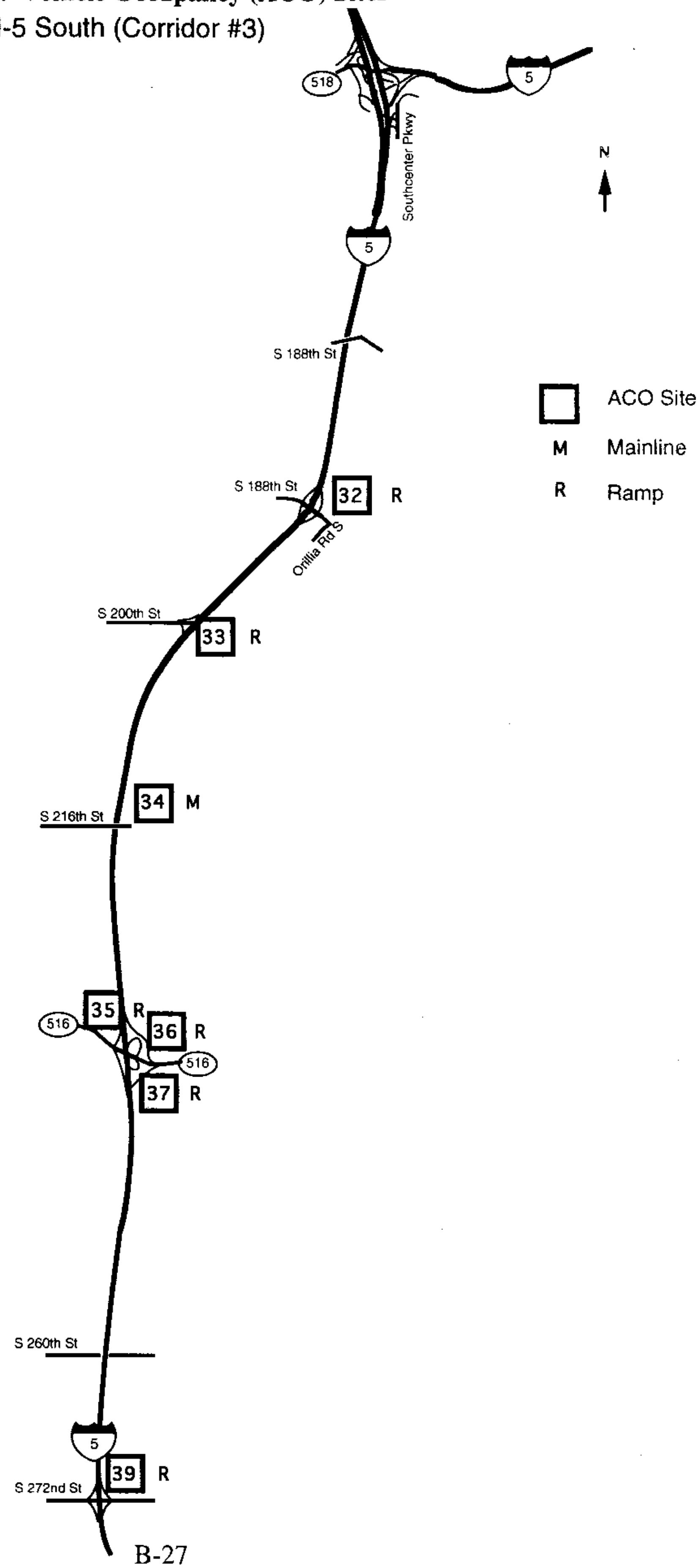
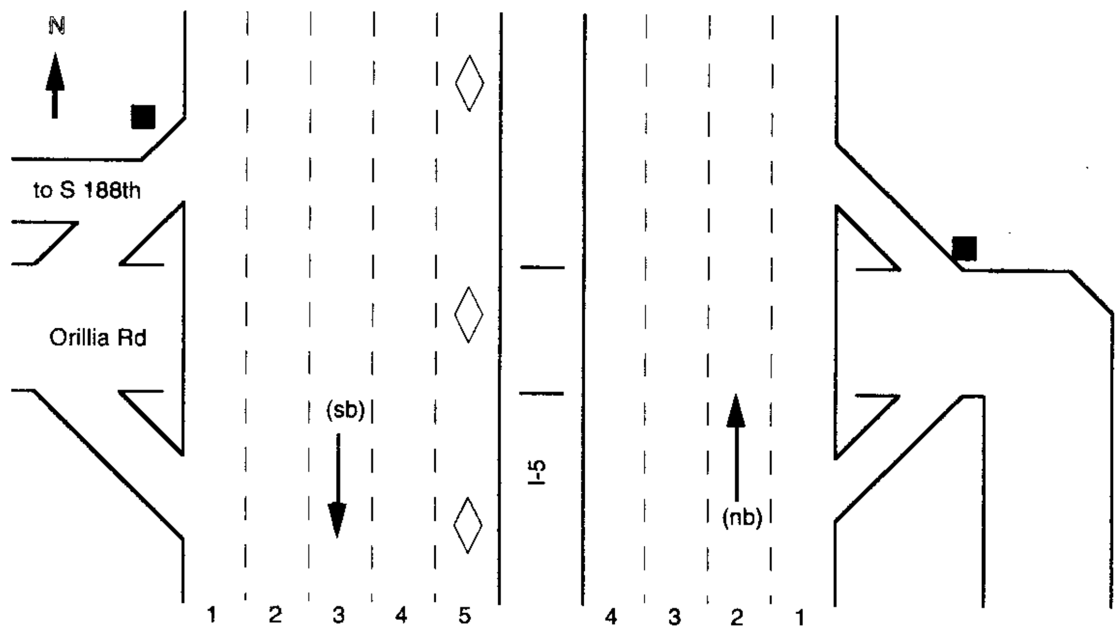


Figure B19. I-5 SOUTH - South 188th St./Orillia Road — SITE #32

■ACO on/ramp NB-am
■ACO off/ramp SB-pm



Note: Since both these ramps are very busy, and there is not a lot of clearance at the edges of the ramps, it is important that you have a vest and hard hat with you and make sure that drivers can see you when sitting at the edge of the ramp.

Table B44. I-5 South S 188th St./Orillia Rd. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	4582	716	97	32	4	1	7	303	426	25	**6193**	**1.19**	**14**
	Q4/92	1274	190	9	11	0	1	5	106	128	3	**1727**	**1.16**	**6**
	Q1/93	2905	357	24	8	2	2	11	238	200	2	**3749**	**1.13**	**9**
	Q2/93	971	125	9	2	0	1	4	75	76	1	**1264**	**1.13**	**3**
														32

Table B45. I-5 South S 188th St./Orillia Rd. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	1390	351	50	36	4	8	1	79	122	6	**2047**	**1.31**	**9**
	Q4/92	901	250	21	5	1	6	2	74	92	11	**1362**	**1.26**	**4**
	Q1/93	1871	362	30	21	0	8	2	115	154	4	**2567**	**1.21**	**9**
	Q2/93	1593	378	53	49	4	4	0	30	32	7	**2150**	**1.31**	**5**
														27

Figure B20. I-5 SOUTH - South 200th Street — SITE #33

■ ACO on/ramp NB-am
■ ACO off/ramp SB-pm

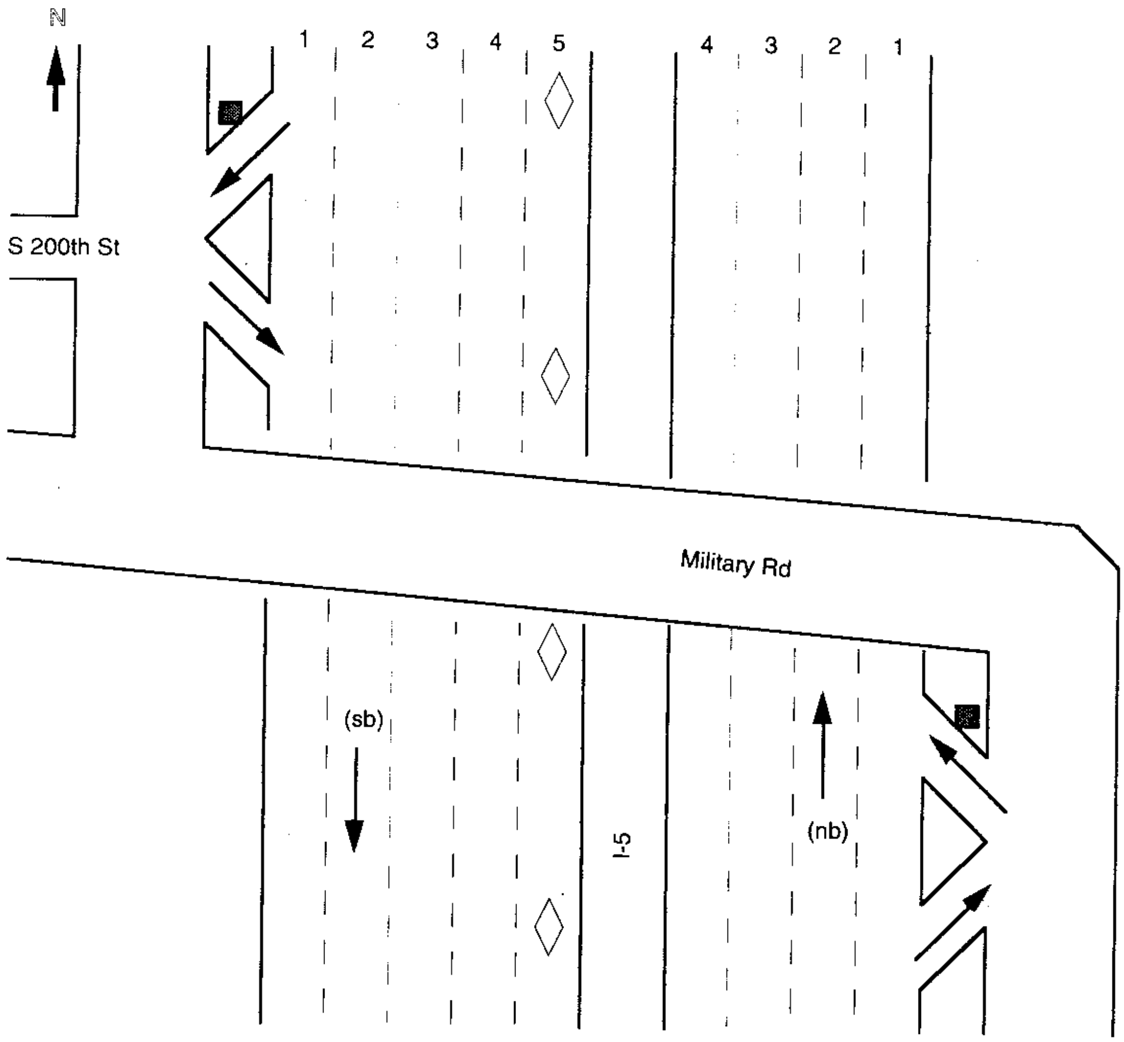


Table B46. I-5 South S 200th St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	3621	531	74	27	5	0	2	35	18	12	**4325**	**1.18**	**18**
	Q4/92	1508	163	10	3	0	0	0	24	5	0	**1713**	**1.11**	**6**
	Q1/93	1149	130	5	10	1	0	0	15	12	9	**1318**	**1.12**	**7**
	Q2/93	562	15	1	0	0	0	0	9	6	3	**596**	**1.03**	**4**
														35

Table B47. I-5 South S 200th St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	2122	408	73	29	1	1	5	25	18	22	**2704**	**1.25**	**15**
	Q4/92	1389	315	50	17	1	0	0	30	12	12	**1826**	**1.27**	**13**
	Q1/93	1386	294	36	15	3	7	0	265	19	3	**2028**	**1.24**	**10**
	Q2/93	480	82	24	4	0	0	0	254	8	3	**855**	**1.24**	**6**
														44

Figure B21. I-5 SOUTH - S 216th St. SITE #34

▲ACO mainline NB-am & SB-pm

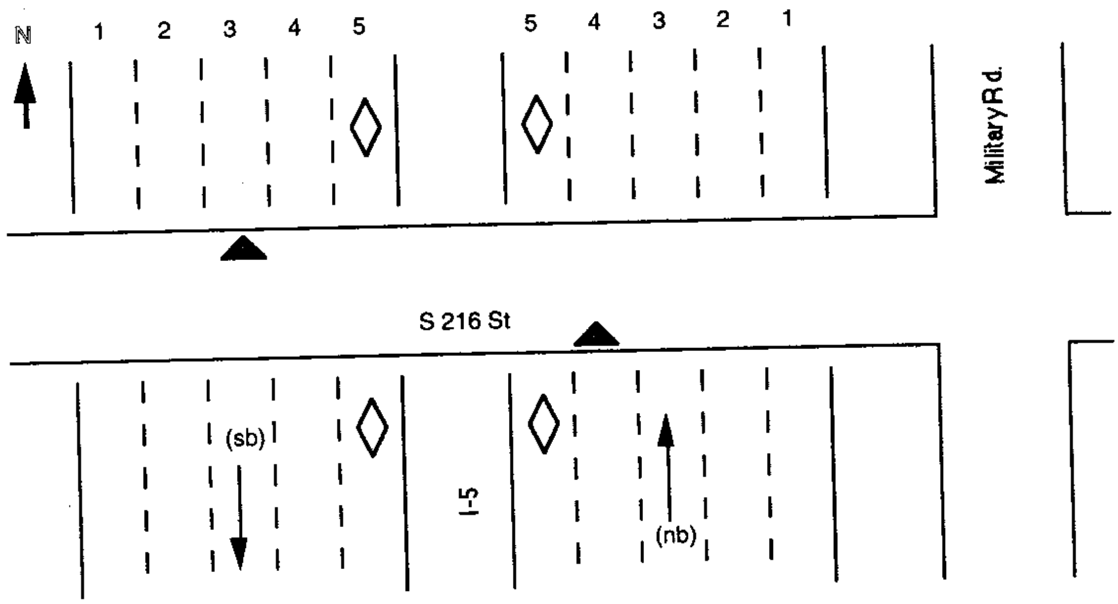


Table B48. I-5 South S 216th St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	7	24	25	14	2	2	1	0	0	7	**82**	2.70	2
	Q4/92	No observations*										--		
	Q1/93	2	24	6	5	0	0	0	0	0	1	**38**	2.41	1
	Q2/93	5	159	33	19	3	7	0	2	0	10	**238**	2.32	2
														5
GP lanes 4	Q3/92	6040	883	72	29	3	11	4	80	200	8	**7330**	1.16	11
	Q4/92	5521	547	48	9	0	8	2	104	244	7	**6190**	1.12	8
	Q1/93	4929	360	21	14	3	7	4	103	171	1	**5613**	1.08	7
	Q2/93	6981	562	60	20	0	10	2	132	235	1	**8003**	1.10	12
														38

Table B49. I-5 South S 216th St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	4	11	112	63	3	11	4	0	0	26	**271**	2.92	1
	Q4/92	7	46	43	8	9	4	0	2	0	3	**122**	2.52	1
	Q1/93	36	642	68	28	12	35	4	2	0	5	**832**	2.12	3
	Q2/93	16	802	168	61	14	31	5	15	0	8	**1120**	2.27	2
														7
GP lanes 4	Q3/92	6558	1215	188	68	8	17	7	102	197	27	**8387**	1.23	13
	Q4/92	3420	451	21	7	0	8	8	67	168	0	**4150**	1.13	7
	Q1/93	10469	1294	95	30	4	15	9	368	344	12	**12640**	1.13	14
	Q2/93	14311	2047	83	4	6	26	6	225	442	14	**17164**	1.14	20
														54

Figure B22. I-5 SOUTH - SR 516: Kent/Des Moines Road — SITES #35,36,37

■ ACO on/ramp NB from Kent-am & from DesMoines-am
■ ACO off/ramp SB-pm

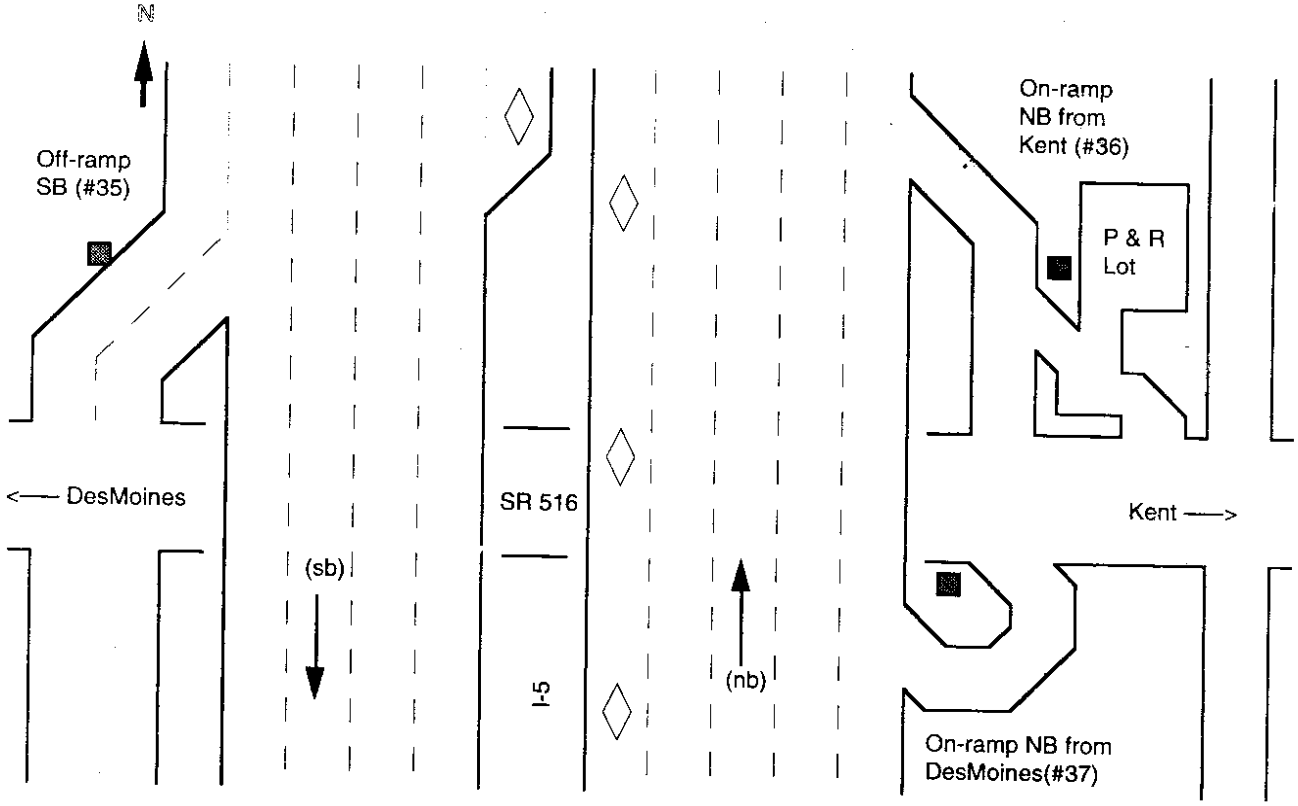


Table B50. I-5 South SR 516 - Kent/DM Rd. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	7681	1429	273	62	17	101	11	161	73	72	9880	1.23	20
	Q4/92	3400	476	70	28	14	34	14	93	50	6	4185	1.16	7
	Q1/93	5364	838	91	46	16	58	3	67	50	8	6541	1.18	11
	Q2/93	2414	419	57	15	7	22	5	49	26	13	3027	1.20	5
														43

Table B51. I-5 South SR 516 - Kent ramp a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	4739	580	80	28	9	77	5	122	90	26	5756	1.15	15
	Q4/92	1099	106	8	2	5	18	0	23	18	1	1280	1.11	3
	Q1/93	6917	666	64	19	17	118	8	111	133	7	8060	1.11	19
	Q2/93	934	117	11	6	3	20	0	32	22	4	1149	1.15	3
														40

Table B52. I-5 South SR 516 - Des Moines ramp a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2778	332	36	17	2	18	3	59	50	10	3305	1.14	16
	Q4/92	800	88	12	1	0	5	1	18	10	2	937	1.13	3
	Q1/93	1770	162	12	1	0	12	1	18	26	2	2011	1.10	10
	Q2/93	No observations*										--		
														29

Figure B23. I-5 SOUTH - South 272nd Street SITE #39

■ **ACO on/ramp NB-am**
■ **ACO off/ramp SB-pm**

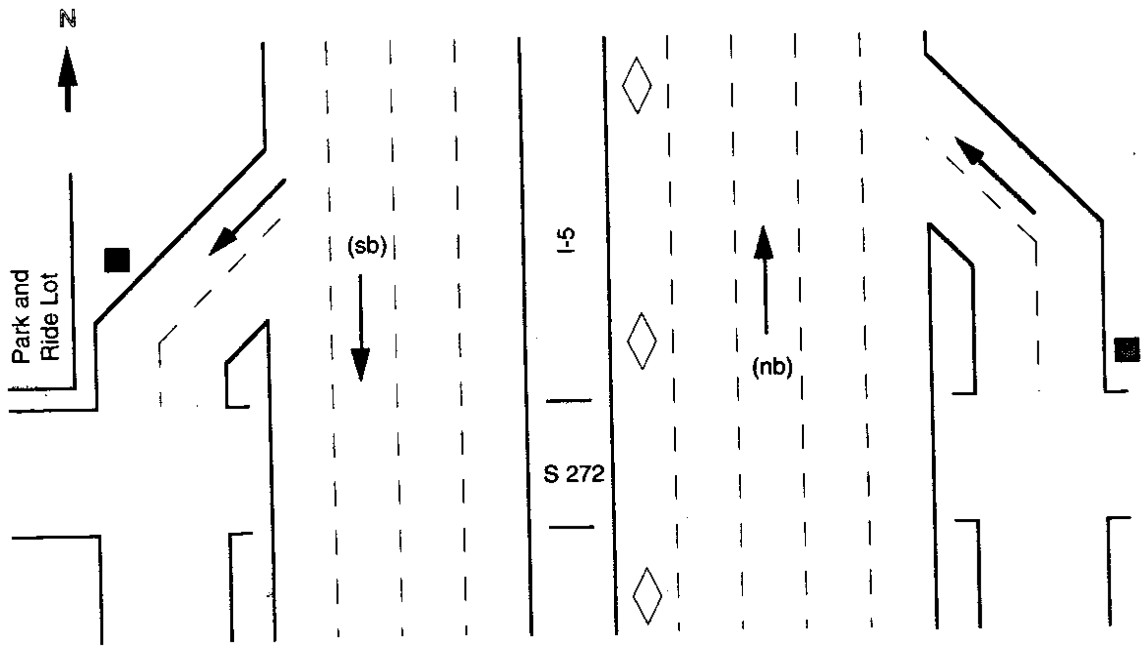


Table B53. I-5 South S 272nd St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	11866	1324	189	87	30	124	5	187	69	99	**13980**	**1.15**	27
	Q4/92	4902	452	46	21	8	61	5	69	37	8	**5609**	**1.11**	13
	Q1/93	6177	689	57	16	15	80	7	74	27	3	**7145**	**1.12**	13
	Q2/93	2071	141	22	9	5	18	1	32	11	6	**2316**	**1.10**	4
														57

Table B54. I-5 South S 272nd St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	6903	1226	279	115	45	66	3	115	28	51	**8831**	**1.25**	15
	Q4/92	3133	397	59	25	14	21	1	50	18	7	**3725**	**1.16**	7
	Q1/93	1541	214	32	9	4	16	0	25	8	1	**1850**	**1.17**	3
	Q2/93	2196	437	72	43	13	21	0	29	21	7	**2839**	**1.26**	5
														30

Figure B24. Vehicle Occupancy (ACO) Sites
SR 520 (Corridor #4)

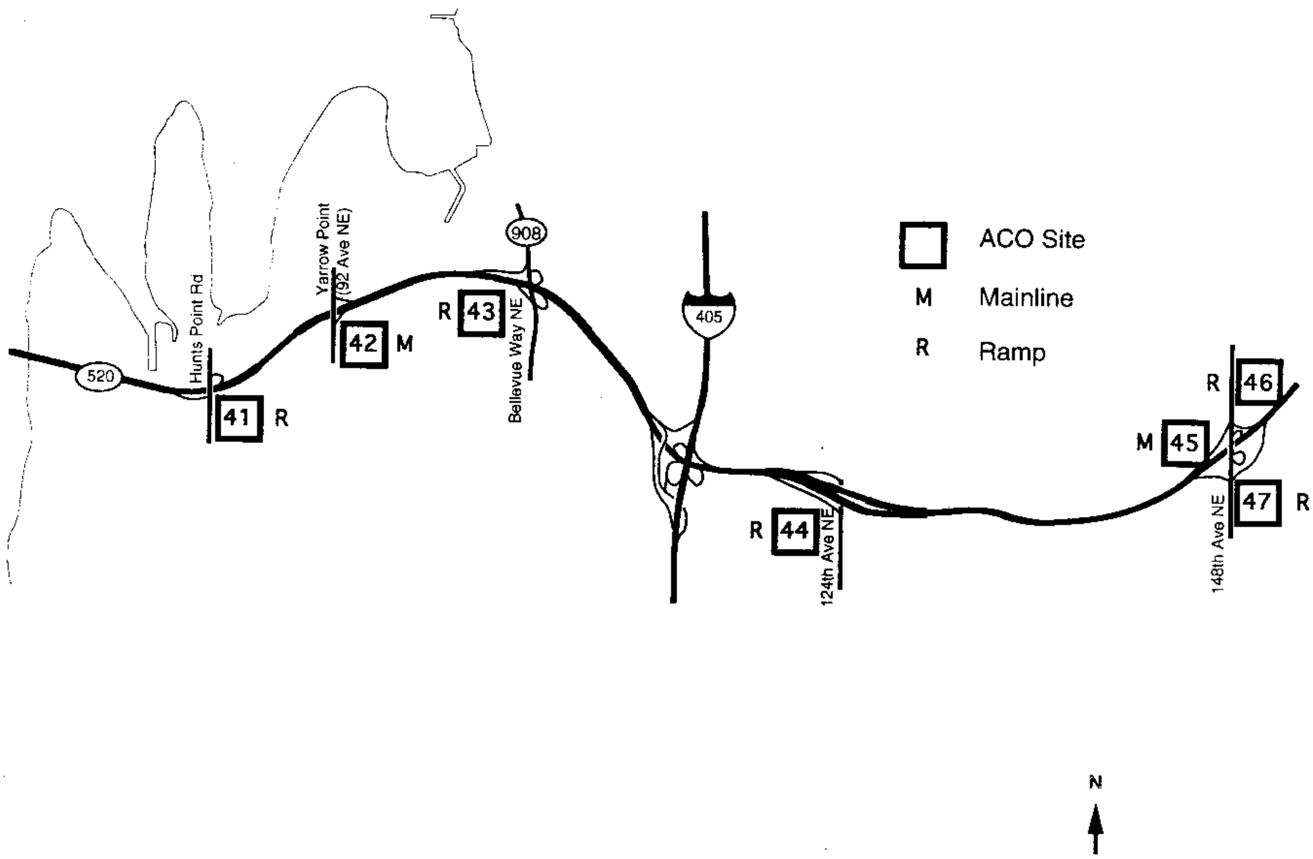
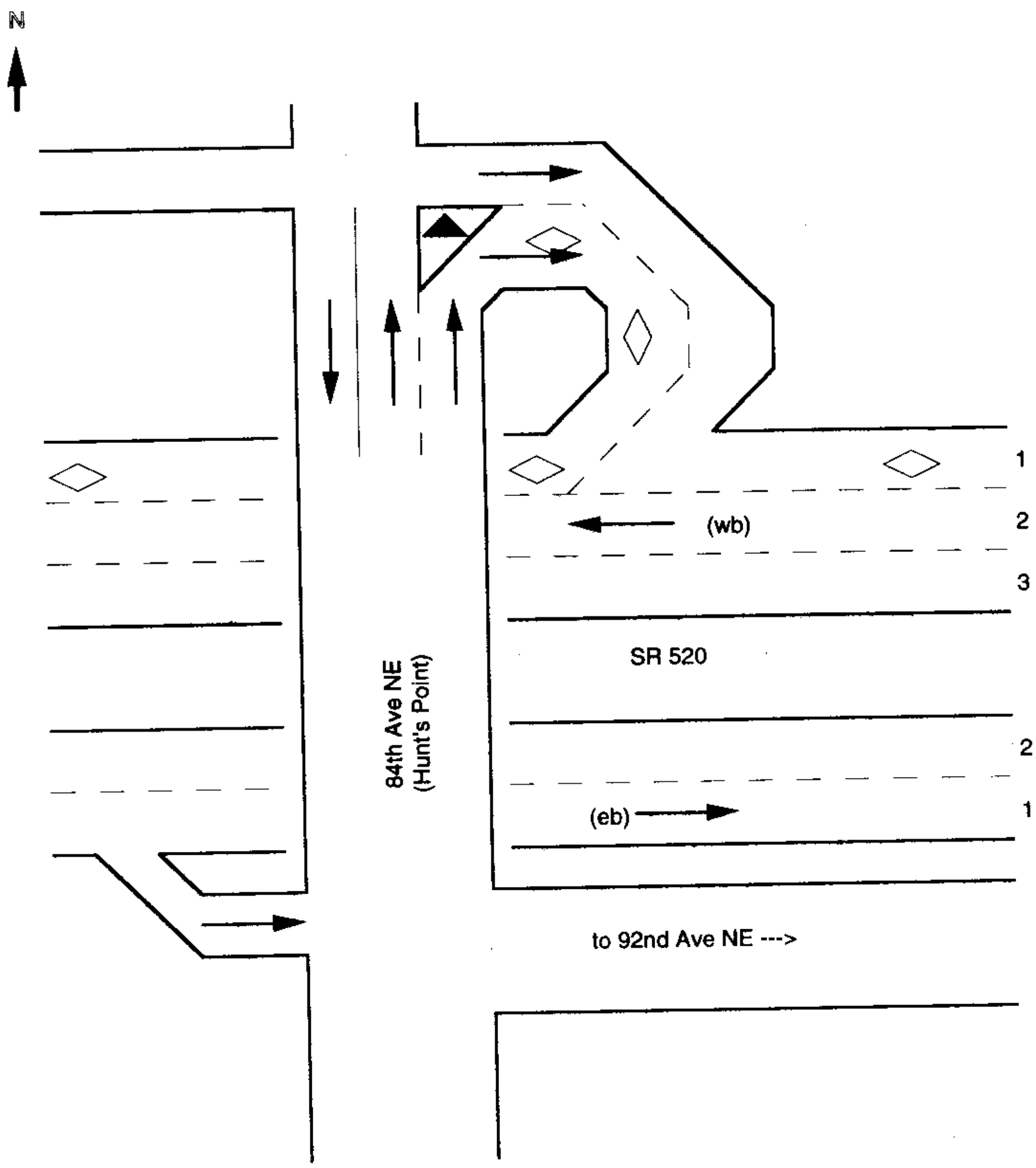


Figure B25. SR 520 - Hunt's Point SITE #41

■ **ACO on/ramp WB-am**



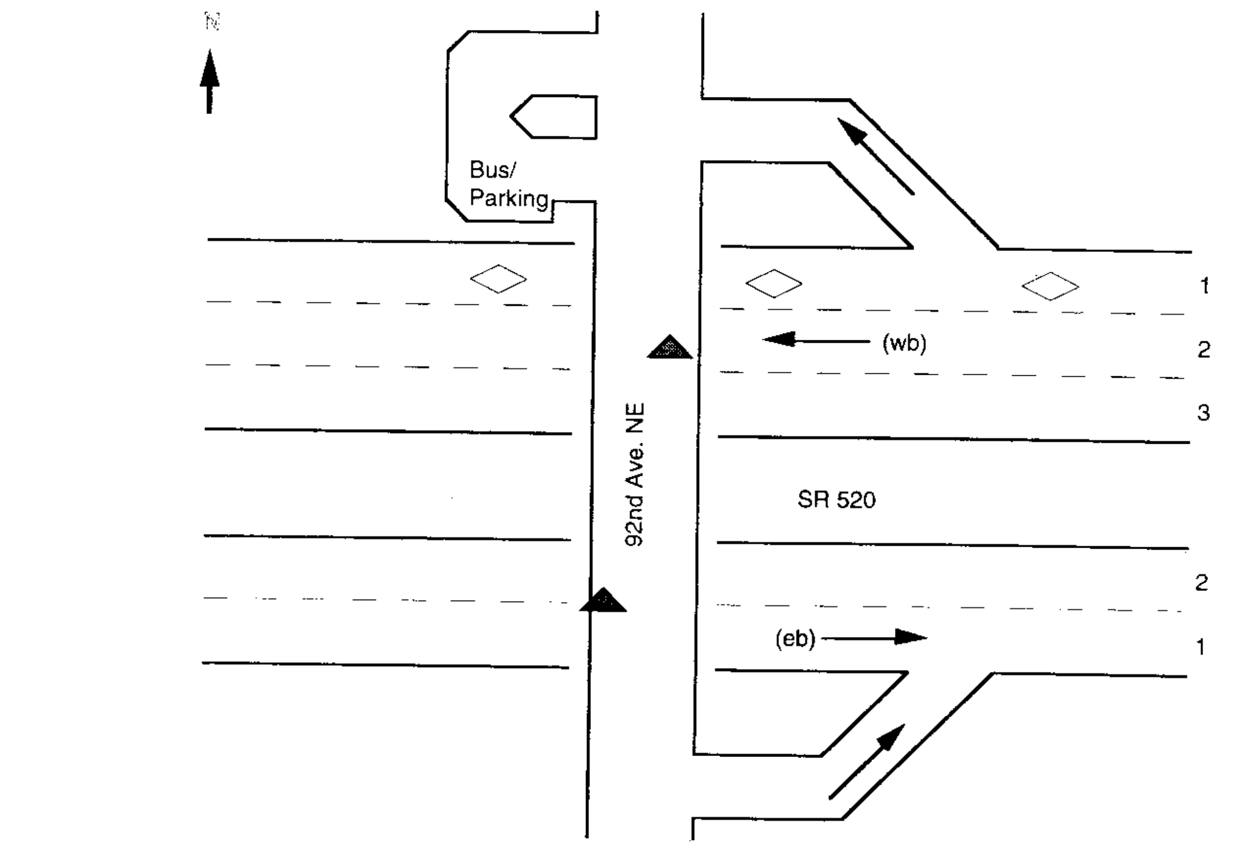
Note: There is an HOV lane on the outside, but only going westbound. There is currently no HOV lane going eastbound at this location.

Table B55. SR 520 Hunt's Pt. a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2917	355	33	23	1	32	3	25	2	5	3396	1.15	15
	Q4/92	No observations*										--		
	Q1/93	922	69	3	1	0	8	0	7	1	0	1011	1.08	4
	Q2/93	No observations*										--		
														19

Figure B26. SR 520 - Yarrow Point SITE #42

▲ ACO mainline WB-am & EB-pm



Note: There is an HOV lane on the outside of the westbound mainline lanes in this location. Be sure to count it as lane #1.

Table B56. SR 520 Yarrow Pt. a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	5	6	26	3	1	20	1	0	0	10	**72**	**2.69**	**2**
	Q4/92	23	9	1	0	0	24	0	0	0	4	**61**	**1.33**	**1**
	Q1/93	3	12	34	8	2	36	1	0	0	6	**102**	**2.85**	**2**
	Q2/93	5	14	79	29	5	94	2	0	0	20	**248**	**3.09**	**4**
														9
GP lanes 2	Q3/92	3170	394	10	3	0	8	1	57	26	2	**3671**	**1.12**	**6**
	Q4/92	1082	86	0	0	0	0	0	22	6	0	**1196**	**1.07**	**2**
	Q1/93	2964	340	6	0	0	0	0	42	18	0	**3370**	**1.11**	**4**
	Q2/93	7004	823	29	5	3	13	3	145	78	3	**8106**	**1.11**	**12**
														24

Table B57. SR 520 Yarrow Pt. p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 2	Q3/92	4480	879	99	32	2	49	0	46	16	28	**5630**	**1.21**	**15**
	Q4/92	4157	626	36	8	1	49	3	61	24	11	**4976**	**1.15**	**6**
	Q1/93	1897	310	38	8	8	20	5	51	1	3	**2341**	**1.18**	**6**
	Q2/93	10760	1997	151	28	4	138	5	2245	53	63	**15444**	**1.18**	**21**
														48

Figure B27. SR 520 - SR 908: Bellevue/Kirkland — SITE #43

■ ACO on/ramp WB`from Kirkland-am
■ ACO off/ramp EB to Kirkland-pm

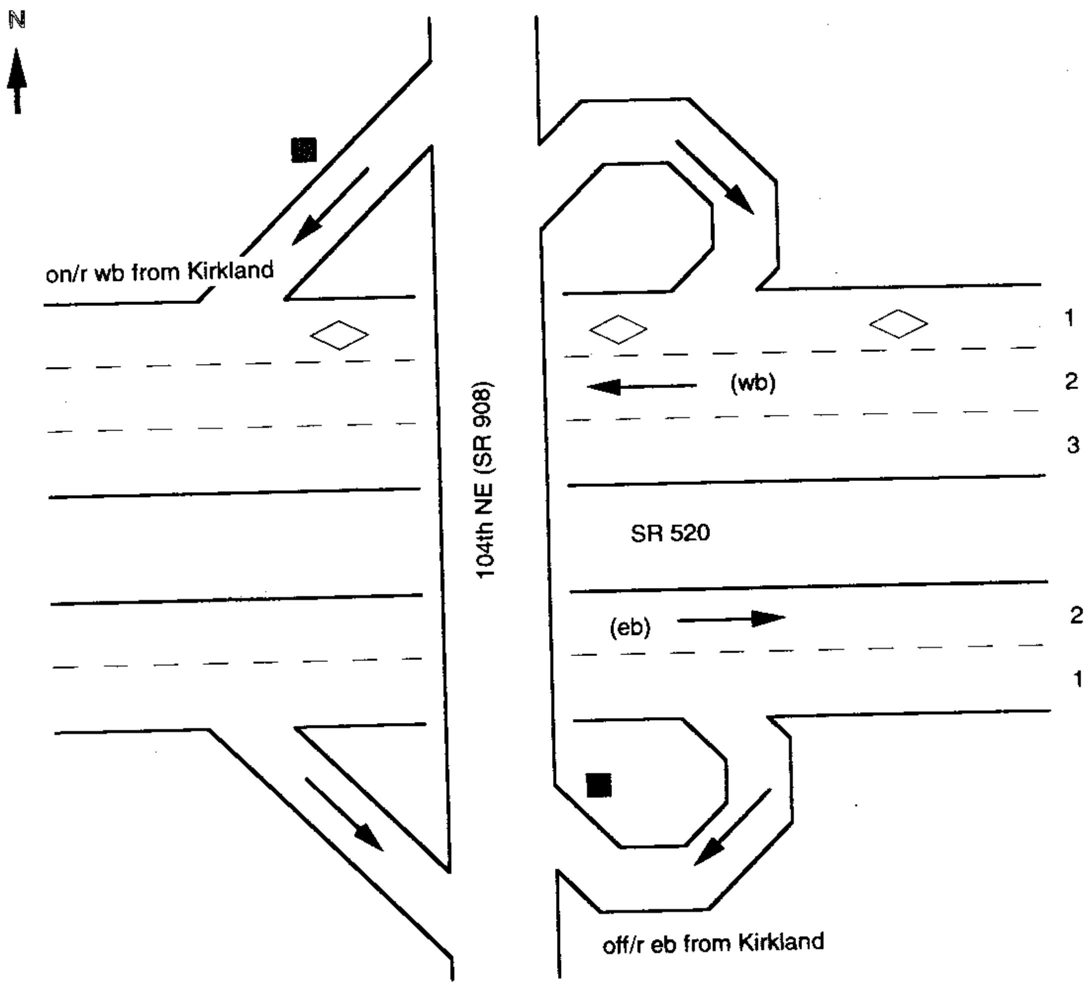


Table B58. SR 520 SR 908 - Bell/Kirk a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1776	212	20	9	3	7	0	11	3	7	**2048**	**1.14**	**11**
	Q4/92	1914	178	19	2	3	9	0	14	5	3	**2147**	**1.11**	**8**
	Q1/93	954	64	12	4	1	4	0	4	0	1	**1044**	**1.10**	**4**
	Q2/93	1784	140	12	5	0	6	0	16	4	6	**1973**	**1.09**	**7**
														30

Table B59. SR 520 SR 908 - Bell/Kirk p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	940	228	33	16	2	14	1	5	2	7	**1248**	**1.28**	**4**
	Q4/92	2892	433	41	26	2	38	2	22	4	7	**3467**	**1.18**	**15**
	Q1/93	3481	612	76	54	4	70	0	458	6	12	**4773**	**1.22**	**14**
	Q2/93	1326	263	36	22	0	17	0	10	2	13	**1689**	**1.25**	**6**
														39

Figure B28. SR 520 - 124th Avenue NE — SITE #44

ACO on/ramp WB-am
ACO off/ramp EB-pm

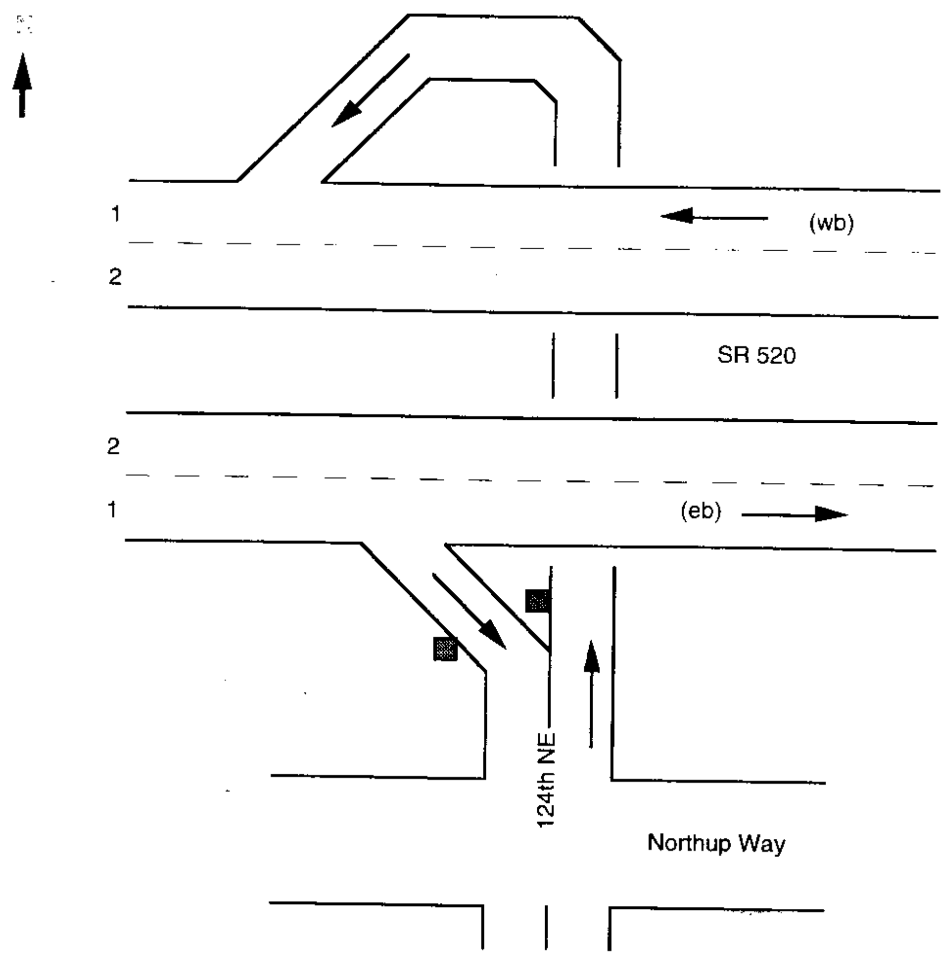


Table B60. SR 520 124th Ave. NE a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2604	314	50	24	4	25	2	134	149	9	**3315**	**1.16**	**15**
	Q4/92	3225	265	29	13	3	30	4	271	242	2	**4077**	**1.10**	**19**
	Q1/93	No observations*										--		
	Q2/93	1802	199	19	9	0	23	2	140	121	2	**2317**	**1.13**	**9**
														43

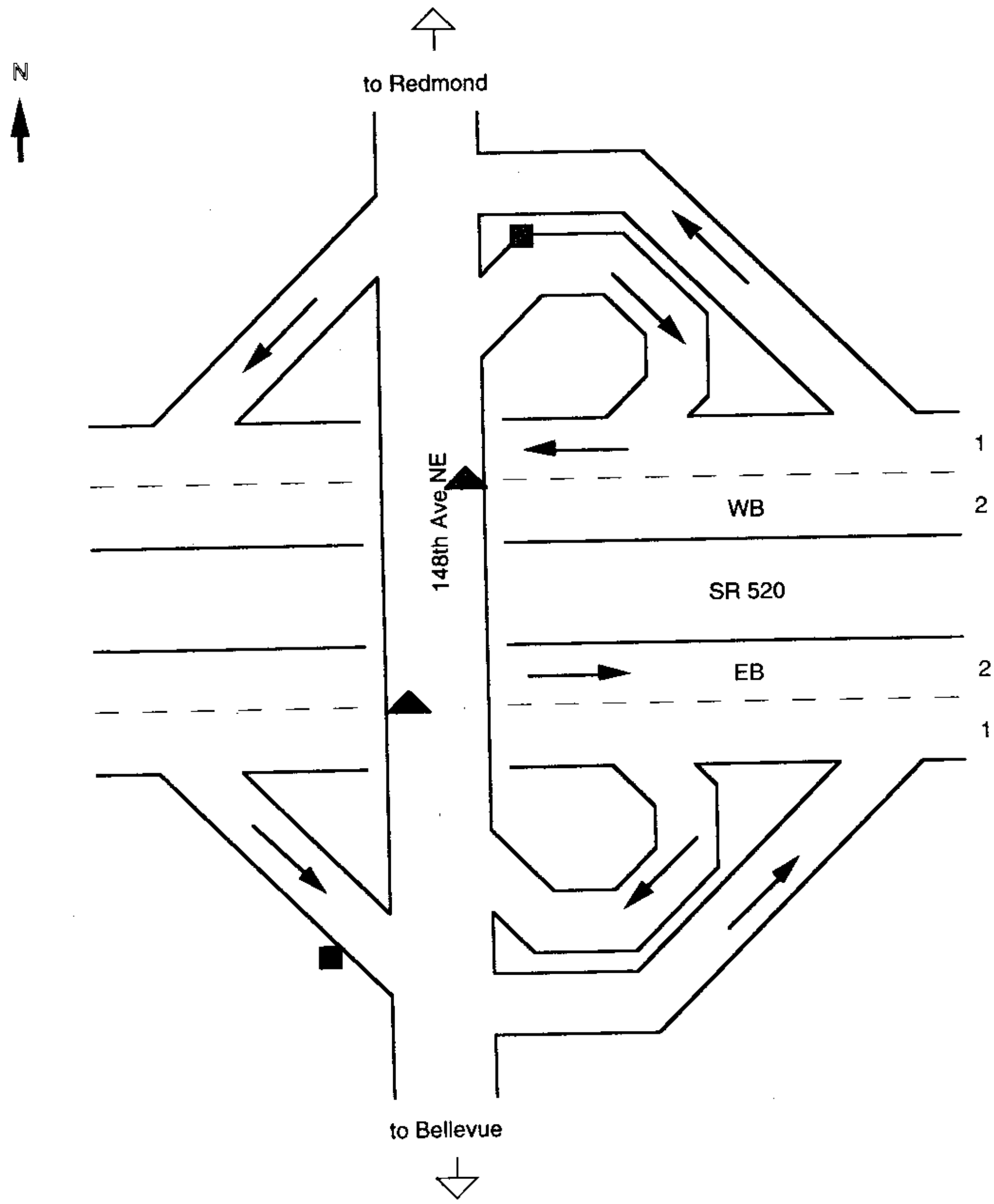
Table B61. SR 520 124th Ave. NE p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	4565	844	153	71	1	35	6	160	187	39	**6061**	**1.24**	**17**
	Q4/92	2748	435	45	13	2	7	1	116	77	5	**3449**	**1.17**	**7**
	Q1/93	1873	262	44	8	2	9	3	55	69	8	**2333**	**1.17**	**7**
	Q2/93	No observations*										--		
														31

Note: This is a very busy ramp, so it is a good idea to have a vest with you for visibility and safety.

Figure B29. SR 520 - 148th Avenue NE **SITES #45, 46, & 47**

▲ ACO mainline WB-am & EB-pm
■ ACO on/ramp WB from Bellevue-am & from Redmond-am
■ ACO off/ramp EB to Bellevue-pm & to Redmond-pm



Note: To count ACO mainline westbound in the morning, you must walk down the east side of 148th NE and go behind the concrete overpass barrier to find a place to sit in the grassy embankment. You will be looking down and to the side to see the mainline traffic.

To count ACO mainline eastbound in the afternoon, you can sit on the sidewalk on the west side of the 148th NE overpass. The entrance and exit ramps on this location are split, so you have to look carefully to be sure you are counting the right ramp.

Table B62. SR 520 148th Ave. NE a.m. westbound

GP lanes 3

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	5289	533	51	15	3	13	0	172	77	16	**6169**	**1.12**	**12**
Q4/92	No observations*										--		
Q1/93	1971	191	13	6	1	5	2	46	18	4	**2257**	**1.11**	**4**
Q2/93	3472	238	14	5	0	17	3	89	68	6	**3912**	**1.08**	**10**
													26

Table B63. SR 520 148th Ave. NE p.m. eastbound

GP lanes 2

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	2446	465	46	9	1	8	2	50	30	18	**3075**	**1.20**	**7**
Q4/92	2435	389	31	5	1	9	2	61	27	13	**2973**	**1.16**	**7**
Q1/93	No observations*										--		
Q2/93	3633	584	28	4	1	14	1	101	21	14	**4401**	**1.15**	**9**
													23

Table B64. SR 520 148th - Redmond ramp a.m. westbound

On ramp

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	2068	242	44	16	2	23	2	24	11	4	**2436**	**1.16**	**13**
Q4/92	782	106	9	5	0	10	0	4	3	0	**919**	**1.16**	**6**
Q1/93	1792	230	20	14	1	24	2	170	3	2	**2258**	**1.15**	**11**
Q2/93	1096	105	18	4	0	14	0	171	1	3	**1413**	**1.13**	**8**
													38

Table B65. SR 520 148th - Redmond ramp p.m. eastbound

Off ramp

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	1038	171	35	30	1	12	0	11	6	8	**1312**	**1.26**	**9**
Q4/92	1583	225	24	6	0	21	0	21	12	2	**1894**	**1.16**	**15**
Q1/93	No observations*										--		
Q2/93	488	85	6	1	0	2	0	9	3	3	**597**	**1.17**	**4**
													28

Table B66. SR 520 148th - Bellevue ramp a.m. westbound

On ramp

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	2657	274	47	28	0	26	1	36	10	6	**3085**	**1.15**	**12**
Q4/92	1383	128	10	1	2	13	2	8	6	1	**1554**	**1.10**	**7**
Q1/93	2987	289	29	2	2	25	2	45	13	2	**3396**	**1.11**	**14**
Q2/93	2035	240	28	14	2	27	8	17	17	10	**2398**	**1.15**	**9**
													42

Table B67. SR 520 148th - Bellevue ramp p.m. eastbound

Off ramp

Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Q3/92	2397	503	103	55	4	15	6	15	11	14	**3123**	**1.29**	**11**
Q4/92	4177	621	79	24	3	25	7	59	10	5	**5010**	**1.17**	**14**
Q1/93	1038	141	17	1	1	4	2	2	0	3	**1209**	**1.15**	**3**
Q2/93	1507	271	47	19	1	7	4	22	1	11	**1890**	**1.23**	**5**
													33

Figure B30. Vehicle Occupancy (ACO) Sites
I-90 (Corridor #5)

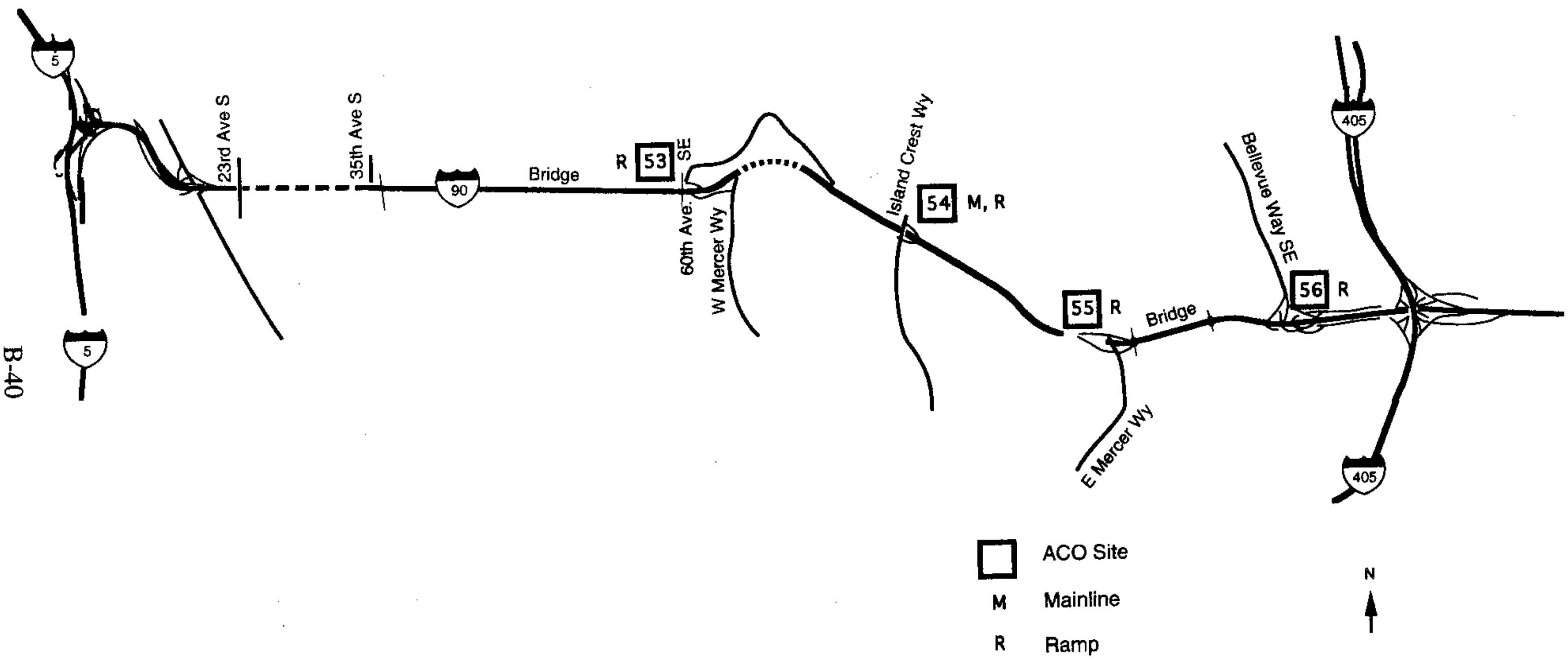


Figure B31. I-90 - 60th Avenue SE

SITE #53

■ ACO on/ramp WB-am
■ ACO off/ramp EB-pm

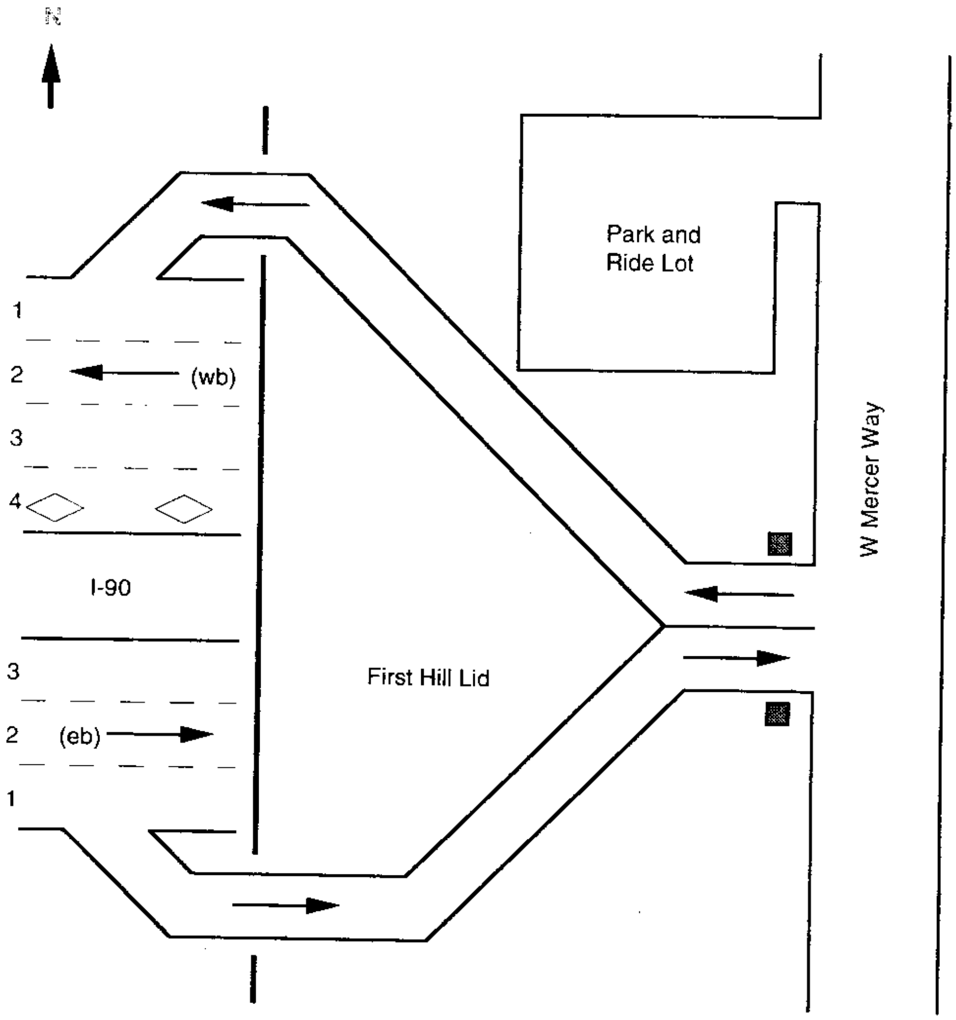


Table B68. I-90 60th Ave SE/W Mercer Way a.m. westbound

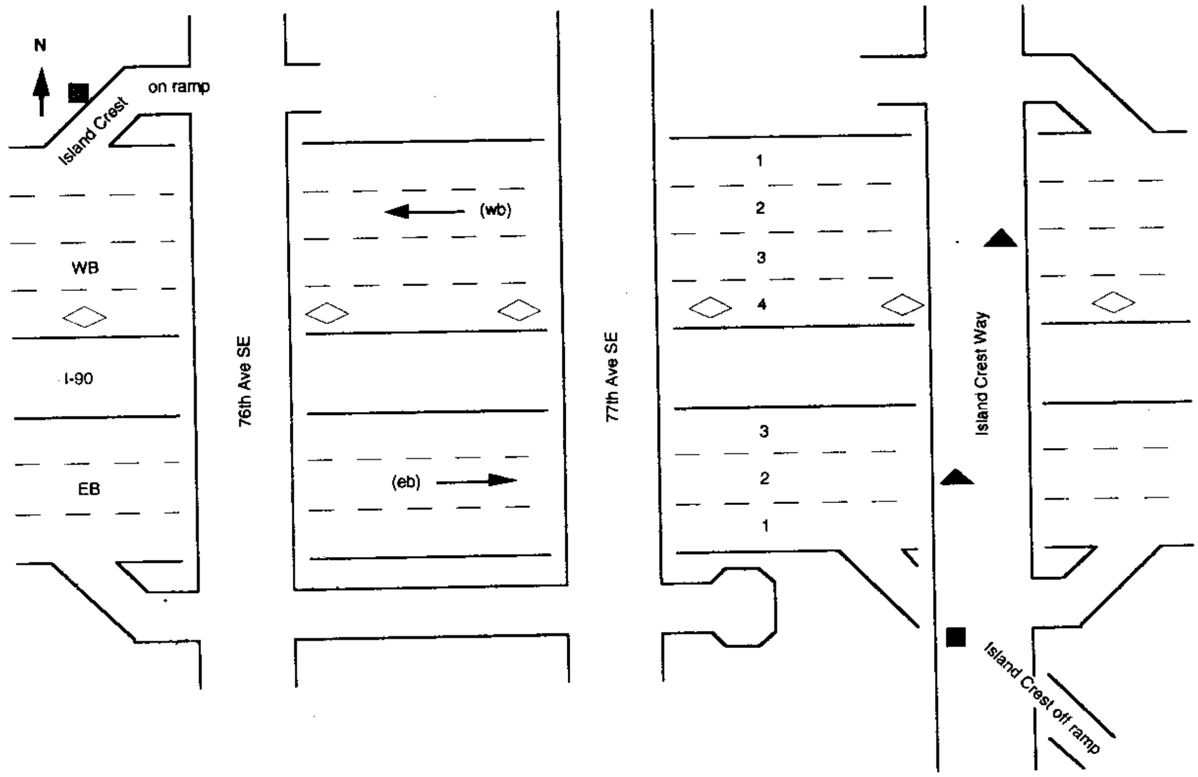
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1570	185	21	10	0	18	1	6	2	1	**1814**	**1.15**	**13**
	Q4/92	1201	154	13	6	0	15	2	7	1	2	**1401**	**1.14**	**8**
	Q1/93	1697	166	12	3	0	18	1	5	1	0	**1903**	**1.11**	**10**
	Q2/93	538	59	17	1	0	7	1	9	0	0	**632**	**1.16**	**4**
														35

Table B69. I-90 60th Ave SE/W Mercer Way p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	1256	278	52	28	0	13	0	8	2	6	**1643**	**1.29**	**10**
	Q4/92	2269	491	50	19	1	22	9	34	1	4	**2900**	**1.23**	**14**
	Q1/93	1110	220	40	11	0	16	1	465	0	4	**1867**	**1.24**	**12**
	Q2/93	956	189	30	18	0	12	1	156	1	1	**1364**	**1.26**	**9**
														45

Figure B32. I-90 - Island Crest Way

■ ACO on/ramp WB-am
■ ACO off/ramp EB-pm
▲ ACO mainline WB-am
▲ ACO mainline EB-pm



Note: The on/ramp westbound at this location is actually located at 76th Avenue SE. Occasionally the sprinklers in the landscaping will turn on unexpectedly, so it is a good idea to always have plastic bags and ponchos with you when you count at this location!

Table B70. I-90 Island Crest Way a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	26	919	84	15	4	46	2	0	1	49	1146	2.09	7
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	5	311	15	6	0	8	3	2	0	4	354	2.07	2
														9
GP lanes 3	Q3/92	4777	294	18	6	0	1	0	56	93	4	5249	1.07	13
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	4863	156	18	7	3	17	1	82	114	2	5263	1.04	10
														23

Table B71. I-90 Island Crest Way p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 3	Q3/92	14886	2890	319	112	9	60	5	156	204	83	18724	1.21	28
	Q4/92	2139	278	23	7	2	8	6	19	30	5	2517	1.14	4
	Q1/93	5904	708	26	4	2	0	5	85	72	4	6810	1.12	9
	Q2/93	9828	1165	45	18	1	1	7	1024	144	21	12254	1.12	21
														62

Table B72. I-90 Island Crest Way a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
On ramp	Q3/92	2351	452	52	10	4	38	3	22	13	3	**2948**	**1.21**	**15**
	Q4/92	989	111	8	1	0	0	3	2	1	0	**1115**	**1.12**	**5**
	Q1/93	No observations*										**--**		
	Q2/93	480	73	7	2	0	19	0	197	2	1	**781**	**1.17**	**5**
														25

Table B73. I-90 Island Crest Way p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
Off ramp	Q3/92	2725	476	101	25	0	1	2	14	3	12	**3359**	**1.23**	**24**
	Q4/92	2253	272	40	16	2	0	0	7	1	0	**2591**	**1.16**	**19**
	Q1/93	1422	207	18	10	0	0	6	9	0	0	**1672**	**1.17**	**15**
	Q2/93	1888	391	39	7	0	0	0	8	3	2	**2338**	**1.21**	**22**
														80

Figure B33. I-90 - East Mercer Way SITE #55

■ ACO on/ramp WB-am
■ ACO off/ramp EB-pm

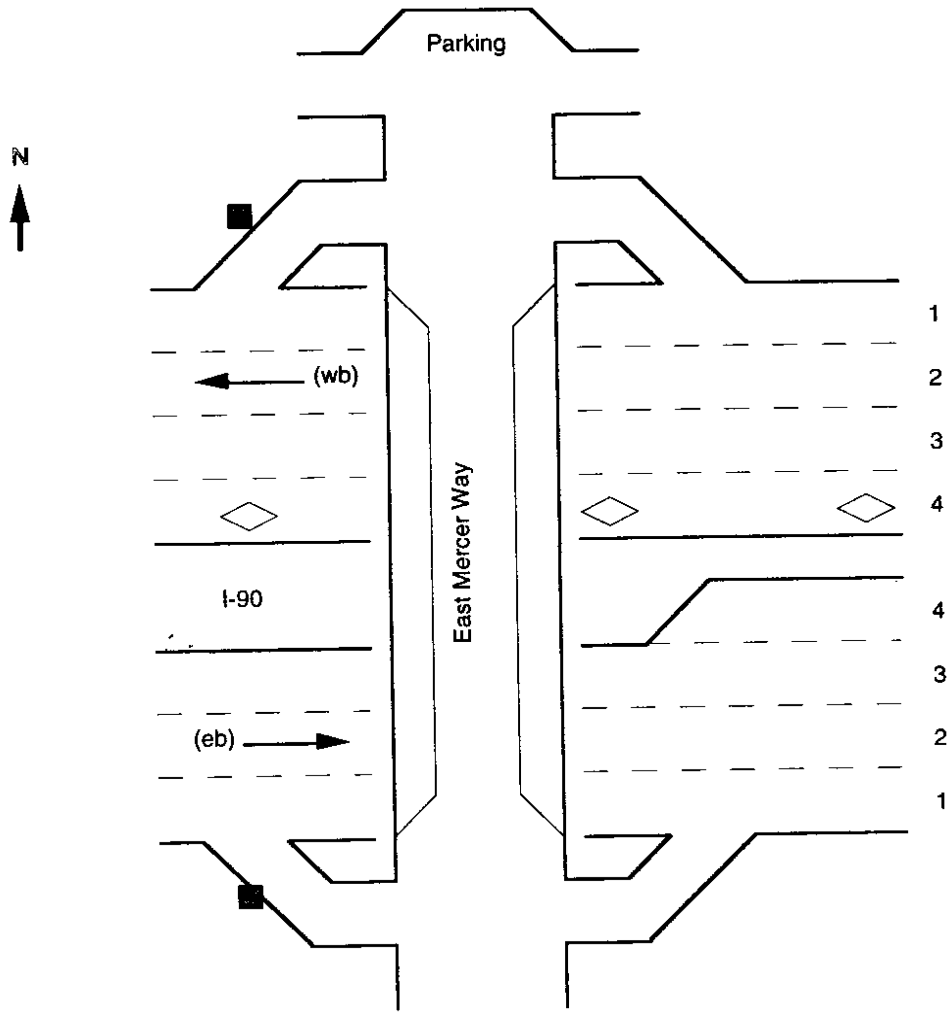


Table B74. I-90 East Mercer Way a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	213	23	6	0	0	4	0	3	0	1	250	1.14	5
	Q4/92	406	36	7	2	0	4	1	3	2	0	461	1.13	3
	Q1/93	36	6	1	0	0	0	0	0	0	0	43	1.19	1
	Q2/93	No observations*										--		
														9

Table B75. I-90 East Mercer Way p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	199	47	2	2	0	6	0	1	0	0	257	1.23	6
	Q2/93	241	51	10	6	0	6	0	4	0	1	319	1.29	5
														11

B34. I-90 - Bellevue Way

SITE #56

■ACO on/ramp WB-am
■ACO off/ramp EB-pm

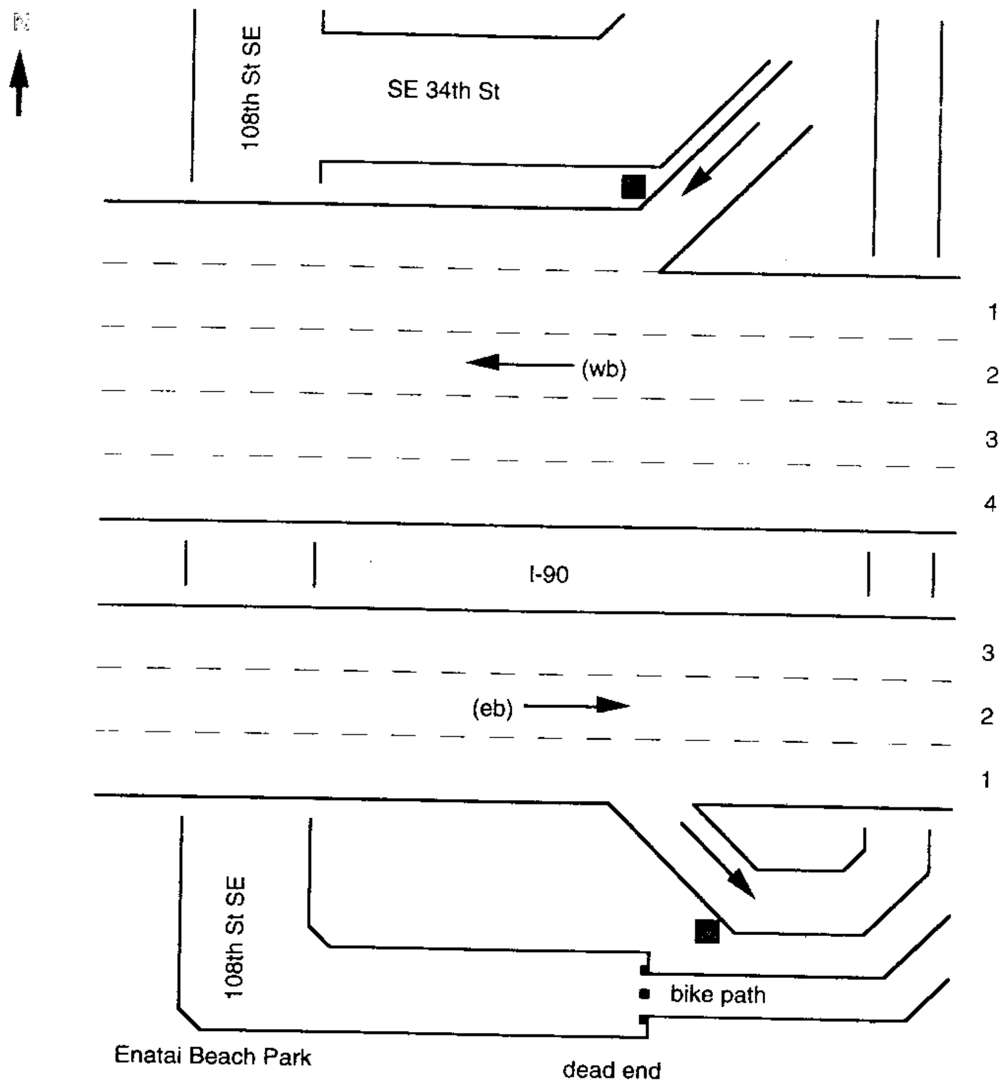


Table B76. I-90 Bellevue Way a.m. westbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	2388	285	39	9	3	64	1	43	18	5	**2855**	**1.14**	**13**
	Q4/92	1114	106	12	4	0	28	0	22	4	4	**1294**	**1.12**	**5**
	Q1/93	2689	266	27	7	3	76	2	32	15	1	**3118**	**1.11**	**14**
	Q2/93	1464	202	24	4	0	46	0	20	9	5	**1774**	**1.16**	**8**
														40

Table B77. I-90 Bellevue Way p.m. eastbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	4617	1117	227	95	5	76	2	37	18	19	**6213**	**1.31**	**16**
	Q4/92	1577	286	40	9	2	27	1	12	4	3	**1961**	**1.21**	**6**
	Q1/93	4838	839	90	41	2	41	3	27	12	5	**5898**	**1.20**	**17**
	Q2/93	1232	204	29	12	1	3	1	14	0	2	**1499**	**1.20**	**4**
														43

Figure B35. Vehicle Occupancy (ACO) Sites
I-405 (Corridors #6)

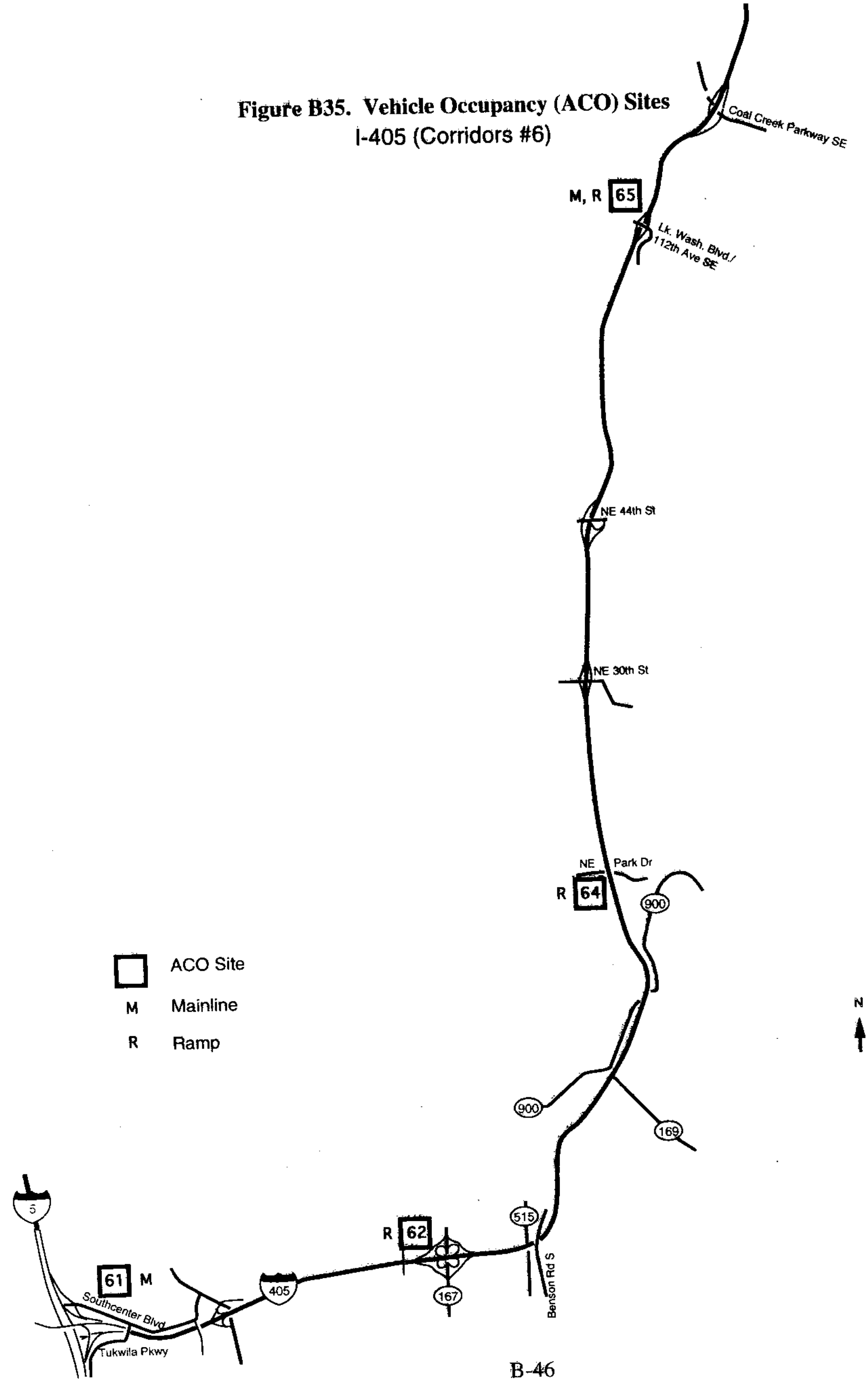
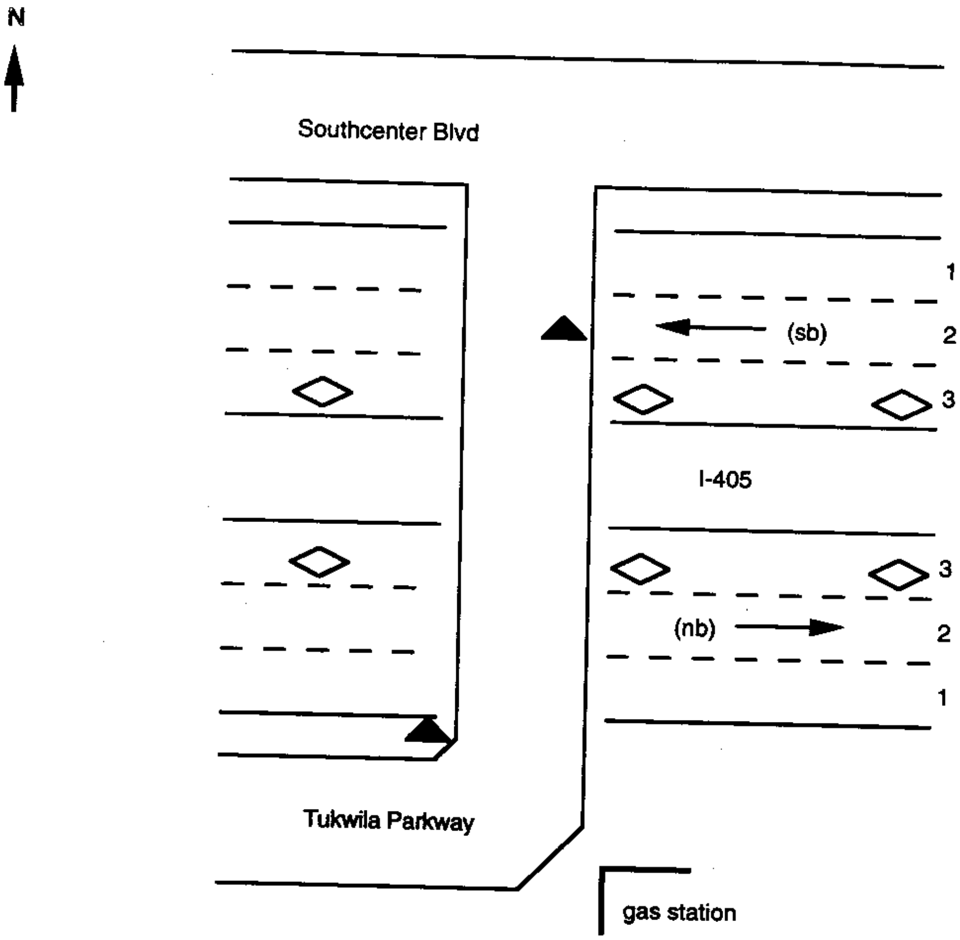


Figure B36. I-405 SOUTH - Tukwila Parkway **SITE #61**

▲ACO mainline NB & SB-am & pm



Note: The freeway here is called I-405 North and South, but you will actually be looking east or west when you observe traffic. Northbound I-405 goes east toward Bellevue, and southbound I-405 goes west toward the airport. Be sure to indicate north or south in the program.

There is a sidewalk on only the east side of Tukwila Parkway. In order to count northbound I-405 traffic on the mainline at this location, you have to cross the street, step over the jersey barrier, and sit on the very narrow strip of dirt at the very edge of the overpass. You will be looking down and to the side at the mainline traffic. Be sure to wear a vest in this location.

Table B78. South I-405 Tukwila Pkwy. - S/center a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	2	19	1	0	0	0	0	0	0	0	22	1.95	1
	Q1/93	17	73	11	6	0	0	0	2	0	16	115	2.07	2
	Q2/93	12	134	23	7	0	1	1	1	0	4	183	2.15	2
														5
GP lanes 2	Q3/92	No observations*										--		
	Q4/92	593	25	1	1	0	0	4	14	31	0	669	1.05	1
	Q1/93	2844	176	6	0	2	2	1	78	94	4	3207	1.06	5
	Q2/93	2419	172	20	2	1	8	1	76	103	1	2803	1.08	4
														10

Table B79. South I-405 Tukwila Pkwy. - S/center p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	10	428	43	33	2	1	0	9	0	12	**538**	**2.21**	**2**
														2
GP lanes 2	Q3/92	1722	219	31	9	0	0	1	30	59	3	**2074**	**1.16**	**3**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	5982	305	48	17	1	0	5	120	180	8	**6666**	**1.07**	**10**
														13

Table B80. South I-405 Tukwila Pkwy. - S/center a.m. southbound

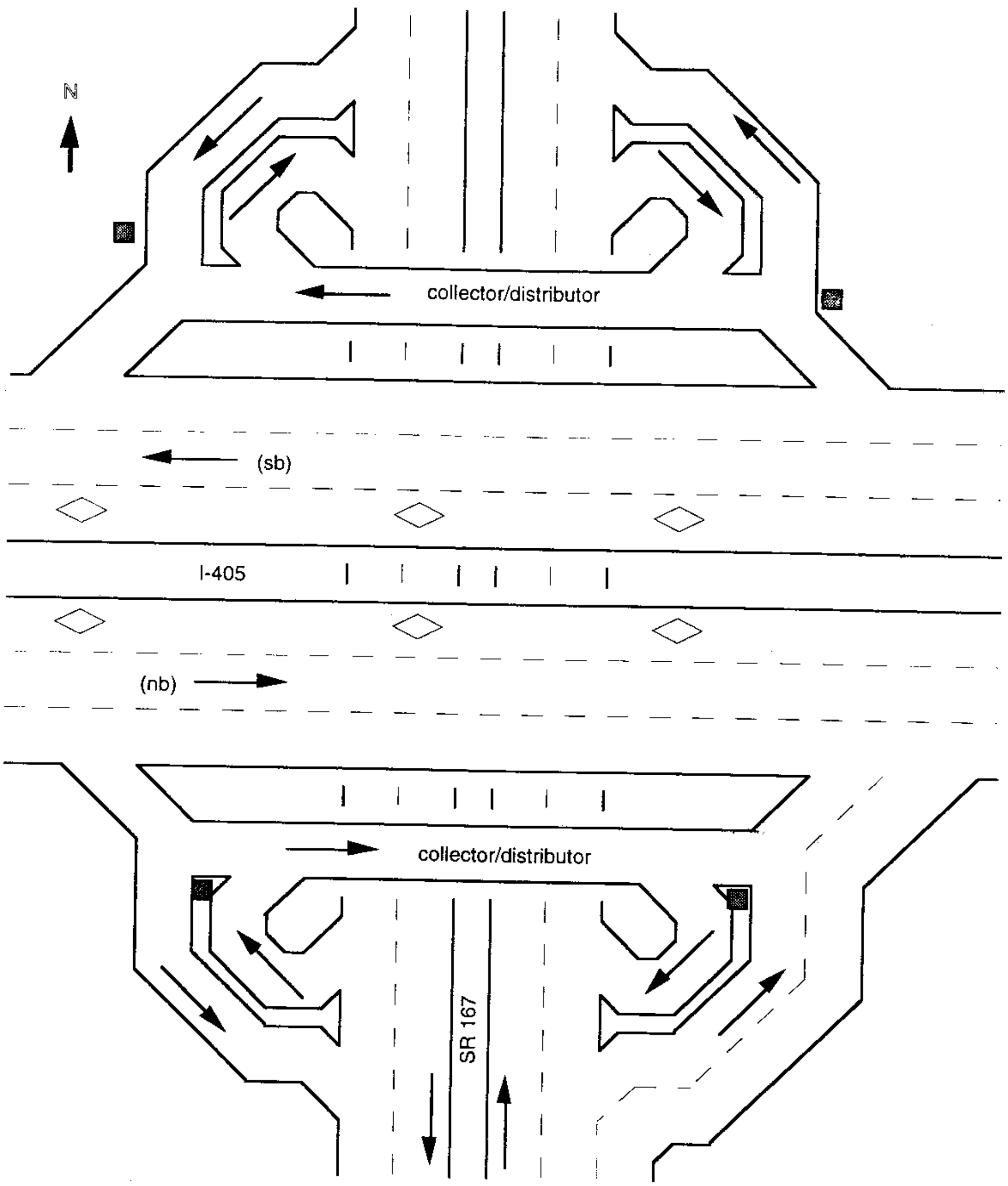
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	39	347	74	16	3	0	12	2	1	23	**517**	**2.15**	**5**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	4	50	23	3	0	0	0	0	0	1	**81**	**2.32**	**1**
														6
GP lanes 2	Q3/92	4935	428	52	13	2	1	1	112	212	6	**5762**	**1.11**	**8**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	1444	148	16	10	1	0	0	29	46	3	**1697**	**1.13**	**2**
														10

Table B81. South I-405 Tukwila Pkwy. - S/center p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	3	53	15	2	0	0	1	1	0	5	**80**	**2.22**	**1**
	Q4/92	5	1	67	0	0	0	0	0	0	0	**73**	**2.85**	**1**
	Q1/93	8	54	14	3	0	1	0	0	0	1	**81**	**2.16**	**1**
	Q2/93	9	234	55	22	2	2	3	4	0	9	**341**	**2.30**	**4**
														7
GP lanes 2	Mar-92	1434	382	32	14	0	1	4	27	55	3	**1952**	**1.26**	**4**
	Apr-92	1385	245	6	0	0	3	0	18	35	5	**1697**	**1.16**	**3**
	Jan-93	1396	336	23	6	1	1	3	25	45	0	**1836**	**1.23**	**3**
	Feb-93	6338	1477	194	48	10	6	7	181	157	17	**8435**	**1.25**	**11**
														21

Figure B37. I-405 SOUTH - SR 167/Rainier Avenue South — SITE #62

■ACO on/ramp NB-am & pm
■ACO off/ramp SB-am & pm



Note: The on/ramp northbound from SR 167 to I-405 is very busy, and traffic travels at near-freeway speeds most of the time. The off/ramp southbound is just as busy, but traffic may not be traveling quite as fast. It is very important that you wear a vest in each of these locations, and stay protected as much as possible from oncoming traffic.

Since these are split ramps in all directions, you will need to determine in advance and be quite clear about exactly which ramp in which direction you are to observe.

Table B82. South I-405 SR 167 - Renton a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1155	125	10	1	3	2	0	58	149	8	**1511**	**1.11**	**3**
	Q4/92	6449	740	69	15	11	14	5	524	705	6	**8538**	**1.13**	**15**
	Q1/93	229	35	2	1	3	1	0	32	43	0	**346**	**1.16**	**5**
	Q2/93	No observations*										--		
														23

Table B83. South I-405 SR 167 - Renton p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1861	494	72	51	2	0	1	57	76	15	**2629**	**1.32**	**5**
	Q4/92	No observations*										--		
	Q1/93	3648	346	32	12	2	0	6	68	113	3	**4230**	**1.11**	**8**
	Q2/93	No observations*										--		
														13

Table B84. South I-405 SR 167 - Renton a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	4576	493	72	29	2	0	3	164	196	16	**5551**	**1.14**	**7**
	Q4/92	1204	75	6	1	0	0	4	42	65	1	**1398**	**1.07**	**2**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														9

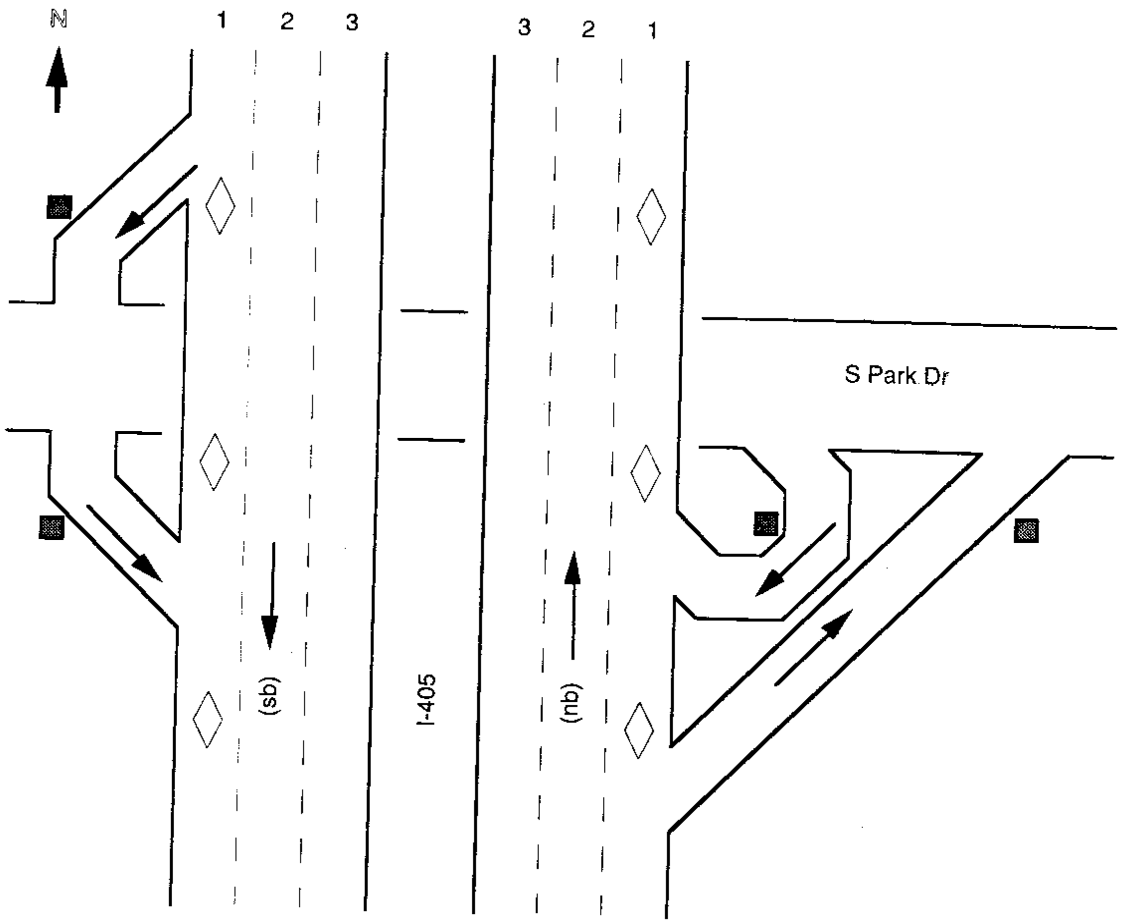
Table B85. South I-405 SR 167 - Renton p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	1389	157	20	5	5	1	1	40	84	5	**1707**	**1.14**	**6**
	Q1/93	1486	224	30	3	5	1	0	63	47	5	**1864**	**1.17**	**3**
	Q2/93	No observations*										--		
														9

Figure B38. I-405 SOUTH - S Park Drive

SITE #64

ACO on/ramp NB & SB-am & pm
ACO off/ramp NB & SB- am & pm



Note: There are a lot of Boeing plants and offices in this part of Renton, so traffic conforms to Boeing work schedules. If possible, it is a good idea to count these ramps from 5:30-8:30 in the morning, and from 2:00-5:00 or 5:30 in the afternoon. You will notice a significant drop in traffic after the shift change commute ends.

Table B86. South I-405 S Park Dr. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	425	63	8	4	2	10	0	8	1	2	523	1.18	4
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	401	67	9	5	1	12	0	17	6	2	520	1.21	5
														9

Table B87. South I-405 S Park Dr. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	5084	482	38	21	39	82	5	463	13	8	6235	1.11	16
	Q2/93	No observations*										--		
														16

Table B88. South I-405 S Park Dr. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	No observations*										--		
	Q4/92	910	89	8	3	0	10	5	15	24	1	**1065**	**1.11**	**6**
	Q1/93	680	48	4	1	1	0	4	20	14	0	**771**	**1.08**	**4**
	Q2/93	609	52	10	2	0	0	0	15	31	0	**719**	**1.12**	**4**
														14

Table B89. South I-405 S Park Dr. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	1781	326	65	18	9	7	0	304	28	4	**2542**	**1.23**	**12**
	Q2/93	No observations*										--		
														12

Table B90. South I-405 S Park Dr. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	310	41	3	2	1	0	1	11	19	3	**391**	**1.15**	**4**
	Q4/92	362	29	3	0	1	0	0	18	24	0	**437**	**1.09**	**3**
	Q1/93	504	35	8	1	1	0	3	26	26	0	**604**	**1.10**	**4**
	Q2/93	534	48	7	6	0	0	1	26	28	2	**652**	**1.14**	**3**
														14

Table B91. South I-405 S Park Dr. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	513	13	3	0	0	0	1	11	2	1	**544**	**1.04**	**3**
	Q1/93	2183	274	26	3	0	3	0	37	20	8	**2554**	**1.13**	**13**
	Q2/93	No observations*										--		
														16

Table B92. South I-405 S Park Dr. a.m. southbound

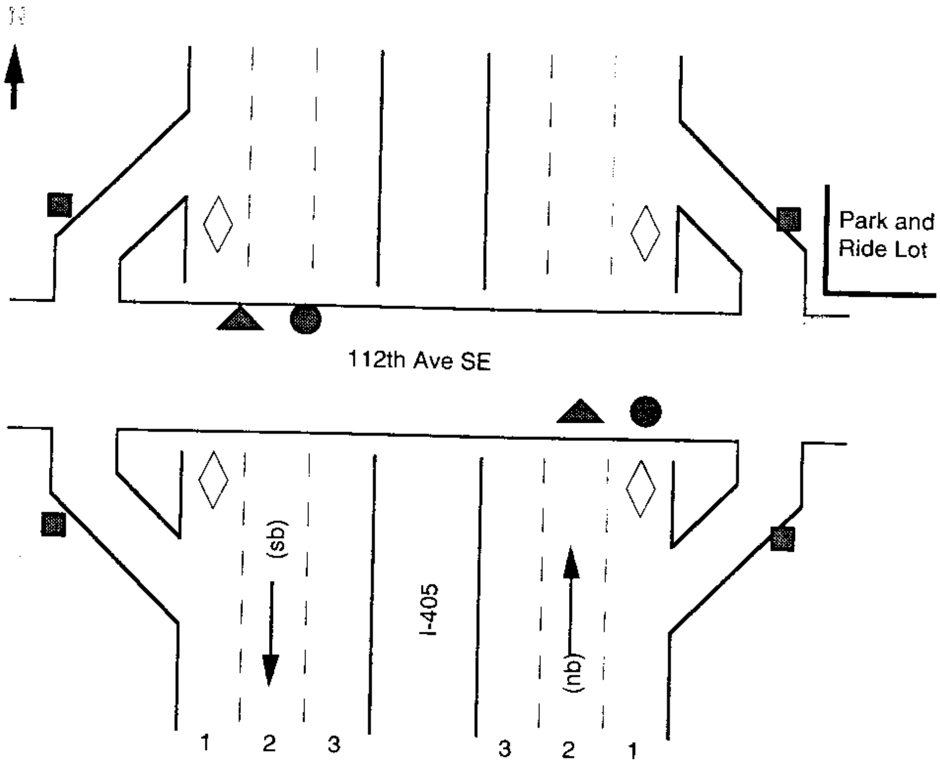
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	1305	142	17	9	8	12	0	18	8	40	**1559**	**1.14**	**5**
	Q4/92	799	74	4	0	6	9	0	5	8	1	**905**	**1.09**	**3**
	Q1/93	2183	164	9	2	6	19	5	12	5	2	**2407**	**1.08**	**6**
	Q2/93	1029	58	8	3	3	9	1	16	5	1	**1133**	**1.08**	**4**
														18

Table B93. South I-405 S Park Dr. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	No observations*										--		
	Q4/92	478	72	9	3	8	11	1	12	5	0	**599**	**1.18**	**3**
	Q1/93	2056	380	60	22	15	53	3	46	9	1	**2645**	**1.23**	**13**
	Q2/93	No observations*										--		
														16

Figure B39. I-405 SOUTH - 112 Avenue SE/Lk Washington Blvd SITE #65

▲ Mainline ACO NB & SB-am & pm



Note: There is a sidewalk only on the south side of this street. If you are counting ACO mainline traffic southbound, you will be sitting on the shoulder on the north side of the street, and you must wear a vest.

The HOV lane is on the outside of the freeway in both directions at this location. Be sure to count it as lane #1.

Table B94. South I-405 112th Ave SE/L Wash Blvd a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	15	317	55	23	5	1	0	2	0	13	**431**	**2.22**	**2**
	Q4/92	No observations*												
	Q1/93	99	1168	99	9	24	8	9	18	0	14	**1448**	**2.01**	**5**
	Q2/93	45	716	103	21	16	5	1	17	0	17	**941**	**2.12**	**4**
														12
GP lanes 2	Q3/92	938	56	6	4	0	0	1	39	116	2	**1162**	**1.08**	**2**
	Q4/92	No observations*										**--**		
	Q1/93	7791	155	10	2	3	1	1	255	247	0	**8465**	**1.02**	**10**
	Q2/93	4662	137	26	9	1	1	1	184	261	4	**5286**	**1.05**	**6**
														18

Table B95. South I-405 112th Ave SE/L Wash Blvd p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	67	829	95	27	8	6	0	318	3	6	1359	2.09	8
	Q2/93	101	984	150	16	13	6	1	12	1	6	1290	2.07	5
														13
GP lanes 2	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	8091	610	21	11	4	1	1	1194	132	2	10067	1.08	19
	Q2/93	6664	526	48	3	3	0	1	135	143	2	7525	1.09	8
														27

Table B96. South I-405 112th Ave SE/L Wash Blvd a.m. southbound

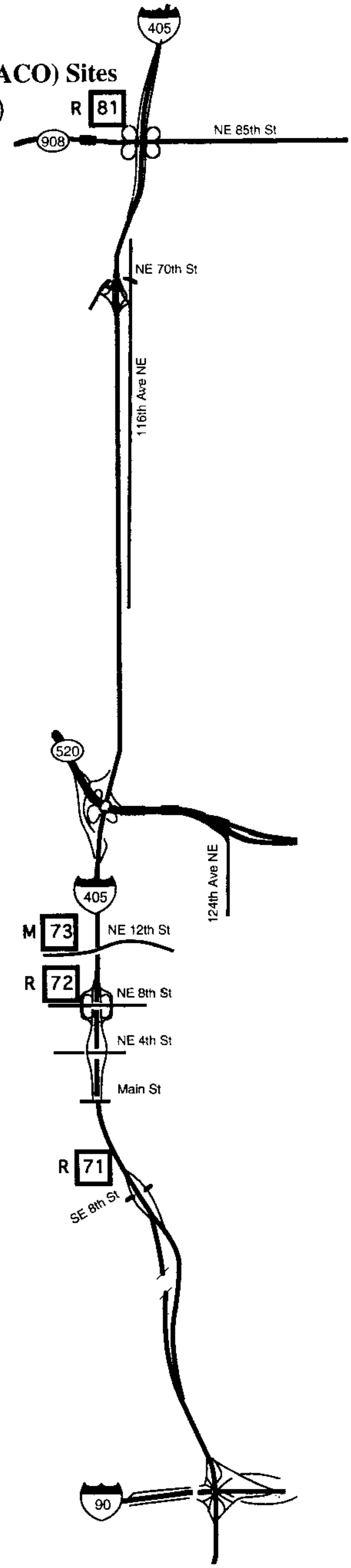
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	46	691	53	11	55	8	6	4	0	4	848	2.04	5
	Q2/93	10	230	31	14	6	2	4	12	0	4	313	2.18	2
														7
GP lanes 2	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	5202	296	10	8	1	2	2	132	180	4	5837	1.06	16
	Q2/93	3594	204	14	5	2	0	0	97	201	0	4117	1.06	6
														22

Table B97. South I-405 112th Ave SE/L Wash Blvd p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
HOV lanes 1	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	136	736	27	1	0	1	2	3	1	15	922	1.88	6
	Q2/93	28	708	120	33	23	2	6	181	1	10	1112	2.19	4
														10
GP lanes 2	Q3/92	No observations*										--		
	Q4/92	No observations*										--		
	Q1/93	13690	1034	27	1	3	0	1	269	250	4	15219	1.07	13
	Q2/93	4690	419	45	3	5	1	2	1231	171	6	6573	1.10	13
														26

Figure B40. Vehicle Occupancy (ACO) Sites

I-405 (Corridors #7 & 8)



ACO Site

M Mainline

R Ramp

Figure B41. I-405 CENTRAL - SE 8th Street SITE #71

■ACO on/ramp NB & SB-am & pm
■ACO off/ramp NB & SB-am & pm

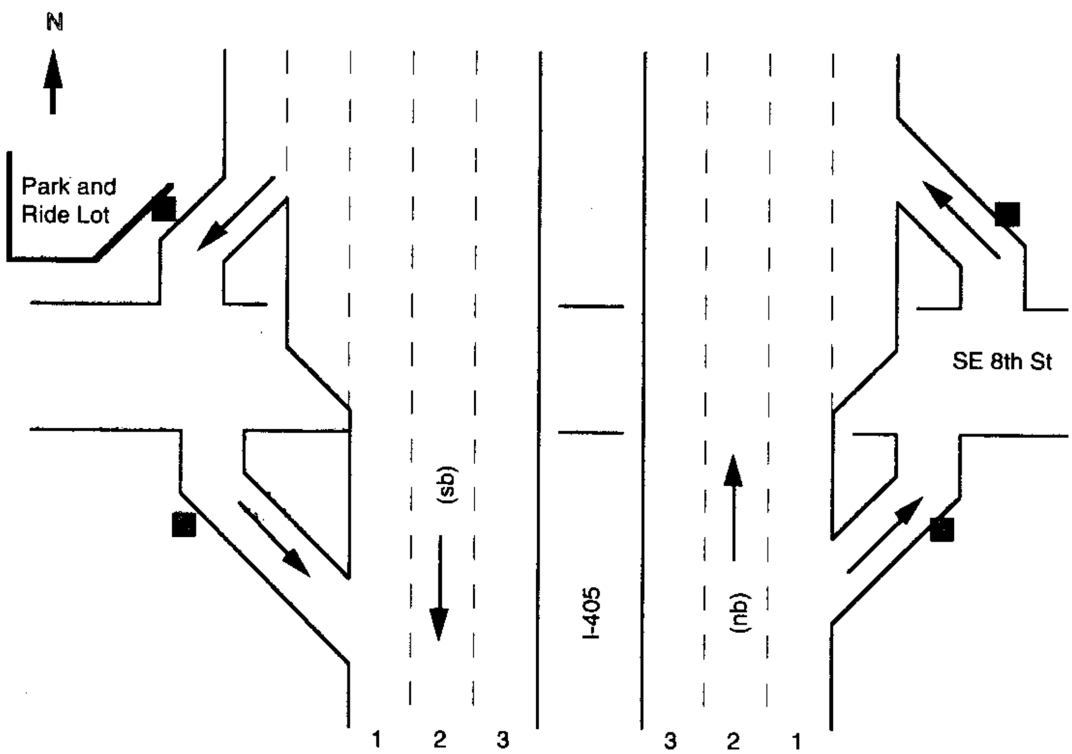


Table B98. Central I-405 SE 8th St. - Bellevue a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1589	136	12	6	5	16	3	39	21	3	**1830**	**1.10**	**8**
	Q4/92	1035	74	16	6	3	9	4	38	12	0	**1197**	**1.11**	**6**
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														14

Table B99. Central I-405 SE 8th St. - Bellevue p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	1227	154	29	21	3	0	1	30	8	6	**1479**	**1.20**	**7**
	Q4/92	991	112	19	4	1	0	1	19	5	3	**1155**	**1.14**	**4**
	Q1/93	1629	198	23	11	1	5	2	28	5	0	**1902**	**1.15**	**7**
	Q2/93	1170	180	21	6	2	1	5	26	7	5	**1423**	**1.18**	**5**
														23

Table B100. Central I-405 SE 8th St. - Bellevue a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	288	54	9	2	3	1	0	7	5	1	**370**	**1.22**	**4**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														4

Table B101. Central I-405 SE 8th St. - Bellevue p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
On ramp	Q3/92	1018	130	27	13	1	5	0	8	6	6	**1214**	**1.19**	**3**
	Q4/92	1070	92	6	0	3	8	2	11	8	3	**1203**	**1.09**	**4**
	Q1/93	2987	269	28	11	6	30	10	16	5	0	**3362**	**1.11**	**12**
	Q2/93	1389	185	54	18	12	14	0	7	6	4	**1689**	**1.21**	**5**
														24

Table B102. Central I-405 SE 8th St. - Bellevue a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
Off ramp	Q3/92	No observations*										**--**		
	Q4/92	990	103	8	2	3	5	1	7	12	2	**1133**	**1.11**	**6**
	Q1/93	2213	210	13	7	4	13	4	386	10	2	**2862**	**1.11**	**10**
	Q2/93	No observations*										**--**		
														16

Table B103. Central I-405 SE 8th St. - Bellevue p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
Off ramp	Q3/92	No observations*										**--**		
	Q4/92	540	84	21	10	0	0	4	24	2	1	**686**	**1.24**	**4**
	Q1/93	1230	219	42	14	6	0	10	39	1	2	**1563**	**1.23**	**9**
	Q2/93	No observations*										**--**		
														13

Table B104. Central I-405 SE 8th St. - Bellevue a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
Off ramp	Q3/92	2547	168	22	1	2	2	4	44	13	11	**2814**	**1.08**	**8**
	Q4/92	2695	328	12	3	1	3	3	39	12	0	**3096**	**1.12**	**10**
	Q1/93	4028	304	18	2	4	4	10	38	13	3	**4424**	**1.08**	**12**
	Q2/93	No observations*										**--**		
														30

Table B105. Central I-405 SE 8th St. - Bellevue p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	**TOTAL OBS.**	**ACO**	**Counts**
Off ramp	Q3/92	1737	344	55	37	4	15	1	23	13	6	**2235**	**1.26**	**5**
	Q4/92	5398	757	60	29	18	40	4	71	38	14	**6429**	**1.16**	**15**
	Q1/93	3449	671	96	23	15	34	2	67	14	3	**4374**	**1.22**	**9**
	Q2/93	No observations*										**--**		
														29

Figure B42. I-405 CENTRAL - NE 8th Street **SITE #72**

■ **ACO on/ramp NB & SB-am & pm**
■ **ACO off/ramp NB & SB-am & pm**

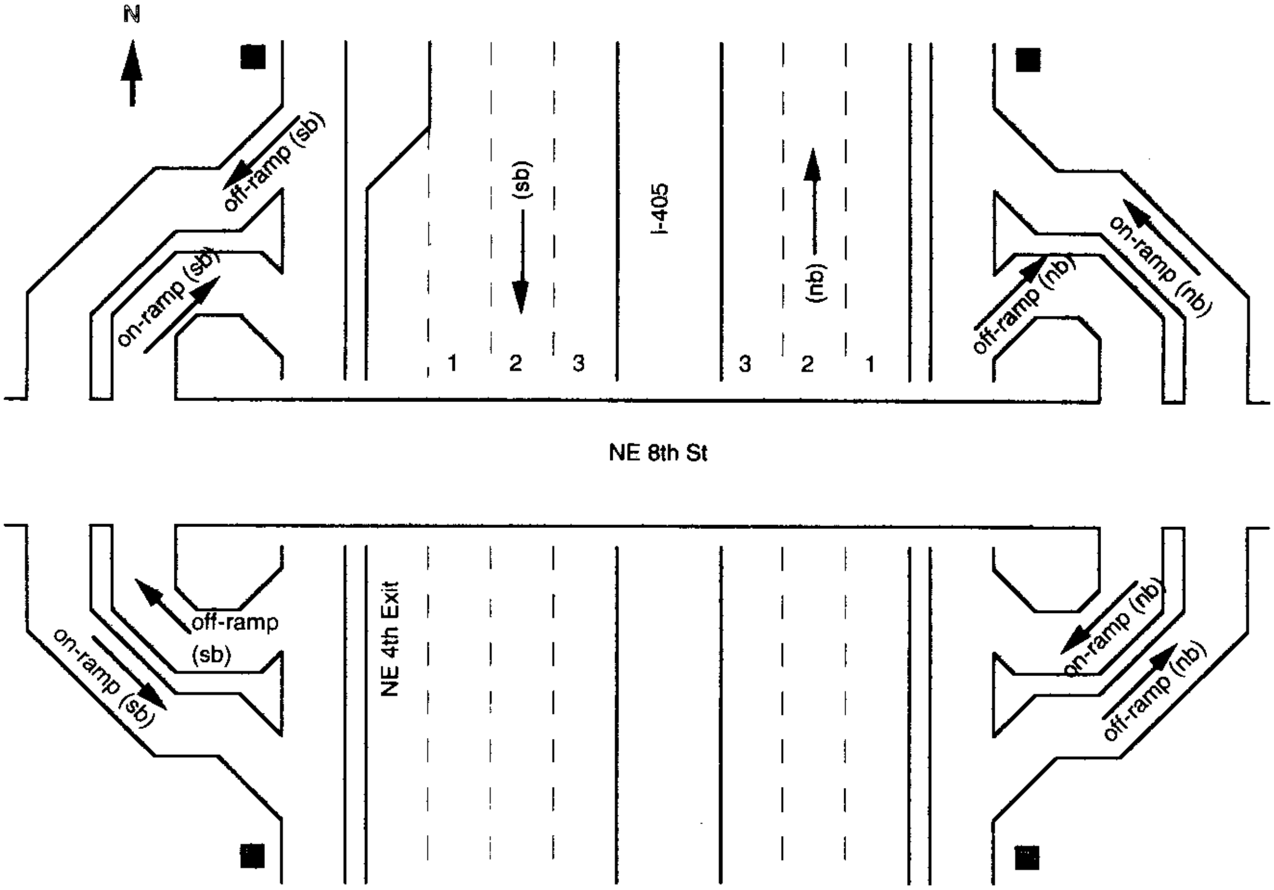


Table B106. Central I-405 NE 8th St. a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	3527	270	17	3	2	2	1	56	26	8	**3912**	**1.08**	**5**
	Q4/92	No observations*										--		
	Q1/93	5626	374	18	0	1	2	2	78	21	9	**6131**	**1.07**	**8**
	Q2/93	No observations*										--		
														13

Table B107. Central I-405 NE 8th St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	225	14	1	2	0	0	0	3	1	1	**247**	**1.09**	**1**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	No observations*										--		
														1

Figure B43. I-405 CENTRAL - NE 12th Street — SITE #73

▲ACO mainline NB & SB-am & pm

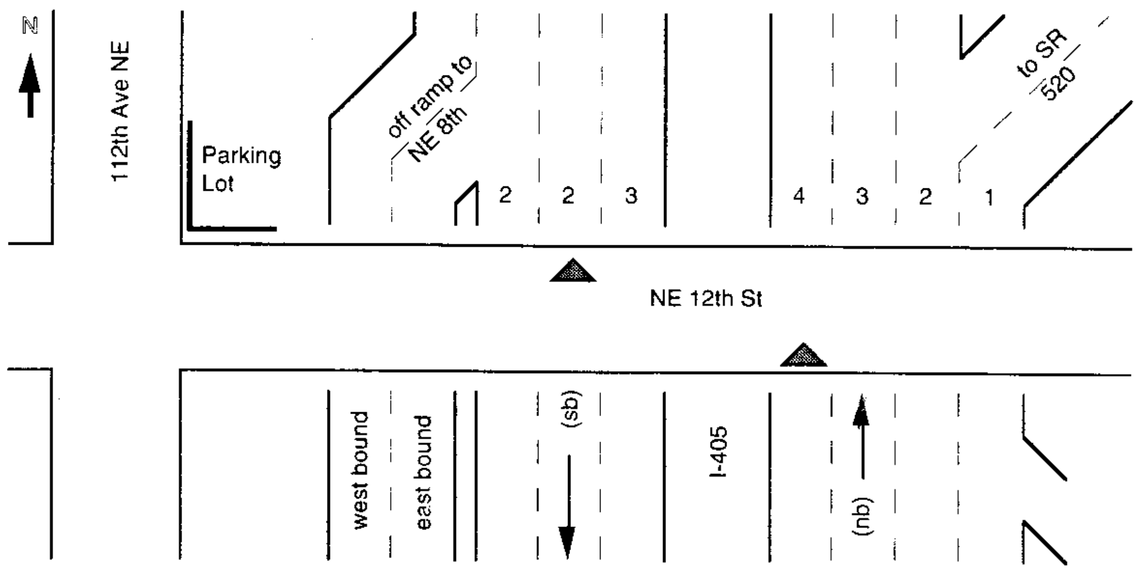


Table B108. Central I-405 NE 12th St. a.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 4	Q3/92	6606	727	48	8	2	16	3	164	274	21	**7869**	**1.11**	**16**
	Q4/92	No observations*										--		
	Q1/93	No observations*										--		
	Q2/93	945	115	12	3	2	3	0	4	65	4	**1190**	**1.14**	**3**
														19

Table B109. Central I-405 NE 12th St. p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 4	Q3/92	4235	945	90	40	26	6	3	48	53	33	**5479**	**1.24**	**10**
	Q4/92	825	153	15	1	1	2	0	17	11	1	**1026**	**1.19**	**2**
	Q1/93	No observations*										--		
	Q2/93	7363	1465	204	31	7	19	5	177	106	17	**9394**	**1.22**	**12**
														24

Table B110. Central I-405 NE 12th St. a.m. southbound

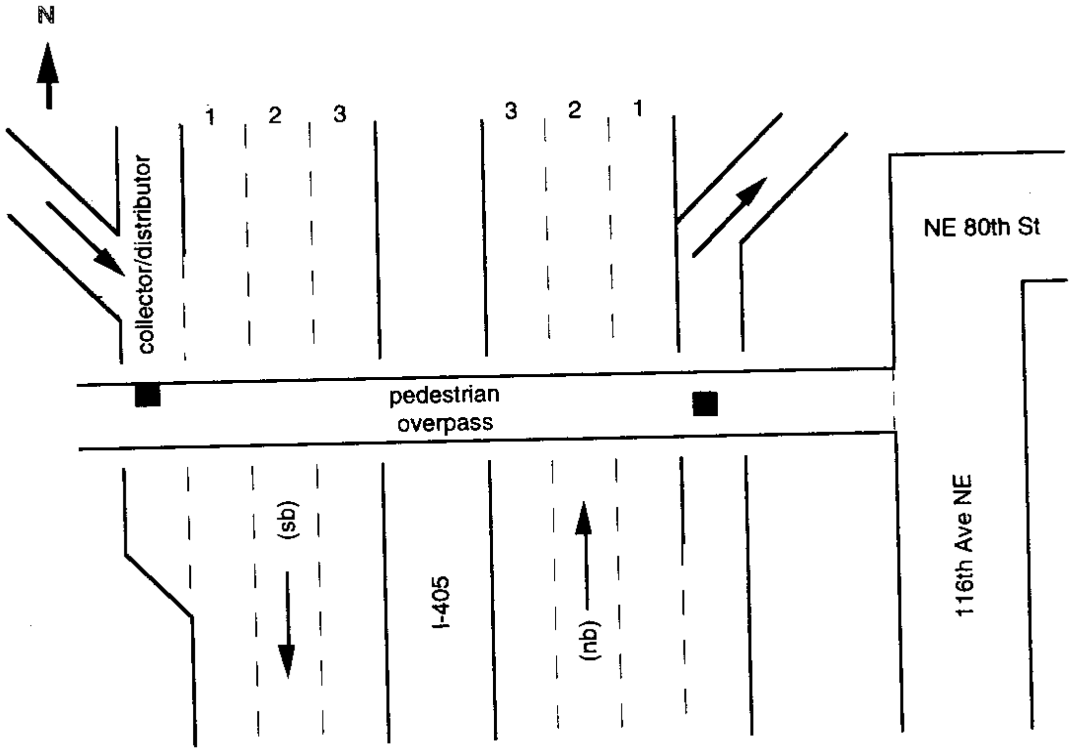
	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 3	Q3/92	6837	906	85	12	5	18	4	131	220	21	**8238**	**1.14**	**10**
	Q4/92	3615	256	9	1	0	8	0	99	65	3	**4056**	**1.07**	**5**
	Q1/93	No observations*										--		
	Q2/93	3054	279	16	3	5	21	0	85	108	7	**3578**	**1.10**	**6**
														21

Table B111. Central I-405 NE 12th St. p.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
GP lanes 3	Q3/92	5961	1285	167	48	14	27	11	179	180	41	**7913**	**1.24**	**12**
	Q4/92	1280	243	17	3	3	1	3	54	37	2	**1643**	**1.19**	**2**
	Q1/93	No observations*										--		**5**
	Q2/93	1973	462	79	54	4	12	5	110	82	22	**2803**	**1.31**	**4**
														23

Figure B44. I-405 NORTH - SR 908: Central Way/NE 85th **SITE #81**

■ ACO on/ramp SB-am
■ ACO off/ramp NB-pm



Note: In the winter, you can also park on the shoulder of each ramp in order to gain better visibility for ACO ramp counts.

Table B112. North I-405 SR 908-Kirkland/Redmond a.m. southbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
On ramp	Q3/92	4322	495	71	22	3	7	5	135	63	18	**5141**	**1.14**	**12**
	Q4/92	2356	211	32	5	0	2	8	25	25	1	**2665**	**1.11**	**6**
	Q1/93	4164	389	33	3	0	4	5	81	46	8	**4733**	**1.10**	**12**
	Q2/93	No observations*										--		
														30

Table B113. North I-405 SR 908-Kirkland/Redmond p.m. northbound

	Qtr.	1	2	3	4+	Van	Public Transit	Other Bus	2 Axle	3+ Axle	Motor-cycle	TOTAL OBS.	ACO	Counts
Off ramp	Q3/92	7581	1351	254	124	16	71	3	114	47	44	**9605**	**1.24**	**21**
	Q4/92	3047	342	60	12	10	27	5	41	20	8	**3572**	**1.14**	**8**
	Q1/93	1539	262	24	19	4	13	2	33	5	8	**1909**	**1.20**	**4**
	Q2/93	1544	286	44	19	3	4	0	36	6	6	**1948**	**1.23**	**5**
														38

APPENDIX C

OBSERVER COMMENTS MADE DURING VEHICLE OCCUPANCY SESSIONS

Below is a sample of comments made by observers while collecting occupancy data throughout this period. Generally, these comments can be categorized into three types: comments regarding data collection, comments about traffic conditions, and comments about weather conditions. Ellipses represent time gaps between comments made by the observer. Because the length of comments is limited by the program used, words are sometimes cut off.

DATA COLLECTION

1. actually counting i-5nb off/r at madison st. mainline's moving well.

2. hard to see people in the back seat due to the angle

3. cars in this lane enter a patch of shade just before i can see them clearly, and don't emerge until just before they go under the overpass. on such a bright, sunny day, it makes it hard to see into back seats, esp in dark colored cars.

4. rolling slowdown, site is ok, sidewalk on s side is too narrow, so I'm watching them going away from me

6. just lost a file I started at half capacity battery I couldn't believe it

7. just lose a count, battery dead backup battery is also not full?! I will count as much as it can do

8. hve to go to meet other observers

9. no light for the inside lanes.......end counting

10. trying to get bus numbers

11. taking a break

TRAFFIC CONDITIONS

1. traffic in fast lane came to an abrupt stop one car skidded- almost a crash.......traffic is flowing smoothly again, but traffic speed is less than 55.......another quick stop in the fast lane along with some more burnt rubber.

2. CARS ENTERING FROM TOWN CROSS OVER LANES HER

3. MAINLINE OFF-RAMP AT STEWART ST. ST.........EXPRESS LANE OFF-RAMP CLD BE COUNTED HERE BY A SECOND PERSON.......THERE ARE POSSIBLY, AGAIN AS MANY CARS EXITTING FROM THE EXPRESS LANES AS THIS

4. TRAFFIC HAS MOVED WELL ALL MORNING, ONLY ONE SLOW-DOWN

5. JUST AS THIS LANE COUNT CLOSES, THE SPEED OF FLOW DROPS TO A CRAWL

6. THE BUSES HAD NO PASSENGERS

7. congestion because of traffic lights occured during the last 20 minute

8. mainline is moving very slowly. The motorcycle that exited here had 2 occupants

9. foggy-49 degrees, wet road.......traffic is heavy but is moving.....traffic slows down.......stop and go traffic.......my battery is running out.......accident below the overpass........I think the driver saw me and did not look at the traffic

WEATHER CONDITIONS

1. mountains are absolutely beautiful. Clear as a bell.

2. FREEZING/HARD RAIN

3. hot, hot, hot, hot,

4. sunny, hot, windy

5. clear,beautiful

6. rain rain rain

7. sunny and clear

8. cold, overcast, dark, finger-numbin' fun

9. cold drizzle--and i forgot my damn glove

10. Some sunshine bvut not enuf

APPENDIX D

ACO DATA ANALYSIS

Table D1. Adjustment Factors for Comparing Average Car Occupancies (ACO)

Parameter	Mainline	Ramp
DAY		
Monday	0.000	0.000
Tuesday	0.001	0.004
Wednesday	0.013	-0.006
Thursday	0.016	0.015
Friday	0.030	0.035
QUARTER		
Q3/92	0.000	0.000
Q4/92	-0.060	-0.050
Q1/93	-0.068	-0.057
Q2/93	-0.041	-0.028
LANE		
HOV	0.000	n/a
inner	-1.007	n/a
center	-1.008	n/a
outer	-1.033	n/a

USING TABLE D1 ADJUSTMENT FACTORS

To use the adjustment factors presented in table D1, merely add (subtract) the appropriate number to the ACO figures presented in Appendix B, based on the aplicable parameters. Continuing the example of the northbound general purpose lanes of I-5 at NE 145th Street during the evening peak in Chapter Three, one would perform the following steps to correct the observed ACO for sample bias.

1. Lookup the ACO value for each quarter of I-5 North, NE 145th Street (Site 14), p.m., northbound general purpose lanes (Table B7). This yields the following values:

   Q4/92 = 1.12
   Q1/93 = 1.13

2. Adjust the ACO for each quarter according to Table D1 as follows:

   Q4/92 = 1.12 - 0.060 = 1.060
   Q1/93 = 1.13 - 0.068 = 1.062

One can now conclude that ACO slightly increased during Q4/92 through Q1/93.

Table D2. Trends in Adjustment Factors by Lane Location

	Overall	Days					Lanes				Quarters				Time Periods
		M	T	W	Th	F	HOV	in	mid	out	Q3 92	Q4 92	Q1 93	Q2 93	
North I-5															
N 145th St															
AM - SB															early --low
PM - NB	lo					hi				lo					
Downtown I-5															
Roanoke St.															
AM - NB	hi									hi				hi	
AM - SB												lo			
PM - NB	hi				hi										
PM - SB	hi														
S Holgate St.															
AM - NB	hi				lo							hi			late --low
AM - SB						lo									
PM - SB	hi				lo	lo				hi					
Albro Pl.															
AM - NB	hi									hi				lo	convex
PM - NB	hi		hi							hi					
PM - SB	hi			hi											
S 144th St.															
AM - NB	hi									hi					
PM - SB	hi														
Madison St.															
AM - SB															
PM - SB	lo					lo	lo								
South I-5															
S 216th St.															
AM - NB				hi	lo		hi								
PM - SB							hi			lo	hi				
SR 520															
Yarrow Pt															
AM - WB			hi		hi								hi	hi	late --low
PM - EB		hi	lo							lo					
148th Ave NE															
AM - WB	lo								lo				hi		late --low
PM - EB						hi						hi			
I-90															
Island Crest Wy.															
AM - WB	lo														
PM - EB		hi		lo		lo								lo	
South I-405															
Tukwila Pkwy.															
AM - NB			hi			lo							hi		
AM - SB	lo														
PM - NB	lo														
PM - SB	hi					hi*						lo	hi		
112th Ave. SE															
AM - NB	lo														
AM - SB	lo														
PM - NB	lo														
PM - SB	lo				hi		lo			hi					
Central I-405															
NE 12th St.															
AM - NB														hi	early --low
AM - SB		hi				lo									early --low
PM - NB								lo			lo				
PM - SB	hi							lo				lo		hi*	

*very high

Table D3. Trends in Adjustment Factors by Ramp Location

	Overall	Days					Quarters				Time Periods
		M	T	W	Th	F	Q3/92	Q4/92	Q1/93	Q2/93	
North I-5											
236th St. SW											
AM - SB -on ramp	hi						lo				convex
PM - NB -off ramp	hi	hi					hi	lo			
NE 175th St.											
AM - SB -on ramp				hi	lo				lo	hi*	convex
PM - NB -off ramp		hi				lo	hi	lo			
N 145th St											
AM - SB -on ramp			hi			lo	lo	hi			concave
PM - NB -off ramp										hi	
NE Northgate											
AM - SB -on ramp		hi		lo			lo				
PM - NB -off ramp	hi	hi	lo				hi			lo	
Downtown I-5											
Stewart St.											
AM - SB -off ramp								hi		lo	concave
Roanoke St.											
AM - SB -off ramp	lo						lo	hi			concave
PM - NB -on ramp						hi	hi	lo			
Michigan											
AM - NB -on ramp								hi	lo		
PM - NB -on ramp											
Corson											
AM - SB -off ramp	lo					lo					concave
PM - SB -off ramp	hi		hi				lo	hi			convex
Olive Wy.											
AM - NB -on ramp			lo		hi			hi		lo	
PM - NB -on ramp		lo		hi				lo			
Howell/Yale St.s											
AM - SB -on ramp											
PM - SB -on ramp				lo		hi					
Madison St.											
AM - NB -off ramp								hi		lo	
South I-5											
S 188th											
AM - NB -on ramp					lo						
PM - SB -off ramp					lo				lo		
S 200th											
AM - NB -on ramp						lo				lo	
PM - SB -off ramp					lo						
SR 516 -Kent DM Rd.											
PM - SB -off ramp											
SR 516 -Kent Ramp											
AM - NB -on ramp		lo						hi			
SR 516 -Des Moines Ramp											
AM - NB -on ramp		lo						hi			
S 272nd St.											
AM - NB -on ramp					lo						convex
PM - SB -off ramp								lo			convex
SR 520											
Hunt's Pt.											
AM - WB -on ramp											
SR 908 -Bell Kirk											
AM - WB -on ramp											convex
PM - EB -off ramp		lo									
124th Ave NE											
AM - WB -on ramp				hi							convex
PM - EB -off ramp											
148th -Redmond Ramp											
AM - WB -on ramp								hi		lo	
PM - EB -off ramp											
148th -Bellevue Ramp											
AM - WB -on ramp											
PM - EB -off ramp					lo				lo	hi	

I-90				
60th Ave SE				
AM - WB -on ramp				drops
PM - EB -off ramp			lo	
Island Crest Wy.				
AM - WB -on ramp		lo		
PM - EB -off ramp			lo	
Bellevue Wy.				
AM - WB -on ramp				
PM - EB -off ramp		lo hi	hi	concave
South I-405				
SR 167 -Renton				
AM - NB -on ramp			~~lo~~ hi	
AM - SB -off ramp		hi lo		concave
PM - NB -on ramp			hi lo	
PM - SB -off ramp				
S. Park Dr.				
AM - NB -off ramp				
AM - SB -on ramp				
AM - SB -off ramp			lo	
PM - NB -on ramp				
PM - NB -off ramp		hi		
PM - SB -on ramp				rises
PM - SB -off ramp	hi	lo hi		
Central I-405				
SE 8th St.				
AM - NB -on ramp	lo			
AM - NB -off ramp				
AM - SB -off ramp	lo	hi		
PM - NB -on ramp				
PM - NB -off ramp	hi			
PM - SB -on ramp			hi	
PM - SB -off ramp		lo hi		
NE 8th St.				
AM - SB -off ramp	lo		lo hi	drops
North I-405				
SR 908 -Kirkland/Redmond				
AM - SB -on ramp		hi lo		
PM - NB -off ramp		lo	lo	

*very high

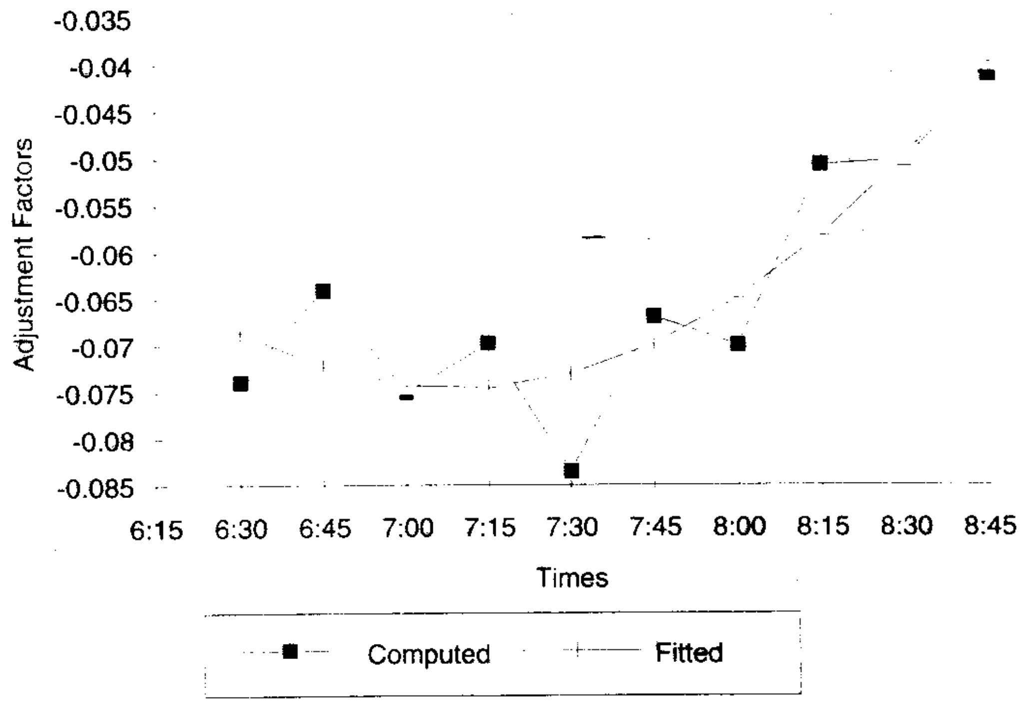


Figure D1. AVO Adjustment Factors – AM Lanes

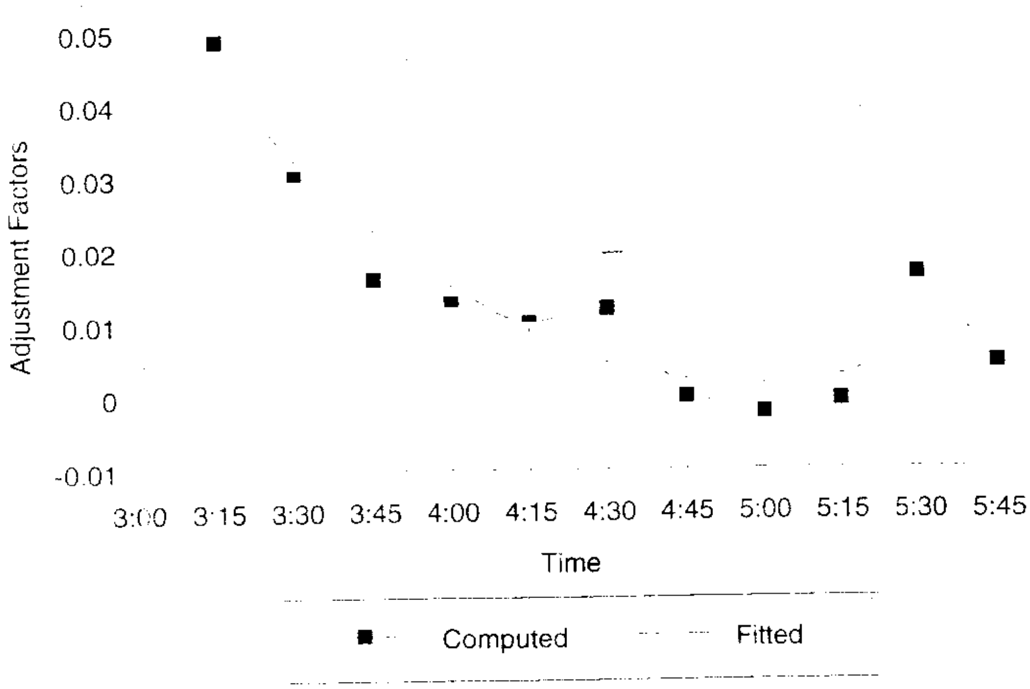


Figure D2. AVO Ajustment Factors – PM Lanes

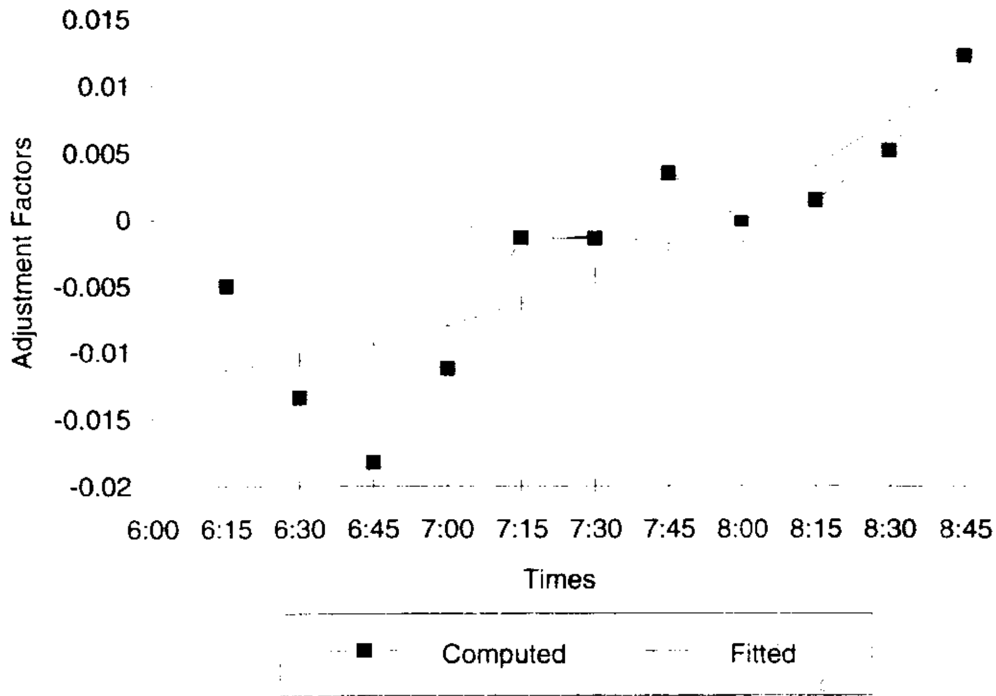


Figure D3. AVO Adjustment Factors - AM Ramps

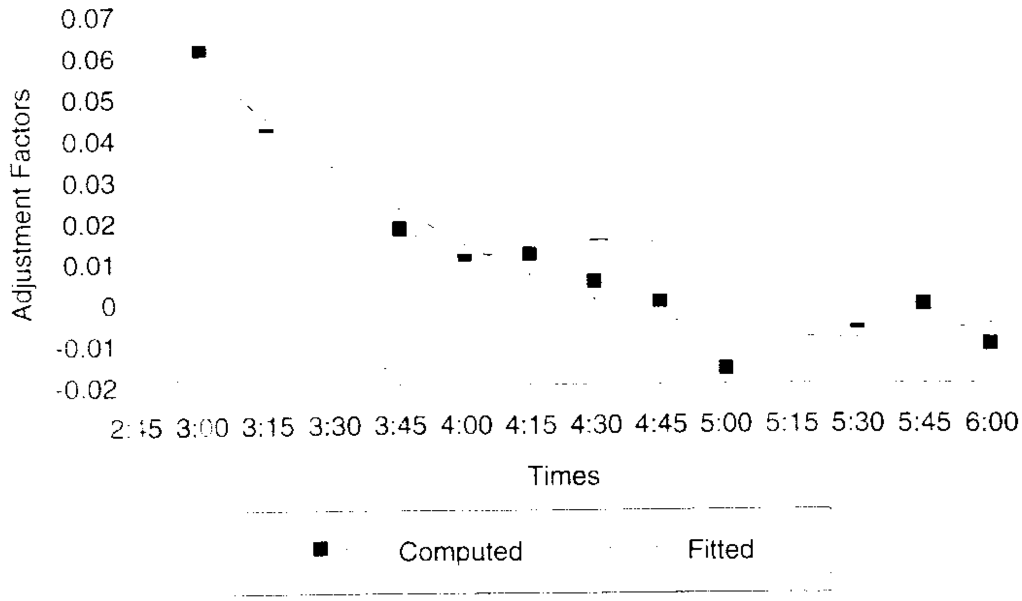


Figure D4. AVO Adjustment Factors – PM Ramps

APPENDIX E

TRAVEL TIME DATA

Table E1. Travel Time Observation Sites, July 1992 - July 1993

I-5 North (corridor 1)	I-5 Downtown (corridor 2)	I-5 South (corridor 3)
11 = SW 236th St	21a = Lakeview Blvd.	31 = S 178th St
12 = N 185th St	22 = Holgate St	32
13	23	33
14	24	34 = S 216th St
15 = N 117th St	25 = Albro Pl	35
16	26 = S 144th St	36
	27	37
	28	38 = S 260th St
	29	
	20	
SR 520 (corridor 4)	**I-90 (corridor 5)**	**I-405 South (corridor 6)**
41 = Hunt's Point	51 = 23rd Ave S	61 = Tukwila Pkwy
42	52 = 35th Ave S	62
43 = SR-908 - Bellevue/Kirkland	53	63 = Benson Rd S
44	54	64
45 = 148th Ave NE	55 = East Mercer Wy	65 = 112th Ave SE/Lake Wash. Blvd.
46	56	
47		
I-405 Central (corridor 7)	**I-405 South (corridor 8)**	**Outlying Locations**
71	81= SR 908 -Kirkland/Redmond	
72		
73 = NE 12th St		

Table E2. Travel Time Study Section Length

Study Section	Length (kilometers)
North I-5	
236th St. SW to NE 117th St.	8.24
NE 117th St. to NE 185th St.	5.75
Downtown I-5	
Lakeview Blvd. E to S Holgate St.	4.96
Lakeview Blvd. E to Albro Pl.	9.39
Lakeview Blvd. E to S 144th St.	18.87
S Holgate St. to Albro Pl.	4.43
S Holgate St. to S 144th St.	13.91
Albro Pl. to S 144th St.	9.48
South I-5	
S 178th St. to S 216th St.	4.54
S 260th St. to S 216th St.	4.28
SR-520	
SR-908 to Hunt's Pt.	2.72
148th Ave. NE to Hunt's Pt.	7.89
Hunt's Pt. to SR-908	2.72
148th Ave. NE to SR-908	5.17
I-90	
23rd Ave. S to E Mercer Way	7.74
E Mercer Way to 35th Ave. S	6.63
I-405	
Tukwila Pkwy. to Benson Rd. S	3.36
Tukwila Pkwy. to 112th Ave SE	13.67
Tukwila Pkwy. to NE 12th St.	21.49
Tukwila Pkwy. to SR-908	27.48
Benson Rd. S to 112th Ave SE	10.30
Benson Rd. S to NE 12th St.	18.13
Benson Rd. S to SR-908	24.12
112th Ave SE to NE 12th St.	7.82
112th Ave SE to SR-908	13.81
NE 12th St. to SR-908	5.99

Figure E1. Travel Time Sites

I-5 North (Corridor #1)

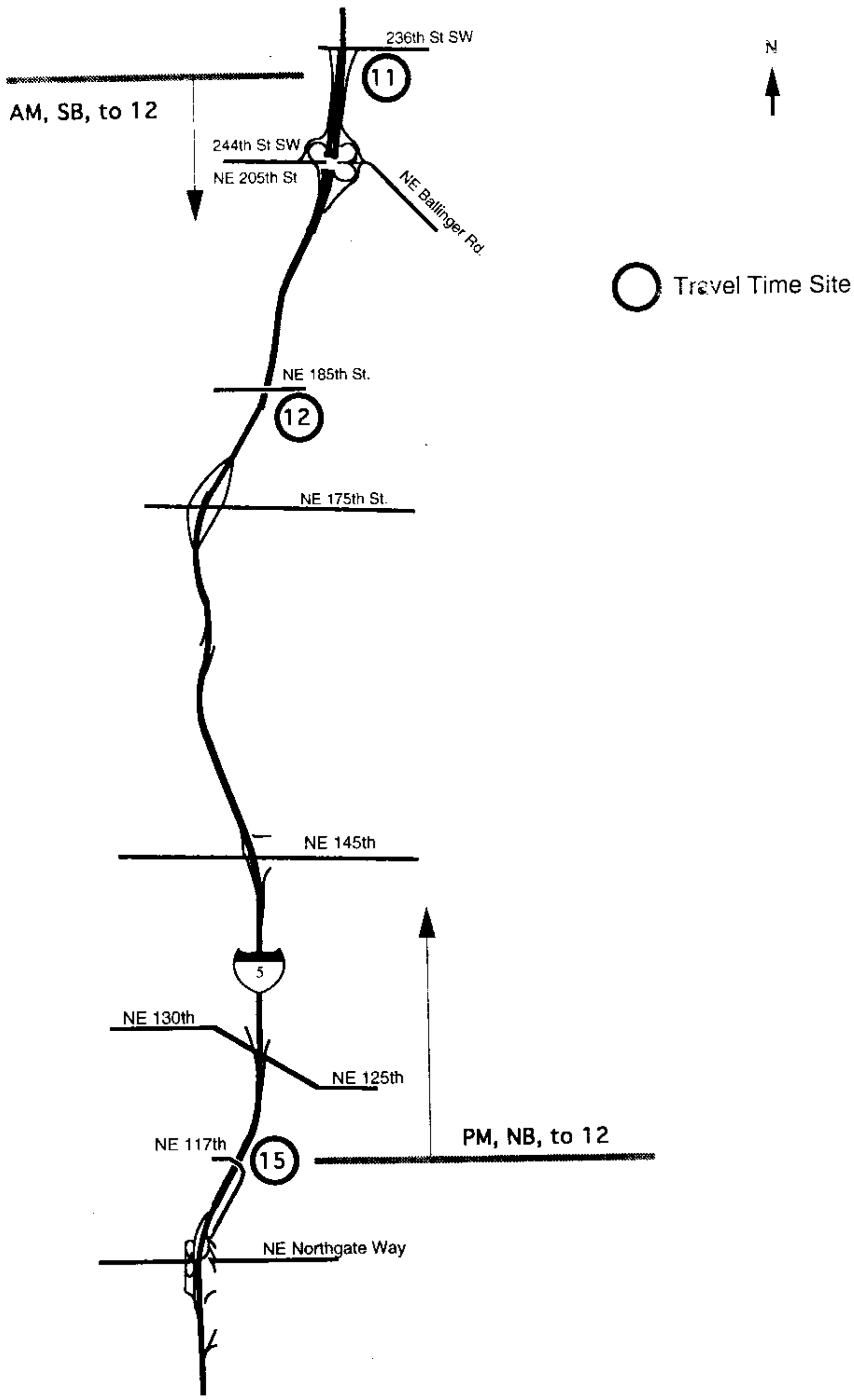


Figure E2. I-5 NORTH - SW 236th Street **SITE #11**

Travel times SB-am

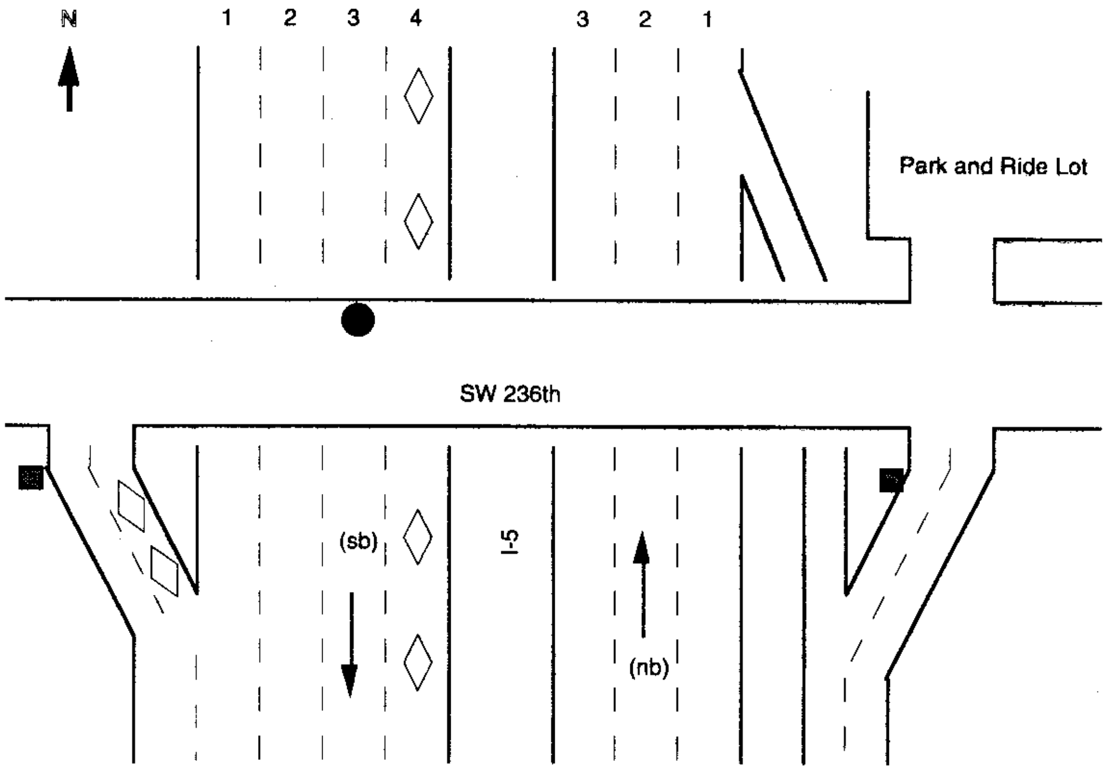


Figure E3. I-5 NORTH - North 185th Street **SITE #12**

Travel times NB-pm

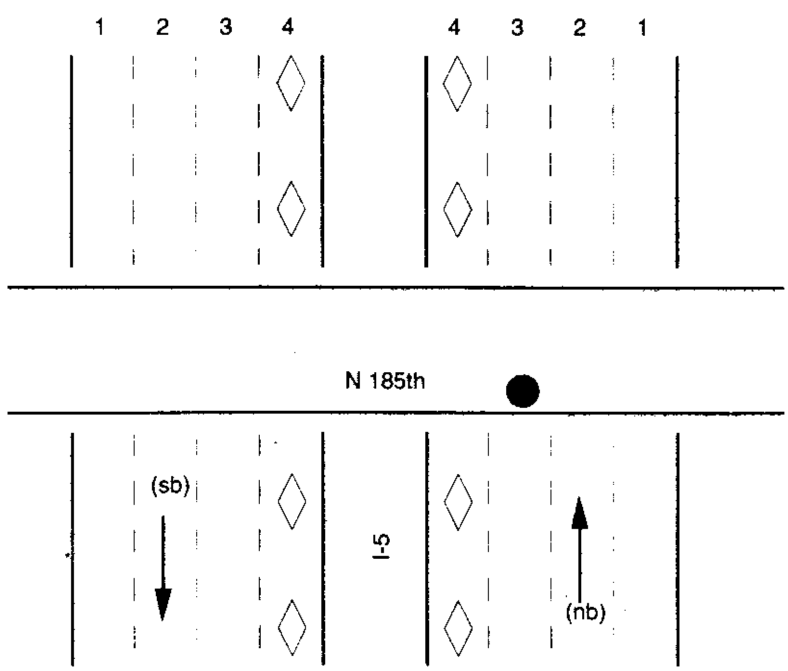
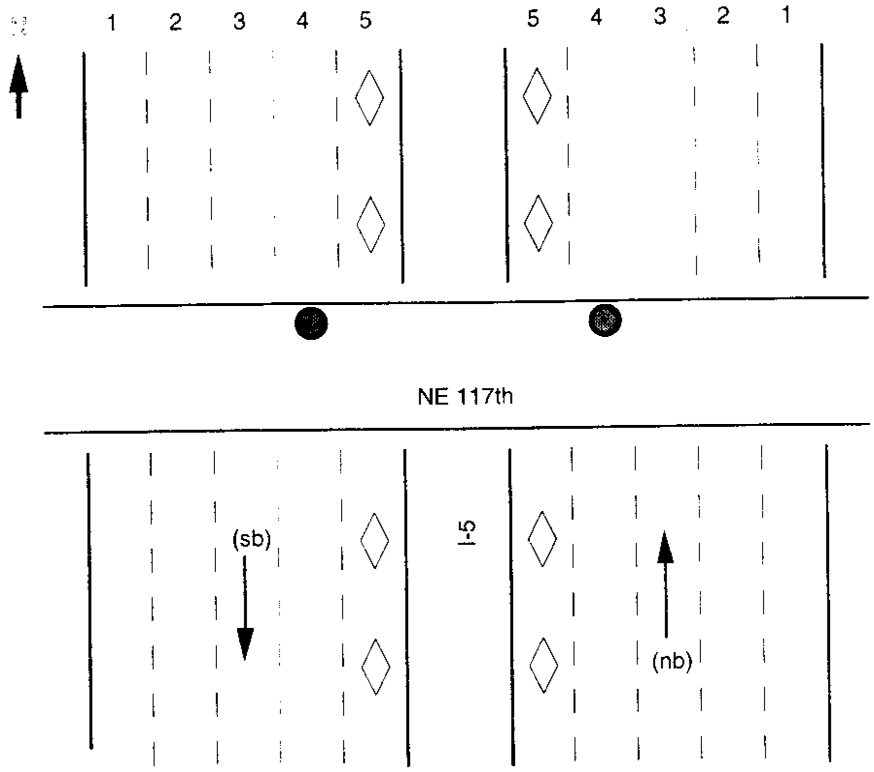


Figure E4. I-5 NORTH - 117th Avenue NE SITE #15

Travel times SB-am
Travel times NB-pm



Note: There is a sidewalk only on the north side of this overcrossing. You may count southbound traffic as it comes toward you, but you must count northbound traffic as it comes under the overcrossing and goes away from you.

Table E3. North I-5 236th St. SW to 117th St. NE , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	59.5	59	58	56.8	55	52.6	53.6	57.6	58.6	59	59.4
	Q4/92	–	–	–	–	–	–	–	–	–	–	32.6	32	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	57.6	–	–	–	53	–	–	–	–	–
HOV Lanes	Q3/92	–	–	–	–	55.7	57.1	53.6	55.8	55.5	53.7	56.3	57.4	58.8	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	50	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	54.7	–	–	–	–	–

Table E4. North I-5 117th St. NE to N 185th St. , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	52.6	57.4	53.6	42.5	36.8	29.7	31.2	31.7	27.1	28.7	35.4	46.7
	Q4/92	–	–	5.3	9.8	31.3	34.9	22.9	37.3	–	–	–	–	–	–
	Q1/93	–	1.2	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	2.1	60.2	61.3	43.3	52.2	43.2	59.9	57	59.8	58.4
HOV Lanes	Q3/92	–	–	51.6	61.9	65.1	45	37.3	33.8	42.9	37.6	46.5	39.9	44.6	54.3
	Q4/92	–	–	–	–	37.7	28.1	–	43.4	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	59.2	60.4	59.3	58.6	55.3	58	57.3	57.5	56.5

Figure E5. Travel Time Sites
I-5 Downtown (Corridor #2N)

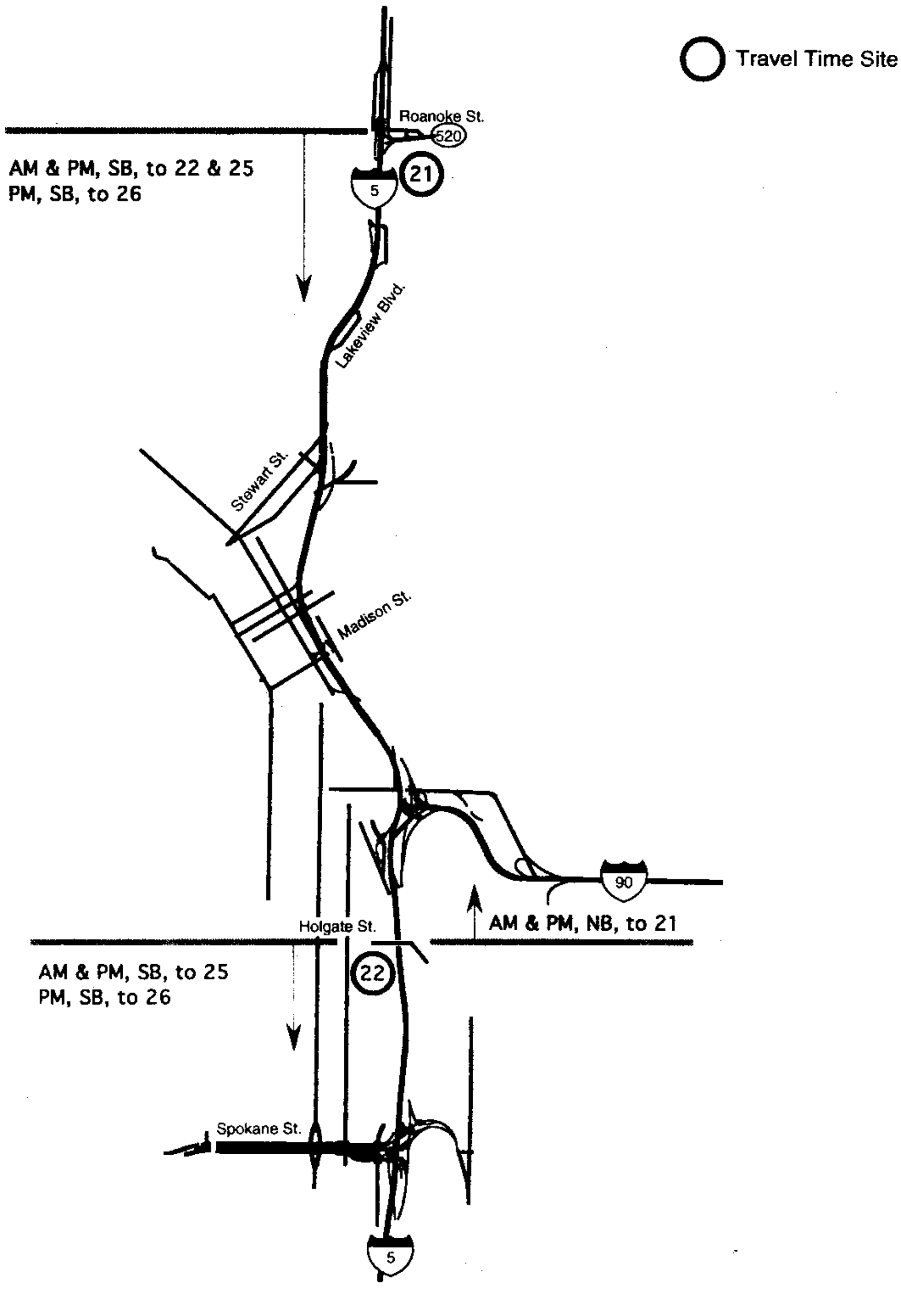


Figure E5. Travel Time Sites (cont.)
I-5 Downtown (Corridor #2S)

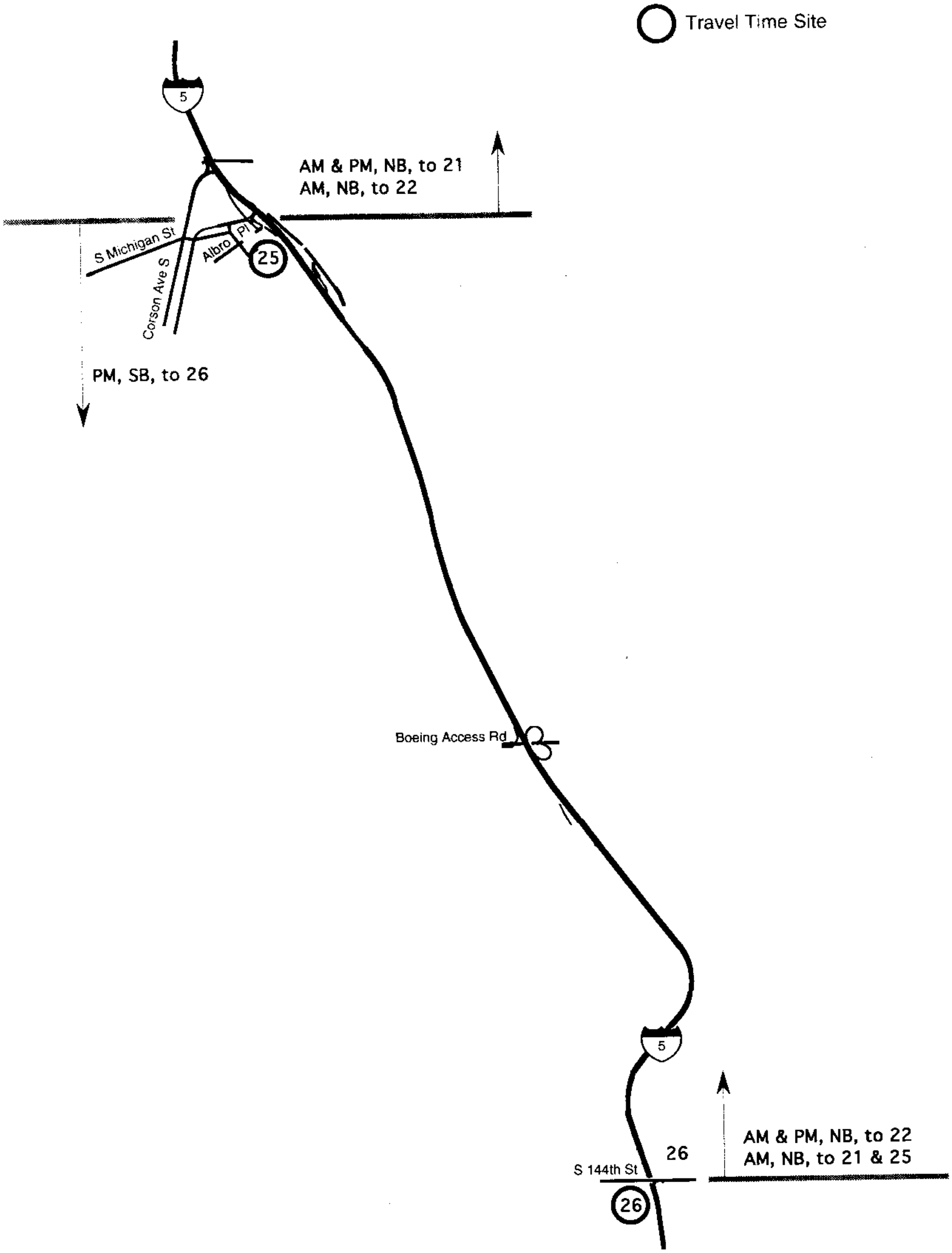


Figure E6. I-5 DOWNTOWN - Roanoke St. SITE #21b

Travel times SB&NB-am&pm

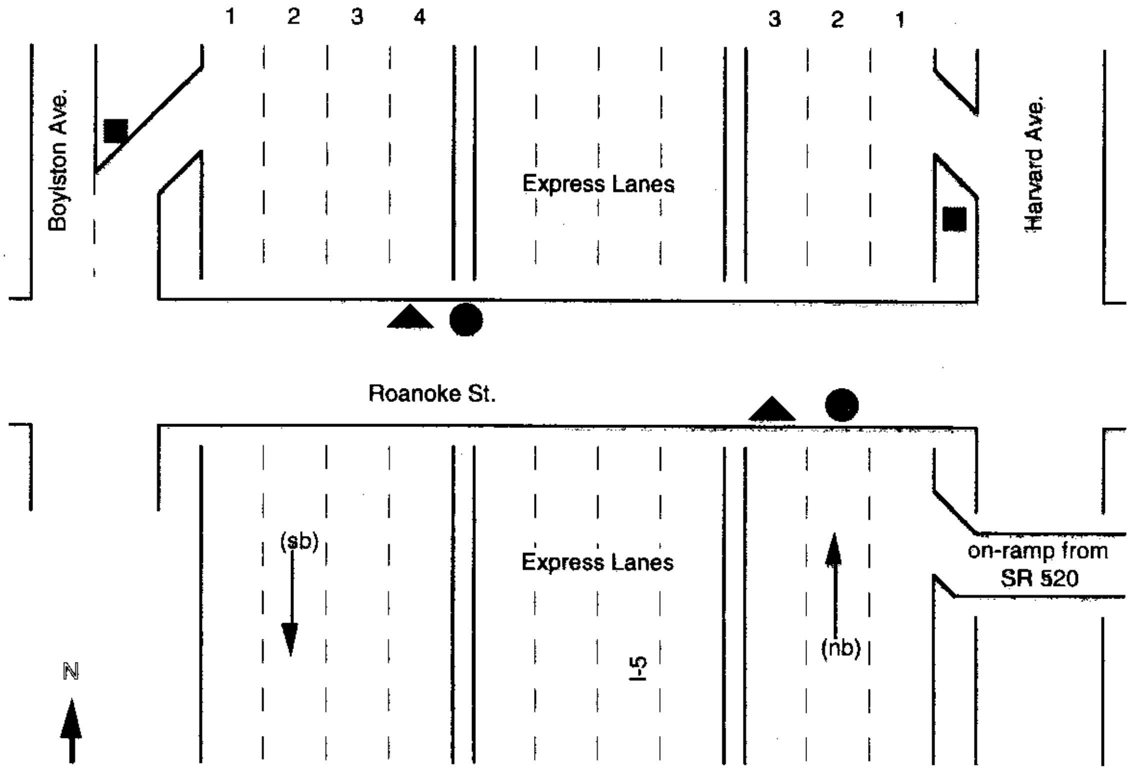


Figure E7. I-5 DOWNTOWN - S Holgate St. SITE #22

Travel times SB&NB-am&pm

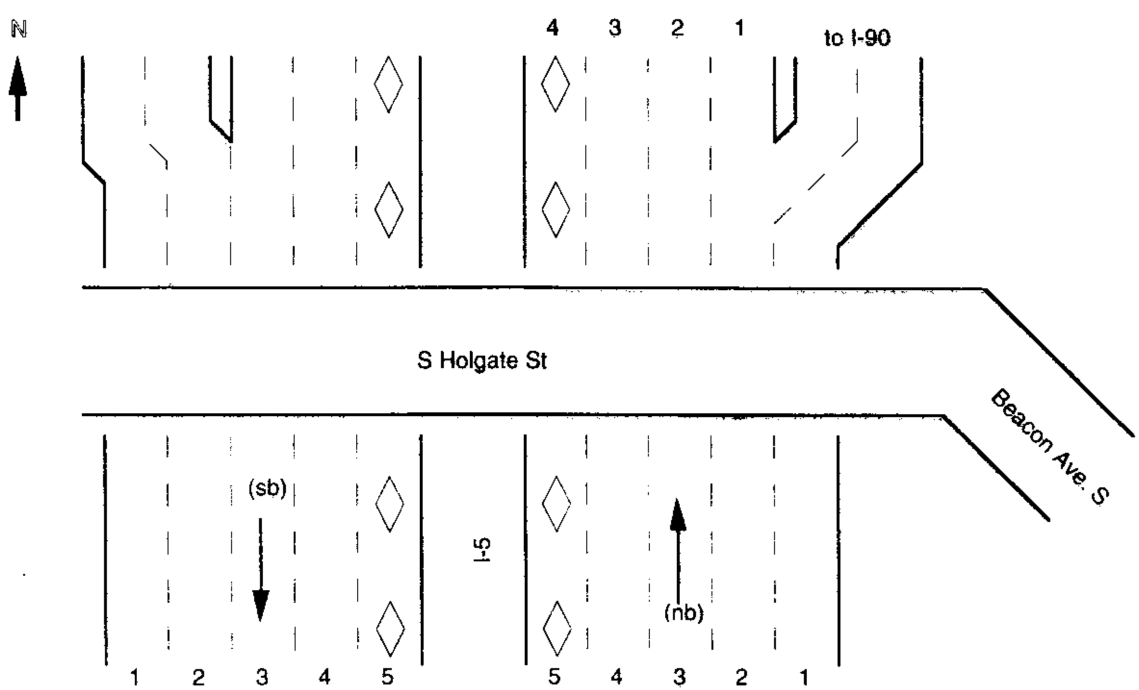


Figure E8. I-5 DOWNTOWN - Albro Place SITE #25

Travel times SB & NB-am & pm

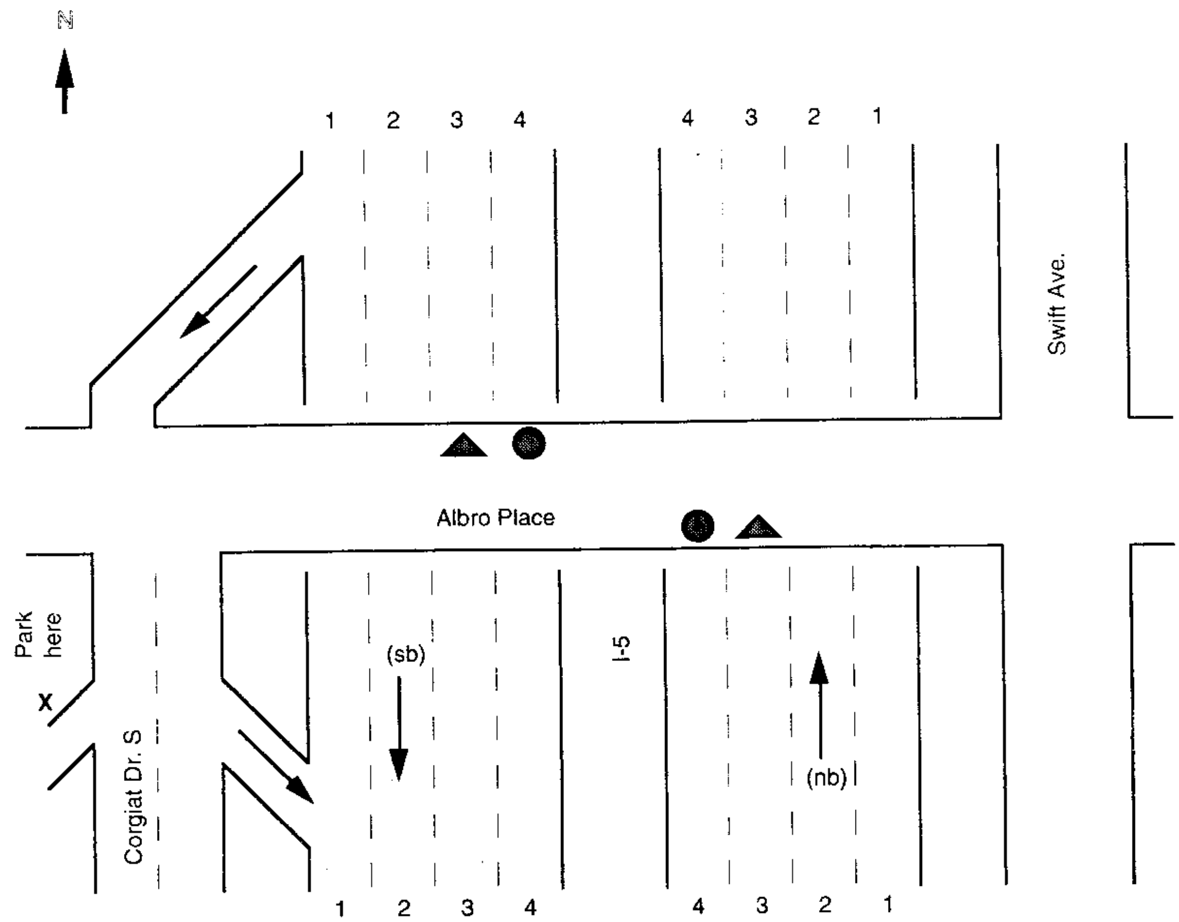


Figure E9. I-5 DOWNTOWN - South 144th St. **SITE #26**

Travel times NB-am & SB-pm

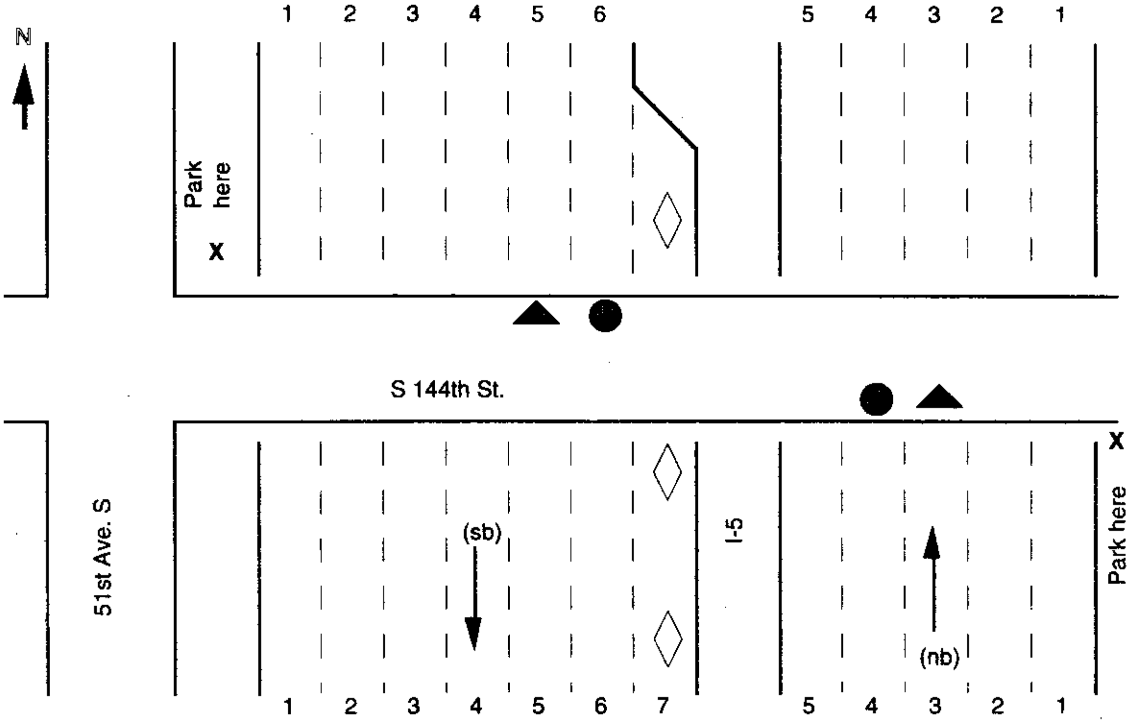


Table E5. I-5 Downtown — Lakeview Blvd E to S Holgate St. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	60.8	57.4	50.5	44.3	48.3	52.1	53.8	49.5	52.3	57
	Q4/92	–	–	–	–	–	–	–	53.3	57.1	–	58	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	58.9	56	59.6	–	–	–	–

Table E6. I-5 Downtown — Lakeview Blvd E to S Holgate St. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	26.1	27.5	24.7	25.4	24.9	25.3	25.7	26	27.9	22.5	18.4	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	35.5	33.1	42.8	28.2	40.1	39.1	22.1	12.4	2	1.8
	Q2/93	–	–	–	–	31.4	25.2	27.4	24.2	29.3	29.8	38.6	43.1	46.2	–

Table E7. I-5 Downtown — Lakeview Blvd E to Albro Pl. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	47.5	44.5	34.5	31	46.7	54.6	53.7	55.7	–
	Q4/92	–	–	–	–	–	–	–	55.5	52.3	57.2	56.7	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E8. I-5 Downtown — Lakeview Blvd E to Albro Pl. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	31.3	31.9	32.4	32	33.9	34.7	34.4	33.9	31	26.9	31.5
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	7.8	–	14.2	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E9. I-5 Downtown — Lakeview Blvd E to S 144th St. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	53.4	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E10. I-5 Downtown — S Holgate St. to Lakeview Blvd E , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	60.3	56.1	41.5	54.4	55.2	55.3	49.8	52.1	50	55.1	50.7
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	31.9	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	56.6	53.4	51	53.7	47.3	49.3	–	–	–	–

Table E11. I-5 Downtown — S Holgate St. to Lakeview Blvd E , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	27.9	–	–	–	–	–	32.9	–	32	–	–
	Q4/92	–	–	–	–	–	36.4	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	44.9	6.1	5.5	3	–	2.2	1.8	1.6	–
	Q2/93	–	–	1.9	10.7	35.8	28.6	28.2	32.1	31.3	33.9	26.9	32.3	27.9	–

Table E12. I-5 Downtown — S Holgate St. to Albro Pl. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	50.4	60.4	67.3	54.8	67.1	67.2	69	–
	Q4/92	–	–	–	–	–	–	54.1	53.3	54.9	56.4	56.4	56.7	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E13. I-5 Downtown S Holgate St. to Albro Pl. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	58.1	58	56.6	57	59.3	60.8	60.2	57.2	61.1	54.8	59.3
	Q4/92	–	–	–	40	49.7	50.6	56.8	54.5	52.7	–	–	–	–	–
	Q1/93	–	–	–	58.4	61.7	58.3	61.8	51.6	62.4	63.4	64.4	64.8	63.3	64.5
	Q2/93	–	–	–	–	58.4	53.9	53.9	52.4	63.3	–	63.4	63.2	63.5	–

Table E14. I-5 Downtown S Holgate St. to S 144th St. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	47	–	19.3	15.2	20.6	24	22.6	32.5	34.8	53.6	52.9	–
	Q4/92	–	–	–	–	15.2	20.5	17.2	11.4	11.9	16.1	17.2	31.5	23.4	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E15. I-5 Downtown Albro Pl. to Lakeview Blvd E , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	24.2	55.9	56	48.8	29.2	39.8	53.6	44.3	46.6	50.7
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E16. I-5 Downtown Albro Pl. to Lakeview Blvd E , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	43	42.7	31.8	29.6	31	28.5	31.1	37	31.5	28	32.4
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	21.4	19.4	18.1	11.2	10.6	9.5	7.2	5.3	4.3	3.5	3.8

Table E17. I-5 Downtown Albro Pl. to S Holgate St. , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	54.3	49.1	49.5	46.1	47.2	48.2	34.5	48.6	55.3	68.9
	Q4/92	–	–	–	–	–	–	–	–	–	27.6	28.3	26.2	27.8	29.1
	Q1/93	–	–	–	–	–	–	–	39.6	41.6	38.1	40.9	41.9	52.8	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E18. I-5 Downtown Albro Pl. to S Holgate St. , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	42.9	39.2	30.6	34.3	30.3	17.9	19.4	19.3	33.9	30.2	26.1

Table E19. I-5 Downtown Albro Pl. to S 144th St. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	53.4	55.3	57.9	55.6	53.1	59.4	58.4	57.4	59.5	61.3
	Q4/92	–	–	–	–	39.1	53.8	61.6	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	60.3	60.6	60.3	59.6	8.6	–	–	3.8	3.1	–
	Q2/93	–	–	–	76.3	75.2	73.1	71.6	73.4	73.9	74.2	73.2	71.9	70.3	–

Table E20. I-5 Downtown S 144th St. to Lakeview Blvd E , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E21. I-5 Downtown S 144th St. to S Holgate St. , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E22. I-5 Downtown S 144th St. to Albro Pl. , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	63.7	61.1	61.9	59.8	43.6	32	31.7	45.2	61.8	63.2	64.3
	Q4/92	–	–	–	–	–	–	–	–	52.8	57.6	37.1	54.4	5.7	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Travel Time Sites

I-5 South (Corridor #3)

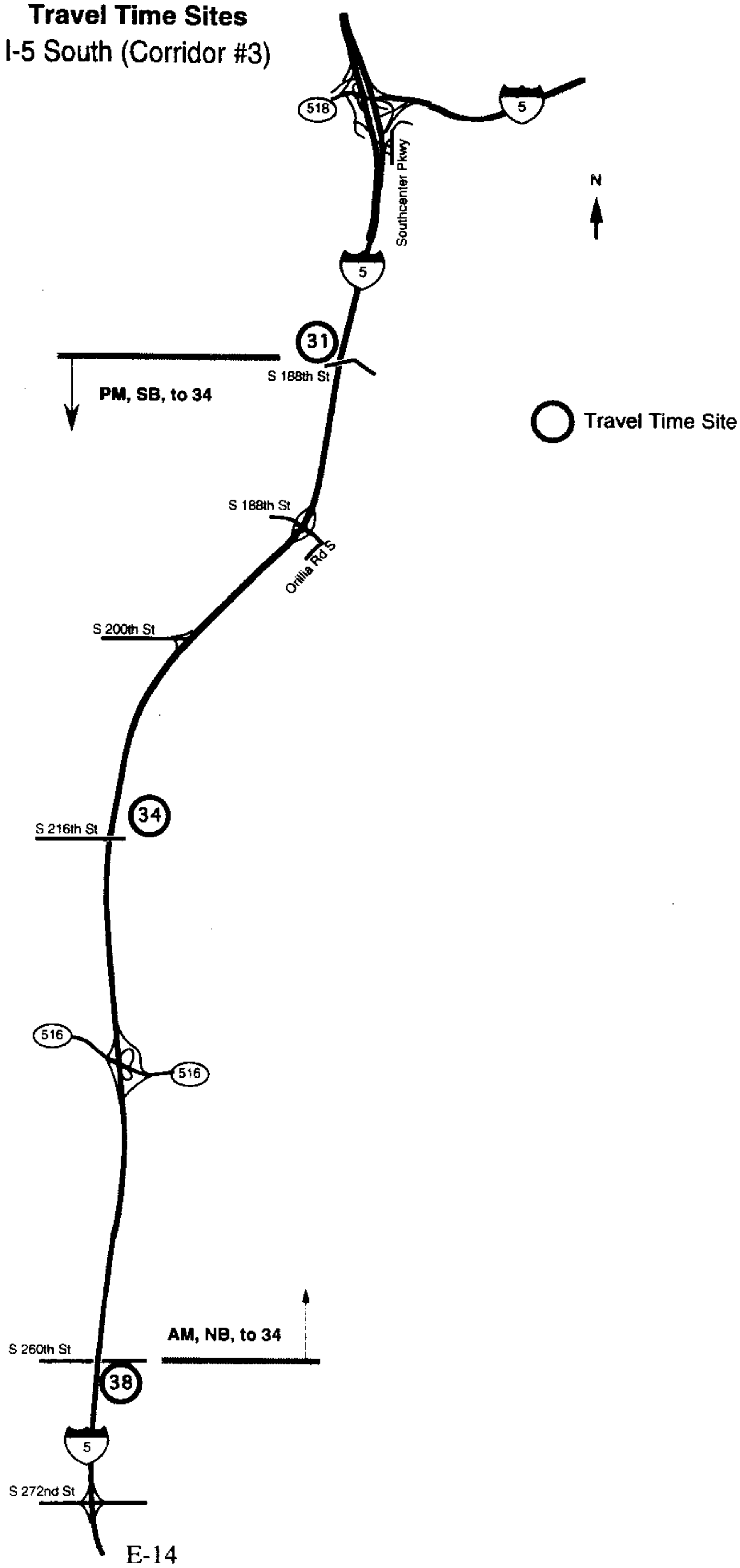


Figure E11. I-5 SOUTH - S. 178th Street SITE #31

Travel times SB-pm

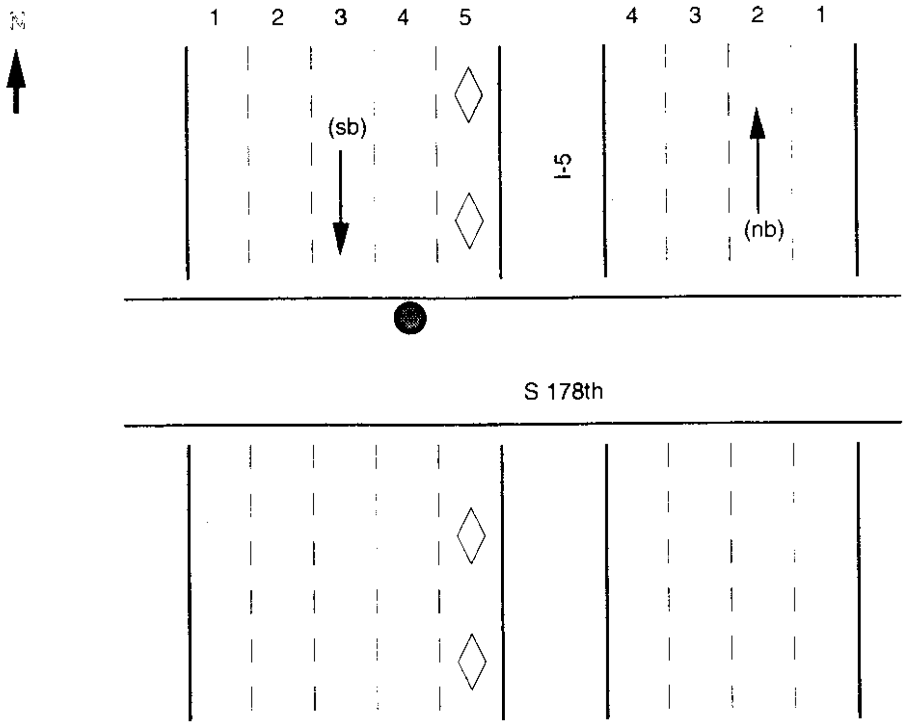


Figure E12. I-5 SOUTH - S 216th St. SITE #34

Travel times NB-am & SB-pm

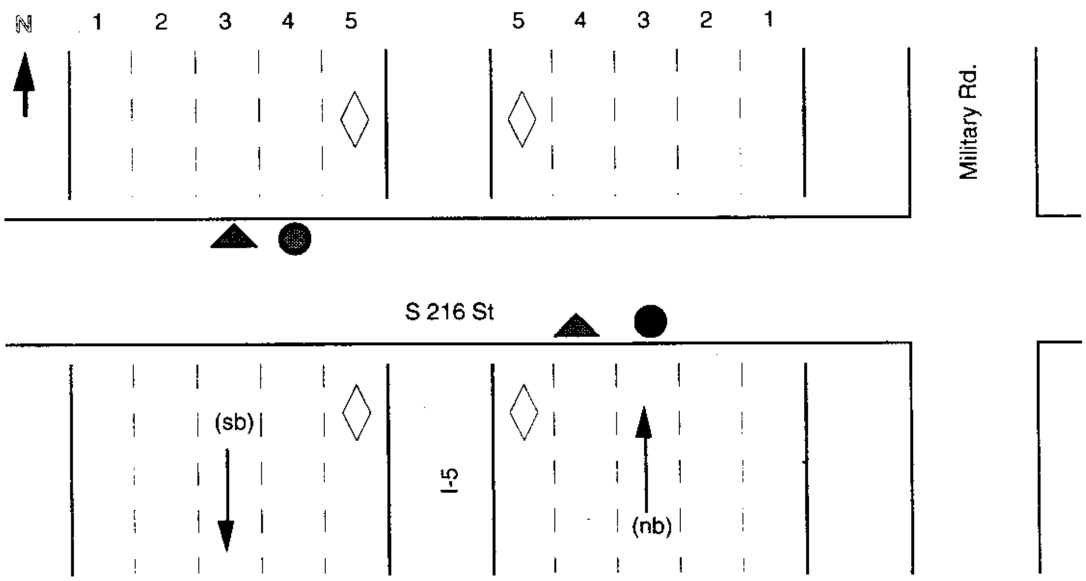
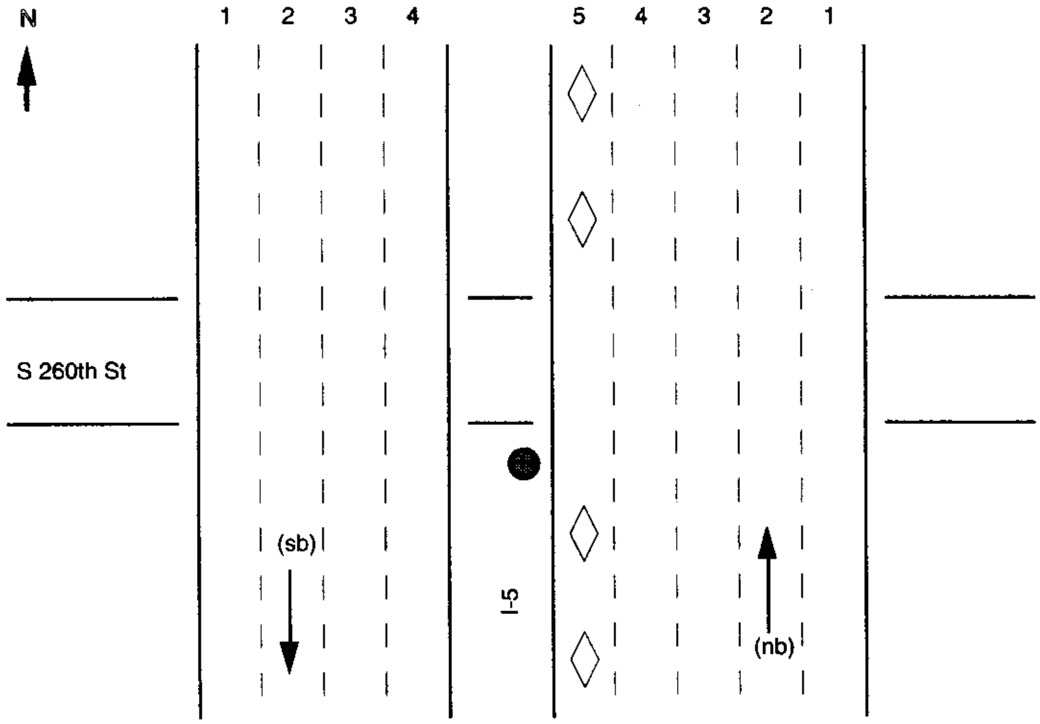


Figure E13. I-5 SOUTH - S 260th St. **SITE #38**

Travel times NB-am



Note: You have to scramble up the hill on the south side of S. 260th and between the northbound and southbound freeway lanes. Climb over the fence at the top of the hill, and sit behind the jersey barrier at the edge of the freeway (the HOV and fast lanes northbound will be closest to you). Since you are in the freeway right-of-way at this location, you <u>must</u> wear a vest.

Table E23. I-5 South S 178th St. to S 216th St., southbound p.m.

	Qtr.	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30	6:45	7:00	7:15
GP Lanes	Q3/92	35.6	39.7	37.4	37.2	42.7	42	43.2	47.8	41.8	52.3	66.1	–	–	–	–
	Q4/92	–	18.2	17.7	20	19.2	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	46.8	40.5	32.8	38.1	40.1	54	40.7	42	39.2	46.4	46.4	55.2	66.4	–
	Q2/93	8	40.4	35.2	40.6	40.3	39.3	38.1	39.1	36.2	30.6	20.7	22.2	37.5	60	62.4
HOV Lanes	Q3/92	41.2	33.2	38.4	43.1	36.9	38	35	45.2	45.7	49.7	55.7	73	–	–	–
	Q4/92	–	51.1	52.4	45.5	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	47.6	30.7	31.3	46.2	40.4	42.3	37.5	39	36.7	37.8	–	57.8	–
	Q2/93	–	–	45.6	46.5	42.7	40.3	43.9	45.7	42.1	36.8	29.6	29.5	–	–	–

Table E24. I-5 South S 260th St. to S 216th St., northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	38.8	36	37.7	38.1	38.9	41.2	53.2	61.3	61.9	62.2
	Q4/92	–	–	–	–	–	–	–	21.8	26.9	33.8	55.8	61.1	–	–
	Q1/93	–	–	–	–	–	28.6	23.9	12.8	15.4	18.2	29.4	37.8	46.1	51.8
	Q2/93	–	–	–	–	61.3	56.4	47.3	41.4	40.1	51.5	47.8	36.5	–	–
HOV Lanes	Q3/92	–	–	–	–	–	53.5	50.4	51.4	50.5	50.4	58.6	57.7	–	–
	Q4/92	–	–	–	–	–	–	–	45	44.6	48.1	–	–	–	–
	Q1/93	–	–	–	–	–	–	40.1	44.6	42.4	46	45.4	49.4	39.4	–
	Q2/93	–	–	–	–	–	52.1	52.8	52.9	52.5	51.9	–	45.1	–	–

Figure E14. Travel Time Sites
SR 520 (Corridor #4)

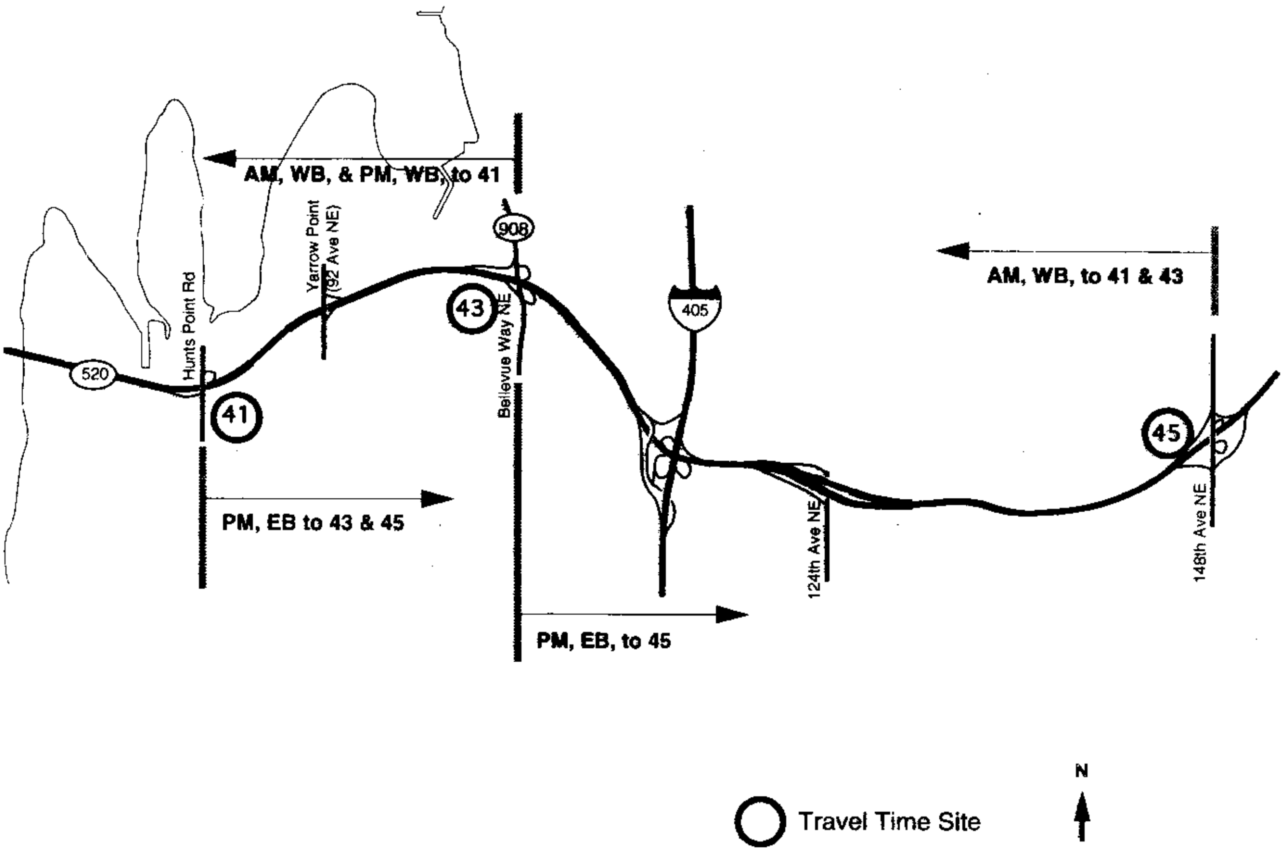


Figure E15. SR 520 - Hunt's Point SITE #41

Travel times WB-am & EB-pm

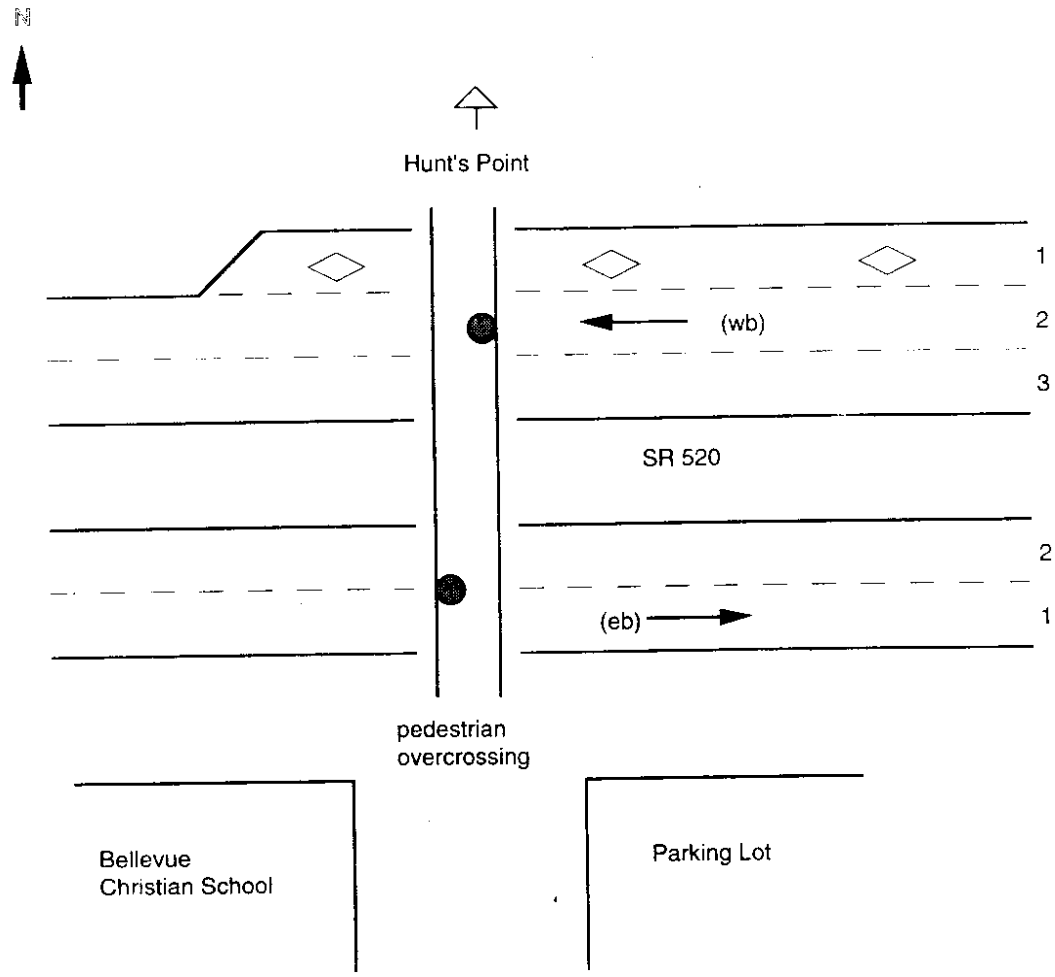


Figure E16. SR 908 - Hunt's Point - Bellevue/Kirkland **SITE #43**

Travel times EB-am & WB-pm

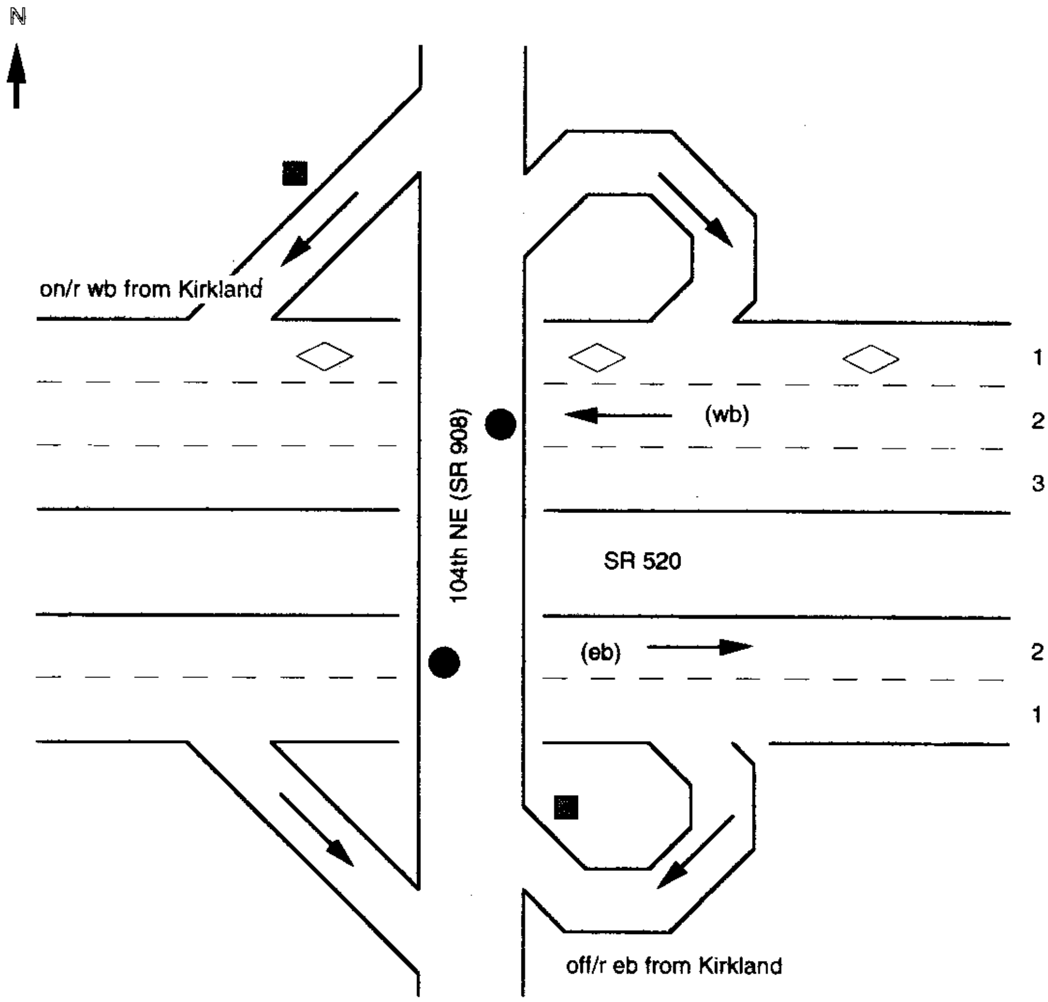


Figure E17. 148th Ave. NE	SITE #45

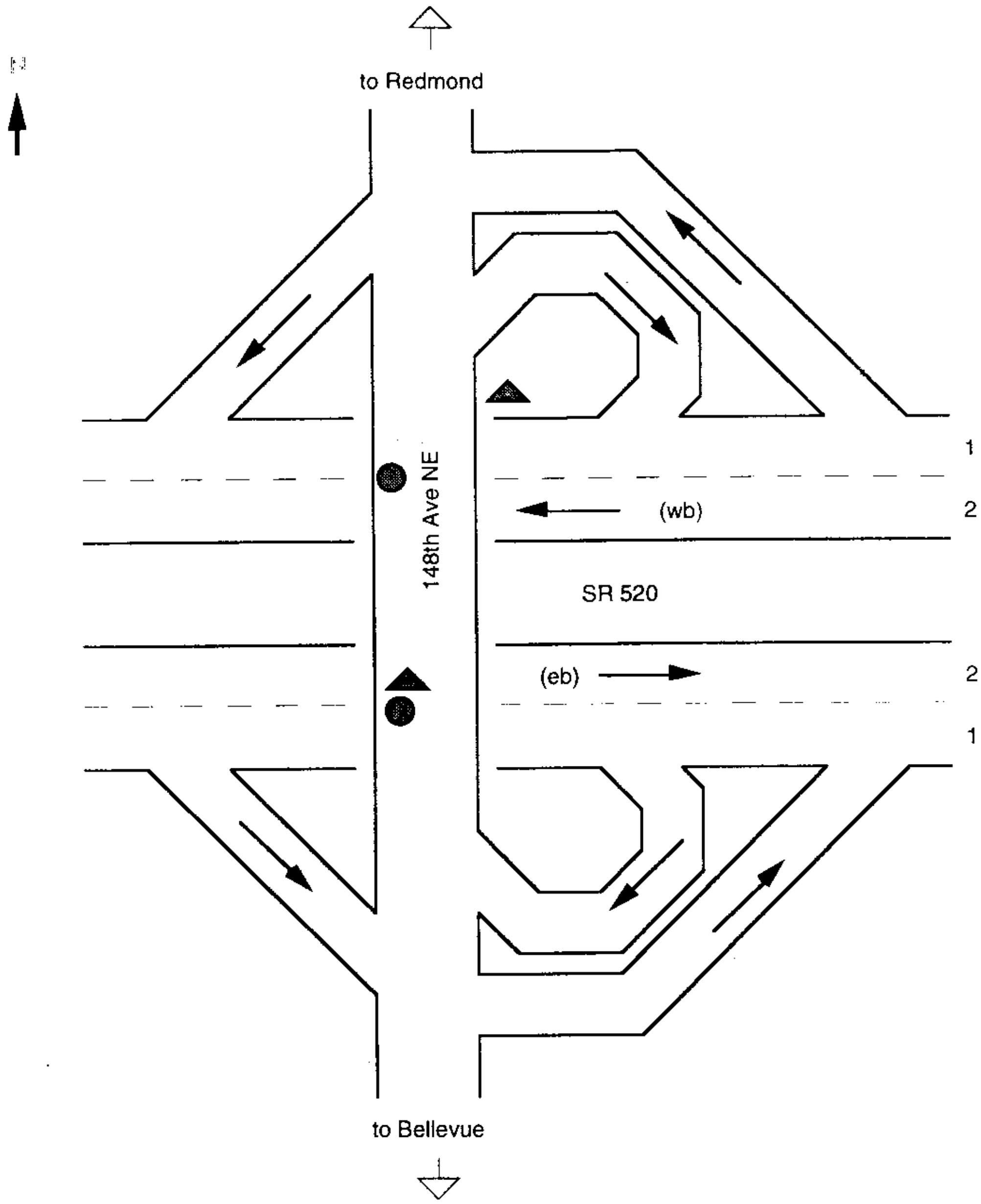


Table E25. SR 520 Hunt's Pt. to SR 908 , westbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	56.7	51.1	51.1	26.9	18	16.7	22.6	27.5	41	
	Q4/92	–	–	–	–	–	–	–	–	14.7	13.3	13.7	13.6	–	
	Q1/93	–	–	–	–	3.3	2.6	2.5	2.7	2.3	11.8	13.6	14.7	13.6	
	Q2/93	–	–	–	11.7	2.8	27.9	28.8	–	–	–	–	–	–	
HOV Lanes	Q3/92	–	–	–	–	–	52.5	54.8	–	–	1	9.3	17.2	1.4	
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	
	Q1/93	–	–	–	–	–	40	34.9	36.6	–	30.8	35.5	35.6	–	
	Q2/93	–	–	–	–	48.3	45.6	40.6	–	–	–	–	–	–	

Table E26. SR 520 Hunt's Pt. to SR 908 , westbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	55.9	55.8	56	56.8	51.3	38.8	38.9	24.4	22.4	12.3	11.2	11.4
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	16.2	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E27. SR 520 Hunt's Pt. to 148th Ave. NE , westbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	25.3	18.1	25.8	24.2	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E28. SR 520 SR 908 to Hunt's Pt. , eastbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	56.2	53.6	49	50.2	51.4	53.5	48	48.6	49.7	50.2	49.9	46.2	57.2
	Q4/92	–	–	–	–	–	–	60.1	59.4	58.5	59.9	60.1	–	–	–	–
	Q1/93	–	–	–	–	–	52.6	54.1	53.1	52.4	54.2	51.2	52.6	52.3	48.6	–
	Q2/93	–	58.9	57.6	56.2	54.5	48	56.3	38	39.3	40.7	54.1	56.1	51.5	40.7	–

Table E29. SR 520 SR 908 to 148th Ave. NE , westbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	61.7	62.2	58.7	55.6	41.9	27.1	30.6	32.3	27	23.5
	Q4/92	–	–	–	–	–	–	–	30.8	30.7	30.4	37.4	33	12.2	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	14.2	42.2	9.1	5.9	3.3	2.5	2.2	1.8	1.6	1.5

Table E30. SR 520 148th Ave. NE to Hunt's Pt. , eastbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	55	54.3	54.8	56.1	54.8	54.2	49.8	52.2	53.2	54.8	56.7
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	57.6	56.6	56.2	47.2	38.7	40.4	43.4	44.8	50.8	51.5	52.3	–

Table E31. SR 520 148th Ave. NE to SR 908 , eastbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	48.5	52.5	54.9	54	55.2	47.2	43.8	46.4	49.7	53.7	56.1	56.4
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	58	57	57.8	58.3	59.4	57.4	56.5	57.2	56.5	49.5	50.5	–	–

Figure E18. Travel Time Sites
I-90 (Corridor #5)

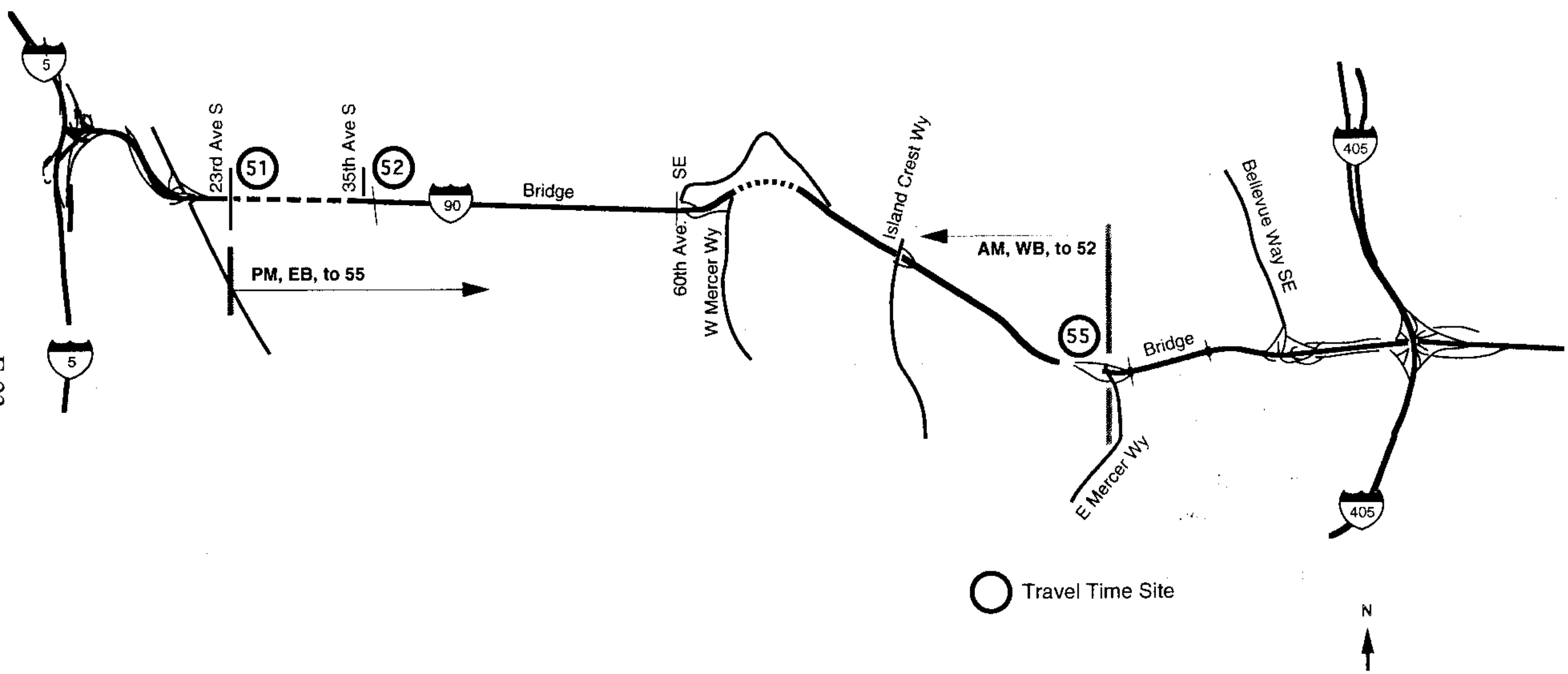
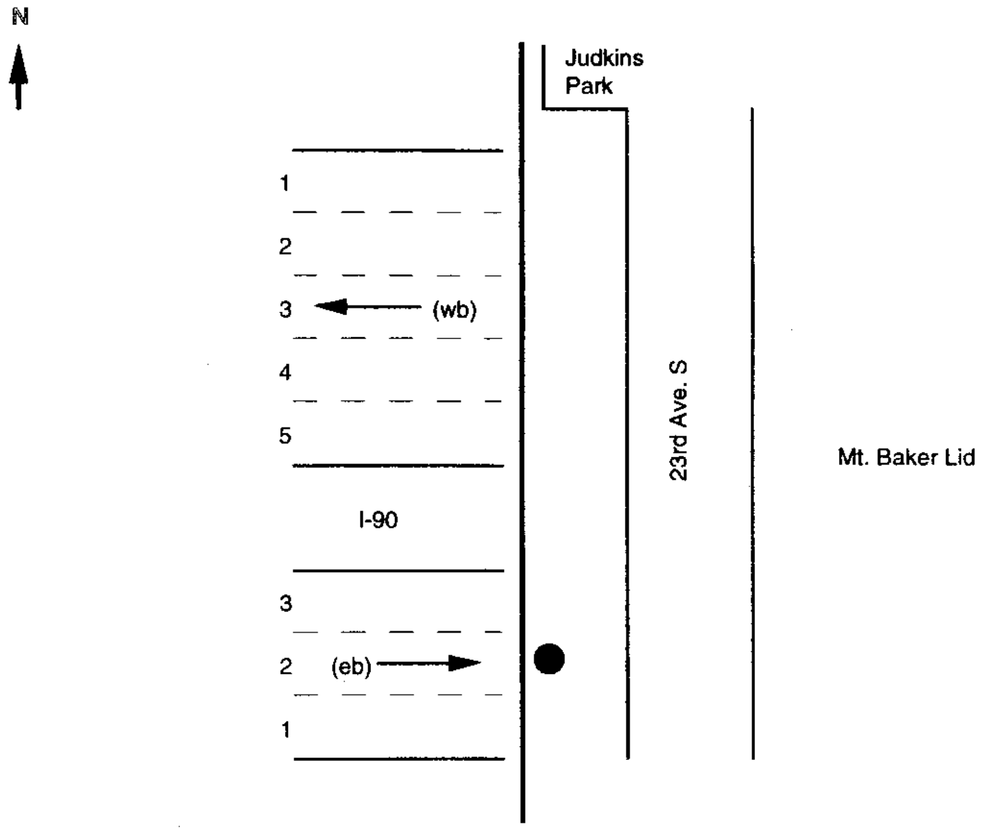


Figure E19. I-90 - 23rd Avenue South (west end of Mount Baker tunnel) **SITE #51**

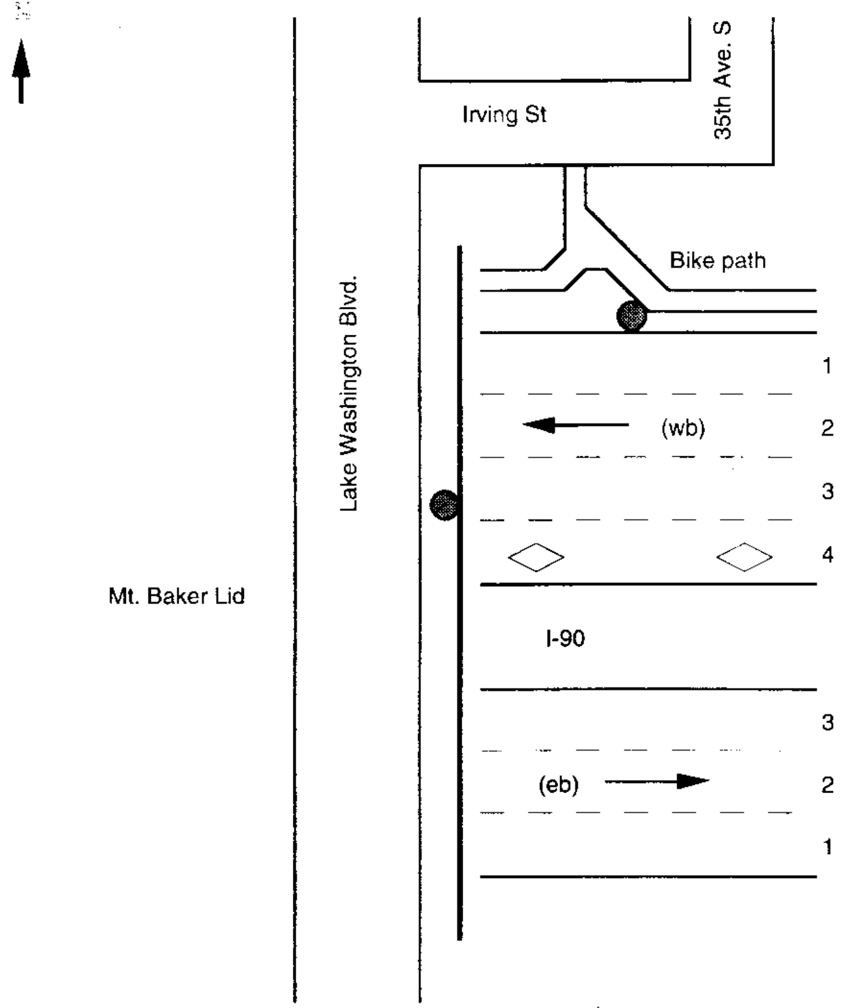
Travel times EB-pm



Note: The wall at the edge of the tunnel lid is about four feet high at this location, so you will have to stand to count.

Figure E-20. I-90 - 35th Avenue South (east end of Mount Baker tunnel) SITE #52

Travel times WB-am



Note: You will have to look across several lanes of traffic in order to see license plates in the fast and HOV lanes at this location.

Figure E21. I-90 - East Mercer Way SITE #55

Travel times WB-am & EB-pm

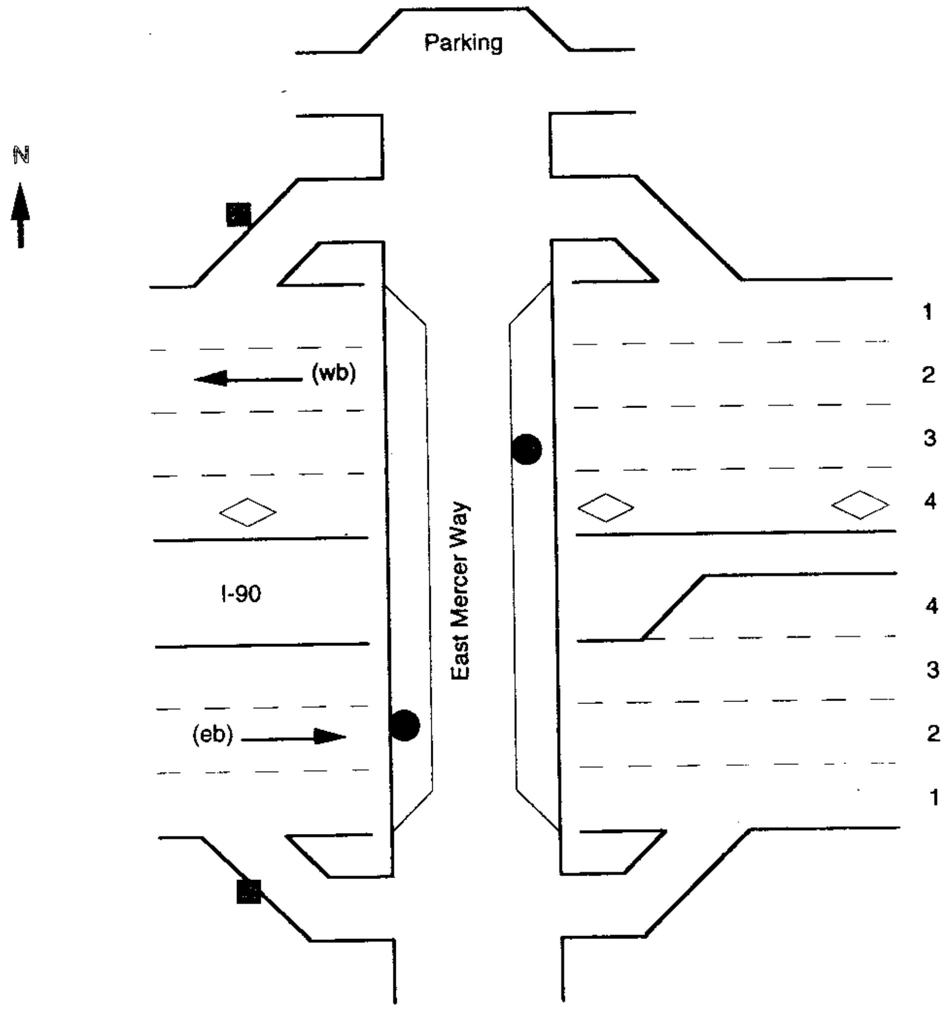


Figure E-22. I-90 - 142nd Place SE **SITE #59**

Travel times WB-am

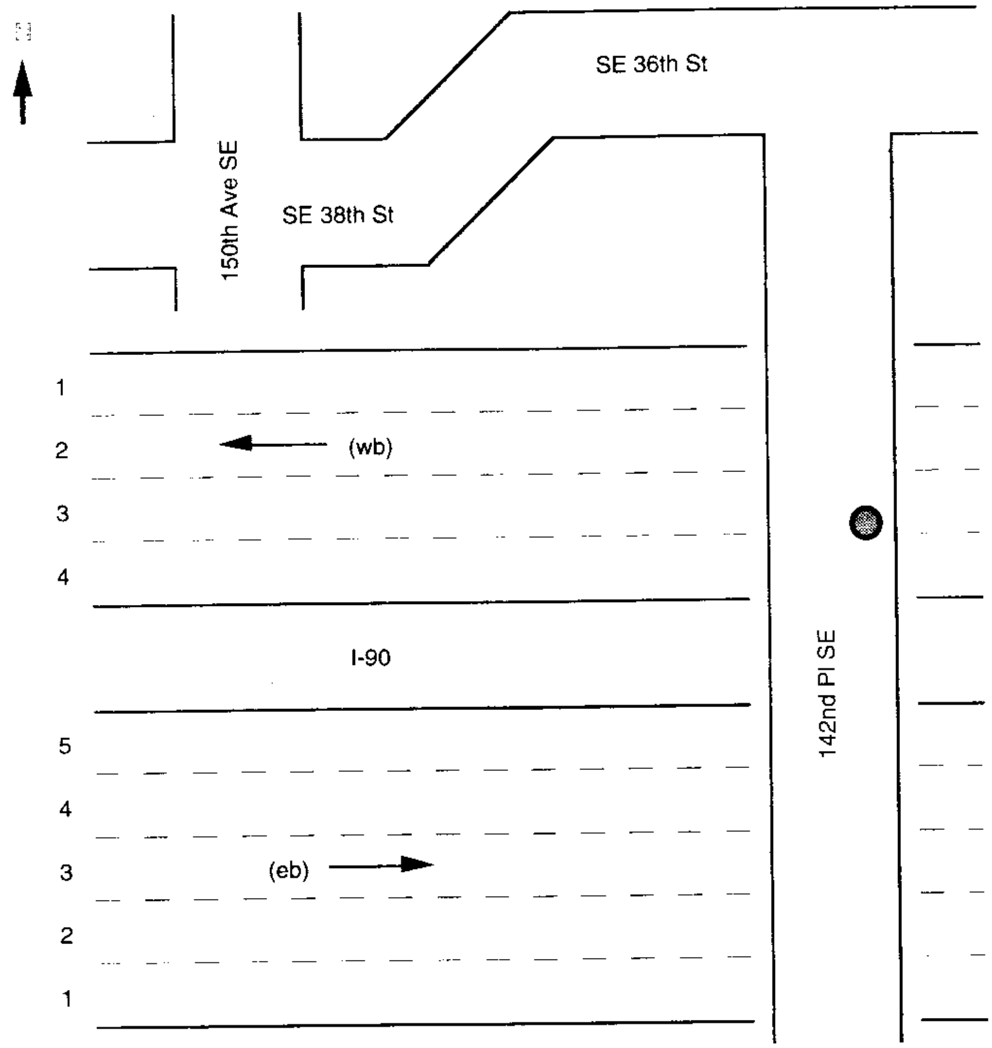


Table E32. I-90 23rd Ave. S to East Mercer Way , eastbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	12.9	21.2	33.5	43.5	49.2	45.7	49.5	54.9	53.2	42	44.5	27.6
	Q4/92	–	–	–	–	36	55.9	50.9	52.2	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	58.4	56.9	55.6	55.1	54.1	51.8	43.7	44.5	45	47.6	43.4

Table E33. I-90 East Mercer Way to 35th Ave. S , westbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	57.1	57.1	54.6	51.6	45.2	42.2	50.8	50	55.7	59.2
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	2.5	1.6	20.7	38.7	9.7	27.4	35	–	–
	Q2/93	–	–	–	–	57.9	58.2	56.4	54.7	51.4	52.6	57.4	57.8	–	–
HOV Lanes	Q3/92	–	–	–	–	48.5	53.6	52	50.9	52.1	54.7	53.2	54.9	54.1	59.6
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	42.1	43	43.4	46.7	44.7	51.1	54.4	–	–
	Q2/93	–	–	–	–	52.1	55.8	54.6	53	52.3	52.9	54	55.2	–	–

Figure E23. Travel Time Sites

I-405 (Corridors #6)

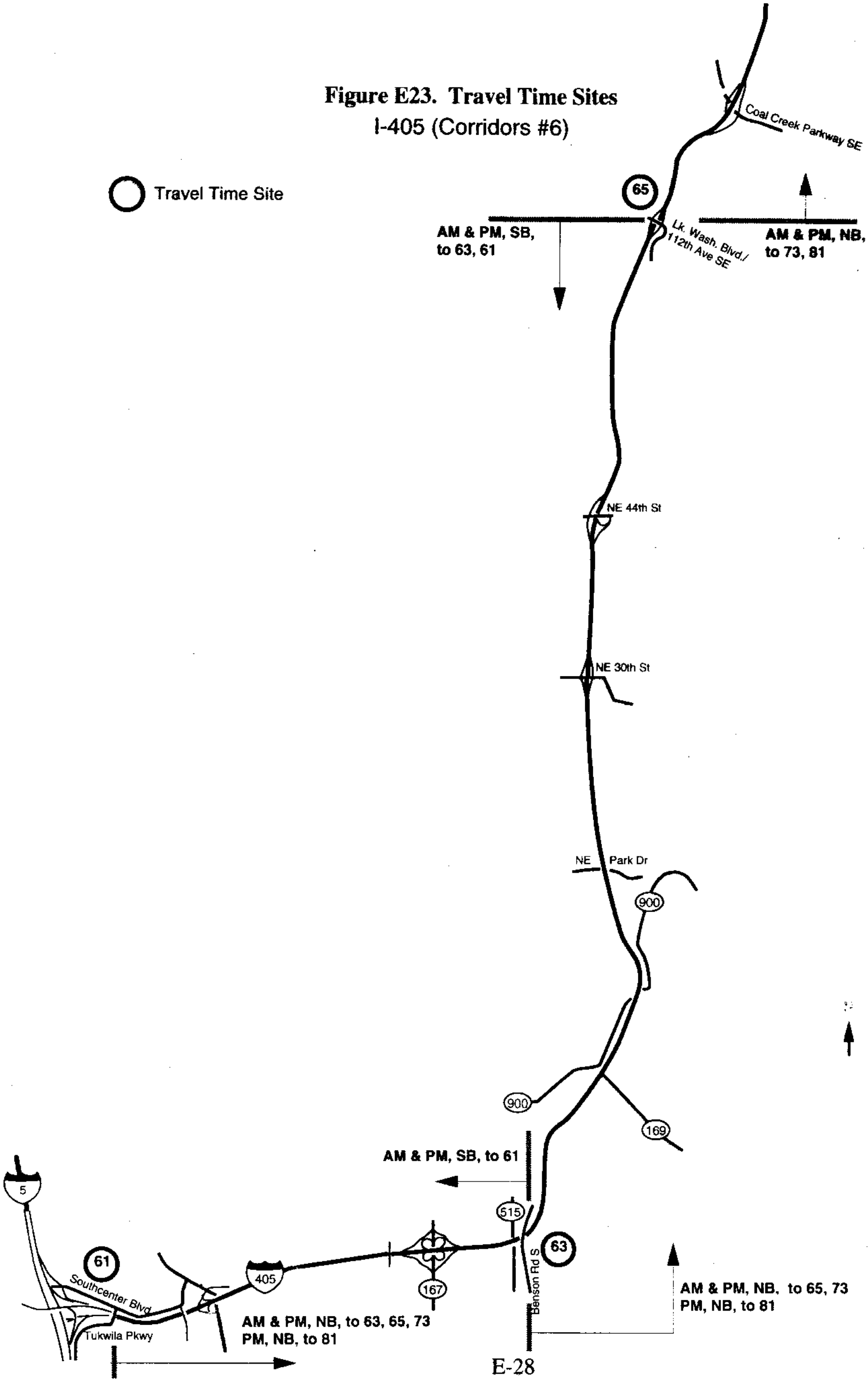


Figure E23. Travel Time Sites (cont.)

I-405 (Corridors #7 & 8)

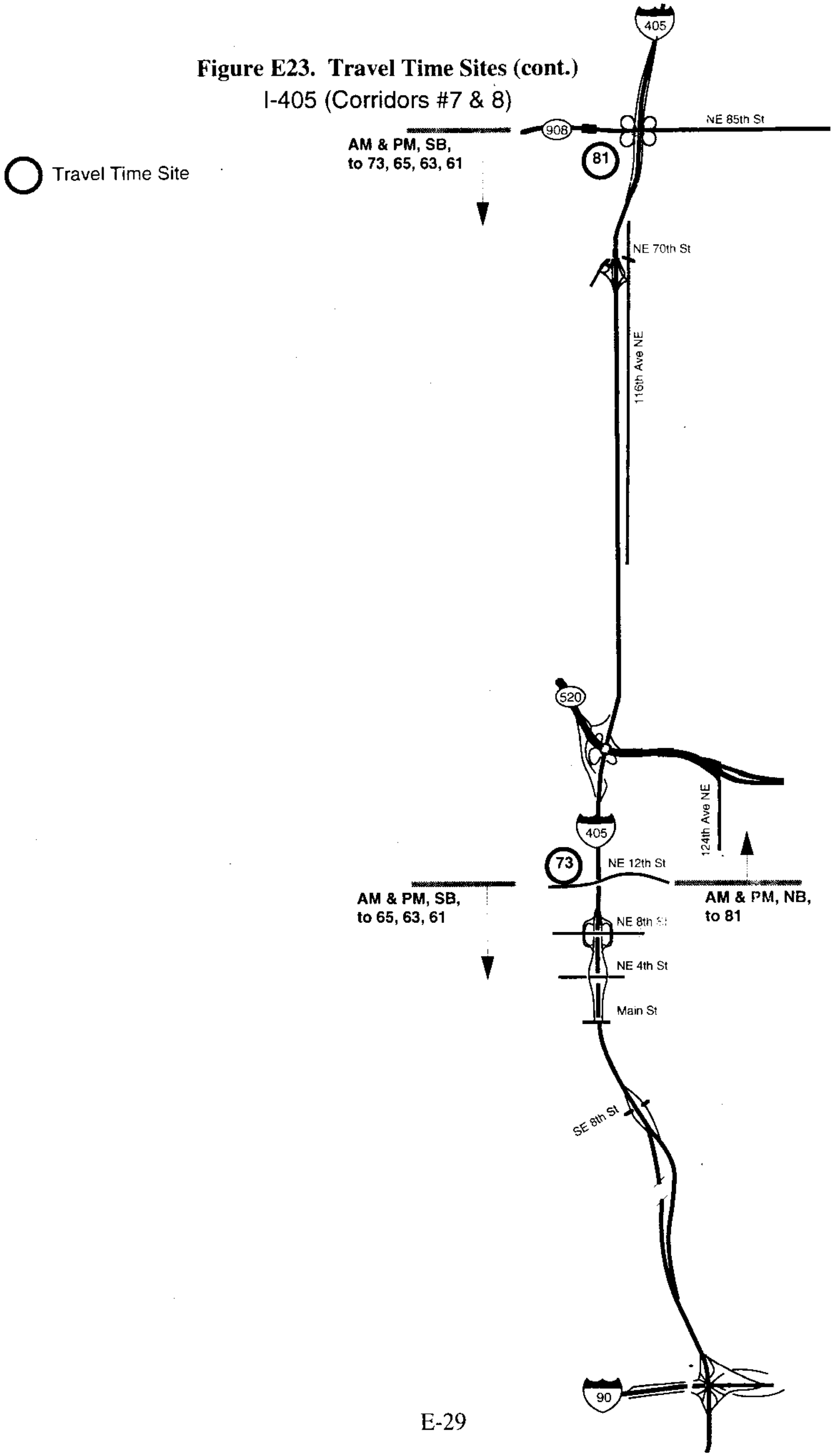


Figure E24. I-405 SOUTH - Tukwila Parkway **SITE #61**

Travel times NB & SB-am & pm

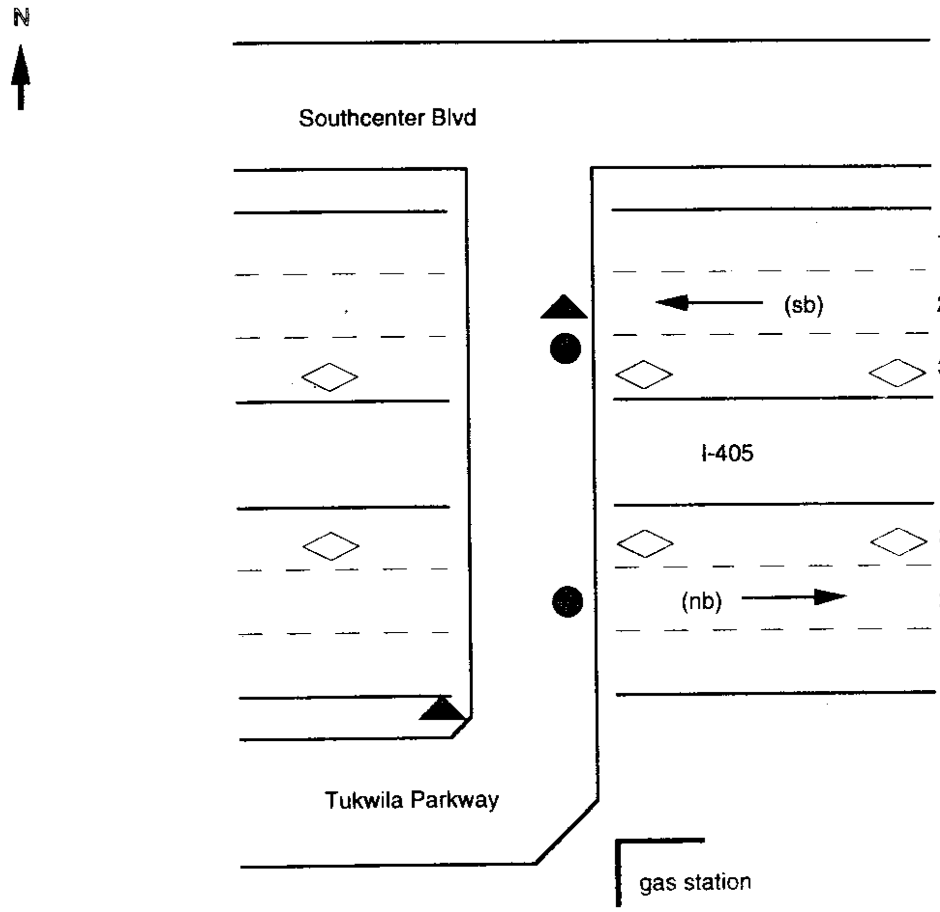
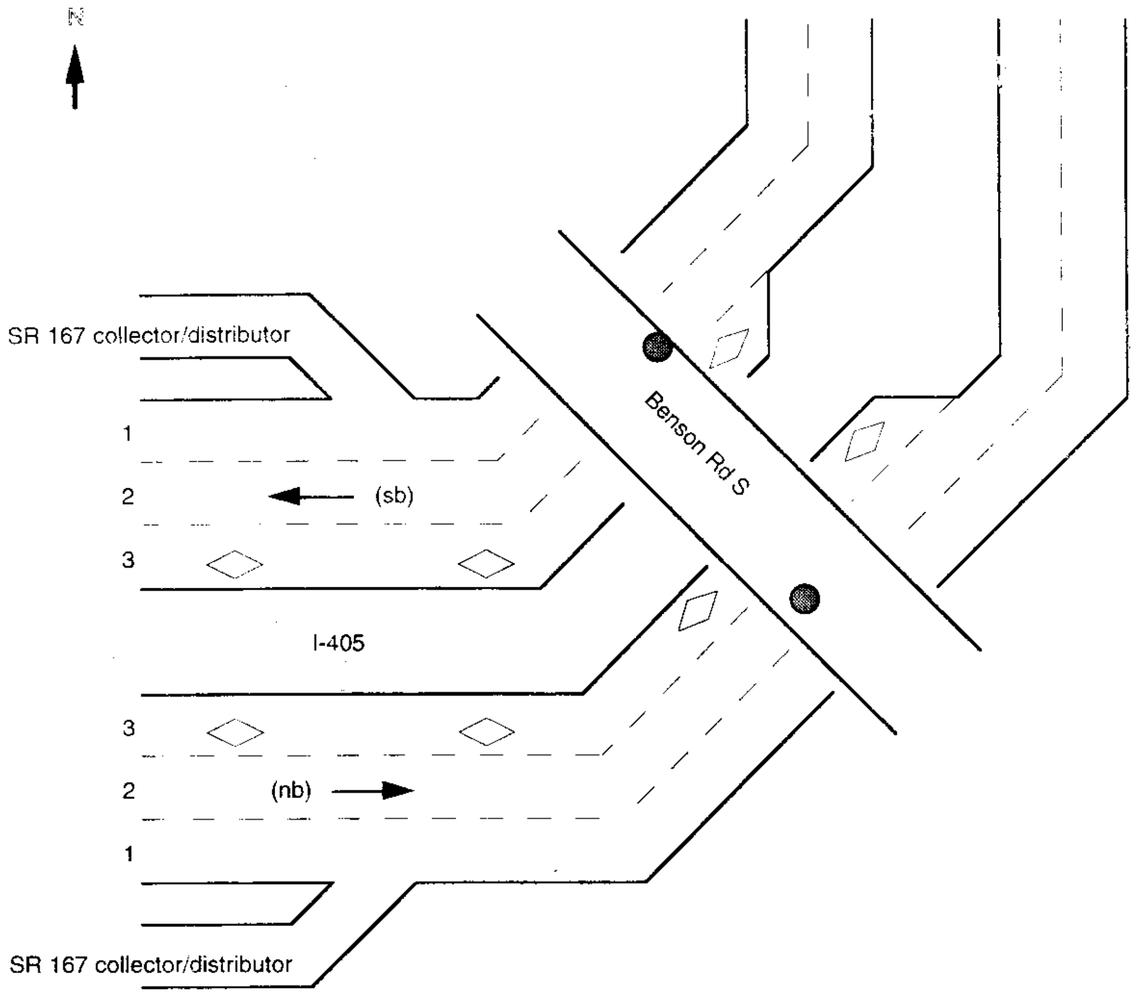


Figure E25. I-405 SOUTH - Benson Road South SITE #63

Travel times NB & SB-am & pm



Note: There is a wide sidewalk on the west side of this overpass, and a very narrow one on the east side. If you are counting southbound traffic on the narrow sidewalk, it is a good idea to wear a vest in this location.

Figure E26. I-405 SOUTH - 112 Avenue SE/Lk Washington Blvd SITE #65

Travel times NB & SB-am & pm

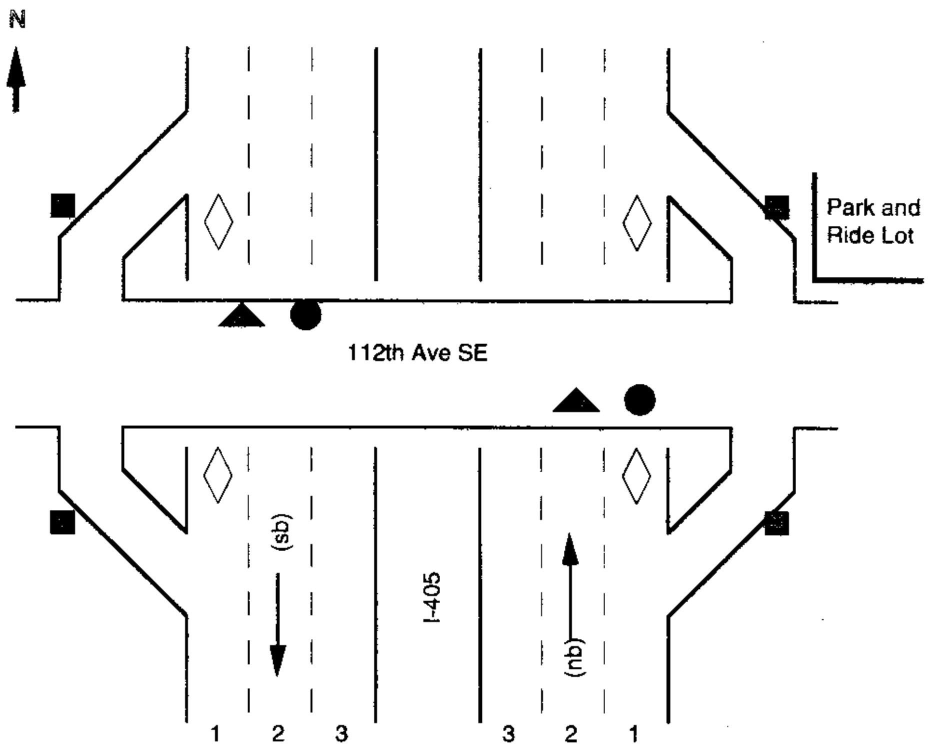


Figure E27. I-405 CENTRAL - NE 12th Street SITE #73

Travel times NB & SB-am & pm

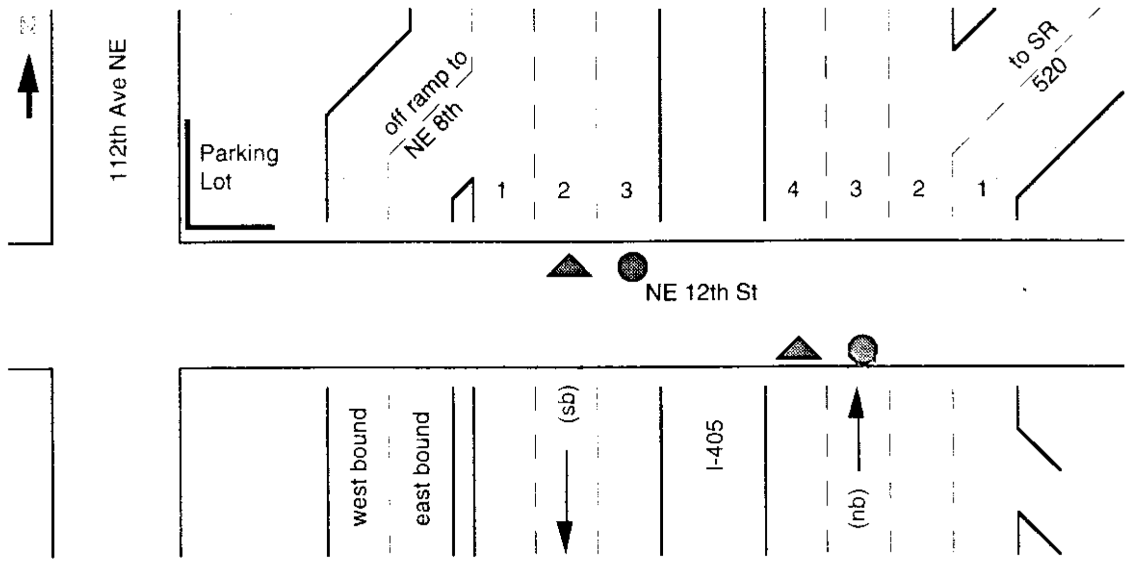


Figure E28. I-405 NORTH - SR 908: Central Way/NE 85th St. SITE #81

Travel times SB-am & NB-pm

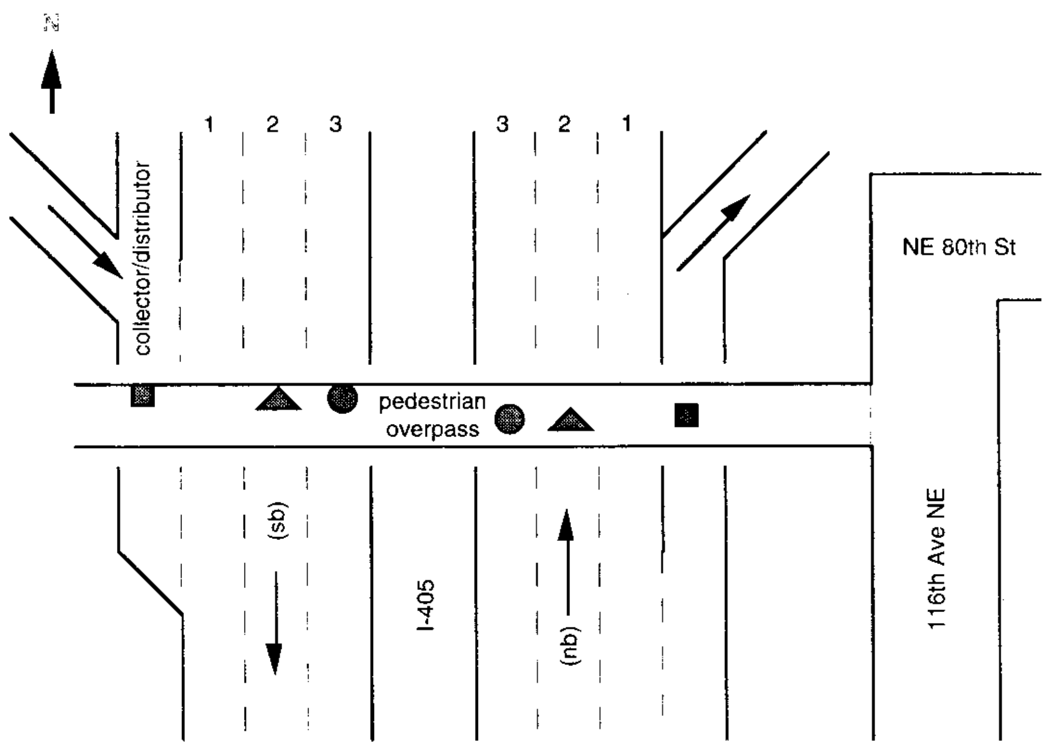


Table E34. I-405 Tukwila Pkwy. to Benson Rd. S , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	62.8	53.6	42.3	48.4	61.4	62.8	62.1	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	52.1	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E35. I-405 Tukwila Pkwy. to Benson Rd. S , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	28.2	33.6	36.4	26.4	23.6	22.6	24.9	16.4	17.1	8.6	2
	Q4/92	–	–	–	–	3.9	31.5	33.7	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	1.7	–	–	–	1	–	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	2.2	–	–	2.2	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E36. I-405 Tukwila Pkwy. to 112th Ave SE , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	51.9	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E37. I-405 Tukwila Pkwy. to 112th Ave SE , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E38. I-405 Tukwila Pkwy. to NE 12th St. , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	14.8	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E39. I-405 Tukwila Pkwy. to NE 12th St. , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E40. I-405 Tukwila Pkwy. to SR 908 , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E41. **I-405** **Benson Rd. S to Tukwila Pkwy. , southbound a.m.**

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	33.2	33.6	31.4	32.9	30.6	31.4	34.3	33.8	33.3
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	52.5	55.7	48.6	51.1	44.6	49.7	56.7	–	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	3.7	–	–	–	–	–

Table E42. **I-405** **Benson Rd. S to Tukwila Pkwy. , southbound p.m.**

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	12.2	15.6	3	11.1	1.7	–	–	–
	Q1/93	–	–	–	–	1.4	17.5	27.2	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	58.2	59.2	56.5	59.2	58	58.8	59	58.3	60.1	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	1	–	1.2	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	64.3	–	–

Table E43. **I-405** **Benson Rd. S to 112th Ave SE , northbound a.m.**

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	41.5	36.2	46.2	56.3	55.9	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E44. **I-405** **Benson Rd. S to 112th Ave SE , northbound p.m.**

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	32.9	26.9	31.4	28.2	33.9
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	48.6	46.7	48.9	43.8	49.9	50	51.9	51.6	52.7	52.9	–

Table E45. **I-405** **Benson Rd. S to NE 12th St. , northbound a.m.**

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15
GP Lanes	Q3/92	–	–	–	–	–	–	61.7	–	58.4	–	57	56.1	57.4	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	30.8	36.3	53.9	72.3	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E46. **I-405** **Benson Rd. S to NE 12th St. , northbound p.m.**

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	15.9	17.5	19.6	18	15.6
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E47. **I-405** **Benson Rd. S to SR 908 , northbound p.m.**

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E48. I-405 112th Ave SE to Tukwila Pkwy. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	21.1	26.4	25.1	26.6	28.9	41.5	50	57.3	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E49. I-405 112th Ave SE to Tukwila Pkwy. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	20.8	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E50. I-405 112th Ave SE to Benson Rd. S , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	41	39.4	37.5	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E51. I-405 112th Ave SE to Benson Rd. S , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	12.5	13.9	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	15.1	16.4	–	–	–	–	–	–	–	–	–	–

Table E52. I-405 112th Ave SE to NE 12th St. , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	43.5	–	34.7	–	–	23.9	23.7	22.4	23.1	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	55.5	45.8	56.5	63	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E53. I-405 112th Ave SE to NE 12th St. , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	42.9	40.6	37.6	34.2	35.9	36.2	37.3	40.1	44.2	–	–
	Q4/92	–	–	–	–	–	56.3	58.6	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E54. I-405 112th Ave SE to SR 908 , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E55. I-405 112th Ave SE to SR 908 , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E56. I-405 NE 12th St. to Tukwila Pkwy. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	9	21.2	33.3	26.6	31.8	22.1	44.6	61.9	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E57. I-405 NE 12th St. to Tukwila Pkwy. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E58. I-405 NE 12th St. to Benson Rd. S , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	37	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E59. I-405 NE 12th St. to Benson Rd. S , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	11.3	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E60. I-405 NE 12th St. to 112th Ave SE , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	18.5	21.7	–	18.1	21.2	24.6	24.6	23.1	23.9	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	15.5	–	21.4	10.8	9.5	–	–	–	–
	Q2/93	–	–	–	–	–	61.1	59.1	58.2	59.5	60.4	58.5	59.4	58.9	–	–

Table E61. I-405 NE 12th St. to 112th Ave SE , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	47.5	45	46.1	–	40.4	42.5	38.7	–	–	–	–	–
	Q4/92	–	–	–	53.2	53.7	37.1	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	44.6	–	–	–	–	–	–	50	55.3	–	–
	Q2/93	–	–	–	–	46.5	44.4	46.1	46.2	54.8	44.3	31.5	21.1	21.9	–	–

Table E62. I-405 NE 12th St. to SR 908 , northbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HOV Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E63. I-405 NE 12th St. to SR 908 , northbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	25.9	23.8	23.5	27.6	25.6	21.9	19	–	–	–
	Q4/92	–	–	–	–	–	25.9	23.8	23.5	27.6	25.6	21.9	19	–	–	–
	Q1/93	–	–	–	38.4	14.2	16.7	8.3	5	3.5	3.3	2.4	2.3	1.9	–	–
	Q2/93	–	–	–	–	–	18.5	16.1	16.5	16.7	15.3	14	14.9	16.6	–	–

Table E64. I-405 SR 908 to Tukwila Pkwy. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E65. I-405 SR 908 to Benson Rd. S , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E66. I-405 SR 908 to 112th Ave SE , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	36	33.8	34.4	38.2	37.5	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E67. I-405 SR 908 to 112th Ave SE , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table E68. I-405 SR 908 to NE 12th St. , southbound a.m.

	Qtr.	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
GP Lanes	Q3/92	–	–	–	27.4	58.3	57.8	56.6	52.2	50.9	48.6	53.4	56.1	49.5	54.4	–
	Q4/92	–	–	–	–	–	–	–	26.9	30	30.4	30.3	–	–	–	–
	Q1/93	–	–	–	–	46.4	15.8	19.7	51.1	51	45.5	–	56.8	58.5	–	–
	Q2/93	–	–	–	–	46.4	–	–	–	–	–	–	–	–	–	–

Table E69. I-405 SR 908 to NE 12th St. , southbound p.m.

	Qtr.	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30
GP Lanes	Q3/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q4/92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q1/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Q2/93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

APPENDIX F

OBSERVER COMMENTS MADE DURING TRAVEL TIME SESSIONS

Below is a sample of observer comments made during travel time data collection throughout this period. Like vehicle occupancy comments, they fall into three categories of data collection, traffic, and weather conditions. Elipses represent time gaps between comments made by the observer. Because the length of comments is limited by the program used, words are sometimes cut off.

DATA COLLECTION

1. computer #52 I just found out is 18 minutes faster than #53 which was the other
2. cold, cloudy.... ...... the previous count was lost due to computer malfunction
3. it's not quite daylight yety hard to read plates.......CT COULDNT READ #
4. it's too dark to see anything but busues at this pt........traffic is very backed up.........the radio said ther is a big wreck up at 405 + 520 - not much traffic here
5. I am too far up and it is too dark to see yet-headlights are impediment also
6. it is very hard to see on this overpass.
7. Hard to see with the big traffic sign in the way...
8. some of thee number keys are wet and not working
9. time to change batteries bacik ijn a moment
10. Head aches too many counts today of TT! Bye!

TRAFFIC CONDITIONS

1. I'm wet .. traffic is slowed slightly ... no real stoppages
2. there is a stsalled car & a stste patrol car off to the right

3. RAINY AND MISERABLE..........TRAFFIC WAS TERRIBLE GETTING HERE SO WE STARTED WAY LATE...IT STAYED PRETTY TER-...RI.........SEE AT ABOUT 6:30 OR SO. ACCIDENTS..

4. cloudy, warm-60 degrees, dry road........traffic is moving well........light traffic......police stopped somebody in the express lane.......traffic is still moving well, below capacity.......another police pulling over somebody in the express lane.......traffic moving well during counting

5. THERE WAS A MAJOR BACKUP ALL-DAY AT THIS SITE. IT POURED FOR ABOUT 20 MINUTES.

6. traffic is sluggish. gonna collect some license plates for MH!

7. final tally: two rear-enders, two near misses, 1 frazzled counter

WEATHER CONDITIONS

1. COLD/DARK/RAINY

2. FREEZING COLD/WINDY/GETTING DARK

3. sunny but hell cold!

4. SUNNY AND 80F. MINIMUM WAGE WEATHER.

5. I am late and it is wet. This is a bad day for me.......Traffic is stop and go

6. still dark due to daylight saving time last weekend......heavy traffic heavy traffic, but it is still moving well.........the rain has stopped for some time

7. cloudy, threatening; summer is grand

8. sunny, tantalizing, frenetic, abusive, c........no problem : YOW! sunshine ... on my shoulder ... makes me happy

APPENDIX G

SAMPLE SURVEY

Washington State Department of Transportation

University of Washington

Washington State Transportation Center

HIGH OCCUPANCY VEHICLE LANE ANALYSIS PUBLIC OPINION SURVEY

The Washington State Department of Transportation and the Washington State Transportation Center at the University of Washington are working together to study the high occupancy vehicle (HOV) lanes, also known as carpool lanes. We would like to understand your commuting preferences and your perception of HOV lane use and effectiveness.

Please give this survey to the person in your household who most often commutes to work. Ask him or her to fill out the survey and return it by mail within one week. We would appreciate your response. No postage is necessary

This survey is anonymous. Your answers will not be associated with your name. If you are willing to be contacted by telephone, you may so indicate in Section C of this survey. You may also contact Cy Ulberg at 543-4365 between 8:00 A.M. and 5:00 P.M. if you wish to discuss the survey.

Section A: Your Commute Trip

1. Indicate how you *usually* get to and from work.

___ Drive alone
___ Carpool—you and 1 other person
___ Carpool—you and 2 or more other people
___ Vanpool
___ Bus
___ Bicycle, Walk
___ Motorcycle
___ Other: ___________________

2. Have you ever used the HOV lanes while traveling in the Seattle area? Please mark yes or no for each.

Yes	No		Yes	No	
___	___	on a bus	___	___	in a vanpool
___	___	in a 2 person carpool	___	___	alone in a car
___	___	in a 3 person carpool	___	___	on a motorcycle

3. If you have used HOV lanes while traveling in the Seattle area, on which freeway do you usually use them?

___ I-5 north of Northgate
___ I-5 between Northgate and Southcenter
___ I-5 south of Southcenter
___ I-90
___ SR-520
___ I-405

4. Do you ever have enough people in your vehicle to qualify for HOV lanes but don't use them?

Yes___ No___ If yes, why? (check all applicable)

___ slower than regular lanes
___ too much trouble to change lanes
___ the HOV lanes are not safe
___ all traffic moves fast enough
___ forget to use HOV lanes
___ other _______________

Section B: Your Opinions

5. Place an "X" by the *three options* that you think would most likely make HOV lanes more attractive for carpooling or bus riding.

___ Wider and safer lanes.
___ Connection of these lanes with other HOV lanes.
___ HOV lanes on the right side of the freeway rather than on the left side of the freeway.
___ Park & ride lots near freeway entrances/exits.
___ Better police enforcement against violators.
___ Employers' help with paying for part or all of bus passes or parking for carpoolers.
___ Opening all HOV lanes to 2 person carpools.

6. Please indicate the extent to which you agree or disagree with the following statements.

	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
HOV lanes are a good idea.	___	___	___	___	___
Vehicles dart in and out of HOV lanes too often for the lanes to be safe.	___	___	___	___	___
HOV lanes help save all commuters a lot of time.	___	___	___	___	___
Constructing HOV lanes is unfair to taxpayers who choose to drive alone.	___	___	___	___	___
Existing HOV lanes are being adequately used.	___	___	___	___	___
HOV lane violators commit a serious traffic violation.	___	___	___	___	___
HOV lane violators are common during the commute hours.	___	___	___	___	___
Many more people would carpool if the HOV lanes were more widespread.	___	___	___	___	___
HOV lanes should be opened to all traffic.	___	___	___	___	___
HOV lanes are convenient to use.	___	___	___	___	___
HOV lane construction should continue, in general.	___	___	___	___	___
HOV lanes should be enforced with police who observe violators and mail tickets to the owner of the auto.	___	___	___	___	___
2-person carpools should be allowed to use all HOV lanes	___	___	___	___	___

Section C: About Yourself

7. Are you? ... ___Male ___Female

8. What is your age? ___under 31 ___31–40 ___41–50 ___51–64 ___65+

9. What is your highest level of education?
   - ___ did not finish high school
   - ___ high school
   - ___ community college or trade school
   - ___ college/university
   - ___ post graduate

10. Including yourself, how many people live in your household? ____

11. How many people living in your household are over age 15? ____

12. How many people living in your household work outside the home? ____

13. How many vehicles (in working order) do you have? ____

14. What is the Zip Code of your work place? __________ your home? __________

15. Which freeways do you use in your normal commute route? (Check all that apply)

___ I-5 north of Northgate	___ I-90
___ I-5 between Northgate and Southcenter	___ SR-520
___ I-5 south of Southcenter	___ I-405

16. Would you be willing to answer more questions by a telephone call? If so, please provide your name, phone number, and best time to call ________________________________
____
____

PLEASE USE THIS SPACE FOR ANY COMMENTS:

____
____
____
____
____
____

APPENDIX H

COMMENTS OF SURVEY RESPONDENTS

The following are examples of respondent's written comments. The comments generally fall into four categories, support for HOV lanes, opposition to HOV lanes, solutions to traffic problems, and miscellaneous. Respondents' comments are overwhelmingly in opposition to HOV lane restrictions and further HOV lane construction. Ten representative comments illustrate respondents' input.

1. We strongly support recent efforts to extend HOV lanes and would encourage further efforts in this regard! Should keep open to 2-person [carpools].

2. I think HOV lanes are great and should be added on all major highways. It may take higher gas prices to entice more people to carpool.

3. When I am stuck in traffic and am in a hurry and cars with one person whiz past in the HOV lane it is VERY frustrating. The HOV lanes should be enforced strictly or eliminated. The way it is now scoff-laws use HOV lanes and get places quickly.

4. I carpool via I-5 from Kent to Seattle daily. We use the carpool lane, which starts around Tukwila and ends above Boeing, which saves time . . . until we get to the end! Then merging traffic backs up so that we don't save much time at all, if any. We'd rather that you either extend the carpool lane all the way into Seattle or just get rid of it. The way it is now, it doesn't help carpoolers save a lot of time. Thanks.

5. Vehicles typically run more efficiently and generate less pollution at higher speeds. HOV lanes are typically underutilized. Eliminating HOV lanes would help minimize congestion, increase freeway commute speed and reduce pollution. Adding HOV lanes to I-90 east of I-405 will change this route from a reasonable commute to a slow commute. The three

non-HOV lanes will have a vehicle load increase of 20-25% resulting in traffic moving 25-40% slower.

6 Traffic problems will not be solved until we have some other mass transit besides buses. Having sat on buses stuck in traffic, I know that buses are not the answer.

7 HOV lanes are shortsighted! Light rail or uni-rail would be more cost-effective in the long run!

8 I think a lot of commuters think the HOV lanes are for speeding. I like the lanes for convenience but it really scares me with the traffic darting back and forth.

9 I often use the HOV lane when I have my small son in the car with me. I am sure to someone driving by that it looks like I'm alone. That is why I don't think observation and mailing a ticket is not [sic] a good idea.

10 I am a real estate appraiser and use these freeways to travel to and from appointments. Due to my profession I am not able to use the HOV lanes on a regular basis. It amazes me the number of multiple occupant vehicles that do not use HOV lanes. I would be interested in knowing why they don't.