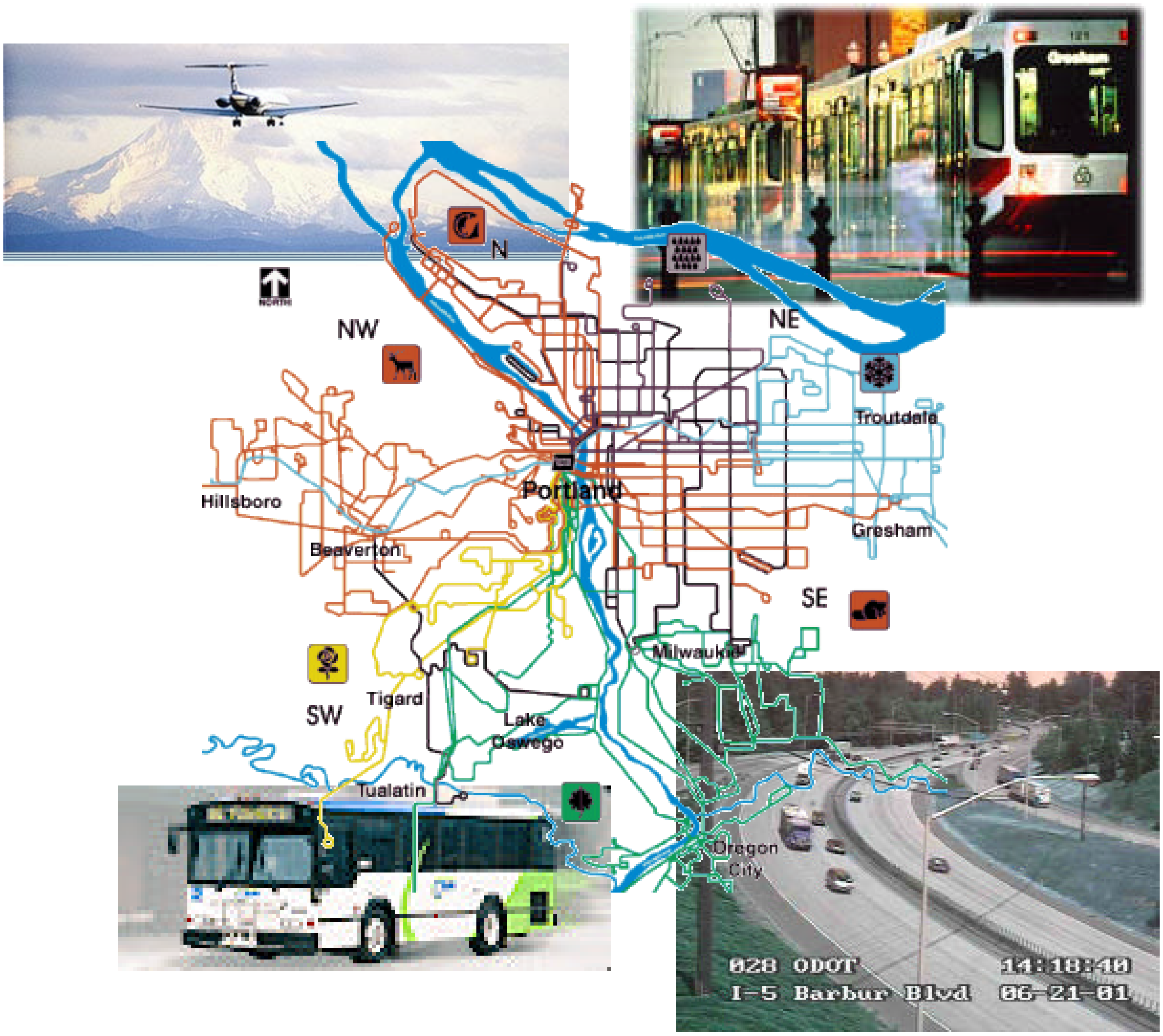
Oregon Regional Intelligent Transportation Systems (ITS) Integration Program

Final Phase II Report



Submitted to:
United States Department of Transportation

Science Applications International Corporation (SAIC)
Cambridge Systematics, Inc.

July 12, 2002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

For further information please contact:

Kelley K. Pécheux
SAIC
P.O. Box 50132
8301 Greensboro Dr.
McLean, VA 22101
703.676.2385

Mark R. Carter
SAIC
P.O. Box 50132
8301 Greensboro Dr.
McLean, VA 22101
202.366.2196

Andre Chandra
CSI
1300 Clay Street
Oakland, CA 94612
510.873.8700

EXECUTIVE SUMMARY

The Portland metropolitan region has a long history of investing in multi-modal transportation solutions to enhance mobility and maintain the region's livability standards and reputation. As a complementary means to enhance the efficiency and safety of travel, the Portland region has been actively involved in the planning and deployment of Intelligent Transportation Systems (ITS) since the early 1990s. Portland's commitment to ITS as a solution to transportation problems is evidenced by *TransPort 2000*, a regional ITS plan consisting of 16 integrated and interoperable projects. *Transport 2000* includes significant bi-state, urban-rural, and multi-modal components and represents the joint planning efforts of a regional committee consistent with statewide and regional planning processes in Oregon and Washington. The *Transport 2000* projects build on the region's significant existing ITS investment and fills current gaps in planning, emergency management, traveler information, and parking subsystems.

Under the direction and partial funding of the United States Department of Transportation (USDOT), National ITS evaluations are being conducted to accelerate the integration and interoperability of ITS in metropolitan and rural areas. To investigate the success of ITS across the country and to provide insights into the potential strengths and weaknesses of the overall national integration program, the Oregon Regional ITS Integration Program was selected for independent national evaluation. Specifically, four projects were selected for evaluation:

- Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays,
- I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project,
- COATS Bi-State Rural Integration Project, and
- Transit Buses as Traffic Probes project.

This document outlines the evaluation strategies, data collection plans, and baseline results for the Oregon Regional ITS Integration Program.

Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays

Transit Tracker information displays, a component of the Regional Intermodal Transit Traveler Information and Security System, use global positioning satellite technology and algorithms to calculate real-time bus and train arrivals, which are displayed at transit stops. The signs display a minute-by-minute countdown of the arrival time of the buses once they are within some pre-selected time of arriving at the stop (generally 15 to 25 minutes). If a bus is outside of this time threshold, the signs simply show the scheduled arrival time. The focus of this project is to make the bus and light rail arrival information available to riders through the information displays.

Evaluation Approach

The purpose of the Transit Tracker evaluation is to collect and analyze data related to a change in bus riders' behaviors and perceptions of service and security as a result of the Transit Tracker information displays. Four measures of effectiveness (MOEs) were selected to test the impact of the information on riders' behaviors and perceptions:

- Riders' use of trip planning information,
- Riders' perceptions of system efficiency,
- Riders' perceptions of personal security, and
- Riders' overall satisfaction with the system.

In addition, Bus Dispatch System (BDS) data will be examined in Phase III to determine accuracy of the system information, and website use statistics will be used to determine if the real-time information increases customer use of the Tri-Met website. These results, along with qualitative lessons learned during implementation and operation of the system, will be documented in the Phase III report.

Findings

The SAIC team conducted baseline Transit Tracker intercept surveys in Portland for four days in January 2002. Two teams of two surveyors went to different bus stops during the morning peak, over the lunch hour, and during the evening peak for three days. In all, 240 completed surveys were obtained.

Riders' use of trip planning information

Between 41 and 76 percent of respondents indicated that they *rarely or almost never* use four types of fixed-schedule information, depending on the type of information (i.e., printed brochure schedules, schedules posted at bus stops, on-line Internet schedule, and 238-RIDE phone number). A couple of reasons why riders may not use or need fixed-schedule information were identified. Forty-five percent of respondents indicated that they *frequently or almost always* just go to the bus stop and wait for the next bus to arrive (not knowing the scheduled arrival time). Over half of respondents indicated that they do not use schedule information because they *frequently or almost always* have their routes and times memorized. Chi-squared tests showed that the use of schedule information is dependent on automobile ownership. Specifically, non-auto owners tend to use guides posted at stops and the 238-RIDE phone number more often than auto owners; and auto owners tend to use the Internet schedule more often than non-auto owners.

When asked about the accuracy of the fixed-schedule information, 70 percent indicated that the information that they do use is *frequently or almost always* accurate.

Riders' perceptions of system efficiency

Rider perception of on-time performance was used as a measure of system efficiency. About 73 percent of respondents reported that the bus they catch at the stop is usually on time. Only 10 percent reported that the bus is not usually on time, and about 16 percent reported that they did not know if the bus was usually on time (either because they had never been to the stop before, or because they did not know the scheduled arrival time). When asked how long they usually wait for the bus at the stop, 26 percent of the respondents gave a range, while the remaining 74 percent reported an integer value. The most common response was *5 minutes* (42 percent of respondents), followed by *10 minutes* (32 percent of respondents), and *15 minutes* (13 percent of respondents). The average number of minutes of the respondents who gave an integer value for wait time was 8.6 minutes. The most common response for those reporting a range was *5 – 10 minutes* (46 percent) with the second most common response being *10 – 15 minutes* (17 percent). Taking an average of each range, the average wait time reported for those giving a range was 9.2 minutes (only 0.6 minutes higher than those reporting an integer value).

When asked how satisfied they were with the bus' adherence to the posted schedules, 91 percent of respondents indicated that they were either *satisfied* or *extremely satisfied*. In other words, respondents seem to be very satisfied with bus service in terms of on-time performance.

Riders' perceptions of personal security

An overwhelming 97 percent of respondents reported that they *agree* or *completely agree* that they feel safe waiting for the bus at the stops during the day. Only about 63 percent of the same riders reported that they *agree* or *completely agree* that they feel safe waiting for the bus at the stops at night, while 20 percent reported that they *disagree* or *completely disagree* that they feel safe at night. Therefore, while it may be difficult, if not impossible, for Transit Tracker to have much impact on bus riders' perceptions of personal security during the day, there does exist some room for improvement at night.

Average nighttime (9:00 p.m. to close of service) boardings from the Spring of 2001 were also examined to see if Transit Tracker might increase perceived personal security at night. (It was hypothesized that if there is an increased sense of security related to the presence of Transit Tracker, riders may feel safer riding at night, when they normally may not be comfortable riding the bus.) The nighttime ridership numbers for the four stops ranged from only 8 to 16 riders. While the numbers are low, they are not uncommon, and they will be compared with nighttime ridership numbers after Transit Tracker has been installed at the same locations. An increase in ridership after Transit Tracker installation may be indicative of an increased sense of security at night; however, overall ridership numbers will also be examined to determine if there is any corresponding upwards trend in overall ridership that may account for the increase at night.

The baseline survey conducted by SAIC was compared to a baseline survey of 830 transit riders that was conducted by Tri-Met in the spring of 2000. The results of the two surveys, in terms of riders' perceptions of efficiency, personal security, and overall customer satisfaction, were very similar.

Riders' overall satisfaction with the system

Respondents were asked to rate how satisfied they are with the bus service at the stops surveyed. An overwhelming 91 percent of respondents indicated that they are either *satisfied* or *completely satisfied* with the bus service at the stops, while only 4.5 percent reported being *dissatisfied* or *completely dissatisfied*.

I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project

The City of Portland and the Oregon Department of Transportation (ODOT) are implementing cooperative strategies to test the deployment of ITS on a parallel freeway/arterial corridor. As part of the regional advanced traffic management system (ATMS) program, traffic and incident management along the regional freeway and arterial systems are planned with freeway/arterial integration. Specifically, this project will accelerate the current deployment and integration of traffic surveillance and control devices in a high volume freeway/arterial corridor.

Evaluation Approach

The baseline data were obtained through field data collection along Barbur Boulevard and I-5 (e.g., volumes, speeds, crash rates) and a web-based driver survey (e.g., drivers' perceptions and behaviors). The results from the mobility/safety study and the customer satisfaction study will be compared to similar data collected after installation of the system during Phase III data collection. These results, along with qualitative lessons learned during implementation and operation of the system, will be documented in the Phase III report.

The mobility/safety study on I-5 and Barbur Boulevard aims to discover impacts of the freeway-arterial integration on traveler mobility, using the following measures of effectiveness:

- Speed/travel time in the primary direction during incident conditions,
- Speed/travel time reliability in the primary direction during incident conditions,
- Vehicle throughput in the primary direction during incident conditions,
- Incident detection, response and clearance times, and
- Freeway crash rates.

In order to test the impacts of the corridor traffic management project on customer satisfaction, an understanding of baseline perceptions is required. Thus, the initial questionnaire was designed to obtain baseline information on a variety of issues including: commuter demographics, commute time and distance, access to and use of traveler information, commute patterns, frequency of incident-related delays, and perceptions of traffic conditions on I-5 and Barbur Boulevard.

Findings

Mobility/safety study

On average over the peak period, traffic on northbound I-5 during the morning peak period has remained the same for the last two years. I-5 is the major corridor connecting downtown Portland with the suburban areas to the north and south. The I-5 northbound corridor within the study area has three lanes, with a posted speed limit of 55 mph. It carries about 3,900 vehicles per hour during the morning peak period at average speeds of 45-55 mph, depending on the segment. Speed and travel time reliabilities have also been consistent the last two years, averaging about +/- 9 mph and +/- 2.5 minutes, respectively.

A closer inspection of the volume and speed data during the morning peak 30-minute period revealed a big difference between historic and baseline traffic. Between 7:30 and 8:00 a.m., which is one of the corridor's busiest 30-minute periods, northbound I-5 experienced a volume increase of 42.9 percent since 2000/2001. This finding was also confirmed with a more noticeable drop in speeds found during the same 30-minute period between historic and baseline evaluation periods.

Similar analysis was done on Barbur Boulevard traffic volumes; however, there are not enough historic volume data to warrant definitive conclusions, as data were obtained only from three dates in 2000. Nevertheless, the comparison between historic and baseline Barbur Boulevard volumes shows that northbound traffic volumes have been consistent since 2000, with slight increases between 7 and 9 a.m.

Barbur Boulevard, although having a lower average speed than I-5, had excellent speed reliability compared to I-5, both throughout the peak period and on average throughout the week. For example, while I-5 showed slightly lower average speeds on Wednesday and Friday, average speeds on Barbur Boulevard remained very consistent.

The results of the freeway crash analysis show that the average number of crashes per month for the past two years has been declining. Injury crash rates have remained roughly the same for the last two years, at a rate of about two to three injury crashes per month. Crashes that only resulted in property damages, however, have steadily decreased, from 58 crashes per month in 2000 to only 48 crashes in January 2002. The evaluation team found no obvious reason for this consistent decline in PDO crash rates, but it is perhaps worth noting that the 2002 statistics only include the month of January. For a more representative 2002 crash rates, a few more months of data would be necessary.

Incident reports coinciding with the evaluation time periods were also analyzed. This analysis revealed that there were seven incidents occurring in the northbound direction of I-5 during the morning peak, with no secondary incidents. The duration of the incidents ranged from 46 minutes to two hours, but averaged just over an hour.

On average, vehicle speed declined by four to six miles per hour after an incident. Individual incident characteristics show that incidents that occurred early in the peak period suffered the greatest, as the recoveries were slowed by the increasing peak period traffic. On the other hand, incidents that occurred later in the peak experienced less impact, as peak period traffic was most likely beginning to clear. The average decrease in speeds translates to about one minute of travel time increase. At 30 minutes prior to the incidents' confirmation, the average travel time on I-5 northbound was 8.4 minutes, which increased to over 9 minutes after the incident occurred.

By comparing standard deviations of speed with and without the incidents, speed and travel time on I-5 northbound became less reliable (increased standard deviation) during incident conditions, with speed standard deviation increasing by 23 percent and travel time standard deviation increasing by 35 percent. Comparing the speeds on I-5 and Barbur Boulevard, there is evidence that incidents caused traffic to deviate from the freeway mainlines to the arterial, as hourly Barbur Boulevard traffic volumes increased by an average of 18 percent during incident conditions, and Barbur Boulevard speeds decreased by about 8 percent. Also, speeds on Barbur Boulevard were 28 percent less reliable during incident conditions.

Customer satisfaction study

Four hundred sixty downtown Portland commuters qualified to participate in the I-5/Barbur Boulevard customer satisfaction panel survey. The following is a summary of the key findings of the baseline customer satisfaction panel survey:

- 61 percent of the panel members generally do not find out about delays on their route until *after* they see the congestion on the roadway. In other words, they do not receive traffic information soon enough to make important decisions about their commute time and route.
- Of the respondents who reported that they generally find out about incident-related delays *before* they leave home, about 65 percent reported that they generally *use an alternate route that does not include a freeway*, and about 15 percent indicated that they make *no change*.
- The respondents who reported that they generally do not find out about incident-related delays on their route until *after* they leave home were also asked to indicate what they usually do to avoid the delays when they become aware of them. Nearly 56 percent reported that they generally *use an alternate route that does not include a freeway*, while about 38 percent indicated that they make *no change* at all.
- The most common answer as to how often they experience incident-related delays on northbound I-5 in the morning was *less than once* per month (given by about

22 percent of the panel members). About 21 percent of the panel members reported that they experience incident-related delays in the study area during their morning commute *two times* per month. Nearly 25 percent, however, reported delays four or more times per month, or nearly once per week on average.

- About 73 percent of panel members indicated that they do use Barbur Boulevard to avoid delays on I-5.
- While nearly 36 percent of panel members reported being *satisfied* with traffic operations on northbound I-5 in the morning during a typical commute, 33 percent reported that they were either *dissatisfied* or *extremely dissatisfied* with normal traffic operations. On the other hand, only about 5 percent of panel members reported that they were *satisfied* with traffic operations during incident conditions, and nearly 78 percent reported being *dissatisfied* or *extremely dissatisfied*. These ratings indicate that there is much room for improvement of drivers' satisfaction with traffic operations along I-5 during normal operations and during incidents.
- The respondents who sometimes use Barbur Boulevard to avoid delays on I-5 were asked to rate their level of satisfaction with travel speed, volume, and signal operations. Very few respondents reported that they are *extremely satisfied* with any of the three elements of traffic operations when they use Barbur Boulevard. Panel members appear to be the most opinionated about travel speed. Forty-two percent of respondents reported that they are *satisfied* or *extremely satisfied* with travel speed (compared to 37 and 36 percent of respondents for traffic volume and signal operations, respectively). In addition, 38 percent of respondents reported that they are *dissatisfied* or *extremely dissatisfied* with travel speed (compared to 37 and 35 percent of respondents for traffic volume and signal operations, respectively). These ratings indicate that there is much room for improvement of drivers' satisfaction with traffic operations along Barbur Boulevard during incidents in the morning.
- Of five sources of traffic information, radio reports in the car are used by more panel members than the other types of information (used by about 93 percent of panel members). Freeway VMS are the second most common source of traffic information used by panel members, with approximately 76 percent reporting use of VMS. Television reports and radio reports at home are used by only about half of respondents (46 percent and 50 percent, respectively). Eighteen percent of panel members reported using the Internet for traffic information.
- Radio reports in the car are perceived by more panel members as being timely and useful compared to the other information sources and were rated by the fewest panel members as being *rarely or almost never* timely or useful. Freeway VMS were rated by more panel members as being *frequently or almost always* accurate than the other information sources considered.
- Overall, the panel members reported the traffic information to be more accurate than either timely or useful.

While a sample of 460 drivers is a large enough sample to be representative of the population of commuters on northbound I-5 in the morning, the method of survey administration (i.e., Internet) limits the applicability of the results. In other words, the opinions of the sample are representative of I-5 commuters who work in an office setting and have access to a computer/Internet and can provide valuable information about their behaviors and perceptions; however, the results cannot be generalized to the population as a whole.

COATS Bi-State Rural Integration Project

The California Oregon Advanced Transportation System (COATS) is a project that seeks to encourage regional, public, and private sector cooperation between California and Oregon to better facilitate the planning and implementation of ITS in the bi-state area. The COATS study area includes 13 counties in northern California and the southern half of Oregon and is not defined by county lines but rather by roadway segments. The intent of this project is to facilitate the use of ITS to enhance safety, improve the movement of people, goods, and services, and subsequently promote the economic development of the region.

Evaluation Approach

Measures of effectiveness originally selected for this evaluation included efficiency, safety, and customer satisfaction. However, the original evaluation plan was adjusted as a result of a concurrent evaluation of COATS being conducted by the Western Transportation Institute at Montana State University, Bozeman. The scope of this national evaluation is now concentrated solely on the safety analysis. Therefore, pre-deployment crash rates were the focus of the Phase II data collection, and the results will be compared to similar data collected after installation of the COATS projects. These results will be documented in the Phase III report.

Findings

Crash statistics were obtained from ODOT's *2000 Statewide Crash Rate Tables*, to serve as the baseline for this study. Four segments that are currently in the pre-deployment stage were selected for analysis:

- OR 242 between MP 55 and Sisters (advanced warning system for narrow lane widths),
- OR 42S between US 101 and OR 242 (automated flood warning system),
- US 97 between MP 143 and the Klamath County Line (animal detection system), and
- US 101 between Coos Bay and OR 42 (automated flood warning system).

In general, year 2000 crash rates in rural Oregon, based on data from the studied segments, averaged 1.12 crashes per million vehicle miles of travel (VMT), ranging as low as 0.73 at OR 42S, to as high as 1.39 at OR 242. Crash rates at all of the study segments, except at US 97 dropped in 2000, with an average reduction of 30 percent. On the other hand, US 97 experienced an increase of 0.5 crashes per million VMT when compared to the average rates from 1996 to 1999. The reason for the drops in incident rates is unknown. On the other hand, US 97 experienced an increase of 0.5 crashes per million VMT when compared to the average rates from 1996 to 1999.

Transit Buses as Traffic Probes Project

This regional transit-traffic management integration project addresses the technically challenging integration and utilization of real-time transit data for the purpose of establishing arterial (and freeway) network status. This project will support the use of travel time data for real-time management of traffic signals as well as analysis of corridor performance. Tri-Met buses traveling along their normal routes (in regular revenue service) will be collecting data as they normally do. Appropriate bus routes will be chosen in order to capture data from desired arterials. The real-time collection of travel times on several river crossings are of particular interest, as these tend to be congestion points in the system, and buses are traveling with the mixed-flow traffic on these bridges.

The information collected from the buses will be color-coded and added to the ODOT network status maps that are available on ODOT's website. These data will allow the agencies to better monitor and manage the transportation system and will fill gaps in network management.

Evaluation Approach

For this project, data gathered will not focus on "before" and "after" system deployment, as with the other three projects. Instead, data will be collected after system deployment, and information will be presented in a case study format. The case study will reference quantitative data (such as the additional amount of roadway from which real-time traffic data are generated as a result of using buses as probes). The case study will address the reliability and accuracy of the bus probe data, the utility of the information gathered to traffic managers, and the institutional issues associated with this type of project. For the institutional issues study, interviews will be held with ODOT, City of Portland, and Tri-Met personnel.

Evaluation Risk Assessment

The continuation of the evaluation of the Regional Oregon ITS Integration Program offers significant opportunities, with little to no risk. Based on these opportunities and the evaluation team's experience in developing the evaluation plan, working with the project partners, collecting baseline data, and analyzing baseline conditions, the evaluation team recommends that the FHWA COTR consider continuing with Phase III evaluation efforts.

1 INTRODUCTION

This document outlines the evaluation strategies, data collection approach, and baseline results for the Oregon Regional Intelligent Transportation System (ITS) Integration Program. Under the direction and partial funding of the United States Department of Transportation (USDOT), National ITS evaluations are being conducted to accelerate the integration and interoperability of ITS in metropolitan and rural areas.

The Portland metropolitan region has a long history of investing in multi-modal transportation solutions to enhance mobility and maintain the region's livability standards and reputation.(1) As a complementary means to enhance the efficiency and safety of travel, the Portland region has been actively involved in the planning and deployment of ITS infrastructure since the early 1990s. Considering a forecast regional population increase of nearly 500,000 residents by the year 2040 and a related increase of 55 percent in vehicle miles traveled (VMT) on regional transportation facilities in the next 20 years, integrated ITS deployment is considered critical in meeting future transportation demands.(2)

To investigate the success of ITS across the country and to provide insights into the potential strengths and weaknesses of the overall national integration program, the Oregon Regional ITS Integration Program was selected for independent national evaluation. Specifically, four projects were selected for evaluation:

- Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays,
- I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project,
- COATS Bi-State Rural Integration Project, and
- Transit Buses as Traffic Probes project.

1.1 Organization of Report

This Phase II report represents the second major deliverable of the evaluation effort. The Evaluation Plan, which presents the detailed objectives, hypotheses, and data needs for each evaluation goal, was the first deliverable.(3) The next major deliverable will be the Phase III report, which will include before-and-after analyses of the projects' impacts on system performance, safety, and customer satisfaction by comparing the data collected in Phase II and Phase III of the evaluation. This document presents the plan for conducting the independent evaluation and is structured in the following format:

- **Section 1 – Introduction –** Provides background information on the projects, including project participants, system components, and system objectives.
- **Section 2 – Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays –** Details the data collection

plan, data collection process, and baseline results related to riders' perceptions of service efficiency, trip planning information, and safety.

- **Section 3 – I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project –** Details the data collection plans, data collection processes, and baseline results related to system efficiency, safety, and customer satisfaction.
- **Section 4 – COATS Bi-State Rural Integration Project –** Details the data collection plan, data collection process, and baseline results related to traveler safety in rural Oregon.
- **Section 5 – Evaluation Risk Assessment** – Provides an assessment and recommendations for the continuation of Phase III of the evaluation in terms of the current deployment plans and schedules and opportunities.

The Transit Bus as Traffic Probes project is not addressed in this Phase II report, as there are no "baseline" data to be collected. Due to the nature of the project, the evaluation will be written as a case study (with quantitative data) and will be presented in the Phase III report.

1.2 Background

Portland's commitment to ITS as a solution to transportation problems is evidenced by *TransPort 2000*, a regional ITS plan consisting of 16 integrated and interoperable projects. *Transport 2000* includes significant bi-state, urban-rural, and multi-modal components and represents the joint planning efforts of a regional committee consistent with statewide and regional planning processes in Oregon and Washington. The *Transport 2000* projects build on the region's significant existing ITS infrastructure investment and fills current gaps in planning, emergency management, traveler information, and parking subsystems. These projects integrate:

- Transit with ATIS,
- Transit with freeway and arterial management,
- Freeway and arterial management,
- Arterial and incident management, and
- Freeway and incident management.

When deployed, the projects will complete the region's core intelligent transportation infrastructure consistent with the USDOT's National ITS goals for safety, efficiency, productivity, mobility, and environmental improvements.(2)

The project partners have been working to continue progress on the incremental conceptualization, planning, design, and deployment of operational ITS. The *Transport 2000* partners include the following agencies:

- Washington and Oregon Departments of Transportation (WSDOT and ODOT);

- City of Portland Department of Transportation;
- Metro—The directly-elected regional government that offers a wide range of services, including transportation and land use planning, to more than 1.3 million residents in three counties and 24 cities. By working with residents and local and state partners, Metro's goal is to provide effective transportation options to move people and goods throughout the region;
- Southwest Washington Regional Transportation Council (RTC)—The metropolitan planning organization for Southwest Washington. RTC's mission is to minimize transportation-related air pollution and to encourage and promote the development of a balanced, efficient, and affordable regional transportation system that meets the mobility needs of people and goods, within and through the Southwest Washington region;
- The Port of Portland—Owns and maintains five marine terminals, four airports (including Portland International) and seven business parks. Its mission is to provide competitive cargo and passenger access to regional, national, and international markets while enhancing the region's quality of life;
- Tri-County Metropolitan Transportation District of Oregon (Tri-MET)—Provides public transit service for the Portland metropolitan area. Based on Tri-Met's goals and objectives of increased mobility, increased system performance, reduced costs, and improved customer satisfaction, the agency has proposed ten ITS projects, three of which are part of Transport 2000;(1)
- C-TRAN—Clark County's public transit provider operates 29 buses, C-VAN curb-to-curb service for people who cannot access regular route service, carpool and vanpool services, and a Bike & Bus program; and
- Academic and private partners.

1.3 Project Descriptions

The Oregon Regional ITS Integration Program includes 16 different projects. The following four projects were selected for national evaluation:

- Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays,
- I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project,
- COATS Bi-State Rural Integration, and
- Transit Buses as Traffic Probes.

These projects cover a range of transportation modes and a host of intelligent transportation technologies. Three of the projects are targeted at improving transportation in the Portland metropolitan region, while the COATS project is focused on a primarily rural area of Southwest Oregon and Northern California. This section describes each of these projects in more detail and lists the expected benefits of the projects, as defined by the project partners.

1.3.1 Regional Intermodal Transit Traveler Information and Security System—Transit Tracker Information Displays

Transit Tracker information displays are part of the larger Regional Intermodal Transit Traveler Information and Security System. The goal of this overall system is to provide a seamless and complete regional multi-modal traveler information system that will result in more complete information service and enhanced public transportation security. This system will serve transit riders with a variety of services and information including interactive access to schedule and fare information, trip planning, and en-route information on Tri-Met bus and light rail, C-TRAN bus, and transit service to and from Portland International Airport. The system will also provide access to integrated regional traffic and transit information from fixed sites or through personal access services (e.g., Internet, dial-in services). For public transportation security, this project will provide for integrated emergency notification and response throughout the four county service region, exclusive of transit provider or current vehicle location.

Tri-Met has an extensive operational traveler information distribution infrastructure and is in the process of completing the installation of bus mall kiosks, smart bus signs, interactive pylons, and automated ticket vending machines. For seamless regional transit operations, it is expected that C-TRAN will also provide an equivalent level of traveler information service and security to its customers.

Figure 1-1. Transit Tracker Display

Tri-Met has installed its prototype Transit Tracker information displays. Transit Trackers use global positioning system (GPS) technology to calculate real-time bus and train arrival information, which is displayed on the signs at transit stops. The signs display a minute-by-minute countdown of the arrival time of the transit vehicles once they are within a pre-selected time of arriving at the stop (generally 15 to 25 minutes, a parameter that is selected by Tri-Met). If the bus or train is outside of this time threshold, the signs simply show the scheduled arrival time (Figure 1-1). The focus of this project is to make the arrival information available to riders through the information displays.

The information is also available on Tri-Met's website (Figure 1-2). Using the on-line Transit Tracker information, riders can check that their bus or train is on time before leaving home or work.

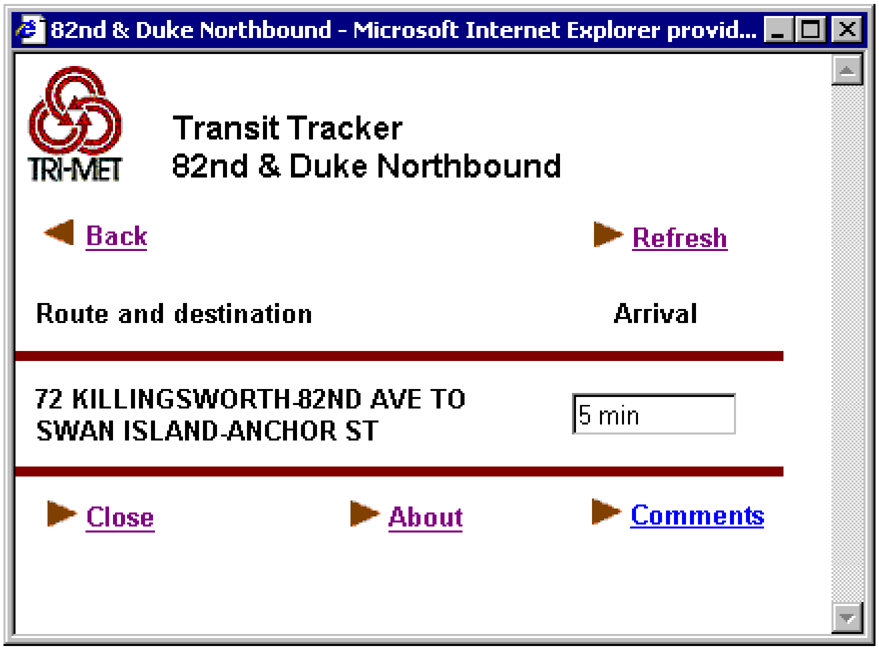


Figure 1-2. On-Line Transit Tracker Information

While Tri-Met is skeptical about the ability of the Transit Tracker displays, per se, to increase ridership, they believe that the information is a good tool to reduce the anxiety and frustration sometimes associated with riding transit, especially when using an unfamiliar transit system for the first time. The primary goals of the Transit Tracker displays are to provide useful information to customers that was not previously available, thereby improving customer satisfaction with Tri-Met's transit system and possibly increasing rider security.

1.3.2 I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project

The City of Portland and ODOT are implementing cooperative strategies to test the deployment of ITS on a parallel freeway/arterial corridor. As part of the regional advanced traffic management system (ATMS) program, traffic and incident management along the regional freeway and arterial systems are planned with freeway/arterial integration. Specifically, this project will accelerate the current deployment and integration of traffic surveillance and control devices in a high volume freeway/arterial corridor.

This project will facilitate cooperative use of specific agency devices and control software (arterial signal timing, freeway ramp meter signal operation, electronic message signs, CCTV) to integrate these capabilities and manage shared resources in the high-density, parallel I-5/Barbur Boulevard freeway/arterial corridor (Figure 1-3). This integration will allow for multi-agency traffic-responsive corridor management that includes emergency and transit priority treatment.

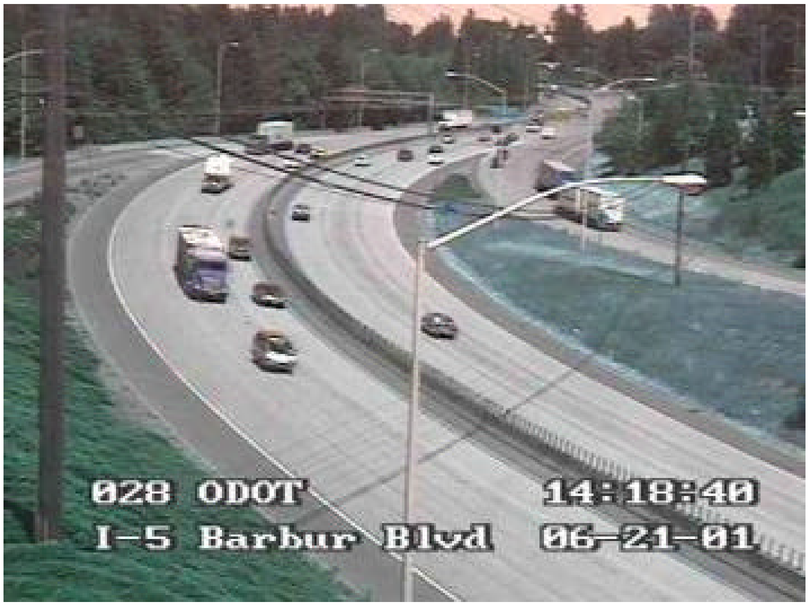


Figure 1-3. CCTV View of I-5 at Barbur Blvd.

A map of the study area is shown in Figure 1-4 (designated by the box). The study area lies south of downtown Portland and begins generally from the point where I-5 crosses into Multnomah County (near the S.W. Barbur Boulevard Exit #294, which is where Barbur Boulevard begins to parallel I-5) and extends approximately 3.5 miles north toward the downtown Portland area.

Project partners expect the benefits of the I-5/Barbur Boulevard parallel corridor traffic management demonstration project to include:

- Sustained or increased corridor capacity/throughput during incident conditions,
- Reduction of on-ramp incidents using ramp metering,
- Improved safety and efficiency of urban corridors,
- Improved integration of regional freeway systems with local signal systems,
- Improved incident detection and notification to reduce incident response time, and
- Provision of freeway and arterial corridor status to system operators.

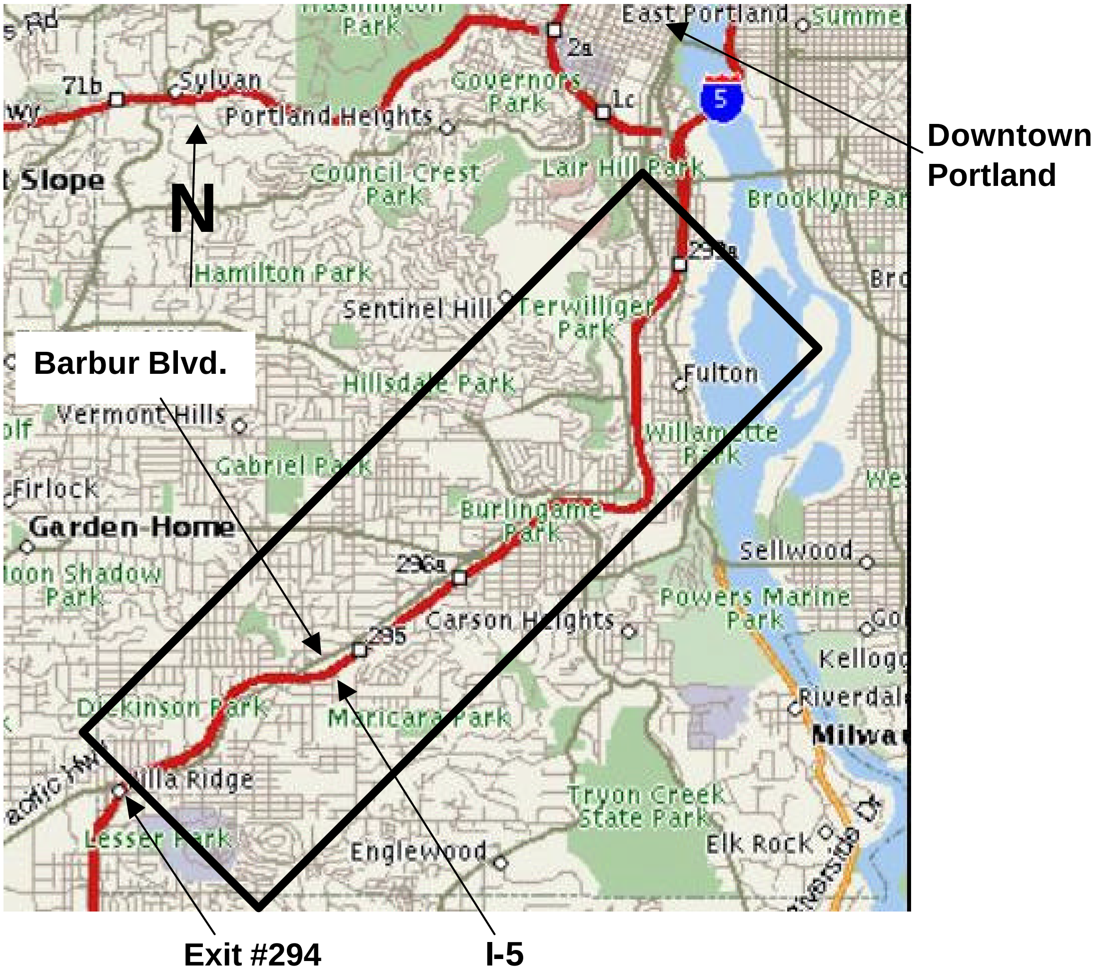


Figure 1-4. Map of I-5/Barbur Boulevard Study Area

1.3.3 COATS Bi-State Rural Integration

The California Oregon Advanced Transportation System (COATS) is a project that seeks to encourage regional, public- and private-sector cooperation between California and Oregon to better facilitate the planning and implementation of ITS in the bi-state area. The COATS study area includes 13 counties in northern California and the southern half of Oregon and is not defined by county lines but rather by roadway segments. The intent of this project is to facilitate the use of ITS to enhance safety, improve the movement of people, goods, and services, and subsequently promote the economic development of the region.(4)

The COATS bi-state area contains transportation links vital to the region's economy and commercial industry. Numerous primary and secondary routes serve commercial vehicles destined for urban centers throughout the West. Unpredictable weather patterns and mountainous topography add to the transportation challenges. Travelers throughout the corridor must contend with diverse and rapidly-changing weather conditions including snow, high winds, fog, and heavy rain. The combination of varied driving conditions and abundant off-road, commercial, and recreational traffic produces an immediate and expanding need for increased traffic safety measures and information dissemination techniques.[4]

In the short-term, there are three main strategies of the COATS project: [4]

- Address operational efficiency and public safety (monitor road-weather conditions with road-weather information, wind monitoring stations, automated flood warning systems, automated visibility systems, etc. and monitor roadway rights-of-way for potential animal-vehicle conflicts or for detecting landslides);
- Advise unfamiliar travelers of unsafe driving conditions through advance warning systems, variable message signs (VMS), and highway advisory radio (speed/travel conditions, wide loads on narrow lanes, etc); and
- Provide for the development of centers to coordinate, communicate, and cooperate with each other, nearby communities, local organizations, State agencies, and other regions (Redding and Eureka, CA and Salem, Bend, and Medford, OR).

Project partners expect the benefits of the COATS bi-state rural project to include:

- Improved traffic and roadway status information dissemination and access to avoid stranding drivers in remote locations due to unexpected road closures, restrictions, and adverse weather conditions;
- Safer rural travel that is also more efficient and convenient; and
- Improved coordination among the agencies involved in managing bi-state corridors through the provision of more complete real-time information to operations and maintenance personnel.

1.3.4 Transit Buses as Traffic Probes

Portland's regional traffic management centers require a complete status for both freeway and arterial roadways to effectively perform traffic control and incident management and to provide traffic information to the public. The regional freeway system is suitably instrumented for this purpose, but extended arterial network surveillance is cost prohibitive. Thus, transit probe data may afford a viable opportunity to provide arterial status information in this region. [1]

Tri-Met and C-TRAN operate the two transit systems serving the four-county area in Oregon and Washington (Figure 1-5). These transit properties operate an extensive fixed-route schedule in the region, and Tri-Met's buses are suitably equipped to collect schedule adherence data and serve as traffic probes. Tri-Met currently collects and post-processes bus operation data, including schedule adherence, for consideration in fixed-route scheduling. Additionally, Tri-Met is beginning to share these data with local jurisdictions for operational use. [1]

This regional transit-traffic management integration project addresses the technically challenging integration and utilization of real-time transit data for the purpose of establishing arterial (and freeway) network status. This project will support the use of travel time data for real-time management of traffic signals as well as analysis of corridor performance. [1]

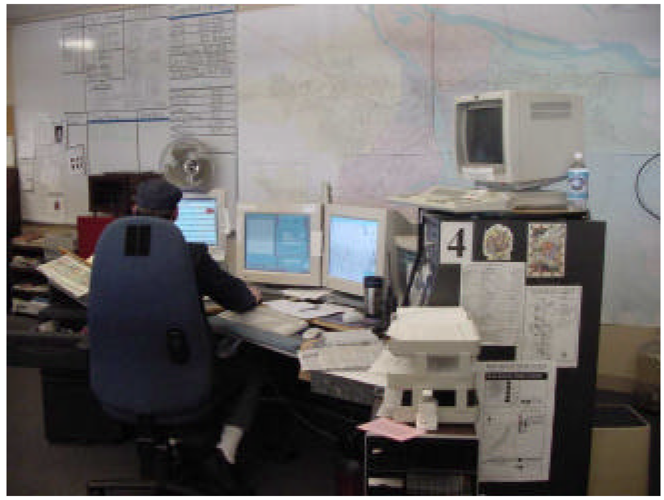


Figure 1-5. Tri-Met Bus Dispatch Station

Tri-Met buses traveling along a number of key corridors will report speeds or travel times on selected street segments determined to be of interest to the City of Portland and ODOT Region 1. The real-time collection of speeds on several river crossings are of particular interest, as these tend to be congestion points in the system, and buses are traveling with the mixed-flow traffic on these bridges (i.e., there are no transit stops).

The information collected from the buses will be color-coded and added to the ODOT network status maps that are available to the public on ODOT's website. These data will allow the agencies to better monitor and manage the transportation system and will fill the gaps in network management. Although the long-term plan includes giving speed and travel time information collected by the AVL technology on the buses directly to the motorists, more variable message signs are needed before this can be fully realized.

Project partners expect the benefits of the Transit Buses as Traffic Probes project to include:

- Better information for which to make traffic and incident management decisions,
- More accurate information disseminated to public,
- More efficient operation of the freeway and arterial transportation network, and
- Increased traveler mobility.

2 REGIONAL INTERMODAL TRANSIT TRAVELER INFORMATION AND SECURITY SYSTEM—TRANSIT TRACKER INFORMATION DISPLAYS

The purpose of the Transit Tracker evaluation is to collect and analyze data related to a change in bus riders' behaviors and perceptions as a result of the Transit Tracker information displays. Four measures of effectiveness were selected to test the impact of the information on riders' behaviors and perceptions:

- Riders' use of pre-trip and en-route planning information,
- Riders' perceptions of system efficiency,
- Riders' perceptions of personal security, and
- Riders' overall satisfaction with the system.

In order to test the information's impact on riders' behaviors and perceptions, an understanding of baseline behaviors and perceptions is required. This baseline information will be analyzed to provide a basis for comparison with any data collected during the post-deployment period.

In addition to the baseline surveys conducted for the national evaluation, Tri-Met conducted surveys of over 800 transit riders prior to the installation of any Transit Tracker displays. Results of both surveys are presented in this section of the report.

2.1 Data Collection Approach

The Transit Tracker evaluation concentrates on the behaviors and perceptions of Tri-Met bus riders in Portland. These behaviors and perceptions are being evaluated primarily through intercept surveys. These intercept surveys were conducted at stops where Transit Tracker had not yet been installed, but where plans existed for near-term installation. These data will be compared to data collected at the same locations after Transit Tracker information displays have been installed to determine if there are differences in riders' behaviors and perceptions.

The approach was to use one survey instrument to obtain information for each of the four goals of the Transit Tracker evaluation: (1) assess riders' use of pre-trip and en-route planning information, (2) assess riders' perceptions of system efficiency, (3) assess riders' perceptions of personal security, and (4) assess riders' overall satisfaction with they system. Surveys were administered at four Tri-Met bus stops in Portland, the locations of which were suggested by Tri-Met. Riders were approached and told that surveyors were doing a customer satisfaction survey of the Tri-Met bus service. They were asked if they would mind answering a few questions while they waited for their bus to arrive. Riders who agreed to participate were given a copy of the survey to follow along as the surveyor read each question aloud. Surveyors recorded each rider's responses on a separate survey form. A copy of the baseline Transit Tracker survey can be found in Appendix A.

2.1.1 Use of Trip Planning Information

One of the goals of the Transit Tracker evaluation is to assess riders' use of pre-trip and en-route planning information. The hypothesis is that Transit Tracker will provide riders with useful information with which they can make informed decisions about their trips in real time. For example, currently riders have access to only fixed-schedule information (from paper brochures, schedules posted at bus stops, on-line Internet schedules, etc.). While frequent users may have many of their schedules and routes memorized, newer riders may not be aware of when or how often the buses run. Transit Tracker information displays will allow riders to see not only the number of minutes until the next bus arrives, but also the number of minutes until the next two or three buses arrive. With this type of information, riders may decide to take a different route or may decide to run an errand while waiting, instead of waiting at the stop. This information could be especially useful in inclement weather conditions (which are common in Portland) when riders may not want to wait outside too long for the bus to arrive. This type of information can afford the transit rider with more opportunities to make alternative route or travel decisions, as well as opportunities to do other things while they wait for their bus. Finally, Transit Tracker also offers the intangible benefit of reducing anxiety and stress associated with waiting for a bus that is late, therefore improving customer satisfaction.

Several questions on the survey were formulated to determine if and how often riders make use of the current fixed-schedule information that is available to them, as well as their perceptions of the accuracy of such information. In the Phase III post-deployment surveys, questions will be geared toward users' perceptions of how Transit Tracker has changed their strategy for catching the bus as well as their perceptions of the accuracy and usefulness of the information provided by the Transit Tracker displays. In addition, riders will be directly asked if they used the information to make a decision related to their trip.

The real-time bus arrival information displayed on the Transit Trackers is also available on the Tri-Met website. The information became available for select routes and locations in March 2002, and Tri-Met is planning to expand it to all bus stops. Thus, a website usage survey will also be conducted to determine how many hits the website receives before and after transit tracker, how long users are on the website, and what type of information they obtain. Riders will also be asked in the follow-up intercept interviews if and how often they access the website to obtain real-time bus schedule information for pre-trip planning information.

2.1.2 Perceived Efficiency

Another goal of the Transit Tracker evaluation is to assess riders' perceptions of system efficiency. It is hypothesized that riders will perceive an increase in efficiency, in terms of on-time performance, even if there is no change in the actual system performance. This is due to the fact that the Transit Tracker signs will provide riders with real-time bus arrival information. In other words, even though the bus may be operating behind schedule, the Transit Tracker displays will show the actual (versus scheduled) time of arrival. If the system is accurate, the bus will arrive when the counter on the display nears zero and the sign displays the word "Due." In the minds of riders, arrival of the bus when the displays say it will arrive, whether or not it is at the scheduled arrival time, may indicate and may constitute an improvement in system efficiency.

Several questions on the survey were formulated to measure users' perceptions of the efficiency of the transit system in terms of how long they typically wait for the bus and if it is usually on time. The responses to these questions will be compared to similar questions asked in post-deployment surveys at the same bus stops.

2.1.3 Perceived Personal Security

Another goal of the Transit Tracker evaluation is to assess transit riders' perceptions of personal security. It is hypothesized that riders will perceive an increase in personal security, even if there are no other measures taken to increase security (such as increased police presence). While Transit Tracker will likely have little impact on the actual security of transit riders, having access to more accurate arrival time information may afford them the opportunity to wait elsewhere for the bus, such as a coffee shop, if they have a long wait, if it is after dark, or in areas where they are not familiar or comfortable. In addition, having access to Transit Tracker information on the Internet may allow customers to wait longer before leaving home, shortening their wait times at stops. Having information available to make these types of decisions could have an impact on users' perception of personal security.

Several questions on the survey were formulated to determine users' current perceptions of personal security. The responses to these questions will be compared to similar questions asked in post-deployment surveys at the same bus stops.

In addition to surveys, ridership data is also being examined, with attention focused on ridership statistics after dark. Tri-Met has expressed their skepticism about relating increased ridership to the Transit Tracker information displays. Transit ridership in Portland has been increasing steadily over the past several years, and it would therefore be difficult to conclude that the Transit Tracker information contributed directly to an increase in ridership. However, if there is an increased sense of security related to the presence of the Transit Tracker information, riders may feel safer riding at night, when they normally may not be comfortable riding the bus. Therefore, nighttime ridership before and after Transit Tracker installation will be compared for the four stops.

2.1.4 Overall Customer Satisfaction

Finally, several survey questions were formulated to determine users' overall satisfaction with Tri-Met bus service. While much of a riders' satisfaction, or lack thereof, with the bus system may have to do with his or her perceptions of accuracy, efficiency, and safety, there may be other factors that influence bus riders' perception of service quality.

2.2 Findings

Findings are presented in two parts. First, the findings of the Tri-Met surveys administered in the Spring of 2000, prior to installation of the Transit Tracker displays, are summarized. Subsequently, the findings of the baseline surveys conducted by SAIC in January 2002 are presented.

2.2.1 Tri-Met Customer Satisfaction Survey

Between April 24 and May 14, 2000, Tri-Met conducted intercept surveys with bus riders at two bus stops and one light rail stop in Portland.[(5)] A copy of the Tri-Met baseline intercept survey can be found in Appendix B. The purpose of the survey was to obtain the following baseline information prior to installing Transit Tracker displays:

- Overall satisfaction ratings with the transit service at each location;
- Perceived waiting time;
- Perceptions of on-time performance;
- Perceptions of safety when waiting for the bus or light rail;
- Transit use characteristics including riding frequency, time of day, day of the week, and level of transit dependence; and
- Passenger age and gender.

In all, 830 surveys were administered at three locations. The following is a summary of the key findings:

- 76 percent indicated that they were *somewhat* or *very satisfied* with the transit service.
- 72 percent were "heavy" transit uses (making more than 46 trips per month on average.
- 57 percent were transit dependent.
- Fewer than 22 percent knew the scheduled arrival time of the next bus or train before coming to the stop. Those who did know got their information from a

printed schedule or a Tri-Met Guide. Of those who did not know, 45 percent (at one location) said they looked at the schedule posted at the stop, while only 8 percent at another location looked at the posted schedule.

- Riders reported waiting for the bus or light rail an average of 8.5, 11.6, and 13.5 minutes at the three stops where surveys were administered.
- 70 percent at two of the locations and 63 percent at the other reported the bus or train that they wait for is *usually on time*.
- Personal safety was generally not a concern for passengers at these locations. Overall, 97 percent of respondents indicated that they felt safe waiting for the bus or train.

The survey results indicate that the majority of the respondents were generally satisfied with Tri-Met service, perceive the service as usually being on time, and voice few concerns for their personal safety.

While these results indicate an overall satisfaction with the Tri-Met service, Tri-Met believes that the Transit Tracker project offers the opportunity to improve the perceptions of on-time performance and increase the proportion of riders who report being very satisfied by improving their waiting experience.

2.2.2 Baseline Transit Tracker Intercept Survey

SAIC conducted additional baseline Transit Tracker intercept surveys in Portland on Tuesday afternoon, January 22, 2002 through Friday morning, January 25, 2002. The survey instrument used by the SAIC team was similar to that of the survey used by Tri-Met (discussed in the previous section); however, the surveys differed in the following three ways: some of Tri-Met's questions were slightly re-worded, not all Tri-Met's questions were included, and new questions were added to the SAIC survey that were not included on Tri-Met's survey. A copy of SAIC's Transit Tracker intercept survey can be found in Appendix A.

For survey administration, two teams of two surveyors went to different bus stops during the morning peak (7 – 9 a.m.), over the lunch hour (11:30 a.m. – 1 p.m.), and during the evening peak (4 – 6 p.m.). Table 2-1 illustrates the mean weekday boardings from Spring 2001 by time of day at each bus stop surveyed. Table 2-2 shows the number of completed surveys obtained by time of day at each bus stop. In all, 240 completed surveys were obtained.

Overall, bus riders were extremely receptive and cooperative. In fact, about 9 out of 10 people approached agreed to participate in the survey. The only difficulty experienced in survey administration was the ability to complete the survey before the bus arrived. In about 1 or 2 out of 10 riders surveyed, surveys were not completed before the bus arrived and therefore could not be used in the analyses. This was particularly problematic on rainy days at small shelters, as many riders arrived at the stops just before the bus arrived.

Table 2-1. Ridership Data for Four Bus Stops in Portland

Bus Stop	*Mean Weekday Boardings by Time of Day (Spring 2001)*			
	7 – 9 a.m.	9 a.m. – 4 p.m.	4 – 6 p.m.	9 p.m. – service end
Barbur Transit Center	294	150	58	9
Weidler @ Lloyd Center	12	163	81	9
Burnside and 28th	70	158	44	16
Burnside and Grand	25	86	42	8

Table 2-2. Number of Completed Baseline Customer Satisfaction Surveys

Bus Stop	*Number of Completed Surveys by Time of Day (Jan. 2002)*			
	7 – 9 a.m.	9 a.m. – 4 p.m.	4 – 6 p.m.	Total
Barbur Transit Center	109	0	0	109
Weidler @ Lloyd Center	0	18	35	53
Burnside and 28th	40	11	11	62
Burnside and Grand	0	9	7	16

At the time of administration of the SAIC baseline survey, Transit Tracker signs were not present at the four bus stops surveyed. However, there were Transit Tracker signs that had already been installed at four other bus stops elsewhere in Portland and on several of the light rail platforms on the MAX line to the airport. Thus, there was a possibility that riders surveyed as part of this evaluation had seen the signs at other locations, and that this awareness may have some impact on their survey responses.

To account for the previous installation of Transit Tracker signs at other locations, several steps were taken to avoid bias in the survey and to identify if bias existed. First, survey questions were worded to pertain to the stop at which the survey was being administered. For example, one question asked, "*At this bus stop*, how satisfied are you with bus adherence to the posted schedules?" By phrasing questions in this manner, riders were asked to focus on that bus stop when responding to questions, and not another stop that may have a Transit Tracker display.

In addition, so as to be able to test for bias in the survey responses, the last question on the survey inquired about whether riders had waited at one of the stops where Transit Tracker had been installed. The results showed that about 55 percent of those surveyed reported that they had seen a Transit Tracker sign at another location. Many respondents, however, reported that they had not really used the information on the sign (they had just seen it in passing), and only about 27 percent correctly identified a bus stop where a sign had been installed (others reported seeing a sign where one did not exist or had seen a sign only on the light rail system).

To determine if the signs that had already been installed had an affect on riders' responses to survey questions, the responses of those who had seen a sign were compared to the responses of those who had not seen a sign. Comparisons were made for two of the important measures of effectiveness, perception of on-time performance and overall satisfaction with the system. The results showed no statistically significant differences in the responses of the two groups of riders. Therefore, it is assumed that the presence of the Transit Tracker signs at other locations did not impact the responses of the participants in the baseline Transit Tracker survey, and all survey responses are included in these analyses.

2.2.2.1 Demographic Information

Of the 240 bus riders surveyed at the four stops, 43 percent were male, and 57 percent were female. The age distribution of the riders surveyed by SAIC is illustrated in Figure 2-1 and is compared to the age distribution of 112 riders surveyed by Tri-Met in January 2001 (exactly one year earlier) at different locations. Figure 2-2 shows a comparison of the SAIC survey conducted in January 2002 and the Tri-Met survey conducted in January 2001 to another survey conducted by Tri-Met in May 2000 in which 830 riders were surveyed (at the same locations as their 2001 survey). Age categories were aggregated for the 2002 and 2001 surveys to match the numbers reported in the 2000 survey.

Figure 2-1 illustrates that every age category was represented in the SAIC survey, and that the age distribution of respondents was very similar to that of the 2001 Tri-Met survey. The SAIC survey did capture a greater percentage of riders in the *25 – 34* age category and fewer riders in the *under 25* age category than the Tri-Met survey.

When comparing the 2002 and 2001 surveys to the 2000 Tri-Met survey (Figure 2-2) that surveyed over 800 riders (using the 2000 Tri-Met survey's age aggregation), age distributions are nearly identical for the three surveys.

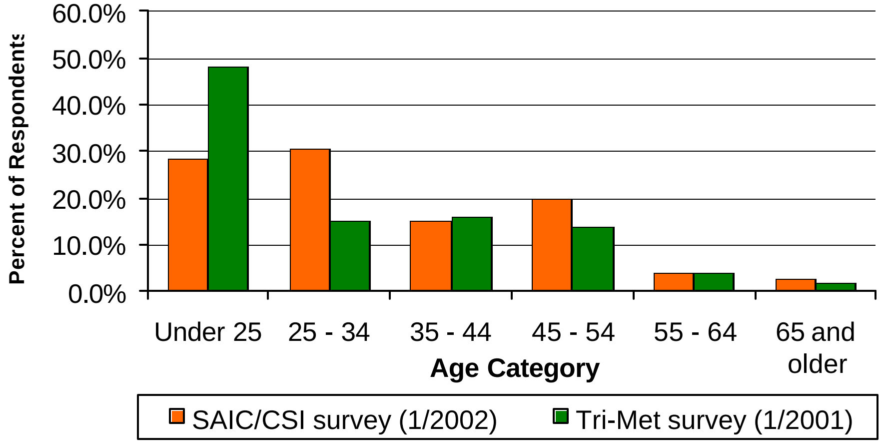


Figure 2-1. Age Distribution of Survey Respondents Compared to 2001 Tri-Met Survey

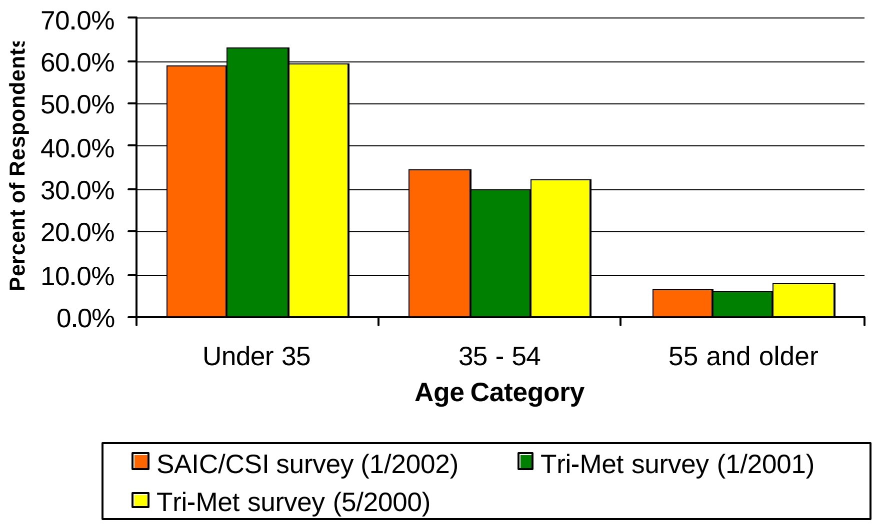


Figure 2-2. Age Distribution of Survey Respondents Compared to 2000 and 2001 Tri-Met Surveys

Figure 2-3 illustrates the reported frequency with which respondents ride the bus. Just over 70 percent of respondents reported that they ride the bus *nearly every day*. About 26 percent indicated that they ride the bus *one to four days per week*, and only about 3 percent reported that they ride the bus *less than one day per week*. It should be noted that those respondents who take the bus five days per week for work (but usually not on weekends) are represented in the *nearly every day* category.

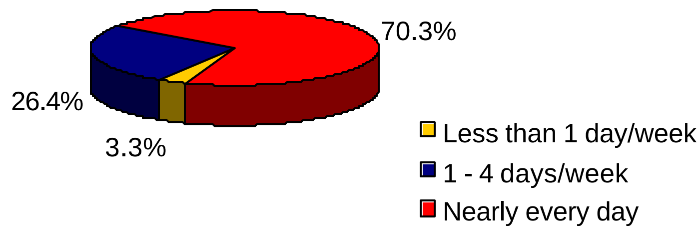


Figure 2-3. Frequency with Which Respondents Ride the Bus

Respondents were also asked to indicate for which trip purposes they most frequently ride the bus. Trip purposes included: *work*, *school*, *shopping*, *recreation*, *other,* and for *most all trips*. The distribution of responses as to the most frequent trip purpose are shown in Figure 2-4.

Figure 2-4 illustrates that just over half of respondents (51 percent) indicated that they ride the bus most frequently for *work* trips. About 12 percent of respondents reported that they ride the bus most frequently for *school* trips, and another 12 percent indicated that they ride the bus for *most all their trips*. Five percent or less of the respondents indicated that they ride the bus most frequently for each of the other trip purposes. (It should be noted that nearly half of the completed surveys were obtained from the Barbur Boulevard Transit Center, which is a major transit hub for downtown workers who drive to the park-and-ride and ride the bus to work).

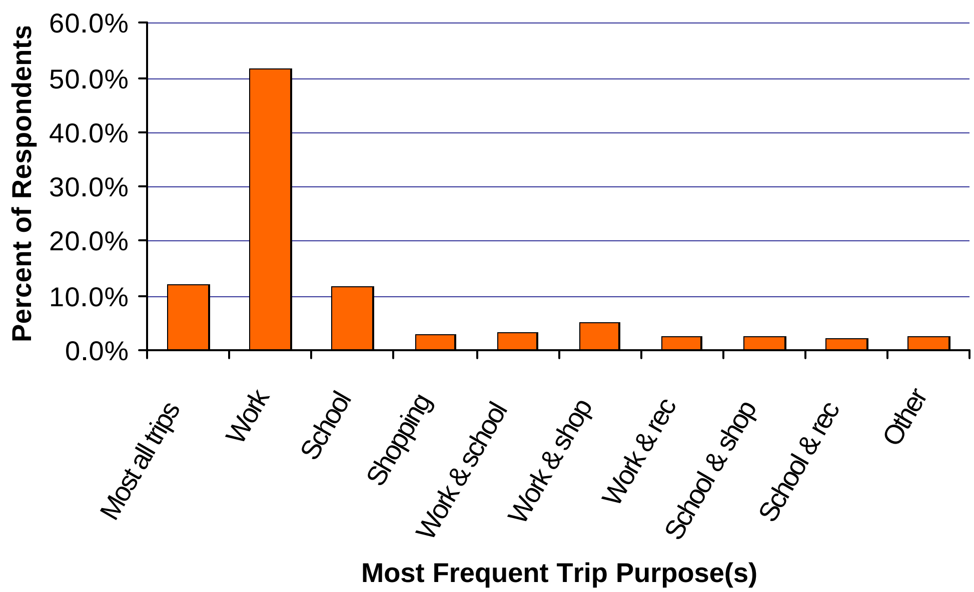


Figure 2-4. Distribution of Most Frequent Trip Purposes

When asked whether or not they had an automobile available for their use, 62 percent of the respondents indicated that they do have an automobile available, and 38 percent indicated that they do not have an automobile available to them. In other words, about one-third of the bus riders surveyed are transit dependent.

To determine if bus ridership in Portland is related to automobile ownership, an analysis of frequency of bus use versus automobile ownership was performed. Table 2-3 shows the number of auto and non-auto owners by frequency of bus use. A chi-squared test was performed on the distribution of responses to determine if frequency of bus use is related to automobile ownership. Chi-squared tests test for the independence of two variables. The calculated chi-squared value is compared to chi-squared table values. If the calculated value is higher than the table value, the two variables are not independent of one another.

The calculated chi-squared value for this test was 5.17. For one degree of freedom, the chi-squared values at the 5 percent and 1 percent level of significance are 6.64 and 3.84, respectively. Because 5.17 is greater than 3.84, but less than 6.64, the test is significant at the 5 percent level. In other words, frequency of transit use is not independent of auto ownership. From the data, it can be seen that non-auto owners tend to take transit *more frequently* than auto owners.

Table 2-3. Automobile Ownership Versus Frequency of Bus Use

Auto Ownership	***Frequency of Bus Use***		
	Every day	*Less than 5 days per week*	Total
Auto Owner	96	51	147
Non-auto Owner	72	19	91
Total	168	70	238

2.2.2.2 Riders' use of trip planning information

As previously discussed, one of the goals of the Transit Tracker evaluation is to assess riders' use of trip planning information. The results of how riders use fixed-schedule information (and it's perceived usefulness) will be compared to how riders use the real-time information provided by Transit Tracker in Phase III of the evaluation. Several questions on the survey probed respondents about the frequency with which they use different types of fixed-schedule information, as well as their perception of the accuracy of the information. Schedule information included: printed brochure schedules, schedules posted at bus stops, the on-line Internet schedule, and the 238-RIDE phone number. The frequency with which riders reported using these types of schedules is presented in Figure 2-5.

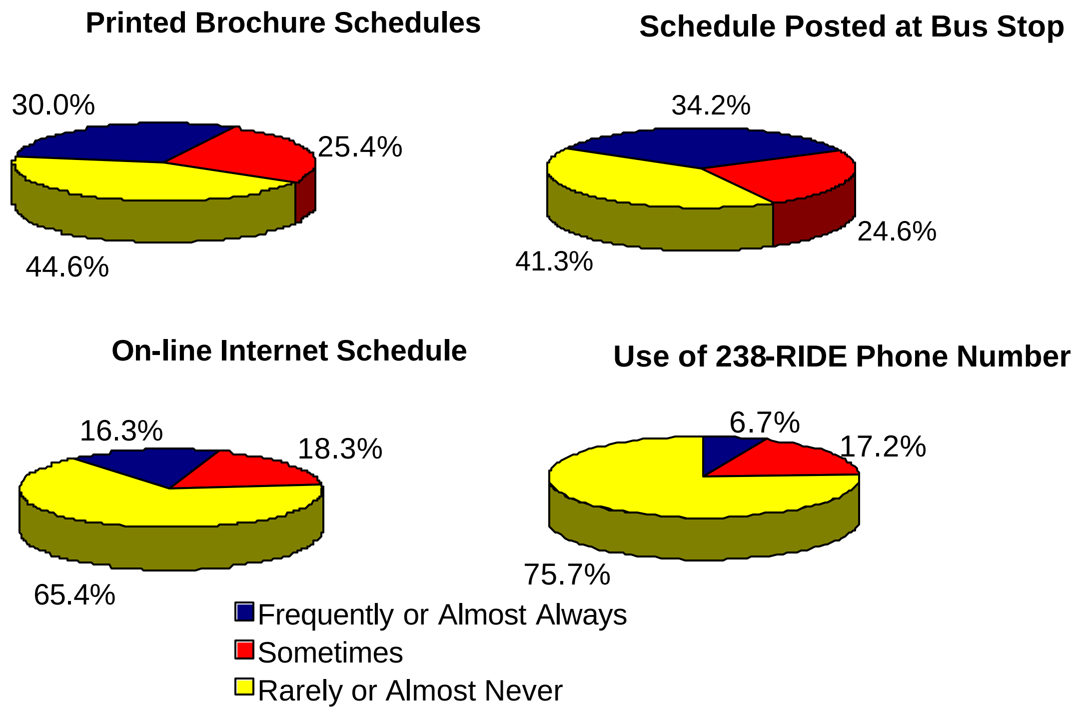


Figure 2-5. Frequency With Which Respondents Use Bus Schedule Information

More respondents indicated that they *rarely or almost never* use the schedule information than those who indicated that they *sometimes* use the information or than those who indicated that they *frequently or almost always* use the information. Schedules posted at bus stops was rated by more respondents (34 percent) as being *frequently or almost always* used than any other type of information, while 238-RIDE was rated by the fewest respondents (7 percent) as being *frequently or almost always* used.

Considering these results, one might wonder how transit riders obtain information about their trips, if few report that they *frequently or almost always* use these types of schedule information. To try and get a better idea of how riders plan for and schedule their transit trips, two additional questions were asked with regard to riders' trip-planning behaviors. The questions are shown in Table 2-4. These questions considered two reasons why riders may not need schedule information: because they just go to the stop and wait and because they have their routes and times memorized. The results are shown in Figure 2-6.

The responses to these questions offer some insight as to why many respondents *rarely or almost never* use the available bus schedule information. Forty-five percent of respondents indicated that they *frequently or almost always* just go to the bus stop and wait for the next bus to arrive (not knowing the scheduled arrival time), and about 19 percent indicated that they do so sometimes. Over half of respondents indicated that they do not use schedule information because they *frequently or almost always* have their routes and times memorized.

Table 2-4. Survey Questions About Riders' Trip Planning Behavior

Please rate <u>HOW OFTEN</u> the following statements are <u>TRUE</u>:

I generally do not use the Tri-Met schedule information—I just go to the bus stop and wait for the next bus to arrive.

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5
o	o	o	o	o

I generally do not use the Tri-Met schedule information, because I have most of my times/routes memorized.

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5
o	o	o	o	o

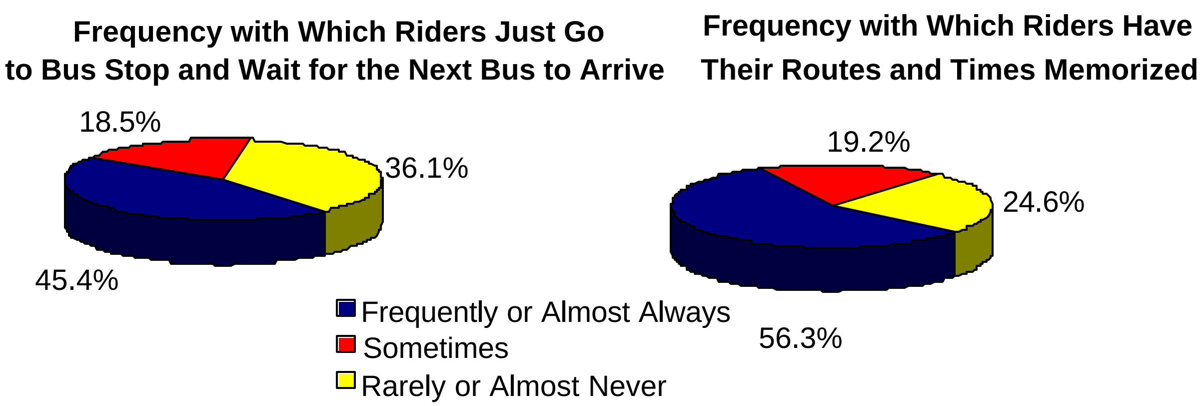


Figure 2-6. Alternative Trip Planning Behaviors

Respondents who reported that they *rarely* or *almost never* just go to the bus stop and wait or who reported that they *rarely* or *almost never* have their routes and times memorized were compared to the overall average response to the frequency of use of trip-planning information. This comparison was made to determine if these riders do in fact use information more often. Table 2-5 shows the percentages of respondents in each category that frequently or almost always use schedule information.

Considering the printed brochures, overall only 30 percent of respondents reported that they frequently or almost always use them when planning their transit trips. However, 50 percent of riders who reported that they rarely/almost never just go to the stop and wait reported that they frequently or almost always use the printed brochures. Considering the schedules posted at stops, overall only 34 percent of respondents reported that they frequently or almost always use them when planning their transit trips. However, 56 percent of riders who reported that they rarely/almost never have their routes/times memorized reported that they frequently or almost always use the guides posted at stops. These results are similar for on-line schedules and the 238-RIDE phone number. These results show that different riders have different needs when it comes to scheduling their transit trips; some riders tend to have their times/routes memorized, others tend to just go to the stop and wait, and others tend to rely on the available schedule information.

Table 2-5. Comparison of Use of Trip-Planning Information

Information Type	*Percent Who Frequently or Almost Always Use Schedule Information*		
	Overall Average	*Rarely/almost never Just go to stop and wait*	*Rarely/almost never have times/routes memorized*
Printed brochures	30%	**50%**	**42%**
Posted at stop	34%	**41%**	**56%**
On-line	16%	**24%**	10%
238-Ride	7%	**10%**	**15%**

One possible reason that riders may not use schedule information could be because they feel that the information is inaccurate. One question on the survey inquired about respondents' perception of the accuracy of the schedule information they use. The results are shown in Figure 2-7. The results indicate that, in fact, nearly 70 percent of respondents indicated that the schedule information that they use is *frequently or almost always* accurate, while only about 7 percent indicated that the information is only *rarely or almost never* accurate. In other words, inaccuracy of schedule information is not the reason most riders' report not using the information.

Other possible reasons for not using schedule information, while speculative, could be the lack of knowledge that the information exists or the lack of usefulness or availability (in the case of the Internet) of the information.

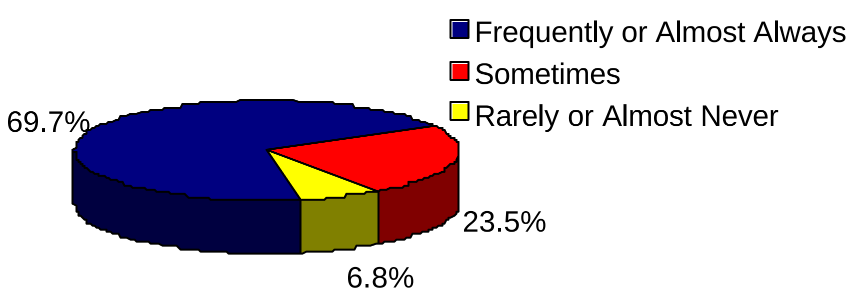


Figure 2-7. Respondents' Perceptions of Accuracy of Schedule Information

These analyses were taken one step further to try and determine if there was a group of riders that uses schedule information more frequently than others. Two categories were considered in these analyses: auto ownership and age. It was hypothesized that auto ownership may affect the use of schedule information. For example, it is likely that people who own automobiles take transit for only very specific trips (such as going to work or school). While they may need to use schedule information once to determine which bus they will take to get to work/school on time, they probably will not need to refer to the information again unless they change jobs, change work schedules, or the bus schedules change. It was shown previously that people who do not own automobiles are more reliant on transit for most or all their trips (i.e., take transit every day). It is less likely then that they would have all their routes and times memorized, as it is much more difficult to remember bus times for all trips than for two trips per day (to and from work). They would therefore need to refer to schedule information more often.

As for age, it was hypothesized that age may have an effect on riders' use of schedule information, as riders of different ages may have different needs when it comes to riding the bus (e.g., older riders may need to know exact times and know of more time/route options than younger riders) and/or may like to obtain their schedule information from different sources (e.g., Internet versus telephone).

Chi-squared (?^{2}) tests were used to determine if there is a relationship between use of schedule information and auto ownership and age. The results are shown in Table 2-6 and Table 2-7, respectively. The relationship between age and use of schedule information was found to be independent for all four types of schedule information. In other words, age does not affect the use of schedule information, contrary to what was hypothesized. However, it was found that auto ownership and use of schedule information are not independent for three of the four types of schedule information (shown in bold in Table 2-6). The use of guides posted at bus stops is dependent on auto ownership (at the 1% significance level); the use of on-line Internet schedules is dependent on auto ownership (at the 5% significance level); and the use of the 238-RIDE phone number is dependent on auto ownership (at the 1% significance level). The use of printed brochure schedules, however, was found to be independent of auto ownership.

To help further explain these results, the distribution of responses to use of schedule information versus auto ownership is shown in Figure 2-8. For guides posted at bus stops, the distribution of responses of the frequency with which auto owners use the information is nearly the inverse of the distribution of the frequency with which non-auto owners use the information. About half of non-auto owners reported using the guides posted at the bus stops *frequently or almost always*, while only 26 percent of auto owners reported *frequently or almost always* doing so. Likewise, about half of auto owners reported *rarely or almost never* using the guides posted at the bus stops, while only about 27 percent of non-auto owners reported *rarely or almost never* using the guides. Therefore, the hypothesis was correct, non-auto owners tend to use guides posted at stops more frequently than auto owners.

Table 2-6. ?^{2} Results for Auto Ownership Vs. Use of Schedule Information

Information Type	Degrees of Freedom	?^{2} Calculated	?^{2} 5% sig. level	?^{2} 1% sig. level
Printed brochures	4	2.64	9.49	13.29
Guides posted at stop	4	22.38	**9.49**	**13.28**
On-line	4	11.10	**9.49**	13.29
238-Ride	3	14.26	**7.82**	**11.34**

Table 2-7. ?^{2} Results for Age Vs. Use of Schedule Information

Information Type	Degrees of Freedom	?^{2} Calculated	?^{2} 5% sig. level	?^{2} 1% sig. level
Printed brochures	12	6.88	16.92	21.67
Guides posted at stop	9	15.31	21.03	26.22
On-line	9	12.42	16.92	21.67
238-Ride	6	9.22	12.59	16.81

While the most frequent response to the use of Internet schedules was *almost never*, many more non-auto owners reported that they *almost never* use the Internet than auto owners, and over twice as many auto owners than non-auto owners reported that they sometimes use the Internet to obtain information. This result is the opposite of what was hypothesized. This could be because people who own automobiles use transit for specific trips such as work and therefore may have better access to the Internet before making their transit trips (for instance, before their trip home from the office). Thus, it may be a question of accessibility to this type of information that affects its frequency of use.

For the 238-RIDE number, more auto owners reported that they *almost never* use the information than non-auto owners. Likewise, more non-auto owners reported that they *almost always*, *frequently*, or *sometimes* use the phone number than auto owners. This could be a question of the need for information and the accessibility of the information. While the 238-RIDE number does not seem like the preferred source of information, it may be more accessible to non-auto owners than the on-line Internet schedules.

2.2.2.3 Riders' perceptions of system efficiency

When asked if the bus is usually on time at the stop, about 73 percent of respondents said *yes*, that the bus is usually on time. Only 10 percent said *no*, that the bus is not usually on time, and about 16 percent reported that they did not know if the bus is usually on time (either because they had never been to the stop before, or because they did not know the scheduled arrival time). This same analysis was performed separately for frequent (every day) versus less frequent (less than 5 days per week) riders. These results showed that slightly more less-frequent riders reported that the bus is usually on time (91 percent versus 86 percent overall), maybe because they are less aware of the schedule than those who ride every day. In addition, more less-frequent riders reported that they did not know if the bus is usually on time (24 percent versus 13 percent overall).

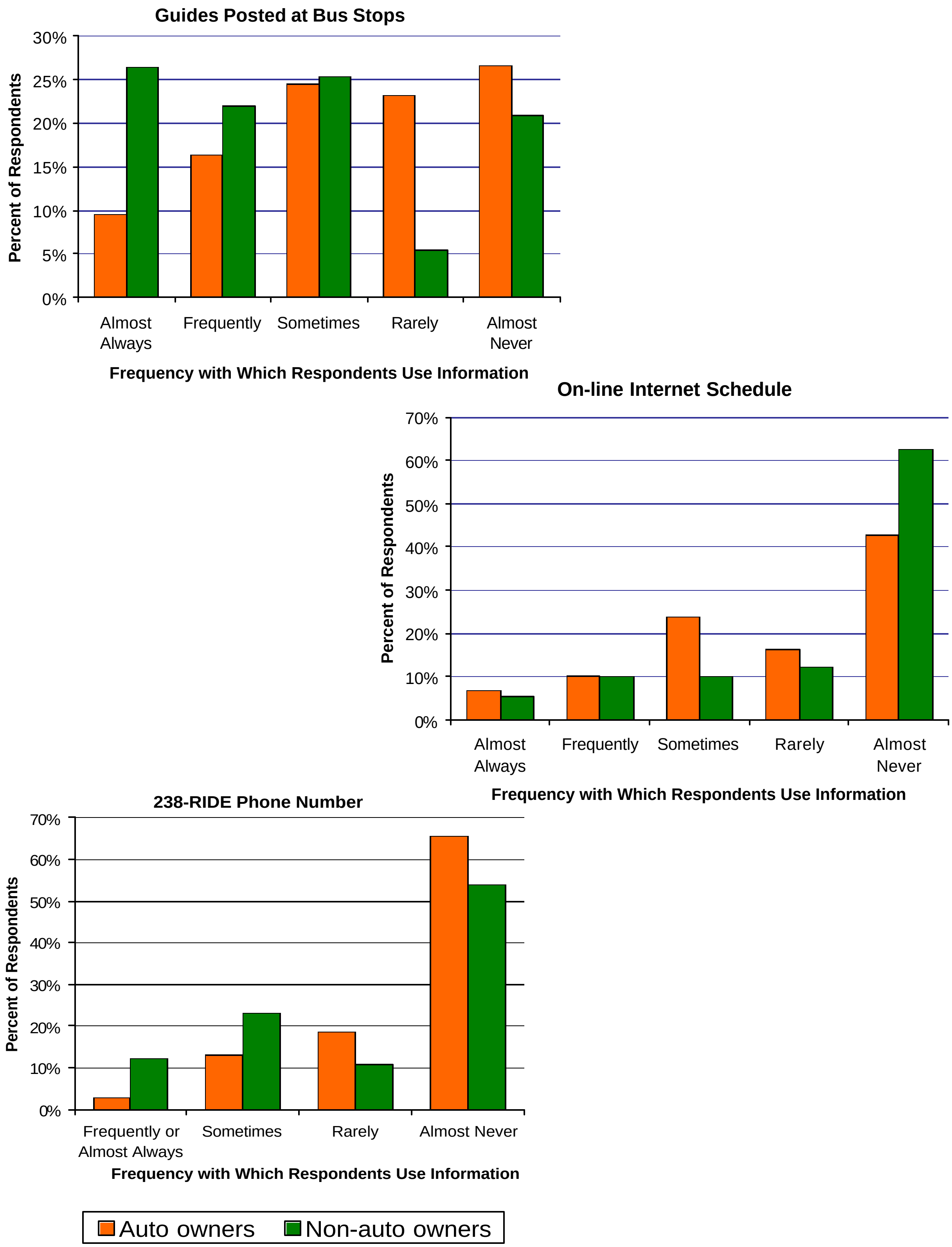


Figure 2-8. Comparison of Auto Ownership and Use of Schedule Information

When asked how long they usually wait for the bus at the stop, 26 percent of the respondents gave a range (e.g., 5 – 10 minutes), while the remaining 74 percent reported an integer value. The distribution of responses for those reporting an integer is shown in Figure 2-9.

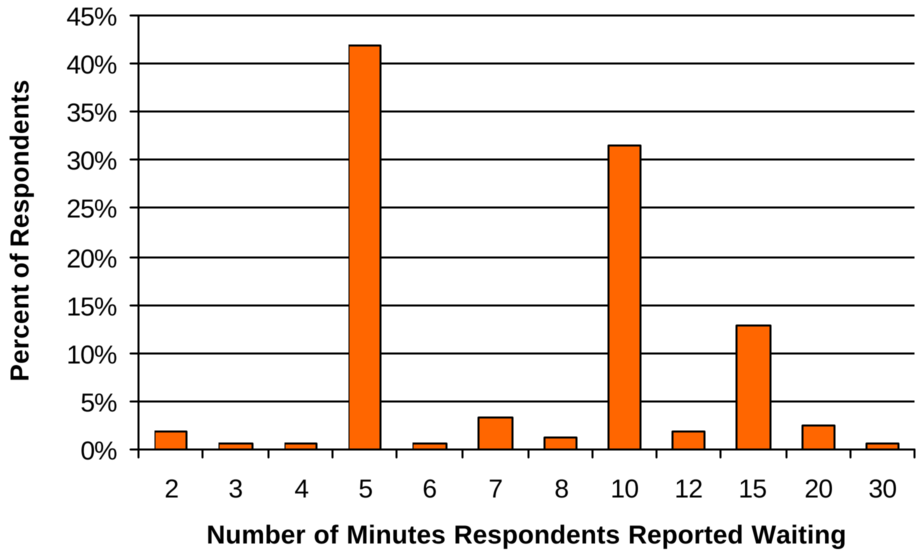


Figure 2-9. Distribution of Responses for Those Reporting an Integer for Wait Time

The most common response was *5 minutes* (42 percent of respondents), followed by *10 minutes* (32 percent of respondents), and *15 minutes* (13 percent of respondents). The average number of minutes of the respondents who gave an integer value for wait time was 8.6 minutes.

The distribution of responses for those reporting a range is shown in Figure 2-10. The most common response was *5 – 10 minutes* (46 percent) with the second most common response being *10 – 15 minutes* (17 percent). Taking an average of each range, the average wait time reported for those giving a range was 9.2 minutes (only 0.6 minutes higher than those reporting an integer value).

It will be interesting to see if the Transit Tracker information helps to improve the accuracy of riders' perceived wait times, especially for those who did not feel comfortable reporting a single value, but gave a range (and a somewhat large range in several cases). In other words, a decrease in the number of people who report a range for wait time before and after Transit Tracker installation could indicate a system impact on accuracy of perceived wait time. While this does not necessarily equate to an increase in perceived service quality, riders may feel that the variability of the wait time has decreased, providing them with a more reliable wait time and giving them more confidence in the system. In addition, Transit Tracker information may result in an overall decrease in perceived wait times (i.e., a shift in the distribution of reported wait times), whether there was an actual decrease in wait times or not. This would indicate that the presence of the Transit Tracker information has a positive impact on user perception of on-time performance.

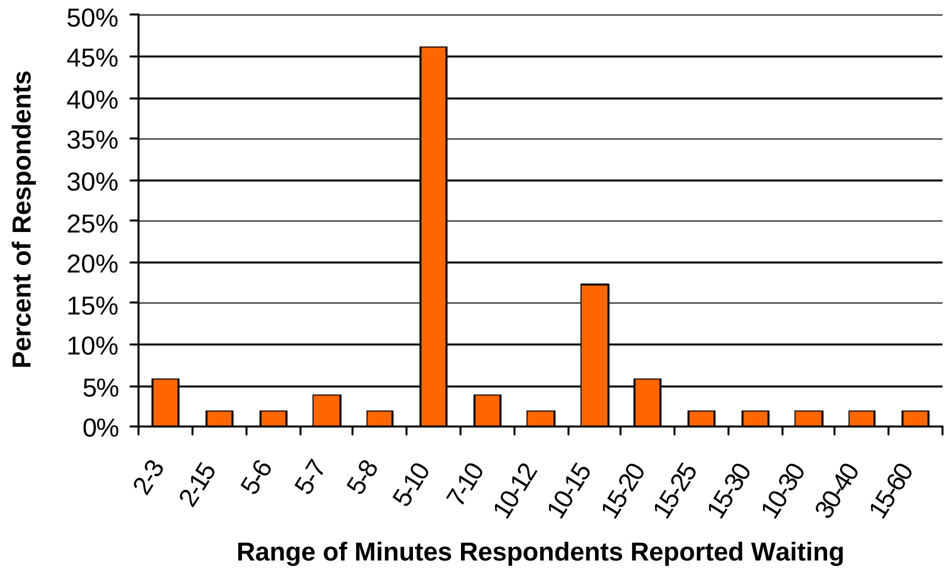


Figure 2-10. Distribution of Responses for Those Giving a Range for Wait Time

When asked how satisfied they were with the bus' adherence to the posted schedules, 91 percent of respondents indicated that they were either *satisfied* or *extremely satisfied* (Figure 2-11). In other words, respondents seem to be very satisfied with bus service in terms of on-time performance.

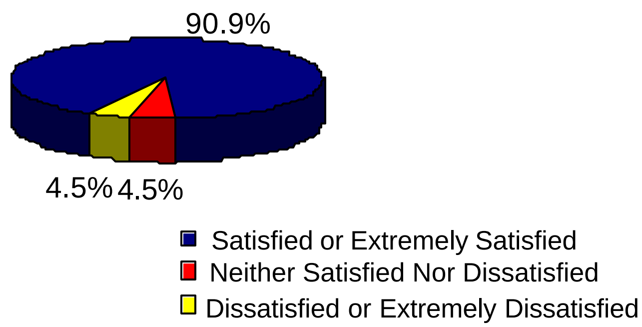


Figure 2-11. Riders' Level of Satisfaction with the Bus' Adherence to the Posted Schedules

2.2.2.4 Riders' perceptions of personal security

Respondents were asked to rate the degree to which they agree with the following two statements:

- I feel safe waiting for the bus at this bus stop **DURING THE DAY**.
- I feel safe waiting for the bus at this bus stop **AT NIGHT**.

The results are illustrated in Figure 2-12. An overwhelming 97 percent of respondents reported that they *agree* or *completely agree* that they feel safe waiting for the bus at the stops during the day. Only about 63 percent of the same riders reported that they *agree* or *completely agree* that they feel safe waiting for the bus at the stops at night, while 20 percent reported that they *disagree* or *completely disagree* that they feel safe at night. Therefore, while it may be difficult, if not impossible, for Transit Tracker to have much impact on the riders' perceptions of personal security during the day, there does exist some room for improvement at night. (It should be noted that the four locations surveyed were adjacent to busy streets and had nearby business establishments. Therefore, while riders may feel safe at these locations, there may be other locations where the same riders would not feel as safe.)

In addition to the survey, the evaluation team is also considering actual nighttime ridership numbers before and after Transit Tracker installation. As was discussed previously, if there is an increased sense of security related to the presence of Transit Tracker, riders may feel safer riding at night, when they normally may not be comfortable riding the bus. Average nighttime (9:00 p.m. to close of service) boardings from the Spring of 2001 were presented in Table 2-1 for the four bus stops where surveys were administered and are shown again in Table 2-8 below.

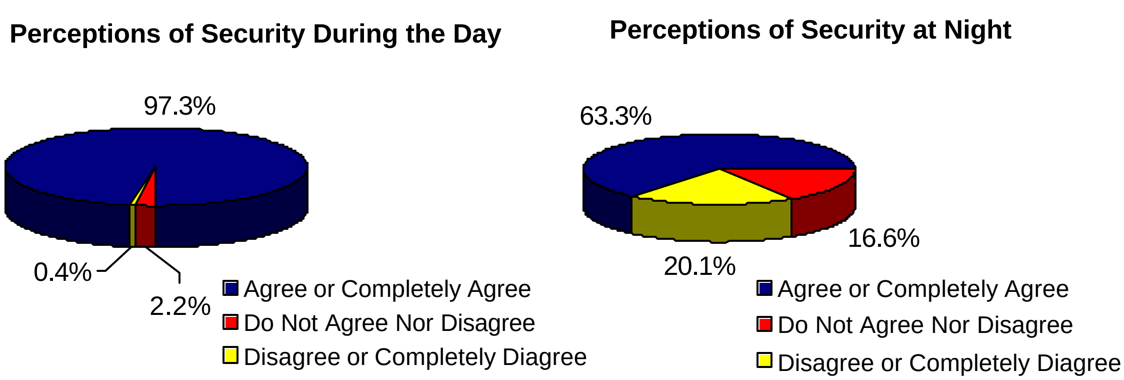


Figure 2-12. Riders' Perceptions of Security

Table 2-8. Nighttime Boardings for Spring 2001

Bus Stop	*Spring 2001 Boardings (9 p.m. – close of service)*
Barbur Transit Center	9
Weidler @ Lloyd Center	9
Burnside and 28th	16
Burnside and Grand	8

The nighttime ridership numbers are rather low, and they will be compared with nighttime ridership numbers after Transit Tracker has been installed at the same locations. An increase in ridership after Transit Tracker installation may be indicative of an increased sense of security at night; however, overall ridership numbers from the same analysis period will also be examined to determine if there is any corresponding upwards trend in overall ridership that may account for the increase at night.

2.2.2.5 Riders' overall satisfaction with the bus service

Finally, respondents were asked to rate how satisfied they are with the bus service at the stops. The results are shown in Figure 2-13. Again, an overwhelming 91 percent of respondents indicated that they are either *satisfied* or *extremely satisfied* with the bus service at the stops, while only 4.5 percent reported being *dissatisfied* or *extremely dissatisfied*.

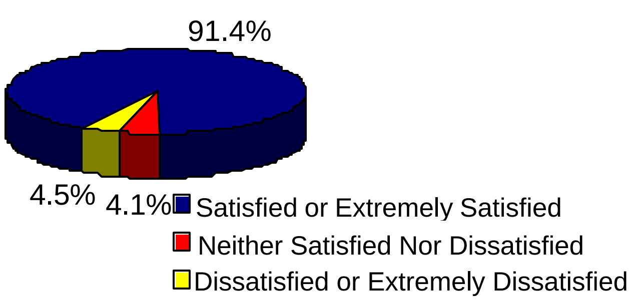


Figure 2-13. Riders' Perceptions of Service Quality

2.2.3 Comparison of Baseline Results from Tri-Met Survey and SAIC Survey

In general, the SAIC baseline Transit Tracker survey conducted in January 2002 and the Tri-Met baseline Transit Tracker survey conducted in the Spring of 2000 at different locations had very similar findings. This comparison is made to associate "historical" and "baseline" results for the purpose of validating the baseline data. These findings are briefly summarized below:

- Most respondents indicated that they were satisfied or very satisfied with the transit service (91 percent for SAIC survey and 76 percent for Tri-Met survey).
- More respondents reported using transit primarily for commuting to work than any other trip purpose.
- Riders reported waiting an average of about 8.6 minutes in the SAIC survey (9.2 minutes for those who gave a range). In the Tri-Met survey, riders reported waiting an average of 11.6, and 13.5 minutes at the two bus stops surveyed.
- Most respondents reported that the bus is usually on time (73 percent in the SAIC survey and 70 and 63 percent at the two bus stops surveyed by Tri-Met).
- Personal safety is generally not a concern for Tri-Met passengers at the locations surveyed in the two surveys—97 and 63 percent reported feeling safe during the day and at night, respectively in the SAIC survey, while 97 percent overall reported feeling safe or very safe in the Tri-Met survey.

3 I-5/BARBUR BOULEVARD PARALLEL CORRIDOR TRAFFIC MANAGEMENT DEMONSTRATION PROJECT

The purpose of the I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project evaluation is to collect and analyze data related to a change in system efficiency, traveler mobility, safety, and customer satisfaction as a result of the project. Several measures of effectiveness were selected to test the impact of the project on efficiency, mobility, safety, and customer satisfaction:

- Mainline and arterial capacity/throughput,
- Mainline and arterial speeds/travel times,
- Number of crashes in freeway corridor,
- Number of secondary crashes in freeway corridor,
- Mainline and arterial speed variability, and
- Traveler perceptions of system efficiency.

In order to test the impacts of the corridor traffic management project on system efficiency, traveler mobility, safety, and customer satisfaction, an understanding of baseline operations, safety, and perceptions is required. This baseline information will be analyzed to provide a basis for comparison with any data collected during the post-deployment period.

3.1 Mobility/Safety Study

The mobility/safety study on I-5 and Barbur Boulevard aims to discover impacts of the corridor-arterial integration on traveler mobility, using the following measures of effectiveness:

- Speed/travel time in the primary direction during incident conditions;
- Speed/travel time reliability in the primary direction during incident conditions;
- Vehicle throughput in the primary direction during incident conditions;
- Incident detection, response, and clearance times; and
- Freeway crash rates.

3.1.1 Data Collection Approach

The data collection methods employed in this study were driven by the need to analyze traffic conditions during both incident and non-incident conditions. Since incidents occur at random, no manual data collection methods normally associated with mobility studies were used. Instead, automated traffic data collection methods through the use of in-pavement loop detectors and hose counters were utilized. Incident statistics were gathered from the ODOT incident database. The baseline data collection period occurred between January 7 and February 1, 2002. Because some comparisons between the baseline and historic traffic performance are also needed for evaluation, some archived historic freeway metrics were gathered from January, September, and October of the years 2000 and 2001; historic arterial data were provided by Tri-Met and the City of Portland.

The following provides additional detail on the format, assumptions, and collection methods used in gathering data to test the hypotheses outlined in the evaluation plan.

3.1.1.1 Freeway mainline traffic volume and speed

Data from the ODOT freeway loop detector stations were collected along I-5 within the boundaries of the study area (please refer to Figure 3-1 for a map of the study area). Travel times were derived based on the collected speed and occupancy data. The following information pertains to freeway mainline data:

1. Data structure:
   - Twenty-second mainline traffic volume and speed data per freeway lane,
   - Fifteen-minute on-ramp volume data,
   - Data aggregated to 15-minute periods, and
   - Data collected from detector stations on I-5 northbound during the A.M. peak period along a six-mile segment from south of Pacific Highway (near Lesser Road) to I-405.

2. Assumptions:
   - ODOT mainline and on-ramp detectors were functional, and
   - ODOT had the majority of the mainline detectors in the study corridor calibrated and operational by the start of the data collection period and maintained their operation throughout the evaluation period.

3. Evaluation periods:
   - Data collection from Monday, January 7, 2002 through Friday, February 1, 2002; and
   - Historic volume and speed data from January, September, and October in 2000 and 2001.

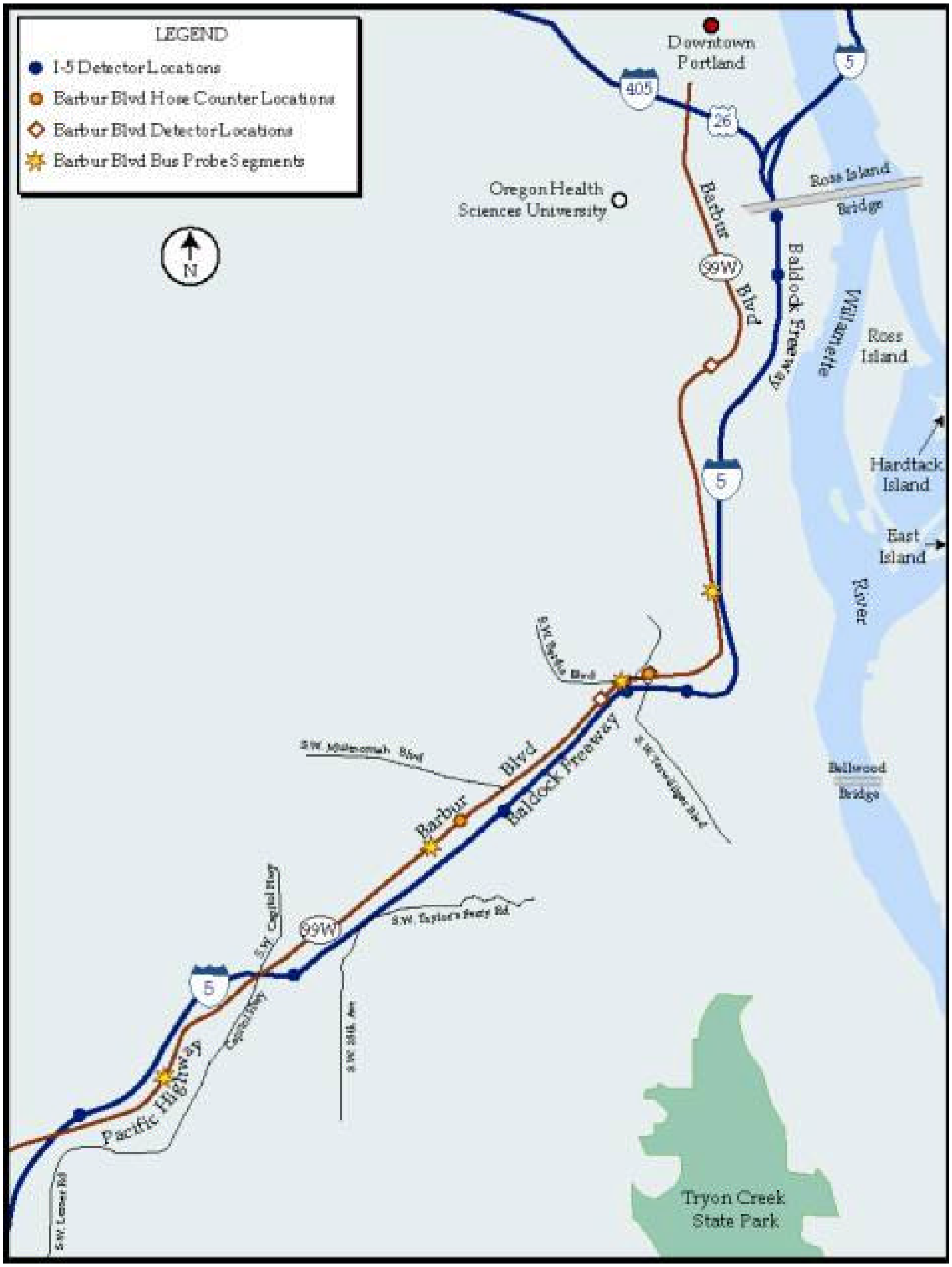


Figure 3-1. I-5 Northbound/Barbur Boulevard Study Area

3.1.1.2 Freeway mainline incident logs

ODOT Incident logs were used to assess incident information along the study corridor within the boundaries of the study area. Details on the incident data requirements are provided below:

1. Data structure:
   - Incident data containing date, time, location, lane blockages and duration; and
   - Data collected from detector stations on I-5 northbound during the morning peak period along a six-mile segment from south of Pacific Highway (near Lesser Road) to I-405 (show in Figure 3-1).

2. Evaluation periods:
   - Data collection from Monday, January 7, 2002 through Friday, February 1, 2002; and
   - Historic incident data from January, September, and October in 2000 and 2001.

3.1.1.3 Arterial traffic volume

The evaluation team and the City of Portland deployed temporary hose counters to measure baseline volume, speed, and speed reliability at two locations along Barbur Boulevard, also shown in Figure 3-1. The following information pertains to the arterial volume data:

1. Data structure:
   - Fifteen-minute volume data during 5:00 – 10:00 a.m. peak period,
   - Northbound direction only,
   - Data aggregated to directional totals (sum of all lanes),
   - Five days of data per week (Monday through Friday), and
   - Data were collected at two locations on Barbur Boulevard:
     ? Near 26th Avenue and
     ? Near Terwilliger Boulevard.

2. Assumptions:
   - The hose counters were distanced from driveways, turning bays, and intersections to avoid picking up queues or slow vehicles;
   - City of Portland ran daily visual checks during the study period, to ensure that the hoses stayed intact;
   - City of Portland ran weekly data checks on the hose counters to ensure proper data flows; and

3. Evaluation period:
   - Data collection from Monday, January 7, 2002 through Friday, February 1, 2002.

- Historic volume data from available intersection counts obtained in June 16, August 16, and October 16, 2000.

3.1.1.4 Arterial speed

Arterial speeds were obtained from two different sources. The hose counters deployed along Barbur Boulevard were used to obtain baseline speed and speed reliability, and historic data were obtained from Tri-Met Bus Dispatch System (BDS) data. The following information pertains to the arterial data:

1. Hose counter (baseline) data structure:
   - Fifteen-minute speed data during 5:00 – 10:00 a.m. peak period,
   - Northbound direction only,
   - Data aggregated to directional averages (average of all lanes),
   - Five days of data per week (Monday through Friday), and
   - Data were collected at two locations on Barbur Boulevard (shown in Figure 3-1):
     ? Near 26th Avenue and
     ? Near Terwilliger Boulevard.

2. Bus probe (historic) data structure:
   - Northbound direction only;
   - Five days of data per week (Monday through Friday); and
   - Bus probe data were collected at four segments on Barbur Boulevard (shown in Figure 3-1):
     ? Between Brier and Nebraska,
     ? Between 30th and 26th,
     ? Between Bertha and Terwilliger, and
     ? Between 53rd and Luradel.

2. Assumptions:
   - The hose counters were distanced from driveways, turning bays, and intersections to avoid picking up queues or slow vehicles;
   - City of Portland ran daily visual checks during the study period, to ensure that the hoses stayed intact;
   - City of Portland ran weekly data checks on the hose counters to ensure proper data flows; and
   - Barbur Boulevard speed is roughly equal to the maximum bus speed along the evaluated segments.

3. Evaluation period:
   - Baseline data collection from Monday, January 7, 2002 through Friday, February 1, 2002; and
   - Historic bus probe data from January and August of years 2000 and 2001.

3.1.2 Findings

3.1.2.1 Traffic performance

First, a comparison between the historic and baseline freeway traffic volume and speed on I-5 was performed (Table 3-1). This was done to ensure that traffic performance during the baseline study period was consistent with performance from the recent past. Figure 3-2 and Figure 3-3 show volumes and speeds averaged over the peak period for both the historic and baseline traffic.

Table 3-1. Summary of Northbound AM Freeway and Arterial Traffic Performance

Metric	*Historic*	*Baseline*	*Difference*
I-5			
Average peak period flow (vph)	3,914	3,869	-1.1%
Average peak 30-min volume	1,513	2,162	42.9%
Average peak period speed (mph)	48	47	-1.9%
Average peak 30-min speed (mph)	45	43	-3.7%
Standard deviation of speed (mph)	9.4	9.2	-1.8%
Average travel time (min)	7.7	7.8	+1.9%
Standard deviation of travel time (min)	2.3	2.5	+6.2%
Barbur Boulevard			
Average hourly volume	797	825	+3.0%
Average speed (mph)	35.5	42.1	+18.4%
Standard deviation of speed (mph)	5.9	8.5	+44.7%

On average over the peak period, traffic on northbound I-5 during the morning peak period has remained the same for the last two years. The analysis shows that I-5 northbound carries about 3,900 vehicles per hour during the morning peak period (or about 1,300 vph per lane), at average peak hour speeds of 45-55 mph, depending on the segment. The freeway speed reliability is also shown in Figure 3-3, with the dotted lines above and below the solid line indicating speeds at one standard deviation above and below the average, respectively. Similarly, the freeway travel time and reliability are shown in Figure 3-4. Average speed and travel time reliabilities have also been consistent the last two years, averaging about +/-9 mph and +/-2.5 minutes, respectively.

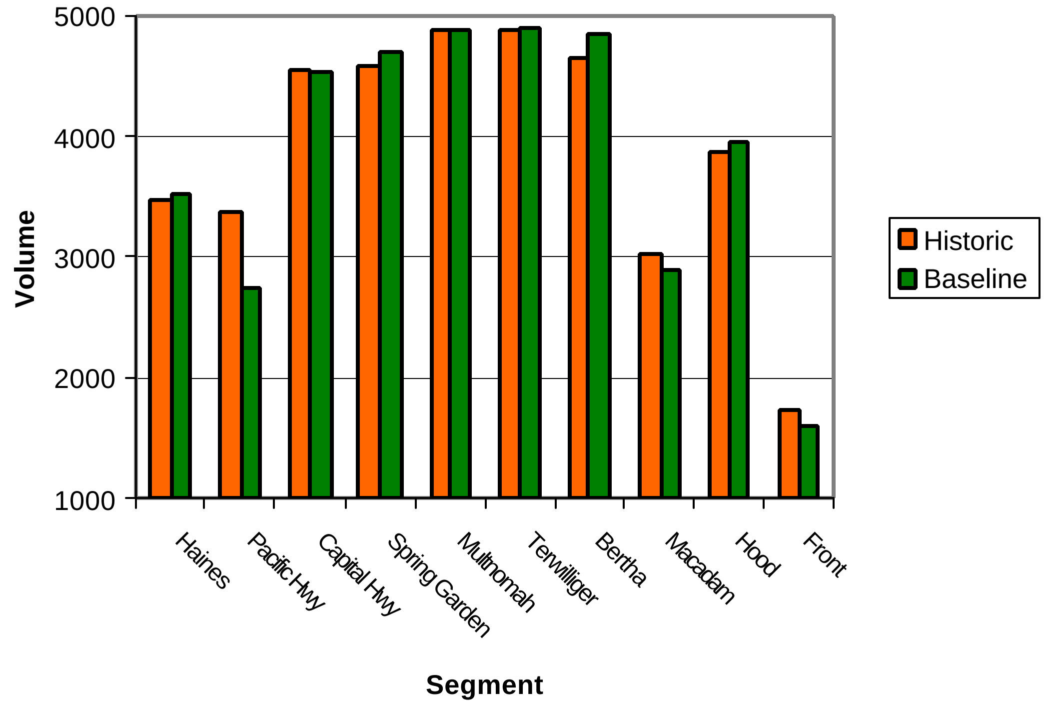


Figure 3-2. I-5 Northbound AM Peak Period Average Hourly Volumes

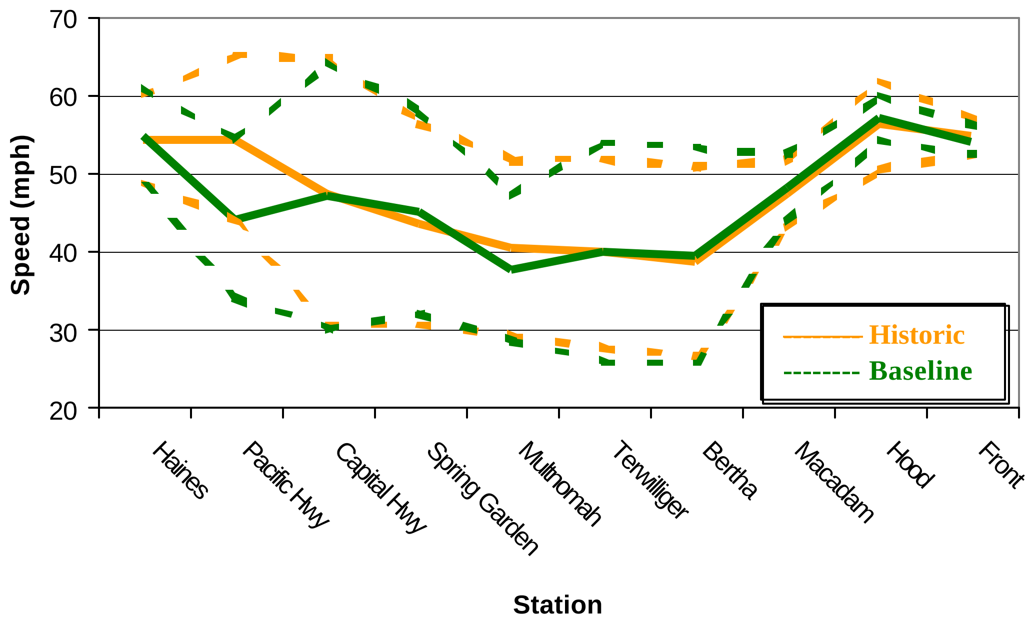


Figure 3-3. I-5 Northbound AM Peak Period Average Speed

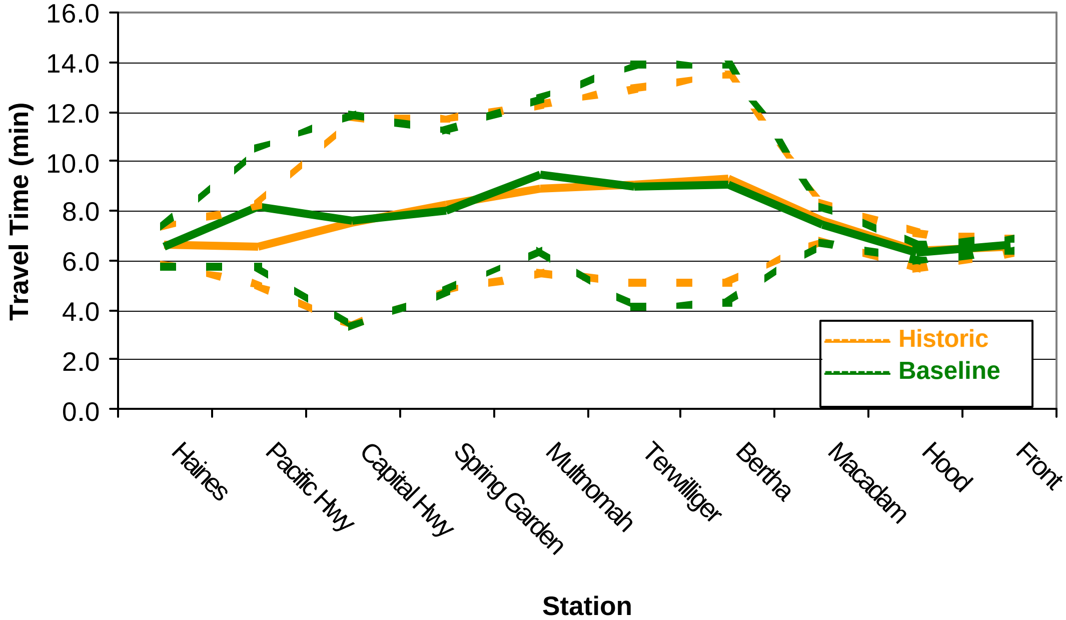


Figure 3-4. I-5 Northbound AM Peak Period Average Travel Time

However, a closer inspection of the volume and speed data during the morning peak 30-minute period revealed a big difference between historic and baseline traffic. Between 7:30 and 8:00 a.m., which is one of the corridor's busiest 30-minute periods, northbound I-5 experienced a volume increase of 42.9 percent since 2000/2001, as shown in Figure 3-5 (note that the baseline data were only obtained from January 2002, while the historic data were averaged over several months from years past). This finding was also confirmed with a more noticeable drop in speeds found during the same 30-minute period between historic and baseline evaluation periods (Figure 3-6). Thus, traffic volumes along northbound I-5 within the study area have increased over the past few years causing decreased speeds and increased congestion within the corridor. (This increase in traffic volume will be further discussed in the findings of the customer satisfaction survey in Section 3.2.2.1.)

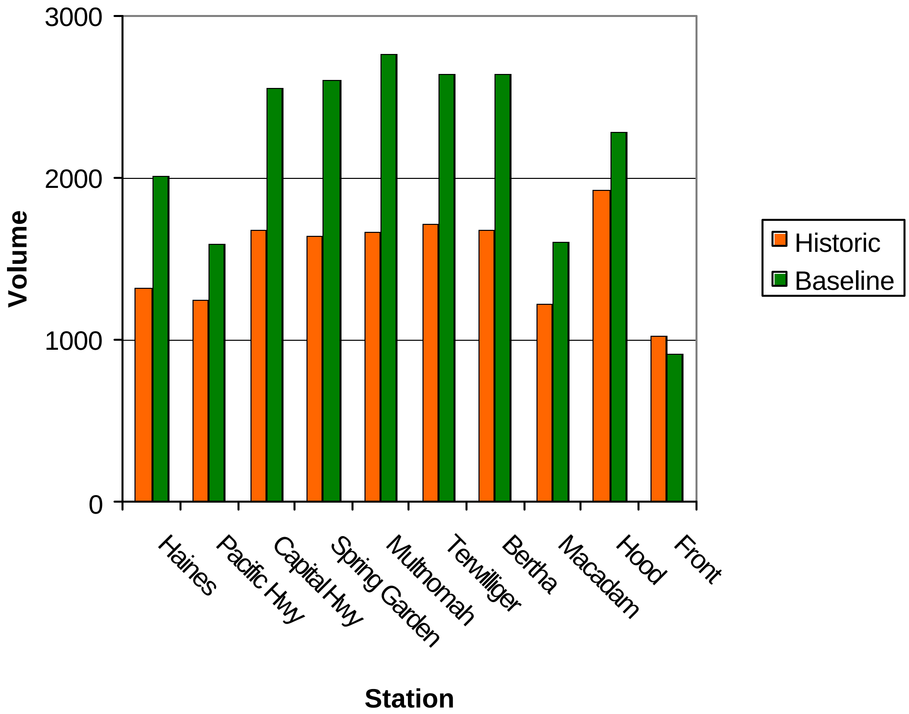


Figure 3-5. I-5 Northbound AM Peak 30-min (7:30-8:00 AM) Volumes

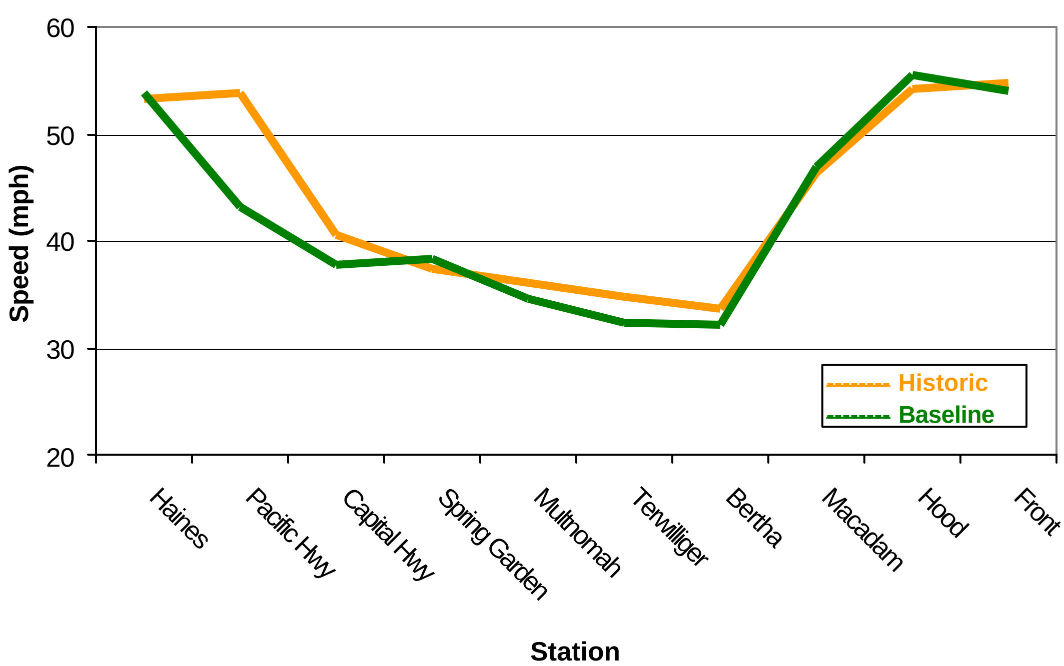


Figure 3-6. I-5 Northbound AM Peak 30-min (7:30-8:00 AM) Speed

On Barbur Boulevard, a similar peak period volume and speed analysis was performed. Please note that the Barbur Boulveard data were mostly sporadic; they were taken from different time periods and locations, and might not be suitable for direct comparisons. Nevertheless, Figure 3-7 shows the comparison between historic and baseline Barbur Boulevard volumes. The historic Barbur Boulevard volume data were taken from two locations on three non-consecutive days in 2000, while the baseline data were obtained from two other points in January 2002. From the available data, northbound traffic volumes have remained fairly consistent since 2000, with slight increases between 7:00 and 9:00 a.m.

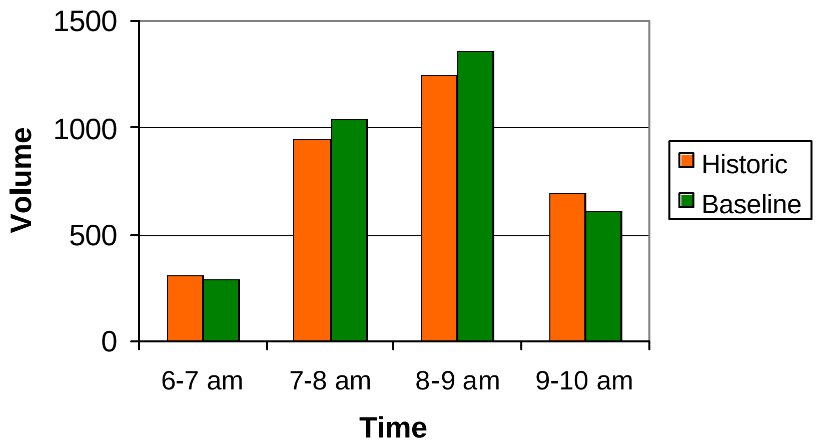


Figure 3-7. Barbur Boulevard Northbound AM Peak Hourly Volume

As discussed previously, Tri-Met Bus Dispatch System (BDS) data were used to analyze the historic speed and speed reliability on Barbur Boulevard, while baseline speed data were obtained from the hose counters. The Barbur Boulevard historic free-flow speed is assumed to roughly equal the maximum bus speed at long stretches between bus stops. Figure 3-8 shows the historic speeds at four segments on Barbur Boulevard, which ranged between 27 and 47 mph. The upper and lower tick marks indicate speeds at one standard deviation above and below the average, respectively. Figure 3-9 shows the baseline period speed and speed reliability obtained by the hose counters. Again, the differences in locations and methods of data collection may not permit a direct comparison between historic and baseline evaluation periods. The historic and baseline average speeds on Barbur Boulevard were found to be 35.5 mph and 42.1 mph, respectively (18.4 percent increase). On the other hand, speed reliability has *worsened* from +/-5.9 mph to +/-8.5 mph (a 44.7 percent decrease).

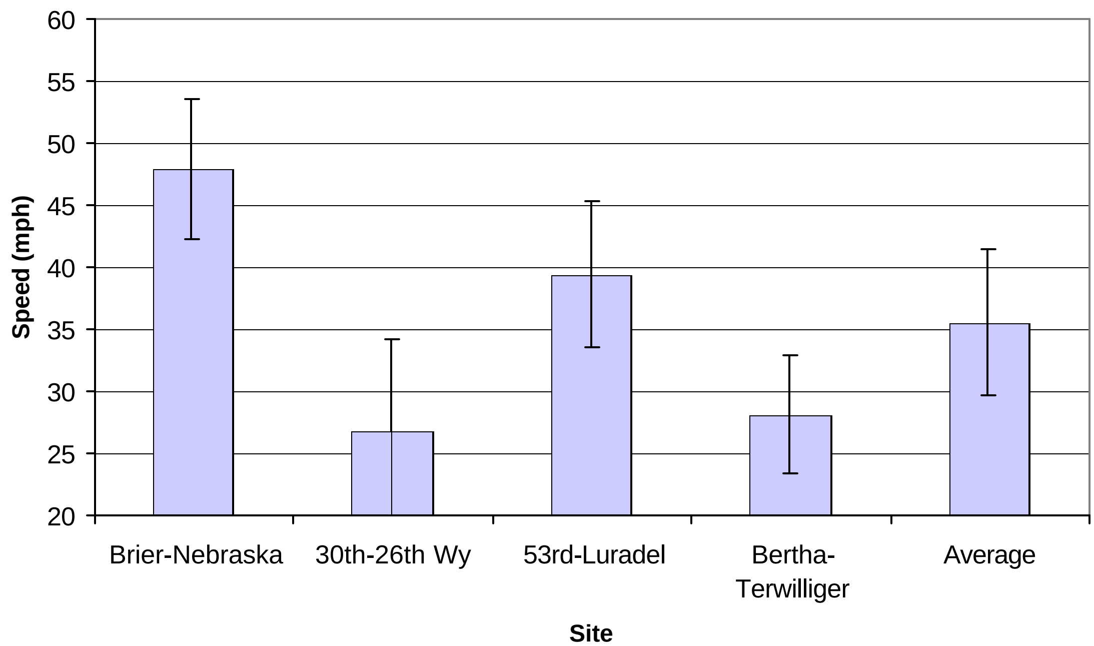


Figure 3-8. Barbur Boulevard Northbound AM Peak Average Speed (Historic Speed from Tri-Met Bus Probes)

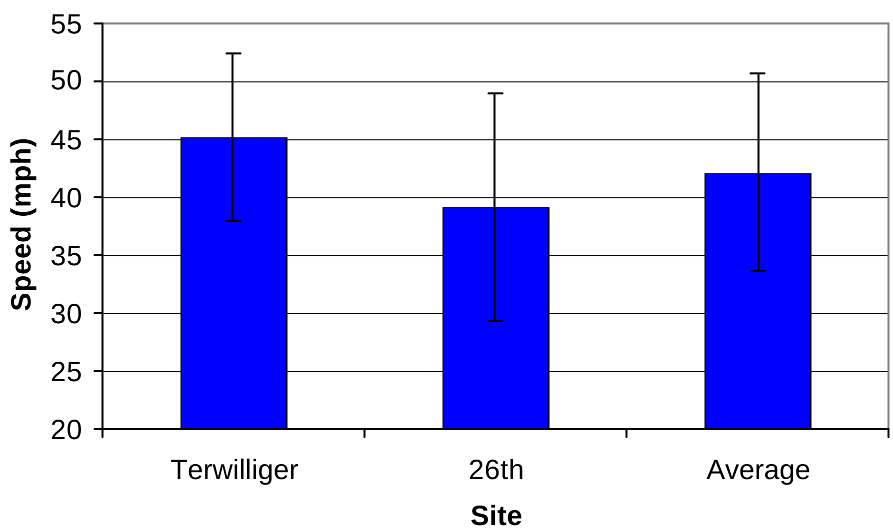


Figure 3-9. Barbur Boulevard Northbound AM Peak Average Speed (Baseline Speed from Hose Counters)

Further analysis on the baseline data was conducted to estimate the day-to-day or time-of-day variation in speed. Weather conditions were assumed to be a non-significant factor in this analysis, since no inclement weather according to local standards (i.e., heavy snow, hailstorms, etc.) was observed during the evaluation period.

Figure 3-10 shows that there are no significant speed variations for the different days of the work week on I-5 and Barbur Boulevard. Figure 3-11 shows that as expected, speeds decreased between 7:00 and 9:00 a.m. on the freeway corridor, suggesting that the peak hour occurs near or within this time interval (note that these figures were averaged over all detector stations within the study area, and the variations at each location might be different). It can be seen in both figures that Barbur Boulevard, although having a lower average speed than I-5, had excellent speed reliability compared to I-5, both throughout the peak period and on average throughout the week. Figure 3-10 shows that, while I-5 showed slightly lower average speeds on Wednesday and Friday, average speeds on Barbur Boulevard remained consistent. Referring to Figure 3-11, it can be seen that, near the edges of the peak period, I-5 flowed at over 50 mph, but speeds averaged only 42 to 44 mph during the middle of the peak period. On the other hand, the traffic on Barbur Boulevard was able to maintain an average speed of 41 of 43 mph throughout the morning.

When incidents occur, it is expected that I-5 speeds would become even more unreliable, prompting commuters to switch to an alternate route. With this route diversion, it is possible that Barbur Boulevard may experience increases in traffic volume, which result in a reduction in speed and possibly decreased speed reliability (higher standard deviation). Interactions between I-5 and Barbur Boulevard during incident conditions will be discussed further in Section 3.1.2.3.

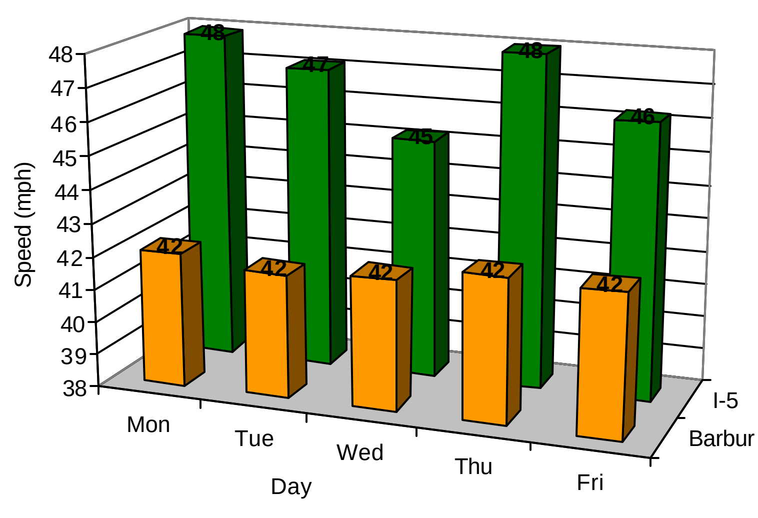


Figure 3-10. I-5 and Barbur Boulevard Northbound AM Speed by Day of Week

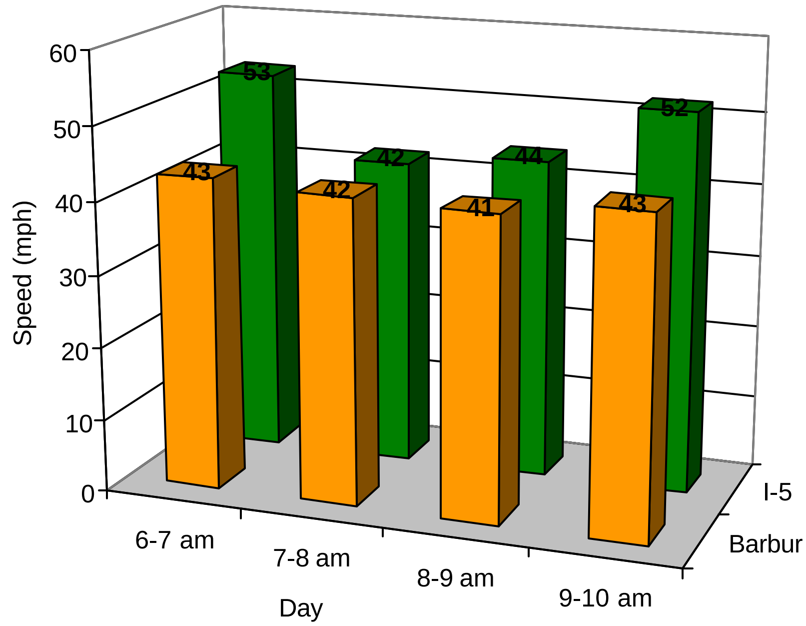


Figure 3-11. I-5 and Barbur Boulevard Northbound AM Speed by Hour of Day

3.1.2.2 Freeway Crash Analysis

The results of the freeway crash analysis show that the average number of crashes per month for the past two years has been declining, as illustrated in Figure 3-12. (Please note that the historic monthly incident rates were obtained only from selected months from each year.) Injury crash rates have remained roughly the same for the last two years at a rate of about two to three injury crashes per month. Crashes that only resulted in property damages, however, have steadily decreased, from 58 crashes per month in 2000 to only 48 crashes in January 2002. The evaluation team found no obvious reasons for this consistent decline in property damage only crash rates, but it is perhaps worth noting that the 2002 statistics only included the month of January. For a more representative 2002 crash rates, a few more months of data would be necessary.

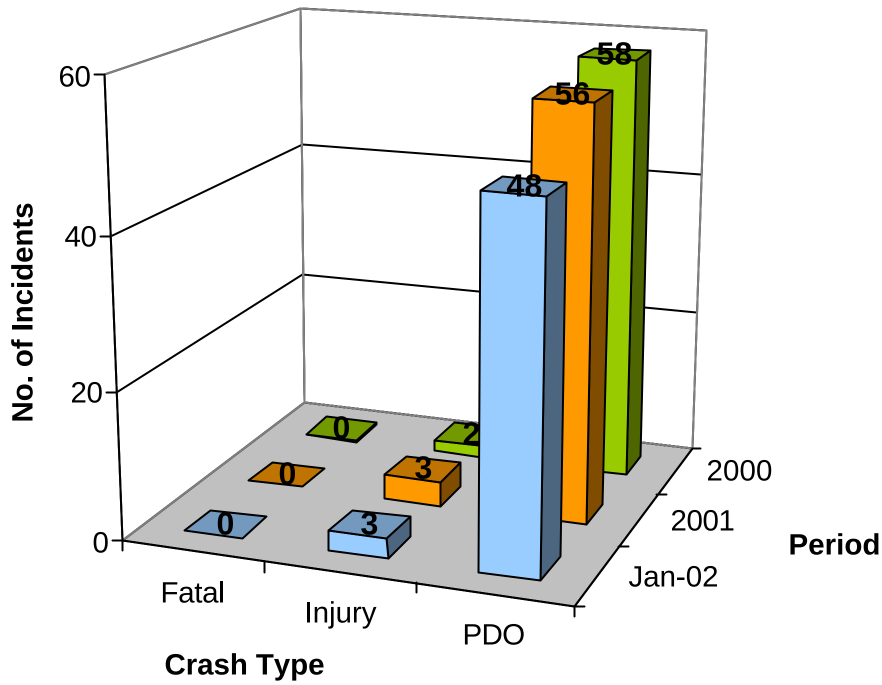


Figure 3-12. I-5 Northbound AM Peak Monthly Crash Rate

3.1.2.3 Traffic Performance During Incident Conditions

The analysis to this point has been focused on establishing the baseline conditions for all days. This section involves the estimation of baseline speed and travel time performance during incident conditions on I-5. The incident baseline was then compared with the average baseline to evaluate if there was a significant difference.

Incident reports coinciding with the evaluation time periods were collected. This analysis revealed that there were seven incidents occurring in the northbound direction of I-5 during the morning peak, with no secondary incidents. The duration of the incidents ranged from 46 minutes to 2 hours, but averaged just over an hour. Incidents with very low impacts were not obtained for analysis, because they would be unlikely to show any differences in traffic performance or trigger traffic diversion onto Barbur Boulevard. Table 3-2 lists the incidents analyzed in this task.

Table 3-2. Summary of Freeway Incidents During Evaluation Period

No.	Date	Confirm Time	Nearest Cross Street	Comments	Lanes Blocked	Duration
1	Jan 7	7:16 a.m.	Capitol Hwy	Crash in right lane, later moved to shoulder	1	0:46
2	Jan 7	8:04 a.m.	South of Spring Garden	Stalled semi in right lane, later moved to shoulder	1	2:00
3	Jan 10	6:37 a.m.	99W	Stalled vehicle in right lane, later moved to shoulder	1	1:56
4	Jan 16	8:33 a.m.	South of Capitol Hwy	Unknown	4*	0:59
5	Jan 18	8:09 a.m.	Breeze Hill	Stalled dump truck in right shoulder	0	0:59
6	Jan 25	6:43 a.m.	North of Terwilliger Blvd	Stalled van in right lane	1	Unknown
7	Jan 30	6:06 a.m.	Near Terwilliger On-Ramp	Stalled vehicle in right shoulder	0	1:00

*Possibly a data entry error.

Because ODOT cannot reliably determine the exact time when an incident occurred, all incidents were logged into the database based on when they were confirmed by traffic management center staff. Assuming that all incidents were detected within 30 minutes, the evaluation team gathered speed data (study corridor average) from 30 minutes prior to the confirmation time until about 90 minutes afterwards.

Using the speed at 30 minutes prior to the confirmation time as a baseline, Figure 3-13 shows the changes in speeds on I-5 northbound before, during, and after incidents. The solid red line represents the average speed change from all observed incidents during the evaluation period, while the numbered dashed lines represent the speed changes for each incident listed in Table 3-2.

On average, vehicle speed declined by four to six miles per hour after an incident. Examining individual incident characteristics, it seemed that incidents that occurred early in the peak period suffered the greatest, because their recoveries were slowed by increasing peak period traffic, as exhibited by incidents numbers 1, 3, 6, and 7. On the other hand, incidents that occurred later in the peak, such as incident 5, experienced less impact, as peak period traffic was most likely beginning to clear. Similar conditions should have been exhibited by incident 2, except that this incident involved a semi-truck trailer and took two hours to clear. Hence, while the speed impact is slightly less dramatic than the early-occurring incidents, this incident caused more fluctuations in speed and behaved almost like an early-occurring incident. Lastly, not much is known about incident 4, except that it occurred late in the peak and blocked four lanes. However, the speed patterns did not indicate that the incident was of this magnitude, indicating that this may have been a data entry error.

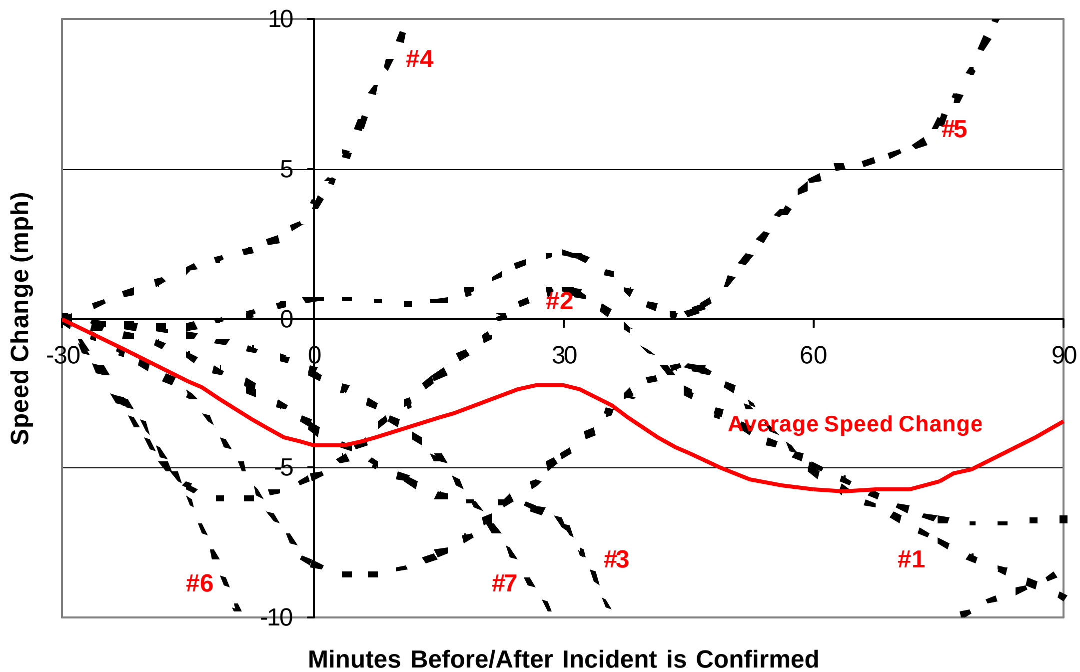


Figure 3-13. I-5 Northbound AM Peak Changes in Speed due to Incidents

Deriving the travel times from the speed data, Figure 3-14 illustrates the travel times before, during, and after incident conditions. On average, speeds decline by four to six miles per hour after an incident, which translates to about one minute of travel time increase. At 30 minutes prior to the incidents' confirmation, the average travel time on I-5 northbound was 8.4 minutes, which increased to over nine minutes after the incident occurred.

Table 3-3 summarizes northbound morning traffic performance during incidents. Comparing standard deviations of speed with and without the incidents, speed and travel time on I-5 northbound became *less reliable (increased standard deviation)* during incident conditions, with speed standard deviation increasing by 23 percent and travel time standard deviation increasing by 35 percent.

Comparing the speeds on I-5 and Barbur Boulevard, there is evidence that incidents caused traffic to deviate away from the freeway mainlines to the arterial. Table 3-3 shows that hourly Barbur traffic volumes increased by an average of 18 percent during incident conditions, while Barbur Boulevard speeds decreased by about eight percent. Also, speeds on Barbur Boulevard were 28 percent *less reliable* during incident conditions.

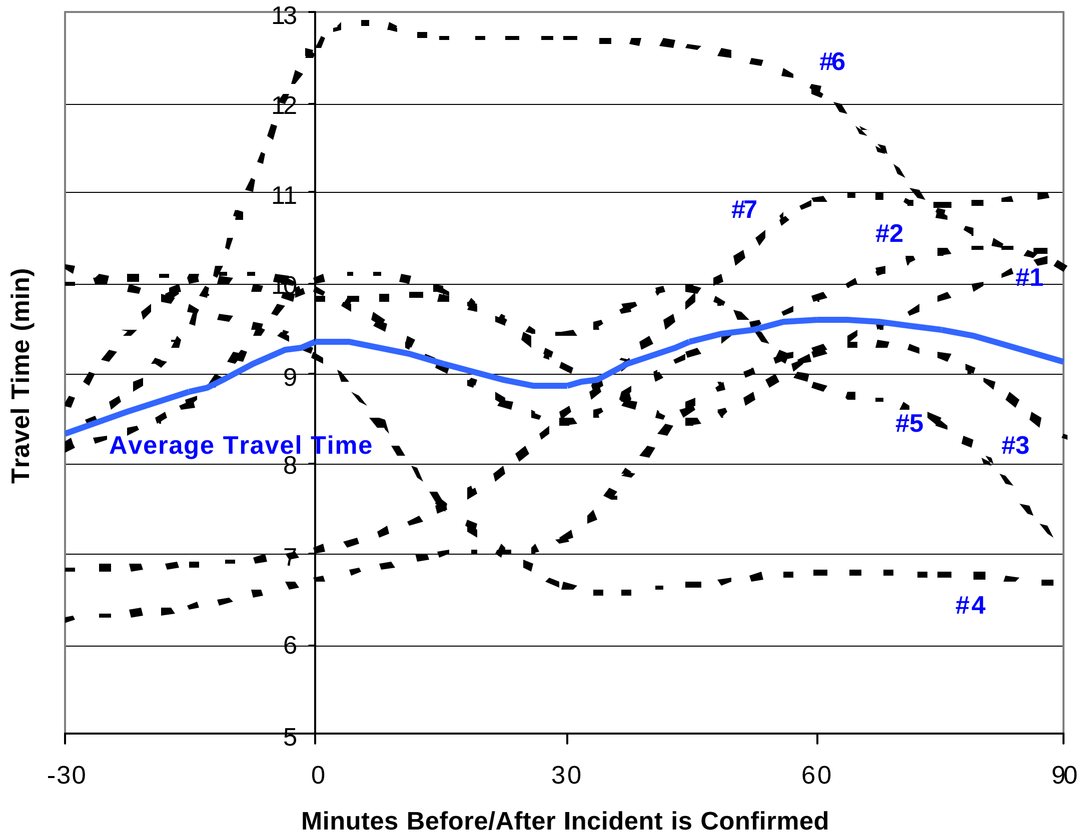


Figure 3-14. I-5 Northbound AM Peak Travel Time During Incident Conditions

Table 3-3. Summary of Northbound AM Baseline Traffic Performance During Incident Conditions

Metric	Non-Incident	Incident	Difference
I-5			
Average hourly volume	3,869	3,752	-3%
Average speed (mph)	47	41	-12%
Standard deviation of speed (mph)	9.2	11.4	+23%
Average travel time (min)	7.8	8.8	+14%
Standard deviation of travel time (min)	2.5	3.4	+35%
Barbur Boulevard			
Average hourly volume	825	972	+18%
Average speed (mph)	42	39	-8%
Standard deviation of speed (mph)	8.5	11.0	+28%

3.2 Customer Satisfaction Study

It is hypothesized that the I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project will increase corridor efficiency and travel time reliability during incident conditions, thereby resulting in an improvement in customer satisfaction. The objective of the customer satisfaction study is to determine: (1) driver demographics and commute patterns, (2) driver behaviors during incidents/delays, (3) driver perceptions of traffic operations in the corridor, and (4) driver use of traffic information to make commute decisions.

3.2.1 Data Collection Approach

The data collection approach for the I-5/Barbur Boulevard customer satisfaction study is a web-based survey instrument. The survey was designed in three parts: a qualifying questionnaire, an initial questionnaire, and follow-up incident questionnaires. Each is described in more detail below.

3.2.1.1 Part I—Qualifying questions

The qualifying portion of the survey was designed to identify drivers who commute northbound, through the study area, in the morning, on a regular basis (at least three days a week). While parallel corridor traffic management will work in both the north- and southbound directions of I-5 and Barbur Boulevard, the project partners feel it will be more efficient in the northbound direction, as there are more options for getting on and off the freeway and onto the arterial in the northbound direction. In addition, traffic congestion on northbound I-5 is heaviest in the morning (drivers commuting to work into downtown Portland). Therefore, the target audience for the customer satisfaction survey is drivers who commute on northbound I-5 and/or Barbur Boulevard in the morning.

Table 3-4 illustrates the two qualifying questions for survey participation. If respondents answered "no" to either one or both of these two questions, they were given the following message:

> *Your commute patterns do not match those required for participation in this study. Thank you for volunteering and taking time to complete this questionnaire.*

If respondents answered "yes" to both questions, they were automatically given access to Part II of the survey, the initial questionnaire.

Table 3-4. Customer Satisfaction Survey—Qualifying Questions

I-5/Barbur Boulevard Customer Satisfaction Survey—Qualifying Questions
1. Do you commute into Portland in a private vehicle (including carpools, vanpools, and motorcycles) **AT LEAST** 3 days in the typical work week (Monday – Friday)? ? Yes ? No
2. Do you typically travel **NORTHBOUND** on I-5 and/or Barbur Blvd. in the **MORNING**? ? Yes ? No

3.2.1.2 Part II—Initial questionnaire

In order to test the impacts of the corridor traffic management project on customer satisfaction, an understanding of baseline perceptions is required. Thus, the initial questionnaire was designed to obtain baseline information on a variety of issues including: commuter demographics, commute time and distance, access to and use of traveler information, commute patterns, frequency of incident-related delays, and perceptions of traffic conditions on I-5 and Barbur Boulevard. An illustration of the website information, as well as Part I and Part II of the panel survey, can be found in Appendix C. This baseline information will be analyzed to provide a basis for comparison with any data collected during incidents in the post-deployment period.

The web-based survey instrument was designed to automatically skip questions that were not relevant to individuals based on responses to previous questions. The survey was also designed to prevent respondents from advancing without answering a question, thus eliminating non-responses. At the end of the initial questionnaire, respondents were allowed to submit any additional comments that they had.

3.2.1.3 Part III—Follow-up incident questionnaires

Follow-up incident questionnaires will be designed and distributed to panel survey members via email when an incident occurs in the corridor or that affects traffic flow in the corridor. These questionnaires will be designed to determine the following:

- How did drivers become aware of the incident or incident-related delay?
- Was the information they received regarding the incident/delay timely, accurate, and useful?
- How long was the delay?
- What actions did they take, if any, to avoid the incident/delay?
- Did the actions result in an improvement in travel time over staying in the congestion?
- What were drivers' perceptions of the traffic conditions during the incident/delay?

If possible, follow-up incident questionnaires will be administered after the initial questionnaire, but prior to system deployment. This will allow for stated response information for a particular incident rather than simply the more general information obtained in the initial questionnaire. After deployment of the I-5/Barbur Boulevard Traffic Management System, similar follow-up questionnaires will be administered to determine if the system has impacts on users' commute patterns and/or perceptions of traffic conditions during the incident. Additional questions may be included to obtain the following:

- Did drivers see the VMS warning of the up-coming incident?
- Did drivers divert to Barbur Boulevard to avoid the I-5 delays?
- What were drivers' perceptions of traffic conditions during the incident/delay on both I-5 and Barbur Boulevard?
- Was the diversion efficient and did it save time?

3.2.1.4 Subject recruitment

Subjects were recruited through their employer. The *2002 Largest Employers of the Portland/Vancouver Metropolitan Area* guide was obtained from the Portland Chamber of Commerce.[7] Employers were chosen by the zipcodes that were most easily reached from south of downtown Portland using northbound I-5. Employers were contacted via phone and explained the purpose and objective of the study, for whom the study was being conducted, and the importance of participation. Generally, employers would ask to see a copy of the questionnaire before making a decision to participate. In all, 10 private companies, universities, and public agencies agreed to participate.

Companies that elected not to participate in the study gave several reasons for doing so. Some companies reported that the majority of their employees do not have access to email and would therefore have no way to access the survey. Several companies indicated that they did not participate in surveys. A couple of companies felt that their employees would not qualify, because they do not live south of downtown Portland and do not use I-5 (one company indicated that many of their employees live west of downtown, and that a large proportion of employees are involved in the transportation incentive program, thus taking transit to work.). One company indicated that they felt language would be an issue with many of their employees.

Table 3-5 indicates the number of employees in each private company (7), university (1), and public agency (2) that agreed to participate. Also shown in the table are the number of employee responses, the number of employees who qualified, and the number who completed the initial survey.

Table 3-5. Companies Contacted for Survey Participation

Company	# of Employees	# of Responses	# Qualified	# Completing Initial Survey
1	10100	543	206	153
2	7093	68	23	18
3	~5000	242	76	68
4	~5000	172	142	111
5	2787	78	26	25
6	2500	58	44	36
7	1200	101	35	31
8	720	53	7	5
9	200	15	14	13
10	250	4	0	--
Total	34,850	1334 (4%)	573 (43%)	460 (80%)

Of the 10 companies/universities/agencies that agreed to participate, most were very enthusiastic about the opportunity. While it was requested that they send a company-wide email to their employees with a link to the survey website and the company's password, several companies put information about survey participation in their electronic company newsletter.

Overall, 1334 people (about 4 percent of the employees that could have potentially received information about the survey) responded by going to the website and answering the two qualifying questions. Of these, 573 (43 percent) qualified to participate in the panel survey based on their commute patterns. Of those who qualified, 460 (80 percent) completed the initial questionnaire. The following sections describe the findings from the analyses of the 460 surveys.

3.2.2 Findings

Findings are presented in terms of the four objectives of the customer satisfaction survey: (1) determine driver demographics and commute patterns, (2) determine driver behaviors during delays, (3) determine driver perceptions of traffic operations in the corridor, and (4) determine driver use of traffic information to make commute decisions. It should be noted up front that while a sample of 460 drivers is a large enough sample to be representative of the population of commuters on northbound I-5 in the morning, the method of survey administration (i.e., Internet) limits the applicability of the results. In other words, the opinions of the sample are representative of I-5 commuters who work in an office setting and have access to a computer/Internet and can provide valuable information about their behaviors and perceptions; however, the results cannot be generalized to the population as a whole.

3.2.2.1 Driver demographics and commute characteristics

Of the 460 survey respondents who qualified for participation and who answered the initial questionnaire, 41 percent are male and 59 percent are female. The age distribution of the panel is illustrated in Figure 3-15. About 37 percent of the panel members are between *41 and 50 years* old, and about 28 percent are between *51 and 60 years* old. There were very few respondents 30 years old or younger or 61 years old or older.

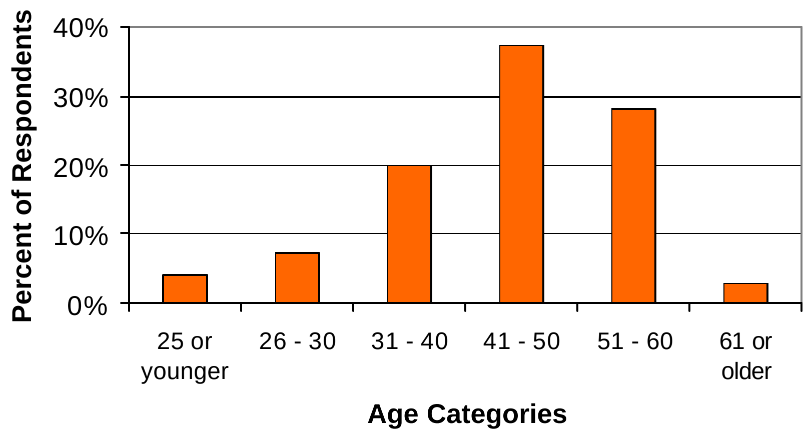


Figure 3-15. Age Distribution of Panel Members

Panel members were asked how long they have been commuting in the Portland area, and the results are shown in Figure 3-16. The most common response, by about 29 percent of the panel members, was *more than 20 years*, with an additional 27 percent commuting in Portland *11 to 20 years*. In fact, 77 percent of respondents have been commuting in Portland for six years or more. Therefore, most of the panel members are very familiar with the area and are likely familiar with local commute characteristics, trouble spots, and alternate routes (or the lack thereof).

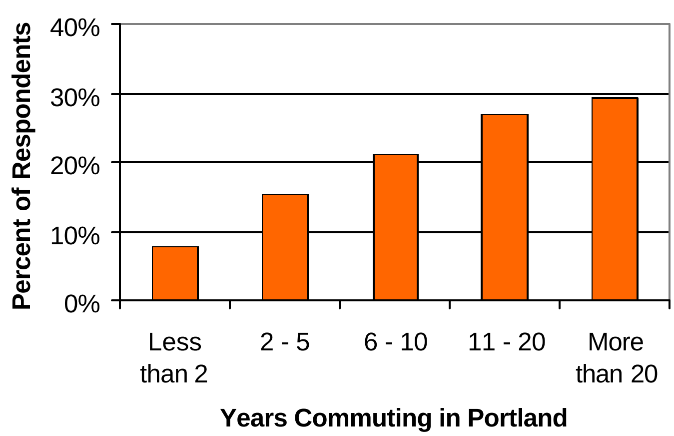


Figure 3-16. Years Panel Members Have Been Commuting in Portland

Regarding their typical commute patterns, respondents were asked to report at what time of the morning they are generally commuting within the bounds of the study area. The majority of panel members, nearly 70 percent, reported that they are within the bounds of the study area between 7:00 and 9:00 a.m., the typical morning peak period. About 27 percent indicated that they are within the bounds of the study area earlier than 7:00 a.m., and only 3 percent reported driving through the study area after 9 a.m. Seventeen panel members commented at the end of the questionnaire that the commute is easier and that the traffic is less congested during the earlier hours of the morning commute. Several even went as far to say that they had changed their morning departure time to avoid the heavier traffic later in the morning. These comments are listed in Table 3-6.

Table 3-6. Panel Member Comments Regarding Morning Commute Time

Panel Member Comments
• I leave my house at 6am and traffic is still light at this time in the morning. • My commute time is generally between 5:45 and 6:10, so although I do experience traffic it does not compare to those who drive at later times. This may be why my responses are generally in the satisfied range. • 2 days per week I commute at 7:00 am with few problems. 3 days per week I travel at 8:00 with more frequent problems. • There are rarely problems with traffic in the morning. I leave my home in Sherwood at 5:45am, so traffic is fairly light. I think people who travel at that time of the day are not as aggressive as at other times. Everyone just kind of drives at a decent speed and doesn't switch lanes. • I normally arrive in downtown Portland by 7:00 am to avoid traffic congestion. I use to not arrive downtown until 7:30 or so but changed my schedule because of traffic continuing to get heavier and heavier. • Due to the early hour of my commute to work, I rarely have trouble on Barbur Blvd. However, on the return home at 3:30-4:00, I periodically encounter delays due to accidents on I-5 which divert traffic on to Barbur Blvd. • My commute is very early in the morning and fairly early in the afternoon on I-5. This change in schedule has made a tremendous difference in my commute challenges. • Leaving for work at 5:15 AM has the advantage of avoiding most of the morning traffic and problems. There is a logrithic increase in traffic as the morning progress as you are well aware. • I actually leave my home at 7 AM and enter I-5 NB about 5 minutes later. I find that the commute is much heavier if I leave my home at 7:15 or 7:30. In fact, it can add 10-15 minutes to my total commute time. • One of the reasons I work early hours is to avoid the I-5 commute during rush hour. It's not too bad at 5:30-6:00am and I can almost always drive the speed limit without pausing, but it has become increasingly more congested in the last few years. • When I travel northbound on I-5 later than my typical 6:45 time (from 7:10 - 8:15am), I am dissatisfied with the normal traffic flow. • This year I converted my work schedule so I am leaving by 6am in the morning. Last year I was on the freeway at 7am. It was slow most of the time. I have cut my commute from 30-40 minutes to 15-20 minutes. • Because I commute around 6:00 a.m. Mon-Fri, the traffic is not bad. The worst part is going South on 1-5 in the afternoon, gets worse every month! • Because I leave for work so early, I rarely encounter problems (at 6 am). I am much more likely to encounter problems at 2:45 pm, and to take alternate routes then.

Respondents were also asked to report their typical commute times and distances. Commute time and distance distributions are illustrated in Figure 3-17. About 41 percent of the panel members reported that their commute is between *10.1 and 20 miles*, and about 46 percent reported that it takes about *16 to 30 minutes*. Interestingly, while 40 percent of the panel members reported a commute of *10 miles or less*, only 12 percent reported a commute time of *15 minutes or less*. Likewise, only 20 percent of panel members reported that their commute is more than 20 miles, yet 43 percent reported a commute time of more than 30 minutes. This imbalance in commute time and distance suggests that many of the respondents encounter congestion during their typical commute.

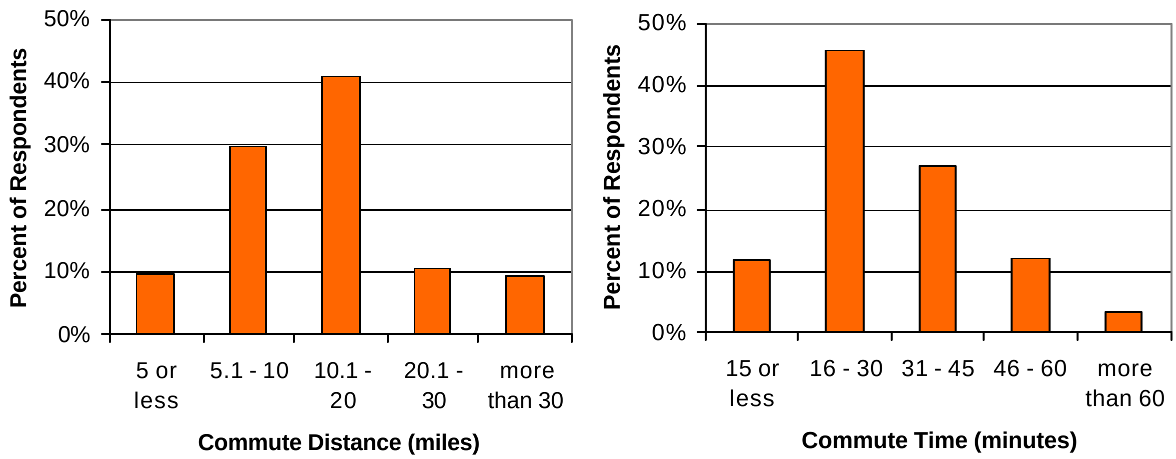


Figure 3-17. Respondents' Commute Times and Distances

3.2.2.2 Driver behaviors during delays

Panel members were asked to indicate how often they experience incident-related delays on northbound I-5 in the morning. Responses to the frequency with which they experience delays in the study area are shown in Figure 3-18. The most common answer, given by about 22 percent of panel members, was *less than once* per month. About 21 percent of the panel members reported that they experience incident-related delays in the study area in the morning *two times* per month. Nearly 25 percent, however, reported delays an average of four or more times per month, or nearly once per week.

One surprising result from this question was that about 5 percent of the panel members reported that they *had never experienced out-of-the-ordinary delays in the study area*. While some of these panel members reported that they typically commute outside of the peak period (before 7 a.m. or after 9 a.m.), more than half reported that they typically commute during the peak period. After carefully examining the comments given by panel members at the end of the questionnaire, it became evident that some of these people do not commute on I-5, but rather on Barbur Boulevard and other alternative routes. Therefore, they never experience incident-related delays because they do not take the freeway, where these incidents most commonly occur.

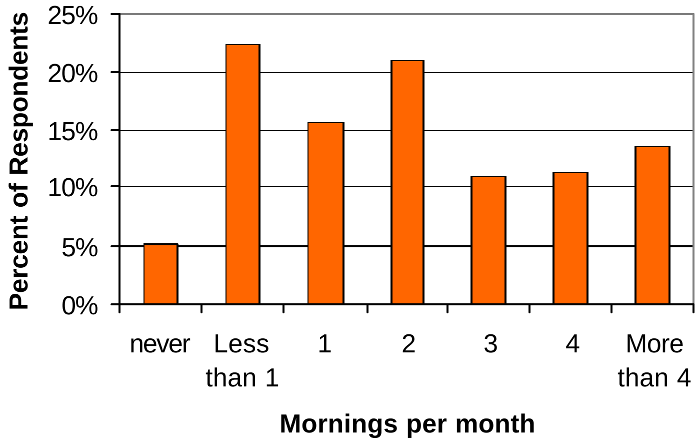


Figure 3-18. Frequency With Which Panel Members Experience Incident-Related Delays in the Study Area in the Morning

To better understand drivers' behaviors during incident-related delays, those respondents who reported experiencing incident-related delays were asked a series of questions about when they usually discover that there are incidents on their route and what, if any, actions they take to avoid the corresponding delays.

Respondents were first asked to report when they generally find out about "out-of-the-ordinary" delays on their route. Knowing when they find out about delays will help determine what actions they are able to take in response. Only 11 percent reported that they generally find out about delays *before they leave home*, and only 28 percent indicated that they find out about delays *after they leave home, but before they see the congestion on the roadway*. Therefore, 61 percent generally find out about delays on their route only *after they see the congestion on the roadway*. In other words, most of the panel members are not receiving traffic information soon enough to make changes in their commute times and routes. In fact, there were 12 comments regarding the Variable Message Signs (VMS) on northbound I-5 within the study area. Several of these comments are shown in Table 3-7. Most of the comments were in regard to the placement of the VMS, specifically that it is located too far north to be useful. Panel members stated that the information that is displayed would be more useful if it were available to them further south so that they could make decisions about an alternative route in the case of an incident on I-5. Additionally, some of the respondents said there needs to be more accurate, updated information on the VMS, because sometimes the information that is displayed is old and not useful to those already at that point of the commute.

Table 3-7. Panel Member Comments Regarding VMS

Panel Member Comments
• Electronic reader board is located too close to city. Needs to be closer to Tigard. In current location, it's too late to avoid traffic by the time a driver is alerted to trouble.
• I feel the information sign on northbound I-5 is poorly situated. If I get to that point for traffic information, I am most likely caught in the middle of trouble already and have no options to get off I-5 for a significant distance. I would recommend relocating the sign further south, before the Barbur Blvd. exit, or Taylors Ferry exit to give commuters more advance notice and options for taking alternate routes.
• The sign posted at the north end of the Terwilliger Curves is irritating. By the time we get there we've been stuck in traffic seemingly forever if it is an unusual event -- it doesn't really help any. Maybe you need more signs.
• The electronic sign board is useless on this travel segment because if there is an incident within the study area, once you can actually read the sign - there are no alternatives.
• It would be nice if the new transportation signs were used more frequently to inform people of the upcoming traffic conditions instead of just accidents.

The respondents who reported that they generally do find out about incident-related delays *before they leave home* were asked to indicate what they usually do to avoid the delays when they hear about them. Keeping in mind that there are only 48 panel members (11 percent of those who reported experiencing incident-related delays) in this category, about 65 percent reported that they generally *use an alternate route that does not include a freeway*. About 15 percent indicated that they *do nothing*; in other words, they leave at the same time and take the same route as usual, perhaps because they must be at work by a certain time or they know of no viable alternate route. Only 4 percent reported that they generally delay their departure time to avoid the delays. The remaining 12 percent reported some *other* action in response to knowing about delays on their route before they leave home. Other actions included: leaving home earlier, depends on type of incident and severity of delay, and taking an alternate route that includes a combination of a freeway and non-freeway.

The respondents who reported that they generally do not find out about incident-related delays on their route until *after* they leave home were also asked to indicate what they usually do to avoid the delays when they become aware of them. Nearly 56 percent reported that they generally *use an alternate route that does not include a freeway*, while about 38 percent indicated that they make *no change* at all (they remain on their usual route). About 3 percent indicated that they *use an alternate route that does include a freeway*, and none of the respondents marked the response choice *I go back home.* About 3 percent reported some *other* action, which were similar to those reported by those who find out about delays before they leave home.

Panel members were then asked to report if they ever use Barbur Boulevard to avoid out-of-the-ordinary delays on northbound I-5 in the morning. About 73 percent indicated that they do use Barbur Boulevard to avoid delays on I-5, while only 27 percent indicated that they do not. This result is not surprising considering the number of panel members who reported that they generally *use an alternate route that does not include a freeway* to avoid delays on their route. However, only 57 percent reported that they generally do so compared to the 73 percent who reported specifically using Barbur Boulevard.

Those respondents who reported that they do use Barbur Boulevard to avoid delays on I-5 were asked to report how often they do so. The results are shown in Figure 3-19.

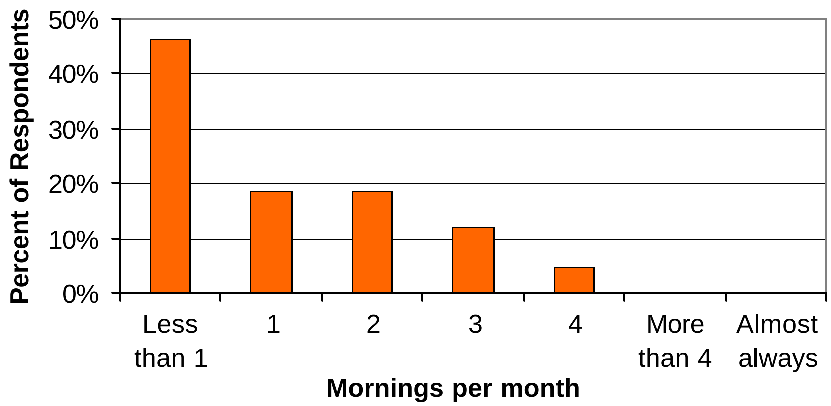


Figure 3-19. Frequency With Which Panel Members Use Barbur Boulevard to Avoid Delays on I-5

About 46 percent reported that they use Barbur Boulevard to avoid delays on I-5 *less than once* per month. About 18 percent reported doing so *once* per month, 18 percent reported doing so *twice* per month, and about 12 percent reported doing so *three times* per month. Very few panel members reported using Barbur Boulevard *four times* per month (or approximately once per week), and no one reported doing so more that *four times* per month or *almost always*.

As was mentioned previously, there were a group of panel members that reported that they have never experienced delays on northbound I-5 in the morning (Figure 3-18). With this response, they were precluded from any further questions that asked about delays on I-5, including this question. However, it was determined through comments at the end of the questionnaire that many of these panel members were taking Barbur Boulevard as their normal commute route, thus avoiding delays on I-5. Therefore, while there are a number of panel members who *almost always* take Barbur Boulevard, they did not receive this question. The comments they made at the end of the questionnaire are listed in Table 3-8.

Table 3-8. Panel Member Comments Regarding Barbur Boulevard as a Primary Route Choice

Panel Member Comments
• When I first started commuting from Newberg to Portland, it was a 40-minute drive. It's now a hour+ drive each way and that's only if there are no accidents or bad weather. Have actually started using Barbur all the way because at least you're not brake-dancing like you would do just about daily on I-5 anymore (very maddening -- its a freeway after all).
• I started using Barbur as my main route from 11th & Division to Sherwood each day after I was involved in a rear end collision by a semi-truck leaving downtown in 2000. I find Barbur both quicker and safer than the I-5 North and South routes due to the Terwilliger curve and stop and go traffic that usually occurs there.
• Because of the problems that can occur on the freeway, I have changed my route so that I routinely take Barbur instead of the I-5 Northbound.
• Thank you for doing this. I am one of those people who routinely takes Barbur because my experience on I-5 is consistently unpredictable and unpleasant.
• Recently I almost stopped using I-5 in the mornings to get to work, using instead Barbur Blvd. because traffic on I-5 is really slow for no obvious reason.
• I typically take Barbur because of the routine delays on I-5
• Over the past 5 years, the traffic on I-5 has gotten markedly worse, especially in the morning. Now usually exit onto Barbur just north of Haines and use Barbur for a.m. commute to avoid Terwilliger curves mess. Always go home (PM) on I-5 as it is usually less congested then Barbur in p.m.
• When I commute, I always take the Barbur exit because the Terwilliger turns are so frequently congested that it's just quicker and more reliable to take Barbur.
• I-5 is such a mess, so often, that I routinely take Beaverton-Hillsdale to Barbur to Front Ave. and across the Steel Bridge to get to work. I don't even try for I-5.
• I have changed my drive route to completely avoid I-5. I use Boones Ferry RD to Terwilliger Rd to Barbur Blvd to Front to Naito Pkwy, cross the Steel Bridge and north on Interstate Ave to my work place. By avoiding I-5 altogether, I save time, have a less stressful drive and feel much safer while driving. I had too many close calls with slamming on brakes, being cut off and coming close to being rear-ended.
• My experience using I-5 north is almost always negative, therefore I have made Barbour Blvd my standard route now.

It is apparent from these results that while some drivers do divert to Barbur Boulevard to avoid incident delays on I-5, they tend to do so less frequently than their reported experience of incident-related delays on I-5 (illustrated in Figure 3-18). In other words, it seems as though they may "pick and choose" the incidents for which they use Barbur Boulevard instead of staying on I-5. Perhaps they choose to use Barbur when the incidents are worse (lanes blocked versus vehicle on the side of the road) and/or when the delays are longer (either from hearing radio reports or experiencing the delays first hand). In addition, Barbur Boulevard may not be a viable option for some panel members due to the location of their work place.

3.2.2.3 Driver perceptions of traffic operations in the corridor

In order to establish a baseline of drivers' perceptions of current corridor traffic operations, panel members were asked a series of questions about how satisfied they are with corridor operations. Specifically, respondents were asked to rate their satisfaction with traffic conditions on northbound I-5 in the morning both during normal conditions and during incident conditions. They were asked to rate their satisfaction with the traffic operations on a scale of *1* to *5*, with *1* being *extremely satisfied* and *5* being *extremely dissatisfied*. The results are illustrated in Figure 3-20.

While nearly 36 percent of panel members reported being *satisfied* with traffic operations on northbound I-5 in the morning during a typical commute, 33 percent reported that they were either *dissatisfied* or *extremely dissatisfied* with normal traffic operations. On the other hand, only about 5 percent of panel members reported that they were *satisfied* with traffic operations during incident conditions, while nearly 78 percent reported being *dissatisfied* or *extremely dissatisfied*.

It is apparent from these results that panel members do experience delays, both during normal operations and during incident conditions that affect their satisfaction with system performance. Perhaps the deployment of the parallel corridor traffic management project will help improve customers' levels of satisfaction.

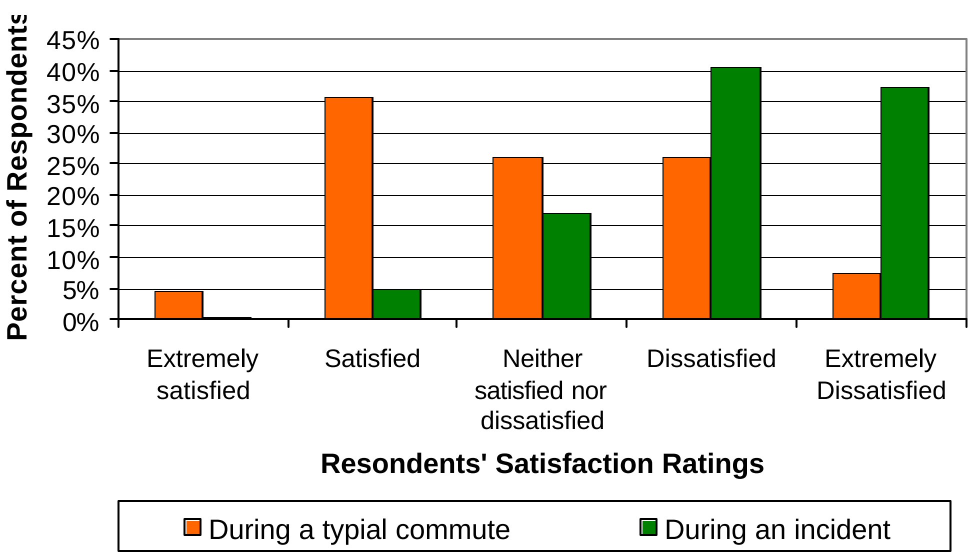


Figure 3-20. Panel Members' Satisfaction Ratings for Northbound I-5

Those panel members who reported that they use Barbur Boulevard to avoid out-of-the-ordinary delays on northbound I-5 in the morning were asked to rate their satisfaction with several elements of the traffic operations along Barbur Boulevard when they do so. The three elements of traffic operations they were asked to rate included: traffic volume, travel speed, and signal operations. The results are illustrated in Figure 3-21.

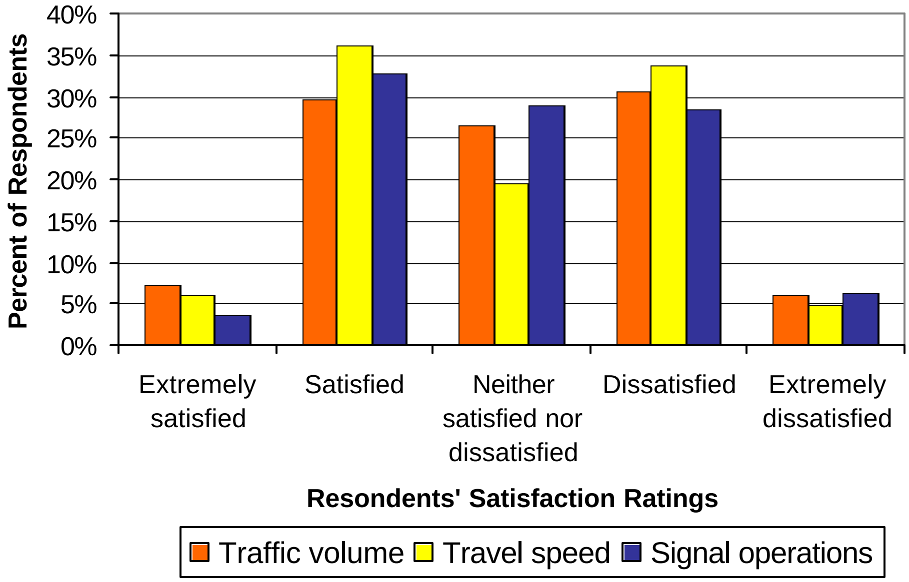


Figure 3-21. Panel Members' Perceptions of Operating Conditions Along Northbound Barbur Boulevard in the Morning During Incidents on I-5

Very few respondents reported that they are *extremely satisfied* with any of the three elements of traffic operations when they use Barbur Boulevard. Of the three elements, panel members appear to be the most opinionated about travel speed. Forty-two percent of respondents reported that they are *satisfied* or *extremely satisfied* with travel speed (compared to 37 and 36 percent of respondents for traffic volume and signal operations, respectively). In addition, 38 percent of respondents reported that they are *dissatisfied* or *extremely dissatisfied* with travel speed (compared to 37 and 35 percent of respondents for traffic volume and signal operations, respectively). These ratings indicate that there is much room for improvement of drivers' satisfaction with traffic operations along Barbur Boulevard during incidents in the morning. (It should be noted that the majority of panel members who answered this question rated the conditions on Barbur Boulevard during incident conditions on I-5. However, the ratings by those panel members who specifically indicated in their comments that they always take Barbur Boulevard instead of I-5 would be based on their overall perceptions of conditions on Barbur Boulevard, not just during incidents.)

Satisfaction ratings with incident conditions on Barbur Boulevard tend to be higher than satisfaction ratings for incident conditions on I-5, and this can be seen when comparing the ratings from Figure 3-20 and Figure 3-21. While 34 to 40 percent of panel members are *satisfied* or *extremely satisfied* with conditions on Barbur Boulevard when used as an alternate route during incidents, only 5 percent of panel members are *satisfied* or *extremely satisfied* with incident conditions on I-5. Likewise, 36 to 40 percent of panel members are *dissatisfied* or *extremely dissatisfied* with conditions on Barbur Boulevard, while about 78 percent of panel members reported being *dissatisfied* or *extremely dissatisfied* with incident conditions on I-5.

While there were very few comments about the volume or speed of traffic along Barbur, there were numerous comments regarding the traffic signal operations. There were also a few comments that specifically addressed the conditions on Barbur Boulevard during an incident on I-5. Specifically, these comments stated that while Barbur Boulevard is generally a better option than I-5, during incidents, the conditions along Barbur are degraded by traffic diverting from the freeway. These comments are listed in Table 3-9.

Table 3-9. Comments About Traffic Signals and Incident Operations on Barbur Boulevard

Panel Member Comments
• Please note when incidents occur northbound on I-5 that somehow the traffic lights on Barbur are shifted to take care of the increased traffic flow on Barbur. • Barbur could be a useful alternate route, if the traffic lights could be timed on Barbur and 99. • When traveling northbound on I-5 in the a.m. (or southbound in the p.m.), if there is a serious traffic problem then one problem is … if Barbur is backed up with alternate traffic, the sequencing (or lack thereof) of traffic lights seems to create additional problems. • Love the lights on Barbur, they are so well-timed you never have to experience a red one. • The timing of the lights on Barbur reduces its usability as an I-5 alternate. • The traffic lights on Barbur Blvd. don't seem to be set to handle the extra volume of traffic created by an accident on I-5. • I tried Barbur Blvd. sometimes but with all the stop lights and cars it didn't seem to help unless it was one the days where there was an accident. If there was an accident on I-5, Barbur Blvd usually was better if I happened to hear it on the radio soon enough before continuing on or if I was on the road already when the accident happened. If the accident had happened a while ago you end up sitting on Barbur Blvd also. • The signal at 35th/Barbur is never timed with the I-5 off-ramp traffic. When traffic is really backed up on Barbur because of an incident on I-5, the signal at Barbur/Capitol Highway can't handle the demand. It would be great if the system could gauge when there is additional traffic on Barbur and adjust the timing. • The series of traffic signals in Tigard where Barbur crosses I-5 hinder the flow of traffic rather than help. The series of traffic signals on Barbur at the Bertha/I-5 intersection and at Terwilliger are also real bottleneck areas. • ODOT Responds quickly to accidents but the volume of traffic is so much heavier than the roads were designed for that traffic backs up quickly on I-5 and other parallel roads like Barbur. The signals are timed but traffic there is usually fairly heavy with those who choose not to use the freeway, and it gets worse whenever there is any incident on I-5. Barbur going through Tigard and beyond is awful most all the time not just during peak travel hours. • Barbur becomes very congested and slow when people switch their route from I-5 during extreme traffic delays. I now think that it is likely to be as fast to stay on the freeway than to travel Barbur. • I avoid I-5 northbound almost always. I find that the commute on Barbur is always much more satisfactory, even with traffic control devices traffic is usually better. The exception being when there is a major problem on I-5 and people are avoiding that route ahead of time. • When there is congestion I don't get off I-5 to use Barbur Blvd. because it is usually just as congested and there are traffic signals that increase commute time. I've found, through experience, that it is best to just stay on the freeway unless it is completely shut down.

3.2.2.4 Driver use of traffic information to make commute decisions

It was also of interest to determine what type of traffic information panel members use, as well as their perception of the information. The different types of information rated included: television reports, radio reports at home, Internet, radio reports in the car, and variable message signs (VMS). Panel members were asked to rate the information in terms of the following: timeliness of information, accuracy of information, and usefulness of information. Respondents were asked to rate, on a scale of 1 to 5, how often the information is timely, accurate, and useful. Respondents could also state that they *do not receive information from this source* to indicate they do not use a particular type of information source.

Of the five types of information, radio reports in the car are used by more panel members than the other types of information (used by about 93 percent of panel members). Freeway VMS are the second most common source of traffic information used by panel members, with just about 76 percent reporting use of VMS. Television reports and radio reports at home are used by only about half of respondents (46 percent and 50 percent, respectively). The Internet was reportedly used by only 18 percent of panel members. The results of the subjects' ratings (excluding the Internet) are summarized in Table 3-10.

More panel members perceive television reports as being *frequently or almost always* accurate than they do them being timely or useful. In fact, television reports were rated by more panel members as being *rarely or almost never* timely or useful when compared to the other sources of information. This could be due to the fact that televisions are only available to commuters before they leave home for work (or from work to home) and are therefore not able to provide updates as commuters make their way along their commute route.

Table 3-10. Summary of Panel Members' Ratings of Traffic Information

Info Source	*Frequency*	*Percent of Panel Members*		
		Timely	*Accurate*	*Useful*
Television reports	Frequently / almost always	26%	**55%**	36%
	Rarely / almost never	38%	14%	28%
Freeway VMS	Frequently / almost always	25%	**69%**	43%
	Rarely / almost never	34%	6%	22%
Radio reports at home	Frequently / almost always	36%	**50%**	38%
	Rarely / almost never	37%	14%	25%
Radio reports in the car	Frequently / almost always	**53%**	**61%**	**54%**
	Rarely / almost never	14%	8%	14%

More panel members also perceive freeway VMS as being *frequently or almost always* accurate than they do them being timely or useful. In fact, more panel members rated VMS as being frequently or almost always accurate compared to the other types of information (nearly 70 percent). Interestingly, however, of the four types of traffic information, freeway VMS were rated by the fewest panel members as being *frequently or almost always* timely, even though the information is generally given to motorists on the road just prior to an incident or congestion. Compared to television reports, freeway VMS are perceived to be a more useful and accurate source of traffic information.

As with television reports and VMS, more panel members perceive radio reports at home as being *frequently or almost always* accurate than they do them being timely or useful; however, fewer panel members rated radio reports at home as being *frequently or almost always* accurate compared to television reports and VMS. Radio reports at home were rated by slightly more panel members as being useful when compared to television reports.

Radio reports in the car are perceived by the most panel members as being *frequently or almost always* timely and useful when compared to the other types of traffic information. In addition, radio reports in the car are perceived by the fewest panel members as being *rarely or almost never* timely and useful when compared to the other types of traffic information.

In addition, there were eight comments made at the end of the questionnaire that were specific to the accuracy and timeliness of traffic information in Portland. These comments are listed in Table 3-11. All of the comments indicated that there is a lack of accurate, updated information during the typical radio traffic reports. Panel members who commented feel that the radio reports do not provide enough information about accidents and other delays, and when they do report them, many times they are not accurate or updated frequently enough to be of use.

While freeway VMS were rated by more panel members as being *frequently or almost always* accurate than the other information sources, radio reports in the car appear to be the preferred source of traffic information by respondents. Information gleaned from radio reports received in the car are used by more panel members than any of the other sources of information. This information source was rated by most panel members as being timely, accurate, and useful.

Table 3-11. Comments About Accuracy and Timeliness of Traffic Information

Panel Member Comments
• I watch TV in the morning but not right before I leave so I miss any up to the minute information. Information on TV after 7:00 is not frequent or regular. • The radio is variable; some stations (the talk stations) have frequent reports but I don' like to listen to these stations. Music stations of all kinds do not have frequent reports unless there are huge accidents so you can miss the information you need. • I think that it would be very helpful if there were a Portland area radio broadcast that only reported traffic problems. Commuters could simply tune to that station when they get in their cars to learn of any trouble spots. The source of information could be the same as the new message light-boards, but not be limited to the viewing area of the light-boards. Congestion is often hidden from view because of the terrain along I-5 and the feeder roads. Many times drivers encounter congestion after they have already entered a part of the route that affords no alternatives. Such a radio service would allow many commuters to avoid being trapped. • Many of the traffic radio reports I hear especially KOPB (public broadcasting) are inaccurate or have not been properly updated. Very frustrating to reroute my commute when the problem has been cleared up. • Unfortunately, the radio updates are pretty standard and don't usually give enough detail to be useful. They typically say usual slowing in the curves etc. but rarely give accurate info on accidents - and if they do, usually the accident is gone by the time you reach that area. • I usually listen to K103 for traffic information before leaving the house or in the car. The information is usually delayed and therefore not accurate. If you adjust your route, you discover that the problem is all cleared up or never existed and you are still late for work. • I don't understand why an excellent traffic reporter like Dennis Norden on KEX cannot have access to Barbur Blvd info and why it is usually not covered in any of the morning reports or afternoon reports either.

4 COATS BI-STATE RURAL INTEGRATION

The objective of the COATs evaluation is to measure the system impacts on the safety of rural travel in Southern Oregon.

4.1 Data Collection Approach

Currently, the Western Transportation Institute (WTI) at Montana State University – Bozeman is conducting a large-scale evaluation of the COATS project. This four-year evaluation (through fiscal year 2004) will include the evaluation of over ten project components. While some of the proposed evaluations are still being devised, the following is a list of many of the components that are being considered for evaluation:

- Operational Impacts of Weather and Lane Closures on Rural Highways. The methodology would consist primarily of collecting traffic volume and speed data on a variety of highways throughout the COATS study area, along with weather data and information on road closures to develop relationships between highway capacity and these conditions.
- ITS Maintenance Evaluation. This evaluation would utilize a case-study approach, relying on maintenance log records and observations from DOT staff.
- Detection Equipment. The methodology would consist of a comparison between actual detector measurements and those recorded by the ITS field equipment. It would likely include any records on long-term reliability or maintenance needs associated with the detectors. A special area of emphasis would be the ability of the detection equipment to perform reliably during adverse weather and visibility conditions.
- Agency Surveys. The emphasis of this evaluation would be qualitative survey data to establish how much people use ITS elements and to assess their opinions of usefulness.
- Traveler Satisfaction Survey. This evaluation would attempt to include both qualitative and quantitative data to determine the effects of ITS on the traveling public as well as the perceived benefits. One intriguing question that could be answered by this research is the effect of ITS and improved traveler information on reducing traveler delay, as travelers change routes and departure times or even opt out of certain trips.
- Emergency Response Evaluation. This evaluation would involve significant data collection from the dozens of emergency response agencies in the COATS region. Part of this evaluation may also examine the role of cellular phone coverage in improving emergency notification, and to what extent the lack of cellular coverage hinders emergency response efforts.
- RWIS Evaluation. This evaluation would include a mix of qualitative, subjective assessments, as well as surveys of maintenance staff.
- Evaluation of Institutional Relationships and Mainstreaming ITS. This evaluation would utilize a case study/literature approach with dozens of agencies and stakeholders throughout the COATS study area.

- Communications Improvement for Rural Field Devices. This evaluation would also use a case-study approach, taking a number of field elements and describing how the element communicates with other field elements and/or TMC, the cost of providing communications, problems experienced with communications for that location, and strategies for dealing with communication problems in the future.
- Small Urban ITS Evaluation. This evaluation would likely be quantitative, focusing on data that reflect the volume and efficiency of travel in a small urban area. This could include a combination of traveler surveys, more specific agency surveys, incident response statistics, etc.

Based on WTI's on-going evaluation, the data collection approach for this national evaluation will stay focused solely on crash data. Several sites where ITS has been installed or is planned to be installed were identified for which to obtain crash statistics. The sites and a description of the ITS projects are shown in Table 4-1.

Table 4-1. COATS Sites Identified for Crash Data Analysis

COATS Site	*Description of ITS Project*
Coos County	Bicycle and pedestrian detection systems in North Bend and Coos Bay
US 101 just south of Coos Bay	Automated flood warning system
42 from US 101 to milepost 5	Automated flood warning system
OR 42S between US Route 101 and OR 42	Automated flood warning system
US 101 at mileposts 330 and 360	RWIS
OR 42 at milepost 10.8 and at Cape Blanco on US 101	RWIS
Near Humbug Mt. at milepost 321	DMS for visibilty and wind
Port Orford	Automated wind advisory system
Brookings	HAR for low visibility
Santiam Pass on US 20/OR 126	Regional incident management system, automated gate closure system, and AVL for fleets in area
US 97 between mileposts 143 and Klamath Co. line	Animal detection systems
OR 242 from milepost 55 to Sisters	Advanced warning system for narrow lane widths
Siskiyou Pass in Jackson Co. on I-5	Regional incident management, VMS, DMS for runaway trucks, advisory TV, CCTV
Medford viaduct	Automated anti-icing

4.2 Findings

In addition to WTI's COATS evaluation, crash statistics were obtained from ODOT's *2000 Statewide Crash Rate Tables*, to serve as the baseline for this study. Of the proposed COATS sites listed in Table 4-1, four segments that are currently in the pre-deployment stage were selected for analysis:

- OR 242 between MP 55 and Sisters;
- OR 42S between US 101 and OR 242;
- US 97 between MP 143 and the Klamath County Line; and
- US 101 between Coos Bay and OR 42.

In general, year 2000 crash rates in rural Oregon, based on data from the studied segment, averaged 1.12 crashes per million vehicle miles of travel (VMT), ranging as low as 0.73 at OR 42S, to as high as 1.39 at OR 242. The summary of these findings is illustrated in Figure 4-1 and is also listed in Table 4-2. Crash rates at all of the study segments, except at US 97 dropped in 2000 (as compared to 1996 – 1999), with an average reduction of 30 percent. On the other hand, US 97 experiences an increase of 0.5 crashes per million VMT when compared to the average rates from 1996 to 1999.

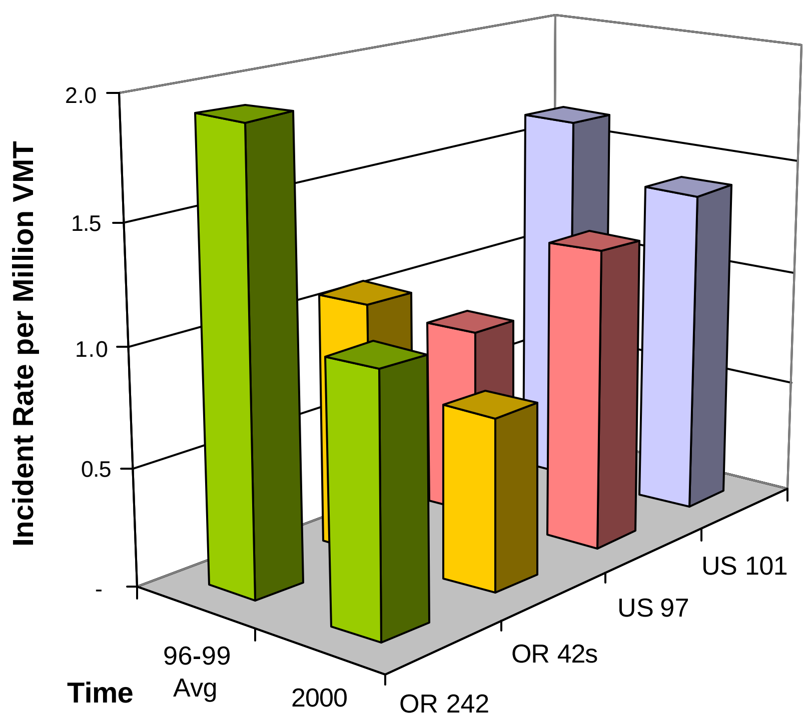


Figure 4-1. Historic Crash Rates at Selected Rural Oregon Highways

Table 4-2. Summary of Incident Conditions

Segment	*'96-'99 Average*	*2000*	*Difference (% Diff)*
OR 242 between MP 55 and Sisters	1.92	1.08	-0.8 (-44%)
OR 42S between US 101 and OR 242	1.07	0.73	-0.3 (-32%)
US 97 between MP 143 and Klamath Co Line	0.81	1.27	+0.5 (+57%)
US 101 near Coos Bay	1.63	1.39	-0.2 (-14%)

5 EVALUATION RISK ASSESSMENT

The purpose of this section is to provide an evaluation of the appropriateness of the Oregon deployments as Phase III integration evaluation sites. This section identifies the opportunities and assesses the risks involved in continuing with a post-deployment evaluation of the Oregon Regional ITS Integration Program. Based on this assessment, the recommendations of the evaluation team regarding the future opportunities are presented in Section 5.4.

5.1 Deployment Plans and Schedules

This section briefly discusses the current status of the deployments as well as future deployment plans and schedules.

5.1.1 Transit Tracker Information Displays

The Transit Tracker project is already up and running in the prototype phase. As of April 2002, there were 19 Transit Tracker signs, 9 at bus stops, and 10 on light rail platforms. Tri-Met has several more signs ready to be installed at bus stops, for a total of 18 signs at 17 bus stops by June 30, 2002. Tri-Met will be completing their phase 1 of Transit Tracker by hosting focus groups and/or doing intercept surveys to determine riders' understanding of the signs' contents and other design/usability-type concerns. Tri-Met's phase 2 of Transit Tracker will begin in their next fiscal year, beginning July 1, 2002. They plan to implement another 50 Transit Tracker signs by June 30, 2003.

5.1.2 I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project

Preliminary engineering of sites and devices along SW Barbur Boulevard was completed in February 2001. A problem of inadequate funding to install the desired hardware along Barbur Boulevard was encountered. To mitigate this problem, the City has considered alternative ways to system installation as well as possibly reducing the number of locations and/or modifying the type of devices. The variable message signs (VMS) and fixed message signs (FMGS) have been tested and are ready to be installed. A consultant is on-board working on an Incident Management Operational Plan. The rest of the message signs have been received. The project went out bid on Monday 20th of May, 2002. The City is holding a pre-construction meeting on the 29th of May, 2002. The bid opening date is June 4th, 2002, and the contract will be awarded in the middle of June. The selected contractor will have 150 calendar days to finish the installation.

5.1.3 COATS Bi-State Rural Integration Project

The following is the status of numerous projects in the COATS area:

- Completed installation of Wind Warning System (near Gold Beach) and High Water Warning System (near Coos Bay) on US 101. The systems are now operational.
- Completed installation of a VMS on US 199 near Grants Pass. This project also included a fixed sign with flashing beacons installed near Cave Junction. Both signs are operational.
- Completed installation of an upgrade to the Highway Advisory Radio System at Ashland on I-5. Currently installing software and the system should be operating within a couple of weeks.
- Completed installation of an additional camera at milepost 6 on the Siskiyou Pass on I-5. The camera is operational.
- The Transportation Operation Center Software project, which will address device integration, traffic management, emergency management, and integration with other agencies, is in contract negotiations. A contract should be signed in about a month.
- Two VMS on Hwy 140 (Lake of the Woods Highway) are under construction.
- One VMS on NB I-5 in Medford is currently being designed. Bids will be opened later this summer.
- Four cameras have been installed on I-5 near Roseburg in conjunction with a construction project in the area.
- Two additional cameras are being designed for installation on the Medford Viaduct on I-5 in Medford in conjunction with a bridge re-decking project.

5.1.4 Transit Buses as Traffic Probes Project

National Engineering Technologies (NET) has finished the preliminary analysis for bus probe requirements for the TransPort ATMS. Tri-Met and Orbital Sciences Corporation (OSC) are working on adding tasks to the existing OSC contract to make changes to Tri-Met software and firmware. A statement of work for the Orbital portion of the project was developed in the spring of 2002. OSC will also begin work on preliminary analysis and a statement of work. Tri-Met and ODOT are working to finalize their agreement.

5.2 Opportunities

The Oregon Regional ITS Integration Program maintains some distinct advantages that make the deployment a good candidate for future evaluation (as a Phase III evaluation site). The evaluation team has identified the following evaluation opportunities:

- The Oregon Regional ITS Integration Program provides the opportunity to observe the impacts of an integration of ITS technologies including transit with ATIS, transit with freeway and arterial management, freeway and arterial management, arterial and incident management, and freeway and incident management.
- The project partners from ODOT, the City of Portland DOT, and Tri-Met have demonstrated an established, cohesive, and cooperative working relationship in all aspects of the *TransPort 2000* Project.
- The Transit Tracker Information Displays have already been deployed in the prototype phase. Equipment has already been purchased and is ready for installment, which will represent the completion of Tri-Met's Phase 1 deployment (planned by July 31, 2002).
- Much of the equipment has been installed for the I-5/Barbur Boulevard Parallel Corridor Traffic Management Demonstration Project. In addition, the VMS and FMGS have been tested and are ready to be installed, and the rest of the signs have been received. With a consultant on-board working on an Incident Management Operational Plan, the partners expect to go to bid and complete the equipment installation by mid-November.
- Tri-Met already has contractors working on statements of work for the Transit Trackers as Probes project.
- Numerous components of the COATS project have already been deployed. In addition, several more are in the design or construction stage. The Transportation Operation Center Software project, which will address device integration, traffic management, emergency management, and integration with other agencies, is in contract negotiations.
- The project partners have been extremely cooperative and responsive to requests for data and information. Tri-Met has worked with the evaluation team to establish acceptable locations for survey administration and have provided ridership data. ODOT has been helpful in arranging meetings, as well as providing freeway and crash data. The City of Portland DOT agreed to not only place traffic counters along Barbur Boulevard, but also to monitor them over the month-long data collection period, to pick them up, and to mail them back to the evaluation team. The City of Portland DOT also distributed an email to all city employees with the I-5/Barbur Boulevard customer satisfaction survey information and encouraged them to participate.

5.3 Risks

Very few risks were identified by the evaluation team, as all projects are on or ahead of schedule, and project partners seem confident that the deployments will take place as planned. The only risk identified is associated with the COATS Bi-State Rural Integration Project. The partners have had difficulty with the integration with Caltrans; however, they are moving forward with deployments on the Oregon side, as well as the integration of three rural traffic management centers in Oregon. Thus, while it may not be feasible to evaluate the bi-state integration component of the COATS project, there exist numerous opportunities to evaluate rural integrations in Oregon. In addition, as was previously mentioned, WTI at Montana State University, Bozeman is conducting a concurrent $1 million evaluation of COATS. Therefore, the scope of this national evaluation has been scaled appropriately in the evaluation plan.

5.4 Recommendations

The continuation of the evaluation of the Regional Oregon ITS Integration Program offers significant opportunities, with little to no risk. Based on these opportunities and the evaluation team's experience in developing the evaluation plan, working with the project partners, collecting baseline data, and analyzing baseline conditions, the evaluation team recommends that the FHWA COTR consider continuing with Phase III evaluation efforts.

REFERENCES

1. Tri-Met 5-Year Intelligent Transportation System Plan Final Report, February 2000. PB Farradyne, Battelle.
2. *TransPort 2000*, A FY 2000 Federal Transportation Appropriations Bill Project Request, June 15, 2001.
3. Oregon Regional Intelligent Transportation System Integration Program: Final Evaluation Plan, Prepared by Science Applications International Corporation and Cambridge Systematics, U.S. Department of Transportation, October 31, 2001.
4. Strong, C. and S. Albert. California-Oregon Advanced Transportation Systems ITS: Strategic Deployment Plan, Western Transportation Institute, University of Montana—Bozeman, Bozeman, MT, May 2001.
5. Real-Time Information Pilot Project—Baseline Study Results, Tri-Met Marketing Information Department, Portland, OR, May 2000.
6. Stong, Chris, Showcase: Summary of Proposed Evaluations (Revised Proposal), Prepared for the U.S. Department of Transportation and the State of California, Western Transportation Institute, Bozeman, MT, March 2001.
7. Largest Employers of the Portland/Vancouver Metropolitan Area, Portland Chamber of Commerce, Portland, OR, 2001.

APPENDIX A

SAIC's Transit Tracker Baseline Questionnaire

TRANSIT TRACKER USER SATISFACTION BASELINE QUESTIONNAIRE

1) I'm going to ask you **HOW OFTEN YOU USE** several different types of bus schedule information when scheduling your transit trips. Please use a rating scale of 1 to 5, with 1 being "almost always" and 5 being "almost never."

HOW OFTEN DO YOU USE…	Almost Always 1	Frequently 2	Sometimes 3	Rarely 4	Almost Never 5
the printed paper schedules from Tri-Met	?	?	?	?	?
the Tri-Met guides posted at bus stops	?	?	?	?	?
on-line/Internet schedules	?	?	?	?	?
238-RIDE	?	?	?	?	?
other, please specify ___________________	?	?	?	?	?

2) Please rate **HOW OFTEN** the following statements are **TRUE:**

I generally do not use the Tri-Met schedule information—I just go to the bus stop and wait for the next bus to arrive.

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5

o------------------o-------------------o-----------------o---------------o

I generally do not use the Tri-Met schedule information, because I have most of my times/routes memorized.

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5

o------------------o-------------------o-----------------o---------------o

3) Please rate how often the schedule information you use is **ACCURATE** (again, with 1 being "almost always" and 5 being "almost never").

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5

o------------------o-------------------o-----------------o---------------o

4) About how long do you usually wait for the bus at this bus stop?
   a. ___________minutes
   b. Don't know

5) Is the bus you catch at this bus stop usually on time?
   a. Yes
   b. No →In general, about how many min. early/late is it?__min. early/late (circle one)
   c. Don't know

6) At this bus stop, how satisfied are you with bus adherence to the posted schedules?

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied	N/A
1	2	3	4	5	
o	o	o	o	o	o

7) On a scale of 1 to 5, how strongly do you agree with the following statement: I feel safe waiting for the bus at this bus stop **DURING THE DAY**.

Completely Agree	Agree	Do Not Agree Nor Disagree	Disagree	Completely Disagree	N/A
1	2	3	4	5	
o	o	o	o	o	o

8) On a scale of 1 to 5, how strongly do you agree with the following statement: I feel safe waiting for the bus at this bus stop **AT NIGHT**.

Completely Agree	Agree	Do Not Agree Nor Disagree	Disagree	Completely Disagree	N/A
1	2	3	4	5	
o	o	o	o	o	o

9) On a scale of 1 to 5, how satisfied are you with the bus service at this bus stop?

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied	N/A
1	2	3	4	5	
o	o	o	o	o	o

10) For what trip purposes do you most frequently take the bus? (Mark all that apply.)
- ? Work
- ? School
- ? Shopping
- ? Recreation
- ? Other: ________________
- ? For most all of my trips

11) Do you have an automobile available to you for your use?
- ? Yes
- ? No

12) On average, how often do you ride the bus?
- ? Less than one day per week
- ? 1 – 4 days per week
- ? Nearly every day

13) Please stop me when I've read the age category that contains your age.

? Under 25	? 45 – 54
? 25 – 34	? 55 – 64
? 35 – 44	? 65 or older

14) Have you ever waited to catch a bus at a bus stop where there was a Transit Tracker display, a real-time electronic sign showing when the next bus will arrive?
- ? Yes (if so, where?)____
- ? No

RECORD:
Sex: ________Male __________Female
Time: _______a.m / p.m.
Date: _______________
Bus stop:___________________________

APPENDIX B

Tri-Met's Transit Tracker Baseline Questionnaire

Date __ __ / __ __ / 00 Arrival Time at Stop __ __:__ __ AM/PM Survey __ __

REAL TIME CUSTOMER INFORMATION SURVEY – BUS SURVEY

INTRO: Hello, I'm _______________ from Gilmore Research. We are conducting a short survey for Tri-Met to help the agency improve transit service for customers at this location.

1. First, how did you get to this stop today? (DO NOT READ. PROBE TO FIT.)
   - ÿ Walked **PROBE:** How many blocks did you walk? # of Blocks ______
   - ÿ Drove and parked
   - ÿ Transferred from bus # _____
   - ÿ Dropped off by vehicle
   - ÿ Other ____

2. How many days in an average month do you catch the bus from *this* location?
   _____ Days per month ☐ This is the first time ☐ Don't know

3. Using a scale from 5 to 1 where 5 is very satisfied and 1 is not at all satisfied, how satisfied are you with the bus service at *this* location?

Very Satisfied				**Not at All Satisfied**	
5	4	3	2	1	☐ Don't Know

4. Which bus will you be catching now? (DO NOT READ UNLESS DON'T KNOW)
   - ÿ 6 – Martin Luther King Jr. Blvd.
   - ÿ 15 – Belmont
   - ÿ 51 – Vista
   - ÿ 72 – Killingsworth/82nd Avenue
   - ÿ 18 – Hillside
   - ÿ 63 – Washington Park – OMSI
   - ÿ Don't Know

5. What is the main purpose of *this* bus trip? (ACCEPT ONE ANSWER. READ IF NEEDED.)
   - ÿ Work
   - ÿ Home
   - ÿ Shopping
   - ÿ Personal Business
   - ÿ Doctor/Medical Appointment
   - ÿ Recreation
   - ÿ Visiting friends or releatives
   - ÿ School
   - ÿ Other ______________________
   - ÿ Don't Know

6. About how long do you usually wait for the bus at this location?
_____ Minutes ☐ Don't know

7. Is the bus you catch at this stop usually on time?
☐ Yes ☐ No ☐ Don't Know

8. Do you know what time your bus was supposed to arrive before coming to *this* stop today?
☐ Yes → **ASK 8a.** ☐ No → **ASK 8b.** ☐ Don't Know → **SKIP TO Q9**
IF LOCATION IS MLK, SKIP TO Q9.

ÿ From printed schedule or Tri-Met Guide

ÿ From the Tri-Met web site

ÿ Asked a friend, co-worker, or family member

ÿ Other ___________________________

ÿ Asked a Tri-Met driver

ÿ I already knew the schedule

ÿ Called 238-RIDE

ÿ Don't know

8b. **IF NO:** When you arrived at this stop, did you look at the posted schedule to see what time your bus would come?

ÿ Yes ☐ No ☐ Don't know

9. How safe do you feel waiting for the bus at *this* location? Would you say you feel…

ÿ Very Safe ☐ Not very safe ☐ Don't know

ÿ Somewhat safe ☐ Not at all safe

IF NOT VERY SAFE OR NOT AT ALL SAFE: what would help you to feel safe while waiting at *this* location?

____

____

10. How many trips do you make on a Tri-Met bus or MAX in the last month? Please count each direction as one trip.
_____ Trips ☐ Don't know

11. Which of the following statements best describes why you ride the bus/MAX? (READ 1-4.)

ÿ I ride because I can't drive or don't know how

ÿ I ride because I don't have a car available

ÿ I don't have a car available, but prefer to take the bus or MAX

ÿ Don't know

12. Please stop me when I get to the category that includes your age. Are you…

- ÿ 12 to 16
- ÿ 17 to 18
- ÿ 19 to 24
- ÿ 25 to 34
- ÿ 35 to 44
- ÿ 45 to 54
- ÿ 55 to 64
- ÿ 65 or Older
- ÿ Refused

13. What is the zip code where you live? ______________________

THANK YOU FOR YOUR HELP TODAY AND HAVE A GOOD TRIP ON TRI-MET!

---

14. **RECORD GENDER:** ☐ Male ☐ Female

15. **RECORD LOCATION:** ☐ MLK & Killingsworth ☐ Salmon & 5th

APPENDIX C

I-5/Barbur Boulevard Baseline Customer Satisfaction Questionnaire

Welcome to the
Portland, Oregon I-5 Transportation Survey
Website!

Project Description

The City of Portland and the Oregon Department of Transportation (ODOT) are working together to improve traffic conditions in and around the Portland area. The two agencies are in the process of testing an advanced traffic management system on Interstate Highway 5 (I-5), generally from the point where I-5 crosses into Multnomah County (near S.W. Barbur Blvd., Exit #294) to the downtown Portland area (see map of ***Study Area****). It is the hope that this system will help improve traffic flow along I-5, especially during traffic incidents such as crashes, stalled vehicles, etc. when part or all of the freeway may be blocked.*

This is your chance to let us know how you feel about traffic conditions along I-5!

How Do I Participate in the Survey?

This survey is completely voluntary. If you choose to participate in the Portland, Oregon I-5 Transportation Survey, you will be asked to answer 2 questions about the roads you frequently use. Based on your responses, you will be selected for participation if you are a frequent traveler in the ***Study Area****. All you need to participate is an e-mail address (home or work)!*

If you are selected to participate, you will be asked to complete an initial questionnaire to determine your typical commute patterns and how you feel about traffic conditions on I-5. The questionnaire should take you less than 10 minutes to complete.

How Many Questionnaires Will I Have to Complete?

After the initial questionnaire, you may receive up to 6 additional questionnaires over the next 6-12 months. These follow-up questionnaires will be sent to you when there is a traffic incident along I-5 in the ***Study Area****, and you will be asked to answer a few questions about how you learned about the incident and what actions you may have taken to avoid it. You will be notified of a follow-up questionnaire by e-mail and will be asked to go to the study website to complete the questionnaire. Each questionnaire should take you less than 10 minutes to complete.*

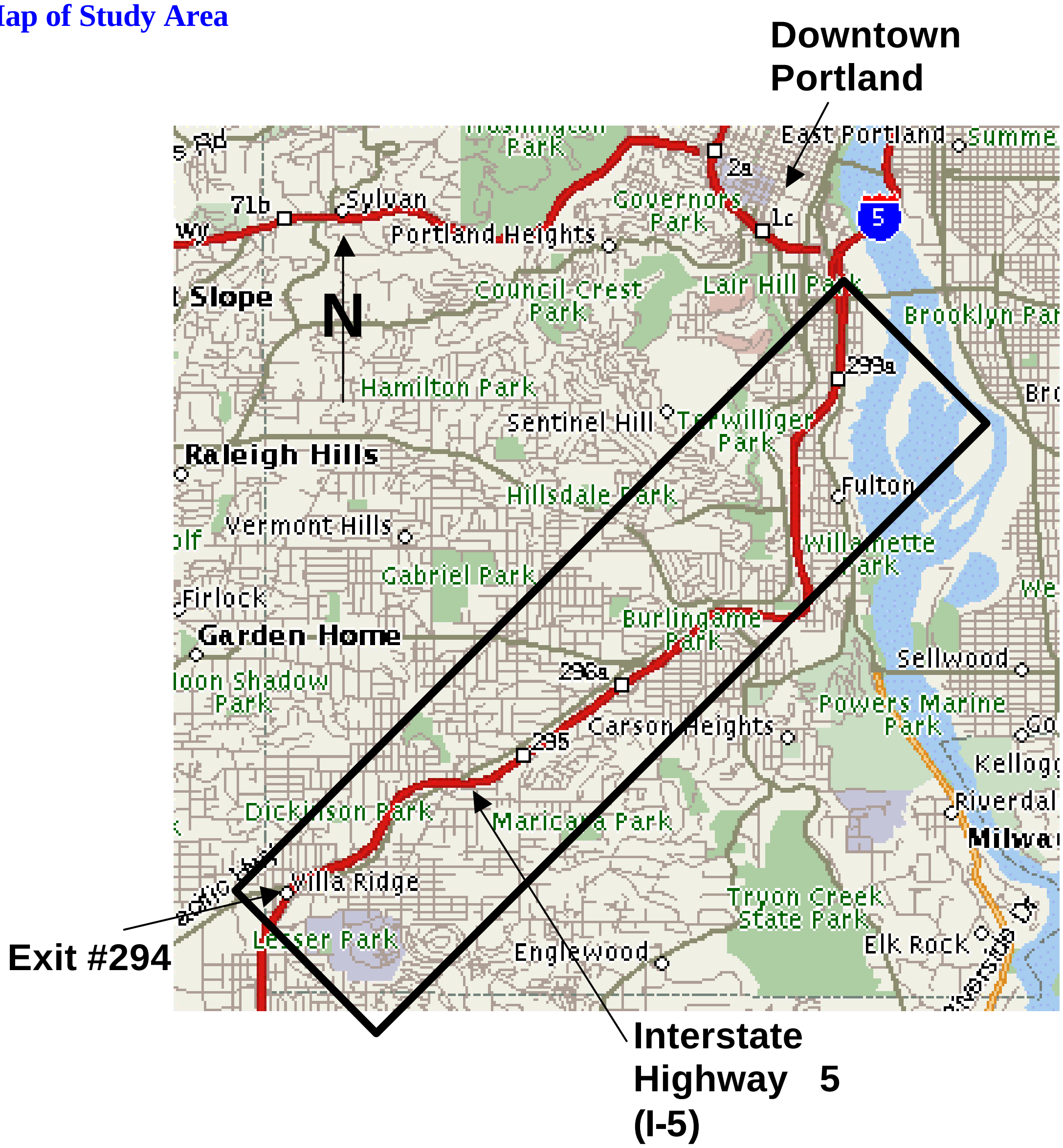
Confidentiality Statement

Your questionnaire responses will be kept strictly confidential and will not be shared with anyone. All results will be presented in aggregate form, with no references made to individual responses.

Project Significance

The results of this study will be published in a national report to the United States Department of Transportation and will help transportation agencies and officials across the country make future investment decisions.

Map of Study Area



PART I

The first e-mail will provide a link to a website that will briefly describe the transportation project and will contain 2 qualifying questions for survey participation.

Please answer the following 2 questions by clicking the circle next to the appropriate response choice. Your answers to these questions will determine if your commute patterns match those required for participation in this study.

1. Do you commute into Portland in a private vehicle (including carpools, vanpools, and motorcycles) **AT LEAST** 3 days in the typical work week (Monday – Friday)?
   - Yes
   - No

2. Do you typically travel **NORTHBOUND** on I-5 and/or Barbur Boulevard in the **MORNING**?
   - Yes
   - No

Please review your answers and make any necessary changes. Once you have verified your answers, click “Submit Responses.”

PART II

If the user does not answer "Yes" to both questions, he/she is NOT qualified to continue and will see the following statement:

Your commute patterns do not match those required for participation in this study. Thank you for volunteering to participate and taking time to complete this questionnaire.

If the user IS qualified to continue, he/she will see the following questions:

Based on your responses to the first 2 questions, you have been selected to participate in this study.

Please provide your e-mail address so that we may enter you into our database. Your email address, along with your questionnaire responses, will be kept **STRICTLY CONFIDENTIAL** and will not be shared with anyone.

Your e-mail address:___________________________
Please re-enter your e-mail address for verification:___________________

Entering the e-mail address will take the user to Part II of the survey.

Thank you for your participation in the Portland, Oregon I-5 Transportation Survey. To help us get a better understanding of your commute patterns, please provide responses to the following questions by clicking the circle next to the appropriate response choice. This questionnaire should take less than 10 minutes to complete.

1. At what time in the morning are you typically traveling on I-5 and/or Barbur Boulevard within the bounds of the Study Area?

- Before 7:00 a.m.
- 7:00 a.m. - 9:00 a.m.
- After 9:00 a.m.

2. In general, how much time does it take you to commute from home to work in the morning?

- 15 minutes or less
- 16 - 30 minutes
- 31 - 45 minutes
- 46 minutes - 1 hour
- More than 1 hour

3. How far do you commute to get from home to work in the morning?

- 5 miles or less
- 5.1 - 10 miles
- 10.1 - 20 miles
- 20.1 - 30 miles
- More than 30 miles

4. On average in a typical month, how many **MORNINGS** do you encounter **out-of-the-ordinary** delays that are caused by incidents/accidents in the Study Area? (Please note, in this survey, "out-of-the-ordinary delays" refers to delays that are **worse** than those you **normally encounter** during your commute.)

- I've never experienced out-of-the-ordinary delays in the Study Area
- Less than 1 morning per month
- 1 morning per month
- 2 mornings per month
- 3 mornings per month
- 4 mornings per month
- More than 4 mornings per month

5. When do you generally find out about out-of-the-ordinary delays on your route?

- **BEFORE** I leave home
- In the car **AFTER** I leave home, but before I see the congestion on the roadway
- In the car **AFTER** I see the congestion on the roadway

6. When you find out about out-of-the-ordinary delays on your route **BEFORE** you leave home, what do you usually do?

- I delay my departure time from home to avoid the delays
- I use an alternate route that includes a freeway
- I use an alternate route that does not include a freeway
- I do the same as usual - I leave at my normal time and use my normal route
- Other (please specify):

7. When you encounter out-of-the-ordinary delays on your route **AFTER** you leave home, what do you usually do?

- I use an alternate route that includes a freeway
- I use an alternate route that does not include a freeway
- I go back home
- I do the same as usual - I stay on my normal route
- Other (please specify):

8. Do you ever use Barbur Boulevard to avoid out-of-the-ordinary delays on **NORTHBOUND** I-5 in the **MORNING**?

- Yes
- No

9. When you experience out-of-the-ordinary delays on **NORTHBOUND** I-5 in the **MORNING**, how often do you use Barbur Boulevard to avoid the delays? Please respond by using a scale of 1 to 5, with 1 being "Almost Always" and 5 being "Almost Never."

Almost Always	Frequently	Sometimes	Rarely	Almost Never
1	2	3	4	5
o	o	o	o	o

10. When you use Barbur Boulevard to avoid out-of-the-ordinary delays on **NORTHBOUND** I-5 in the **MORNING**, how satisfied are you with the **volume of traffic** on Barbur Boulevard?

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied
1	2	3	4	5
o	o	o	o	o

11. When you use Barbur Boulevard to avoid out-of-the-ordinary delays on **NORTHBOUND** I-5 in the **MORNING**, how satisfied are you with the **travel speed** on Barbur Boulevard?

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied
1	2	3	4	5
o	o	o	o	o

12. When you use Barbur Boulevard to avoid out-of-the-ordinary delays on **NORTHBOUND** I-5 in the **MORNING**, how satisfied are you with the **traffic signal operations** on Barbur Boulevard?

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied
1	2	3	4	5
o	o	o	o	o

13. Please rate how frequently the traffic information you receive from the following sources is **TIMELY**. (In other words, how frequently do you receive the information in time to make important decisions about your commute time/route?)

Information Source	Almost Always	Frequently	Sometimes	Rarely	Almost Never	Don't receive info from this source
	1	2	3	4	5	6
Television reports	•	•	•	•	•	•
Radio reports at home	•	•	•	•	•	•
Internet	•	•	•	•	•	•
Radio reports in my car	•	•	•	•	•	•
Electronic message signs along freeway	•	•	•	•	•	•
Other (please specify):	•	•	•	•	•	•

14. Please rate how frequently the traffic information you receive from the following sources is **ACCURATE**.

Information Source	Almost Always	Frequently	Sometimes	Rarely	Almost Never	Don't receive info from this source
	1	2	3	4	5	6
Television reports	•	•	•	•	•	•
Radio reports at home	•	•	•	•	•	•
Internet	•	•	•	•	•	•
Radio reports in my car	•	•	•	•	•	•
Electronic message signs along freeway	•	•	•	•	•	•
Other (please specify):	•	•	•	•	•	•

15. Please rate how often the traffic information you receive from the following sources is **USEFUL**. (In other words, how often do you receive information with enough detail to make important decisions about your commute time/route.)

Information Source	Almost Always	Frequently	Sometimes	Rarely	Almost Never	Don't receive info from this source
	1	2	3	4	5	6
Television reports	•	•	•	•	•	•
Radio reports at home	•	•	•	•	•	•
Internet	•	•	•	•	•	•
Radio reports in my car	•	•	•	•	•	•
Electronic message signs along freeway	•	•	•	•	•	•
Other (please specify):	•	•	•	•	•	•

16. Using a scale of 1 to 5, with 1 being "Extremely Satisfied" and 5 being "Extremely Dissatisfied," please indicate how satisfied you are with morning traffic conditions on **NORTHBOUND** I-5 (within the bounds of the Study Area) during a **TYPICAL COMMUTE** (no out-of-the-ordinary delays).

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied
1	2	3	4	5
o	o	o	o	o

17. Using a scale of 1 to 5, with 1 being "Extremely Satisfied" and 5 being "Extremely Dissatisfied," please indicate how satisfied you are with morning traffic conditions on **NORTHBOUND** I-5 (within the bounds of the Study Area) when there are **OUT-OF-THE-ORDINARY DELAYS**.

Extremely Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Extremely Dissatisfied
1	2	3	4	5
o	o	o	o	o

18. What is your sex?

- Male
- Female

19. Please choose the category that includes your age.

- 25 years old or younger
- 26 - 30 years old
- 31 - 40 years old
- 41 - 50 years old
- 51 - 60 years old
- 61 years or older

20. How long have you been commuting in the Portland area? (Please round to the nearest year.)

- Less than 2 years
- 2 - 5 years
- 6 - 10 years
- 10 - 20 years
- More than 20 years

Please click “Continue” to verify your responses before they are submitted.

Please review your answers and make any necessary changes. Once you have verified your answers, click “Submit Responses.”

When user has completed these questions, the following message will appear:

Thank you for completing this questionnaire! Your responses are important to us. On days when a serious incident occurs in the **Study Area**, you may be contacted by e-mail and asked to complete a brief questionnaire about your commute experience during the incident. This questionnaire will ask questions regarding your awareness of the incident and any commute-related decisions you made in response to the congested conditions.

US Department of Transportation
400 7th Street, S.W. (HOIT)
Washington, DC 20590

Toll-Free "Help Line" 866-367-7487

www.its.dot.gov

EDL Document No.: 13682 **Publication No.: FHWA-OP-02-088**