ITS EARLY DEPLOYMENT PROGRAM

I-5 SEATTLE TO VANCOUVER, B.C.

Technical Memorandum 3

CORRIDOR STRATEGIES

prepared for the

Washington State Department of Transportation

prepared by

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TABLE OF CONTENTS

LIST OF FIGURES

1 .O INTRODUCTION

This Technical Memorandum has been prepared as part of the I-5 Seattle to Vancouver, B.C. & I-90 Seattle to Spokane Inter-City Urban/Rural Corridors ITS Early Deployment Project. This is the third technical memorandum for the ITS Early Deployment Plan for the I-5 Corridor and is submitted in fulfillment of Work Element 3: Recommend Corridor Strategies. Revisions based on the review of this draft document will be presented in Work Element 7: I-5 ITS Corridor Study - Final Report, which will be composed of subsequent memoranda in their final form from the other five work elements in this study.

Summarized in this memo is the outcome of the final steering committee meeting which presents the results of Work Element 3.3 - Prioritization Plan, for the proposed corridor strategies. The summary of the project prospectuses, as conducted under Work Element 3.1- Develop Project/Program Profiles, are presented in the second memorandum and will not be restated here for the purpose of brevity. The results of Work Element 3.2 - Funding Source Assessment, an integral part of each prospectus, are presented in the second Memorandum, and will not be restated in this memorandum. The project prospectuses and the funding source potential of each of these prospectuses will be refined in Technical Memorandum 4 - Corridor Development Plan, as the projects are more clearly defined in terms of specific application sites. The scope of Work Element 3.3 - Prioritization Plan is as follows:

> The CONSULTANT shall conduct joint work sessions with WSDOT staff to prioritize the range of potential strategies. The various factors contained in each profile shall be examined. Guidance from the participants at the workshop held as part of Work Element 2 shall be a major factor as well as existing WSDOT Statewide strategies and policies. The end result shall be a prioritized list of recommended strategies, segregated by Region in the case of the I-5 corridor, to address transportation needs in the corridor to be incorporated in the development of ITS corridor implementation plan in the next work element.

This Technical Memorandum summarizes the results from the third and final steering committee meeting at which the Corridor ITS opportunities memo was presented outlining candidate project prospectuses. During this meeting held on September 26th, 1996, these prospective ITS corridor strategies were discussed as to their relative merits in addressing existing corridor problems. As a precursor to examining corridor-specific ITS opportunities, a brief overview of the FHWA ITS User Services was also presented. The ITS strategies were then prioritized for viability in terms of user benefits, availability of technologies, stakeholder support and funding potential. Some of these ITS strategies were dropped from further consideration based on degree of need, technology requirements and preliminary cost estimates. Each of these strategies was then rated and prioritized according to its implementation potential. This memorandum presents a prioritized list of the ITS technologies that address the existing corridor needs.

2.0 STEERING COMMITTEE MINUTES

The following is a brief summary of the discussion regarding each of the ITS prospectuses as presented at the steering committee meeting. The reader is referred to the second Technical Memorandum for a more complete description of each strategy.

Internet Pre-trip Traveler ***Information:*** This system was thought to provide useful information at a relatively low cost due to the use of readily available technology and information sources. Concern was expressed over the ease and availability of the internet to travelers given the relatively small percentage of the population that currently has access to the internet. It was agreed, however, that access to Internet services will expand and improve over time. A suggestion was made to link MoTH information to the WSDOT northwest region home page.

Broadcast Radio Dissemination System: This system was thought to have broad potential for application along the corridor with its ability to provide a public-private mechanism for the dissemination of traffic, traveler, and tourist related information. Institutional issues were discussed as a potential hurdle to its implementation. A suggestion was made to coordinate the use of broadcast radio with HAR, and to provide signing along the corridor identifying appropriate radio frequencies for travel information.

Mayday Support System: Discussion of this system by the Steering Committee focused on the new global positioning system (GPS) technologies integrated with advanced cellular phone communications. It was thought that with emerging technologies, particularly the future requirement for the locating of cellular calls[1], a conventional mayday support system would become redundant. Concerns over staffing requirements to respond to multiple calls was also discussed.

Border Crossing.- There was general consensus and support for the package of proposed ITS solutions for the U.S./Canadian border crossing. Two specific observations were made. First, WSDOT stated that they have experienced some problems with pole stability and shading associated with the use of auto scope. Second, it was suggested that an automated diversion system, designed to divert passenger cars from the Blaine truck crossing when the demand results in excessive delay for commercial trucks, be implemented as a "short-term" solution. Additional border crossing capacity was stated as a longer-term need.

Speed Detection/VMS Warning System: The benefits of this system were discussed and it was agreed that this would have potential application along the corridor.

Variable Speed Limit Signing and Weather Warning System: This system, as currently being deployed in the TravelAid project in the I-90 corridor, was considered a good candidate for implementation in other areas. There was some discussion regarding the enforceability of a variable speed limit sign. It was noted that variable speed limit signs are defined as a "traffic control device" by the State of Washington, and therefore are enforceable.

1FCC Report and Order Docket #94-102 adopted July 26th, 1996 requires portable 911 locations to the nearest sector by the 1st of January 1996. (This is the sector of coverage from a cell tower, if the tower is sectored) and 125m location accuracy for 67% of the time by the year 2001.

Ice Defection Weather Warning System: The overall consensus of this system was that it has potential, particularly in reducing accidents on bridges.

Portable License Plate Optical Reader System: This was believed to have good traffic operations and enforcement potential. Privacy concerns were discussed as issues that should be addressed as part of implementation. A list of articles related to privacy issues associated with the use of license plate readers was distributed to members of the steering committee [2] It was noted by the WSP that use of this technology in high-speed pursuits must be accompanied by the ability to identify the vehicle's occupants to be useful in prosecutions.

Visibility (Fog/Dust) Detection Warning System: Visibility detection was not perceived as a primary concern of many of the steering committee members and was not thought to be a high priority for further consideration. Accident data will be reviewed again to determine if there are spot locations were this could be deployed in a cost-effective manner. It was also noted that MoTH has a number of applications in the Vancouver, B.C. area.

Rock Fall Warning Sysfem: This system was thought to be difficult to maintain and would be subject to false calls. It would also be difficult to determine specific application sites for this system. It was recommended that it be dropped from further consideration based on these issues. It was noted that MoTH has experience with rock fall warning systems on the Sea-to-Sky Highway[3].

Animal Crossing Warning System: This system had several merits, but few potential application sites. It was recommended that it be dropped from further consideration based on its relative expense, the inability to determine exact locations for application, and current degree of problems associated with the system.

Over-height Detection: The overall consensus of this system was that it has potential, particularly in locations with low bridge or overpass clearance.

Portable Traffic Management System: This system was considered viable for special events occurring within the corridor. It was suggested that in addition to the Tulip Festival, application of this system be considered for the Peace Arch Celebration (June of each year), 4th of July fireworks purchases at the Tulalip Indian Reservation, and for Labor Day Weekend activities.

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[2] Copies of the following articles were transmitted to Eldon Jacobson on September 24, 1996. A list of these articles was distributed to Steering Committee Members at the September 26, 1996 meeting.

- "Privacy Oversight and Enforcement Optlons for Intelligent Transportation Systems: A Background PapeP by Robert Gellman for ITS America.
- "Eyes on the Road: Intelligent Transportation Systems and Your Privacy" by Tom Wright, the Information and Privacy Commissioner of Ontario, Canada.
- A news article on Photo Enforcement from the Western ITE's May-June 1996 issue
- A news article on Video-Based Systems found in the March 1996 issue of *ITS: Intelligent Transport Systems.*
- An abstract on the proceedings of the Intelligent Transportation Society of America 6th Annual Meeting and Exposition. This abstract discusses planning for the addition of new technologies at national border crossings.
- Newsletter from ITS America which is an update of its efforts on privacy. This includes the Draft Final Intelligent Transportation Systems Fair Information and Privacy Principles.
- Parsons Brinckerhoffs agreement of confidentiality of the license plate data collected for a former project on SR 16.

[3] The Sea-To-Sky Highway connects Vancouver, B.C. to Whisler B.C. Contact Mike Oliver, Senior Geotechnical Engineer, MoTH (250-367-3353) for additional information on MoTH rock fall warning system application.

Northwest Region TSMC Geographic Enhancemenfs: Steering committee members expressed strong support for continued enhancements to the TSMC.

Mf. Vernon & Bellingham Traffic Management Systems: This system was considered to have far reaching benefits in terms of safety, incident response, traffic operations and enforcement. Upgrade to the existing communications system was considered a prerequisite to the implementation of a Traffic Management System.

Rest Area Traveler Information Kiosks: This was considered an appropriate application of technology for the dissemination of data to the roadway user. Several concerns were noted including personal safety issues, vandalism, maintenance, and limited accessibility to the majority of the traveling public.

***Rest Area* Security System:** This system was thought to have potential for implementation. Video data was considered important for use as evidence. Seventy-two-hour continuous recording was proposed as an adequate time to retrieve video evidence. Co-location of a WSP station and a rest area was also suggested as a means of enhancing rest area security. Silverdale was mentioned as an example.

Public Private Initiative Rest Area: This project was considered to have limited probability for success and was outside of the scope of ITS solutions. It was recommended that this project be dropped from further consideration. It was noted that some state and federal policies and regulations would need to be changed to fully implement such an initiative.

Maintenance Management System: The overall consensus of this system was that it is needed to support the ITS investments over time.

Advanced Vehicle Lateral Control System: This system was considered to be heavily dependent on the advancing technologies associated with the Automated Highway Systems, and was not considered feasible for deployment within the planning time frame of this project, A suggestion was made to install rumble strips as a short-term, low-tech solution. It was noted that rumble strips are already installed in many places along the I-5 corridor.

3.0 SUMMARY OF CORRIDOR ITS OPPORTUNITIES

Figure 1 presents a summary of the priorities for the strategic deployment of the ITS Project Prospectuses for the I-5 Corridor. The projects are ranked either low, medium, or high based on the steering committee's assessment of viability. Priorities in terms of the specific project sites and implementation schedule will'be fully defined in Technical Memorandum 4, the Corridor Development Plan.

Figure 1
Summary of I-5 Corridor Priorities for ITS Project Prospectuses

User Service		ITS Project Prospectus	Priority
Traveler Information	1	Animal Crossing Warning System	X
	2	Broadcast Radio Dissemination System	●
	3	Ice Detection Weather Warning System	◕
	4	Internet Pre-Trip Traveler Information	●
	5	Rest Area Traveler Information Kiosks	◕
	6	Over-height Detection	◕
	7	Rock Fall Warning System	X
	8	Visibility (Fog-Dust) Detection Warning System	○
Traffic Management	9	U.S./Canadian Border Crossing Systems	●
	10	Portable Traffic Management System	◕
	11	Speed Detection/VMS Warning System	◑
	12	Variable Speed Limit and Weather Warning System	◔
	13	Northwest Region TSMC Geographic Expansion	●
	14	Mt. Vernon & Bellingham Traffic Management System	◕
Emergency Management	15	Mayday Support System	○
	16	Rest Area Security System	●
	17	Public-Private Initiative Rest Area	X
CVO/Enforcement*	18	Portable License Plate Optical Reader System	◕
	19	Maintenance Management System	◕
Advanced Vehicle	20	Advanced Vehicle Lateral Control System	X

* The CVO Components of this project have been largely deferred to the Statewide CVO plan development project

Priority Ranking

○ **Low**
◔ ▲
◑ |
◕ ▼
● **High**
X **Dropped from further consideration**

EARLY DEPLOYMENT PLAN

B-5 SEATTLE TO VANCOUVER, B.C.

DRAFT

Technical Memorandum 4

CORRIDOR DEVELOPMENT PLAN

prepared for the

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1,0 INTRODUCTION

This Technical Memorandum has been prepared as part of the I-5 Seattle to Vancouver, B.C. and I-90 Seattle to Spokane Inter-City Urban/Rural Corridors Intelligent Transportation System (ITS) Early Deployment Project. It has been revised to incorporate comments received by the Washington State Department of Transportation (WSDOT) and corridor stakeholders. This is the fourth Technical Memorandum for the ITS Early Deployment Plan for the I-5 Corridor and is submitted in fulfillment of Work Element 4: Corridor Development Plan. Project tasks that led up to this memorandum include work completed under Work Element 1: Corridor Needs Assessment; Work Element 2: Corridor ITS Opportunities; Work Element 3: Corridor Strategies; and Work Element 5: Communications Plan. This Revised document is in fulfillment Work Element 7: I-5 ITS Corridor Study - Final Report.

Summarized in this memo are the recommended corridor ITS prospectuses and a proposed implementation schedule. The implementation plan as described in this memorandum, creates a vision of ITS solutions that meet many of the corridor needs as documented in the earlier memoranda. This strategic plan presents and consolidates the work undertaken in Work Element 3, and assigns a proposed implementation plan including preliminary costs and benefits. The implementation plan is based on several factors including corridor priority, feasibility, equity sharing amongst stakeholders, physical requirements for a systematic implementation, funding source considerations, and cost benefit calculations. Phasing of individual projects are also based on these overriding factors, and are scheduled for a phased implementation. Costs and benefits associated with individual projects represent only the short-term implementation since determination of these values will fluctuate over time.

Scope of Work for Element 4, as reflected in the projects Scope of Services, is as follows:

4.1 Develop Project Descriptions/Prospectuses

A critical success factor for this development plan shall be the identification of projects, programs, and strategies that have the highest chance of success. These shall be items that address critical needs, can be implemented, and have funding sources. Given the 20-year planning horizon for this effort, the development plan must account for the changing availability of funding and the rapid advancement of technology. The short-term portion of the plan shall include specific projects and programs to be implemented. The medium- and long-term portions shall be more strategic in nature.

The CONSULTANT shall also prepare programming information for recommended short term projects deemed by WSDOT to be implementable. This programming information will be in a prospectus format that permits the projects to be listed for funding and construction within WSDOT's budget and programming process. Up to twenty-four (24) total prospectuses will be produced.

4.2 Implementation Plan and Schedule

The CONSULTANT shall strive to develop a plan that is flexible and has built-in check points to assess current conditions and technology. The CONSULTANT shall identity the strategies that are critical links in implementation. These critical strategies are actions upon which future activities are based. The plan shall be a road map that points to the critical junctions and decisions. In addition, the CONSULTANT shall develop a recommended mechanism that shall require periodic assessments and updates of the plan to adjust for changing conditions. The plan, as a technical memorandum reviewed by WSDOT, shall also include supporting communications requirements. The technical memorandum shall contain a set of maps for each time period to graphically illustrate the recommended plan.

2.0 PROJECT PROSPECTUS OVERVIEW

This memorandum presents each of the project prospectuses in a comprehensive format that states corridor need, presents an ITS project that fulfills the need, outlines system requirements, presents a proposed time frame for implementation, and estimates costs and benefits. These projects represent the beginning to an ITS vision for the corridor. This vision however, is based on several overriding assumptions and in some cases is dependent on certain pre-requisite projects being implemented. The following describes some issues that should be considered while reviewing these prospectuses.

Data Sharing and Exchange - A central information source is implied throughout the prospectuses which relates to the vision of a common data exchange network. Many of the projects listed, especially related to Advanced Traveler Information Systems (ATIS), refer to a central source of information where data are generated or received. This source of information is referred to as the WSDOT Smart Trek ITS Backbone and is currently being developed under the U.S. DOT Model Deployment Initiative (MDI) program. Ultimately, the intent is for these projects to share information with the ITS Backbone. This will create synergy between projects while reducing future costs of system expansion.

Cross-Border Coordination - The data exchange network identified above will also play an important role in cross-border coordination. Although the Trade Services Act of 1927 prohibits the sharing of commercial information with Canada, ITS-related data exchange will prove to be an important tool in traffic management along the border. ITS data exchange can range from the exchange of traffic counts and traffic conditions as well as real-time video exchange and electronic message sign status. This sharing of information will lead to improved efficiency in traffic operations along the border.

Public-Private Partnerships - Several projects have a potential for participation with private interests. This is true in the case of Rest Area Information Kiosks, and the Broadcast Radio Dissemination project. ‘Private participation may also be sought for projects including Rest Area Security. Although these potential benefits are not reflected in the benefit/cost calculation, value added or more cost-effective opportunities should not be overlooked when assessing funding potential of these projects.

Project Costs/Benefit Cost Calculation - Costs and benefits were only shown for the near-term implementation phase. The rationale for this approach reflects the reality of determining any reliable forecast of true benefits and costs given the changing nature of ITS technologies and needs of the corridor.

Implementation Schedule/Project Phasing - Projects were distributed across the corridor to provide opportunities by the various WSP and WSDOT offices and facilities to gain system management experience and share operational responsibilities, while not overburdening scarce personnel resources. The long-range plan assumes that each district will have a “system hub” that will eventually be part of an overall “information web” . Each project is initially designed to be self-contained, with the ultimate plan to devise a system upon which stakeholders could commonly share information, as described earlier.

Communications - The communications infrastructure to support each of the various ITS applications recommended for the I-5 corridor is addressed within each project prospectus prepared as part of this memorandum. In general, the recommended communication network includes both the expansion of the existing Northwest Region WSDOT Synchronous Optical Network (SONET) as well as the use of leased communication lines. In the short-term, the fiber optic system expansion is recommended at high density locations north of Marysville, extending to the Bellingham urban area (MP 256), while leased lines are recommended for use in outlying areas where they prove to be more cost-effective. The long-term plan recommends the extension of the fiber optic network along the entire corridor north to the U.S./Canadian border.

Project Risk Assessment - ITS is a developing industry. As such, ITS programs inherently carry the potential for significant risks along with the potential benefits. Identified here are common areas of potential risk that are recognized in the industry. Awareness of these potential risks as this program moves toward and through deployment will allow for advanced detection, monitoring, and mitigation of those risks and will help ensure project success. Project success means useful functions delivered on time and within budget.

Technology --ITS is the application of technology to the resolution of transportation needs and thus inherently carries a degree of risk generated by the rapidly evolving technology sector. Technological risks include technology that may be unproven for the intended application, technology that is rapidly evolving and may become obsolete even as it is deployed, or technology that is too costly to implement, operate and maintain. This risk is somewhat tempered through increased design and operational experience gained through a greater degree of exposure to computerized applications and electronic field devices including variable message signs (VMS), Highway Advisory Radio (HAR), vehicle detection systems, signal systems, and others, which have become mainstream applications

Another risk that requires management is software. Software is increasingly present in all aspects of life and is ubiquitous in ITS by its presence in VMS, communications equipment, monitoring and control systems, signal controllers, ramp meters, and weather systems. Software development is more correctly characterized as a research and development activity than a pure engineering endeavor. The risks and costs associated with software development are affected by many factors including the quality of the definition of requirements and specifications, complexity (more functions/features exponentially increase complexity), evolution of technology, arbitrary schedule changes after development is underway, and the presence or absence of standards. Software risk is mitigated through the provision of clear, stable requirements and designs, careful estimating and ample communications including deliverable reviews between developers and users.

Many of the prospectuses presented in this report include a software component. An effort has been made to provide reasonable ranges for software cost estimates that reflect both basic and more advanced implementations and consider the elements of technological risk involved. As projects evolve towards implementation these risk factors and potential cost and schedule impacts should be monitored and reviewed to assure success.

Communications Protocol - Many of the systems components as described in these prospectuses are not compatible due to the proprietary nature of their design. To construct systems as described requires system integration through sharing of communication protocols and cooperation amongst participating vendors, which is sometimes difficult. Adoption of a national communication protocol such as National Transportation Communications ITS Protocol (NTCIP) will allow a greater degree of compatibility in the design of these systems.

Common system communication protocols for many surface transportation systems devices such as signals, vehicle detection, closed circuit television (CCTV), VMS, and highway advisory radio (HAR) are being developed under NTCIP. However, many other interfacing systems still have integration obstacles.

As an example, communications systems in support of weather technology are open and very accessible, nationally and internationally. However, commercial vendor weather systems fielded in support of surface transportation, specifically for state departments of transportation for road maintenance (primarily snow and ice control), have evolved with closed systems and proprietary components. The NTCIP has not been developed for application to the weather information and technology area to date. However, work is currently under way by the NTCIP Committee to establish a standard protocol using the internationally accepted Binary Universal Form for the Representation of Meteorological Data (BUFR) as a basis for the standard. In the interim, it is recommended that major procurements require an open protocol at a minimum.

Liability - Any traffic or traveler information system carries with it the risk of liability by the owning and operating agency. WSDOT may be liable for any claims made for personal injury or property damage made in connection with either the correct, incorrect, or failed operation of ITS devices or errors of commission or omission in data provided through ITS systems.

Classes of Benefits Data - Benefits data are available from a number of sources that vary in precision, accuracy, and repeatability. Benefits data described in this report generally fall into the following categories:

Measured - outcome results from field measurement of desired quantities through engineering studies, which are the most compelling.

Anecdotal - output measures or estimates made by people directly involved in fielded projects, which are also compelling, but less reliable than measured outcomes in terms of quantitative benefits estimates.

Predicted - results from analysis and simulation, which can be useful tools to estimate impacts of an ITS deployment when field experience is not available or when projects are not of sufficient scope to determine system impact.

The terms “outcome measure” and “output measure” are adopted from the Government Performance and Results Act of 1993. Outcome measures relate directly to the goals of the ITS program, while output measures (which are grouped with experiential estimates as the anecdotal class) identify results which bear some relationship to the goals, but do not directly measure the degree of achievement of those goals. For example, in discussing the achievement of a goal such as average travel time and average delay found in a before-and-after study, an output measure would be the number of additional lane miles with freeway management systems installed. While the installation or expansion of a freeway management system does not directly define the value of such systems, departments of transportation invest in such procurements because they have reliable indications of their value.[1]

[1] *Review of ITS Benefits: Emerging* Successes, MItretek Systems, September 1996, p, 3

3.0 PROJECT PROSPECTUSES

Based on Technical Memorandum #3: Corridor ITS Opportunities, candidate prospectuses were refined from 19 projects to 14 projects. Five of these initial prospectuses were dropped from further consideration due to their relative lack of merit in addressing the existing corridor problems. Rejected projects included Visibility (Fog/Dust) Detection Warning System, Rock Fall Warning System, Animal Crossing Warning System, Public-Private Initiative Rest Area, and Advanced Vehicle Lateral Control System. In addition to these projects, there was general consensus support for developing and implementing a comprehensive maintenance management system to support the ITS applications. The following section describes each of the ITS project prospectuses that have been chosen for consideration.

The following section describes each of the ITS project prospectuses that subsection are recommended for implementation along the corridor. Figure 1 presents a proposed implementation schedule. Figure 2 is a summary of costs and benefits of each project prospectus and includes the initial Steering Committee priority ranking. Figures 3, 4 and 5 are corridor maps that graphically illustrate this phased implementation plan for the short-term, mid-term and long term periods, respectively. Figures 1 through 5 follow the last prospectus in this memorandum.

3.1 Broadcast Radio Dissemination System

Project Title: Broadcast Radio Dissemination System

User Service: Traveler information

Time Frame: Near-Term

Objective:

The objective of this project is to implement a Broadcast Radio Dissemination System that allows for route, weather, and traffic condition information to be sent to local broadcast radio stations. Each station would then have the capability to broadcast this information to its listeners.

Project Background:

Broadcast radio is currently widely used in many major urban areas to disseminate weather, route, construction, event, and traffic information. Broadcast radio also has the advantage of reaching a large number of travelers over a broad geographic area. Travelers can use this information to aid the decision-making process regarding choice of mode, travel time, and route, either before departure or en-route. While many stations rely on their own resources to gather this information (including privately-owned traffic helicopters and planes), most traffic data can now be collected and disseminated through publicly-operated traffic operations centers (TOCs).

Outside of major urban areas, radio stations disseminate weather and event conditions, but commonly have little access to real-time traffic and travel conditions. Presently, there are several traffic and road condition sensors operating along the I-5 corridor, with more planned as various ITS initiatives are implemented. However, a system to comprehensively disseminate this information to private entities, such as radio stations, is not currently in place.

Statement of Need:

For many travelers, the most easily accessible source of en-route real-time traffic and weather information is local radio broadcasts received through their in-vehicle radio. Currently however, it is difficult for local radio stations to obtain real-time information on traffic, travel, and weather conditions. A system is needed to disseminate travel information to radio stations serving the corridor.

Project Description:

This project involves the integration of an information database, computer workstation, and communications infrastructure to disseminate traffic, weather, and travel condition information to local broadcast radio stations. The project is composed of the following components:

- Computer Workstation/Fax Server

  WSDOT maintenance offices along the I-5 corridor will be equipped with a computer workstation/fax server. The workstation will be a PC or similar computer with access to a central information database which stores information regarding incidents, road closures, special events, weather data, and other real-time traveler information. Access to the database will either be through an internet connection or through a direct leased line. The workstation will be equipped with several fax/modem cards to allow simultaneous dissemination of multiple faxes.

- Participating Radio Station Database

  A database of participating radio stations will be established that lists which stations request information, the stations' fax numbers, and the particular information they are interested in receiving.

- Broadcast Radio Station interface

  For larger radio stations, or those willing to invest in the purchase of a computer workstation with graphical display capabilities, a local terminal could be provided and linked through the Internet or through direct leased telephone company lines with the WSDOT workstation. Smaller stations will likely prefer to be updated via fax.

System Capabilities:

The proposed Radio Broadcast Dissemination System will have the following capabilities:

- a computer workstation/fax server with the ability to access traffic, weather, and road condition information via the Internet or through a dedicated line connection to a WSDOT central database;
- the ability to send information via fax to all participating radio stations; and,
- the ability to respond to requests from the radio stations for specific information which is of interest to them.

Project Scope:

This project scope will involve one phase with the following steps:

1. Develop information needs, data requirements, and determine data sources.
2. Develop specifications for system hardware, software, and communications (fax/modem) requirements.
3. Develop the workstation/fax server hardware, software, and communication links to access the desired information.
4. Establish agreements with local radio stations and develop a database of participating stations.
5. Deploy the system along the I-5 corridor from Seattle to Vancouver B.C.

6. Coordinate the implementation of a broadcast radio dissemination system with radio stations in the greater Vancouver, BC area.

Project Cost:

Table 1 presents a summary of the estimated project cost in 1997 dollars. The design and evaluation costs are estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost. It should be noted that the software cost assumes a basic, stand-alone fax server system that can extract and summarize traffic and incident data. The variability in sources (Internet, WSDOT database, manual, etc.) also causes a corresponding variability in cost (i.e., covering all those sources may range as high as $300,000 versus just pulling data from a database). A system to support a graphical user interface at the radio station and the creation of that interface is probably more in the range of $500,000 or more.

Table 1

I-5 Corridor Broadcast Radio

Item	Unit Cost*	Units	Total Cost*
Processor/Fax Server	$ 10,000	3	$ 30,000
Software	$ 100,000	1	$ 100,000
Communications Hardware	$ 5,000	3	$ 15,000
Total Construction Cost			$ 145,000
Design & Evaluation Cost			$ 29,000
Total Capital Cost			**$ 174,000**
O&M Cost/Year			**$ 17,400**
*1997 dollars			

Project Benefits:

The project benefits are expected to come from an increase in travel information available to tourists, the movement of goods, and local travelers on the I-5 corridor.

The Statewide IVHS Plan2 identified the potential annual benefits of traveler information as $5,742,476 for the I-5 corridor counties of Snohomish, Skagit and Whatcom. Assuming that 5 percent of these benefits are due to the implementation of the corridor-wide broadcast radio information dissemination project, the annual social benefit is estimated to be $207,124.

2 "State Wide IVHS Plan, Venture Washington" , JHK & Associates, November 1993

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$30,053**
Annual Benefits	**$287,124**
Benefit/Cost Ratio	**9.6 : 1**

Project Schedule:

The project is proposed as a near-term ITS project (Years 0 to 6). The information dissemination system is expected to be developed in the first 12-15 months of the Early Deployment Implementation schedule. Once this dissemination system is established, the next task is to identify and enlist as many corridor commercial radio broadcast stations as possible. This task should only take 2-3 months and may be repeated at a later date depending on the success of the project.

3.2 Ice Detection Weather Warning System

Project Title: Ice Detection Weather Warning System

User Services: En-Route Driver Information, Pre-Trip Travel Information, Travel and Transportation Management

Time Frame: Near-Term: Phase 1, Phase 2

Mid-Term: Phase 3

Objective:

The objective of this project is to plan, design, and implement ice detection and warning systems at selected locations along the I-5 Corridor from Seattle to Vancouver, B.C. Sensors will detect when bridge and road conditions become icy and a warning system will disseminate real-time, site-specific information to travelers, WSDOT maintenance personnel, and the WSP.

Project Background:

Analysis of corridor traffic data indicates a number of locations that experience a relatively high number of ice-related accidents. Icy conditions often occur on bridges in low lying and shadowed areas. Ice-related accidents are a leading cause of non-recurring freeway congestion and can result in property damage, injuries, and fatalities.

Additional costs related to icy roadway conditions include the application of de-icing agents. Deicing agents can be used both to prevent ice build up and to thaw existing ice. However, it can take up to four times as much deicing agent to thaw existing ice as is required to prevent ice formation. Another problem is that maintenance engineers often must "play it safe" and apply deicing agents at times when ice build up may or may not occur. These are added costs that may be reduced if accurate detection and prediction methods are established.

Currently, decisions on how to handle ice build-up are often made after the hazardous conditions have already developed. By this time, accidents may have already occurred. When preventative measures are taken, officials are often relying on weather predictions that are not specific to the site in question.

Motorists traveling to and from British Columbia face an additional challenge with respect to winter roadway conditions. Maintenance crews in British Columbia and in Washington State apply different treatments to address snow and ice conditions. In British Columbia, salt is commonly applied to the roadway surface, whereas in Washington State, sand, gravel, and a chemical agent known as CMA (calcium magnesium acetate) is used. The use of different agents on the roadway surface may result in a noticeable difference in vehicle handling.

The media used to warn drivers of hazardous conditions are also an issue that can affect the number of ice-related accidents. Static signs warning that icy conditions may occur ahead have not been proven effective in reducing the number of ice-related accidents.

Statement of Need:

Ice build up on roadways and bridges is a leading cause of accidents at a number of corridor locations. Current weather forecasting is not effective in predicting when ice will form at specific roadway sites, because it is very difficult to issue an accurate forecast for a location where no pavement and weather data are available to provide trends and current conditions. Application of deicing materials after ice build-up has occurred can be extremely expensive. At the same time, application of deicing materials when it is not necessary is also very costly to the economy and the environment.

Project Description:

This project involves evaluating, planning, design, and implementation of Ice Detection Weather Warning Systems along the I-5 corridor. The project will be implemented in a three-phased approach at five different locations. The following locations are currently identified for the system installation:

- State Route 526 Interchange (MP 189);
- Mount Vernon Vicinity (MP 210 Area);
- Anderson Road Interchange (MP 225);
- Vicinity of Lake Sammish (MP 240); and,
- Nooksak River Bridges (MP 262).

Major components of the ice detection system or a Road Weather Information System (RWIS) include: system sensors, Value-Added Meteorological Service (VAMS) including meteorological satellite and radar data, thermal mapping software, a remote and central processing unit (RPU & CPU), a message dissemination device and a communications infrastructure that links the individual components together and possibly to an operations center. It should be noted that the primary operational benefits from the system are the informed decisions of the maintenance and operations personnel based on the RWIS data.

- Road Weather Information Systems (RWIS)

  RWIS are currently in use at a number of corridor locations, both on the roadside and at nearby airports and schools. RWIS detect and record air temperature, precipitation amount and type, wind speed and direction, and humidity. Some can be further equipped to include pavement temperature, cloud cover, snow depth, and visibility. Information gathered by the RWIS is sent to the local CPU. Table 2 identifies the locations of both existing and planned weather observation sites along the I-5 corridor.

Table 2

I-5 Corridor - Seattle to Vancouver, B.C. Weather Observation Sites

Location	Data Source
I-5 @ SR 524	WSDOT planned site; limited weather info
Lynnwood	Department of Ecology (DOE), Puget Sound Air Pollution Control Authority (PSAPCA); wind data only
Paine Field	National Weather Service (NWS); total weather data
Hoyt Ave & 26th St., (Everett)	DOE/PSAPCA; wind data only
Matysville	PSAPCA; wind data only
Arlington Airport	NWS; total weather **data**
Burlington Airport	NWS; total weather data
Sedro Wooley	Department of Natural Resources; limited weather info
Sedro Wooley	Corps of Engineers; limited weather info
Bellingham Airport	NWS; total weather data
Bellingham Port	U.S. Coast Guard; limited weather info
Puget Sound Area (4 sites in corridor)	King 5 TV, Seattle; limited weather info

The RWIS stations at the sites mentioned above do not currently incorporate ice detection technologies. These sites will be evaluated based on their location and their capability to incorporate ice detection sensors, and a communications interface to a WSDOT site. Ice detection sensors can detect existing ice, measure ground temperature, differentiate between dry, moist and wet pavement states, and even measure the precise freezing point of the water/melting agent mixture found on the road surface. Those locations which prove feasible will be added as additional Ice Detection Sites for the I-5 corridor.

Within RWIS, the combination of sensors, microprocessor, power supply, and modem/communications interface is collectively called a remote processing unit or RPU. Each RPU processes the data from the individual sensors and transmits this data to the central processing unit or CPU. Other components of RWIS are outlined below:

- Value-Added Meteorological Service (VAMS)

The VAMS provides locally tailored weather forecasts, which supply information necessary to the ice detection system. The VAMS develops site-specific forecasts using data provided by RWIS and the National Weather Service's Next Generation Weather Radar (NEXRAD) Information Dissemination System.

- Thermal Mapping Software

Thermal mapping is a process that allows the variation in road surface temperature to be measured across a road network. Thermal maps complete road temperature profiles between RWIS sensor sites. It is then possible to more accurately predict road surface temperatures between RWIS sensor sites.

0 Central Processing Unit (CPU)

The local CPU registers all of the data from the RPUs. A communications interface allows the CPU to send messages to traffic control devices, including flashing beacon and VMS. The CPU can transmit data and an alarm message, to a PC display in a traffic operations center, maintenance facility, or the WSP. Communication methods are expected to use a combination of agency-owned and leased lines.

- Messane Dissemination Device

The message dissemination device could include the use of one of several technologies including VMS, blank out sign, HAR or a static sign with flashing beacons. It is likely that a sign with flashing beacons will be sufficient to capture drivers attention, but effort should be made to coordinate with current and planned VMS and HAR installations to reach a wider audience.

System Capabilities:

The proposed project will have the following capabilities:

- the ability to measure ground and air temperature, humidity, and precipitation;
- the ability to determine if ice has formed on the roadway or predict when it will form;
- the ability to measure freezing point temperature of water/deicing agent mixture on road surface;
- the ability to send data and alarm messages to a WSDOT traffic operations center, maintenance facility, or WSP facility; and,
- the ability to send an appropriate message to a dissemination device (e.g., VMS or flashing beacon warning).

Project Scope:

The project scope will involve three phases.

Phase 1: This phase involves the initial system evaluation, planning, and preliminary engineering design. A Design Report is prepared at this stage that evaluates and places a priority on the sites to be implemented. In addition, a recommendation on the technologies to be utilized during the design phase will be made. Existing weather station sites along the corridor will also be evaluated for their inclusion into the system.

Phase 2: This phase will prepare the plans, specification and estimate (PS&E) package and install three new weather stations at the priority sites as identified in the initial phase.

Phase 3: This phase will develop the PS&E package for the installation of up to an additional five sites as determined in the initial phase. If determined feasible, the upgrade of existing sites will be incorporated as part of this phase.

Project Cost:

Table 3 presents the project costs for Phase 1 and Phase 2.

Table 3

Ice Detection System

Item	Unit Cost*	Units	Total Cost*
Phase 1:			
Design Report	$ 25,000	1	$ 25,000
Phase 2:			
PS&E (3 sites)	$ 125,000	1	$ 125,000
RPU Station	$ 70,000	3	$ 210,000
CPU Station	$ 40,000	3	$ 120,000
VAMS/RWIS	$ 200,000	3	$ 600,000
Flashing Beacon Sign	$ 10,000	6	$ 60,000
Software	$ 70,000	1	$ 70,000
Interface Requirements	$ 50,000	1	$ 50,000
Communications	$ 100,000	1	$ 100,000
Total Construction Cost			$ 1,210,000
Total Design Cost			$ 150,000
Total Capital Cost			**$ 1,360,000**
O&M Cost/Year			**$ 136,000**

Project Benefits:

The project benefits are expected to come from the net reduction in accidents at the locations where the ice detection systems are installed. Additional benefits are anticipated due to reduced deicing/maintenance costs. Once the system is established, maintenance engineers will have the ability to apply a deicing agent before ice build up occurs, and only when necessary. Environmental benefits include a net reduction in the amount of deicing agent that is applied.

Assuming that implementation of the ice detection system would reduce the number of ice-related accidents at the three sites by 30 percent, the societal benefits would be equivalent to $275,006.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	$275,006
Annual Benefits	$234,896
Benefit/Cost Ratio	1.2 : 1

Project Schedule:

Phase 1 and phase 2 are proposed as a near-term ITS project (Years 0 to 6). Phase 3 is proposed as mid-term (Years 7 to 12).

3.3 Internet Pre-Trip Traveler information

Project Title: Internet Pre-Trip Traveler Information

User Services: Traveler Information

Time Frame: Near-Term

Objective:

The objective of this project is to provide pre-trip road, weather, travel, and traffic information to corridor travelers in a convenient and cost-effective manner. Increased use of both home and office computers, combined with the ever increasing popularity of the Internet and the World Wide Web (WWW) and increased capabilities of browser software, offer an ideal medium for the dispersion of this information at a relatively low cost.

Project Background:

WSDOT currently maintains a WWW home page that offers both static and real-time traffic information. The web page focuses primarily on the Central Puget Sound Region, however some information is from other regions in the state. Information provided on the WSDOT WWW home pages includes:

- roadway construction and pre-planned road closure information;
- "hot links" to transportation providers (Metro, Washington State Ferries, Amtrak, etc.).
- freeway congestion conditions (including a traffic flow map and video snapshots);
- unplanned road closures; and,
- mountain pass status including closures, weather, and road conditions.

RWIS can be found at a number of corridor locations, both roadside and at nearby airports. These stations collect temperature, humidity, and wind speed. Some have additional features like pavement temperature sensors and visibility detection, These systems may also be capable of sending real-time data that can be displayed on the www.

In addition, the British Columbia Ministry of Transportation and Highways (MoTH), through their participation in this study, has expressed an interest in having a hot link with WSDOT's home page. This could provide BC-bound travelers with useful pre-trip information.

Statement of Need:

There is a need to consolidate weather, road, traffic, and traveler services information, making it available to travelers in a convenient and cost-effective manner. The amount of information available is going to increase substantially as other ITS initiatives are implemented. The availability of this pre-trip information will help travelers make choices about route, travel mode, and departure time.

Project Description:

Work under this project will include expansion of the existing WSDOT WWW home page by incorporating additional information about the I-5 corridor. Additional information will be available by establishing links to agencies such as Convention and Visitors Bureaus, cities, counties, and local transit agencies for corridor municipalities, and the MoTH for the Southwest region of British Columbia. Data from the other corridor ITS projects (i.e., detection systems) can also be made available over the Internet if communications protocol is defined.

Content of the home pages will depend on available data, but may include:

- static information on local transportation services available;
- transit, rail, bus, and marine schedules;
- roadway construction information, incident reports and/or unplanned road closures and diversions;
- a list of broadcast radio stations and frequencies which provide en-route driver information;
- current and forecast weather conditions;
- real-time traffic conditions;
- incident reports;
- mountain pass status including closures, weather, and road conditions;
- special lane operations;
- truck or hazardous material restrictions;
- information on planned recreational events or other activities that may disrupt traffic flow or require traffic re-routing;
- real-time transit vehicle locations; and,
- US/Canada border crossing information.

These home pages may be maintained by the WSDOT at the NW Region Traffic Systems Management Center (TSMC). Convention and Visitors Bureaus, local governments, and private sector service providers will operate other home pages and supply additional information. Real-time data will be supplied by local and state transportation agencies, while static information will be compiled from both private and public sources.

The project will consist of the following components:

- Web Servers

  It is possible, and perhaps most cost-effective, to expand the existing WSDOT Web server(s).

- Internet Communications Access

  The type of Internet connection used will depend on overall data transfer requirements and selected system architecture. For example, the system may utilize a leased T1 line (1.544Mbs).

- Electronic Data Interface Software

  Electronic Data Interface Software allows the Web page information to be updated automatically directly from electronic sources of data.

- Manual Interfaces

  Some real-time information, such as confirmed incidents, road closures, and construction updates, may not be updated electronically. A manual interface, including a computer keyboard is necessary to update this type of information.

System Capabilities:

The proposed project will have the following capabilities:

- provide travelers with information regarding local traveler services;
- provide commuters and travelers with real-time traffic, road, weather, and congestion information;
- provide incident reports, and unplanned road closures and diversions;
- aid travelers decision making regarding choice of departure time, travel mode, and route choice;
- provide transit, marine, rail and bus schedule information for as many corridor communities as possible;
- provide easily accessible information at a low cost; and
- build on the existing hierarchical structure that allows users to easily find information of direct relevance.

Project Scope:

The project scope involves one phase that begins in the near-term and is planned to be an on-going effort. As each new relevant corridor information source or home page is located or established, effort should be made to link it to the WSDOT main home page. The following is a brief description of the tasks involved in the project:

1. Compile information to be provided through the Internet from meetings with interested groups and agreements made with local agencies, services and transportation providers.

2. Coordinate with existing WSDOT home page project to facilitate design and implementation of enhancements.

3. Develop interface to data collection systems.

4. Complete system design and procure communications and hardware equipment.
5. Establish an ongoing effort to locate and establish links to other relevant information sources and home pages.

Project Cost:

Note that this project proposal is essentially the same as the Internet Pre-Trip Traveler Information proposal contained in the companion ITS Early Deployment Plan for the I-90 (Seattle to Spokane) Corridor. Thus, significant cost savings would be realized in the areas of software development and beta testing if this project were pursued in conjunction with implementation of ITS applications within the I-90 corridor.

Table 4 presents a summary of the estimated project cost in 1997 dollars. The design and evaluation costs are estimated at 20 percent of the construction cost. The annual O&M cost is estimated at 20 percent of the capital cost.

Table 4

Internet Pre-trip Traveler Information

Item	Unit Cost*	Units	Total Cost*
Compile Information	$ 10,000	1	$ 10,000
Hardware	$ 10,000	1	$ 10,000
Software Development	$ 150,000	1	$ 150,000
Total Construction Cost			$ 170,000
Design & Evaluation Cost			$34,000
Total Capital Cost			**$ 204,000**
O&M Cost/Year *1997 dollars			**$ 40,800**

Project Benefits:

The project benefits are expected to come from an increase in travel information available to local and corridor travelers. The increase in travel information is expected to aid travelers in their decision making in regards to choice of mode, departure time, and route.

The Statewide IVHS Plan[3] identified the potential annual benefits of traveler information as approximately $5,750,000 for the I-5 corridor counties (excluding King County). Assuming that 5 percent of these benefits are due to the expansion of information available on the Internet, the annual social benefit is estimated at $287,500.

[3] "State Wide IVHS Plan, Venture Washington", JHK & Associates, November 1993

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$35,234**
Annual Benefits	**$287,500**
Benefit/Cost Ratio	**8.2 : 1**

Project Schedule:

The project is proposed as a near-term ITS project (Years 0 to 6). The project is planned as an on-going effort, adding new links and/or home pages as new sources of corridor information come on-line.

3.4 Rest Stop Information Kiosks

Project Title: Rest Stop Information Kiosks

User Service: Traveler Information

Time Frame: Near-Term: Phase 1, Phase 2

Objective:

The objective of this project is to implement traveler information kiosks at rest stops on the I-5 Seattle to Vancouver, B.C. Corridor. The project will be used to assess operational requirements and will evaluate the performance of information kiosks providing static and real-time traveler information at highway rest stops along this corridor.

Project Background:

There are several operational tests and Traveler Information System (TIS) implementations across the U.S. that employ or intend to employ kiosks to provide traveler information. Within Washington State, the Seattle Smart Traveler program executed an operational test providing transit and ride sharing information to commuters from a single kiosk in Bellevue.

Recently, there have been two local public information efforts that will impact this project. First, the Washington State Department of Information Services implemented a pilot project, Washington Information Network (WIN), providing public information through kiosks. WIN was established to help the state government serve the people of Washington State better, faster, and more cost-effectively. These kiosks provide a public interface to several government databases including transportation and recreation. The impact WIN will have on this project is the local experience gained through its design and implementation. Several issues including data security, communications protocol as well as public experience with the kiosks have already been addressed.

Second, WSDOT presently maintains a home page on the WWW. The Home page provides information such as statewide road closure and construction information (by region), real-time traffic congestion information for the greater Seattle freeways, and transit access information for the greater Seattle area. This home page represents an excellent source of traveler information with established formats and communications protocol (i.e. TCP/IP). Concurrent projects of the I-5 Corridor ITS Early Deployment Program would further add to the information available via the home page.

Although traveler information kiosks represent relatively well proven technology, few outdoor applications have been successfully demonstrated. Furthermore, the majority of previous applications have been primarily directed toward multimodal travel and transit users. As such, it is important to first demonstrate the feasibility and evaluate the potential of the rest stop kiosk information before a wider application can be advanced. These kiosks could provide:

- real-time road, traffic, and weather conditions within the corridor;
- border crossing delay;

- maps displaying possible route alternatives;

- static information on other destinations along the route; and

- static information on tourist attractions (i.e., travel routes and hours of operation), local services and emergency services.

Statement of Need:

People traveling through the I-5 corridor may be unfamiliar with the services, transportation options, and attractions the area has to offer and may not be aware of downstream traffic, weather, or other conditions. Signing cannot convey all the desirable information and has limited capabilities for providing updated real-time information. A medium that can provide information on road conditions, local services, attractions, and route instructions would benefit all corridor travelers, including commuters, regular travelers, and infrequent travelers and tourists.

Project Description:

This project involves the installation of interactive traveler information kiosks at rest areas. The first phase of the project includes the installation and evaluation of a single kiosk at the Custer rest area on southbound I-5. Results of this evaluation will determine the level of deployment during the second phase which allows for the installation of up to six, one each at the six other rest areas within the I-5 corridor. The project will involve the development of user interface, screen format, and control software suitable for providing both dynamic and static traveler information.

Dynamic traffic and weather data will be supplied via a communications link with WSDOT databases. The communication links between the kiosks and the central database(s) will utilize leased telephone company lines or the WSDOT-owned fiber optic communications infrastructure where applicable. Static information will be compiled with the assistance of private sector groups, regional economic development associations, local chambers, and state and federal organizations, to assist travelers in locating local services and attractions. This data will comprise the kiosk's database which will be updated periodically either remotely or by field staff. This data would include attraction locations, hours of operations, route instructions, and information about other local services (i.e. restaurants, accommodations, bank machines and gas stations).

System Capabilities:

The proposed project will have the following capabilities:

- provide a personal interactive interface by which travelers can request information using touch-screen or push-button methods;

- provide dynamic updated weather and road condition information;

- provide static traveler information including attraction locations and hours of operation, route selection, and local services information;

- provide a list of broadcast radio stations and frequencies that participate in the provision of en-route traveler information;

- disseminate traveler information via color monitor, digital voice reproduction, and possibly a printer; and
- communicate with WSDOT and possibly with local agencies via telephone line communication links.

Project Scope:

The project scope will involve two phases. The first phase includes the development of the kiosk interface, screen format, database and communications, and the installation and evaluation of the first kiosk at the Southbound I-5 Custer Rest Area (MP 268). The second phase involves the deployment of the kiosks at the six other rest areas. The following is a brief description of the tasks of each phase.

<u>Phase 1: Develop and Deploy Kiosk at the Southbound I-5 Custer Rest Area (MP 268)</u>

The first phase will consist of the following tasks:

1. Compiling information to be provided at the kiosk from meetings with interested groups and agreements made with local services.
2. Coordinating with WIN to facilitate design and development of similar interface.
3. Determining communication system interface.
4. Coordinating with WSDOT WWW home page for updated traffic and weather conditions.
5. Completing design of the kiosk including interface, communications, database format, and information update methods.
6. Selecting equipment that meets the specifications of the design.
7. Developing and customizing the software for the kiosk.
8. Developing criteria for kiosk evaluation.
9. Purchasing, testing, and evaluating the kiosk and communications hardware.
10. Installing rest area information kiosk at Southbound I-5 Custer Rest Area (MP 268).
11. Evaluating use and performance of kiosk.

<u>Phase 2: Full Deployment of Rest Area Kiosks Within the I-5 Corridor</u>

Phase 2 will implement the kiosks at the six additional I-5 rest areas. The following tasks are included in this phase:

1. Developing a site-specific database of local services by meeting with interested groups and agencies in the vicinity of each rest stop.

2. Determining individual kiosk communications needs if they differ from Phase I.

3. Integrating installation (e.g., power and communications) with the near term rest area security system deployment at Silver Lake MP 188 (Phase 1).

4. Install kiosks at the following rest stops:

   - Custer northbound rest area MP 268;
   - Bow Hill northbound rest area MP 238;
   - Bow Hill southbound rest area MP 238;
   - Smokey Point northbound rest area MP 205;
   - Smokey Point southbound rest area MP 205; and,
   - Silver Lake southbound rest area MP 188.

5. Update kiosk databases and software as necessary.

Project Cost:

Table 5 presents a summary of the estimated project cost in 1997 dollars. The design and evaluation costs are estimated at 20 percent of the construction cost. The annual O&M cost is estimated at 10 percent of the capital cost.

Table 5
Rest Stop Information Kiosks

Item	Unit Cost*	Units	Total Cost*
Phase 1:			
Compile Information	$ 30,000	1	$ 30,000
Kiosk Software	$ 50,000	1	$ 50,000
Kiosk Hardware	$ 10,000	1	$ 10,000
Communications Hardware	$ 500	1	$ 500
Kiosk Cabinet	$ 3,000	1	$ 3,000
Phase 2:			
Compile Information	$ 3,000	6	$ 18,000
CompleteKiosk	$ 13,500	6	$ 81,000
Total Construction Cost			$ 192,500
Design & Evaluation Cost			$ 38,500
Total Capital Cost			**$ 231,000**
O&M Cost/Year			**$ 23.100**
*1997 dollars			

Note that this project proposal is essentially the same as the Rest Stop Information Kiosks contained in the companion ITS Early Deployment Plan for the I-90 (Seattle to Spokane) corridor. Thus, significant cost savings could be realized in the areas of software development and beta testing if this project were pursued in conjunction with implementation of ITS applications within the I-90 corridor.

Project Benefits:

The project benefits are expected to come from an increase in travel information available to local and corridor travelers. The increase in travel information is expected to aid travelers in their decision making in regards to choice of mode, departure time, and route.

The Statewide IVHS Plan[4] identified the potential annual benefits of traveler information as approximately $5,750,000 for the I-5 corridor counties (excluding King County). Assuming that 5 percent of these benefits are due to the expansion of information available on the Internet, the annual social benefit is estimated to be $287,500.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$39,898**
Annual Benefits	**$287,500**
Benefit/Cost Ratio	**7.2 : 1**

Project Schedule:

The project is proposed as a near-term ITS project (Years 0 to 6). The first phase of the project, including design, implementation, and evaluation, will be completed within 24 months. The second phase, or the expanded implementation phase, will be completed over a 24-month period programmed for Year 4.

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4 "State Wide IVHS Plan, Venture Washington", JHK & Associates, November 1993

3.5 Over-Height Detection

Project Title: Over-Height Detection

User Service: Traveler information

Time Frame: Near-Term

Objective:

The objective of this project is to provide individual alert and advanced warning to commercial vehicle drivers and drivers of other high-profile vehicles, regarding existence of bridges with low clearance. Vehicle height sensors can detect the height of on-coming vehicles and warning signs and alarms can send messages to alert drivers to take an alternate route around the bridge and allow sufficient stopping distance to avoid collisions.

Project Background:

There are several locations along the I-5 corridor where overpass clearance is an issue. In fact, four bridges in this corridor are programmed for replacement in order to provide an overhead clearance of 15' 6". An overheight vehicle collision with a low bridge can affect not only the vehicle involved, but may also contribute to secondary accidents due to the sudden stopping of the vehicle and accident debris in the roadway. Drivers involved in these secondary accidents often suffer the greatest injury. Possible damage to the bridge super structure also has maintenance implications. Accidents may be avoided if special, individual warning is provided to drivers of overheight vehicles.

The overpass at MP 226.72 just south of Mount Vernon has a clearance of 14" 4". Due to the urban location of this structure and the subsequent high volumes of commercial traffic, this overpass is frequently struck by overheight vehicles (about four times per year). Until such time as this bridge can be raised to standard clearance, a height detection and warning system is recommended.

Statement of Need:

Current static low-clearance warning signs have proven effective in the reduction of accidents involving overheight vehicles and low bridges. One overpass in particular, (MP 226.72), has been the location of a relatively high number of accidents involving overheight vehicles.

Project Description:

This project involves the implementation of a height detection and warning system in the Mount Vernon area at MP 226.72. Once an overheight vehicle is detected on the freeway approach to the low bridge (both northbound and southbound), the system would provide a warning message and alternate route information to the vehicle driver via VMS or fixed signs with warning beacons. A second detector closer to the bridge would be used as a backup for drivers who may have missed the first warning. This location would also be equipped with a flashing beacon-type warning sign and possibly an audible alarm informing drivers that they must stop the vehicle to avoid colliding with the bridge.

The locations of overpasses with low clearance along the route should also be made available to the other Advanced Traveler Information Systems (ATIS) sub-systems, including rest area information kiosks, internet pre-trip information, and radio broadcasts. Bridge height information should also be used for input into commercial vehicle operator on-board system databases.

The major components of an overheight detection system include vehicle height sensors, the warning system, and the communications infrastructure/systems interface connecting the components with each other and with a traffic operations center (TOC).

- Vehicle Heiaht Sensors

  Vehicle height sensors, which may use a technology such as an infrared light beam, form an invisible barrier across the roadway at the desired height. In the case of infrared technology, a transmitter and a receiver are mounted on poles on opposite sides of the road at a specific height. Once vehicles are detected, the information is forwarded to the warning components of the system and to the TOC. Some height sensors have the capability to determine direction of travel as well as height of vehicles. This allows the warning system to avoid sending alarm messages to vehicles that are traveling away from the structure on bi-directional roads. However, the Mount Vernon site has only unidirectional traffic flow, so the detectors do not need to be direction discerning.

- Warning Sign System

  The first set of warning signs is placed far enough from the structure to allow for alternate routing. The second set of warning signs is located far enough from the structure to allow sufficient stopping distance considering common vehicle speed. The signing system would be made up of either VMS displaying predetermined warning messages or a system of blank out signs with flashing beacons. Audible warning devices can also be included as part of the sign system to ensure that the driver's attention is effectively captured.

- Communications/Systems Interface

  A communications infrastructure is required between the individual system components as well as between the system and the TOC. Component communications is expected to utilize twisted pair copper communication cable methods while communication to the TOC will utilize either telephone company leased lines or WSDOT-owned communications infrastructure if applicable.

System Capabilities:

The proposed project will have the following capabilities:

- the ability to determine if the height of on-coming vehicles exceeds the clearance posted for an overpass;
- the ability to warn individual drivers, using a warning sign system with flashing beacons and/or audible warning, that they must use the alternate route or stop;
- interface with a central TOC; and,

- interface with other ATIS sub-systems, including roadside kiosks at rest areas, public radio broadcasts, and the Internet Pre-Trip information project.

Project Scope:

This project involves one phase that includes system design, installation, and integration. The individual steps in the project scope include the following:

1. Develop specifications for the components of the system, including vehicle height sensors, warning sign system and the communications/systems interface. The communication system interfaces to the TOC as well as the integration with other ATIS projects will be addressed.

2. Prepare the PS&E package for the overheight detection system based on specifications developed in the previous step. Design should include equipment locations, power sources, and communications needs. Equipment locations must consider necessary stopping distances and alternative routes around the overpass.

3. Procure equipment that meets the specifications developed previously.

4. Install equipment at MP 226 at the locations determined in the system design for both northbound and southbound traffic.

5. Test and integrate the system.

Project Cost:

Table 6 presents a summary of the estimated project cost for the Over-Height Detection system.

Table 6
Over-Height Detection

Item	Unit Cost*	Units	Total Cost*
Phase 1:			
Develop System Specifications	$ 25,000	1	$ 25,000
PS&E	$ 45,000	1	$ 45,000
Height Sensors	$ 7,500	4	$ 30,000
Blank out Sign with Flashing Beacons	$ 3,500	8	$ 28,000
Audible Alarm	$ 500	2	$ 1,000
System Integration	$ 50,000	1	$ 50,000
Total Construction Cost			$ 109,000
Total Design Costs			$ 70,000
Total Capital Cost			**$ 179,000**
O&M Cost/Year			**$ 17,900**
*1997 dollars			

The design and evaluation costs are estimated at 20 percent of the construction cost. The annual O&M cost is estimated at 10 percent of the capital cost.

Project Benefits:

The project benefits are expected to come from a reduction in the number of accidents involving overheight vehicles colliding with the bridge in the Mount Vernon area. The costs associated with these accidents include the primary collisions, secondary accidents that may be associated with the stopped vehicle, and subsequent roadway debris. Assuming that 5% of the current number of annual accidents at this location would be avoided due to system implementation, the annual benefits would be equivalent to $84,840.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$30,916**
Annual Benefits	$84,840
Benefit/Cost Ratio	2.7 : **1**

Project Schedule:

The project is proposed as a near-term ITS project (Years 0 to 6). The project is planned in one phase, including design, implementation, and integration. Design work is scheduled to begin in Year 0 and the project should be completed by the end of Year 2.

3.6 Portable Traffic Management System

Project Title: Portable Traffic Management System

User Services: Traffic Management

Time Frame: Near-Term: Phase I, Phase 2

Objective:

The objective of this project is to create a Portable Traffic Management System (TMS) that is capable of managing short-term traffic problems. The TMS would emphasize portable devices including VMS, traffic signals, CCTV, and vehicle detection systems. The system would be made available to WSDOT and WSP personnel during special events occurring within the corridor as well as during incident, maintenance, and construction activities. The Tulip Festival, Peace Arch Celebration, Fourth of July (Tulalip Indian Reservation fireworks purchases), and Labor Day activities have been identified as some of the key special events along this corridor.

Project Background:

Portable TMS devices allow traffic operations personnel to apply the benefits of ITS technologies to specific locations in response to special events, incidents, maintenance, and construction activities. The portable nature of these technologies will allow the WSDOT and WSP to conduct traffic management at multiple locations depending on the special event or condition. In addition to incident, maintenance, and construction activities, the following special events have been identified along the I-5 corridor from Seattle to Vancouver B.C.:

- Tulip Festival (Mount Vernon vicinity)
- Peace Arch Celebration (U.S./Canadian border crossing)
- Tulalip Indian Reservation firework purchases (4th of July)
- Labor Day activities

Statement of Need:

There is a need to provide the WSDOT and WSP with a means to conduct traffic control services on an as-needed basis, during incidents, maintenance operations, scheduled construction, or special events. These conditions can occur at different locations and for a short duration of time, thus making a portable TMS an ideal and cost-effective method for traffic management.

Project Description:

This project consists of the procurement of portable TMS devices by the WSDOT and the training of transportation personnel in the use of these devices. Table 7 identifies the portable TMS devices which are currently being considered.

Table 7

Portable TMS Devices Under Consideration

Portable TMS Device	Functions/Applications
Portable Variable Message Signs (VMS)	• General traffic advisories and information provided to motorists during special events • Incident response - Re-routing of traffic • Driver information for special events
Portable Traffic Signals	• Ramp metering for special events
Portable Data Station	• Vehicle detection for ramp metering functions • Vehicle count data
Portable CCTV	• General visual surveillance during special events. • Video detection operating in conjunction with ramp metering
Ramp Meters	• Metering of vehicles onto the freeway during special events

In addition to the field devices, the Graphical User Interface (GUI) used for the monitoring and control of the field devices would be developed to operate on a laptop PC. WSDOT and WSP personnel would access the portable field devices by the use of laptop PCs. Communications between the portable GUI and roadside devices can use wireline or wireless data communication schemes. Wireless communication links may also be required if the monitoring and control of the portable TMS field devices from a local TOC is desired.

Electric power requirements for the portable TMS devices will utilize a mix of portable generators and battery equipment.

System Capabilities:

The proposed project will have the following capabilities:

- Portable surveillance - CCTV;
- Portable control - ramp metering;
- Portable driver information - VMS;
- Portable field device management - GUI installed on laptop; and
- Central traffic management - monitor and control of portable field devices from TOC.

Project Scope:

Phase 1 - Design Report/Develop Specification. This phase will develop a Design Report which outlines the portable field devices to be procured and the implementation plan for the use of the portable devices. In addition, specifications will be prepared for the technologies to be used for the portable TMS field devices and operator Interfaces. Operational strategies for the use of the system will be addressed at this stage.

Phase 2 - Procure Portable Field Devices and Training. This phase will procure the portable TMS field devices, develop the operator Interfaces to these devices, and provide training for the operations personnel on the use of the portable TMS devices.

Project Cost:

Table 8 presents the costs for the portable TMS project.

Table 8

Portable TMS Device

Item	Unit Cost	Units	Total Cost
Phase 1			
Design Report/Specifications	$ 50,000	1	$ 50,000
Phase 2			
Portable VMS[1]	$100,000	1	$100,000
Portable CCTV[1]	$ 60,000	2	$120,000
Portable Traffic Signal[1]	$ 35,000	2	$ 70,000
Portable Data Station[1]	$ 40,000	2	$ 80,000
Portable Generator[1]	$ 25,000	4	$100,000
Communication Infrastructure	$ 50,000	1	$ 50,000
Training	$ 10,000	1	$ 10,000
Software/System Integration	$200,000	1	$200,000
Phase 2 Total			$730,000
Total Equipment Cost			$730,000
Total Design Cost			$ 50,000
Total Capital Cost			**$780,000**
O&M Cost/Year			**$ 78,000**

1 Cost includes Vehicle/Trailer to transport/support the Portable TMS field

Project Benefits:

The estimated benefits are expected to result from increased driver information, improved traffic management, and reduction in incident response times. The total annual benefit is calculated to be $390,258.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Benefits of the portable TMS include traditional measures of effectiveness such as savings in travel time, reduced fuel consumption, and pollution and noise reduction. Other benefits include both traveler information, and an overall quality of travel. Assuming 2 percent fuel savings from the Mount Vernon to Bellingham area due to improved operations and incident management results in an annual benefit of $780,516.

Equivalent Uniform Annual Costs	$134,720
Annual Benefits	**$390,258**
Benefit/Cost Ratio	**2.9 : 1**

Project Schedule:

Phase 1 and Phase 2 are proposed as near-term (Years 0 to 6).

3.7 Speed Detection/Warning System

Project Title: Speed Detection/Warning System

User Services: Traffic Management

Time Frame: Near-Term

Objective:

The objective of this project is to install a Speed Detection/Warning system along I-5 at steep upgrade and downgrade locations as well as at areas of known recurrent speeding. The warning system will consist of both static sign/flashing beacon and VMS technology. These warning systems will be activated upon the detection of potentially hazardous conditions, improving traffic safety at the specified locations.

Project Background:

Through information obtained during I-5 corridor tours, several basic safety concerns were identified. This project addresses the safety concerns that occur at steep upgrade and downgrade locations as well as at areas of recurrent speeding and high accident rates. The following locations have been identified as the candidate application sites for this project.

Mount Vernon Area, northbound and southbound MP 226 - This area is known for recurrent speeding and high accidents.

Bow Hill, northbound downgrade, MP 236 - This downgrade location experiences an increased incident rate primarily due to overspeed and compact snow and ice conditions.

Bow Hill, southbound upgrade, MP 236 - This upgrade location experiences an increased incident rate primarily due to the long steep upgrade, and frequent icing conditions.

Through the monitoring of the predominant hazardous conditions at each location, the associated warning system(s) would provide a visual indication to the drivers of the potential hazard. For example, for Bow Hill, vehicle speed would be monitored through the use of vehicle detection equipment. Upon detection of vehicle speeds exceeding a pre-determined threshold, the flashing beacons at a static sign reading "Caution - Reduce Speed" would be activated.

Statement of Need:

Steep upgrade and downgrade roadway stretches along the I-5 corridor pose an increased incident risk at these locations. For the upgrade locations, the increased risk is primarily due to vehicle underspeed, while the risk for the downgrade locations is primarily due to vehicle overspeed. Motorists are currently not informed of the potential hazards at these locations.

Project Description:

This project consists of the installation of a Speed Detection/Warning System at steep upgrade/downgrade locations along I-5 as well as areas known for recurrent speeding. Bow

Hill downgrade and upgrade as well as the Mount Vernon area are currently identified as candidate locations. The installed systems would monitor vehicle speeds and provide motorists with an advance warning to potentially hazardous conditions through the use of roadside displays.

For the downgrade locations, vehicle overspeeds will be monitored and the display(s) will be activated when a pre-determined threshold is reached.

For upgrade locations, vehicle underspeed will be monitored and the displays will be activated when a pre-determined threshold is reached. For example, the display may indicate "Caution - Slow Vehicles Ahead."

For the high accident areas, vehicle overspeeds will be monitored and the display(s) will be activated when a predetermined threshold is reached.

The four primary functions envisioned for the successful operation of the Vehicle Speed/Warning System are:

1) Hazardous Condition Detection

2) Roadside Display

3) Information Processing

4) Operator Interface

These functions are discussed below.

Hazardous Condition Detection - Hazardous conditions will be predicted based on vehicle speed detection. A vehicle exceeding a pre-determined speed threshold would activate the warning message. The detection of these hazardous conditions would establish which roadside display message would be provided to motorists and at what point. Future enhancements to the system algorithm should include integration with weather and roadway conditions, vehicle height, and weigh-in-motion systems. In turn, traffic data that is gathered from the vehicle detection system should be integrated with the Traffic Data Management System.

In the case of vehicle speed, several vehicle detection technologies may be used with the most common being induction loops, radar, and video image. Radar detectors are recommended for the early implementation at the three locations due to the following reasons:

- radar technology is an effective low-cost solution for vehicle speed detection; and

- radar technology often activates the in-vehicle radar detectors, providing further incentive for drivers to reduce vehicle speed.

Roadside Display - The roadside display associated with this project would provide a visual indication to motorists of impending hazardous conditions upon their detection. Roadside display technologies fall under two main categories: static signs and variable signs.

For this particular application, it is recommended that static signs equipped with flashing beacons be utilized due to their low cost. VMS would be provided as part of the Mount Vernon and Bellingham area TMS. These signs may be used in conjunction with the flashing beacon system.

Information Processing - Information from the vehicle detectors must be processed and linked to the roadside display system. This information processing can either be accomplished locally through the use of a Programmable Logic Controller (PLC), or at a central **processor** such as a PC in a TOC. It is recommended that this information processing be done locally through the **use** of a PLC. Under this proposed scheme, the PLC would obtain vehicle speed from the radar detectors and process this information. Once a detected speed exceeds a pre-determined threshold, the PLC would relay a signal pulse to the flashing beacons. A time delay relay at the beacon site would put this device into flash mode. The flash would continue for a pre-set amount of time and then turn off unless another signal is sent from the PLC. This distributed processing approach would limit the real-time communication requirements between the TOC and the field location.

Operator interface - This element of the project will provide operations personnel at a TOC providing the capability to monitor and control the implemented system. Communication lines from the TOC to the field location would use either leased telephone company lines or State-owned communications infrastructure, as available. It is recommended that the TOC installed for the Mount Vernon and Bellingham area TMS be utilized as the central monitor and control point for this project.

System Capabilities:

The proposed project will have the following capabilities:

- monitor excessive vehicle speed at downgrade locations and high accident areas;
- monitor slow vehicle speed at upgrade locations;
- provide roadside display information to motorists warning them of impending hazards; and
- provide operator interface(s) for monitoring and control of the installed systems.

Project Scope:

The scope of this project involves two phases. The first phase being the development of design reports and PS&E for the Mount Vernon and Bow Hill locations. The second phase involves the installation of these systems.

<u>Phase 1: Design Report, PS&E</u>

Observe existing conditions - Existing conditions including layout, alignment, and area features need to be documented. It is recommended that photographs or video tape be used to document the existing conditions.

Develop design report - Based on the existing conditions observed, a design report should be developed outlying a proposed solution that best addresses the deficiency **at hand.**

PS&E - Develop plans, specifications and estimates.

Phase 2: Installation

Construction of the Speed Detection/Warning system at the proposed locations.

Project Cost:

Table 9 presents installation costs for the Speed Detection/Warning system.

Table 9
Speed Detection/Warning System

Item	Unit Cost	Units	Total Cost
Phase 1			
Design Report	$ 25,000	1	$ 25,000
PS&E Design	$ 80,000	1	$ 80,000
Phase 2			
Vehicle Detection Hardware	$ 15,000	4	$ 60,000
Roadside Display Hardware	$ 5,000	4	$ 20,000
Information Processing Hardware	$ 35,000	2	$ 70,000
Operator Interface Hardware	$ 3,000	1	$ 3,000
Basic Software Development	$ 75,000	1	$ 75,000
Software Integration	$25,000	1	$25,000
Power	$6,000	2	$12,000
Comm. Hardware	$1000	2	$2,000
Total Construction Cost			$267,000
Total Design Cost			$105,000
Total Capital Cost			$372,000
O&M Cost/Year			$37,200

Project Benefits:

Project benefits are mainly evident in safety concerns. The advance warning provided to motorists will reduce the potential for accidents at the three project locations. Benefits due to safety assume a reduction of 20% of all accidents at the project locations. Average cost per accident is derived from historical accident data obtained at each site. The total annual benefit is calculated to be $298,278.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4percent. Annual benefits are based on the assumption a 20 percent reduction in accidents. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$64,251**
Annual Benefits	**$298,278**
Benefit/Cost Ratio	**4.6 : 1**

Project Schedule:

Phase 1 and Phase 2 are proposed as near-term (O-6 Years).

3.8 Variable Speed Limit Signing and Weather Warning System

Project Title: Variable Speed Limit Signing and Weather Warning System

User Services: Traffic Management

Time Frame: Mid-Term

Objective:

The objective of this project is to implement a Variable Speed Limit Signing and Weather system along the I-5 corridor between Seattle and Vancouver, B.C. The Mount Vernon Hills area (MP 223-228) is currently identified as the candidate location for the project implementation.

Project Background:

Travel Aid is a pilot project implemented by the WSDOT to address the high accident rates encountered in the Snoqualmie Pass area. During the winter months (November through March), this mountain pass experiences winter weather conditions which lead to the increased accident rates. Through the use of weather and ice detection systems, speed detection systems, and variable speed and message signs, the Travel Aid project addresses operational safety along this corridor. Weather and roadway condition data are used to drive the variable speed limit and message signs. When road and weather conditions are poor, the enforceable speed limit is reduced. In addition, the electronic message signs are used to provide advance notification of potentially hazardous conditions to motorists. The existing Travel Aid project covers the area from MP 32.56 - MP 72.28 along the I-90 corridor.

The objectives of this project is to implement a similar project on a smaller scale along the I-5 corridor from Seattle to Vancouver, B.C. As indicated above, the Mount Vernon Hills area (MP 223-228) has been identified as the candidate location due to the historically high accident rates in this area.

Statement of Need:

Motorists traveling along I-5 are not provided with information about hazardous road and travel conditions during the winter months. This lack of information leads to high accident rates. This project would install an enforceable Variable Speed Limit Signing and Weather Warning system near the Mount Vernon Hills area.

Project Description:

This project consists of the installation of a similar system to the existing WSDOT Travel Aid project along Snoqualmie Pass. The project has three main components.

Weather and Ice Detection - These field devices would determine the existing weather and roadway conditions for the project area. This information would be passed on to the system CPU for inclusion in the speed limit calculation.

Speed Detection - These devices would determine the average speed of vehicles traveling along the corridor. This information would be passed on to the system CPU for inclusion in the speed limit calculation.

Central Processing Unit - This would be a PC located in a local TOC or WSDOT maintenance facility. Algorithms would determine the safe and desired speed limit along certain stretches of roadway. This information would be used to drive the variable speed limit.

Variable Speed Limit Sign - These signs would display the enforceable speed limit as determined by the CPU.

Existing hardware and software standards used on the existing Travel Aid project will be used for this project. The communications scheme may be different due to the availability of telephone company lines along this corridor. In addition, integration opportunities for other I-5 corridor projects exist for the following elements:

VMS, TOC - The VMS and TOC to be developed for the Mount Vernon to Bellingham TMS project should be utilized for the roadside display and operations center portions of this project.

Weather Stations - The weather stations to be installed as part of the Weather Warning system project could be utilized for the weather data portion of this project.

System Capabilities:

The proposed project will have the following capabilities:

- weather and roadway condition detection;
- vehicle speed detection;
- variable speed limit signing; and
- variable electronic signing.

Project Scope:

This project is envisioned as a single phase project. The following is a description of the tasks recommended:

Phase 1: Design File/PS&E/Construction

Develop Design File - Design file would be developed recommending the locations of the project field devices and CPU. In addition, hardware, software, and communications standards to be used on the project will be addressed in order to assure compatibility with existing systems.

PS&E - Develop plans, specifications, and estimates for the project.

Construction - Advertise, bid, and construct the PS&E package.

Project Cost:

Project costs for the Variable Speed Limit Signing and Weather Warning system are identified in Table 10.

Table 10

Variable Speed Limit Signing and Weather Warning System

Item	Unit Cost	Units	Total Cost
Phase 1			
Design File	$ 10,000	1	$ 10,000
PS&E	$ 100,000	1	$ 100,000
CONSTRUCTION			
Variable Signs	$ 20,000	6	$ 120,000
Weather Stations	$ 50,000	2	$ 100,000
Speed Detection	$ 20,000	10	$ 200,000
Communications Hardware	$ 50,000	LS	$ 50,000
Software Integration	$ 75,000	1	$ 75,000
CPU	$ 5000	1	$ 5,000
Total Construction Cost			**$ 550,000**
Total Design Cost			**$ 110,000**
Total Capital Cost			**$ 660,000**
O&M Cost/Year			**$ 66,000**

Project Benefits:

Project benefits are expected in the following two areas:

Operations and Enforcement - Through the use of the weather/roadway/speed detection systems, WSDOT and WSP will be able to monitor existing conditions along the I-5 corridor. This is expected to lead to more efficient operations and allow better enforcement by WSP.

Safety - Through the use of variable speed limit signs and electronic messaging, motorists will be better informed of impending hazards, reducing accident rates. It is assumed that 20 percent of ice-related accidents on the section of I-5 from MP 223 to 228 will be reduced. A total annual savings of $375,195 is estimated in terms of reduction in property damage and personal injury.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Annual benefits are based on the assumptions as stated above. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	$113,994
Annual Benefits	$375,195
Benefit/Cost Ratio	3.3 : 1

Project Schedule:

This project is proposed as a mid-term ITS project (Years 7 to 12). The project includes design and implementation, and will take 2 years to complete.

3.9 Northwest Region TSMC Geographic Expansion

Project Title: Northwest Region TSMC Geographic Expansion

User Services: Traffic Control, Incident Management, En-Route Driver Information

Time Frame: Near-Term: Phase 1

Mid-Term: Phase 2

Objective:

The objective of this project is to expand the WSDOT Surveillance, Control & Driver Information (SC&Dl) network along I-5 from Marysville (MP 202) to Mount Vernon interchange (MP 223). This expanded coverage will provide for better traffic management capabilities and increased motorist safety along this stretch of roadway.

Project Background:

The WSDOT NW Region Traffic Management System (TMS) program has proven to be a valuable tool for traffic operations personnel and motorists. This management system is highlighted by WSDOT's SC&DI system. SC&DI focuses on the installation of traffic field devices along the roadway which are interconnected through agency-owned communications infrastructure to the NW Region Traffic Systems Management Center (TSMC) located at the Dayton Avenue facility. This infrastructure allows WSDOT personnel to remotely monitor and control traffic operations on the affected roadway. The primary SC&DI field devices implemented to date, their typical locations, and their primary functions are listed in Table 11.

Table 11

SCD&I Field Devices Implemented to Date

Field Device	Typical Locations	Functions/Applications
CCTV Cameras	Half mile intervals	• General visual surveillance of traffic by TOC staff • Visual surveillance during Incidents used for incident response coordination • Provide local media with CCTV images • Traffic Data Collection - Volume, speed, occupancy, classifications
Variable Message Signs (VMS)	Major Decision Points	• General traffic advisories and information provided to motorists • Incident Response - Re-routing of traffic • Driver Information for special events
Highway Advisory Radio (HAR)	Major Decision Points	• General traffic advisories and information provided to motorists • Incident Response - Re-routing of traffic • Driver Information for special events
Data Stations	Half Mile Interval	• Traffic Data Collection - Volume, speed, occupancy, classifications
Ramp Meters	Freeway On-Ramps	* Metering of vehicles onto the freeway
Weather Station	As necessary, typically at known trouble locations	• Environmental Data Collection - Roadway icing, wind, visibility, precipitation

WSDOT's current SC&DI plans for I-5 Seattle to Vancouver B.C. corridor extends the SC&DI system to Marysville (MP 202). This project would expand the coverage area of the TMS system to Mount Vernon (MP 223).

Extending north from Marysville, the Mount Vernon and Bellingham area TMS project would expand the SC&DI coverage to the Bellingham area (MP 256). Eventually, the coverage area would extend to the U.S./Canadian border (MP 276.62).

Statement of Need:

The existing WSDOT SC&DI system has provided extensive operational benefits both to WSDOT and the WSP. These benefits have occurred in the areas of improved safety, traffic flow and fuel savings to motorists, and improved incident response times by the WSP and maintenance personnel. Geographic expansion of this system between Marysville (MP 202) and Mount Vernon (MP 223) will provide these benefits along this stretch of roadway.

Project Description:

This project consists of the expansion of the existing WSDOT NW Region SC&DI network along I-5 between Marysville (MP 202) and Mount Vernon (MP 223). The proposed SC&DI system will include the following:

- Communications Infrastructure - Cable plant and transmission equipment to support voice, data, and video communications.
- CCTV installations.
- Data stations - traffic data (volume, speed, occupancy) collection along the corridor.
- Ramp metering capabilities.
- VMS - driver information capabilities.
- HAR - driver information capabilities.
- Weather stations - environmental data collection.

System Capabilities:

The proposed project will have the following capabilities:

- Surveillance - traffic data collection, environmental data collection, and visual surveillance;
- Control - ramp metering;
- Driver information - VMS and HAR; and
- Communications - communications infrastructure supporting voice, data, and video.

Project Scope:

The project scope involves two phases.

Phase 1 - This phase will include the following:

- SC&DI Design File for I-5 MP 202 to MP 223. This design file would identify the field device type, location, and priority for this stretch of freeway. In addition, the communications infrastructure requirements would be established. This would include fiber optic and copper cable counts, and communication hubs.
- PS&E MP 202 to MP 223 (priority locations) - PS&E would be developed for the priority locations identified in the Design File.
- Construction MP 202 to MP 223 (priority locations) - Construction of SC&DI infrastructure would take place for the priority locations designed as part of the PS&E.

Phase 2 - This phase will include the following:

- PS&E MP 202 to MP 223 - PS&E would be developed for the remainder of the field device locations and infrastructure identified during the Design File.
- Construction MP 202 to MP 223 - Construction of the Phase 2 PS&E.

Project Cost:

The estimated cost for Phase lof the northwest region TSMC geographic expansion is presented in Table 12.

Project Benefits:

Benefits for the expansion of the existing NW Region TMS include traditional measures of effectiveness including savings in travel time due to both recurrent and non-recurrent congestion, accident reduction, reduced fuel consumption, and pollution and noise reduction. Other more qualitative measures of effectiveness include traveler information and the overall quality of travel. For this analysis, three sources of benefit were estimated including fuel savings, travel time reduction, and accident reduction. Fuel savings was based on a 2 per cent reduction in fuel consumption due to improved operations and incident management and was estimated at $236,520 per year. Travel time reduction based on the same 2 percent improvement in operational efficiency is estimated at $684,375. Accident reduction based on a reduction of 20 percent of all accident along a IO-mile stretch within the project limits is estimated at $554,686.

Table 12

Northwest Region TSMC Geographic Expansion Phase 1

Item	Unit Cost	Units	Total Cost
Phase 1			
Design File	$ 100,000	1	$ 100,000
PS&E (Priority Locations)	$200,000	1	$ 200,000
CONSTRUCTION Ramp Meter	$ 35,000	2	$ 70,000
Data Station	$ 30,000	4	$ 120,000
CCTV	$30,000	4	$120,000
VMS Overhead	$ 150,000	1	$150,000
HAR - Sign/Transmitter	$35,000	1	$ 35,000
Fiber Hub	$ 125,000	1	$ 125,000
Trench/Conduit/Support	$190,000/mile	5	$ 950,000
Fiber Optic Cable	$ 30,000/mile	5	$ 150,000
Twisted Pair (25pr)	$ 15,000/mile	5	$ 75,000
Total Design Cost			$ 300,000
Total Construction Cost			$ 1,795,000
Total Capital Cost			**$ 2,095,000**
O&M Cost/Year			**$ 209,500**

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4%. Annual benefits are based on the assumptions as stated above. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	$361,843
Annual Benefits	**$1,475,553**
Benefit/Cost Ratio	4.1 : 1

Project Schedule:

Implementation for this project is proposed in two phases. Phase 1 will include the development of the SC&DI Design File and the installation of the priority SC&DI infrastructure.

Phase 2 will install the remaining systems identified by the Design File.

Phase 1 of this project is proposed as a near-term project (Years 0 to 6). Phase 2 is proposed as a mid-term project (Years 7-12).

3.10 Mount Vernon and Bellingham Traffic Management System (TMS)

Project Title: Mount Vernon and Bellingham Traffic Management System (TMS)

User Service: Traffic Management

Time Frame: Near-Term - Phase 1, Phase 2

Mid-Term - Phase 3

Objective:

The objective of this project is to install a TMS in the Mount Vernon and Bellingham area (I-5 MP 223 to MP 256). The TMS will consist of traffic field devices including CCTV cameras, VMS, ramp meters, data stations, and HAR connected through a combination of both agency-owned and leased communications infrastructure to a local TOC. WSDOT personnel at the TOC will be able to monitor and control the TMS field devices, effectively managing traffic operations and incidents within this corridor. Data and video from the TMS will also be made available to the WSP, WSDOT Northwest Region TMS, and the WSDOT Internet sites.

Project Background:

TMSs have proven to be a viable alternative to physically building new roads and highways for the WSDOT. The WSDOT NW Region's TMS program in the greater Central Puget Sound metropolitan area has proven to be a valuable tool for operations personnel, enforcement personnel, and motorists. Improvements have occurred in the areas of safety, efficiency, enforcement, incident management, traffic control, and driver information services. These benefits are the driving force behind the Mount Vernon and Bellingham TMS project.

The WSDOT Northwest Region has developed a great deal of experience in the installation, operation, and maintenance of TMS infrastructure. A TSMC is located at the region headquarters Dayton Avenue facility. This TOC is the nerve center for all WSDOT TMS operations in the Seattle area. The significance of this information for the Mount Vernon and Bellingham TMS lies in the fact that WSDOT personnel have gained vast amounts of experience in the design, operations, and maintenance of TMSs. Standards have been developed for TMS field device installations, communications infrastructure, and control hardware and software. This knowledge and experience essentially paves the way for the Mount Vernon and Bellingham TMS.

The Mount Vernon and Bellingham TMS is currently proposed to include the area between MP 223 and MP 256. Initial implementation along this corridor will focus on installing the TMS field devices and their associated communications infrastructure at the Mount Vernon and Bellingham downtown areas and at known high-accident areas. In addition, the TOC facility which serves as the monitor and control point will be brought on-line. The subsequent phase(s) will make up the full deployment of the TMS system along the entire corridor, including the installation of the TMS system (SONET-based fiber optic communications infrastructure.

Statement of Need:

The Mount Vernon and Bellingham area growth is forecasted at 2.5 to 3 percent annually. At this growth rate, the efficiency and safety of travel in this region is impacted. TMSs have been proven to increase safety and efficiency in roadway operations. This project puts into place such a system in the Mount Vernon and Bellingham area.

Project Description:

This project consists of the installation of TMS in the area between Mount Vernon and Bellingham (I-5 MP 223 to MP 256). The project description is subdivided into the following four categories:

- TMS field devices;
- TMS communications infrastructure;
- TMS central hardware and software; and
- Traffic Operations Center.

TMS Field Devices:

Field devices refer to equipment placed along the roadway that provides field intelligence. The proposed field devices, their locations, and their functions and applications are presented in Table 13.

TMS Communications Infrastructure:

Communications infrastructure refers to the communication channels which link the field devices to the TOC. This infrastructure is typically agency-owned and maintained, or it is leased from a local telecommunications provider. Agency-owned infrastructure has a high initial cost with a low monthly maintenance cost. This investment is often the most expensive element of a TMS project. As an alternative, leased communications infrastructure is characterized as having a low initial cost with a high monthly leasing cost.

Another alternative which has been used in other regions of the country involves a sort of bartering method. Under this plan, the state would allow a telecommunications provider access to the highway right-of-way for fiber optic cable installation by the telecommunications company. In exchange, the state would receive an agreed upon amount of dark fibers (transmission electronics excluded). This option should be explored by for the Mount Vernon and Bellingham Region due to the cost-saving potential it offers.

It is recommended that the Mount Vernon and Bellingham TMS project put into place a combination of agency owned infrastructure and telephone company leased circuits for the initial implementation of the TMS. Subsequent phases would proceed to install a full buildout of the field devices and the fiber optic communications system.

TMS Central Hardware/Software:

- Central hardware/software allows for the remote monitoring and control of field devices. This equipment is typically located at a TOC. The WSDOT NW Region currently uses a Digital Equipment Corporation VAX central computer. The system software is proprietary and licensed for use by the WSDOT.

Table 13

Proposed Field Devices

Field Device	Typical Locations	Priority Locations	Functions/Applications
CCTV Cameras	Half mile intervals	• Anderson Road Vicinity (MP 225) • SR 536 Interchange Vicinity (MP 226) • SR 11 Interchange Vicinity (MP 231) • Samish Highway Interchange Vicinity (MP 246) • SR 539 Interchange Vicinity (MP 256)	• General visual surveillance of traffic by TOC staff • Visual surveillance during incidents is used for incident response coordination • Provide local media with CCTV images • Traffic Data Collection - Volume, speed, occupancy, classifications
Variable Message Signs (VMS)	Major Decision Points High Accident Areas	• SR 20 Vicinity (MP 229) • Samish Highway Interchange Vicinity (MP 246) • SR 539 Interchange Vicinity (MP 256)	• General traffic advisories and information provided to motorists • Incident Response - Re-routing of traffic • Driver Information for special events
Highway Advisory Radio (HAR)	Major Decision Points High Accident Areas	• SR 20 Vicinity (MP 229) • Samish Highway Interchange Vicinity (MP 246) • SR 539 Interchange Vicinity (MP 256)	• General traffic advisories and information provided to motorists • Incident Response - Re-routing of traffic • Driver Information for special events
Data Stations	Half Mile Intervals	• SR 536 Interchange Vicinity (MP 226) • SR 11 Interchange Vicinity (MP 231) • SR 539 Interchange Vicinity (MP 256)	• Traffic Data Collection - Volume, speed, occupancy, classifications
Ramp Meters	Freeway On-Ramps	• SR 536 Interchange Vicinity (MP 226) • SR 11 Interchange Vicinity (MP 231) • SR 539 Interchange Vicinity (MP 256)	• Metering of vehicles onto the freeway

Recent advances in PCs have made this technology the industry trend for central hardware. The software for monitoring and control of field devices is currently proprietary to each manufacturer. The ITS Community has acknowledged this shortfall and is currently working with the Federal Highways Administration (FHWA) to develop industry standard protocols such as the NTCIP.

It is recommended that off-the-shelf computer hardware be used for the Mount Vernon and Bellingham area TMS central hardware, and that industry standard software protocols be utilized whenever possible.

Traffic Operations Center (TOC):

TOC refers to the physical area from which operations staff monitor, control, and coordinate traffic operations. A TOC can vary from a single desk to a large room, depending on the complexity of the system, TOCs are also typically located adjacent to or as a part of a radio communications office.

- The Bellingham and Mount Vernon area is a part of the WSDOT Northwest Region. The Northwest Region TOC is located at the Dayton Avenue TSMC (MP 175). Although this facility may be used as the TOC for the Mount Vernon and Bellingham area, it is recommended that a separate facility in the Mount Vernon and Bellingham area be used as this regions TOC. This is primarily due to the lengthy distance (50-75 miles) between these regions. This recommendation would require wideband communications links between the new TOC and the Dayton Avenue TSMC.

- Candidate locations for the Bellingham and Mount Vernon area TMS include WSDOT maintenance facilities and WSP facilities along this corridor.

System Capabilities:

The proposed project will have the following capabilities:

- Surveillance - traffic data collection, environmental data collection, and visual surveillance;
- Control - ramp metering;
- Driver information - VMS and HAR;
- Central traffic management - central clearinghouse environment for data collection and dissemination; and
- Incident management - 24-h.our coverage and WSP coordination.

Project Scope:

The scope of this project involves three phases.

Phase 1 - Design Report Mount Vernon and Bellingham Area TMS. This phase would develop a Design Report which outlines the roadmap for the TMS installations. Field device locations will be provided along with their priorities. Communications infrastructure for both field device-to-TOC links as well as TOC-to-TOC links will be outlined along with the TOC design and central hardware/software. Functional requirements of the system will be determined based on incident and traffic management needs for the corridor.

Phase 2 - PS&E and construction of the Mount Vernon and Bellingham Area TMS. This phase would include the design and installation of field devices for the priority locations outlined in Phase 1. Communications infrastructure and the TOC facility would also be installed.

Phase 3 - Full corridor deployment and system integration of the Mount Vernon and Bellingham Area TMS. This phase would include design and installation of field devices and communications infrastructure for the remainder of the corridor as well as integration of the other stand-alone sub-systems located in this region. These projects include Over-Height Detection, Ice Detection Weather Warning system, and U.S./Canadian border crossing systems. The TOC installation will also be completed as part of this phase.

Project Cost:

The estimated cost for Phase 1 and Phase 2 of the Mount Vernon and Bellingham TMS deployment **is** presented in Table 14.

Table 14
Mount Vernon and Bellingham Area Traffic Management System (TMS) - Phase 1 and Phase 2

Item	Unit Cost	Units	Total Cost
Design Report	$ 100,000	1	$ 100,000
PS&E	$ 400,000	1	$ 400,000
CONSTRUCTION			
Ramp Meter	$ 35,000	4	$ 140,000
Data Station	$ 30,000	6	$ 180,000
CCTV	$30,000	8	$ 240,000
VMS Overhead	$ 150,000	3	$ 450,000
HAR - Sign/Transmitter	$35,000	2	$ 70,000
Fiber Hub	$ 125,000	2	$ 250,000
Trench/Conduit/Support (mile)	$ 190,000	6	$ 1,140,000
Fiber Optic Cable	$ 30,000	6	$ 180,000
Twisted Pair (25pr)	$ 15,000	6	$ 90,000
TOC (Utilize exist. facility)	$200,000	1	$ 200,000
Total Design Cost			$ 500,000
Total Construction Cost			$ 2,940,000
Total Capital Cost			**$ 3,440,000**
O&M Cost/Year			**$340,000**

Project Benefits:

Benefits for the development of the Mount Vernon and Bellingham Area TMS include traditional measures of effectiveness such as travel time reduction due to both recurrent and non-recurrent congestion, accident reduction, reduced fuel consumption, and pollution and noise reduction. Other, more qualitative measures of effectiveness include traveler information, and the overall quality of travel. For this analysis, three sources of benefit were estimated including accident reduction, fuel savings, and travel time reduction for a lo-mile stretch within the project limits. Accident reduction was assumed to be based on a reduction of 20 percent of all accidents and was estimated at a savings of $ 1,311,930/year. Fuel savings was based on a 2 percent reduction in fuel consumption due to improved operations and incident management and was estimated at $118,260/year. Travel time savings based on the same 2 percent improvement in operational efficiency is estimated at $684,375/year.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4percent. Annual benefits are based on the assumptions as stated above. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$594,149**
Annual Benefits	**$2.114.565**
Benefit/Cost Ratio	**3.6 : 1**

Project Schedule:

Implementation for this project is proposed in three phases. Phase 1 and 2 will include the development of the Mount Vernon and Bellingham Area TMS Design Report and the construction of the priority TMS field device and communication infrastructure locations, respectively. Full deployment of the corridor field devices and communication infrastructure as well as integration of the Mount Vernon and Bellingham Area TMS with other ITS projects will take place in Phase 3. Phase 1 and 2 of this project is proposed as a near-term project (Years 0 to 6). Phase 3 is proposed as a mid-term project (Years 7-12).

3.11 Rest Area Security System

Project Title: Rest Area Security System

User Service: Emergency Management

Time Frame: Near-Term - Phase 1
Mid-Term - Phase 2
Long-Term - Phase 3

Objective:

The objective of this project is to enhance public security at rest areas along the freeway. This will be achieved through the establishment of "safe" areas with enhanced lighting, improvements in surveillance, and communication to emergency services.

Project Background:

Often rest areas along I-5 are located in areas remote from urban development. This is beneficial to highway travelers as roadside services are provided for rest and recreation, contributing to a more comfortable trip. Unfortunately, the remote nature of the rest areas also has some drawbacks. Rest areas that are dark and remote may seem uninviting and risky to travelers, discouraging their use. In addition, it has been observed that these remote areas have been used for the disposal or transfer of stolen property and they have also been subjected to vandalism.

In order to project a sense of safety, one solution is to have Washington State Patrol (WSP) increase their patrols of the rest areas. However, the WSP resources are limited and patrols to these remote areas are both difficult and costly.

Through the use of video surveillance, emergency call boxes, and additional lighting, this project will both combat vandalism and other crimes at the rest areas as well as provide a safer environment for motorists.

Statement of Need:

There is a need for enhanced security at rest areas due to the increased incidence of vandalism, assault, and other illegal activities.

Project Description:

To promote safer rest areas and to provide a deterrent to illegal activity, a rest area security system is proposed at rest areas along I-5. The system will include;

- Video Surveillance
  A system of CCTV cameras mounted on existing luminaire poles, existing buildings, or new poles. The images captured by these cameras will be transmitted to a central monitoring location. Transmission of the video images will utilize the state owned communications infrastructure or leased telephone company lines.

- Enhanced Call Boxes
  An installation consisting of a call box and alarm units located in the "safe" area. This call

box would have the capability to transmit both voice and video to the monitoring location. The video feed would allow emergency dispatch personnel to quickly determine if the alarm is genuine.

The units may also include an audible alarm and/or flashing light in order to attract attention to the emergency situation.

- Enhanced Illumination
  The installation of additional lighting at the rest areas will enhance safety at the rest areas.
- Information Sinns
  Static signs will be located at the rest area. Rest areas where video surveillance is in effect would be designated as “safe”.

System Capabilities:

The features of the full implementation of the enhanced security system would include the following:

- visual surveillance;
- call boxes for emergency communications;
- enhanced illumination; and
- improved signing.

Project Scope:

This project has several phases which gradually increase both the coverage and the capability of the security system. The first phase is an initial implementation at the Silver Lake rest area (MP 188). The second phase is an expansion of this application to include all other rest areas between Seattle and Vancouver, B.C.

Phase 1: Silver Lake Rest Area

Phase 1 is an initial implementation at the rest area for each direction at Silver Lake (MP 188). An initial implementation would include:

1. Design, procurement, and installation of an enhanced illumination system. Priority would be given to the high-use areas.
2. Design, procurement, and installation of a video surveillance system consisting of several pole-mounted cameras.
3. Design, procurement and installation of an enhanced call box with the capability to transmit video.

Phases 2 and Phase 3: Full implementation at all rest areas

The final phases of this project consists of the expansion of coverage of the enhanced security system to include all rest areas along I-5. The implementation would include enhanced illumination, video surveillance, and enhanced call box applications.

Project Cost:

Table 15 presents the estimated project costs for the first phase of the Rest Area Security System project. This first phase will serve, in part, as a model for subsequent development. The design and evaluation costs are estimated at 20percent of the construction costs. The annual O&M cost is estimated as 10 percent of the capital cost.

Table 15

Rest Area Security System

Item	Unit Cost*	Units	Total Cost*
Phase 1:			
Enhanced Illumination	$ 10,000	2	$ 20,000
Video Surveillance Camera	$ 10,000	4	$ 40,000
Video Switch	$ 10,000	1	$ 10,000
Time Lapse Video Tape Recorder	$ 1,500	1	$ 1,500
Video Multiplexer	$ 3,000	1	$ 3,000
Video Transceivers	$ 1,000	8	$ 8,000
Central Monitor, Control	$ 4,000	3	$ 12,000
Communications	$ 10,000	1	$ 10,000
Total Construction Cost			$ 104,500
Design & Evaluation Cost			$ 20,900
Total Capital Cost			**$ 125,400**
Communications cost/year			$ 2,500
O&M Cost/year			$ 12.540

*I997 dollars

Project Benefits:

The estimated benefits are expected to result from a reduction in the incidence of crime and, subsequently, the economic costs due to crime.

The economic costs of crime are difficult to quantify as there are many of the costs are intangible (i.e., personal pain and suffering) and many are borne by society in general (i.e., lost work time and increased insurance premiums). Generally, economic losses are used as a measure to determine the cost of crime.

The average economic loss to victims estimated by the Bureau of Justice Statistics for 1992 was $525 per event. However, the mean cost of events related to vehicles was estimated to be approximately $4,000. If it is assumed that a split of 20 percent for vehicle-related events and 80 percent for other exists, the weighted mean cost of events is approximately $1,200.

Assuming that each assistance call recorded for MP 188 (Silver Lake) represents an event, the total number of events for 1996 was 3,080. This represents an annual cost of roughly $3,696,000. If the enhanced security features deter 10 percent of the events at the rest areas, the benefits would be $370,000 per year.

Other immeasurable benefits related to this project include a more effective use of the emergency services person hours (i.e., WSP service hours application). Video will expand the **amount of time that** the rest areas are under surveillance and it may also assist with the identification of participants in crime events which lead to prosecution. Annual benefits are estimated to be $370,000.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Equivalent Uniform Annual Costs	**$21,659**
Annual Benefits	**$370,000**
Benefit/Cost Ratio	**17.1 : 1**

Project Schedule:

The Rest Area Security System project is proposed as a near-term ITS project (Year 0 to 6). The first phase, the initial installation at Silver Lake, is scheduled to begin in Year 0 and be completed in Year 3. The second and third phase of this project, expansion to other rest areas, is scheduled to begin in Year 9 and extend to Year 20.

3.12 Portable License Plate Optical Reader

Project Title: Portable License Plate Optical Reader

User Services: Traffic Management, Commercial Vehicle Electronic Clearance

Time Frame: Near-Term - Phase 1

Mid-Term - Phase 2

Objective:

The objective of this project is to implement a program using portable license optical reader technologies that will assist WSP in streamlining inspection efforts at weigh stations, provide a means to assist in other areas of enforcement, provide WSDOT personnel with a means to conduct origin and destination studies, and reduce the vehicle processing time at the U.S./Canadian border crossing.

Project Background:

Traffic-related enforcement methods have changed very little over the years. Police agencies are now looking at ITS programs for improving enforcement programs. Some systems, such as photo radar, meet strong resistance from the public and police officers alike. Other systems, including linking video surveillance cameras to personal computers equipped with license-reading software connected via a database, are being used to apprehend fugitives, detect stolen vehicles, identify repeat commercial vehicle violations, and locate missing persons. Automated vehicle identification systems have enhanced the ability of police agencies, customs officers, toll facility operators through many applications of this technology to detect a wide variety of violations. The system is not perfect but is rapidly improving in speed and accuracy.

Statement of Need:

There is a need by enforcement agencies for additional aid in the identification of vehicles that have been stolen, are owned by repeat commercial vehicle violators, are being driven by fugitives, are actively being pursued, or that may be involved in other crimes. Due to minimal personnel resources of WSP as related to the geographic coverage area, a method to improve the efficiency of the WSP’s operations is needed.

Project Description:

A portable automated license plate reader would allow license plates to be digitally read via a video camera using optical character recognition. This portable optical reader device would be operated by a laptop computer and would be connected to a national database via wide area wireless communications system. The license plate reader software will be programmable to search for pre-defined records of interest. Upon receiving a positive match, the system would immediately notify response personnel through an audible alarm system, a direct paging feature, or other means. Appropriate action would then be taken by an enforcement agency.

Automatic license plate readers also have multiple CVO applications and could be deployed to weigh stations. As an example, Wisconsin and Minnesota have combined efforts on a License

Plate Reader (LPR) system used in conjunction with their commercial vehicle enforcement program. An LPR system is connected with a database containing records of inspections and violations. The database is kept up to date through the on-line entry of information at each of 20 Wisconsin scales. Minnesota information is entered from paper inspection forms. Wisconsin also has a portable reader mounted on a tripod for use on scale by-pass routes and secondary routes which works off a laptop.

Another system application could include origin-destination surveys by planning agencies. WSDOT or other planning agencies could use two or more of these LPRs placed at strategic points along the corridor. The data could be collected over a selected period of time, resulting in a data file of date-stamped license plate records. These could then be analyzed for origin destination information. To ensure privacy for this application, the license plate number could be encrypted. Similarly, travel time studies or traffic diversions studies could be conducted with this technology.

Due to the portable nature of the system, it may be applied anywhere throughout the corridor. Typical application sites include freeway mainline segments, ramps, weigh stations, rest areas, and the border crossing.

System Capabilities:

Field Devices:

- Automatic License Plate Reader: A portable device that can be used to scan license plates using optical character recognition techniques.
- Laptop Computer: The system will be driven via a laptop computer.
- System Integration/Software: Device drivers, algorithms and communication interface for license plate readers to link to the national database server,

Project Scope:

The scope of this project involves two phases.

Phase 1 - Initial deployment of two prototype portable systems

Phase 2 - Purchase of additional devices for integration with CVO applications. The use of license plate readers, weigh-in-motion, and transponders will further reduce the delays at commercial vehicle inspection locations.

Project Cost:

The initial costs of the Phase 1- Initial Prototype procurement is summarized in Table 16.

Table 16
Portable License Plate Optical Reader
Phase I - Initial Prototype Procurement

Item	Unit Cost	Units	Total Cost
System Procurement	$ 10,000	2	$ 20,000
Training	$ 2,000	1	$ 2,000
Total Capital Cost			**$ 22,000**
O&M Cost/Year			**$ 2,200**

Project Benefits:

The estimated benefits are expected to result from a reduction in the incidence of commercial operators who operate out of compliance by pre-emptive identification of high risk carriers, thereby reducing economic, safety, and environmental risks. Benefits include increased efficiency in screening commercial carriers, increased reduction in accidents, more effective use of personnel, reduced administrative burden to motor carriers, reduce delay for safe and legal carriers.

For purposes of determining a cost savings associated with these benefits, it is assumed that 5 percent of accidents along the entire corridor involving defective commercial vehicle equipment would be identified through implementation of this system. This results in a savings of $33,600 per year.

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of the cost of system procurement and training plus O&M assuming a discount rate of 4 percent. Annual benefits are based on the assumptions as stated above.

Equivalent Uniform Annual Costs	$3,800
Annual Benefits	$33,600
Benefit/Cost Ratio	8.8 : 1

Project Schedule:

Implementation for this project is proposed in two phases. Phase 1 will include the initial deployment of two prototype portable systems. Phase 2 will be the procurement of additional devices for integration with CVO applications corridor wide. Phase 1 of this project is proposed as a near-term project (Years 0 to 6) being completed in a 1-year period. Phase 2 is proposed as a mid-term project (Years 7-12) being completed in a 2-year period.

3.13 U.S./Canadian Border Crossing Systems

Project Title: U.S./Canadian Border Crossing Systems

User Services: Traffic Management, Traveler information

Time Frame: Near-Term - Phase 1

Mid-Term - Phase 2

Objective:

The primary objective of this project is to reduce travel times and improve the efficiencies of the U.S./Canadian border crossing at Peace Arch and Pacific Highway through the utilization of ITS technologies.

Project Background:

The I-5 corridor serves two main crossing along the U.S./Canadian border. The Peace Arch crossing connects I-5 to Highway 99 in British Columbia. This crossing is limited to non-commercial traffic and excludes trucks and passenger buses. The Pacific Highway crossing connects the Pacific Highway in Blaine to Highway 15 in British Columbia. Commercial vehicles, including trucks and passenger buses are required to use this crossing. Recent studies by WSDOT have indicated that wait times of up to 2 hours during peak holiday periods can occur at the Peace Arch crossing. Typical wait times are between 5 and 30 minutes. At the Pacific Highway crossing, wait times of 20 minutes or more also impede truck traffic.

This project will consist of the application of data collection, computer database/algorithm, and driver information technologies to reduce travel times and improve efficiencies for this border crossing location. Specifically, the system will be able to provide motorists with information regarding current wait times at both the Peace Arch and Pacific Highway border crossings. This will allow the motorists to make effective decisions, reducing travel times through these border crossings. In addition, when delay at the Pacific Highway crossing reaches a pre-determined level, non-commercial vehicles will be diverted to the Peace Arch crossing through the use of traveler information methods.

Statement of Need:

Waiting times at the I-5 U.S./Canadian Border crossing are up to 2 hours during peak holiday periods according to recent studies. In addition, the studies indicate that commercial vehicle traffic volumes are increasing and are projected to continue to increase in the future. The existing I-5 facilities lack the infrastructure to collect the necessary traffic data to allow for more efficient operations.

Project Description:

The short-term goals of the system include collecting traffic data, developing the database and computer processing for the system, and disseminating border crossing delay information to motorists. The three main subsystems of this project are discussed below.

Data Collection:

It is recommended that license plate readers compatible with the existing equipment at both U.S. and Canadian border locations be installed. By comparing time stamps on license plate readings, an accurate estimate of travel time through the border can be documented. In addition, conventional induction loop-based data stations are recommended along the I-5 corridor near Blaine to collect traffic volume, occupancy, and speed data.

Database/Processing:

A database structure with common data formats and processing methodologies would be utilized. Database access would be provided both to WSDOT and B.C. MoTH. Data encryption technologies may also be used here to address privacy and data sharing issues. Long-term plans are to introduce the ability to recognize traffic patterns using computer algorithms to predict future conditions at the border locations.

Traveler Information:

Border crossing delay and diversion information will be made available to motorists through both en-route and pre-trip methods. The following mediums to disseminate the information have been considered:

- changeable/variable message signs;
- highway advisory radio;
- broadcast commercial radio stations:
- internet web sites;
- dial-in phone numbers;
- kiosks; and
- television stations.

In the long term, the project goal is to introduce the ability to recognize traffic patterns using computer algorithms to predict future conditions. Pattern matching algorithms will permit U.S. and Canadian customs officials to improve scheduling of operators and provide advance warning to the public. In addition, CVO electronic pre-clearance technologies will be evaluated for use at the border crossings. Having information available to customs agents prior to the arrival of commercial vehicles will provide valuable time and cost saving opportunities. The U.S. Customs and American Presidents Line (APL) pilot project utilized radio frequency (RF) transponders to verify outbound (export) border crossings to trigger required export system reporting. This pilot project provided positive results and will be considered as a long-term application.

System Capabilities:

- measure border crossing delay at Peace Arch and Pacific Highway Crossings;

- develop common database and processing of delay data; and
- disseminate border crossing delay information to motorists through en-route and pre-trip methods.

Project Scope:

The scope of this project includes two phases.

Phase 1 will develop the design report, procure the system hardware, develop the computer database/processing, and install the system at the Peace Arch and Pacific Highway crossings.

Phase 2 will develop the traffic pattern recognition/prediction algorithms and evaluated CVO electronic pre-clearance technologies.

Project Cost:

Project costs for the U.S/Canadian border crossing system are presented in Table 17.

Table 17

U.S./Canadian Border Crossing System

Item	Unit Cost	Units	Total Cost
Phase 1:			
Design Report	$ 20,000	1	$ 20,000
PS&E	$ 100,000	1	$ 100,000
License Plate Recognition Equip.	$ 10,000	4	$ 40,000
Data Station	$ 50,000	1	$ 50,000
Computer Hardware	$ 40,000	1	$ 40,000
Software Development	$ 150,000	1	$ 150,000
Traveler Information Equipment	$ 150,000	1	$ 150,000
Phase 2:			
Software Development	$ 150,000	1	$ 150,000
Total Construction			$ 580,000
Total Design Cost			$ 120,000
Total Capital Cost			**$ 700,000**
Total O&M cost/year			**$ 70,000**

Project Benefits:

The project benefits are expected to come from an increase in travel information available to motorists on the I-5 corridor.

The Statewide IVHS Plan identified the potential annual benefits of traveler information as $5,742,476 for the I-5 corridor counties of Snohomish, Skagit and Whatcom. Assuming that 5 percent of these benefits are due to the implementation of the U.S./Canadian Border Crossing System project, the annual social benefit is estimated to be $287,124.

Equivalent Uniform Annual Costs	**$120,902**
Annual Benefits	**$287,124**
Benefit/Cost Ratio	**2.4 : 1**

Project B/C:

The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus O&M assuming a discount rate of 4 percent. Both the benefits and O&M costs are assumed to be uniform over the 20-year period.

Project Schedule:

Implementation of Phase 1 is near-term (Years O-6). Phase 2 is mid-term (Years 7-12).

Figure 1: ITS Early Deployment Implementation Schedule

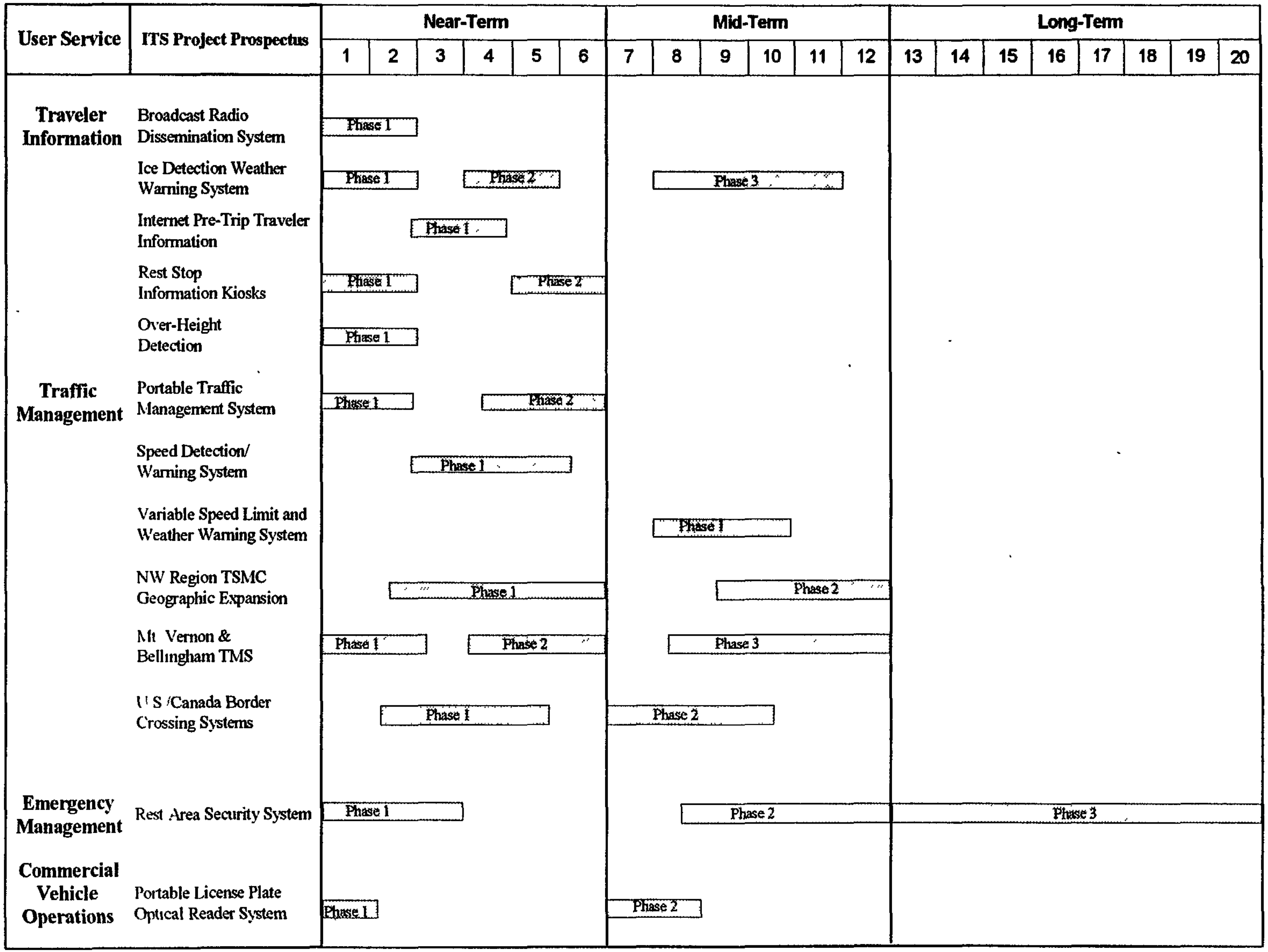


Figure 2: Summary of ITS Project Costs, Benefits and Priorities

User Service		ITS Project Prospectus	Total Capital Costs	Annual Benefits	Annual Costs	B/C Ratio	B/C * Rank	Priority **
Traveler Information	1	Broadcast Radio Dissemination System	$174,000	$287,124	$30,053	9.6	2	●
	2	Ice Detection Weather Warning System	$1,360,000	$275,006	$234,896	1.2	13	◕
	3	Internet Pre-Trip Traveler Information	$204,000	$287,500	$35,234	8.2	4	●
	4	Rest Area Traveler Information Kiosks	$231,000	$287,500	$39,898	7.2	5	◕
	5	Over-Height Detection	$179,000	$84,840	$30,916	2.7	11	◑
Traffic Management	6	Portable Traffic Management System	$780,000	$390,258	$134,720	2.9	10	◑
	7	Speed Detection/Warning System	$372,000	$298,278	$64,251	4.6	6	◑
	8	Variable Speed Limit and Weather Warning System	$660,000	$375,195	$113,994	3 3	9	◕
	9	Northwest Region TSMC Geographic Expansion	$2,095,000	$1,475,553	$361,843	4.1	7	●
	10	Mt. Vernon & Bellingham TMS	$3,440,000	$2,114,565	$594,149	3.6	8	●
	11	U.S./Canadian Border Crossing System	$700,000	$287,124	$120,902	2.4	12	●
Emergency Management	12	Rest Area Security System	$125,400	$370,000	$21,659	17.1	1	●
CVO/Enforcement***	13	Portable License Plate Optical Reader System	$22,000	$33,600	$3,800	8.8	3	◕

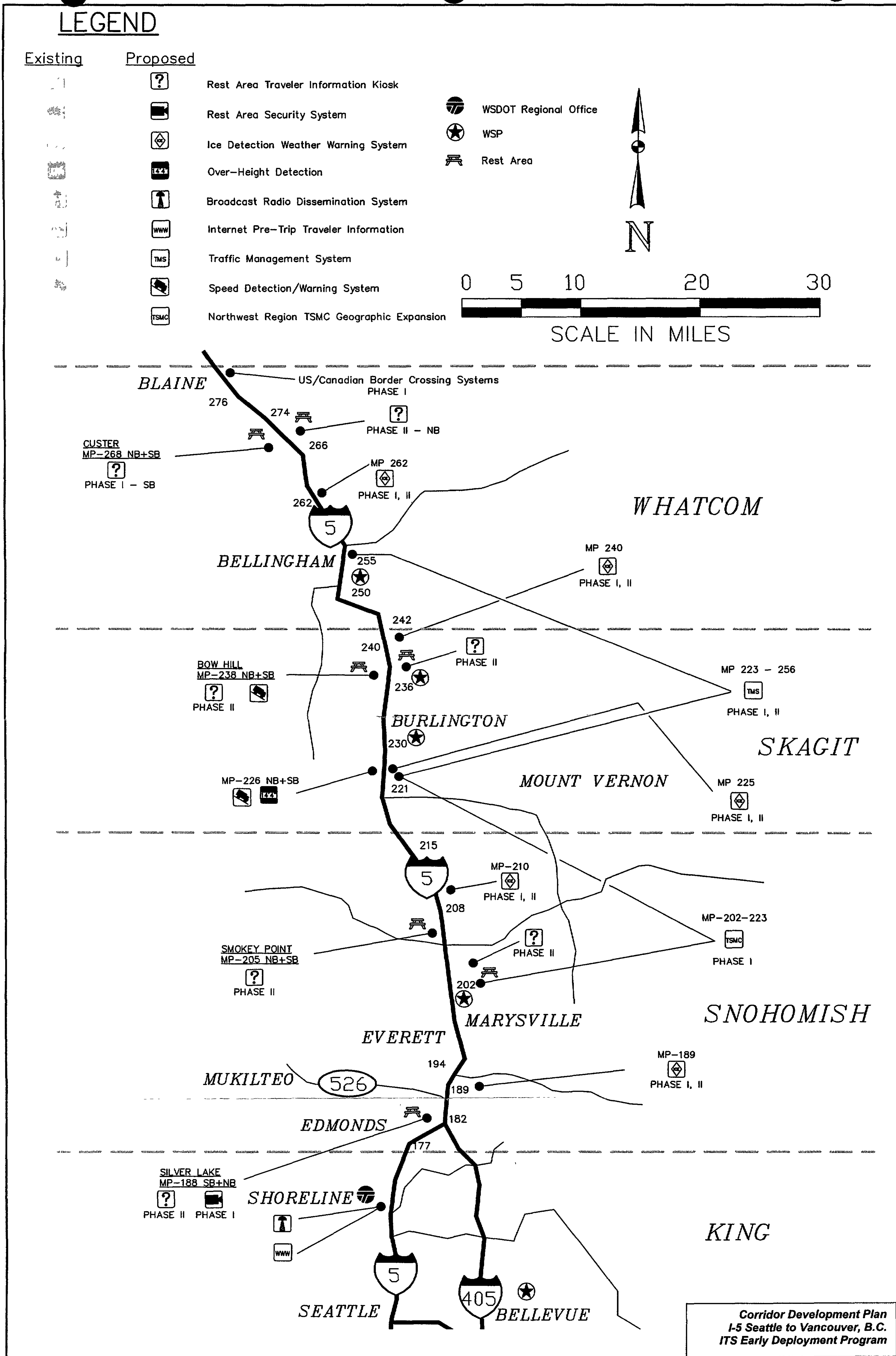
* B/C Rank based on calculated benefit-cost ratios

** Priority based on assessed stakeholder needs

*** The CVO Components of this project have been largely deferred to the Statewide CVO plan development project

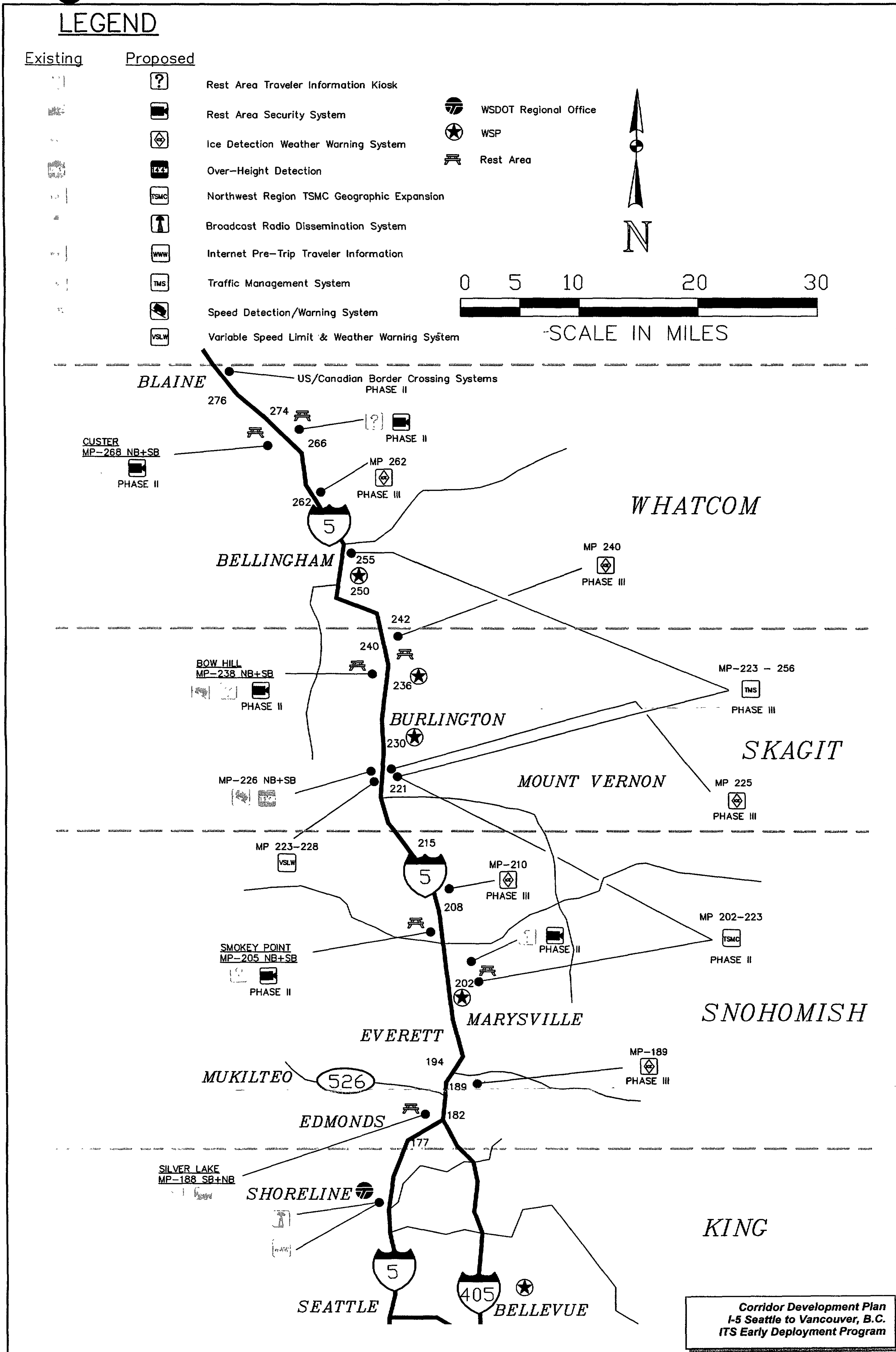
Priority Ranking

○ Low
◔
◑
◕
● High



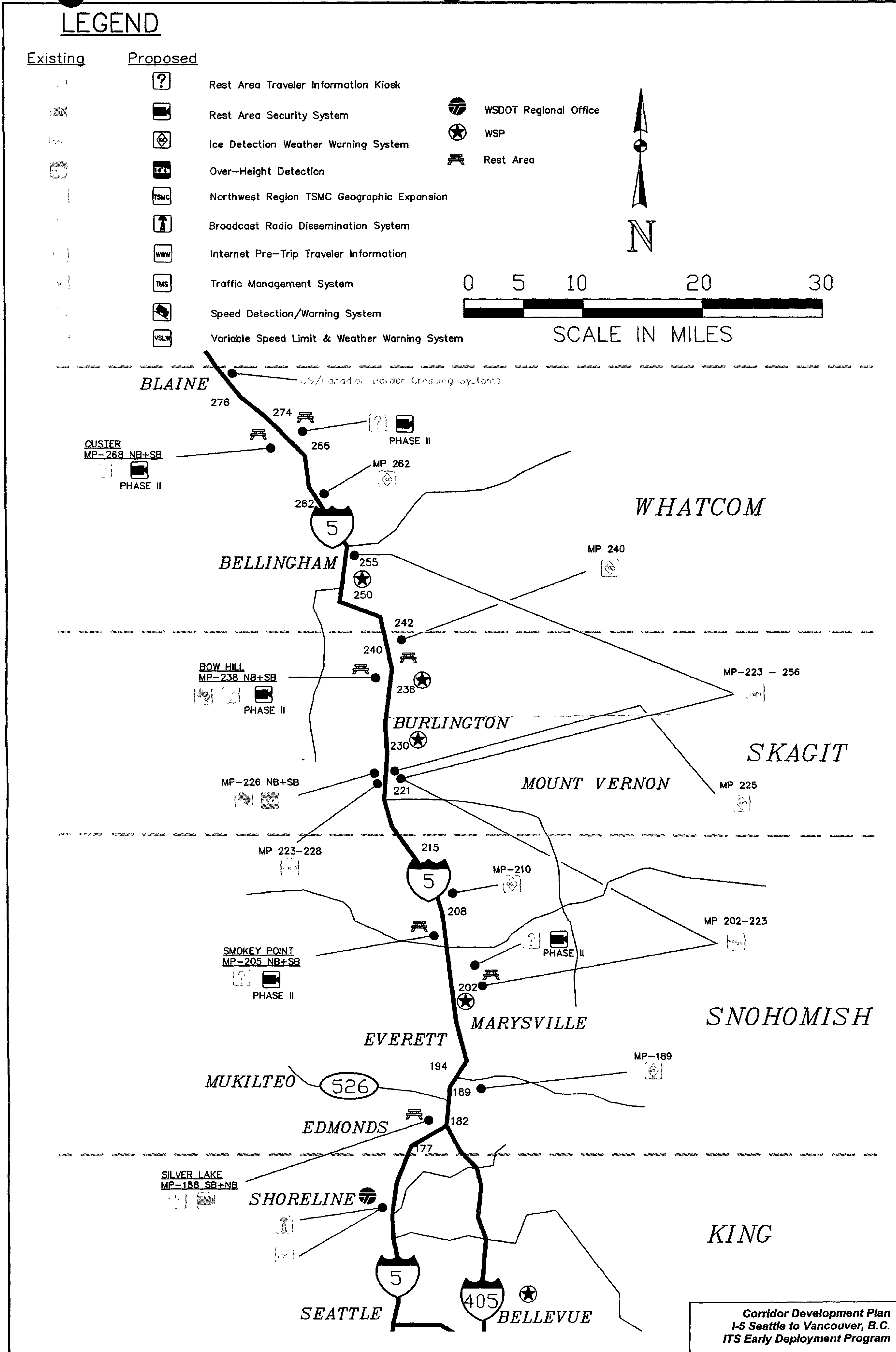
PARSONS BRINCKERHOFF

Near Term ITS Project Deployment
FIGURE 3



PARSONS BRINCKERHOFF

Mid Term ITS Project Deployment
FIGURE 4


LEGEND
Existing
Proposed
Rest Area Traveler Information Kiosk
Rest Area Security System
Ice Detection Weather Warning System
Over-Height Detection
Northwest Region TSMC Geographic Expansion
Broadcast Radio Dissemination System
Internet Pre-Trip Traveler Information
Traffic Management System
Speed Detection/Warning System
Variable Speed Limit & Weather Warning System
WSDOT Regional Office
WSP
Rest Area
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0 5 10 20 30
SCALE IN MILES
BLAINE
276
274
266
PHASE II
CUSTER
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PHASE II
MP 262
262
5
WHATCOM
BELLINGHAM
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MP 240
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240
BOW HILL
MP-238 NB+SB
PHASE II
236
MP-223 - 256
BURLINGTON
230
SKAGIT
MP-226 NB+SB
221
MOUNT VERNON
MP 225
MP 223-228
215
5
MP-210
208
MP 202-223
SMOKEY POINT
MP-205 NB+SB
PHASE II
PHASE II
202
MARYSVILLE
SNOHOMISH
EVERETT
194
MP-189
MUKILTEO
526
189
EDMONDS
182
177
SILVER LAKE
MP-188 SB+NB
SHORELINE
KING
5
405
SEATTLE
BELLEVUE
Corridor Development Plan
I-5 Seattle to Vancouver, B.C.
ITS Early Deployment Program

ITS EARLYDEPLOYMENT PROGRAM

I-5 SEATTLE TO VANCOUVER, B.C.

Technical Memorandum 5

COMMUNICATIONS PLAN

prepared for the

Washington State Department of Transportation

prepared by

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ICON
Matrix Management Group

February 1998

TABLE OF CONTENTS .

LIST OF FIGURES

1.0 INTRODUCTION

This work element has been prepared as a part of the I-5 Seattle to Vancouver, B.C. and I-90 Seattle to Spokane Inter-City Urban/Rural Corridors Intelligent Transportation System (ITS) Early Deployment Project. This is the fifth technical memorandum for the I-5 and I-90 Corridors ITS Early Deployment Plan and is submitted in fulfillment of work element 5: Communications Plan.

Summarized in this memo are the existing communication networks used by WSDOT and other state agencies. This existing infrastructure presents an opportunity to support the ITS-based communication needs for the I-5 and I-90 corridors.

The communications infrastructure required to support each of the specific ITS projects recommended for the I-5 and I-90 corridors are addressed individually within each project description prepared under work element 4: Corridor Development Plan.

2.0 WSDOT COMMUNICATIONS INFRASTRUCTURE

The following sections identify and summarize the WSDOT communications infrastructure used along the I-5 and I-90 corridors. This infrastructure is to be used to support ITS-based communications along the corridors where applicable.

NORTHWEST REGION SC&DI

The Northwest Region is currently installing a digital broadband communication system utilizing a synchronous optical network (SONET) transmission architecture in parallel with an analog video transmission system. The state-owned system has begun to support a planned Surveillance, Control, and Driver Information (SC&DI) system for the approximately one hundred miles of freeway in the greater Seattle area. It will take a number of years to complete the total network system. The system topology, when completed, will provide transmission routing diversity and protection against single point equipment and cable failures. See Figure 1.0 for the location and status of all of the SC&DI projects in the Northwest Region.

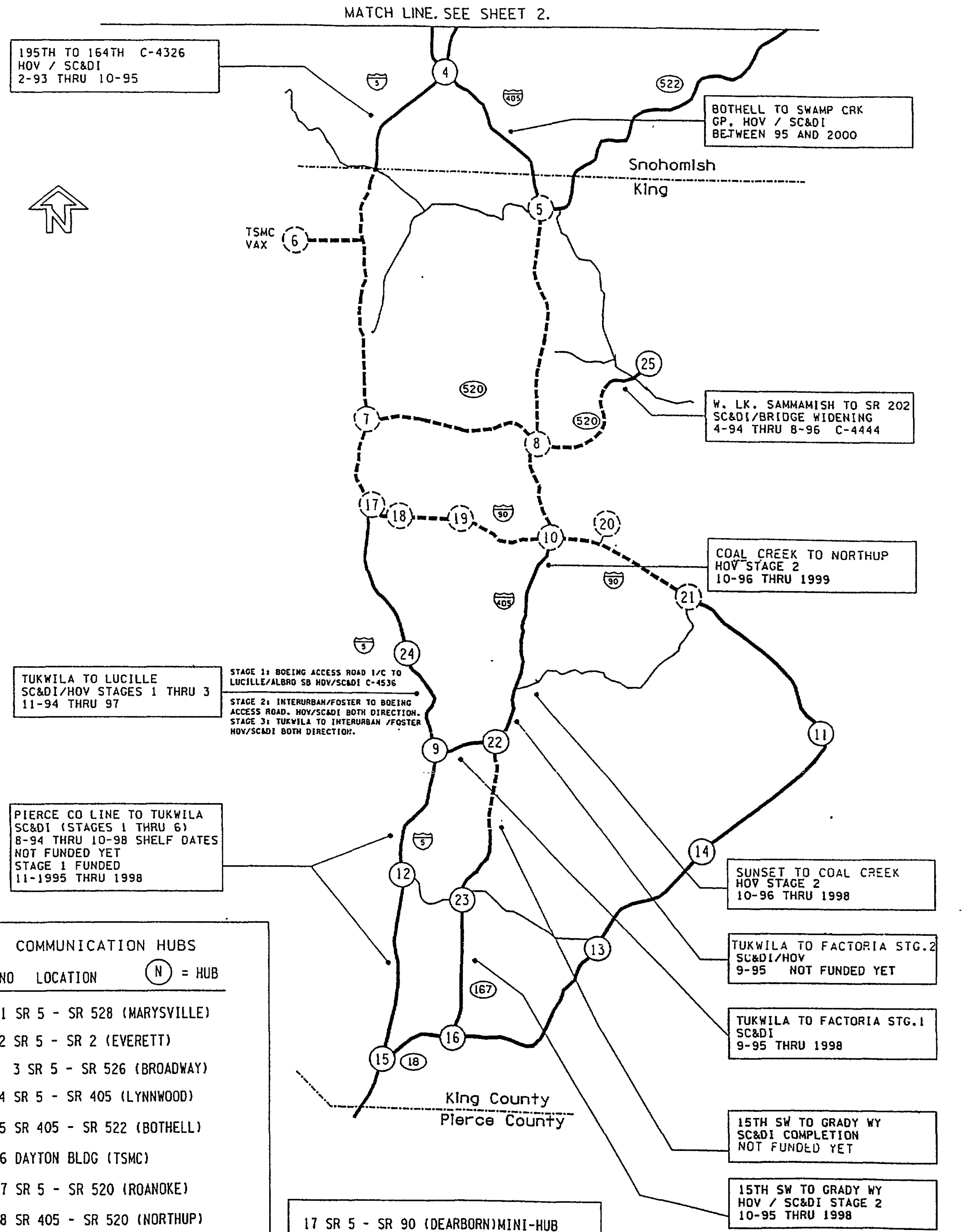
The communication system architecture allows connections between field devices and nearby communication hubs, which are then connected to the Traffic Systems Management Center (TSMC). Numerous circuits are collected at the hubs and then multiplexed together before being transmitted back to the TSMC. This design reduces the quantity and expense of optical fibers and associated equipment, including the conduit infrastructure. The hubs are located along a mainline route with an average interval spacing of approximately 7 to 9 miles.

The state-owned SONET communications system offers a Network Management System (NMS) which provides the hardware and software required to automatically administer and control the SONET transmission system supporting voice and data requirements. The NMS is capable of alarm status reporting, system control and testing, determining fault locations, and circuit provisioning. The NMS capabilities are also used for maintenance activities.

OLYMPIC REGION SC&DI

In the Olympic Region there are five existing variable message signs (VMS) and a ramp meter. Two additional VMS signs are under construction. Communication with the signs and the ramp meter is accomplished by means of dial-up lines leased from the telephone company. The design of an interim Traffic Management System (TMS) along I-5 from Fife south through Tacoma to the SR512 interchange has been completed. Construction has not yet been funded.

As designed, the interim TMS system includes 21 ramp meters, 9 CCTV cameras, and several VMS, CMS, and swing gates. Communication with the ramp meters will be via leased telephone company lines. A microwave radio system is to be constructed for transmission of analog video from the cameras. The communication system installed for this interim system is expected to be replaced with a fiber optic network in the future. See Figure 2.0 for the locations of the proposed ITS devices in the region.



COMMUNICATION HUBS

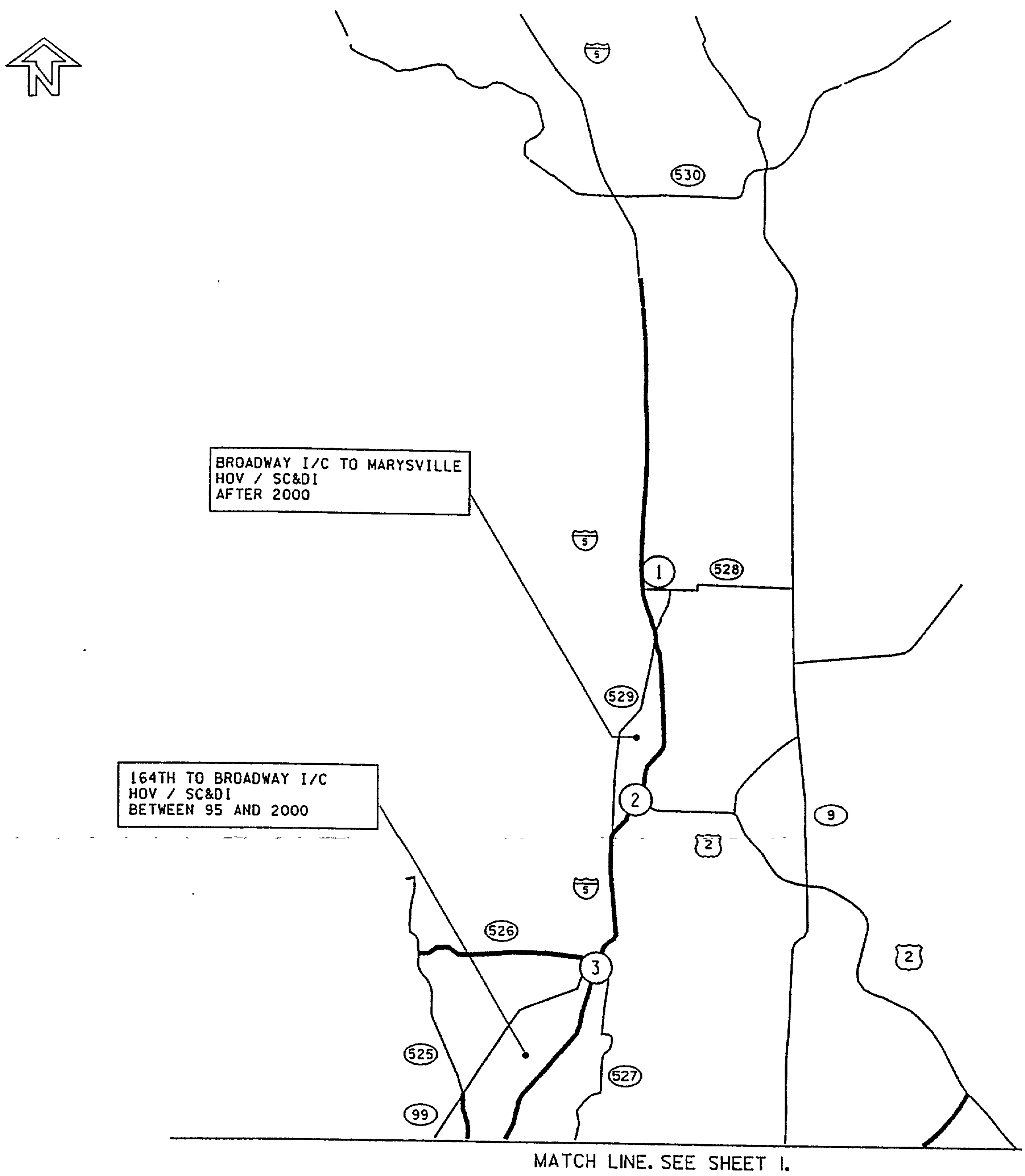
NO LOCATION (N) = HUB

1 SR 5 - SR 528 (MARYSVILLE)
2 SR 5 - SR 2 (EVERETT)
3 SR 5 - SR 526 (BROADWAY)
4 SR 5 - SR 405 (LYNNWOOD)
5 SR 405 - SR 522 (BOTHELL)
6 DAYTON BLDG (TSMC)
7 SR 5 - SR 520 (ROANOKE)
8 SR 405 - SR 520 (NORTHUP)
9 SR 5 - SR 405 (TUKWILA)
10 SR 405 - SR 90 (FACTORIA)MINI-HUB
11 SR 90 - SR 18 (PRESTON)
12 SR 5 - SR 516 (DES MOINES)
13 SR 18 - SR 516 (COVINGTON)
14 SR 18 - 276 AVE SE (HOBART)
15 SR 5 - SR 18 (FEDERAL WAY)
16 SR 167 - SR 18 (AUBURN)
17 SR 5 - SR 90 (DEARBORN)MINI-HUB
18 SR 90 - MT BAKER TUNNEL
19 SR 90 - MERCER ISLAND TUNNEL
20 SR 90 -EASTGATE WSP
21 SR 90 - FRONT ST (ISSAQUAH)MINI-HUB
22 SR 405 - SR 167 (RENTON)
23 SR 516 - SR 167 (KENT)
24 BOEING ACCESS MINI-HUB
25 SR 520/202 MINI-HUB

LEGEND

- - - - EX. MAINLINE FIBER OPTIC
——— PROP. MAINLINE FIBER OPTIC
C-# CONTRACT NUMBER

WSDOT
N.W. Region
SC&DI Project Completion Dates



COMMUNICATION HUBS

(N) = HUB

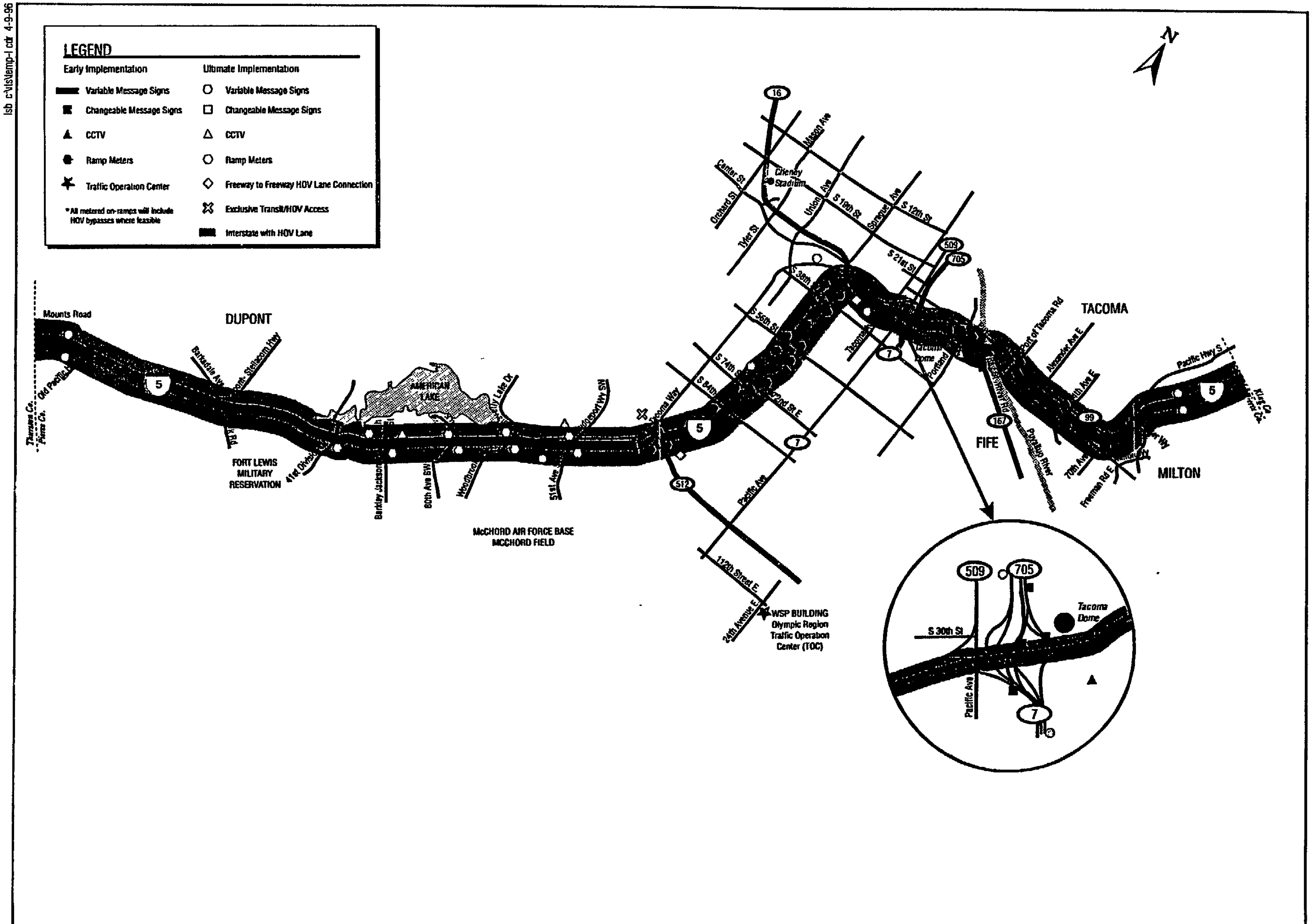
NO	LOCATION
1	SR 5 - SR 528 I/C
2	SR 5 - SR 2 I/C
3	SR 5 - SR 526 I/C

WSDOT
N.W. Reigon
SC&DI Project Completion Dates

JANUARY 1995

LEGEND

- EX. MAINLINE FIBER OPTIC
- PROP. MAINLINE FIBER OPTIC
- C-# CONTRACT NUMBER



PB 100 YEARS

WSDOT Olympic Region TMS

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I-5 Seattle to Vancouver, B.C.

ITS Early Deployment Program

SOUTH CENTRAL REGION

The South Central Region is currently implementing a digital packet radio system for communication through the Snoqualmie Pass area on I-90. The project, known as Travel Aid, covers a 40-mile section of I-90 that experiences adverse winter weather conditions. The system consists of variable message signs (VMSs), variable speed limit signs (VSLs), and in-vehicle display systems.

The Travel Aid system includes 24 field sites, a control center, remote command centers, in-vehicle display units, communication systems, and portable transmitter units. The system is based on the Management information System for Transportation (MIST(R)). The MIST(R) software, residing on a computer network at the Hyak Control Center, will communicate with the field sites and SCAN+ computer to download data and weather reports respectively. The Hyak Control Center will communicate with the field sites through microwave radio links. Figure 3.0 shows communication links to field sites.

EASTERN REGION

A Traffic Management Systems (TMS) plan was developed in 1995 for the Eastern Region. The majority of the system is for traffic in and around the City of Spokane. The plan calls for video detection to monitor traffic flow and for incident verification. The plan also discusses the use of Highway Advisory Radio (HAR) systems for traveler information. The plan recommends microwave radio for transmission of video and data.

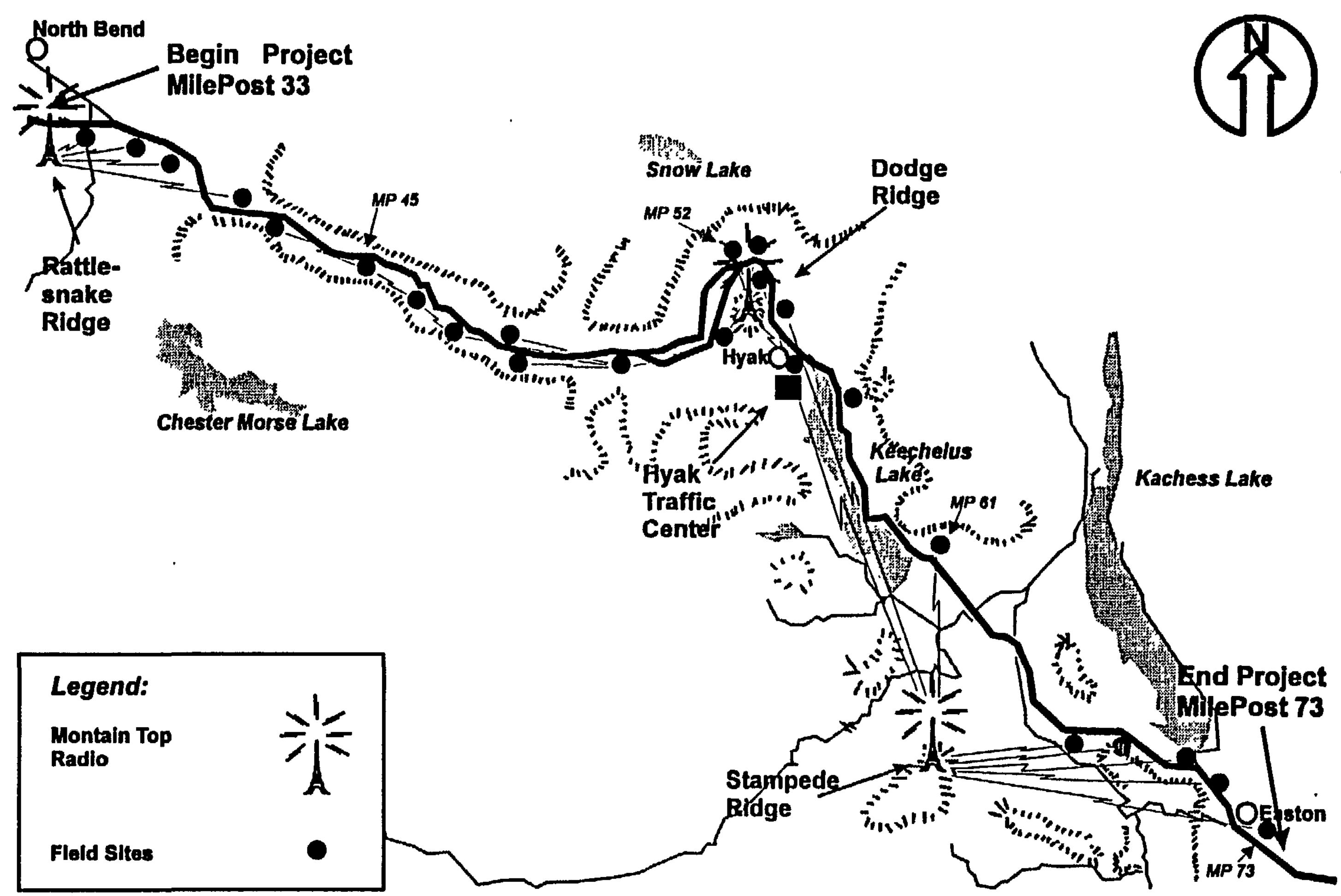
STATE-WIDE 800 MHZ RADIO SYSTEM

WSDOT has a state-wide 800 MHz trunked radio system for communication between the various construction and field offices. This system has 88 repeater sites and approximately 2,000 users. Ultimately, there will be approximately 3,500 users. Installation is complete on the west side of the state and 60 percent complete on the east side. Installation was expected to be 95 percent complete by September 1996.

The FCC has auctioned off frequencies in the 2 GHz band for personal communication services (PCS) with the understanding that the present owners of the frequencies will be “bought out” by the new owners. WSDOT has 4 paths and WSP has nearly 30 paths that are affected by the move. All microwave system plans, additions, or modifications to the system are on hold pending the outcome of negotiations of the frequency buyout.

MICROWAVE RADIO

WSDOT has a state-wide medium capacity microwave radio system in operation. It is very limited in its capacity and connections with WSDOT offices across the state. The microwave system is used to connect WSDOT facilities to Washington State Patrol (WSP) radio sites for long distance communication. Figure 4.0 shows WSP’s microwave radio relay sites in Washington State, and also includes WSDOT radio sites.



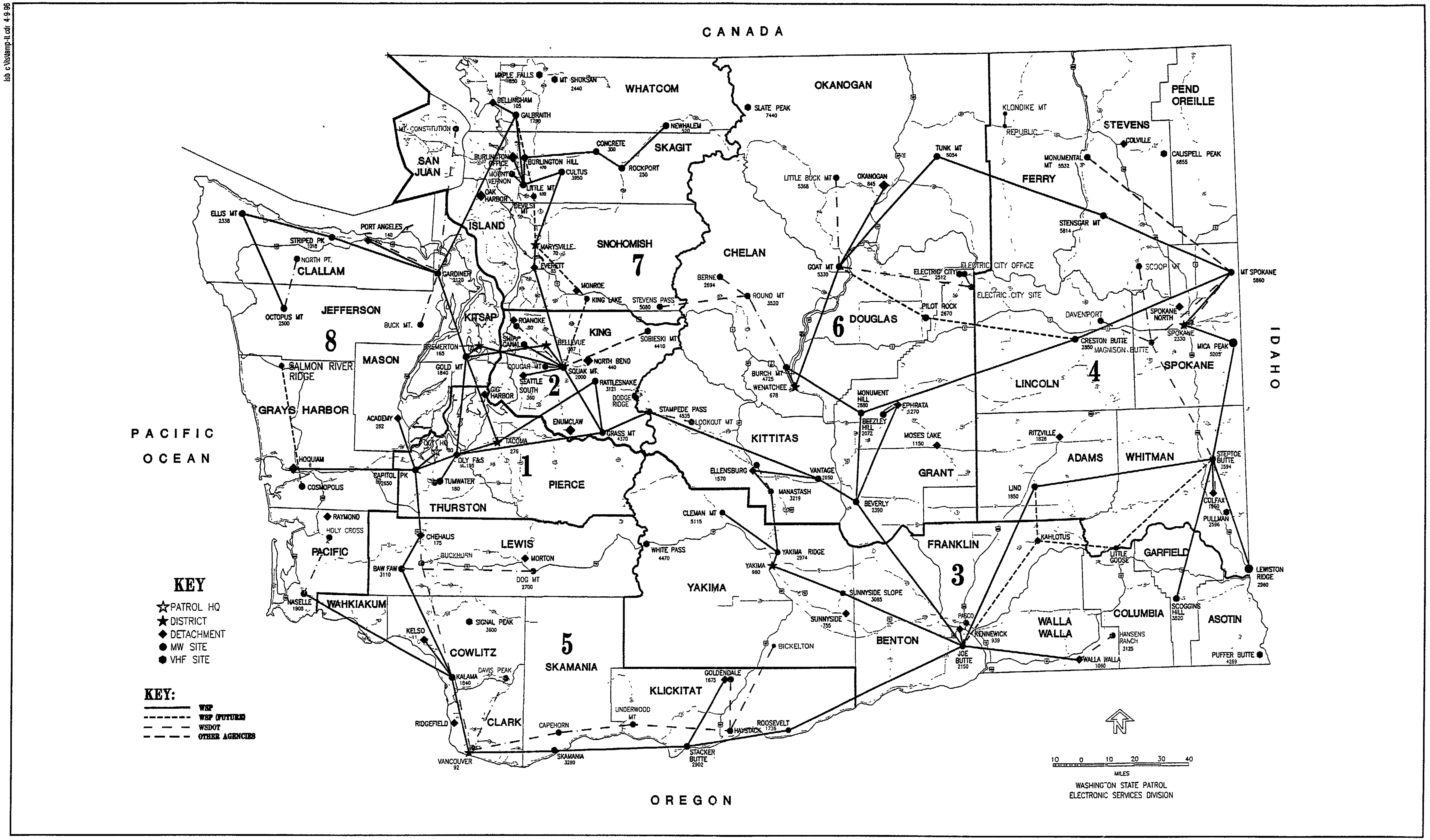
Travel Aid Project - Communications to Field Sites

Travel Aid Project - Communication to Field Sites

Communications Plan

I-5 Seattle to Vancouver, B.C.

ITS Early Deployment Program



PB 100 YEARS

WSP Microwave Radio Network
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ITS Early Deployment Program
FIGURE 4.0

WSDOT MIS LEASED NETWORK

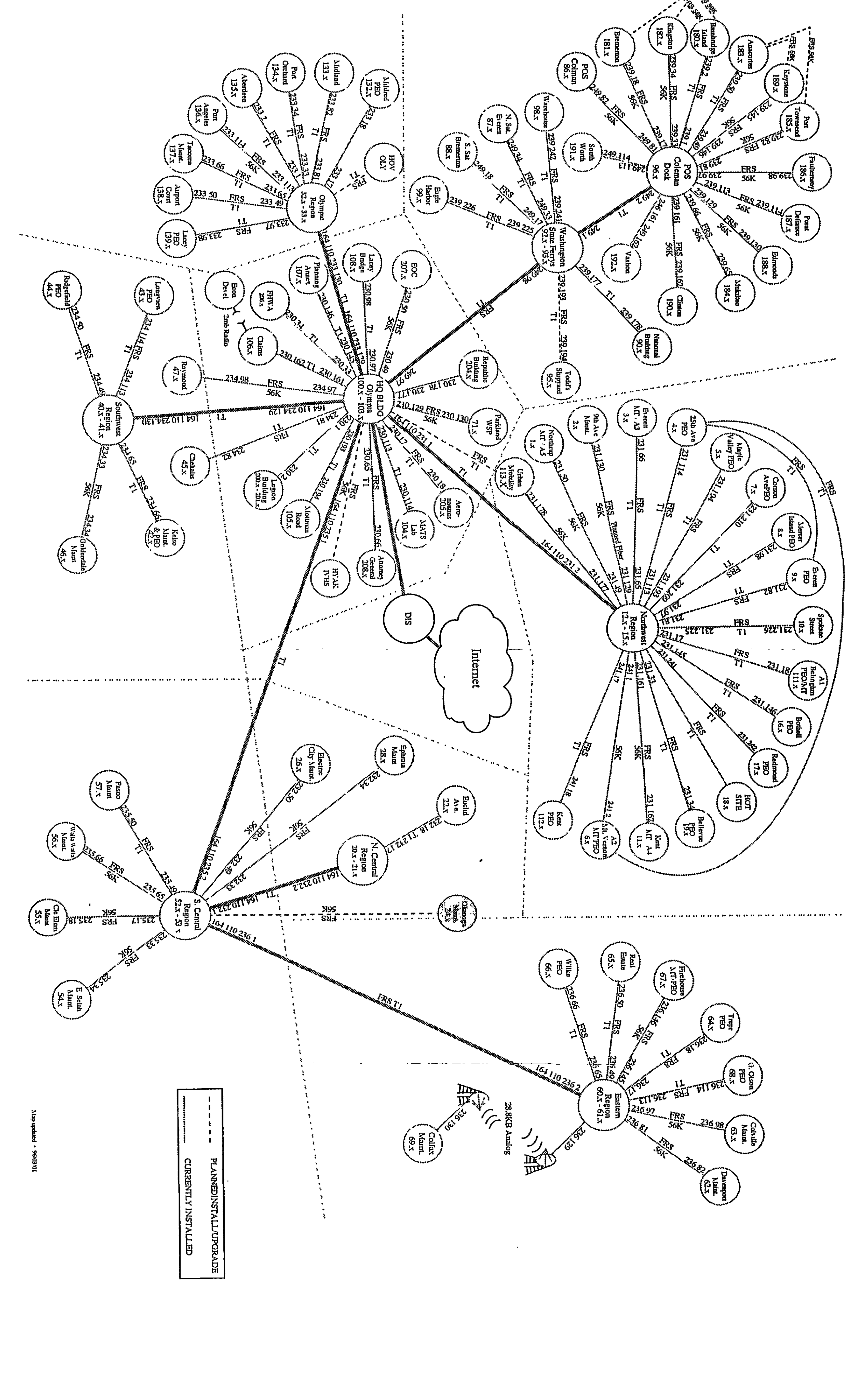
The WSDOT administrative department has an extensive network of leased lines connecting the regional offices to the Olympia Service Center. The leased line network uses T1 and 56 kbps circuits to connect the project engineer offices and WSDOT local offices to the regional offices. Currently, the department is using less than 20 percent of the network capacity. Figure 5.0 shows the configuration status of WSDOT's Wide Area Network (WAN).

The MIS department has a disaster recovery plan in place with hot standby facilities. There are alternative facilities available for all the major communication routes. These can be switched into place manually or in some cases automatically. Manual switchover is preferred at this time due to the nature of the data traffic. It is more cost-effective to switch the circuits over during office hours as there is very little data traffic in the off-hours. There is a pilot program for video conferencing over the WAN with the regional office in Spokane that appears to be successful.

The WAN is currently being used for administrative functions, e-mail, financial information, and transfer of CAD files, point of sale for WSF, and video. Voice communication between offices is provided by an independent leased network connecting the PBX systems at major offices.

WSDOT • Wide • Area • Network

Washington State Department of Transportation



WSDOT Wide Area Network
Communications Plan
I-5 Seattle to Vancouver, B.C.
ITS Early Deployment Program
FIGURE 5.0

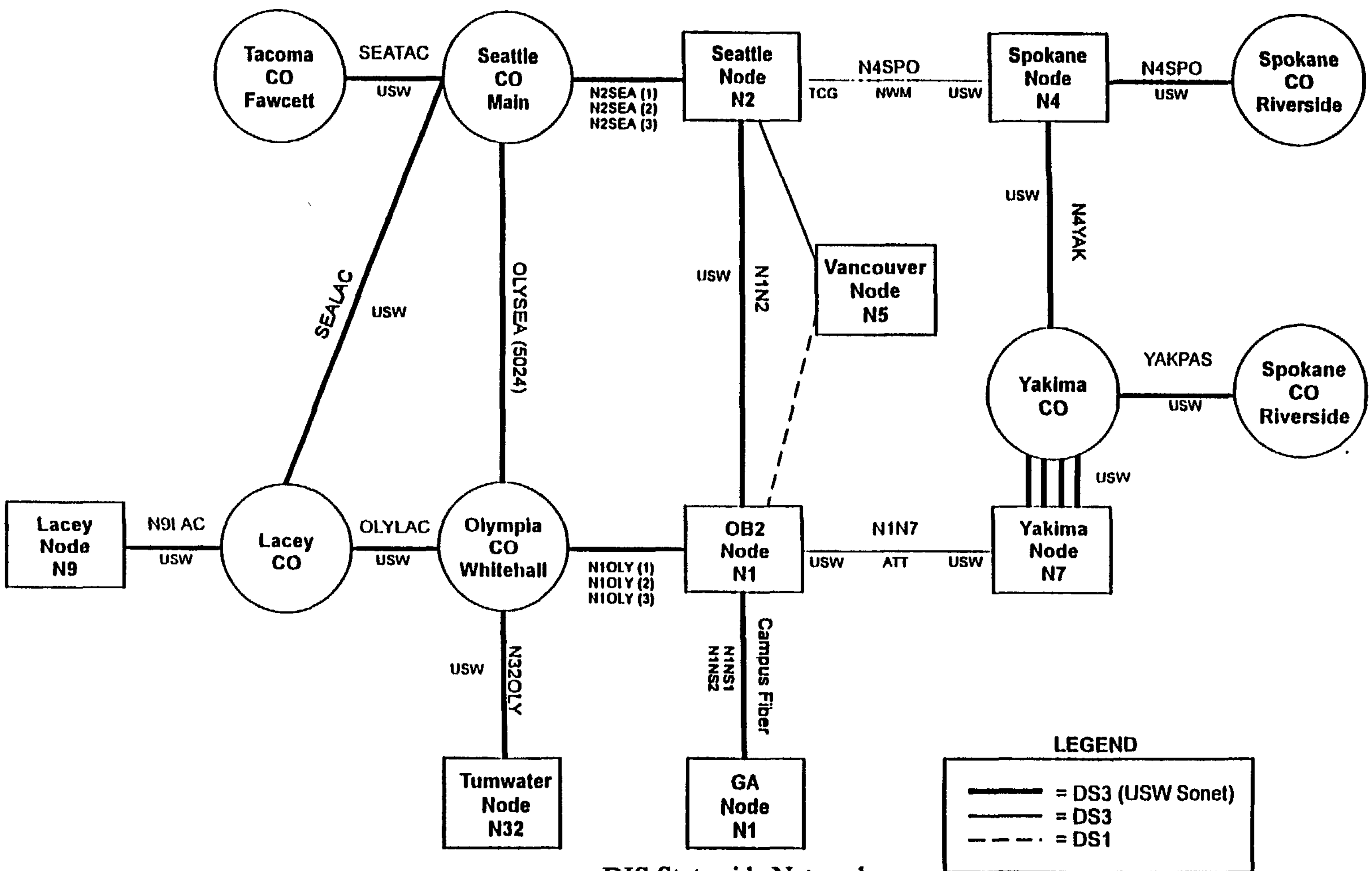
3.0 WASHINGTON STATE PATROL SYSTEMS

The Washington State Patrol (WSP) has a state-wide microwave radio network. The existing microwave radio system operates primarily at 6 GHz with several links at 2 GHz or at 960 MHz. The WSP system runs north to south along I-5 and east to west along I-90. There are numerous spur routes to cover corridors for other state highways. WSDOT currently shares tower and building space at several of the WSP sites across the state. Figure 4.0 shows WSP's existing microwave links. The WSP also has an extensive VHF communication network for their operational communications requirements.

4.0 DEPARTMENT OF INFORMATION SYSTEMS

The State of Washington Department of Information Systems (DIS) communications network consists of leased telephone facilities. The network includes facilities supported by inter-exchange common carrier companies. The DIS network is used to support voice, data, and video communications among the state offices. The existing system operates primarily at a data transmission speed of DS3. Both westside and eastside connections are using a transmission rate of SONET OC-I. The cross-mountain sections are DS3 connections. The DIS statewide network is depicted in Figure 6.0.

DIGITAL TRANSPORT BACKBONE ROUTES



DIS Statewide Network

DIS Statewide Network
Communications Plan
I-5 Seattle to Vancouver, B.C.
ITS Early Deployment Program

5.0 U.S. CUSTOMS DEPARTMENT

Although not a state agency, the needs of the Customs Department at the Blaine border crossing will be addressed by this project. Communication needs at the border crossing are currently served primarily by leased and dial-up telephone company facilities.

6.0 CONCLUSIONS

There are many existing communication networks in place that are operated by WSDOT and other Washington State agencies. Of the identified infrastructure, the SONET-based technology currently deployed by the WSDOT at certain I-5 and I-90 locations presents the greatest opportunity for the support of future ITS-based communication needs. The SONET infrastructure provides a proven standard of compatibility for fiber optic-based communications. This standardization of the optical interface and data stream protocols, as well as the NMS features will continue to provide WSDOT with a robust, expandable, and manageable communication infrastructure for future ITS deployments.