Final Phase II Report

SR 395 Spokane FY99 Earmark Evaluation

Prepared for:

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1.0 INTRODUCTION

1.1 BACKGROUND

The U.S. Federal Highway Administration (FHWA) has provided funding to the Washington State Department of Transportation (WSDOT) to install a road and weather information system in the mostly rural and mountainous region north of Spokane, Washington to the Canadian border. This system is intended to communicate traveler information to commercial vehicle operators, other public motorists, and maintenance crews concerning current weather conditions, road surface conditions, border crossings, floods, slide areas, and other information necessary to assist roadway users in making informed travel decisions. The system will include the installation of Intelligent Transportation System (ITS) information and communication technology, and its integration into a regional ITS system that will assist in the collection and dissemination to travelers of critical road and weather information in the SR 395 corridor. Enhanced traveler information can increase safety, improve the efficiency of commercial vehicle operations, benefit road maintenance activities, and provide the general traveler with an increased level of knowledge and comfort regarding the conditions that they may encounter.

State Route 395 north of Spokane, Washington is a rural, two-lane highway that carries a mix of traffic including commercial vehicles, local and general business commuters, and recreational motorists throughout the year. Commercial traffic in the SR 395 corridor is of particular economic importance to the region. The six-year Eastern Washington Intermodal Transportation Study reported that, "The volume and economic value of cargo passing within or through the U.S. 395 corridor area is substantial. During a typical week day, 5,600 trucks carrying over 100,000 tons of cargo, worth over $139 million in 1994 prices, pass within and through the region over a 24-hour period."[1] As shown in Figure 1, SR 395 is a major north-south trunk-line highway to Canada with traffic flows to and from SR 21, SR 20 and SR 25. It serves the border crossings of Laurier/Cascade, Frontier/Paterson via SR 25, Boundary/Waneta via SR 25, and county roads, Metaline Falls/Nelway via SR 31, and Danville/Carson via SR 21. Notably, SR 395 provides the only direct truck access to mainline rail terminals in Spokane. This network of roads serves significant tourism demand with camping, skiing, water recreation, and other summer and winter outdoor activities readily available in the area.

The FHWA is conducting an independent evaluation of this project in order to better determine and document the benefits of such rural road-weather ITS deployments. The Battelle Memorial Institute, teamed with Meyer, Mohaddes Associates (MMA), were selected to perform the independent evaluation. This Phase II report provides the evaluation approaches and the results of the baseline data collection and analysis, along with an assessment of the likelihood that useful benefit data could be obtained by moving into Phase III of the evaluation.

1.2 PROJECT OVERVIEW

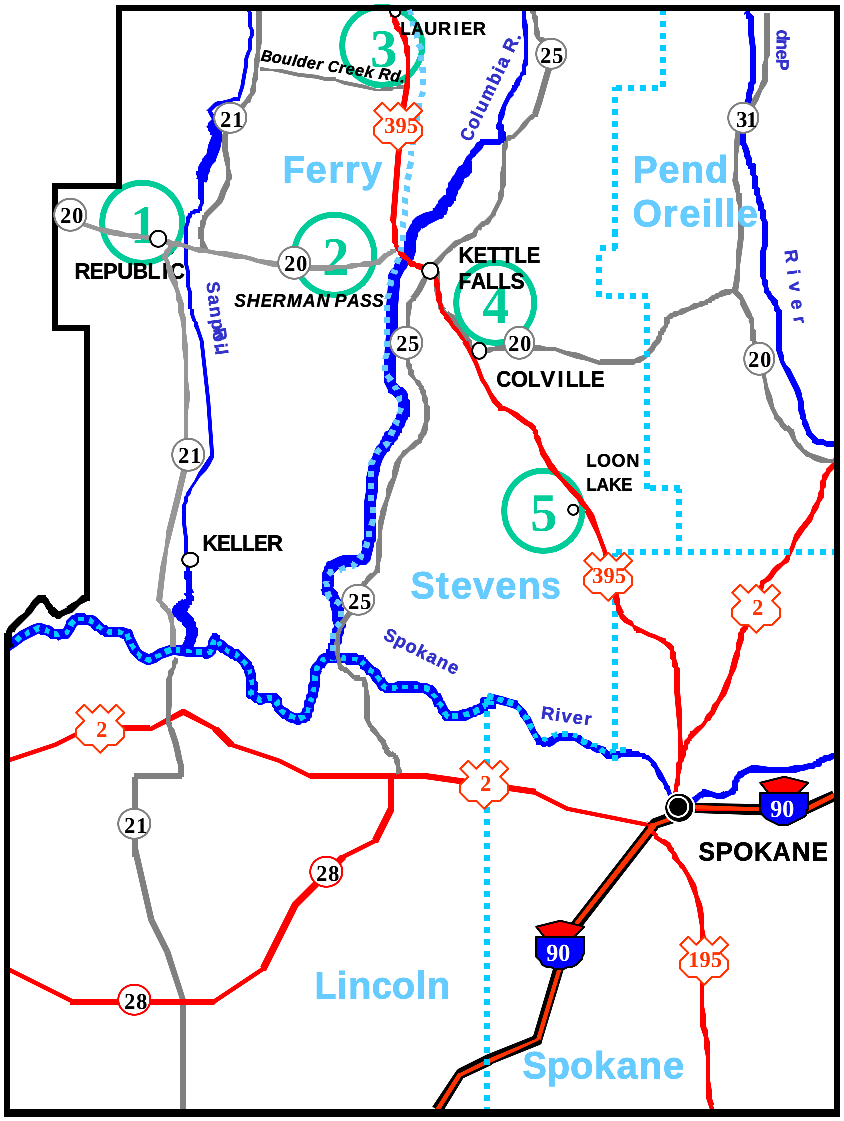
The availability of traveler information regarding accidents, construction activities, road-weather conditions, and flooding events is limited in this study region. The concept underlying this

[1] Casavant, K.L., and W.R. Gillis. 1995. *Importance of the U.S. 395 Corridor for Local and Regional Commerce in South Central Washington.* EWITS Research Report Number 8. (April).

evaluation is that with better road condition information, commercial and individual travelers will be able to make better decisions regarding their trip timing, route selection, and preparedness leading to a more efficient and safer transportation system. In addition, road maintenance crews and system operators will be able to more efficiently manage the transportation facilities for which they are responsible.

The ITS equipment that will be installed under this earmark project includes the following components. These components are illustrated with reference numbers in Figure 1 to show their geographic location in the region.

1. A mobile Highway Advisory Radio (HAR) facility at Republic. Steep terrain, frequent flooding, and a complex junction of State Routes 20 and 21 at this location made a plan to locate a fixed HAR station here infeasible. The HAR equipment will be based in the Republic maintenance shed and will be able to be easily moved to other roadside locations in the corridor region as needed. WSDOT operators will transmit messages remotely, using a solar powered paging system, to the mobile HAR as changing road and weather conditions dictate. These messages will warn motorists of road construction and restrictions, dangerous driving conditions, border crossing conditions, and similar kinds of information that should enhance the comfort and safety of travel.
2. A Road/Weather Information System (RWIS) facility, including a web camera, at Sherman Pass. Sherman Pass, on SR 20, presents one of the more dangerous driving environments in this area during the winter snow season, as well as under spring thaw and rain conditions. WSDOT plans to use cell phone technology to provide communications for this remote rural RWIS station, and having a camera in place will allow visual inspection of conditions on the pass in real-time, providing for more rapid and appropriate response by crews and better information dissemination to travelers. RWIS facilities implemented under this program will be tied into the state-wide road-weather system being operated out of the University of Washington, and will allow WSDOT to provide weather predictions for these localized areas over both HARs and the Internet.
3. Road/Weather Information System (RWIS) with a web camera at Laurier. Laurier is located at the Canadian border, and WSDOT plans to place a weather station and camera at this site to collect atmospheric data including wind speed, temperature, precipitation, pavement conditions, and humidity. This information will be particularly useful to commercial and private road users who are traveling between the United States and Canada.
4. Mobile Highway Advisory Radio (HAR) at Kettle Falls. This mobile HAR will function similarly to the one at Republic, and information broadcast here will include border closure information, other road closures, weather, and incident and construction updates.
5. A web camera with the Existing RWIS at Loon Lake. This RWIS is located on a portion of SR 395 that experiences frequent severe winter weather and dangerous road conditions. WSDOT will install and integrate a camera with their existing RWIS station. The camera will inform travelers about current conditions in the SR 395 corridor, and its images will be made available on the Internet. This location has been demonstrated to be a bell weather indicator for conditions on most of this north-south route.



Map not to scale

FIGURE 1. PROJECT AREA MAP

1.3 PROJECT IMPLEMENTATION SCHEDULE

WSDOT currently anticipates the installation of each of the project component facilities to be completed and operational by December 2001. This is consistent with the schedule assumptions that have been in place for this project and will provide more than adequate lead time for the conduct of Phase III of the evaluation. WSDOT staff has prepared equipment lists, and parts are on order for the two mobile HAR trailers, two complete RWIS weather stations, and a power source for the Sherman Pass installation. WSDOT has applied for a use permit from the U.S. Forest Service for use of the Sherman Pass site. This included submittal of a description of the site, the type of installation required, potential environmental impacts to the area, and expectations for the nature and duration of this use of the site. They are anticipating guidelines and approval to be forthcoming soon from Olympia, Washington. WSDOT expects to have all the needed equipment in hand by September at the latest, after which construction can begin. The construction will take an estimated 25 working days, spread out over one and a half to two months. The advertisement date ("Ad date"), which initiates the process of contractor selection, has not been set yet, but will be soon.

1.4 PHASE II REPORT CONTENTS

This Phase II Report documents progress to date on the evaluation of the SR 395 earmark project. The report includes discussion of the test plans for the evaluation, the collection and analysis of baseline data, and a risk assessment to guide a decision regarding the potential for moving to Phase III of the evaluation. Phase I included a site visit and an initial project assessment that documented the potential for this project to yield useful evaluation results. An Evaluation Plan was prepared for this project under Phase II and submitted to FHWA on November 3, 2000. That plan presented the strategy and goals for the evaluation, and laid out an evaluation and project management approach to conducting the baseline data collection and analysis phase of the evaluation. The plan defined measures, hypotheses, and methods proposed for the main areas of evaluation focus that included:

- Travel and mobility for commercial vehicles
- Travel and mobility for the general public
- Infrastructure operations and maintenance
- System performance and reliability
- Safety

The baseline data have now been collected and analyzed, and the results of those analyses are included in this report. More specific details on the plans and procedures for the conduct of both the baseline data collection and analysis and the Phase III post-implementation assessment related to these focus areas are presented in the test plans. Each Test Plan contains the approach, data collection instruments, and analysis techniques that are being applied in this evaluation. The format of the Test Plans follows FHWA guidelines to assist in the detailed data collection and analysis.

2.0 EVALUATION APPROACH

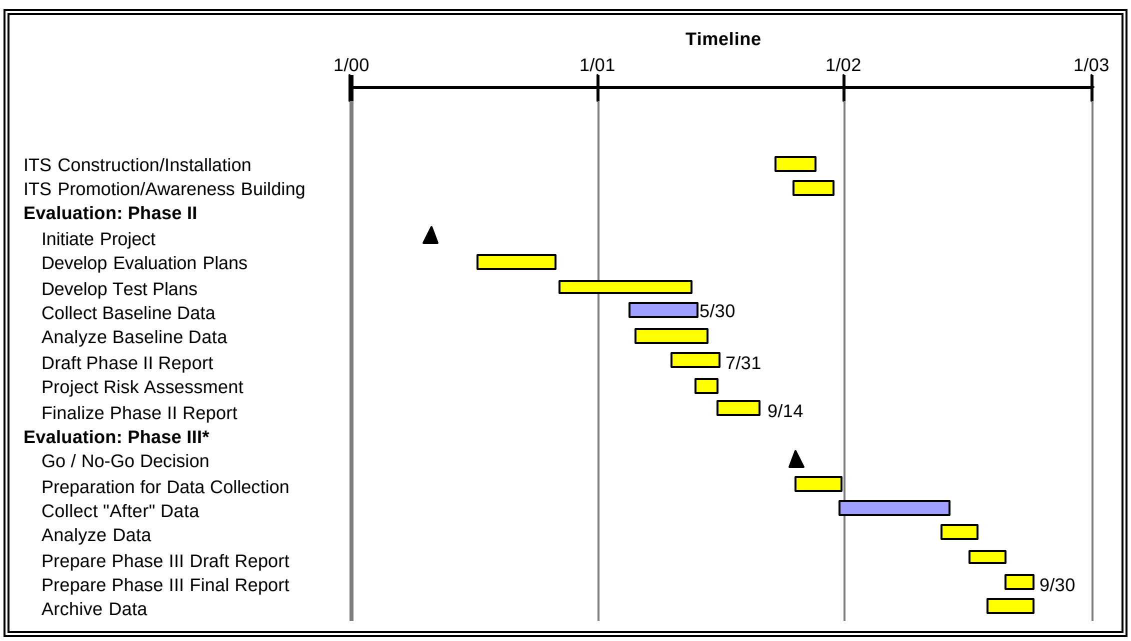
2.1 INTRODUCTION

The objective of this evaluation is to assess the effects of new road-weather information system components being installed in the SR 395 corridor north of Spokane, Washington. Anticipated benefits from the planned ITS improvements in this region include more accurate, up-to-date road-weather information to facilitate the mobility of commercial and private vehicle travel; increased efficiency and cost savings for roadway operations and maintenance; high quality functional operation of the various ITS installations; and, safety improvements for both travelers and operational staff.

This chapter will present the detailed test plans for each of the five evaluation areas introduced in Chapter 1. The test plans expand on the evaluation methods, hypotheses, and data collection methods described in the Evaluation Plan. The purpose of these test plans is to provide the details regarding data collection, analysis, and evaluation documentation for each focus area.

2.2 EVALUATION SCHEDULE

The evaluation schedule is illustrated in Figure 2. Based on the analysis of the Phase II baseline data, the potential risks and benefits of continuing with a Phase III post-deployment evaluation have been assessed and are included in Section 5.0 of this report.



*Pending risk assessment decision to proceed with Phase III

FIGURE 2. SR 395 SPOKANE EARMARK EVALUATION SCHEDULE

The data collection activities under Phase III, if approved, are proposed to begin shortly after all the new ITS systems are installed and operational by December 2001. Evaluation testing will be conducted from late December 2001 through April 2002, and the evaluation will be completed in the summer of 2002, thereby covering a winter season of data collection comparable to the baseline data collection period. However, in order to prepare for the data collection to begin on time, some Phase III activities must be initiated in the Fall of 2001, such as guidance for the collection of the "event" data, the initiation of HAR logs, and the general traveler Internet survey, each of which need to be readied for the winter travel season. This implies a desirable Phase III go-ahead decision in the October 2001 timeframe, along with funding authorization, in order not to lose momentum. The final evaluation results would be available by September 30, 2002.

2.3 GENERAL METHODS OF EVALUATION

The general strategy for evaluating each of the project components is to identify the goal area in which project-related effects can be anticipated, and then to specify measures of project-induced changes or impacts, along with available data sources and methods for collecting the data. Hypothetical statements (called hypotheses) have been framed that express desired outcomes or beneficial effects from elements of the project in a straightforward way that is suggestive of data analysis strategies that can be used to test whether or not the project in fact is having the desired effects or outcomes. These are not intended to be the rigorous testable hypotheses of a controlled scientific experiment; rather, they serve as a guide for the analysis and help structure appropriate ways of approaching the evaluation and data analyses. For each goal area covered, measures, hypotheses, data collection methods, and analytic methods will be discussed in this report.

The overall evaluation design for each of the goal areas includes two data collection periods, one before any of the ITS project improvements have been implemented, and another after implementation and a period of operations. Data collected in the "before" period describe current conditions at the project site and provide a benchmark against which to gauge any changes that may be attributable to the project. A challenge in this type of field evaluation is to be able to disentangle the presumed effects of the project from change effects that are due to other, often unmeasured, factors that are operating in the project environment. A related challenge is to account for changes in baseline conditions that may occur between the time data were collected until the time when the post-implementation data are collected. The most appropriate baseline describes how conditions will be at the time the "after" data are collected, if there had been no project-related effects occurring. Generally, the assumption is made that the "before" data adequately describe those conditions. Other factors that could also account for changes in the measures of interest should be acknowledged, even though they are likely to remain unmeasured directly. Finally, the difference between the "before" and "after" condition is the change or impact. How much of that difference can be attributed to the project, and the interpretation of the significance of that change or impact is sometimes closer to art than science.

Depending on the measures identified as appropriate for each goal area, data collection methods are selected that may include the collection of objectively measured data such as accident statistics, or subjectively measured data such as the perceptions and opinions of drivers. A variety of such methods are used in this evaluation and will be described as they apply in each of the goal areas.

Test plans for each of the goal areas will describe the following topics:

- Background and test objectives
- Approach, including a discussion of anticipated impacts, measures, and hypotheses;
- Pre-test activities, including a discussion of data requirements, development of data collection strategies and instruments, interview protocols, and data recording formats;
- Test activities, such as baseline and post-deployment data collection;
- Post-test activities, focusing on data analysis, interpretation, and presentation of results.

Overall, the test plan will present a suggested Phase III report format and expected contents, and estimated resources required to complete all test activities across all the goal areas.

2.4 TEST PLAN: TRAVEL AND MOBILITY FOR COMMERCIAL VEHICLES

2.4.1 Background and Test Objectives

Commercial vehicles constitute a significant component of the total traffic in the SR 395 corridor region, and CVO operators and their drivers represent important potential beneficiaries of any mobility and safety improvements that might be achieved by this project's planned ITS deployments. There is relatively little research on how the CVO community uses road, weather, and traffic information to provide potential safety and efficiency benefits for their companies and drivers, especially in rural areas similar to this study region. Some of the anticipated benefits from the ITS deployments in the SR 395 corridor are expected to include:

- Safer travel by helping commercial drivers avoid dangerous road and pass conditions, whether caused by snow, ice, rain, slides, construction, or other road hazards.
- More efficient operations for the CVOs by providing information to dispatchers that can help in the timing and routing of truck trips to avoid potential problem areas, enhance on time delivery of goods and services, and reduce costs of operations caused by travel disruptions.
- Increased comfort and reduced stress for CVO drivers by providing them with more accurate and current information about conditions on the routes they plan to travel.

2.4.2 Approach

The anticipated impacts and measures that were described in the Evaluation Plan are guiding this assessment, and they are summarized in Table 1.

The approach being used to measure the impacts of the mobile HAR (Highway Advisory Radio), the RWIS (Road/weather Information Systems), and cameras on commercial vehicle operators (CVOs), is to contact them directly by telephone and conduct individual interviews with drivers, dispatchers, or company owners, depending on the size of the operation and the availability of a knowledgeable person at the time of the interview. Additional information regarding the potential safety benefits of the ITS installations is being obtained through the analysis of state accident statistics, and this aspect of the evaluation is discussed in a separate section of this report.

TABLE 1. ANTICIPATED IMPACTS AND MEASURES FOR COMMERCIAL OPERATIONS

Objectives and Anticipated Impacts	Evaluation Measures	Hypotheses
Increase safety of truck travel	- Number of truck accidents - Perceived safety improvements	- The number of truck accidents and incidents due to weather and bad road conditions will go down - Drivers and CVO managers report improvements in safety due to ITS
Increase mobility of truck travel	- Travel time - Travel decisions/behavior - On-time delivery - Problems encountered on roads	- Better trip planning leads to more timely, reliable trips - Use of information alters trip decisions/behaviors, leading to enhanced mobility - Ability to avoid weather and hazard problems on roadway increases mobility and throughput
Increase efficiency of CVO operations	- Management of timing/routing - Costs of operations	- ITS helps take the guess work out of the truck dispatch process, thereby increasing efficiency - The overall costs of operations are reduced
Increase satisfaction of CVO drivers	- Awareness of information - Use of information - Reported satisfaction	- Drivers are more aware of information availability - Drivers make more use of available information - Drivers' comfort increases and stress associated with potentially dangerous driving situations decreases

2.4.2.1 Pre-Test Activities: Baseline

The first step in this assessment was to create a comprehensive list of all the CVO companies that have active operations in the study region. This is composed primarily of trucking companies based in Washington State who use truck routes that pass through the SR 395 and SR 20 corridors and neighboring roadways in the rural area north of Spokane. It also includes companies based in adjacent states and Canada who have active truck operations through this corridor.

WSDOT provided a list of company contacts that they keep in order to notify these companies by phone when there is a road closure due to a hazardous situation in the region. A much more comprehensive list was obtained from the Washington Trucking Associations (WTA), whose membership includes most of the truck companies in the state and all of the major operators. WTA provided names, addresses and phone numbers for their Spokane chapter members and any others they believed operated trucks in the study area. The trucking associations of Oregon, Idaho, and British Columbia were also contacted to supplement the list. The final working list for the baseline telephone interviews contained 86 names and phone numbers (Appendix A). These companies ranged from major national carriers to smaller regional firms to one-person truck operators.

A telephone interview form was designed to guide the interview process and record baseline data (Appendix B). The questions were designed to explore the hypotheses shown in Table 1 in order to be able to assess the mobility, safety, efficiency, and satisfaction impact categories. The information being gathered for this evaluation from drivers, dispatchers and related personnel includes the following:

- Frequency of travel in the corridor

- Types of vehicles operated in the corridor region
- User awareness of the information – knowledge of availability
- Users' reports regarding access to the information - information accessibility
- Users' frequency in accessing the information from traveler information sources
- Organization structure for the users and how information is disseminated
- Users' reports regarding use of the information – driver and company acceptance
- Users' perceived satisfaction/value of the information
- Ease of travel for travelers and CVO drivers who are aware of and are using the ITS deployments versus those who are not using ITS
- Perceived improvements in safety for users
- Savings in time traveling due to acquired information from traveler information sources
- Changes in timing and routing due to acquired information from traveler information sources

The phone interview form was pretested using several persons not otherwise associated with the project, and it was reviewed by WSDOT and WTA. Mock interviews were performed to assess understandability of the question wording and the length of the interview. This resulted in modifications of the content and question wording. A discussion of the implementation of the interviews is included in the chapter on the analysis of baseline data. The experience gained in talking with CVO drivers and operators will lead to further refinements of the interview form, both to take advantage of what was learned about CVO operations in the baseline and to focus more directly on the impacts due to the new ITS installations that will be operational during the Phase III phone interviewing.

In preparing for the Phase III interviews the contact list will be updated and expanded to reflect any changes in the mix of truck companies operating in the study region. In addition, every effort will be made to contact the same companies and individuals that were contacted during the baseline data collection to facilitate a comparative before and after evaluation.

2.4.2.2 Pre-Test Activities: Post-Deployment

After establishing a baseline understanding of what information is currently used and needed by commercial vehicle drivers and dispatchers to safely and efficiently operate their businesses in the region, the next step will be to evaluate the impacts and benefits of the ITS equipment that will be installed in the fall of 2001. The post-deployment telephone surveys will be conducted in the spring of 2002 (see Figure 2), using a modified telephone interview format very similar to that used in the baseline collection effort and using an updated version of the contact list prepared for the baseline interviews. The process of refining the interview guide will include examining the preliminary guide to ensure that the following questions are addressed:

- Do questions solicit appropriate responses?
- Would closed or open-ended questions provide the best information?
- In what order should the questions appear?
- How long should the interview guide be?
- Does the interview guide adequately address the specific hypotheses the survey is designed to test?

Ideally, pre-testing would be done with 2 – 5 individuals (drivers, dispatchers or stakeholders) to ensure the interview guide meets these criteria. Once specific questions have been finalized, the questionnaire will be formatted to enhance readability and conversational flow. Information from the CVO phone interviews may be supplemented with focus groups and a few interviews with key stakeholders.

The general information asked as a part of the telephone interview such as title, organization name, location, number of years in operation and business type provides a way to identify who uses the corridors, where the users are coming from, what they are hauling, and how long they have been using the corridor. Although it is not feasible to successfully interview every CVO contact on the list, a large enough sampling of companies that vary considerably by size and business activity, suggests that the completed list of CVO respondents is likely to be reasonably representative of the entire group of applicable CVOs.

Phase III data collected concerning travel and mobility of commercial vehicle operations will be used for comparative purposes with the baseline data. The comparison will indicate whether or not improvements in driver safety and efficiency, and the travel and mobility of CVOs are due to the availability of the new ITS equipment in the SR 395 and SR 20 region.

2.4.2.3 Test Activities: Data Collection

The data will be collected from phone interviews with the CVO representatives and stored in a database and analyzed in order to explore the hypotheses laid out in Table 1. The analysis will compare the post-deployment conditions with the baseline conditions in order to assess changes that may be attributable to the increased availability of ITS information in the region from this project.

2.4.2.4 Post-Test Activities: Data Analysis and Interpretation

The analyses will include a descriptive presentation of values on all the measured variables under both baseline and post-deployment conditions. In addition, it will include an exploration of pertinent relationships in the data that will examine changes between "before" and "after" conditions as well as the use and benefit of the various ITS components by geographic location, and by characteristics of the CVO operators, such as truck type, load type, intensity of use of particular road segments, and other variables of interest.

The analyses will explore which types of trucks and CVO operations seem to make the most use of and benefit the most from the ITS capabilities. The analyses also will examine how the CVOs use the different kinds of ITS capabilities in the various locations. Issues related to driver flexibility and autonomy in changing trip timing and route selection will be addressed, along with the balance in different companies regarding where such decisions are likely to be made, such as by dispatchers or drivers or both.

We also want to know how CVO users feel about the value of the ITS information and for what purposes they use the information. This will provide data regarding user satisfaction. It will allow us to see if drivers' and dispatchers' travel planning is eased and safety enhanced by better timing and route choices. We expect that the ITS applications will assist CVOs in determining trip timing, routing and destination. Our questions will probe the amount of time saved by using HAR, RWIS and the cameras. We also expect to see fewer police reported accidents due to the use of these information sources in the corridor.

Finally, we will collect users' suggestions regarding further changes to the information sources or content that could be made to provide greater usability by truck drivers.

2.5 TEST PLAN: TRAVEL AND MOBILITY FOR PUBLIC TRAVELERS

2.5.1 Background and Test Objectives

Members of the public use the roadways in the study region for a variety of purposes, including commuting, sightseeing, personal business and recreation. SR 395 and SR 20 are also used as routes to access places outside the study area. Thus, public travelers using these roadways may live in the study region, may travel to various destinations within the region, or may simply be traveling through the region. Benefits that may accrue to these general travelers are expected to be similar in some respects to the benefits expected for commercial users in this corridor, including:

- Safer travel by helping all members of the driving public avoid dangerous road and pass conditions, whether caused by snow, ice, rain, slides, construction, or other road hazards.
- More efficient travel experience by providing drivers with information that helps them make better trip timing and route selection decisions.
- Increased comfort and reduced stress for drivers by providing them with more accurate and current information about conditions on the routes they plan to travel.

2.5.2 Approach

The anticipated impacts and measures that were described in the Evaluation Plan are guiding this assessment, and they are summarized in Table 2.

In order to assess impacts and benefits for the general driving public that are attributable to the planned ITS deployments (mobile HAR, RWIS, and cameras), data need to be collected directly from drivers who are using this corridor region. The resources that would be required to conduct a general population survey, or otherwise identify a comprehensive population of users of these roadways would be quite large and inconsistent with the scope of this evaluation study. To try to collect both baseline and post-deployment public survey data would also be costly and not likely to yield a commensurate benefit. Also, since the commercial users were identified at the outset to be a primary target of the evaluation and members of the general driving public as secondary, we decided on a simpler but still worthwhile research design. The approach will be to conduct a web-based survey on WSDOT's relevant traveler information web pages as part of Phase III, after the new information sources have been made available. This strategy will yield data from individuals who are aware of and use the Internet to plan their travel in this region. More details about the proposed approach are discussed in the test plan below.

TABLE 2. ANTICIPATED IMPACTS AND MEASURES FOR PUBLIC TRAVELERS

Objectives and Anticipated Impacts	Evaluation Measures	Hypotheses
Increase safety	- Number of accidents - Perceived safety improvements	- The number of accidents and incidents due to weather and bad road conditions will go down - Drivers report improvements in safety due to ITS
Increase mobility	- Travel time - Travel decisions/behavior - Problems encountered on roads	- Better trip planning leads to more timely, reliable trips - Use of information alters trip decisions/behaviors, leading to enhanced mobility - Ability to avoid weather and hazard problems on roadway increases mobility
Increase satisfaction	- Awareness of information - Use of information - Reported satisfaction	- Drivers are more aware of information availability - Drivers make more use of available information - Drivers' comfort increases and stress associated with potentially dangerous driving situations decreases

2.5.2.1 Pre-Test Activities: Baseline

As noted above in the discussion of the approach, baseline data are not being collected from general travelers. An additional rationale for this strategy is that relatively little traveler information is currently available to the general public at this time that pertain to this relatively remote rural part of the state, either over the Internet or via traditional media such as radio or television. The central objective of this earmark project is to enhance the availability of road/weather traveler information.

2.5.2.2 Pre-Test Activities: Post-Deployment

Once the ITS equipment has been installed in the late fall of 2001, WSDOT plans to advertise the availability of the new information to the general traveling public in this area. After allowing for a few months of awareness building, a short survey will be posted on the appropriate pages of WSDOT's traveler information Internet sites. Detailed placement of a banner inviting the web site users to respond to a survey will be discussed with WSDOT personnel, but the sites are candidates for this survey include WSDOT's traveler information pages and the rWeather web site. Site users who click on the banner will be taken to the survey, and once they complete and submit the survey, they will be returned back to the traveler information page they came from.

Respondents who agree to fill out the survey will be a self-selected sub-group of users, rather than a representative sample of visitors to these web sites. Furthermore, the group of respondents will be composed only of those who access the Internet, and will not include representation of travelers who may travel in this region but do not have access to the Internet, for whatever reasons. For these reasons, the results of this approach will not allow us to generalize findings to all travelers in this region. However, the results will provide useful feedback on how some users of traveler information use and value the kinds of new capabilities that are being introduced under this earmark program.

Although no baseline was established for this chapter, the Phase III evaluation activities will provide an understanding of what information is currently used and needed by the many public travelers in the SR 395 and SR 20 corridor to safely and efficiently travel in the region. The information gathered for evaluation will probe drivers concerning:

- Personal information including name, where they are located and contact numbers (optional)
- Drivers' use of the two main routes, and linked routes in the corridor
- Frequency of use in the corridors, such as number of one-way trips per week per user
- Which sources of road/weather and traveler information drivers use
- Users' access to road/weather and traveler information from the two HAR at Republic and Kettle Falls and two RWIS and web cameras at Sherman Pass and Loon Lake
- Users' frequency of use and acceptance of information from the HAR, RWIS and web camera equipment
- Does the traveler information assist in making pre-trip and/or en-route decisions concerning travel timing, route choice and destination
- Users' satisfaction with the HAR, RWIS and web cameras
- Suggestions for improvement or desired changes to the information sources or content to provide greater usability

Before the survey is put on the web, it will be reviewed with the project partners, compared with several other Internet-based traveler information surveys previously conducted by the study team, reviewed by in-house questionnaire experts, refined, and pre-tested among a few persons currently unfamiliar with this study. Criteria to be considered are the reasonableness of the length of the survey, a balance between closed and open-ended question types, the order and wording of individual questions, clarity and understandability, and the survey focus in terms of relevance to the test hypotheses shown in Table 2. Once the individual questions have been finalized, formatting for readability and conversational flow enhancements will be performed.

2.5.2.3 Test Activities: Data Collection

The survey will be posted on the Internet during the winter of 2001-2002, as shown in the evaluation schedule in Figure 2. The public motorists who access the selected WSDOT web pages will be asked to answer the Internet survey and submit their responses and comments, so we can learn how they may have used the ITS equipment in the region. The resulting information will be logged into a database for subsequent analysis.

2.5.2.4 Post-Test Activities: Data Analysis and Interpretation

After the survey period is over and the data have been collected, the data will be analyzed to address the hypotheses formulated in the Evaluation Plan.

The Internet survey begins by asking general questions about the individual, including name, location and other general contact information, and travel patterns in the study region. This information will help classify travelers so that we can assess whether traveler type or characteristic is relevant to information use patterns. It also should allow an assessment of how similar or dissimilar this sample of respondents is in comparison with general population characteristics.

The survey will provide data on the frequency of respondents' travel in the various key corridors in the study region, along with data on motorists' use of road/weather and travel information, and their use of the various ITS equipment. On a comparative basis, analysis of the types, accessibility, frequency of use, and satisfaction with each information source will be evaluated. The data analysis will focus on the extent to which motorists are using this new technology available to them and their level of satisfaction with the information provided.

We will evaluate the usefulness of information sources in the region by determining when and if motorists use information from the HARs, RWIS and the web cameras to make pre-trip and/or en-route decisions concerning travel timing, route choice, and destination. Analysis of the public survey will assist in understanding whether and how the information is affecting travel time and travel behavior patterns, and providing safer travel in the SR 395 and SR 20 region. Also, we will determine what changes to the information sources or content could be made to provide greater usability and benefit to the traveling public.

As mentioned earlier, this research method will not yield a representative sample of the traveling public in the study area, but rather a self-selected group who used the Internet site(s) and opted to complete our voluntary survey. These constraints will be accounted for in the data analysis portion of the evaluation.

2.6 TEST PLAN: INFRASTRUCTURE OPERATIONS AND MAINTENANCE

2.6.1 Background and Test Objectives

The new road and weather information technologies that will be installed under this earmark program offer significant benefits to the regional transportation road operators/maintainers, as well as emergency management personnel. WSDOT's ability to efficiently and safely manage the road systems in this region, as in any other part of the state, depend on knowing where and when to deploy their staff to fix degraded sections of roadway, sand and plow roadway in the winter, set up diversions and warn drivers of hazardous road conditions, and plan efficiently for the general maintenance and upkeep of the road systems. The ITS systems being installed, including the mobile HAR, RWIS stations, and cameras are being strategically located in areas where WSDOT has had problems in the past, such as with the Sherman Pass and Loon Lake areas, particularly in the winter time. The mobile HAR facilities allow WSDOT to be responsive to rapidly changing road-weather conditions in the region, and the cameras allow for remote monitoring. The information gathered by these systems are expected to have a variety of benefits for WSDOT's operations and maintenance as outlined below:

- WSDOT road maintenance operations can be conducted in a more timely, efficient and cost-effective manner, given more current and accurate information about road-weather conditions throughout the region.
- The more efficient assignment of maintenance equipment and personnel will have secondary benefits for all travelers throughout the region, providing for safer and timelier trips.

- Road closure and maintenance decisions can be made in a more timely and effective way.
- Emergency services providers can respond more quickly and effectively to emergency situations.

2.6.2 Approach

The anticipated impacts and measures that were described in the Evaluation Plan are guiding this assessment, and they are summarized in Table 3.

TABLE 3. ANTICIPATED IMPACTS AND MEASURES FOR INFRASTRUCTURE OPERATIONS AND MAINTENANCE

Objectives and Anticipated Impacts	Evaluation Measures	Hypotheses
Increase the efficiency and accuracy with which staff and resources are allocated to meet road maintenance needs and achieve high Levels of Service (LOS)	- Reported change in or improvements in the purposeful allocation of resources - Accuracy with which staff are assigned to road problems - LOS performance records	- With better information, road maintenance crews will be assigned more efficiently to locations where the need is greatest - Capital resources, such as snow plows or maintenance vehicles, will be used more efficiently, in terms of spending a higher percentage of time focused on road problems - LOS are met or exceeded using new information sources
Improve the quality of road closure decisions	- Perceived accuracy of road closure decision-making	- Roads are closed more efficiently and accurately using the new information on road-weather conditions
Reduce the number and severity of incidents and requirements for incident response	- Incident response times	- Emergency service providers (e.g., police, fire) are able to respond more quickly to incidents, both due to access to better information and due to more efficient and safer maintenance of road conditions

The objective of collecting and evaluating information related to infrastructure operations and maintenance is to verify safer, more efficient practices and procedures due to information available from the two HARs located at Republic and Kettle Falls and the three RWIS and web camera sites located at Sherman Pass, Laurier, and Loon Lake. Information regarding WSDOT O&M procedures will be obtained through discussions with key operations and maintenance personnel. Interviews will be conducted to gather information about how the use of the ITS equipment changed their decisions and procedures to operate and maintain the project corridors. Event information will be gathered using an Event Log form (Appendix C) and from WSDOT records of the timing and content of messages displayed on the HAR equipment. An event is defined as anything that has an adverse effect on traffic, potential safety impact, or causes a major road delay, and in addition precipitates a WSDOT response. The information gathered for evaluation will cover:

- Patrol/maintenance records for SR 395 and route 20
- Usage of traveler or road/weather information by maintenance and operations agencies in the region
- Patrol/maintenance's accessibility, frequency of use and type of use of the available information sources

- Allocation of staff/resources due to HAR, RWIS and web cameras to avoid extreme conditions and save time – number of hours
- Travel conditions throughout the year
- Road closure schedules, procedures, maintenance and operation
- Impact of ITS equipment on the incident response process – time savings
- Maintenance and Operation personnel's satisfaction with the ITS deployments
- Specific maintenance performed on HAR, RWIS and web cameras throughout the year
- Hours of down-time for each individual ITS deployment other than scheduled down time
- Personnel's changes to ITS equipment to enhance usability
- When, how and from whom did the event information arrive
- A description of the decisions and actions taken to respond to the event
- O&M personnel's adaptation to the event-based information acquired from HAR, RWIS or the web cameras

Personnel who oversee maintenance and operation work in the SR 395 and SR 20 corridors, and who can be contacted during the test period, will be asked to provide input for this evaluation. They will provide information for the ITS equipment after installation and throughout the following winter season. Copies of the Event Log form have been distributed to WSDOT operations staff to gather baseline data. Event Logs will continue to be filled out, and HAR records will be recorded beginning in the fall/winter of 2001 through the spring of 2002 by DOT maintenance staff (see evaluation schedule in Figure 2). Note that the Log forms as provided to WSDOT are printed front and back on one page, with all the requested information on the front page and the map on the back with room for adding additional comments.

As shown in Appendix C, the Event Log was originally developed to record information about significant road-weather events in the study corridors and WSDOT's decisions and responses to those events for the winter period between February and April 2001. However, in part due to the extremely mild winter experienced in 2001 that has resulted in very few recordable events, and because other kinds of events also may occur that disrupt travel and call for WSDOT responsive actions, we agreed with WSDOT that they will continue to record events as they occur on a continuous basis. We have subsequently learned that personnel changes have occurred in WSDOT that interrupted the recording of events, and this is currently being addressed.

As can be seen from the form in Appendix C, the Log is intended to record a brief description of each event, the timing of the event, how information about the event was obtained, actions taken by WSDOT and emergency service providers to respond to the event, and a description of the impacts from the event on travel in the corridor. The individual who records the event information into the Log is also asked to note the event location on a map of the region.

Because the past winter was so mild and few events occurred, in comparing post-deployment ITS impacts to the baseline conditions, we will assume that WSDOT responses to the few events logged during the baseline data collection period represent current operations and maintenance procedures. The log data will be augmented with current standard procedural information derived from key operations and maintenance personnel interviews. We have received and continue to anticipate a high level of cooperation from WSDOT in the information gathering and interpretation process.

2.6.2.1 Pre-Test Activities: Baseline

Pre-test activities include: design and development of interview protocols and an Event Log record form, development of the data collection instrument for various O&M records, and preparation of a maintenance and operation personnel interview list. The interviews, HAR records, and logs will generate the data needed to test the hypotheses identified as a part of the Evaluation Plan.

The Infrastructure Operations and Maintenance evaluation area focuses on the possible changes in procedures and/or decision processes due to the use of ITS equipment to assist in the operations of the SR 395 region. Through event log data collection and interviews, a baseline has been established that defines current conditions with regard to O&M in the region. The baseline will be the point of comparison with post-ITS implementation data to identify changes in procedures due to the new ITS capabilities that lead to increased operational efficiencies such as faster road clearance, fewer delays, reduced personnel requirements, and more cost effective allocation of capital resources.

Collection of the baseline data for existing conditions falls into two categories: 1) maintenance and traffic control operation procedures, including resource management, and 2) decision processes and resulting actions in response to major events (e.g. severe winter weather, heavy rain/flooding, major incidents or other similar events that disrupt or have the potential to disrupt traffic flow).

The region's WSDOT traffic and maintenance engineers were interviewed in order to better understand current operations and maintenance procedures in the region and to identify potential opportunities and constraints of ITS usage. Also during the baseline data collection period, the WSDOT Maintenance and Operations Superintendent and his staff recorded events into the log form that was designed for this purpose by the evaluation team. As noted above, very few events were recorded during this past winter-spring season due to an unusually mild winter, and therefore these "before" events and the O&M responses to them are being supplemented with more detailed procedural information derived from O&M staff interviews.

2.6.2.2 Pre-Test Activities: Post-Deployment

The experience and insights gained in conducting the baseline O&M interviews and data collection contributed to a preliminary draft of a HAR Log procedure and an interview protocol for guiding interview discussions with various key DOT staff. Pending approval to proceed with Phase III evaluation activities, the interview process and log forms will be further refined as a part of the initial pre-test activities. These will be carefully reviewed and tested with knowledgeable individuals.

Regarding HAR data, we will first assemble a complete set of approved message sets as developed and provided by WSDOT. These will constitute the standard messages from which an operator will select the most appropriate message, given their understanding of circumstances on the road at the time. In addition to the standard message sets, the operator also will have the flexibility to post any message that appropriately describes the unique situation. These procedures will be verified with the DOT operators as these facilities are set up and as part of the Phase III planning. The message will be sent via phone to the HAR to be automatically up-loaded and broadcasted to members of the public traveling in the area. A HAR log will record information surrounding each new message posted on each of the HARs being installed under this project. This may include:

- Name of operator posting message
- Date, time of day message posted, and date and time of day message removed
- Exact message content
- Description of road-weather conditions that prompted posting the message, along with a brief description of the source of road-weather condition information
- Identification of which HAR the message was posted on and location/placement of the mobile HAR
- Any problems encountered with that particular message posting
- Any other information pertinent to understanding the situation surrounding the posting of the HAR message

2.6.2.3 Test Activities: Data Collection

During the winter of 2001-2002, maintenance and operation staff will log events and record HAR data. Following the winter of 2001-2002, key infrastructure operations, maintenance and patrol personnel will be interviewed to learn how they may have used the ITS equipment installed in the region. The evaluation will assess the nature of any changes that occurred in efficiency and safety in operating, maintaining and patrolling the region. Appropriate data will be stored in a database for subsequent analysis.

2.6.2.4 Post-Test Activities: Data Analysis and Interpretation

Data analysis will focus on addressing the hypotheses formulated in the Evaluation Plan and presented here in Table 3. Baseline information collected as a part of Phase II activities (obtained through logs and personnel meetings/interviews, and described later in this report) will be compared to post ITS installment information.

The interviews and meetings to be conducted with key personnel in Phase III are expected to address the following kinds of questions and issues. These topics will be refined and formatted into interview protocols prior to implementation.

- Do you provide patrol/maintenance in the SR 395 corridor region?
- How many hours/week do you patrol/maintain these roadway segments?
- Do you or your organization access traveler or road/weather information for this region prior to patrol or maintenance?
- What information sources do you access?
- Describe how the HARs, RWIS, and web cameras support maintenance and patrol personnel in carrying out their responsibilities by providing travel condition, maintenance time, and resource allocation?
- Give the approximate number of hours saved by using these information sources.

- Were road closures and road maintenance tasks performed more quickly and accurately using ITS information deployments?
- How satisfied are you with the traveler information provided by these ITS deployments in the SR 395 corridor?
- Have incident response times decreased since the installment of the HAR facilities, RWIS sites and web cameras?
- How many times was maintenance performed on the ITS deployments?
- Approximately how many hours of down time occurred with the ITS traveler information sources?
- In general, what are the equipment shut down periods (seasonal, etc.)?
- What changes could be made to improve accessibility and usability of the HAR, RWIS, and web cameras?

We expect that in the first year of operation, patrol and maintenance personnel will still be learning how best to utilize the new technologies; therefore, we anticipate that use will be moderate but increasing over time with training and experience.

2.7 TEST PLAN: SYSTEM PERFORMANCE AND RELIABILITY

2.7.1 Background and Test Objectives

The assessment of system performance and reliability of the new ITS systems that will be installed under this program constitutes a secondary focus of this evaluation, though the integration components of this goal area are of critical concern. Since these issues pertain primarily to the performance of new systems not yet installed and operational, baseline data collection was not warranted. This section will focus on test plans for Phase III activities. The anticipated benefits associated with these aspects of the evaluation include the following:

- The new ITS systems will perform at or above the expected level to provide data and information without interruption to system operators. These data in turn will support the provision of enhanced and reliable information to travelers, WSDOT O&M staff, and emergency personnel in the region.
- The integration objectives of this program will be achieved through the reliable and efficient sharing of data and information across an appropriate set of agencies and individuals both within and beyond the boundaries of the project corridor region.
- A high level of system performance and reliability will enhance the satisfaction of the system operators who are responsible for running and maintaining these systems.
- Ultimately, the costs of operating such systems that perform as expected with a high degree of reliability will be kept low.

2.7.2 Approach

The anticipated impacts and measures that were described in the Evaluation Plan are guiding this assessment, and they are summarized in Table 4.

TABLE 4. ANTICIPATED IMPACTS AND MEASURES FOR SYSTEM PERFORMANCE AND RELIABILITY

Objectives and Anticipated Impacts	Evaluation Measures	Hypotheses
Achieve high equipment reliability and reduce system down-time	- Mean time between failure of system components - Actual system performance versus expectations - Costs to maintain the system	- System operates properly > 95% of expected operational time - System performance meets or exceeds operator expectations - System maintenance costs will be reduced and kept low
Support and enhance the functional integration of systems	- Data/information accessibility and flow among appropriate agencies and organizational components and across target geography	- Institutional entities have ready access to data and information when they need it and in the form they need it
Facilitate institutional integration	- Stakeholder reports of quality of information exchange and data sharing	- Stakeholders report that ITS project has enhanced institutional integration
Achieve high level of operator confidence and satisfaction with equipment	- Operator reports of system quality and performance	- Operators report a high level of trust in and satisfaction with the new ITS systems and their successful integration with legacy systems

The performance and reliability of the ITS deployments will be evaluated by generating two types of data. First, we will collect equipment records for the two mobile HARs, three RWIS and three web cameras in the corridor. Equipment reports will be generated for the different ITS components that describe the performance functionality and quality of the devices. Test plans will be refined to evaluate if the systems operate at a level greater than 95% of expected operation time. A second type of data will be derived from interviews with managers, operators, and equipment maintenance personnel. These interviews will address whether project participants perceived that the equipment performed appropriately, that all involved personnel worked well together to achieve project objectives, and that the systems were well integrated from a functional and institutional perspective. Information will be gathered through operational reports and interviews to address questions such as the following:

- System down time – mean time between failure or system downtime due to a failure versus expected total operation time;
- Scheduled maintenance or system malfunction;
- Documented problems with integration of the components with management centers (i.e. problems with data collection and dissemination);
- Institutional integration (across agencies and geographies); and
- Stakeholders' accounts of how well people worked together during the project, and how well data and information sharing was facilitated by the systems.

Information will be collected through operational data records. Previous interviews and event logs associated with the other goal areas will assist in formulating the approach to the collection efforts for this focus area of system performance and reliability. These records will be collected upon the installation of the ITS equipment and during the first year of operation. It is anticipated that maintenance personnel will assist in the logging and reporting efforts.

2.7.2.1 Pre-Test Activities: Baseline

As discussed above, no baseline data collection was planned or conducted with regard to this goal area.

2.7.2.2 Pre-Test Activities: Post-Deployment

Before the data collection effort begins, two pre-testing activities will be completed. The ways in which operational data from the ITS equipment are generated need to be understood, and maintenance personnel need training in gathering and organizing equipment records. The operation data from the ITS equipment should adequately show all the information needed to respond to the identified hypotheses of the Evaluation Plan. Data reports will provide collected information for testing purposes. Training will ensure a consistent, organized process in gathering the equipment records. However, further refinement and organization of the equipment operational data will be needed as a part of the data analysis process.

2.7.2.3 Test Activities: Data Collection

During and following the installation of the HARs, RWIS and web cameras, reports will be prepared for the 2001-2002 operating years. These reports will be reviewed to calculate ITS system mean time (operational) between failure or system downtime due to a failure versus expected total operation time. Verification of a 95% system operating performance will be completed. System inefficiencies will be identified and documented. From the data reports and key personnel interviews, perceived integration concerns will also be noted. Data also will be collected based on key personnel interviews to assess the institutional effects of this ITS program.

2.7.2.4 Post-Test Activities: Data Analysis and Interpretation

A database will be created for organizing and analyzing the information from reports and system element records. The analysis will address the hypotheses formulated in the Evaluation Plan and presented in Table 4. The analysis will compare actual performance with expected operation time at the time of system design. Calculations on each of the ITS systems will be completed to verify whether a level of performance greater than 95% of expected operation time is achieved. Then users satisfaction and ease of access to data and information will be evaluated, and the level of institutional integration will be documented and interpreted.

The collected data records and personnel interviews will assist in understanding the overall degree of integration of all ITS equipment elements, based primarily on stakeholders’ accounts of how well people worked together during project installation and operation.

2.8 TEST PLAN: SAFETY

2.8.1 Background and Test Objectives

The objective of the safety evaluation is to identify whether or not improvements in driving safety are occurring due to the availability of new and better road-weather traveler information. Accident data will be examined and existing baseline safety conditions in the study corridor will be described. Any changes in motorists' safety experience in the SR 395 region will be evaluated by investigating the accidents statistics over a specified time in the region, from before the ITS improvements are installed to after they are operational.

Accident/incident data reports have been obtained, organized and analyzed to document and understand both the recent history and current safety conditions in the region. Data reports were obtained from the Transportation Data Office (safety databases) in WSDOT for those years for which complete data were available. The state is currently completing and updating their historical records, and the complete data set is expected to be available by the end of 2001. Also, additional safety related information was collected from commercial vehicle operators in the corridor during the telephone interviews discussed in Section 2.4.

The safety information is being collected and evaluated for two particularly problematic route segments in the region; namely, portions of SR 395 and SR 20.

The safety benefits anticipated to be derived from the new ITS installations include:

- A reduction in crashes, accidents, and road incidents
- A reduction in traveler exposure to unsafe road conditions in the region
- Changes in traveler awareness and behavior that leads to safer travel experiences

2.8.2 Approach

The anticipated impacts and measures that were described in the Evaluation Plan are guiding this assessment, and they are summarized in Table 5.

The goal area of safety is a secondary testing and evaluation effort, primarily because of the difficulty we will face trying to derive valid inferences from only a few month's worth of post-deployment accident data. The state accident database is the primary source for safety information in the study corridor, and it contains records for all police reported crashes and incidents. Using these data, we plan to measure the impacts of the mobile HARs, RWIS and web cameras on travelers' safety in the corridor region. The evaluation will assess crash and other road incident records for the SR 395 and SR 20 corridor region for the year following the ITS deployments (i.e., 2002). Specific crash data will be collected showing the number, types, causes, severity, and other characteristics of the reported incidents in the corridor. Test plans will be designed to analyze recent crash records, evaluate the contributing factors of these crashes, and compare the records with the safety baseline conditions, as presented in Section 3.4.

TABLE 5. ANTICIPATED IMPACTS AND MEASURES FOR SAFETY

Objectives and Anticipated Impacts	Evaluation Measures	Hypotheses
Reduce number and severity of crashes and road incidents	- Number of vehicle crashes, accidents, incidents - Perceived changes in travel safety in the region	- The number of crashes, accidents and incidents due to weather and bad road conditions will go down - Drivers and WSDOT/WSP report improvements in safety due to ITS
Reduce traveler exposure to unsafe road conditions	- Changes in awareness and use of traveler information - Changes in travel decisions before and after project	- Traveler diversion around hazardous road conditions will be more timely and effective - Travelers will become more aware of road-weather information after the project than before - Travelers will use the new information to adjust their travel plans to increase the safety of travel

Accident records for the region were available for the years 1992 to 1996. We will update the complete baseline information using 1997 to 2000 data that are expected to be made available by the end of 2001. This will allow analysis, evaluation, and comparisons to be completed for the most recent years. The completion of the post-implementation analysis of accident data similar to that shown in Section 3.4 will provide the information needed to complete the before-after analysis to see how the new ITS systems may have affected the safety of travel in this region. The evaluation will look for changes in the safety data that may be attributable to the availability of improved weather and road condition information in the corridor region. The evaluation will assess whether the recently installed HARs, RWIS, and web cameras are, in fact, assisting motorists in safer travel in the region. The information gathered in these incident reports that will be compared with baseline conditions and evaluated in terms of the following indicators:

- The number of crashes in the project area for the year after the ITS deployments.
- Severity of the crashes that occurred in that year
- The type and cause of incidents
- How many and what kind of vehicles were involved in the incidents
- What time of day the incidents occurred
- Road surface and weather conditions in the corridor at the time of the incident
- Common locations where the incidents occurred along the corridors

We will request the detailed safety data report from WSDOT, similar to the baseline reports, for the entire year following the installation of the ITS equipment. It is anticipated that the information will be obtained in the same format as the baseline data (Appendix D). Information from the WSDOT database will be converted into a working database file for analysis purposes. Analysis and evaluation will be completed to verify improvements in safety to motorists.

The analysis and presentation of results will include the tallying, organization and creation of graphs and percentages similar to what is shown in Section 3.4 for the baseline conditions. It will be assumed that the post-ITS installation information for the duration of a year will typify the benefits of the ITS equipment for future years. A year similar in weather severity and number of events will be used to provide what may be a more appropriate alternative point of comparison. Persons in the state who are knowledgeable about the safety data will assist in the review and interpretation of findings from this evaluation.

Although safety is a primary concern of WSDOT and a major consideration in motivating the deployment of additional road-weather equipment to provide travelers with better information in this region, it will be very difficult to determine measurable safety benefits with only one season of “after” safety data. The baseline data collection and analysis covers about nine year’s worth of safety experience in this region, reflecting a range of weather and other conditions that affect safety outcomes. We will make a best effort to compare these “before” data with a season’s worth of “after” safety data in Phase III, supplementing the “after” data with interview data (e.g., WSDOT, WSP, CVOs, other travelers in the region) to help interpret the effects of the new ITS systems on safety outcomes. Notwithstanding these methodological challenges, we see significant value in conducting an analysis of safety events in this way to help better understand how various factors are influencing overall safety in the study region.

2.8.2.1 Pre-Test Activities: Baseline

As has been discussed above, the baseline data for the evaluation of the safety goal area rely on highway accident records that are maintained by the State of Washington. The records pertinent for the study region have been obtained for the years 1992 through 1996, and these will be supplemented with the remaining data from 1997 to the present as soon as on-going revisions to the state’s database are completed at the end of 2001. The procedures and results of the safety baseline analysis are presented in Section 3.4 of this report.

2.8.2.2 Pre-Test Activities: Post-Deployment

Pre-test activities will be minimal for this focus area, as they will be modeled after the baseline safety assessment. After the database structure has been refined, as may be needed based on our experience to date, the test data collection efforts may begin. WSDOT’s updated safety database will provide all necessary information for testing and evaluation.

2.8.2.3 Test Activities: Data Collection

Following the installation of the HARs, RWIS and web cameras in the fall of 2001, we will observe the ensuing year of motorists’ use of the ITS deployments, and crash reports will be organized from the information in WSDOT’s database for the following route segments known to be the most problematic in the region:

- On SR 395 between Spokane and Colville (focus was on the segment between Loon Lake/Deer Park and the junction of Route 231)
- Colville/Kettle Falls to Republic, specifically Route 20 over Sherman Pass from the junction of SR395 (just west of Kettle Falls) to the junction of Route 21 (Republic)

Reports will be reviewed and data verified to ensure all pertinent information is included and the time period is correct, and the data will be loaded into a database for analysis.

2.8.2.4 Post-Test Activities: Data Analysis and Interpretation

Analyses of the data will be handled in a way similar to that reported for the baseline conditions (Section 3.4), but with the addition of a comparative assessment of *before* and *after* data. First, we will examine the total number of incidents and the percent of the total number of incidents related to weather conditions. Primarily, the focus will be on addressing the hypotheses established in the Evaluation Plan and presented in Table 5. This includes understanding the number and severity of crashes that occur in the project area and verifying self-reported changes in travel decisions (due to information acquired by ITS deployments and safety considerations) before and after project deployment. We can anticipate that the post-deployment safety experience will be similar to the baseline conditions, which suggests we will find approximately 20 to 40 incidents for SR 20 and 40 to 70 incidents reported for SR 395 during the year. It is expected that approximately 50% of the total incidents will be weather related.

The available information will be analyzed to identify high accident/incident locations. We will be interested in comparing the high incident locations and their characteristics in the before and after scenario. We expect that the high accident locations will be similar to what we found in the baseline conditions. Where these locations coincide with increased motorist access to new road-weather information, we will look to see whether there are measurable safety improvements reflected in the accident statistics.

Finally, severity, type, cause, time of day, and vehicle type information will be specifically grouped with the weather-related incidents to understand other factors contributing to the cause of the incident. This assessment will further contribute to answering the hypotheses developed in the Evaluation Plan. We expect that incident causes will be closely related to what we found previously under the baseline conditions. For example, vehicles operating at speeds excessive for the conditions will contribute to a majority of the incidents, and weather and road conditions will be important contributing factors.

3.0 BASELINE EVALUATION RESULTS

3.1 INTRODUCTION

This chapter describes the results of the baseline analyses performed in Phase II of the earmark evaluation process for the following three of the five goal areas:

- Travel and mobility for commercial vehicles
- Infrastructure operations and maintenance
- Safety

Discussions of measures and hypotheses, along with the procedures used to collect the data, were presented earlier in the discussions of the test plans for each of the goal areas. As discussed previously, no baseline data collection was conducted for the remaining two goal areas covering travel and mobility for public travelers, and system performance and reliability. The evaluation for these two goal areas will be conducted after the ITS systems are in place and operational.

The presentation and discussion of baseline evaluation results constitutes only the first part of a full evaluation analysis. The baseline lays the ground work for being able to examine hypothesized changes due to the forthcoming ITS installations in a "before" and "after" analytic framework. For this baseline report, we will provide a description of current conditions with regard to the three goal areas covered. An important component of the baseline investigation is to understand what information is available now and how travelers and system operators are using that information. The baseline is not a clean slate with regard to road-weather information. While the information is limited, we expect to gain some insights into the impact that such information is having on users of the roadways in this region, along with an understanding of what additional information they would like to have. The baseline analysis will offer insights into potentially fruitful lines of inquiry that will be pursued in Phase III, if a decision is made to proceed to that phase of the evaluation.

3.2 TRAVEL AND MOBILITY FOR COMMERCIAL VEHICLES

This section presents the results of the analysis of data collected from telephone interviews with 42 Commercial Vehicle Operators (CVO) who report that they operate one or more trucks in the study region. The baseline methods and procedures for gathering the interview data are described in Section 2.4 of this report.

The CVOs included in our interviews are assumed to represent a cross-section of the kinds of businesses that generate truck traffic in and through the study region. Figure 3 shows the distribution among our respondents of business types. The lumber business predominates, with 38% of the respondents indicating that their company operates one or more log or lumber trucks in the study region, and an additional 12% operate trucks carrying wood by-products—half of all the companies in our sample.

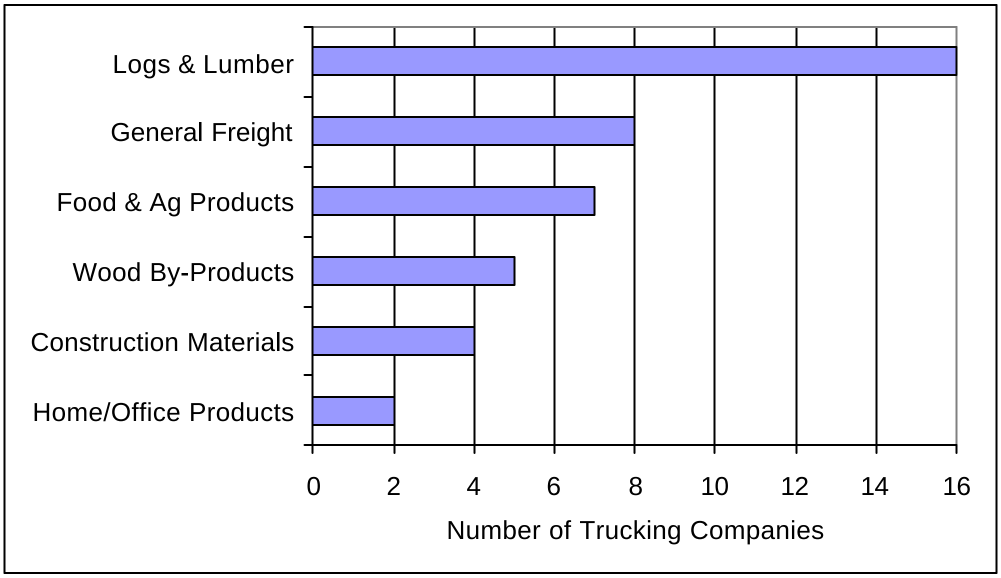


FIGURE 3. NUMBER OF TRUCKING COMPANIES BY CARGO TYPE

This evaluation will examine whether differences in the type of business and truck type makes a difference in whether or not road-weather information is of value to the companies, how frequently they make use of such information, and how their truck drivers respond as road-weather conditions change. Relevant factors may include the type of truck used, the intensity of their use in these corridors, whether they travel frequently in the most hazardous parts of the corridor, and what alternative route options they say they have. Previous discussions with a logging company representative indicated that log truck drivers believe they can drive through any road-weather conditions due to the weight and traction afforded by their vehicle type and load. The chip haulers, on the other hand, apparently perform less reliably when there is snow on the roads. It may be that independent truck owner/drivers respond differently than company drivers due to economic or business reasons. Some of these kinds of differences in how CVOs are likely to respond to road-weather conditions will affect their use of traveler information. Some of these effects can be examined in the baseline phase, while the effects of this ITS project will only be understood in the Phase III part of the evaluation when the CVOs are reinterviewed after the availability and quality of ITS-based road-weather information is expanded.

We next examined the CVO types of businesses that were shown in Figure 3 to learn more about their activity in the two corridors of interest in this evaluation. The 42 companies interviewed operate 2,037 trucks in the study region. Most of these companies operate trucks on both SR 395 and SR 20, but with widely varying intensity, ranging from one one-way trip per week up to a reported 318 trips per week. Over all, the average number of one-way trips per week on SR 395 is 43, and the average for SR 20 is 26 one-way trips per week. Of the total 2,688 one-way trips per week reported, about 66% occur on SR 395 and 34% on SR 20.

TABLE 6. INTENSITY OF CVO USE OF STUDY CORRIDORS BY BUSINESS TYPE

CVO Business Type	Number of Cases	Average Number of Trucks per Company	SR 395		SR 20	
			Average Trips per Week	Ave Trips per Truck per Week	Average Trips per Week	Ave Trips per Truck per Week
Logs & Lumber	16	3.8	28.8	7.8	13.0	3.5
General Freight	8	152.9	19.0	0.1	9.3	0.1
Food & Ag Products	7	44.6	13.0	0.3	2.6	0.2
Construction Materials	5	56.6	117.6	2.1	85.6	1.5
Wood By-Products	4	18.8	110.3	5.9	47.3	2.5
Home/Office Products	2	42.0	18.5	0.4	0.5	0.0
Totals:	**42**	**48.5**	**42.1**	**0.9**	**21.9**	**0.5**
Logs & Lumber	16	3.8	28.8	7.8	13.0	3.5
All Others Combined	26	76.0	50.4	0.7	27.3	0.4

As shown in Table 6, the experience of the log and lumber companies is different in some important ways from the other types of companies. The log and lumber companies represent 38% of our sample, but they account for only 3% of the total number of trucks operating in these corridors. Nevertheless, they operate those trucks at a relatively high intensity, with almost 29 trips per week on SR 395 and 13 trips per week on SR 20. The most intense use, in terms of the average number of trips made per week is by the construction materials carriers, who operate 60% of all the trucks in this sample. They average almost 118 trips per week on SR 395 and 86 trips per week on SR 20. This is a usage level between 4 and 6 times that of the log and lumber companies. However, if we look at the average trips per truck per week, we see a different picture.

Average trips per truck per week is a potentially important measure to consider, because it may be that the intensity of use of individual trucks is related to information use as or more significantly than the overall average number of trips per week for the company. It is plausible that these heavily driven trucks may be operated by a small circle of drivers who therefore have more individual exposure to conditions in these corridors compared to drivers of trucks driven less intensively. We will examine the post-deployment data to see whether and how driver exposure is related to the value of road-weather information.

Bigger companies with more trucks can be expected, all things being equal, to experience more trips per week. The log and lumber companies have many fewer trucks but they operate them in these corridors much more frequently on a per truck basis. In fact, a comparison between the log and lumber companies with all the other company types combined (Table 6) shows that the log and lumber companies experience almost 12 times the number of trips per truck per week on SR 395 and almost 10 times the number of trips per truck per week on SR 20. The wood by-products companies are the next most intense users by this measure, with all the rest of the company types substantially lower in per-truck usage.

A high percentage of CVOs indicated that their drivers use other routes besides SR 395 and SR 20 in the region north of Spokane. Listed below are routes mentioned most frequently.

- HWY 2
- SR 21
- SR 25
- SR 31
- I-90
- SR 97
- Route 211
- Route 231
- Route 290
- Route 292

The CVO respondents to the survey were also asked to consider all trips that were made by their drivers through this region and indicate the most frequent or common trips in terms of origins and destinations. The north-south route between Spokane and Colville on SR 395 was reported by 12 of the CVOs, and 7 CVOs reported they traveled on SR 395 between various cities on the route and the Canadian border. Trips between Colville and Kettle Falls and Kettle Falls and Spokane were reported by 4 CVOs.

We asked CVO respondents during the telephone interview whether they have a dispatch service in their company that provide guidance to their drivers about when and where they need to go. We also wanted to know whether the drivers had the discretion to make their own independent timing and routing decisions. This is a critical issue for this evaluation because we want to understand in the baseline how these companies and their drivers are likely to respond to improvements in the road-weather information that this ITS program plans to make available. In particular, drivers who have more discretion are more likely to be able to make pre-trip and en-route changes in response to real-time information. Dispatch services may also use better information to redirect their drivers when they think road conditions warrant a change in plans.

TABLE 7. FACTORS INFLUENCING TIMING AND ROUTE CHOICE BY CVO TYPE

		Logs & Lumber		Other CVOs	
		Can Drivers Independently Change Timing or Route?			
		Yes	No	Yes	No
Does CVO Have a Dispatch Service?	Yes	3	0	7	15
	No	13	0	3	1

Table 7 shows how the respondents characterize their companies with regard to these two topics, and points out important differences between the log truck drivers and all other CVO drivers. In the entire sample of 42 companies, 60% say they have a dispatch service, but only 19% of the log and lumber companies have that service versus 85% of the other companies. Furthermore, 62% of all the companies say that their drivers can independently change their timing and routing, presumably without having to rely upon specific guidance or authority from their company. When examining decision independence by company type, however, we see that 100% of the log and lumber drivers can make independent timing and route choices, while only 38% of the other company drivers say they have that discretion. These data should not be interpreted to mean that log truck drivers *will* change timing and/or routing in the face of current road-weather information; rather, they may decide to continue on as originally planned. The point is that they have the flexibility to make whatever decision they choose at the time, and that new road-weather information has the potential to be of most value to those drivers who can make their driving decisions freely.

We can also see that some of the CVOs that have dispatch services still allow their drivers to make independent on-the-road decisions. In some companies, drivers were able to use their own judgement based on the traveler information available to them; yet, if the dispatch center called for a change in the route or timing, then they were bound by the dispatcher's instructions. The telephone interviews revealed that for some of the very small truck operations, the husband might be the truck driver and his wife the "dispatcher" at home.

CVO respondents were asked whether their choice of which routes to take was affected by the seasons. This is of interest because the winter snow and spring thaw conditions can make some of the routes in the region particularly hazardous. The respondents were generally split of this issue, with 43 percent saying that the seasons do make a difference and 57 percent saying they do not. However, when asked to indicate the conditions under which they use available sources of traveler information to change routing, about one-quarter (26%) of the respondents said there were no conditions under which they would use information for route changes. Furthermore, there is no apparent correlation between their indicating that seasonality might impact their routing and their use of travel information for that purpose. These responses will be examined closely when considering how best to clarify the question wording for Phase III interviewing. The data do show that use of travel information by these CVO's drivers is somewhat more common for trip timing purposes; 86% of the respondents say their drivers use information that way, whereas 74% of the drivers reportedly use the information for route selection. Five of the drivers apparently use the information for trip timing and not for route changes, but everyone who reports using the information for route changes also uses information for timing. Only one CVO respondent reported that their drivers use travel information to alter their intended destination. Obviously, the data support the conclusion that most all of the trucks have an intended destination and that won't be changed, no matter what the conditions. The utility of travel information for these companies is greatest for making trip timing decisions, almost as useful for route selection decisions, but not used to change where they have to go.

In the course of the telephone interviews, some truckers told us that during harsh weather conditions they avoid mountain passes and stay on the bigger more used corridors. Alternative routes are chosen when lower elevations are reached off the passes. Truckers particularly try to avoid congestion in the SR 395 corridor by traveling on less traveled routes, such as SR 25 and HWY 2.

According to the interviews, 38 percent of the companies said they had no truck-related accidents or incidents resulting in a police report during the past year. Those who did reported an average number that ranged from less than one up to 6 truck-related incidents per year. Generally the larger companies that operated the largest number of trucks in the region reported the greater number of incidents. When asked if they thought improvements in road and weather information would improve travel safety and operations, all but three of CVOs responded affirmatively. This suggests that having access to improved road-weather information will be viewed as a safety benefit by most of the CVOs operating in this region.

Respondents to the survey were asked to indicate which specific sources of travel information their dispatchers and/or drivers currently used, how frequently they used these sources, and whether the use was pre-trip, en-route, or both. Table 8 illustrates the list of information sources available in the SR 395 region that were mentioned to the respondents during the interview. Because cell phones were mentioned by many of the respondents, we have included that source separately in Table 8 from a variety of less frequently mentioned sources. However, since respondents were not specifically asked about cell phone use, caution should be used in comparing those usage figures with figures for the specified information sources. If the respondent reported that a particular source was not available, that item was skipped and the usage questions were not asked.

TABLE 8. FREQUENCY AND TYPE OF USES OF AVAILABLE TRAVEL INFORMATION SOURCES

Source of Information	Not Available	Frequency of Use				Type of Use		Total No. Users
		Often	Sometimes	Rarely	Never	Pre- Trip	En-Route	
AM/FM Radio	0	5	20	13	4	37	14	38
TV	0	4	14	13	11	30	7	31
CB Radio	1	28	7	4	2	22	35	39
WSDOT	0	1	11	17	13	29	6	29
Highway Patrol	0	0	7	17	18	24	4	24
Internet	19	6	6	5	6	17	7	17
Cell Phone*	18	11	10	3	-	18	21	24
Others*	21	-	-	-	-	-	-	21

*NOTES: Cell phones were mentioned frequently by respondents under the “Other” category. Included in addition under “Other” are word of mouth, satellite tracking, Qualcomm, police scanners, and miscellaneous other information media. Because “Other” includes multiple sources, frequency and type of use are not displayed in this table.

These usage data are also presented in graphic form in Figures 4 and 5. Figure 4 shows the frequency of use of each of these information sources where the frequency was reported as often or sometimes. This is a good reflection of which sources are most actively used by the CVO drivers in the sample. Figure 4 shows the number of users who report using that source sometimes or often. Comparable percentage figures for the use of each source are based on these same frequency-of-use figures all drivers. As can be seen in Table 8, both Internet and cell phone may not be available to many drivers, and some drivers for whom a source is available report that they never use that source. The percent of all drivers in the sample who report using each source sometimes or often are:

- CB radio: 81%
- AM/FM radio: 60%
- Cell phone: 50%
- TV: 43%
- Internet: 29%
- WSDOT: 29%
- Highway patrol: 17%

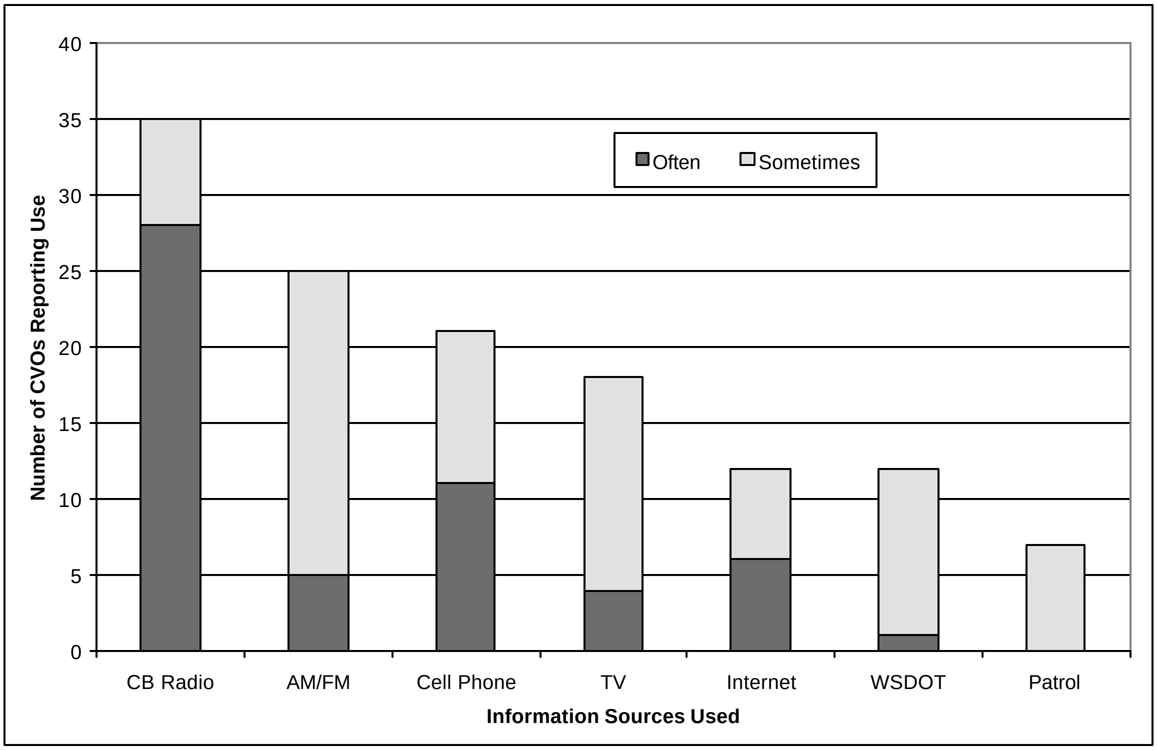


FIGURE 4. FREQUENCY OF USE OF SELECTED INFORMATION SOURCES BY CVO DRIVERS

These figures reflect the level of usage throughout the study area; thus, in considering how best to get road-weather information out to CVO drivers in the region, we would want to maximize the use of the high percentage sources listed above.

A somewhat different slant on these data looks at which sources of information drivers prefer to use *when they have them available*. This leads to a different ordering of the sources as indicated below. The practical implication from this perspective would be to maximize access to CVO drivers of the most heavily used sources.

- Cell phone: 88%
- CB radio: 83%
- AM/FM radio: 60%
- Internet: 52%
- TV: 43%
- WSDOT: 29%
- Highway patrol: 17%

The largest difference in these figures relates to the Internet as an information source. This is important because much of the new information that will be disseminated under this program will be made available over the Internet to anyone who is interested, including both travelers and system operators. Given that the Internet will continue to become a more important mode of communicating all kinds of information, it will be appropriate to look more closely as how best to utilize this capability in the future.

While CB radio and cell phones are the two most frequently used information sources, the CVO respondents noted that cell phone coverage is spotty in the study region, so cell phone may only be useful in some places at some times, and therefore, under the current coverage, may be of uncertain benefit for traveler information, especially in the more remote portions of the region's main corridors.

Figure 5 shows how many of the various information sources are being used by the CVO drivers. Six of the respondents report that their drivers use only one of the sources, while two report that their drivers use six. About half of the CVOs (52%) say their drivers sometimes or often use three or four different information sources. The average use across all drivers is 3.1 sources.

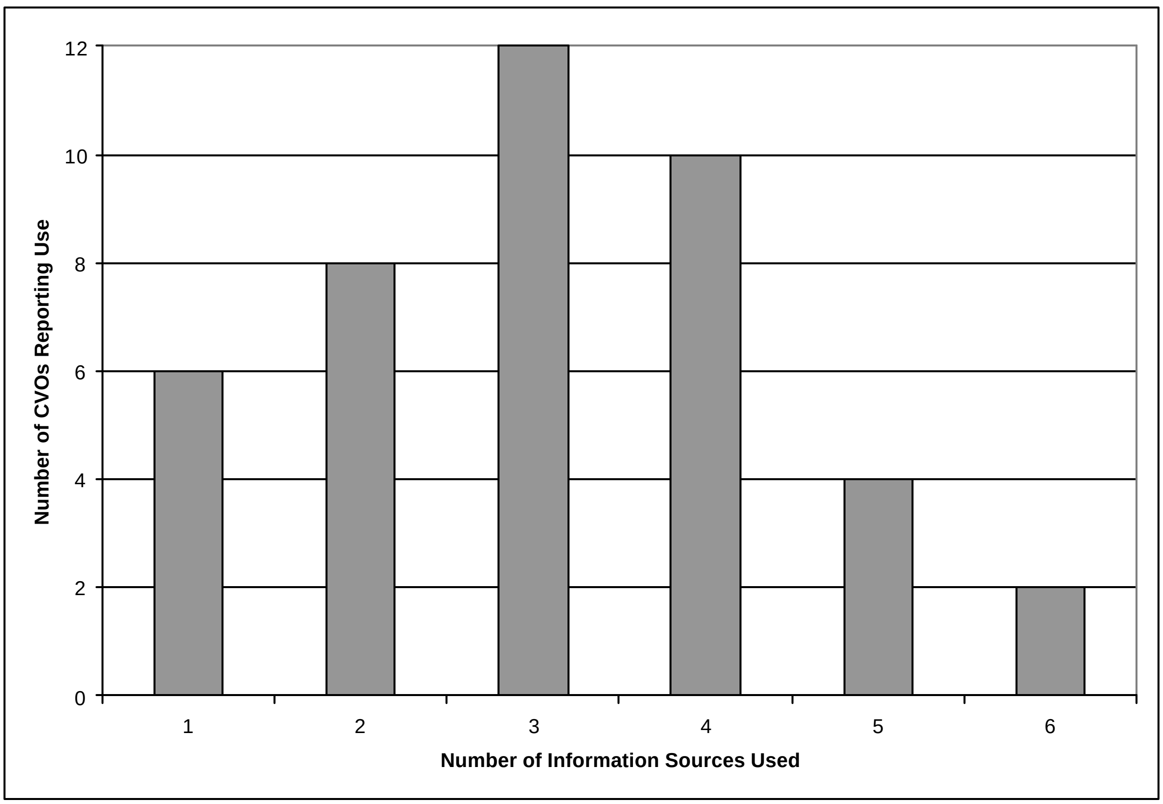


FIGURE 5. NUMBER OF DIFFERENT INFORMATION SOURCES USED BY CVO DRIVERS

During the interviews, many of the respondents mentioned that "word of mouth" is a very important source of information. Drivers obtain information by speaking with other drivers who have recently traveled on the planned route and can report back on current conditions. The popularity of the CB radio as a way to communicate information is consistent with these interview reports. The category “Others” listed inTable 8 indicates a variety of other information sources that were mentioned in the interviews that were not specifically called out in the survey. These other sources are noted below, along with the number of times they were mentioned:

- Word of Mouth (13)
- Satellite Tracking (5)
- Qualcomm Communication (2)
- Newspaper and Other Media (2)
- Scanners (1)

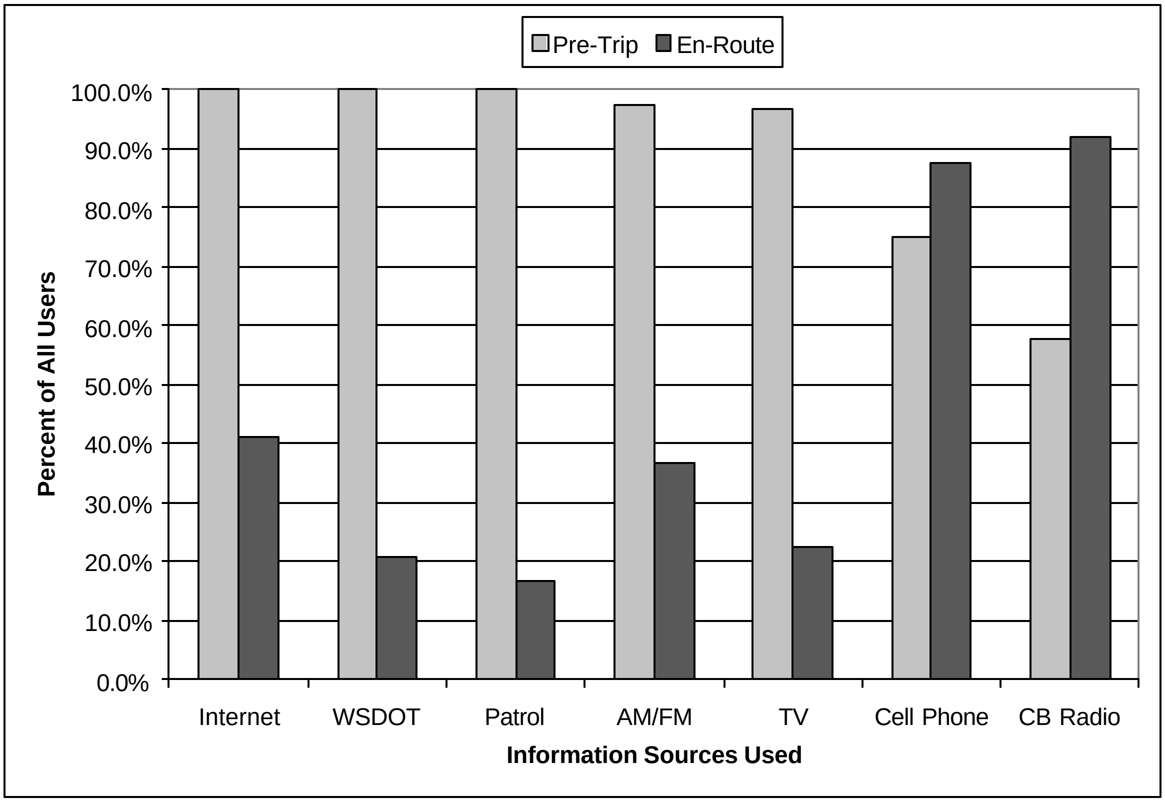


FIGURE 6. USE OF INFORMATION SOURCES FOR PRE-TRIP OR EN-ROUTE TRAVEL PLANNING

Figure 6 presents the data from Table 8 regarding how drivers are using the various information sources in their travel planning. Every CVO respondent (100%) reported that their companies use the Internet, WSDOT, and highway patrol information for pre-trip planning, and most of them also use the AM/FM radio and television. Cell phones and CB radio are used less for pre-trip planning but they are used the most frequently for en-route planning. We have already noted the concern about uncertain cellular coverage in this rural and mountainous area, so at the moment, CB radio appears to be the most viable way that drivers have to acquire information about road and weather condition while they are traveling.

At the end of the interviews we discussed with respondents the quality and accessibility of the traveler information they have regarding road-weather conditions and whether the drivers feel that they are getting the kind of information they need for travel in the SR 395 and SR 20 corridor region. The following responses were typical:

- I want easier access and more updated information.
- I want more information on road closures.
- Accessibility to information is not very good.
- I'm satisfied and have what I need to travel in this area.
- Route 395 is too congested, and there aren't ways to view congestion levels on the corridor from remote locations to assist in pre-trip decisions.
- The quality and timeliness of the information is poor at times.
- The information quality and accessibility is okay but permits are very difficult to obtain.
- Information is very difficult to get, especially during the late hours.

Finally, the survey inquired what changes the operators would make to the information sources and/or content to provide greater usability for truck drivers. Drivers and operation managers provided the following responses:

- Better pre-warning systems are needed.
- We need better, accessible information on the Internet.
- Provide a list of construction zone locations on the Internet.
- Update the information more frequently and provide accurate weather reporting.
- Provide web cameras for night situations.
- Need Highway Advisory Radio installations.
- Notify us of incident closures and make SR 395 a 4-lane corridor.
- Provide more timely information.
- Make the information a call away.
- Provide training and education on obtaining information and organizing maintenance.

The results of these baseline CVO interviews are helpful in understanding what traveler information exists in the SR 395 region, how it is being used by CVO drivers, and how the information can be improved to provide a safer and more efficient travel for truckers. The survey provides a comprehensive and fairly representative list of CVO contacts for follow-up in the post-deployment interviews. If the Phase III evaluation is authorized, the interview protocol will be carefully revisited and revised as needed, based on what we have learned in the course of this baseline effort. CVO logging operations will be closely examined, given the significant differences in their travel and uses of information as identified in the baseline. The consensus of these CVO respondents is that more information could be provided to ensure travel safety and better operation for truck drivers. They cited such needed improvements as better, timelier Internet information, HAR, more pre-warning systems and other ITS applications. Phase III of the evaluation is designed to evaluate the actual effectiveness of the component ITS improvements.

3.3 INFRASTRUCTURE OPERATIONS AND MAINTENANCE

This section summarizes what has been learned during the baseline period about the operational and maintenance procedures of the WSDOT Eastern Division offices. The information has been obtained through a series of interviews with the earmark Project Manager and members of his operations staff, both in Spokane and in the Colville office. This description of how WSDOT has routinely handled its operations and maintenance responsibilities will be reevaluated in Phase III in light of any changes in these procedures that occur as a result of the new road-weather information that will be available through the RWIS, HAR, and camera facilities.

The following information outlines selected current procedures:

- The project area is maintained by WSDOT staff from six outside maintenance sheds in Colville, Republic, Orient, and Loon Lake. WSDOT's Operations Manager supervises two 8-hour shifts, from 4:00 AM to 12:30 PM and 2:30 PM to 11:00 PM. The maintenance sheds are staffed with 2-4 people in the winter, plus the central Colville offices, where there are 7 people every day on the morning shift. Two man sheds may sometimes add temporary staff when needed. Though Republic historically has had 8 staff working 10 hour shifts, they have had to cut back this year. The Republic shed covers SR 20 to the top of Sherman Pass and half way down the east side toward Colville. Standard practice in the winter is to schedule maintenance crews out of Colville in four directions, regardless of the weather, in trucks with plows and sand. That way they feel they are positioned for whatever events may occur.

  The Republic crew typically has 8 full time staff and temps as needed. Laurier, out of Orient, has 2 full time and one temp at night. Grouse Creek, out of Loon Lake, has 3 crew. If Laurier needs help, Colville can send support. WSDOT used to be able to hire as meny temps as they needed, but now they have much less flexibility and resources to do that.

- Weather and road condition information is gathered from existing sources such as the Internet, general media, road crews, law enforcement and emergency service agencies, CB talk from commercial vehicle operators (CBs are in all WSDOT trucks now), and the public (calling in). Efforts are made to gather enough data and assess the reliability of the data before determining the best allocation of resources to address any issues or deploy manpower and equipment. Typically, crews are sent to investigate trouble spots at the first sign of a potential problem (winter weather reports or forecasts of worsening conditions).

- WSDOT has a maintenance performance measure referred to as the Maintenance Accountability Process (MAP) that they are using to record the level of service they are providing. They collect road surface snow and ice conditions to assess traction conditions, and they record data regarding precipitation occurring at 35 degrees or below. These data are collected and recorded for designated sites once a week. They have different sampling points on all road segments. WSDOT began collecting MAP data last year, added mountain passes this year, and now have about 10 data collection sites. The MAP data collection points for 2000-2001 on Sherman Pass (SR 20) include the following mileposts: 320.0 to 322.0, and 332.0 to 334.0. Once the safety database has been completed by WSDOT and is up to date, we can compare the accident statistics to the MAP data using the milepost indicators. The new ITS RWIS and camera installations are not intended to substitute for the MAP process; rather, they will provide additional information to supplement MAP, thereby enriching the data available to provide the media, CVOs, WSDOT crews, and the public.

During these discussions with WSDOT operations and maintenance staff, we asked them to reflect on how they thought the new ITS installations could change how they currently perform their responsibilities and where the benefits might be realized. Some thoughts along these lines include the following:

- Significant changes in maintenance procedures could result from the use of ITS equipment in the following ways:
    - More accurate weather information from specific locations (both sensors and images) could determine if, when, where, and what resources are dispatched. One of the logged events showed that with more timely information about snow and ice building on the road surface, sand trucks could have been dispatched sooner, perhaps avoiding accidents and related problems that subsequently occurred;
    - Use of HAR could prevent collateral problems occurring in an already dangerous condition by diverting vehicles. This would reduce safety risks and extra, more costly work on the part of maintenance crews;
    - Use of HAR will divert traffic from hazardous areas and allow WSDOT crews to maintain those road segments with less interference and more efficiently, ultimately resulting is fewer accidents and delays, and less “down time” for those segments. The net result should be better throughput in the corridors for everyone;
    - WSDOT currently has three portable Variable Message Signs (VMS) that they can use to notify travelers of problem spots. The HARs will be of particular benefit when they become available, and WSDOT anticipates that the CVOs will use the HAR frequently.
    - Reduced number of calls to maintenance offices from motorists, if more reliable information is available and can be provided by other means (Internet, HAR)
    - Many of the events in which maintenance crews respond are due to dangerous driving conditions resulting in numerous crashes. If fewer crashes are the result of more effective and efficient maintenance actions, this can reduce the workload of the maintenance personnel at the event sites.
    - New camera views can help maintenance crews see what the conditions are like in hazardous areas, such as Sherman Pass and Loon Lake. This information will be available at all the WSDOT maintenance sheds over the Internet. It is expected to take a little time for the computer equipment to be available at all the sheds, to get crews trained on the Internet, and for them to become comfortable with it and trusting of the information it provides. However, as they come to use this new information on a regular basis, they will no longer feel the need to send reconnaissance trucks to investigate every possible situation that can be assessed remotely. This has a great potential for savings of money, staff time, and equipment time. A further benefit of these camera images is that they will greatly increase the timeliness and reliability of information WSDOT routinely conveys to the state’s radio stations for public broadcast and for placement on WSDOT’s web sites.

- It is doubtful that labor costs would be reduced due to the use of the new ITS equipment. Even though efficiencies are expected, qualified maintenance crews need to be hired and retained (and skilled staff are difficult to find), and WSDOT will need to fill its commitments on a seasonal basis regardless of the new ITS capabilities. Using temporary or intermittent staff is not an option for this kind of work, because WSDOT can't find qualified personnel when they need them on short notice.
- The amount of resources expended, such as sand used on the roads, is not a good measure of efficiency gains because of the huge variability from season to season.
- It is expected that the ITS facilities will allow WSDOT to deploy its existing manpower and equipment more efficiently. With better real-time information in hand, this may mean sending a smaller truck out on a job when the bigger truck is not needed. As noted earlier, cameras may substitute for having to send staff out to investigate a roadway situation. It may be possible to assign vehicles to jobs, such as sanding or plowing roadway, more efficiently with better knowledge of actual road-weather conditions.
- The availability of new and more reliable road-weather information will fill a gap that has existed in the state's weather data sources. This will allow the RWIS information to be input to the state's weather model to produce more accurate microclimate forecasts. Another of the logged events cited the need for more accurate forecasts. The existing forecast had predicted up to one inch of snow, while the storm that occurred dumped four inches in four hours. This created multiple accidents at the one time, spreading DOT and WSP resources thin.

In discussions about current and projected changes in O&M procedures, the supervisor said, "If our employees are not willing to change in response to these new systems, our maintenance function will cease." He saw a big part of his job was to educate his staff about the new systems and their objectives, and to help staff become knowledgeable and comfortable with them. Through use of ITS equipment, the potential for operations and maintenance effectiveness and efficiency gains are evident and worth the efforts to evaluate the system in Phase III.

3.4 SAFETY

This section presents the results of the analysis of safety records for this region obtained from WSDOT's Transportation Data Office safety databases. The baseline methods and procedures for gathering the data are described in Section 2.5 of this report. Safety data were provided to us in separate tables for SR 395 and SR 20, following the formats outlined in Appendix D. The accident data were organized by milepost for each of the roadway segments.

As shown in Table 9, there were 145 accidents in the SR 20 corridor during the years of 1992 to 1996. SR 395, a more traveled corridor, had a total of 282 recorded accidents for the same time period. As explained in Section 2.5, these data will be brought up to date by the end of 2001, and will be added to the baseline database at that time.

In each of the five years for which we have baseline safety data, there were high percentages of accidents that involved bad weather conditions, as illustrated in Table 9. A weather-related accident was one that involved either road surfaces conditions that include snow, ice or water, and/or reported weather conditions that included rain, snow, or fog. Overall, 49% of all accidents that occurred in the SR 395 corridor for the five reported years were weather-related accidents, and 57% of the accidents that occurred on SR20 were weather-related.

TABLE 9. TOTAL AND WEATHER RELATED ACCIDENTS FOR 1992-1996

SR 395	**1992**	**1993**	**1994**	**1995**	**1996**	**Total**
Total	56	44	53	61	68	282
Weather Related	27	27	17	29	37	137
Weather Related (%)	48%	61%	32%	48%	54%	49%
SR 20	**1992**	**1993**	**1994**	**1995**	**1996**	**Total**
Total	38	20	27	31	29	145
Weather Related	22	11	15	16	18	82
Weather Related (%)	58%	55%	56%	52%	62%	57%

All of the accident data are organized by milepost location along SR 395 and SR 20 in the study region. This allows us to look more closely at those locations where accidents appear to be more prevalent, or the proportion of more severe accidents is higher, or a higher proportion of accidents are weather-related.

Some of the road segments along these two main corridors experienced higher accident rates than others. We examined those segments, identified by their milepost locations, that experienced three or more accidents during the five-year period. Locations of particular interest include Loon Lake (MP 190.58 on SR 395) and Sherman Pass (MP 319.5 on SR 20). Accidents associated with Sherman Pass occur on both sides of the mountain pass, and MP numbers lower than 319.5 indicate the western side of the pass and larger numbers the eastern side. This program includes the installation of RWIS and camera facilities at Sherman Pass and the addition of a camera at the Loon Lake RWIS facility.

Table 10 below shows all the high accident locations on SR 395. An average of 50% of the 90 accidents at these locations were weather-related, compared with 49% overall (Table 9). The comparable figure for accidents on SR 20 (Table 11) is 68, and 66% of those were recorded as weather-related, compared with 57% overall (Table 9). An examination of these data suggests that weather was a factor in the accidents on Sherman Pass to an even higher degree, but that was not the case at Loon Lake. The single largest number of accidents reported during this period occurred between milepost 180.46 and 180.48 where 25 accidents occurred, more than twice any other single location. This is located at the intersection of Monroe Road with SR 395, about 4.5 miles north of the junction of SR 395 and Route 2 (see Figure 1, just north of Spokane). The specific attributes of this location are not known at this time but will be examined more closely during the Phase III component, if authorized.

Tables 10 and 11 show that intersections, curves, steep grades, and high speeds are major contributing factors, along with adverse weather conditions. It is the expectation of this project that providing drivers with better road-weather information will help them become more aware of these hazards and hopefully more attentive, or lead them to change their plans and avoid these high accident locations altogether.

TABLE 10. HIGH ACCIDENT LOCATIONS ON SR 395

MP Location	No. of Accidents	Weather-related	Percent Weather-related	Other Causes	Type of Accident (Primary)	Comments
180.0 - 180.43	4	2	50%	Ex. Safe Speed	Rear-end	Non-intersection
180.46 - 180.48	25	14	56%	Ex. Safe Speed	Rear-end	At intersection
181.06 –181.08	6	3	50%	Fail to Yield	At Intersection (angle)	At intersection
182.82	4	2	50%	Improper Pass	Overturn	On a sharp curve
183.94	5	2	40%	Ex. Safe Speed	Didn't log	On a sharp curve
185.23 - 185.24	5	2	40%	No Violation	At Intersection (angle)	At intersection
185.6	7	2	29%	Ex. Safe Speed	Overturn	Williams Valley Intersection
187.29 - 187.32	8	5	63%	Follow Too Close	Overturn	Winds, snow & fast speeds
187.37 - 187.4	7	4	57%	Ex. Safe Speed	Side	Winds, snow & fast speeds
190.58	11	4	36%	Ex. Safe Speed	At Intersection (angle)	SR 395/292 Junction
202.43	6	3	50%	Fail to Yield	Rear-end	Non-Intersection
Totals:	**90**	**45**	**50%**			

TABLE 11. HIGH ACCIDENT LOCATIONS ON SR 20

MP Location	No. of Accidents	Weather -related	Percent Weather-related	Other Causes	Type of Accident (Primary)	Comments
305.24	5	1	20%	Ex. Safe Speed	Rear-end	SR 20/21 Intersection
309.69 - 309.85	3	2	67%	At Intersection	Angle	Uphill Curve & Shaded
311.59 - 311.67	3	0	0%	Ex. Safe Speed	Overturn	Uphill Curve & Shaded
312.79 -312.99	3	3	100%	Ex. Safe Speed	Overturn	Uphill Curve & Shaded
317.16 - 317.26	3	3	100%	Ex. Safe Speed	Overturn	Uphill Curve & Shaded
317.75 - 317.96	5	5	100%	Follow too close	Overturn	Switchback Curve
319.41 - 319.45	3	3	100%	?	Rear-end	Too Fast
319.95 - 320.05	5	5	100%	Ex. Safe Speed	Overturn	Too Fast
320.25 - 320.33	3	2	67%	Ex. Safe Speed	Overturn	Too Fast
320.45 - 320.67	8	5	63%	Ex. Safe Speed	Overturn	Curve
322.16 - 322.37	3	1	33%	?	Overturn	Curve
323.34 - 323.41	3	2	67%	?	Overturn	Curve
323.7 - 323.87	3	3	100%	Ex. Safe Speed	Overturn	Curve
331.86 - 332.06	4	1	25%	Inattentive	Overturn/Animal	Downhill Steep Grade
337.94 - 338.04	4	4	100%	Ex. Safe Speed	Overturn/Animal	Downhill Steep Grade
338.89 - 339.09	3	1	33%	Fell Asleep	Overturn/Animal	Downhill Steep Grade
340.43 - 340.5	3	3	100%	Ex. Safe Speed	Animal	Downhill Steep Grade/Curves
340.76 - 340.96	4	1	25%	?	Overturn/Animal	Downhill Steep Grade/Curves
Totals:	**68**	**45**	**66%**			

The severity of each reported accident is listed in the accident database and summarized in Table 12. The severity codes as established by WSDOT are shown Appendix D.

The data shown in Table 12 do not suggest a clear relationship between accident severity and weather. Each type of accident is associated with weather causes to about the same extent as the average over all types of accidents (as shown in Table 9).

TABLE 12. ACCIDENT SEVERITY BY ROUTE AND WEATHER

Severity Code	SR 395		SR 20	
	Weather Related Accidents	Other Accidents	Weather Related Accidents	Other Accidents
1	78 (54%)	67	55 (61%)	35
2	4 (57%)	3	1 (50%)	1
5	10 (36%)	18	4 (36%)	7
6	29 (43%)	38	11 (50%)	11
7	16 (46%)	19	11 (55%)	9

Finally, we examined the types of vehicles that were involved in accidents, as recorded in the safety database. The vehicle type codes are listed in Appendix D. All vehicles were classified into three categories, namely cars, trucks, and other, and whether or not they were involved in a weather-related accident. Of the weather-related accidents in the SR 395 corridor, 95% involved cars, 4% involved trucks, and the remaining were considered other vehicle types as shown in Figure 7. Comparable data for SR 20 are shown in Figure 8, where 80% of all weather-related accidents involved cars, 18% involved trucks, and the remaining 2% were “other” vehicle types.

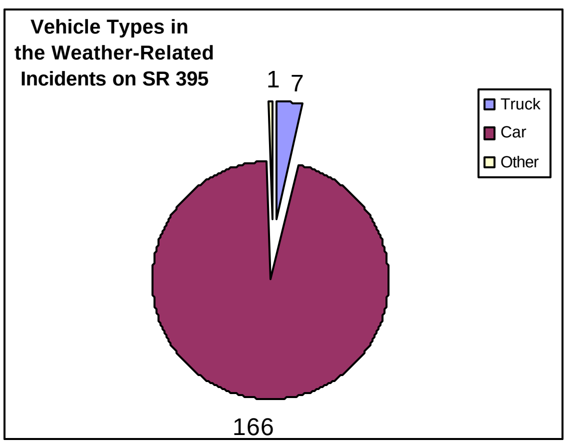


FIGURE 7. WEATHER-RELATED ACCIDENTS BY VEHICLE TYPE ON SR 395

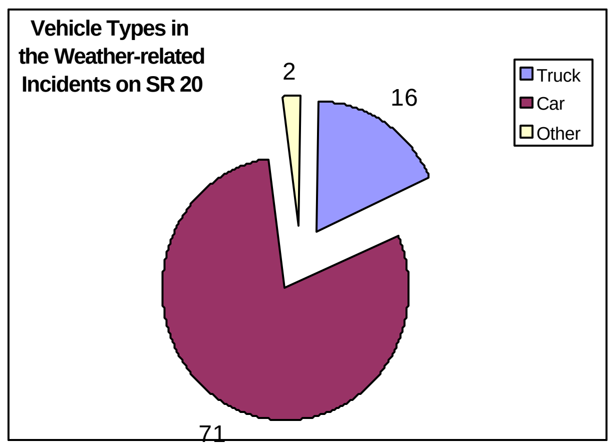


FIGURE 8. WEATHER-RELATED ACCIDENTS BY VEHICLE TYPE ON SR 20

As has been noted earlier, this baseline safety database will be augmented for the years 1997 through 2001 when the data become available, which is anticipated by the end of calendar year 2001. Based on the data examined for the period 1992 through 1996, some general observations include the following:

- A high percentage of the accidents that occurred in this region were weather-related;
- Truck involvement in the accidents that occurred in the corridor was low;
- Fatal crashes were also low;

- Causes of these accidents were primarily poor weather and road conditions, along with steep grades, curvy roads and driver unfamiliarity, inattentiveness and excessive speeds; and,
- There are some particular “hot spots” where the number of accidents is higher than most other areas, and a good example is SR 20 in the vicinity of Sherman Pass.

Because of the large number of weather-related events in this region, the proposed improvements in road-weather information are expected to help reduce the number and severity of accidents. It is also instructive to note that several of the key new RWIS facilities will be located close to some of the worst road segments from a safety perspective.

4.0 PHASE III EVALUATION REPORT

The Phase III report will present the final results from the analysis of the post-deployment data, examining these data independently or making comparisons with the previously collected baseline data where they are available, across the five major goal areas as proposed in this Phase II report. The suggested format for this report and an outline description of the topics to be covered are presented in Table 13 below:

TABLE 13. EVALUATION REPORT FORMAT AND CONTENTS

Section	Suggested Topic Contents
Executive Summary	- Report summary focused on evaluation findings and lessons learned
Introduction and Background	- Brief background on FHWA earmark evaluation goals and objectives - History of this project, WSDOT's objectives, coordination with project partner's evaluation, connection with other programs in state, baseline evaluation from Phase II, overall focus for Phase III
System Description	- System components, operations, objectives - Project schedule and accomplishments - Map of project elements
Evaluation Goals, Measures and Hypotheses	- Summarize 5 goal areas, plus sub-objectives, for this evaluation - Discuss overall ITS rural integration objectives - Distinguish primary and secondary evaluation objectives by goal area - Present in table form
Technical Approach	- Discuss each of the tests applied in each of the evaluation goal areas (data, methods, analytic procedures) - Discuss "before" and "after" research design
Results	- Present and interpret findings in each of the goal area tests - Provide descriptive results and analysis of relationships in the data - Present findings in both tabular and graphic form to maximize communication of results to the reader - Highlight ITS benefits identified (integration and other benefits) - Acknowledge assumptions and limitations of the analysis and conclusions
Conclusions	- Present insights and conclusions from the analysis and interpretation of results - Highlight common conclusions across the goal areas - Identify how findings and conclusions do or do not fit with the existing body of research - Discuss practical implications of results and lessons learned that may apply to other rural areas
Recommendations	- Recommend how best to capitalize on the findings - Recommend additional research that may be appropriate to more adequately understand key issues, supplement inadequacies in the data, or examine related issues

5.0 RISK ASSESSMENT

Phase III of this evaluation proposes to assess the effects of an increase in the level and quality of road-weather information to be provided to travelers and system operators by new ITS equipment being installed at selected sites in a rural environment in northeastern Washington State. The evaluation will focus on travelers' use of the information to improve their mobility and safety. It also will assess WSDOT operations and maintenance personnel's use of the information to enhance their efforts to provide safer highways and more efficient use of road maintenance resources. The systems' impacts on safety in the designated corridors will also be an evaluation focus.

In support of a decision regarding whether or not to proceed with Phase III of this evaluation, the following potential elements of risk and opportunity are discussed:

- Will the project partners successfully adhere to the currently projected deployment plans and schedule?

  The current plan calls for all the ITS equipment to be procured and installed before the end of calendar year 2001. Recent discussions with the WSDOT Project Manager indicate that they are on schedule and are confident that the project components will be constructed and operational by December 2001. This fits the evaluation schedule which calls for post-deployment data collection starting early in 2002.

- Will the project partners carry through with the planned operation and maintenance of the equipment for the duration of the evaluation project?

  The project partners are quite serious about ITS being a very significant part of their overall program and mission. They have been aggressively working to overcome any issues or problems that may interfere with the timely deployment of this project. They are knowledgeable about the equipment, its installation, and operation, and they are eager to move forward. They have adequate resources and the clear intent to operate and maintain this equipment. Furthermore, they are very interested in supporting an evaluation effort that stands to prove the value of these investments.

- Will the project partners support the planned Phase III evaluation effort through the collection of certain data as described in the Phase II report?

  We have been working closely with WSDOT staff on the initial phases of this project. They have been very supportive of our baseline data collection efforts. This includes, for example, maintenance of an event log form, facilitating the collection of needed safety data from Olympia sources, and facilitating our data collection with CVOs who operate in this region. There is no reason to believe that this high level of support won't be forthcoming throughout the Phase III portion of the evaluation.

- Will the project partners coordinate their own evaluation efforts and data collection with this proposed Phase III evaluation activities as currently planned?

We have established excellent working relationships with members of the Transportation Research Center (TRAC) that is responsible for conducting the Partner's evaluation. Their evaluation manager has been present at site visits, and we regularly exchange information, share data where it makes sense, and discuss issues associated with the evaluation. This supportive relationship is expected to continue for the duration of the evaluation.

- Does the Phase III evaluation offer a high likelihood of yielding useful evaluation results in the several goal areas as discussed in the Phase II report? Will the benefits to be derived from the Phase III portion of this earmark evaluation be commensurate with the required investment of time and resources?

  Each goal area will be addressed with regard to these risks:
  - Travel and mobility for commercial vehicles: CVOs travel extensively in these corridors. The baseline data indicate that many of them currently use the available road-weather information and would value the improvements proposed under this deployment. Little research information exists that address CVO use of information, especially in rural areas. The trucking associations and the CVO contacts in our telephone interviews were very cooperative, and we anticipate the same for Phase III. The risks in this goal area appear low and the potential benefits of continuing seem large.
  - Travel and mobility for public travelers: Determining which members of the general public travel in this region, and then being able to contact them to find out whether and how they use road-weather would require a very difficult and costly survey research effort. We decided the most cost effective method would be to place a short survey questionnaire on the traveler information web page(s) and invite responses from travelers in this region who are going to the Internet to obtain such information. It is unclear how successful this approach might be in finding travelers in this relatively remote part of Washington State, but this goal area is considered a secondary priority for the evaluation and the costs and risks of going ahead with this strategy are not particularly large. The potential benefit-cost tradeoffs appear to justify this approach.
  - Infrastructure operations and maintenance: The risk here continues to be the uncertainty about future weather conditions and the likelihood that we can gather enough data about how O&M reacts to adverse events to be able to draw valid conclusions regarding the benefits of ITS in this goal area. During the baseline data collection, WSDOT recorded very few events, and not enough to provide a reliable picture of the range of event conditions or the range of O&M responses to those events in the absence of the new ITS systems. Thus, the risk in this goal area is that one more year of event data will be insufficient to adequately evaluate the impact of ITS on WSDOT's operations. We have recommended from the outset that at least three year's worth of observations are likely to be needed to do an adequate evaluation. If a sufficient number of road-weather events occur next year, then the probability of being able to measure changes in O&M related to the new ITS will increase. If few events occur, as was the case this year, evaluation conclusions will remain tenuous.

- <u>System performance and reliability</u>: The evaluation of this goal area depends on the analysis of secondary data, such as WSDOT records, in Phase III, as no baseline data were collected. This is a fairly straightforward component of the evaluation, and the only real risks are those associated with either a failure to install and operate a component, or the outright failure of that component to operate properly. These risks appear quite low.
- <u>Safety</u>: This is a secondary evaluation goal area, for which a substantial amount of safety data were obtained and reviewed for the baseline assessment. We have experienced good cooperation from WSDOT and WSP in obtaining and interpreting these data. A small risk is that the data managers in Olympia, WA will fail to complete the updating of the database as they said they would. They appear determined to complete this task and are actively working to do so. A further risk is that the data may not prove to be fine enough grained to allow us to measure changes in the level of safety that we can clearly associate with changes in information availability. Perhaps the greatest risk is a methodological one that concerns the difficulty of comparing several month's worth of post-deployment accident data with a nine year baseline, given all the factors other than improved information that effect safety outcomes, not the least of which is variable weather from year to year. We are addressing this in part by supplementing our analysis of the accident data with interviews with CVOs, the state patrol, and the roadway operators to help gain further insight into the relationships between better information and safety outcomes, as directly measured and qualitatively evaluated.

Overall recommendation:

The baseline effort to date suggests that a post-deployment evaluation should yield very interesting and useful findings, particularly given the general lack of research in rural areas in many of these goal areas. The project partners appear to be carrying through with their scheduled installation and planned operation of these new ITS facilities. The risks of slippage appear very low. The principal evaluation goal areas appear likely to yield valuable findings. Some risks in this study are common to any field evaluation of similar design but the risks are being addressed, and they are offset by the benefits that can be obtained by proceeding with Phase III. Taking into consideration all these factors, we recommend moving ahead to complete the full evaluation.

6.0 RESOURCE REQUIREMENTS FOR PHASE III

The test plan discussions in this report specify the activities proposed for Phase III of the evaluation. Table 14 below presents a best current estimate of the level of staff effort required to carry out these activities within the timetable presented in Figure 2. Some of the Phase III activities will require more effort than in the baseline period, primarily because the main effort was projected to be in the post-deployment period. Other activities will benefit substantially from the experience already gained in the baseline Phase II period, such as having CVO interview lists already prepared and clear interview protocols already worked out, or already having the contacts and procedures in place for obtaining and organizing the safety data. There remain uncertainties, such as how much data may become available from the event logs, and how much effort will be required to document O&M responses to those events.

Table 14. Level of Effort for Phase III Evaluation

Task	Battelle Hours	MMA Hours	Total Hours
Conduct Pre-Test Activities	**90**	**128**	**218**
Post-implementation visit to project team	24	24	48
Complete design and testing of questionnaires	40	48	88
Determine final list of interviewees	2	8	10
Finalize other data collection instruments	24	48	72
Collect Post-Deployment Data	**40**	**164**	**204**
Conduct interviews with CVO operators		60	60
Collect data from travelers (internet responses only)	16	8	24
Collect “event” data and interview state personnel	24	40	64
Collect system performance data		24	24
Collect safety data for region		32	32
Analyze Data and compare to baseline conditions	**104**	**190**	**294**
Build CVO response database and analyze results	24	60	84
Analyze responses from general travelers	40	16	56
Analyze “event” data and interview responses	16	50	66
Analyze system performance data	4	24	28
Prepare safety database and analyze data	20	40	60
Prepare Phase III report	**120**	**160**	**280**
Draft Phase III report and send to DOT and stakeholders	80	120	200
Prepare final Phase III report	40	40	80
Archive Data	**20**	**4**	**24**
Project Management	**40**		**40**
Total Hours	**414**	**646**	**1,060**

For estimating purposes, we are assuming three site visit trips will be required as follows:

- An initial post-implementation visit to discuss the pre-test activities and requirements with members of the project partner team.
- A trip to collect on-site event data and conduct interviews
- A trip toward the end of Phase III to present and discuss the draft report and findings.

The budget hours also account for the three trips proposed above.

APPENDIX A

Contact list for 86 CVOs active in the SR 395 study region:

Washington Trucking Assoc.
Idaho Trucking Association
BC Trucking Association
Oregon Trucking Association

Company Name	CVO Location (Washington, Canada, Idaho, Oregon)	Telephone Contact Made*	Baseline Interview Completed
American Van Service Inc.	Washington	*	X
Arlo Huber & Son, Inc.	Washington	*	X
Bell Logging Company	Washington	*	
Bluestem Livestock Transport	Washington		
Bonaparte Hauling	Washington		
Bonte Hauling	Washington	*	
Borders Trucking	Washington		
Buche, Thomas	Washington		
Cattle Carriers, Inc	Washington		
Chapman Moving and Storage	Washington		
Colville Valley Concrete	Washington	*	X
Con Way Western Express	Washington	*	X
Costumes Office Lines	Washington		
Cummins Northwest, Inc.	Washington	*	
Dale L. McNitt Trucking	Washington		
Dawson Trucking Inc.	Washington	*	X
Deer Park Freight Lines	Washington	*	X
Dennis Kroiss	Washington	*	X
Don Mumma Tricking, Inc.	Washington	*	X
Fastway Freight Lines	Washington	*	X
Figenshow Transportation, Inc.	Washington	*	X
Goodyear Tire & Rubber Co.	Washington		

Company Name	CVO Location (Washington, Canada, Idaho, Oregon)	Telephone Contact Made*	Baseline Interview Completed
Hanson Logging	Washington		
Haskins Steel	Washington	*	X
Hatfield Enterprises	Washington		
Interstate Parts & Equipment	Washington	*	
Jensen-Distribution Services	Washington		
Joe E. Schell	Washington	*	X
John M. Kelsch, Jr. Trucking	Washington	*	X
Klingbeil Logging	Washington	*	X
Larry Sell	Washington	*	
Laurin Tanner	Washington		
Leon Zimmerman	Washington		
Lyle Eddings	Washington	*	
Manlowe's Inc.	Washington		
Mercer Trucking Co., Inc.	Washington	*	X
Merritt Trucking	Washington	*	X
Mike Pernsteiner	Washington	*	X
Mike Siracuse Trucking	Washington		
Morrison Moving & Storage Co.	Washington		
Mountain Trucking	Washington	*	X
Oak Harbor Freight Lines	Washington	*	
Ottomeier Trucking	Washington	*	X
Peirone Produce Co.	Washington	*	X
Peninsula Truck Lines, Inc.	Washington	*	X
Power Transport	Washington	*	X
P.O. Newsprint	Washington	*	
Priority Freight Lines	Washington	*	

Company Name	CVO Location (Washington, Canada, Idaho, Oregon)	Telephone Contact Made*	Baseline Interview Completed
Produce Supply Express Inc.	Washington	*	
Puget Sound Freight Lines	Washington	*	X
Puget Sound Trucking	Washington	*	X
Regional Safety Committee	Washington		
Reliance Trailor Co. LLC	Washington		
Richmond Logging	Washington	*	X
Robinson Excavating	Washington	*	X
Ryerson Steel	Washington		
Schwan's Foods	Washington	*	X
Snider Trucking	Washington	*	X
SNT, LLC	Washington		
Spokane Freightliner Inc.	Washington	*	
Spokane Transfer & Storage	Washington	*	X
Stimpson Lumber Co.	Washington	*	X
Supervalu Inc.	Washington		
System-TWT Trasnport, Inc.	Washington	*	X
TDS/ Sound Tire	Washington		
Terry Leak	Washington	*	X
Tiger Trucking Inc.	Washington	*	X
USF Reddaway	Washington	*	X
USFS Coville	Washington		
Vaagen's Colville	Washington	*	
Victor Chimienti, Inc	Washington		
Wild West Trucking, Inc.	Washington	*	X
William E. Moore	Washington	*	X
Williams Lake Resort	Washington		

Company Name	CVO Location (Washington, Canada, Idaho, Oregon)	Telephone Contact Made*	Baseline Interview Completed
Yellow Freight Systems, Inc.	Washington		
Celgar Pulp	Canada	*	X
Chambers, D C	Canada	*	X
Danco Transport Limited	Canada	*	X
Trimak Bulk Systems	Canada		
Westams Truck Lines	Canada		
Chadwick Insurance	Idaho	*	
Claude D. Grove Trucking	Idaho	*	X
Great West Casualty Co.	Idaho	*	
Husky Truck Centers	Idaho	*	
Swift Trucking, Inc.	Idaho	*	X
Oregon/Boise Cascade Office	Oregon	*	X

* Indicates and initial telephone contact was made. Interviews were not completed for CVOs that did not have trucking activity in the study region. Out of 86 companies on the contact list, 57 were contacted, and 42 interviews were completed.

APPENDIX B

Commercial Vehicle Operation Interview Form

Introduction for discussion with CVOs:

- My name is ________________, and I am with Meyer Mohaddes, Associates in Boise, ID.
- In cooperation with the Washington State DOT, we are conducting an evaluation of new road/weather information technologies…
- Our evaluation study is focusing on the Northeast part of Washington in the region north of Spokane up to the Canadian border… Does your company have trucks that travel in that region? If not, record basic contact info and terminate the interview.
- Your name and number was supplied to us by WSDOT (Bryan Hausman), the WTA, or other states' trucking associations.
- This interview is the first step in our year and a half evaluation process.
- The interview should take only about 10-15 minutes. (Schedule an alternative interview time if this won't work for the respondent or if you need to speak with someone who is not available.)

Be assured that your company and individual information will be kept strictly confidential. We will only present aggregate statistics in our evaluation reports.

- In your organization, whom would be most appropriate for me to talk to about this? Note that these questions are best answered by someone familiar with your trucking company's operations or someone who has truck driving experience.

Name: ________________________ Title: ______________________

Organization: ___________________ Location: ___________________

Number of Years Organization has been Operating: ___________________

Date:__________________________ Time of interview:____________

Business Type:___________________

1. Do truck drivers in you organization use any of the following road segments in the corridor region north of Spokane to the Canadian border? If yes, about how many one-way truck trips are made per month on each of these segments?

Yes	No	Corridor road segments	# One-Way Trips per mo.
☐	☐	SR395 between Spokane and Laurier or any alternate north-south segment	________
☐	☐	Route 20 between Republic and Kettle Falls (over Sherman Pass) or any alternative east-west segment.	________

(NOTE: If "No" to both of the above, then terminate the interview at this point.)

2. How many trucks do you have in your company that travel in this corridor?
____

3. What types of vehicles do you operate in this corridor region? Check all that apply:
   - ☐ Flat bed
   - ☐ Dump truck
   - ☐ Wood chip
   - ☐ Tanker
   - ☐ Van
   - ☐ Pickup/delivery
   - ☐ Other type (please specify:______________________________________)

4. Do your trucks use any routes other than SR 395 or SR 20 in this region?

   ☐ Yes ☐ No

   If yes, which other routes?____

5. **Considering all the trips your company makes in or through this region, please indicate your most frequent or common trips in terms of origins and destinations. (Interviewer list these in order from most to least frequent type)**

   Trip type 1: From:______________________ To:________________________

   Trip type 2: From:______________________ To:________________________

   Trip type 3: From:______________________ To:________________________

6. **Do the seasons (winter vs. summer) influence which routes you use?**

   ☐ Yes ☐ No

   If yes, how?____

7. Does your organization/operation use a dispatch service to relay road, weather or other travel information to truck drivers?

   ☐ Yes ☐ No

8. Are your drivers free to independently change the timing or routes they use on their trips?

☐ Yes ☐ No

9. **What is the average number of truck-related incidents per year that involve your trucks/drivers in these corridors? (Define an incident as an event that results in a police report) ___________________________**

10. **Do you believe that improvements in road and weather information would improve travel safety and operation for your truck drivers?**

☐ Yes ☐ No

The following questions are best answered by someone familiar with your company's operations, such as a dispatcher or someone who can answer from a driver's perspective. The focus will be on information relevant to travel in the corridor region north of Spokane.

11. I am going to read a list of different kinds of traveler information sources and ask you to first say whether it is available to you, and for those that are to indicate whether and how often you use them, and whether you use them before your trip, during your trip, or both. Such information could include winter weather, flooding, major incidents, road construction and other delay information:

Source of Information	Not Avail	Frequency of Use				Type of Use	
		Often	Sometimes	Rarely	Never	Pre-trip	En-route
AM/FM Radio	☐	☐	☐	☐	☐	☐	☐
TV	☐	☐	☐	☐	☐	☐	☐
CB Radio	☐	☐	☐	☐	☐	☐	☐
WSDOT	☐	☐	☐	☐	☐	☐	☐
Highway Patrol	☐	☐	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐	☐	☐
Other(s)	☐	☐	☐	☐	☐	☐	☐

List other(s)

____

12. **Please describe the conditions under which drivers use the road/weather and travel information to…**

Change trip timing ____

Change routing ____

Change destination ____

13. **Do drivers feel that they are getting the kind of information they need for travel in the SR 395 and SR 20 corridor region? Briefly comment on information** <u>access</u> **and** <u>quality</u>**, and any other information that is currently unavailable but that drivers wish they had so they could make better driving choices:**

____

____

____

14. **What changes to the information sources or content could be made to provide greater usability by truck drivers?** ______________________________________

____

____

____

15. What are the reasons they do not receive this information?__________________

____

____

Thank you for taking the time to answer my questions. We may be doing a follow-up survey next year and would like to contact you again at that time.

Notes (plus any additional comments or suggestions by respondent):

Appendix C

SR 395 Spokane FY99 ITS Earmark Evaluation: Event Log

This event log is intended to record baseline information about major events in the project corridor region regarding type, location, and impacts of every event between February 2001 and April 2001, as well as decisions and actions taken in response to each event. An event includes winter weather, rain/flooding, a major incident or other similar event that disrupts traffic or causes a safety hazard. Write on the back if necessary.

Date information entered: ____________________ **Entered by:** ______________________________

Brief event description (type of event; location; intensity)[2]: ____

____

____

____

Beginning of event (date/time): ________________ **End of event (date/time):** __________________

(Back to acceptable level of service)

Describe *when, how* and *from whom* you first learned about the event, as well as information you obtained later (document timing, sources, content): ____

____

____

____

Describe step by step (but briefly) the decisions/actions taken (e.g., equipment dispatched; person / hours committed; traffic rerouted) to respond to the event. Include date/time of each action:

____

____

____

____

Describe the impacts from the event on traffic (e.g., accidents; injuries; delays; road closures; severity) and responses (type, timing) from State Patrol, EMS, or others: ____________________________

____

____

[2] A map of the region is on the back of this form. Pencil in the area that is impacted by this event, including the location of incidents, road closures, and any other information you think would be useful in better understanding what happened.

Describe any additional event-related information you wished you had available but did not: ___________

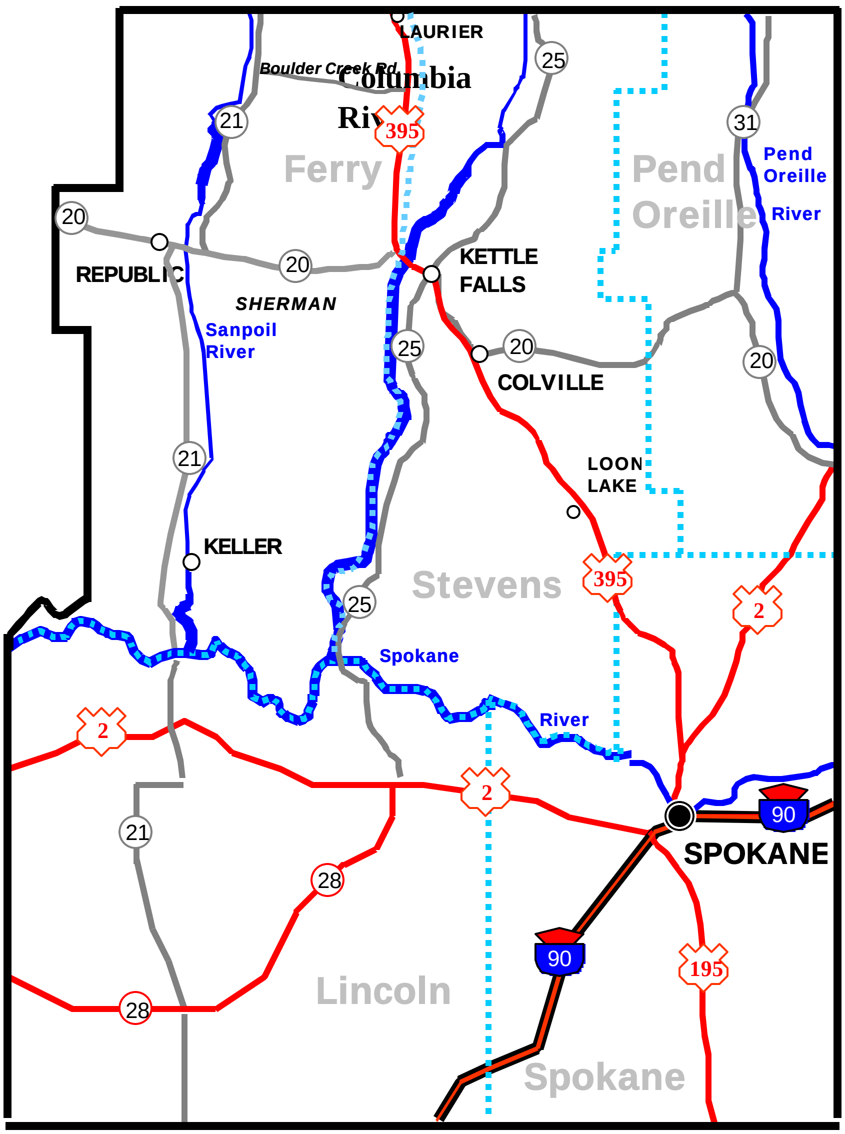
____

____

Add anything else that you think is pertinent to our understanding this event and the response to it:

____

Thank you for your assistance in recording this important information. Please fax this form when completed to Fred Kitchener (208-343-1218), and contact Fred at (208-345-4630) or Chris Cluett at (206-528-3333) with any questions or suggestions.



MAP NOT TO SCALE

Additional space for event details (note which questions are continued below):

APPENDIX D

SAFETY DATABASE CONTENTS

Accident Data Report Headings	Details
State Route Number	SR 395 and SR20
Mile Post Number (s)	
WSP Accident Report Number	
Diagram Analysis Data	
Accident Severity	1 = Property damage only 2 = Fatal 5 = Disabling injury 6 = Evident injury 7 = Possible injury 0 = Not stated
Number of Injuries	
Number of Fatalities	
Date	
Time	
Intersection Relationship	
Roadway Surface	
Weather	
Light	
Diagram Data Collision Type	
WSP Object Struck	
Severity	
Number of Injuries	
Number of Deaths	
Number of Vehicles	
Vehicle 1 Type	0 = Not stated or not applicable 1 – Passenger car 2 = Pickup truck 3 = Flatbed truck or van 4 = Truck and trailer 5 = Truck tractor 6 = Truck tractor and semi-trailer 7 = Other truck combinations 8 = Farm tractor and/or equipment 9 = Taxi 10 = Bus 11 = School bus 12 = Motorcycle 13 = Scooter bike 14 = Other 15 = Moped
Vehicle 2 Type	
Was Alcohol Involved?	
Driver 1 Contributing Circumstances	
Driver 2 Contributing Circumstances	
WSP Collision Type	