ITS Evaluation — Phase 3 (2010)

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ITS Evaluation Phase 3

ITS EVALUATION — PHASE 3 (2010)

by

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16. ABSTRACT

This report documents the results of applying a previously developed, standardized approach for evaluating intelligent transportation systems (ITS) projects to 17 ITS earmark projects. The evaluation approach was based on a questionnaire to investigate technical, management, and organizational lessons learned. The report includes an evaluation report for each of the 17 ITS projects. Each report includes a discussion of the following:

- Background
- Project description
- System usage and benefits
- Cost, operations and maintenance
- Architecture and standards
- Lessons learned.

Most of the lessons learned in this evaluation phase were similar to those documented in previous evaluations.

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EXECUTIVE SUMMARY

This is the fourth report on a project for the Washington State Department of Transportation (WSDOT) that started in 2004 with the objective of developing a methodology for evaluating advanced traveler information systems (ATIS) and testing it on a group of five projects. Phase 2 (covered in two reports) then applied the evaluation methodology to a diverse group of 33 intelligent transportation systems (ITS) projects covering everything from ITS planning to safety improvements.

The evaluation approach was based on a structured interview script that addressed the following topics: project background, system features, system operations, system usefulness, public response, project management, and lessons learned. The interviews were able to elicit the information needed to meet the evaluation requirements.

This Phase 3 used the same interview script in questionnaire form to elicit the same information. Follow-up discussions were used for clarification and to obtain additional information. Seventeen ITS earmark projects were evaluated, and individual reports were prepared to document the following project aspects:

- background
- project description
- system usage and benefits
- cost, operations and maintenance
- architecture and standards
- lessons learned.

The lessons learned were similar to those previously documented and fell into the following four categories:

- planning
- maintenance
- rural development
- project management.

The majority of the lessons learned in this evaluation fell into the area of project management. The reason for this was that these projects were not funded by the normal

WSDOT transportation planning and programming process. Funds and personnel for project management were therefore in short supply, and as a result, traffic operations engineers were often given the responsibility of managing these projects in addition to their regular duties. Problems in coordinating multi-jurisdictional projects—getting consensus from a multi-agency board, for example—occurred on several of these projects.

ITS EVALUATION—PHASE 3 (2010)

1: INTRODUCTION

This is the fourth report on a project for the Washington State Department of Transportation (WSDOT) that started in 2004 with the objective of developing a methodology for evaluating advanced traveler information systems (ATIS) and testing it on a group of five projects funded in FY 1999-2000.

After the development and application of the evaluation methodology (*ATIS Evaluation Framework*, WA-RD 606.1, May 2005, WSDOT), a review of remaining WSDOT intelligent transportation systems (ITS) projects found 16 that were completed and ready for evaluation. The same methodology developed in the framework project, with minor modifications, was successfully used to evaluate that diverse collection of projects. That report was published in June 2007 *(ITS Evaluation Framework – Phase 2*, WA-RD 672.1, June 2007, WSDOT). A continuation of Phase 2 evaluated another 17 projects (*ITS Evaluation Framework – Phase 2 Continuation*, WA-RD 672.2, June 2009, WSDOT).

In Phase 3, 17 additional ITS earmark projects were evaluated with a similarly structured interview process except that, in this case, the interview questionnaires were distributed to the project managers to complete. Where there were questions or if more information was needed, follow-up telephone conversations took place. These projects were funded between 1999 and 2004. They were a diverse collection that involved the deployment of traffic management systems, traveler information systems, and communications systems. Most of the lessons learned were similar to those that were documented in the previous evaluations.

1.1: The Federal Requirements

Evaluations of federally funded ITS projects are required as part of partnership agreements between the U.S. Department of Transportation (USDOT) and local agencies

receiving the funds. Each agency agrees to produce a local evaluation report funded from project resources. The report must include two major parts: 1) a general, overall assessment of the project and 2) two or more specific evaluation products/activities. In addition, the report must contain an executive summary.

The general overall assessment of the project must include a discussion of the major benefits anticipated from achieving project goals. It should also address key aspects of the project, such as

- system and subsystem performance
- resolution of institutional issues, especially those associated with contracting procedures, liability, privacy, regulation, and intellectual property
- implications of achieving consistency with the National ITS Architecture
- consumer acceptance
- life-cycle costs.

In addition to the general overall assessment component of the local evaluation report, two or more of the following evaluation products/activities must be undertaken:

- Evaluate the institutional issues associated with achieving cooperation among public sector agencies and document how they were overcome. This is suitable for evaluation of architectural products.
- Provide a brief lessons learned report on the technical and institutional issues encountered in integrating ITS components.
- Provide an evaluation report on the lessons learned in employing innovative financing or procurement and/or public-private partnering techniques.
- Produce a lessons learned report on the experiences, challenges, and approaches used in achieving consistency with the National ITS Architecture and regional architecture and/or implementation of ITS standards. This is suitable for evaluation of architectural projects. Where regional ITS architectures are developed, the USDOT reserves the right to share them with other locations as examples of good practice.
- Produce a case study on the planning process used to achieve integration into an approved plan and program developed under an area-wide (statewide

and/or metropolitan) planning process that also complies with applicable state air quality implementation plans. This is suitable for evaluation of architectural projects.

- Provide the appropriate metropolitan planning process with data generated by ITS technologies and services, and provide a report on plans or intentions for archiving or using the data.

1.2: The Projects to Be Evaluated

This report collects and summarizes the individual evaluation reports for 17 ITS projects deployed by WSDOT. Construction has been completed on these projects, and the installed systems are currently in operation.

As mentioned previously, the projects were evaluated by using a methodology that was developed in the Phase 1 evaluation of five traveler information projects and further refined for use on a more diverse collection of projects in Phase 2. For data collection, that methodology relies on structured interviews based on a script designed to address a range of project development issues. No actual interviews were conducted in this continuation. Instead, questionnaires based on the previous interview script were sent to the WSDOT project managers by e-mail in September 2008. (A copy of the questionnaire template is included in Appendix A.) Telephone conversations followed to answer respondents' questions or elicit additional information.

Each individual evaluation report includes the required "general overall assessment," which addresses the key aspects of the project and a discussion of the institutional issues associated with multi-agency projects, if applicable, or a discussion of the technical and institutional issues encountered in integrating ITS components. A discussion of the use of the ITS architecture and standards is also included.

1.3: Report Organization

The report contains three main sections: an Evaluation Summary, Individual Evaluation Reports, and appendices.

The Evaluation Summary includes two tables, one that lists the 17 projects included in this evaluation and a second that summarizes the lessons learned from each project.

The Individual Evaluation Reports provide the general overall assessment and the specific lessons learned for each of the 17 projects.

The appendices include the following:

- Appendix A: a questionnaire template that was modified to fit each project and sent by e-mail to each WSDOT project manager
- Appendix B: references to three evaluations of various aspects of the Road Weather Information Systems Enhancement program
- Appendix C: a list of Feature Sets developed and approved by personnel from the traffic management centers of the six WSDOT regions for development of a new statewide Highway Advisory Radio system.
- Appendix D: user survey statistics and comments about Traveler Information System Seattle

2: EVALUATION SUMMARY

2.1 EVALUATION PROCESS

Table 1 lists the projects included in this evaluation, and Figure 1 shows the approximate locations of the projects. They can be grouped under the following application areas:

- Arterial Management Systems
- Freeway Management Systems
- Traveler Information
- Road Weather Management
- Communications Systems.

The framework methodology, developed by the Washington State Transportation Center (TRAC) in a previous ITS evaluation project, was effectively applied to this group of 17 projects. The structured interviews were turned into a questionnaire that addressed the following seven topics:

- project background
- system features
- system operations
- system usefulness
- public response
- project management
- lessons learned.

The questionnaires were able to elicit the information needed to meet the evaluation requirements. Minor modifications to the questionnaires to account for specific project components or attributes were usually required. Follow-up telephone calls were used to obtain clarification or more information.

2.2 LESSONS LEARNED SUMMARY

The individual evaluation reports include background and project description information for each project, as well as detailed discussions of the technical and institutional issues. Table 2 summarizes the lessons learned from each project. The evaluation framework developed in the previous evaluation used seven categories of lessons learned:

Table 1. Projects Evaluated in This Report

Project Name		WSDOT Office	Federal Fiscal Year	Pin	Federal Aid No.
1.	Bellingham Regional Operations Center	Bellingham TMC	2002	100022Q	ITS-2002(035)
2.	Advanced Snowplow Systems	NCR	2002	200022Q	ITS-2002(036)
3.	I-90 Kittitas County Workzone Safety	ER	2002	509021Q	ITS-2002(038)
4.	US-195 Rural Traveler Information System	ER	2002	619523Q	ITS-2002(043)
5.	SR 543/I-5 to International Boundary	Bellingham TMC		100056Q	ITS-0543(001)
6.	Tri-Cities Advanced Traffic Management	Yakima TMC	2003	501231Q	ITS-2003(052)
7.	Olympia Arterial Advanced Traffic Management	OR	2003	300032Q	ITS-2003(062)
8.	Remote Traffic Operations Center	NWR	2003	100031Q	ITS-2003(062)
9.	Seattle ITS Incidents and Operations	Seattle	2003	000541Q	ITS-2003(062)
10.	Spokane Traffic Operations for Arterials	Spokane	2003	609031Q	ITS-2003(062)
11.	Seattle City Center ITS	Seattle	2004	N/A	ITS-2004(047)
12.	Statewide Transportation Operations Center	HQ	2004	000058Q	ITS-2004(050)
13.	I-90/Snoqualmie Pass Variable Speed Limit	SCR	2004	509043Q	ITS-2004(052)
14.	Vancouver ATMS	SWR	2004	400541Q	ITS-2004(056)
15.	Puget Sound Traffic Map Expansion Project — Northwest Region	NWR	2005	100011Q	ITS-2005(033)
16.	Puget Sound Traffic Map Expansion Project — Olympic Region	OR	2005	300001Q	ITS-2005(033)
17.	Traveler Information System	Seattle	2005	N/A	ITS-2005(042)

HQ = WSDOT Headquarters
NWR = WSDOT Northwest Region
SCR = WSDOT South Central Region
OR = WSDOT Olympic Region
ER = WSDOT Eastern Region
NCR = WSDOT North Central Region
SWR = WSDOT Southwest Region

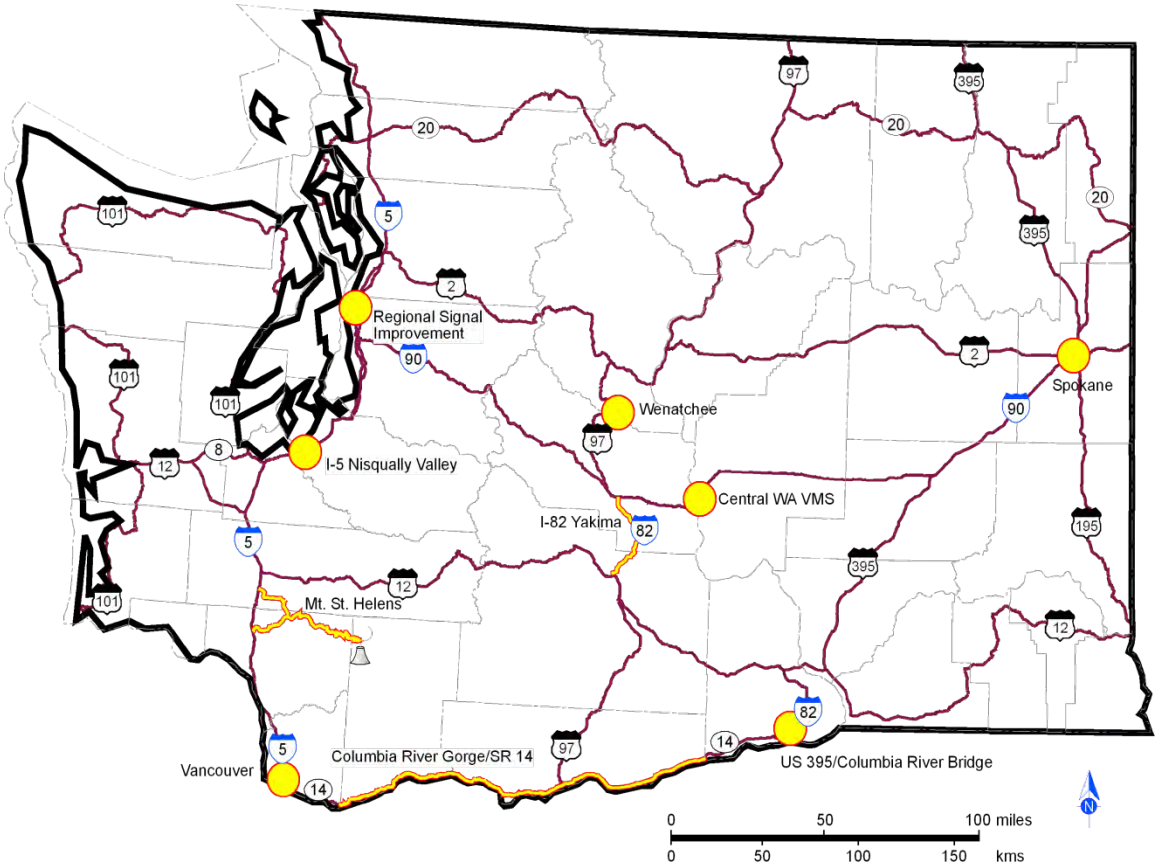

Figure 1. Approximate Locations of Evaluated Projects
(Statewide projects are not shown)

Table 2. Lessons Learned

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Planning																	
The communications link to the Bellingham TMC is critical for this system to work as expected. At this time, everything is connected by a single link, so a cut fiber optic cable or malfunctioning radio could halt communications to a large amount of equipment. It is important to recognize critical failure paths like this and plan to address them when funding is available	√				√												
Allow adequate time to work with a vendor to obtain a system that meets requirements. When this project started there was nothing on the market that met the requirements. Region personnel spent a great deal of time working with the vendor to build the system that they wanted. The result, other than a system that met requirements, was a system that cost less than estimated so the project was able to install additional microwave backbone links.			√														
Better guidance is needed on device selection/ deployment and benefit/cost. Information on the lifecycle costs and the benefits of various ITS devices is needed so designers can make informed choices. For example, how can the benefits of these devices be quantified, particularly the contribution of traveler information delivery to reduced delay?				√						√							

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Planning (Continued)																	
State law limits WSDOT's ability to procure ITS equipment and perform ITS work at the lowest possible cost. If an item (such as an RWIS station) is procured by competitive bid, it likely cannot be installed by state personnel because both the equipment procurement cost and the labor cost are added to determine whether the total project costs exceed the limit on state force work. This compels WSDOT to prepare a PS&E bid package and hire a contractor, resulting in a more expensive project.				√						√							
This project suffered from the typical earmark problem of not enough funding to accomplish what was proposed in the application. This was a result of not enough time being provided to develop a good conceptual design and accurate cost estimate. (Also, because earmarks were not assured, there was no incentive to provide adequate resources to prepare these designs and estimates.)						√											
Using a systems engineering approach to develop the project concept and the scope of work would have produced a more realistic scope, schedule, and cost estimate.							√										

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Planning (Continued)																	
The Olympic Region needs to rely on other agencies to provide ITS communications, which has caused many problems. Even when the use of other communications systems has been initially agreed upon, the situation may change between the scoping and design phases, leading to additional costs and delay.							√										
SDOT had to develop some standards for ITS devices that hadn't been installed in the city before. Some design work was delayed because of this. Future projects can take advantage of these standards. If future ITS deployments require standards to be developed, delays should be anticipated.											√						
The main lesson learned was that a more thorough needs assessment for EOC operations, conducted before development of the project scope, would have improved project delivery. The schedule for submitting requests for earmark funds and the uncertainty of obtaining the funds precluded a comprehensive needs assessment, scoping, or preliminary design process.												√					

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Planning (Continued)																	
Working in advance with the bridge designers to determine whether they would approve a more economical design, if there had been enough time before the proposal deadline, could have helped with the development of a more accurate scope. If more installations of this type are likely, it would be worthwhile to work with the bridge designers to produce a more economical, standard VSL sign support system.													√				
Wetland issues affected the scope of the project. Knowing that these sensitive areas were present within the project limits and likely to be affected by the installation of the detectors during the preparation of the project application would have resulted in better alignment between what was proposed and what was actually installed.																√	
SDOT was not aware that real-time detector data could not be retrieved from its central traffic signal system software. When the project scope of work is being developed, data sources should be carefully assessed to determine whether they will fit the needs of the project.																	√

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Project Management																	
Development was hampered because of a lack of objective information on the systems available to do this type of project. All of the potential vendors indicated that they had products (e.g., data transmission system, vehicle temperature sensor) that could perform the desired functions, but further investigation – which took valuable project time –determined that they could not.		√															
The project manager eventually found a vendor that was willing to develop products that met the system requirements, rather than trying to revise the system requirements to be consistent with what its products could do. The lesson is to be skeptical of all vendor claims until a product has been successfully demonstrated. Look for vendors that show an interest in the project specifications and functional requirements.		√															

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Project Management (Continued)																	
Because these types of projects are not developed and funded through the normal project development process, and because funding is often limited, they are not assigned a typical project manager. Instead, they are often assigned to the Traffic Operations staff and are added to the already heavy workload of operations personnel. As a result, such projects do not get the attention of a full-time project manager, designer, or construction manager. This often saves money but results in delays and difficulties, as personnel have to learn as they go.		√				√											
Several project elements were tied to larger regional projects. Dependence on other very large and complicated projects caused significant delays in the deployment of these relatively small ITS projects. It is important to look for ways to combine work with other projects to avoid redundancy and save money, but recognize that coordinating schedules can cause delay. In some cases, it may not be worthwhile tying similar ITS projects to larger projects.								√	√								

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Project Management (Continued)																	
This project attempted to fill in widely separated gaps in the Puget Sound Traffic Congestion Map. To do that required some creative incorporation of the work into projects that were widely separated both geographically and in time. This helped the budget but negatively affected the schedule. It did, however, improve the project by allowing more work to be accomplished than would have been possible if the effort to coordinate with projects already in the pipeline had not been made.															√		
The very broad scope of work made the project difficult to manage. One or two small project elements that are delayed can cause the delay of the entire project. The project manager advised developing several projects, each with a more focused scope of work.									√								
The project was delayed by very slow permit processing (18 months) from Seattle City Light for the use of luminaire poles to hang fiber optic cable. This put the project about 3 months behind schedule. It is necessary to coordinate with permitting agencies to either speed the granting of permits or to include in the schedule the necessary time for obtaining permits.											√						

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Project Management (Continued)																	
During construction, the original location was determined to be inappropriate. This change in location increased the budget and delayed the project.												√					
The project managers would like to have been more involved in the tracking and monitoring of the progress of ODOT's TOCS project. This was made difficult by the fact that ODOT wanted to keep much of that information inside its organization.														√			
Individual agency policies, differing goals or expectations, and various other differences can sometimes create control problems during bi-state or multi-agency projects and make it difficult to find consensus. Fortunately, this project had some well intentioned individuals who wanted to work together and find mutually acceptable solutions to the problems that inevitably arose. Also very beneficial, and strongly recommended for similar partnerships, was to have Bi-State/Intergovernmental Agreements drawn up and in place describing the various expectations and responsibilities for the project.														√			

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
Project Management (Continued)																	
The scope of work, schedule, and budget were carefully tracked throughout the project. As a result of some cost savings, SDOT was able to add additional features to the website congestion map. Without this careful tracking of expenses, this additional work would not have been possible.																	√
Maintenance																	
Locate the sign controllers in a place that is easy for maintenance technicians to access.													√				
System Data																	
It is important to design systems that can take advantage of new developments in technology, particularly communications. The flexible design of this project allows the equipment to be used from almost anywhere that Internet access is available, providing good redundancy and a range of options.								√									

Table 2. Lessons Learned (Continued)

Lessons Learned	Bellingham Regional Operations Center	Advanced Snowplow Systems	I-90 Kittitas County Workzone Safety	IS-195 Rural Traveler Informatuin ystem	SR 543/I-5 to International Boundary	Tri-Cities Advanced Traffic Management	Olympia Arterial Advanced Traffic Management	Remote Traffic Operations Center	Seattle ITS Incidents and Operations	Spokane Traffic Operations for Arterials	Seattle City Center ITS	Statewide Transportation Operations Center	I-90/Snoqualmie Pass Variable Speed Limit	Vancouver ATMS	Puget Sound Traffic Map Expansion Project — Northwest Region	Puget Sound Traffic Map Expansion Project — Olympic Region	Traveler Information System
System Data (Continued)																	
This project used the Olympic Region's existing fiber optic communications system to bring the data from the field to the TMC. A small amount of fiber was installed to connect the data stations to the existing fiber. Having the communication system already in place made it easy to add additional equipment.																√	

- Planning
- Maintenance
- Rural Deployment
- Project Management
- Staff, Training and Support
- Customer Response
- System Data.

The majority of lessons learned from the deployment of the projects in the current phase fell into the categories of planning and project management. It is probably not surprising that the majority of technical and institutional issues, and thus most of the lessons learned, fell into these areas. The reason is that the normal WSDOT transportation planning and programming process was not followed to obtain the funding for these projects. Rather, all of these projects were funded from ITS earmark funds appropriated by Congress. In fact, WSDOT does not have a dedicated source of funding for ITS projects of this type, so without an ITS earmark appropriation, these projects would not have been implemented. As a result, initial cost estimates were often guesses, and in most cases the projects were not assigned to a design office or a construction office for those phases of deployment. Instead, this work was usually done by traffic engineering personnel assigned to a region or headquarters traffic operations office. It was usually added to their existing workload, and rarely were personnel assigned solely to manage these projects. Consequently, project funding was usually just barely adequate, and projects were frequently delayed.

Another factor was that as more data collection and traffic management infrastructure is deployed, more emphasis is placed on the sharing of information and operations coordination. This results in more multi-jurisdictional projects and also more project management problems. The need to plan for the slower decision making process encountered in multi-jurisdictional projects was a frequently observed lesson learned.

2.3: APPLICATION OF ITS ARCHITECTURE AND STANDARDS

The project descriptions clearly describe that these 17 projects were based on the principles of data sharing and coordinated operations promoted by WSDOT's Statewide ITS architecture. Several projects involved the installation of fiber optic cable to enable data to be shared with other transportation agencies. Enabling the sharing of video images from closed-circuit television (CCTV) cameras was also a frequent goal.

Nearly all projects were also based on the appropriate National Transportation Communications for ITS Protocol (NTCIP) standards.

3: PROJECT EVALUATION REPORTS

BELLINGHAM REGIONAL OPERATIONS CENTER (ITS-2002(035), PIN 100022Q)

Background

WSDOT has deployed data collection and traveler information devices on I-5 in Bellingham and at each of the four border crossings into Canada. These devices have been installed to help motorists make informed choices regarding travel to Canada and to help them choose among the various USA/Canada border crossings. There was a need for a central location where the data from these various devices could be collected, archived, and integrated to provide useful motorist information.

In addition, it would not have been cost effective to establish communications from these field devices directly to the Northwest Region traffic management center (TMC) in Shoreline. Driving time to these devices for Shoreline TMC ITS personnel would have been over 2 hours.

Project Description

The objective of this project was to remodel an existing facility in Bellingham to add a TMC large enough for three work stations. Computer equipment to handle the functions mentioned previously would be purchased and installed. A permanent ITS engineer would be located in the TMC. The TMC would be connected to the Northwest Region's TMC in Shoreline and to the City of Bellingham's TMC.

The project would also establish cost effective communications to field devices by using a combination of the City of Bellingham's fiber optic network, leased lines from telephone companies, and WSDOT-owned microwave or fiber optic networks.

Description of proposed work in the project application

The project application listed the following work items:

- Convert office space in an existing building into a TMC.
- Install computer hardware, software, and communications equipment in the TMC to integrate data from existing ITS field devices.
- Develop a Bellingham area FLOW map containing congestion information, CCTV images, and border crossing information.
- Install an interface with the City of Bellingham's arterial traffic signal system.

Description of what was actually deployed

The following items were actually deployed:

- Space at the Bellingham Maintenance facility was remodeled to serve as a TMC. The TMC includes an equipment room (231 sq. ft.) and a control room (316 sq. ft.). A raised floor was installed in these two rooms to facilitate cable routing (see floor plan, Figure 2).
- An operator console with room for two operators was installed (see Figure 3). Existing servers, desktop computers, and video equipment were moved into the new facility.
- Fiber optic cable was installed between the Bellingham TMC and I-5. This links the TMC to the City of Bellingham's fiber network and serves as the connection point to future WSDOT mainline fiber on I-5.
- Fiber was also installed on SR 539 to enable existing traffic signals and future field devices to be connected to the Bellingham TMC via the City of Bellingham's fiber network.
- A CCTV camera was installed on I-5 at Old Fairhaven Pkwy, and fiber was installed to connect it to the City of Bellingham's network.
- The City of Bellingham installed a client of its central signal software at the Bellingham TMC to allow joint operation of coordinated signal systems along corridors intersecting the I-5 ramps. It also installed a client of its central camera control software at the Bellingham TMC to allow access to its camera system.

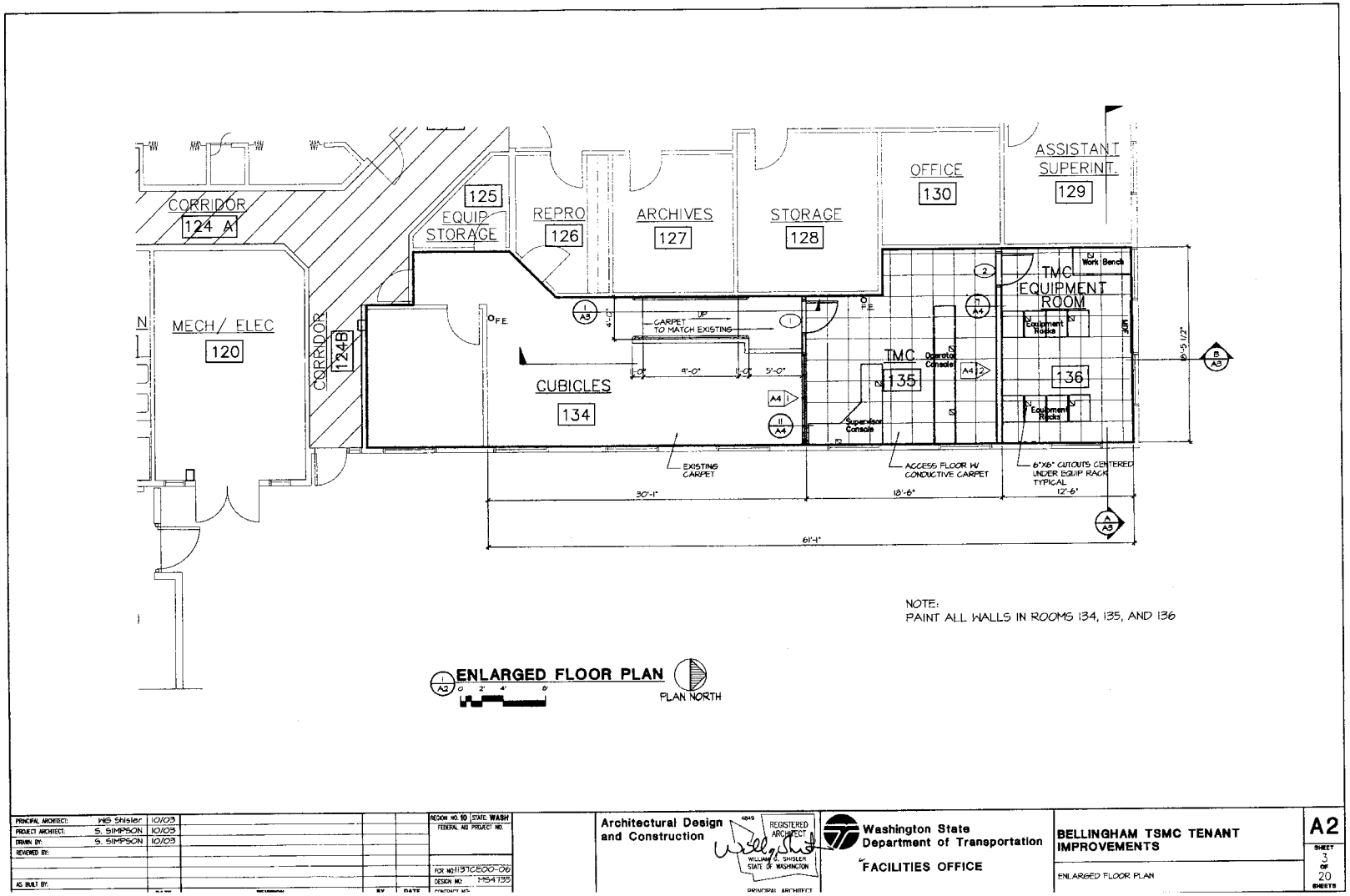

Figure 2. Bellingham TMC Floor Plan

Figure 3. Operator Console

- Both Bellingham and border traffic maps are now available on the WSDOT website:

  http://www.wsdot.wa.gov/traffic/bellingham/.
  http://www.wsdot.wa.gov/traffic/border/

  Border wait times are available for the four western Washington border crossings. Traffic congestion information is provided for a short section of I-5 through Bellingham, and the website provides information about the messages displayed on two variable message signs (when the signs are in use). Both websites provide access to CCTV camera images.

Explanation of the differences (if any)

There were no differences between what was proposed in the application and what was actually deployed.

System Usage and Benefits

The system is operated by an ITS Engineer and a Signal Operations Engineer in the Bellingham TMC. The Region TMC Operators or Radio Operators in Shoreline provide supplemental coverage after normal work hours.

The system generates and reports border wait times automatically around the clock. The central signal system software is monitored and adjusted during the morning and afternoon peak periods as needed. When accidents, construction, or other road closures occur, the ITS Engineer at the Bellingham TMC operate the system is operated locally, or the Northwest Region TMC or Radio Operators in Shoreline operate it remotely. Engineers adjust the signal system locally approximately three to five times a week. Remote operators at the Region TMC in Shoreline access some component of the traffic management and information system approximately once a day.

The page for the I-5 camera at Peace Arch Park received over 50,000 views in one day during the 2010 Olympics in Canada. This is just one of 17 different cameras on the border Web page. Thirteen cameras are also featured on the Bellingham Web page. The response of the public has been positive.

The local ITS Engineer maintains all WSDOT servers and equipment in the Bellingham TMC. The City of Bellingham maintains its fiber network and the PC with the central signal and camera clients in the Bellingham TMC. It also maintains the central signal and camera servers at the City's TMC. WSDOT Traffic Signal maintenance maintains the roadside devices. Northwest Region Radio Technicians maintain the microwave radios.

Cost, Operations and Maintenance

The project cost was approximately $750,000.

Architecture and Standards

The project used the applicable NTCIP standards.

Lessons Learned

The following were the lessons learned on this project:

- The communications link to the Bellingham TMC is critical for this system to work as expected. At this time, everything is connected by a single link. This means that a cut fiber optic cable or malfunctioning radio could halt communications to a large amount of equipment. There are plans to install fiber optic cable along I-5 through Bellingham and up to the border. This fiber, in combination with the radio links already in place and the City of Bellingham's existing fiber network, will create redundant paths for communications to the TMC. It is important to recognize critical failure paths like this and plan to address them when funding is available.

- The partnership with the City of Bellingham has worked well for both agencies and has served the public well.

ADVANCED SNOWPLOW SYSTEMS (ITS-2002(036), PIN 200022Q)

Background

WSDOT's North Central Region is predominantly rural, with long sections of low volume, high speed roads. This area experiences significant snowfall in the winter that impacts the safety and economic vitality of the area. To improve highway conditions during snow events, the region recently implemented a program to actively manage resources during storms. Roadways have been prioritized and surface goals have been set according to traffic characteristics and volumes. Snowplow routes have been designed to reduce or eliminate "invisible boundaries" between maintenance areas and to allow resources to be deployed in a seamless manner.

Significant data are necessary for storm managers to produce maximum results. Knowledge of weather and roadway conditions throughout the region allows resources to be deployed in accordance with surface condition priorities. The locations of snowplows and the quantities of sand, anti-icing, and de-icing material being dispensed are critical data for this effort

Project Description

The purpose of this project was to demonstrate the integration of radio data transfer and processing into the storm management program.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Install communications equipment at mountain top radio repeater sites and on vehicles, including the following:
  - GPS devices on vehicles
  - Sensors on vehicles to monitor when sand, anti-icing, or de-icing chemicals are applied
  - Pavement temperature sensors on vehicles
  - Pre-set communications buttons on vehicles so drivers can report roadway surface and weather conditions with the push of a button

- Joystick truck controls.

- Create or modify software to process the data from the vehicles into a usable format.

Description of what was actually deployed

The following were the components of this project:

- The project was able to use existing snow and ice application precision controllers that had already been installed on the snowplow fleet (these controllers had already been used to control the spreaders that broadcast both solid and liquid de-icing and anti-icing chemicals). The trucks were outfitted with various communications devices to poll data from these controllers and from the temperature devices on the vehicles and communicate those data to the central database for use by storm management personnel. The communications devices were able to utilize either cellular telephone, IP Radio (700 MHz), or 802.11 (Wi-Fi) technologies, depending on which method was the most effective.

- The project deployed data modems on the vehicles. These modems are able to use two communications forms to deliver data (e.g., cellular telephone or Wi-Fi, IP radio or cellular telephone, etc.). These modems take data from the snow and ice controllers, the temperature gauges, and manual input devices for road/sky/weather conditions. Mobile data computers and mobile data terminals were deployed in vehicles that had snow and ice controllers to allow manual operator input, when necessary. GPS-based devices for warning operators when they enter a no-wing zone or other documented hazard were also installed. An IP radio (700 MHz) communication system was deployed in 10 vehicles and tested through the winter. Multiplexor devices were installed to be able to handle the complex communication among all the electronics in the trucks.

- The project also installed three IP radio (700 MHz) repeaters on mountain top locations.

Explanation of the differences (if any)

When this project was conceived, the WSDOT 800 MHz radio system was proposed as the communication medium. The 800 MHz radio system was tried but the data transmissions overrode the region's voice communications, so it was determined it was, it was not feasible to use this system. ,

The region also tried cellular communications which worked to an extent. The phones were reliable where service was available, but in the region's rural areas there where many gaps in the cellular telephone system. One other issue with cellular telephone is concern that during emergencies this system can become overloaded and may not have capacity to send data when needed.

To complete the test, 700 MHz antennas were be installed on 3 mountaintop locations with corresponding equipment on the trucks. As the region increases the 700 MHz coverage they expect to be able to remove the cellular telephones from some of the trucks.

All equipment was installed in the vehicles, and additional work was done to make the reporting system as automatic as possible.

System Usage and Benefits

The system is in operation whenever snowplows are used for snow and ice control operations. The system is maintained by Maintenance and Transportation Equipment Fund (TEF) personnel (mechanics). The equipment is operated by snowplow drivers. It operates mostly automatically, with manual inputs required in selected areas.

The system currently has some inconvenient features, and WSDOT is evaluating whether to work to eliminate these or wait until the Transportation Operations Center System (TOCS) development effort is complete. For example, the database entry is initially very labor intensive to implement and update.

Cost, Operations and Maintenance

The project cost approximately $850,000 to implement. There are ongoing costs of cellular telephone service for vehicle communications.

Architecture and Standards

No standards for these types of systems existed at the time.

Lessons Learned

The following lessons were learned on this project:

- This was a cutting edge project. Development was hampered by a lack of objective information about the systems available for this type of project. All of the potential vendors indicated that they had products that could perform the desired functions, but further investigation—which took valuable project time—it revealed that they could not.

    - As mentioned, the project concept involved using WSDOT's 800 MHz radio system for data transmission. However, early in the project, several tests showed that the 800 MHz system could not be used for data transmission without affecting critical voice communications. Therefore, in order for the project to proceed, a different communications system had to be deployed.

    - The project manager also discovered that vehicle temperature sensors caused problems because they transmitted a nearly continuous stream of temperature readings. This caused a tremendous overload on the communications network. A new temperature sensor had to be found that didn't constantly read and transmit the temperature.

- A great many vendors said that their products met the requirements of various systems needed for this project. However, further investigation determined that their products did not. A great deal of time was wasted in investigating these claims. The project manager finally found a vendor that was willing to develop products that met the system requirements, rather than trying to revise the system requirements to be consistent with what its products could do. The lesson is to be skeptical of all vendor claims until a product has been successfully demonstrated. Look for vendors that show an interest in the project specifications and functional requirements.

- Because these types of projects are not developed and funded through the normal project development process, and because funding is often limited, they are not assigned a typical project manager. Instead, they are often assigned to the Traffic Operations staff and are added to the already heavy workload of operations personnel. As a result, such projects do not get the attention of a full-time project manager, designer, or construction manager. This often saves money but results in delays and difficulties, as personnel have to learn as they go.

I-90 KITTITAS COUNTY WORKZONE SAFETY (ITS-2002(038), 509021Q)

Background

The Kittitas County work zone safety system was conceived as a way to address the recurring problem of traffic back-ups on I-90 through Snoqualmie Pass. This problem, which used to be a weekly occurrence when motorists traveled over the pass to/from the Puget Sound urban area on weekends, has become a daily one since the project to reconstruct I-90 started.

Project Description

The project was intended to develop a portable work zone system that would include technology to

- monitor existing traffic conditions by using surveillance devices such as traffic detectors and CCTV cameras
- communicate that information to motorists by using variable message signs (VMS) and highway advisory radios (HARs).

A portable system was necessary to accommodate rapidly changing work zones.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Deploy a portable system that would use a mix of VMS, HAR, and the Internet to deliver traveler information to the public on construction activities on I-90.
- Connect the system to the South Central Region TMC in Yakima so it could be remotely controlled from there.

Description of what was actually deployed

Six portable work zone stations were designed, built, and purchased for this project. They consist of trailers with radar traffic detectors, a VMS, and a CCTV camera. Electrical power is provided by a combination of solar collector/battery and diesel generator. Communications are provided by a cellular modem, but, when feasible, the

system uses a microwave backbone along I-90 between Hyak and the Region TMC in Yakima. Project funding was used to construct several of these backbone links.

Explanation of the differences (if any)

The portable work zone stations did not include HARs.

System Usage and Benefits

The system is operated by personnel at the Yakima TMC. It is used as needed to mitigate the impacts of construction work. When they are not needed to provide construction related information, the stations are moved to strategic locations along I-90 to provide CCTV camera images that are displayed on the WSDOT website.

WSDOT South Central Region Traffic Operations personnel maintain the system's ITS devices that are mounted on the trailers. The Transportation Equipment Fund (TEF) maintains the trailers.

Cost, Operations and Maintenance

The project cost was approximately $744,000. Fees are paid into the TEF to cover maintenance of the trailers. The cellular modem costs approximately $80 per month per unit.

Architecture and Standards

The project used the applicable NTCIP standards.

Lessons Learned

The following was the lesson learned on this project:

- Allow adequate time to work with a vendor to obtain a system that meets requirements. When this project started there was nothing on the market that met the requirements. Region personnel spent a great deal of time working with the vendor to build the system that they wanted. The result, other than a system that met requirements, was a system that cost less than estimated so the project was able to install additional microwave backbone links.

US-195 RURAL TRAVELER INFORMATION SYSTEM (ITS-2002(043), 619523Q)

Background

The Spokane metropolitan area has experienced high population growth and the traffic congestion usually associated with the demand induced by such growth. Outside of the metropolitan area, congestion is caused by traffic incidents, roadway construction delays, and adverse weather.

Most of the traffic management infrastructure installed in the Spokane area has been on I-90. US 195, which runs north–south on the south side of Spokane, lacks the infrastructure to collect roadway condition information and disseminate it to travelers.

Project Description

This project was designed to improve the effectiveness and timeliness of weather, incident, and construction information distributed to travelers on US 195.

Description of proposed work in the project application

The following equipment was proposed for installation in the project application:

- road and weather information system (RWIS) stations
- variable message signs (VMS)
- highway advisory radio (HAR) stations.

Description of what was actually deployed

This project deployed the following equipment:

- two RWIS stations; one at Uniontown and one at Spangle
- two HAR stations; one at Pullman and one at Rosalia.

Explanation of the differences (if any)

The VMS was not installed because of insufficient funding, which became apparent as design-level cost estimates were prepared.

System Usage and Benefits

The system is integrated into the traffic systems managed by the staff at the Spokane Regional Transportation Management Center. It is used primarily to provide motorist information and to help with incident management. The Center is staffed around the clock, and the operators use these systems around the clock to manage incidents or inform motorists of construction projects or adverse weather.

WSDOT Eastern Region ITS Technicians maintain the devices.

Images from the CCTV cameras installed on the RWIS stations are provided to the public over local TV stations and via the WSDOT website. The HAR stations broadcast radio messages for the public to receive.

Cost, Operations and Maintenance

The project cost was approximately $422,000.

Architecture and Standards

The project used the applicable NTCIP standards.

Lessons Learned

The following were the lessons learned on this project:

- Better guidance is needed on device selection/deployment and benefit/cost. Information on the lifecycle costs and the benefits of various ITS devices is needed so designers can make informed choices.

- Consider the available methods of project delivery, as well as their implications, during the initial stages of the project (e.g., during development of the Project Management Plan). The Small Works Roster was used to advertise the HAR installation in order to reduce the costs of printing and advertisement. However, the fact that Small Works projects cannot contain federal funds (CFR requires formal advertisement) caused some issues with federal expenditures for the project.

- State law limits WSDOT's ability to procure ITS equipment and perform ITS work at the lowest possible cost. If an item (such as an RWIS station) is procured by competitive bid, it likely cannot be installed by state personnel because both the equipment procurement cost and the labor cost are added to

determine whether the total project costs exceed the limit on state force work. This compels WSDOT to prepare a PS&E bid package and hire a contractor, resulting in a more expensive project.

SR 543/I-5 TO INTERNATIONAL BOUNDARY (ITS-0543(001), 100056Q)[1]

Background

The western Washington/British Columbia border is the fourth-busiest commercial crossing on this country's northern border, with over $30 million of trade crossing each day. This commercial activity, combined with increased security concerns and border staffing limitations, has resulted in long queues of trucks, both north and southbound. While a number of efforts have collected data about queue lengths and truck processing times at the crossings, these studies have occurred periodically and not continually. Long-term continuous data collection about the movement of trucks over the border is necessary to provide the historical and seasonal information that the periodic data collections efforts cannot provide. Such continuous truck data are used to guide engineering and planning decisions involving border infrastructure, as well as to assist the border enforcement agencies in resource allocation and operational decisions.

Before this project, the only border wait time information available consisted of images from two CCTV cameras on SR 543 (the Blaine truck crossing) that were available on the WSDOT website. This did not come close to adequately meeting WSDOT's goals of providing full CCTV camera coverage and automated wait times at all four border crossings in Washington state.

Project Description

This project was proposed to remedy that situation by installing an automated commercial vehicle data collection system at the three commercial vehicle border crossings in western Washington. The intent of this project was to use data and images from several types of vehicle counting and classifying equipment, CCTV cameras, and existing roadside transponder readers. The project was planned for integration with a

[1] This project is part of the following project, which is being evaluated by SAIC under an FHWA contract: Commercial Vehicle Border Data System, Federal ID Number = ITS-2004(055), 000056Q.

similar effort supported by Transport Canada and the British Columbia Ministry of Transport on the Canadian side of the border. Also proposed was development of an Internet-based data integration and archiving system. The systems deployed by this project were expected to form the foundation of a future truck-oriented border traveler information system.

Description of proposed work in the project application

The project application listed the following work that was supposed to be performed at all three western Washington border crossings:

- Install weigh-in-motion sensors to capture weight and vehicle classification information.
- Install roadside transponder readers to record the movement of individual vehicles for travel time calculations.
- Develop an Internet-based data aggregation, integration, and archiving system.

Description of what was actually deployed

This project deployed the following equipment:

- Four data stations and five CCTV cameras were installed along SR 543, including the truck lanes leading to the commercial inspection booths.
- Fiber optic cable was installed along the full length of SR 543 to provide communications from the field devices.
- A border wait times Web page was developed to archive and display the data.

Explanation of the differences (if any)

- A signal mast arm was installed over the truck spur to facilitate future installation of transponder readers, but no new transponders were installed under this contract. Prior to the design of this project, WSDOT had ended a project to test the use of transponders to help border agencies process trucks at the border. That effort determined that loop detectors and CCTV cameras would provide information on border wait times in a more cost-effective manner.

- The weigh-in-motion (WIM) station was installed on I-5, but that work was outside of this specific contract. In order for the system to operate, communications to the field devices was needed. The installation of fiber optic cable provided communications capability for this project and future device installations. Because the WIM could be installed under a different contract, it made sense to install the fiber under this contract.

System Usage and Benefits

The border wait time system operates automatically, around the clock. The CCTV cameras are monitored manually as needed to confirm accidents or incidents. The ITS Engineer at the Bellingham TMC operates the system. The TMC or Radio Operators at the Northwest Region TMC provide backup monitoring.

The system is maintained by the ITS Engineer and the Region Traffic Signal Maintenance technicians.

The wait times and CCTV camera images are available from the WSDOT website. They receive several thousand hits a day.

Cost, Operations and Maintenance

The project cost was approximately $450,000.

Architecture and Standards

The project used the applicable NTCIP standards.

Lessons Learned

The following was the lesson learned on this project:

- The communications link to the Bellingham TMC is critical for this system to work as expected. At this time, everything is connected by a single link. A cut fiber optic cable or malfunctioning radio could halt communications to a large amount of equipment. There are plans to install fiber optic cable along I-5 through Bellingham and up to the border. This fiber, in combination with the radio links already in place and the City of Bellingham's existing fiber network, will create redundant paths for communication to the TMC. It is important to recognize critical failure paths like this and plan to address them when funding is available.

TRI-CITIES ADVANCED TRAFFIC MANAGEMENT (ITS-2003(052), 501231Q)

Background

Richland is one of the three cities that make up the Tri-Cities area of Washington. (The others are Pasco and Kennewick.) It is located closest to the Hanford Nuclear Reservation, and the vast majority of commuter traffic heading to the Reservation passes through Richland. The Richland Bypass (SR 240) carries most of this traffic. This access-controlled roadway is six miles long and has six lanes and six coordinated traffic signals. At the end of the Richland Bypass, traffic that is headed to Hanford continues onto Stevens Drive. The City of Richland is widening this roadway to six lanes and installing four traffic signals. Integrating these two roadways, and their traffic signal management systems, into a coordinated corridor will improve travel conditions for commuters.

Project Description

The objectives of this project were the following:

- Begin the development and implementation of a regional monitoring and data sharing system that will allow all the jurisdictions in the area to have real-time information on traffic conditions.
- Begin to develop coordinated arterial and freeway operations between jurisdictions to enhance the transportation network.
- Provide a means to improve detection, response time, and system efficiency under incident conditions.

The proposed project would construct a system to collect data on the Richland Bypass corridor, transmit them to the Region traffic management center in Yakima, monitor traffic conditions on the corridor, and provide this information to the public. The expected result of providing motorists with this information on traffic conditions was reduced congestion due to better informed travel decisions.

The proposal included developing a traffic congestion map and providing travel times to commuters. The information would be delivered via the WSDOT website and local radio stations. Closed-circuit television (CCTV) camera images would be displayed on the website.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Install data stations along the Richland Bypass and Stevens Drive.
- Install CCTV cameras on the Richland Bypass, Stevens Drive, at the I-182/SR 240 Bypass interchange, and at the I-182/SR 240/George Washington Way interchange.
- If sufficient funding was available, install additional data stations and CCTV cameras on George Washington Way in the City of Richland.
- Install a communications backbone between the City of Richland and the WSDOT Central Washington TMC.

Description of what was actually deployed

This project deployed the following equipment:

- 16 radar detectors
    - I-812, MP 4.36
    - SR-240, MP 37.15
    - SR-240, MP 38.39
    - SR-240, MP 39.41
    - I-182, MP 3.48
    - I-182, MP 6.33
    - I-182, MP 9.31
    - I-182, MP 10.89
    - I-182, MP 12.46
    - I-182, MP 13.12
    - I-182, MP 13.92
    - I-182, MP 15.06
    - US-395, MP 25.21
    - US-395, MP 19.76
    - US-395, MP 19.2
    - US-395, MP 20.27

  The types and locations of the stations for the SR 240 bypass and US -395 (through Kennewick) are still being studied. Traffic counting systems will not provide the information needed on a signalized corridor.

- To date the project has not had success with trials for Bluetooth tracking. The numbers of addresses captured have been too low to provide meaningful data on travel times through the corridors. The project will

work with the University of Washington in a final attempt to use this technology for this project.

  - License plate readers were too expensive for these locations.
  - No equipment was placed on Stevens Drive for the same reason as discussed above: it is a signalized corridor with no good solution yet, and it is a 35 mph city street off the state highway system.
  - The project is attempting to get appropriate data from the main highway loop of 240/395/182 and to show that flow map on the Web. Data from the 240 Bypass and Stevens Drive will have to come later.

- One CCTV camera
- Six microwave links from the Tri-Cities area to the Yakima TMC.

Explanation of the differences (if any)

The communications backbone required more microwave links than expected; therefore, not as many CCTV cameras could be installed as were proposed. However, cameras were installed in several of the proposed locations by other projects, and the communications backbone installed by this project carries their images to the TMC. Funding was insufficient to install devices on George Washington Way in Richland.

System Usage and Benefits

The system is operated by personnel at the Yakima TMC. It is used around the clock. At the present time, data are not available from all of the data stations. A prototype Region traffic congestion map is being tested in-house but is not yet available to the public.

WSDOT South Central Region Maintenance and Traffic Operations personnel maintain the system.

Cost, Operations and Maintenance

The project cost was approximately $831,000. The service lives of the radar detectors and the CCTV cameras are between 5 and 15 years. The microwave

communications equipment has a service life of approximately 20 years. Additional operating costs include communications tower rental fees.

Architecture and Standards

The project used the applicable NTCIP standards. The Region is using the new statewide central software, NG_TMS, that was developed in the Northwest Region.

Lessons Learned

The following lesson was learned on this project:

- This project suffered from the typical earmark problem of not enough funding to accomplish what was proposed in the application. This was a result of not enough time being provided to develop a good conceptual design and accurate cost estimate. (Also, because earmarks were not assured, there was no incentive to provide adequate resources to prepare these designs and estimates.) Because of the way these projects were funded, the project was assigned to an operations organization for design and construction management. As a result, it suffered from a lack of priority, which led to schedule delays.

OLYMPIA ARTERIAL ADVANCED TRAFFIC MANAGEMENT (ITS-2003(062) 300032Q)

Background

Olympia is the state capital of Washington. It is located about 60 miles south of Seattle in Thurston County. Interstate 5 passes through the city, and when there is an incident on I-5, traffic will divert to the city's arterial roadway system. This traffic diversion causes congestion on the arterials.

Project Description

The project had two objectives. The first was to add closed-circuit TV (CCTV) cameras at key intersections that are commonly used as alternative routes. These would be used to monitor congestion. The second was to provide the capability to adjust traffic signal timing to give priority to these alternative routes to ease congestion.

Description of proposed work in the project application

The project application proposed the following work:

- Install three VMS: one near US 101and two on or near I-5.
- Install three CCTV cameras between I-5 and US 101.
- Install two ramp meters with the City of Olympia.
- Enhance the traffic signal interconnect in the City of Olympia.

Description of what was actually deployed

The project actually completed the following work:

- Install six CCTV cameras at the following locations:
    - I-5/Eastside St. overcrossing
    - I-5/College St. overcrossing
    - I-5/Martin Way interchange
    - Plum St./Union Ave. intersection
    - Sleater-Kinney Rd./Martin Way intersection
    - College St./Martin Way intersection

Two of the cameras were connected to the region traffic management center (TMC) in Parkland via fiber optic cable. The remaining four CCTV cameras use a microwave connection to the TMC.

Explanation of the differences (if any)

The initial scope of work made some incorrect assumptions regarding the type and availability of communications that could be used to connect the CCTV cameras to the TMC. During the design phase of the project, the proposed communications system design was found to be inadequate, and a different system had to be designed. This increased both the design costs and the cost of the communications system. As a result, the funding was insufficient to cover all of the proposed work. The project managers decided to use an Amber Alert implementation grant to fund the installation of two variable messages signs (VMSs) on northbound I-5 at Tumwater Blvd. and on southbound I-5 at the Dupont interchange. They also decided that additional CCTV cameras would provide greater benefit than the installation of two ramp meters.

System Usage and Benefits

The cameras operate full time. They are managed by WSDOT's Olympic Region TMC operators. The CCTV cameras allow the TMC operators to monitor traffic conditions. This capability can improve incident detection times and helps the TMC to monitor the progress of incident management efforts. The information from the cameras is also provided to the public via the WSDOT website, so travelers can use the information to plan their trip to avoid congestion. The CCTV images are also provided to area news stations, which make them available to the public for trip planning.

Each CCTV camera receives an average of 150 to 200 views per day. When there is an incident or poor weather conditions, this can increase to 1,000 views per day.

Cost, Operations and Maintenance

The cost of the project was approximately $380,000. The Olympic Region Signal Operations group maintains the equipment.

Architecture and Standards

This project was based on the Thurston Regional Planning Council's Thurston Region System Architecture. Specifically, the project was based on the Advanced Traffic Management Systems category with the following market packages:

- Network Surveillance
- Traffic Information Dissemination
- Traffic Incident Management Systems

Lessons Learned

The following are the lessons learned on this project:

- Using a systems engineering approach to develop the project concept and the scope of work would have produced a more realistic scope, schedule, and cost estimate.

- The Olympic Region does not have a good backbone communications system for ITS. The Region needs to rely on other agencies to provide communications, which has caused many problems. Even when the use of other communications systems has been initially agreed upon, the situation may change between the scoping and design phases, leading to additional costs and delay.

REMOTE TRAFFIC OPERATIONS CENTER (ITS-2003(062) 100031Q)

Background

The current Northwest Region traffic management center (TMC) and the fiber optic communications system that supports it began operation almost 18 years ago. Since then, there have been tremendous technological advances in communications systems. New traffic management strategies have been adopted to respond to changes in the economy and the political landscape. Centralized control, which used to be the standard practice, is now yielding to more distributed control as agencies strive to be more interconnected and interoperable. In addition, a single point of control (i.e., with one TMC) with no backup site is vulnerable to man-made or natural disasters.

Project Description

Since the transportation system is critically needed during catastrophic events, it is necessary for WSDOT to continue its efforts to monitor, control and inform the public and other agencies about the status of the system when disaster strikes. The purpose of this project was to modify and enhance the existing communications system to provide operators with access to field equipment without having to go through the existing TMC.

The intent of this project was to introduce a flexible network environment to the ITS system that would allow operators full access to any field device from selected communications hubs. Also proposed was exploration of a different approach to TMC operations by using distributed intelligence. Processing tasks that are conventionally performed at a central location would be delegated to communications hubs. Each hub could independently operate as a mini-TMC, or it could network with adjacent hubs to form a coordinated system.

Description of proposed work in the project application

The application proposed installing the following equipment:

- Install a field server, video switch, and MPRG codec (coder/decoder) at each communications hub on the WSDOT fiber network.

- Purchase one complete mobile 800 MHz base station and one mobile computer with WSDOT Radio dispatching capability, matching the existing Orbicom system. These components will be stored in the emergency storage area near the Region headquarters at Dayton Ave.

Description of what was actually deployed

The following work items were actually installed:

- Initially, the intent was to install a field server, video switch, and MPRG codec/decoder at each of the 12 communications hubs on the WSDOT fiber network. By taking a laptop computer to any of those hubs and connecting it to the system, an operator would have been able to control the freeway management system. Subsequently, communications advances made it possible for an operator with a laptop computer and a VPN connection to control the freeway management system from any place with Internet access, not just from the 12 communications hubs.

  However, because of rapid changes in technology, the concept of adding a server was dropped in favor of adding Internet Protocol (IP) and switching to digital communications. Rather than install analog video equipment, we converted our SONET system to support Ethernet and installed a Cisco 3560 Ethernet switch in each hub. This device provides the interface to connect the laptop. The video was also switched to IP.

  Some of the equipment was funded by this project and some was leveraged from other projects and state funds; for instance, the IP video was provided by Puget Sound Interagency Video and Data Network (Traffic Buster). The bulk of the project funding was used to install the buildings and equipment inside of the buildings. State funds purchased the buildings and the required network enhancements.

- Because of concern about placing personnel in the existing communications hubs, which are underground facilities, two surplus, prefab, concrete communications buildings were installed: one in the parking lot at the Northwest Region headquarters building at Dayton Avenue in Shoreline and one at the Kent Maintenance facility. A primary need was to have an operational location near Dayton Avenue to use as a backup during Dayton TMC fire alarms. But rather than just build each hub for remote access, we built two remote TMCs. Both of these buildings are physically isolated from

the Dayton TMC and have backup power, and they are ready to use, with a desk and chair, small wall of monitors, and computers with freeway management system control software to enable remote operation of the system. These sites will be enhanced with radio.

Explanation of the differences (if any)

Installing the equipment in the communications hubs was more costly than expected. As a result, there was insufficient funding to install the radio base station and dispatch computer. However, this equipment was installed, with state funding, at the Incident Response Team office at Corson Ave. This provides the remote backup radio base station and dispatch system that this project originally intended to deploy.

System Usage and Benefits

The system will be used only when disaster strikes. Originally deployed in December 2009, it remains on standby at all times. So far, it has only been operated for testing purposes.

It is operated by the Region TMC staff when needed, and the equipment is maintained by Region traffic signal maintenance technicians.

Cost, Operations and Maintenance

The project cost approximately $333,000 to implement.

Architecture and Standards

All applicable NTCIP standards were used.

Lessons Learned

The following lessons were learned on this project:

- The project manager combined this project with a much bigger project in order to get some of this project's work completed in a cost effective manner. That led to delays. It is important to look for ways to combine work with other projects to avoid redundancy and save money, but recognize that coordinating schedules can cause delay.

- It is important to design systems that can take advantage of new developments in technology, particularly communications. The flexible design used for this project allows the equipment to be used from almost anywhere that Internet access is available. The remote traffic operations center can be operated from the auxiliary buildings installed at two WSDOT locations, from any communications hub, or from any location with a suitable Internet connection, providing good redundancy and a range of options.

SEATTLE ITS INCIDENTS AND OPERATIONS (ITS-2003(062) 000541Q)

Background

This project comprised five elements intended to expand and integrate new ITS technology with existing systems deployed in the City of Seattle. The project elements were as follows:

- North Seattle Bridges and Approaches ITS: Driver information is needed to reduce delay at two city bridges across the Ship Canal. Approximately 30 bridge openings occur each day that severely delay traffic.

- Rainier Valley ITS: Emergency vehicle preemption needs to be implemented in the Rainier Valley before implementation of Sound Transit's light rail system, which will run on surface streets. This is essential for avoiding emergency vehicle conflicts.

- 1st Ave S. Transit Signal Prioritization: This corridor is targeted for increased transit service. The implementation of transit signal priority will support increased transit ridership and will help reduce traffic delays caused by commuter, special event, and ferry-generated traffic.

- Radio Traffic Advisory System: This traveler information system is needed so that commercial vehicle operators can be advised of accidents, traffic congestion, construction delays, and special events.

- Portable Traffic Devices: These devices are needed to mitigate the effects of traffic accidents and construction activity.

Project Description

Description of proposed work in the project application

The project application proposed the following work:

- North Seattle Bridges and Approaches.
    - Install variable message signs (VMS), closed-circuit television (CCTV) cameras, fiber optic communications, traffic controller, and traffic signal upgrades at two city bridges that cross the Lake Washington Ship Canal.
    - On Montlake Bridge, install three CCTV cameras and fiber optic communications to connect them to the Seattle TMC.

- Rainier Valley ITS (Martin Luther King Jr. Way ITS)
    - Install emergency vehicle pre-emption at 33 intersections and three CCTV cameras.
- 1st Ave S. Transit Signal Prioritization (TSP)
    - Install eight TSP readers at five intersections.
- Radio Advisory System
    - Evaluate options for the operation of a radio traffic advisory system for commercial vehicles and the general public.
    - Implement a demonstration radio service.
- Portable Traffic Devices
    - Purchase portable VMS for use at incident sites.

Description of what was actually deployed

The project actually completed the following work:

- The North Seattle Bridges work was completed.
- The Rainier Valley ITS was completed.
- 1st Ave S. transit signal priority was completed.
- The Radio Advisory System was evaluated, and planners decided to not deploy it at that time.
- Portable VMS were purchased.

Explanation of the differences (if any)

There were no differences between what was proposed in the project application and what was deployed except for the Radio Advisory System. The evaluation determined that the AM frequency had poor reception in the desired area of deployment. The decision was made to deploy it with a future project if FM frequency bands become available.

System Usage and Benefits

The signals, emergency vehicle preemption (EVP), transit signal priority (TSP), CCTV cameras, and VMS are operated by existing systems at the Seattle traffic management center (TMC). The central signal system runs traffic signals. TSP is handled by field controllers/cabinets. The CCTV cameras are fed into a video distribution system in the TMC. EVP is handled by the field controller/cabinet.

The portable VMS are staged at the Seattle Department of Transportation (SDOT) Traffic Shops, central maintenance facility, and north maintenance facility. The signs are deployed from those locations to address incidents as they occur.

All devices and systems are operated by SDOT. CCTV cameras, TSP, EVP, and VMS are all operated around the clock. The portable VMS are deployed on an as-needed basis.

SDOT maintains all devices. SDOT is responsible for operations and maintenance costs. In 2004 SDOT funded "ITS Maintenance" at $250,000 per year. Those funds are used to maintain all of the ITS infrastructure in the city, including the devices deployed by this grant.

CCTV images are posted on the city's traveler information website. The VMS at the Fremont Bridge lets motorists know about bridge conditions. Portable VMS advise motorists of incidents. The cameras in the Montlake area are very popular with the public. The Montlake/Pacific camera is one of those viewed most often. When it went out of service, WSDOT receives many requests to get it back in service.

In addition, King County Metro Transit strongly supports the implementation of TSP.

Cost, Operations and Maintenance

The cost of the project was approximately $2,000,000. The following information on maintenance and life cycle costs is provided for each type of device installed on this project:

- Surveillance Traffic Cameras
  critical life = 8 years
  annual maintenance = $1,500 per camera
  replacement cost = $8,000 per camera

- Emergency Preempt
  critical life = 15 years
  annual maintenance = $680 per intersection
  replacement cost = $8,000 per intersection

- Transit Signal Priority
  critical life = 12 years
  annual maintenance = not available
  replacement cost = $20,000 per approach

- Variable Message Sign
  critical life = 12 years
  annual maintenance = $6,700 per sign
  replacement cost = $40,000 per sign

Architecture and Standards

NTCIP standards were used for the VMS signs and CCTV cameras.

Lessons Learned

The following are the lessons learned on this project:

- Several of these project elements were tied to larger regional projects. The CCTV camera installation was dependent upon Sound Transit's light rail project for the installation of fiber optic cable. The highway advisory radio deployment was dependent on the Alaskan Way Viaduct construction. Dependence on these very large and complicated projects caused significant delays in the deployment of these relatively small ITS project. The project managers indicated that they would not recommend tying similar ITS projects to these larger projects.

- The very broad scope of work made the project difficult to manage. One or two small project elements that are delayed can cause the delay of the entire

project. The project manager advises developing several projects, each with a more focused scope of work.

SPOKANE TRAFFIC OPERATIONS FOR ARTERIALS (ITS-2003(062), 609031Q)

Background

Between 1990 and 2002, the Spokane metropolitan area's population increased by 14 percent to 425,000 people. Congestion has increased proportionately, and as a result, the Spokane area has 46 intersections operating at over 90 percent of capacity and 38 road segments operating at over 80 percent of capacity. By 2025, the number of over-capacity intersections is projected to increase to 135, and the number of over-capacity road segments is expected to increase to 69. Vehicle miles traveled (VMT) in the Spokane area is expected to increase by 63 percent by 2025.

Partly as a result of this congestion, the Spokane area has been designated a non-attainment area by the Environmental Protection Agency for carbon monoxide (CO) and particulate matter smaller than ten microns (PM1). Several of the air pollution "hot spots" are the arterials in the central business district adjacent to I-90 on- and off-ramps. Improved management of these congested arterial corridors is essential to eliminating these air pollution hot spots. Early detection, identification, and management of incidents and improved traffic signal operations are two ways to improve arterial operations. Expanding signal control to more arterials and interconnecting those signals are steps that are necessary to improve operations.

The Spokane Regional Transportation Management Center (SRTMC) was created as a regional partnership to provide area-wide traffic management coverage during peak travel periods to detect, monitor, and respond to incidents, and to share data. The SRTMC was formed in 1998 by agreement between the City of Spokane, Spokane County, Spokane Regional Transportation Council, Spokane Transit Authority (STA), and WSDOT's Eastern Region. The City of Spokane Valley, incorporated in 2003, joined the partnership after incorporation.

Project Description

The intent of this project was to link the existing Spokane Valley traffic signal system to the Spokane Valley City Hall and the SRTMC to improve regional traffic management, arterial traffic signal control, and incident response. Also proposed was extension of the communications system to integrate the City of Spokane Valley with the existing regional system, allowing communications with the SRTMC's central software. In addition, the proposal called for the installation of data stations, closed-circuit television (CCTV) cameras, and variable message signs (VMSs) on arterial roadways in the Spokane area. One final item was to transmit data from transit automatic vehicle identification (AVI) devices (called the TOTE system) to the SRTMC and to link an STA park-and-ride facility to the region communications network.

Description of proposed work in the project application

The project application proposed the following work:

- Link the existing Spokane Valley traffic signal system to the Spokane Valley City Hall and the SRTMC. This was to be accomplished by extending the communication hardware and software to integrate the city into the existing system, thereby allowing communication with the SRTMC central software.
- Integrate three TOTE AVI stations into the SRMTC software.
- Integrate four WSDOT freeway data stations into the SRTMC software.
- Provide a communications link between the Spokane Transit Authority (STA) Plaza in downtown Spokane and an STA park-and-ride facility.
- Install an arterial dynamic message sign (DMS) and integrate it into the SRTMC software.
- Install five arterial CCTVs and integrate those into the SRTMC.
- Install data stations along the Sprague/Appleway couplet and Division Street and integrate the data from these into the SRTMC software.

Description of what was actually deployed

The project actually completed the following work:

- The project extended fiber optic communication to traffic signals in Spokane Valley to connect them to the SRTMC as proposed.

- Fiber optic cable was installed near the STA park-and-ride for a communications link.

- An arterial DMS was installed on westbound Sprague Ave just east of the westbound entrance to I-90 in order to provide route choice for using either westbound I-90 or westbound Sprague Ave.

- Three CCTV cameras were installed:

  - Appleway/Dishman-Mica
  - Appleway/Park
  - Appleway/University

Explanation of the differences (if any)

The remaining items from the application that were not installed (the four freeway data stations, two CCTV cameras, and the arterial data stations) were omitted because the installation costs for the communications link between the Spokane Valley signals and the SRTMC, which was the highest priority component, were a great deal more than had been estimated.

- The number of CCTV installations was reduced from five to three because difficulties were encountered with right-of-way availability in selecting locations. Cost was another issue.

- The four freeway data stations were dropped from the project because the TOTE AVI technology was out of date; essentially money would have been spent to connect fiber communications to something that was of limited use and would have provided data only from vehicles (mostly Spokane Transit Authority buses) that had a transponder. Remote traffic microwave sensors (RTMS) were used to develop the travel map on the Web page.

System Usage and Benefits

The system operates full time. The primary function of the system is incident management and traveler information. It is operated by the staff at the SRTMC.

Cost, Operations and Maintenance

The cost of the project was approximately $825,000. The Eastern Region maintains the equipment.

Architecture and Standards

The applicable NTCIP standards were used on this project.

Lessons Learned

The following are the lessons learned on this project:

- The WSDOT Standard Specifications and Construction Manual only marginally cover the installation and acceptance of ITS materials, so we have a fairly extensive set of Special Provisions we use for ITS projects. After each project, we review how well those Special Provisions worked. During this particular project some fiber turned out to be damaged. It was never clear whether the fiber was bad before it was acquired or something happened during installation. Nevertheless, while we believed that the specifications were clear as to the responsibilities of the Contractor and WSDOT and that the steps and methods of acceptance would have led to identification of the bad fiber at the appropriate time, the Project Engineer executed a change order to participate in paying for fiber replacement. This led us to revise the acceptance specifications in order to prevent a reoccurrence of the problem.

- Better guidance needs to be developed on device selection and deployment and the benefit/cost ratio of each device. How can the benefits of these devices be quantified, particularly the contribution of traveler information delivery to reduced delay?

- State law limits WSDOT's ability to procure ITS equipment and perform ITS work at the lowest possible cost. If an item (such as an RWIS station) is procured by competitive bid, it likely cannot be installed by state personnel because both the equipment procurement cost and the labor cost are added to determine whether the total project costs exceed the limit on state force work. This compels WSDOT to prepare a PS&E bid package and hire a contractor, resulting in a more expensive project.

SEATTLE CITY CENTER ITS (ITS-2004(047)

Background

This city-wide project comprised four elements that were intended to expand and integrate the City of Seattle's existing ITS program. The four elements were as follows:

- SR 519 Freight Mobility Project ITS: This work included enhanced traffic signal operations and advanced/enhanced traffic management, traffic surveillance, traveler information, and communications system enhancements.

- Duwamish ITS Project, Phase 3: This project was intended to deploy various ITS equipment to resolve traffic and rail conflicts in lieu of grade separation of the roadway and rail facilities.

- Traffic Signal Enhancement Program: The goal of this project was to replace outdated traffic signal controllers in the city.

- ITS Strategic Plan Implementation: This project consisted of three elements:

  - Rainier Avenue: The objective of this project element was to replace traffic signal controllers that are part of the Rainier Avenue proprietary signal system with controllers that are compatible with the city's central system. Closed-circuit television (CCTV) cameras would be installed at key locations.
  - 4th Avenue South: This project element was meant to install vehicle detection on the mainline approaches to signalized intersections to allow traffic-responsive operations.
  - Traffic Management Center (TMC) Improvements: The goal of this project element was to enhance some traffic control systems that support TMC operations.

Project Description

Description of proposed work in the project application

The project application proposed the following work:

- SR 519 Freight Mobility Project ITS.

  - Install six CCTV cameras, four variable message signs (VMS), traffic signal control equipment and cabinets, fiber optic communications, and emergency vehicle detection devices.

- Duwamish ITS Project, Phase 3
    - Install VMS and CCTV cameras on Lower Spokane Street, Harbor Island, and the 1st Ave. S. Bridge.
- Traffic Signal Enhancement Program
    - Install new, warranted traffic signals at key ITS Network locations.
- ITS Strategic Plan Implementation
    - Rainier Avenue
        - Replace traffic signal controllers and rewire cabinets.
        - Install CCTV cameras.
    - 4th Avenue South
        - Design and deploy advanced vehicle detection to allow for traffic responsive signal operation.
        - Implement a demonstration radio service.
    - TMC Performance Improvements
        - Install a recording device for CCTV camera images.
        - Install an expansion module for the central control system.
        - Install enhanced processing equipment for the video display system.
        - Install an asset management system.

Description of what was actually deployed

All of the project elements proposed in the original application were deployed except for the new traffic signals proposed in item iii, Traffic Signal Enhancement Program.

Explanation of the differences (if any)

The amount of funding provided was reduced to a level that was insufficient to cover the installation costs of the new traffic signals. The amount requested was $5 million, and the amount actually received was approximately $4.3 million.

System Usage and Benefits

The new equipment is part of existing systems controlled by operators at the Seattle TMC. All devices and systems are operated around the clock.

Seattle Department of Transportation (SDOT) maintains all devices. SDOT is responsible for operations and maintenance costs. In 2004 SDOT funded "ITS Maintenance" at $250,000 per year. Those funds are used to maintain all of the ITS infrastructure in the city, including the devices deployed by this grant.

Additional CCTV camera images added to the SDOT website and awareness of traveler information over the last few years have resulted in the following number of user "hits":

2004 — 2.7 million
2005 — 2.9
2006 — 4.8
2007 — 7.3
2008 — 9.4
2009 — 19.7 million

The camera images are very popular, and SDOT receives "complaints" when one is down for maintenance.

Automated messages related to bridge openings and travel times are displayed on dynamic message signs (DMS).

Cost, Operations and Maintenance

The cost of the project was approximately $4,300,000. The following information on maintenance and life cycle costs is provided for each type of device installed on this project:

- Surveillance Traffic Cameras
  critical life = 8 years
  annual maintenance = $1,500 per camera
  replacement cost = $8,000 per camera

- Emergency Preempt
  critical life = 15 years

annual maintenance = $680 per intersection
replacement cost = $8,000 per intersection

- Transit Signal Priority
  critical life = 12 years
  annual maintenance = not available
  replacement cost = $20,000 per approach

- Variable Message Sign
  critical life = 12 years
  annual maintenance = $6,700 per sign
  replacement cost = $40,000 per sign

Architecture and Standards

NTCIP standards were used on the project.

Lessons Learned

The following are the lessons learned on this project:

- The project was delayed by very slow permit processing from Seattle City Light for the use of luminaire poles to hang fiber optic cable. Permit processing took over 18 months! This put the project about 3 months behind schedule. It is necessary to coordinate with permitting agencies to either speed the granting of permits or to include in the schedule the necessary time for obtaining permits.

- SDOT had to develop some standards for ITS devices that hadn't been installed in the city before. Some design work was delayed because of this. Future projects can take advantage of these standards. If future ITS deployments require standards to be developed, delays should be anticipated.

STATEWIDE TRANSPORTATION OPERATIONS CENTER (ITS-2004(050), 000058Q)

Background

WSDOT's regions operate seven mostly autonomous traffic management centers (TMCs), but there was no capability to collect and store regional data at a central location, nor was there any capability to monitor or coordinate major emergencies or disasters that cross regional boundaries.

Project Description

The center was proposed as a way to improve the ability of the WSDOT emergency operations center to obtain and distribute real-time statewide transportation information to other involved agencies during emergency situations. The goal of this project was to develop systems to monitor and coordinate with other WSDOT offices and partner agencies across Washington during major emergencies and disasters.

Description of proposed work in the project application

The project application indicated that the funding would be used to design, procure elements for, and begin building a statewide traffic emergency operations center.

Description of what was actually deployed

A fully functional statewide emergency operations center (EOC) was built (Figure 4 is a photograph of the center). The center consists of approximately 950 sq. ft. of space divided into an operations room, public information office, situation room, and communications room (Figure 5 is a site plan of the facility). Computer workstations are provided for approximately 40 staff. Analog, digital, and satellite telephone connections are provided to the center. Two 800 MHz radio control stations are provided to allow the EOC to monitor WSDOT and Washington State Patrol (WSP) radio communications. Access is also provided to the WSP computer-aided dispatch system.

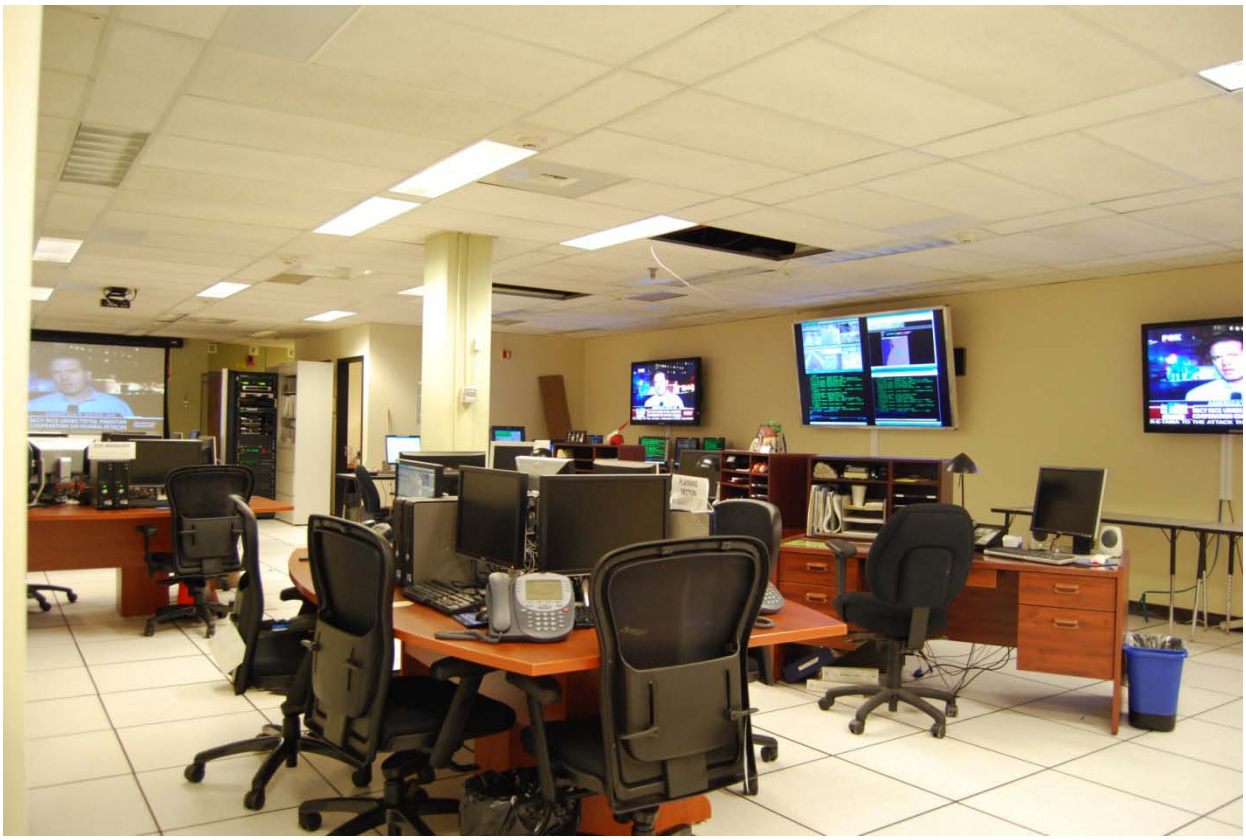

Figure 4. Statewide Emergency Operations Center

The EOC has four large LCD monitors, one 82-inch LCD display with split screen capability, and one 96-inch projection screen with a projector. The system is capable of displaying 16 computer video sources as well as cable TV, satellite TV, TIVO, and output from a DVD/VCR. It can also display forward looking infra-red video from WSP, National Guard, or King County aircraft (Table 3 lists the capabilities of the EOC).

Explanation of the differences (if any)

There were no differences between what was proposed and what was built, other than the facility functions more as an emergency operations center than a traffic management center.

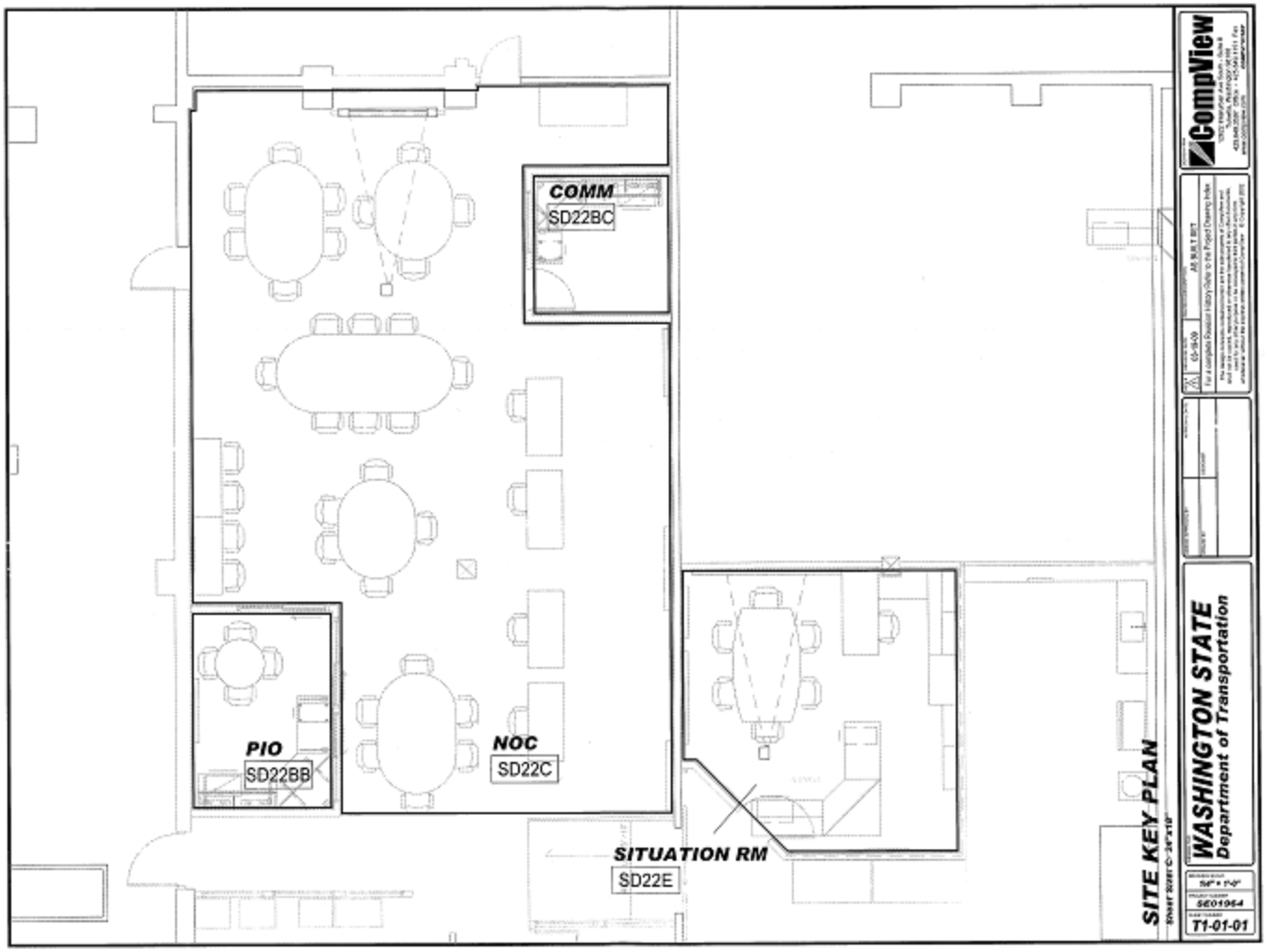

Figure 5. Site Plan of the Statewide Emergency Operations Center

Table 3. Emergency Operations Center Capabilities

- State of the Art Visual Information System
  - 2 57-in. Samsung LCDs
  - 1 82-in. Akira/Samsung LCD
    - Quad split capability
  - 1 96-in. 16:9 Projection Screen w/projector
  - 1 42-in. LCD TV
    - Quad split capability
  - 1 52-in. Akira/Samsung LCD
  - 1 Smart Board 4:3 w/projector
    - 2 TIVO DVR Services
    - 2 Comcast HD DVRs
    - 6 Basic Comcast CTV services
    - 2 Dual tuner Satellite Receivers Dish Network
    - 1 DVD/VHS Recorder
    - Capability to display 16 PC video sources as well as cable TV, satellite TV, TIVO, and DVD/VCR on LCDs and projectors and raw video downlink from Forward Looking InfraRed, WSP, National Guard, and King County
    - 70-v multi-room audio system; 12 speakers throughout facility
    - Wireless microphone system
    - Analog telephone patch into audio system
- Computers and Network
  - 40 + thin client workstations for EOC staff
  - Wireless LAN
  - 146 new data connections and 1000-mbps full duplex switch assigned to EOC
  - HP Plotter (42-in.), HP color laser-jet, Konica Minolta Bizhub Copier/Fax/Scanner, HP2727 Printer/Fax
- PBX and Satellite Phone System
  - 30 Avaya digital telephone system lines and phones
  - 4 Analog POTS lines
  - 1 Skybox NS3 Iridium fix mounted satellite phone
- Radio System
  - 2 800-Mhz WSDOT radios (control stations)
  - Wireless microwave system, 200-mbps pipe
  - Infrastructure in place for future radio over IP (RoIP) WAVE system

Other capabilities include the following:

- ESRI ArcGIS mapping software and high performance computer and monitor

WSP Computer Aided DispatchSystem Usage and Benefits

The system is available around the clock. During non-emergency times the system is utilized for all aspects of emergency management to include preparedness, monthly training sessions, and planning. During declared emergencies full EOC operations are conducted.

Daily operations are handled by WSDOT emergency management staff. Three positions are devoted to emergency management; an emergency manager, coordinator, and specialist. During EOC activation, the center can be occupied by as many as 44 persons from various WSDOT sections, the Washington State Patrol, and the Federal Highway Administration.

The center is maintained by WSDOT Office of Emergency Management staff. State funds from both the Maintenance Program and the Office of Information Technology are used for operations and maintenance of the facility

Cost, Operations and Maintenance

The total project costs were approximately $250,000. Operations and maintenance costs are estimated to be approximately $100,000 per biennium.

Architecture and Standards

Center to Center (C2C) communications standards were used on this project.

Lessons Learned

The following problems occurred during implementation:

- During construction, the original location was determined to be inappropriate. This change in location increased the budget and delayed the project.
- Unfortunately, the current facility is not in compliance with seismic standards. A redundant facility is maintained to compensate for this, in the event that an earthquake takes the primary EOC out of service.

- The main lesson learned was that a more thorough needs assessment for EOC operations, conducted prior to developing the project scope, would have improved project delivery. As mentioned in other evaluations of ITS earmark projects, the schedule for submitting requests for earmark funds and the uncertainty of obtaining the funds preclude a comprehensive needs assessment, scoping, or preliminary design process. Fortunately, this method of funding ITS project has been discontinued.

I-90/SNOQUALMIE PASS VARIABLE SPEED LIMIT (ITS-2004(052), 509043Q)

Background

I-90 is the primary east-west route across the State of Washington. It connects the Seattle metropolitan area with the eastern parts of the state and the rest of the nation. The highway passes through the Cascade Mountains approximately 50 miles east of Seattle. This mountain pass, called Snoqualmie Pass, is notorious for bad weather, resulting in a high winter accident rate. In 1997, one of the few variable speed limit (VSL) systems in the nation was installed on the western approach to Snoqualmie Pass to try to improve roadway safety. The VSL system has been very effective in making vehicle speeds more uniform and reducing accidents.

Project Description

This project was intended to upgrade and expand the central software that operates all of the existing VSL signs. A new operating system would replace one that is obsolete and it would allow remote operation from other traffic management centers, such as the Yakima traffic management center (TMC) and the Statewide Traffic Operations Center in Olympia, in addition to the Hyak traffic operations center (TOC) at the maintenance facility at Snoqualmie Pass. Another goal of this project was to extend the VSL zone to cover the east approach to the Pass.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Deploy four static "SPEED LIMIT" signs that consist of a small VMS that can display two numbers. These signs would be located after the on-ramps from the Cabin Creek and Stampede Pass interchanges.
- Upgrade the central system that operates all of the existing variable message signs that are used for the VSL system. Connect the system to the Yakima TMC so it can be remotely controlled from there.

- If sufficient funding is available, install new radar detectors to replace the inadequate ones installed originally.

Description of what was actually deployed

This project deployed the following equipment:

- Two full matrix, walk-in style variable message signs were installed on mono-tube cantilevers.

Explanation of the differences (if any)

WSDOT Bridge Design would not approve a much less expensive cantilever support for the smaller speed limit signs that were originally proposed. Because of this, only two signs were installed. Funding was also insufficient to replace the existing control system; however, it will be replaced by another project in 2010. There was insufficient funding to replace the radar detectors.

System Usage and Benefits

The addition of two VMSs in this project enabled WSDOT to expand the variable speed zone 9 miles to the east, from milepost 61 to milepost 70. The two new VSL signs are operated by a separate sign control software system from either the Yakima TMC or Hyak TOC. This will change when the existing control system is replaced in 2010. The system is in operation around the clock.

WSDOT South Central Region Maintenance and Traffic Operations personnel maintain the system.

Cost, Operations and Maintenance

The project cost was approximately $751,000. The service life of the VMS is about 20 years. Annual maintenance is about $5000 for each VSL sign.

Architecture and Standards

The project used the applicable NTCIP standards.

Lessons Learned

The following were the lessons learned on this project:

- Locate the sign controllers in a place that is easy for maintenance technicians to access.

- The project scope was based on the assumption that small speed limit signs could be mounted on traffic signal-style cantilever supports. When this was rejected by bridge design engineers, the extra expense of bigger equipment affected the budget and schedule. Working in advance with the bridge designers to determine whether they would approve a more economical design, if there had been enough time before the proposal deadline, could have helped with the development of a more accurate scope. If more installations of this type are likely, it would be worthwhile to work with the bridge designers to produce a more economical, standard VSL sign support system.

VANCOUVER ATMS (ITS-2004(056), 400541Q)

Background

The Vancouver Area Smart Trek (VAST) project is a regional transportation management and traveler information effort covering the Vancouver, Washington/Portland, Oregon, metropolitan area. It involves WSDOT, Oregon Department of Transportation (ODOT) and several county and city transportation management and planning agencies.

WSDOT's effort is led by the Southwest Region Traffic Operations office, which operates a traffic management center in Vancouver that is co-located with the Washington State Patrol's dispatch center.

ODOT uses a version of advanced traffic management system (ATMS) software originally called "Navigator" developed for Atlanta, Georgia. ODOT calls the version used in the Portland area the "TransPort" system. The next generation of this system is the Transportation Operations Center System (TOCS).

WSDOT's Southwest Region is using a TransPort-based system for traffic management in the Vancouver area to facilitate seamless movement for commuters and others traveling in the bi-state metropolitan area. The WSDOT system is a client connected to the ODOT server via a fiber optic connection. When the TOCS's operating system is converted to a Windows-based platform with an SQL database, then WSDOT will get its own TCOS server.

Project Description

WSDOT wanted to improve traffic management coordination for travelers crossing the Washington/Oregon border and moving within the Vancouver/Portland metropolitan area. Communications between WSDOT and ODOT were inconsistent and not very timely, which affected the management of incidents and special events. This project was designed to develop an integrated and interconnected ATMS to provide

seamless traffic management throughout the metropolitan area. It was intended to develop an operating agreement, develop a process for achieving seamless operation, and implement a system that could accomplish this.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Expand the current Navigator-based TransPort ATMS software to provide the following:
  - Integrated computer aided dispatch (CAD)
  - Integrated communications and support with external emergency service providers
  - Support for regional transportation operations and maintenance
  - Improved traveler information via VMS, HAR, and the Internet.
- Replace components of the existing TransPort ATMS software with components that are more standard, cost effective, and better supported.

Description of what was actually deployed

The following work items were actually deployed:

- Computer Aided Dispatch (CAD): Integrated the Page Gate application (a database of traffic management personnel and stakeholders) into the ATMS. This application is used to contact and communicate with incident responders, partners, and customers (via text messaging, paging, or email).
- Event Management: Designed a module within ODOT's TOCS to support special event management by consolidating stand-alone systems, devices, and processes into one user interface. This provides enhanced communication, more complete information, and immediate dissemination to ODOT customers and partners (public and private).
- Traffic Management: Integrated the ATMS into the TOCS to support traffic management devices and systems that collect data, disseminate information, and respond to various traffic conditions.
- HAR Integration: The Southwest Region participated in the development and testing of WSDOT's Networked HAR project (a separate ITS earmark project), and WSDOT adopted and implemented this product in the summer of 2007. Under this ATMS project, modifications were made to field equipment

and other systems to integrate them into the networked HAR system. This new HAR control system will eventually be integrated into a future module of the TOCS to allow shared WSDOT / ODOT HAR device control.

- TransPort ATMS Platform Upgrade: Upgraded the current ODOT TransPort ATMS operating system from the Solaris 2 platform to Solaris 10, upgraded the current TransPort ATMS database from Oracle to Microsoft SQL Server, and performed other commercial off-the-shelf (COTS) and support software upgrades. Moving to SQL was a first step in migrating to a Microsoft operating system, a goal that is included in the TOCS development plan. All existing applications will be upgraded to provide the same functional capability on the new platforms.

- TransPort ATMS Functionality Enhancement: This upgrade provided WSDOT with the ability to fully utilize the ATMS incident response plan for the Southwest Region and will allow database updates for WSDOT's specific information and devices. Also, WSDOT is able to integrate specific incident response information into the ODOT ATMS database, add new WSDOT-specific devices to the system database through the current client-server connection, and run and print daily reports at the WSDOT TMC.

- GIS Data and Additional Extended Area for User Interface System Regional Map: Enhanced and extended the transportation system map and added additional layers of GIS information.

Explanation of the differences (if any)

The work elements in the proposal were fairly general descriptions of enhancements to the current ATMS. The specific work items listed above contributed to the achievement of these general goals. The CAD system was integrated into the ATMS, and the other work improved regional communications, operations, and the provision of traveler information. The platform upgrade moved much of the ATMS to more standardized and better supported software.

System Usage and Benefits

The system is operated by WSDOT and ODOT traffic safety system operators located at the WSDOT and ODOT TMCs. It is in use around-the-clock. The ATMS and associated database are maintained by WSDOT's Region ITS Operations Engineer and ITS Applications Engineer and ODOT's ITS Architect.

The system is deployed via a Client/Server connection from ODOT's District 1 TMC to WSDOT's TMC. At this time, ODOT hosts a SUN server that runs the ATMS Transport application, which WSDOT and ODOT clients connect to with an XWindows application called Exceed Hummingbird. ODOT is in the process of eliminating the SUN server portion of its system and moving toward a Windows-based program. At that time WSDOT will consider establishing a replica of ODOT's server on a server of its own.

The ATMS and its operating system are very stable, and there is very little down time. It has powerful capabilities for event and incident management. It allows timely messages to be posted to the Region's VMSs, and it provides other travel and incident information to the traveling public.

The system currently has some inconvenient features, and WSDOT is evaluating whether to work to eliminate these or wait until the TOCS development effort is complete. For example, the database entry is initially very labor intensive to implement and update.

Cost, Operations and Maintenance

The project cost approximately $425,000 to implement.

Architecture and Standards

All pertinent NTCIP standards were part of the design criteria.

Lessons Learned

The following lessons were learned on this project:

- The project managers would like to have been more involved in the tracking and monitoring of the progress of ODOT's TOCS project. This was made difficult by the fact that ODOT wanted to keep much of that information inside its organization.

- Bi-state or multi-agency projects can have many challenges. Individual agency policies, differing goals or expectations, and various other differences can sometimes create control problems and make it difficult to find consensus.

Fortunately, this project had some well intentioned individuals who wanted to work together and find mutually acceptable solutions to the problems that inevitably arose during the project. Also very beneficial, and strongly recommended for similar partnerships, was to have Bi-State/Intergovernmental Agreements drawn up and in place describing the various expectations and responsibilities for the project.

PUGET SOUND TRAFFIC MAP EXPANSION PROJECT—NORTHWEST REGION (ITS-2005(033), PIN 100011Q

Background

The WSDOT Puget Sound Traffic Map is an Internet-based traveler information system that provides congestion information to motorists traveling in the central Puget Sound region. Most of the existing information covers the region's freeway system, particularly the Interstate highways. There is very little information on the major arterial roadways such as SR 18 and SR 522. No projects were programmed in the near future to remedy this situation.

Project Description

The purpose of this project was to obtain data on traffic congestion for some of the major arterial roadways in the central Puget Sound region and to deliver that information to the public via the Puget Sound Traffic Map.

Description of proposed work in the project application

The following work items were proposed in the project application:

- SR 18 from Auburn to I-90
  - Extend the communications system from SR 167 to SR 164.
  - Install data stations, ramp meters, CCTV cameras, VMS, HAR, and other ITS devices in the vicinity of the City of Auburn.
  - Install data stations and CCTV cameras at key interchanges between SR 164 and I-90 and at Tiger Mountain summit.
  - Provide connectivity to the City of Auburn arterials.
- SR 522 from the I-405 vicinity to the Woodinville-Duvall Interchange
  - Install a communications system, data stations, ramp meters, and CCTV cameras at the SR 202 interchange.

- Install a communications system, data stations, ramp meters, and CCTV cameras at the Woodinville-Duvall interchange.
- Provide connectivity to the City of Woodinville arterials

- SR 5 near Everett and Marysville
  - Add data stations and CCTV cameras.

Description of what was actually deployed

The following work items were actually deployed:

- SR 18:
  - Loop detectors (data stations) were installed at MP 4.09 and 4.25.
  - CCTV cameras were installed at MP 3.69 and 4.21.
  - A road/weather information station (RWIS) was installed at MP 3.66.
  - 7,400 feet of 4-inch conduit and fiber optic cable were installed from MP 2.84 to 4.26.
- SR 522:
  - 6000 feet of 4-inch conduit and fiber optic cable were installed from MP 11.00 to 12.00.
  - 12000 feet of 4-inch conduit and fiber optic cable were installed from MP 12.00 to 14.10.

Explanation of the differences (if any)

No ramp meters, VMS, or HAR were installed on either SR 18 or SR 522. This was because of the need to install expensive communications infrastructure in these corridors. The project elements proposed for installation on I-5 were installed as part of another project that extended the I-5 HOV lanes to the north.

System Usage and Benefits

The data from the detectors are sent to the Region TMC in Shoreline over the Region's fiber optic cable system. From there the data are used to display congestion

information on the WSDOT Puget Sound Traffic Map website. The data from the deployed components are available around the clock, every day of the year, as long as the data stations are working. The data from Section 2, on SR 522, will be available in the summer of 2010.

Cost, Operations and Maintenance

The project cost approximately $2,100,000 to implement. No additional maintenance or operations staffing was provided for this project. The incremental maintenance and operations costs will be absorbed by current staff.

Architecture and Standards

All relevant NTCIP standards were used on this project. King County and the cities of Auburn, Kirkland, and Woodinville participated by providing information about their current ITS system architecture and ITS plans to ensure future connectivity and interoperability.

Lessons Learned

The following lesson was learned on this project:

- This project attempted to fill in widely separated gaps in the Puget Sound Traffic Congestion Map. To do that required some creative incorporation of the work into projects that were widely separated both geographically and in time. This helped the budget but negatively affected the schedule. It did, however, improve the project by allowing more work to be accomplished than would have been possible if the effort to coordinate with projects already in the pipeline had not been made.

PUGET SOUND TRAFFIC MAP EXPANSION PROJECT— OLYMPIC REGION (ITS-2005(033), 300001Q)

Background

The WSDOT Puget Sound Traffic Map is an Internet-based traveler information system that provides congestion information to motorists traveling in the central Puget Sound region. There is a big gap in coverage (i.e., a lack of traffic detectors) in the area north and south of the King/Pierce County border. The area north of the county border lies in WSDOT's Northwest Region and the area south of the border lies in the Olympic Region. There were no projects programmed in the near future to remedy this situation.

Project Description

The purpose of this project was to extend the coverage of, and fill gaps in, the Puget Sound Traffic Map. The project accomplished this by installing data collection stations that use side-fire radar detectors. The additional data stations would eliminate the gaps on the Puget Sound Traffic Map Web page on I-5 between Seattle and Tacoma. They would also extend the coverage of the map on I-5 to the south to the Berkeley Interchange and on SR 512 to Pacific Ave.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Install traffic data detectors (loops, radar detectors, or video detectors) and the associated roadside cabinets at the following locations:
  - I-5 northbound and southbound
    - MP 139.12 (Porter Way Bridge)
    - MP 138.55 (Ardena Road Bridge)
    - MP 137.50 (SR 99 Bridge)
    - MP 135.40 (Puyallup River Bridge)
    - MP 134.07 (McKinley Way Bridge)
    - MP 129.57 (72nd Street Bridge)
    - MP 127.28 (SR 512 Bridge)
    - MP 125.92 (Bridgeport Way Bridge)

        - MP 125.29 (New York Avenue Bridge)
        - MP 124.70 (Gravelly Lake Drive Bridge)
        - MP 123.64 (Thorne Lane Bridge)

    - SR 512 Eastbound and Westbound

        - MP 0.63 (Steele Street Bridge)
        - MP 1.22 (Ainsworth Bridge)
        - MP 2.22 (SR 7 Bridge)
        - MP 3.00 (Near Golden Givens Bridge)
        - MP 3.71 (Portland Avenue Bridge)

- Install approximately 1.06 miles of fiber optic cable from Gravelly Lake Drive to Thorne Lane.

<u>Description of what was actually deployed</u>

The following work items were actually deployed:

- Detector installations (see Figure 6, vicinity map):

    - Ten data stations were installed on I-5 at the following locations (each data station consists of two side-fire radar detectors, one each for northbound and southbound):

        - MP 138.73 (Porter Way VMS)
        - MP 137.47 (54th Ave. CCTV)
        - MP 130.68 (56th Street)
        - MP 129.62 (72nd/74th Street)
        - MP 128.11 (96th Street)
        - MP 126.65 (Lakeview Maintenance)
        - MP 125.80 (Bridgeport Way)
        - MP 125.21 (New York Ave.)
        - MP 124.61 (Gravelly Lake)
        - MP 123.60 (Thorne Lane)

    - Two data stations were installed on SR 512 at the following locations:

        - MP 0.65 (Steele Street)
        - MP 2.21 (SR 7 Interchange)

- The fiber optic cable was installed as proposed.

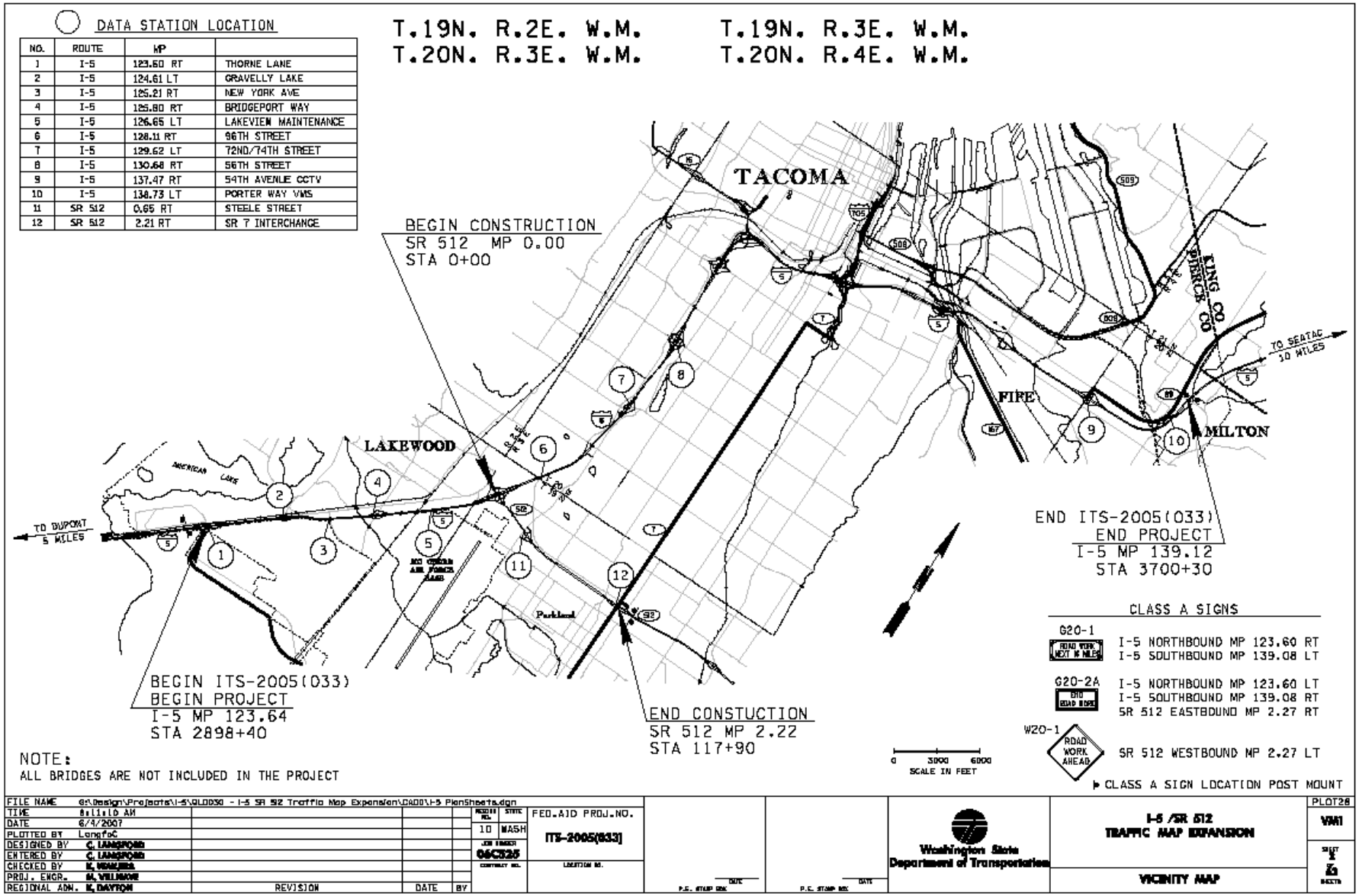

Figure 6. Vicinity Map

Explanation of the differences (if any)

On I-5, the data stations planned for installation within the limits of the project to construct HOV lanes from Mckinley Way to Ardena Road were not installed because an HOV project would install them within a year.

The original locations of the remaining proposed data stations were approximately one mile apart, farther apart than desirable. Because the number of data stations was the same as proposed but there were fewer miles to cover, the locations of the remaining data stations could be adjusted to provide approximately ½-mile spacing for better coverage.

Only two data stations were installed on SR 512 instead of the five proposed. The design process showed that installing data stations at the other locations along SR 512 would affect wetlands, and the project could not afford to mitigate those impacts. Therefore, those data stations were dropped from the project.

The application proposed detector coverage of 15.48 miles of I-5 and 3.08 miles of SR 512. The actual detector coverage was 15.13 miles of I-5 and 1.56 miles of SR 512. The actual installation, however, had a 7-mile gap in coverage at the north end of the project that will be filled by a subsequent project.

System Usage and Benefits

The data from the detectors are sent to the Tacoma TMC in Parkland over the Region's fiber optic cable system. From there the data are used to display congestion information on the WSDOT Puget Sound Traffic Map website. The data are available around the clock, every day of the year, as long as the data stations are working. The Tacoma part of the Puget Sound Traffic Congestion Map gets an average of 150 to 200 views per day. This can increase to as much as 1,000 views when the public is notified of an incident or during poor weather conditions.

Cost, Operations and Maintenance

The project cost approximately $732,000 to implement. The life cycle of the side-fire radar detectors is estimated to be 10 years. Maintenance is expected to consist of one inspection of each detector per year. Since the detectors are side-fire radar detectors, they can be installed along the roadside on poles. That means that they do not require road closures for maintenance. They can also be easily adjusted in the event that the lanes are shifted as a result of road construction.

Architecture and Standards

All pertinent NTCIP standards were part of the design criteria. A system engineering approach was used to determine the best type of detection system for this application. The detection methods that were considered were induction loops, video, and two types of side fire radar detectors. Ease of maintenance, ease of working with the data, and cost were some of the factors that determined the type of equipment.

Lessons Learned

The following lessons were learned on this project:

- This project used the Olympic Region's existing fiber optic communications system to bring the data from the field to the TMC. A small amount of fiber was installed to connect the data stations to the existing fiber. Having the communication system already in place made it easy to add additional equipment.
- Wetland impacts affected the scope of the project. Knowing that these sensitive areas were present within the project limits and likely to be affected by the installation of the detectors during the preparation of the project application would have resulted in better alignment between what was proposed and what was actually installed.

TRAVELER INFORMATION SYSTEM SEATTLE (ITS-2005(042)

Background

Offering the City of Seattle Traffic Information website is one of the key strategies identified in the city's ITS Strategic Plan. It takes advantage of infrastructure being implemented to improve traffic operations and the high level of Internet connections in the region to provide pre-trip information on traffic congestion about key city arterials via the Internet.

Project Description

This project was designed to integrate the Seattle Department of Transportation's (SDOT's) website with WSDOT's Puget Sound traffic conditions website and provide Seattle area commuters with new information to help them make better travel decisions. Bus lane congestion information on Aurora Avenue North would also be provided in order to facilitate mode choice for many that use that route. The city has installed closed-circuit television (CCTV) cameras along many of its key arterials, and images from those cameras were to be provided on the website.

The city ultimately wants to provide information on all major arterial roadways on the website. Unfortunately, adequate field devices are not yet in place to accomplish that. This project funded Phase 1 of the traveler information effort, which included about 80 percent of the strategic ITS network identified in the Strategic Plan. The project included funding for devices to collect arterial congestion data, but the majority of the congestion data was provided by the Mobility Technology Traveler Information Project, which is a public/private partnership funded by a federal program to encourage the installation of traffic detectors and the display of traveler information.

Description of proposed work in the project application

The following work items were proposed in the project application:

- Traffic detection
  - Install two types of detection: system loops and the radar detection that is part of the Mobility Technologies project.
  - Integrate existing system loops into the data collection system for the website.
- CCTV cameras
  - Install additional CCTV cameras and integrate existing CCTV cameras into the system.
- Servers
  - Install two new servers: one to gather the Mobility Technologies radar detector data and one to process the raw field data from the system loops and the radar data and process them for display on the Web page.
- Software
  - Develop software to "clean" the raw detector data.
  - Develop two new algorithms to make the data ready for display on the Web page: one to process volume/occupancy data and one to process speed data from Rainier Avenue.
- Web design
  - Develop a website to present congestion data and CCTV images.
  - The website will also include bus-lane congestion data for Aurora Avenue N.
  - The website will be integrated with the WSDOT website and the King County Metro Transit website.

Description of what was actually deployed

All of the items listed in the original scope of work were deployed except for the system loop detectors that were not installed.

Explanation of the differences (if any)

The SDOT central traffic signal system is not able to archive real-time traffic data from loop detectors. As a result, no useful traveler information would result from an effort to install system loops and feed those data into the central system. Instead, wireless magnetometers were installed for use as system detectors. These data are combined with the data provided by the Mobility Technologies' radar detectors (mentioned in the description of proposed work) to provide the congestion information displayed on the city's Web page

System Usage and Benefits

System operation is shared by SDOT, Seattle Department of Information Technology, and Seattle Public Utilities. It is in use around-the-clock. These three agencies maintain the system.

Field data from the Mobility Technologies detectors are gathered via an XML data stream and stored in an Oracle server. Field data from the magnetometers are also sent to an Oracle table. An algorithm converts the data to congestion threshold values; the data are stored in ArcSDE format and are then sent to a web services server. Finally, the data are sent to the public via a Web presentation server that displays camera images and congestion indicators on a map.

The site was launched in April 2009. The following are the number of "hits" to the SDOT camera page over the past 6 years. The camera images are now included on the traveler information Web page that this project developed. The number of hits more than doubled after this Web page was launched in 2009.

2004 — 2.7 million
2005 — 2.9
2006 — 4.8
2007 — 7.3
2008 — 9.4
2009 — 19.7 million

SDOT has received plenty of positive feedback regarding the website. When some cameras are off-line for any reason, the public is quick to provide comments. Requests to add more cameras and streets to the Web page are frequently received. A few neighborhood blog sites have prominent links to the SDOT website.

A survey of users was placed in the Department of Transportation Page on the City of Seattle web site (http://www.seattle.gov/default.htm) in December 2010. This survey asked about customer's satisfaction with the traffic map.

One hundred and fifty-four people responded to the survey. The initial section of survey established how the respondents accessed the site and traffic information. When asked how they located the traveler's information maps the response where as follows:

- link from WSDOT (http://www.wsdot.gov/) 29%
- link from City of Seattle (http://www.seattle.gov/) 41%
- link from local online media (television, newspaper, blog) 16%
- other source 25%. The most common other source of access to the information was through Google.

Other sources used to provide information about Seattle traffic included:

- television (51%)
- radio (54%)
- newspaper (print or online) (33%)
- blogs (21%)
- other source (28%)

The survey next explored how the respondent used the travel time information. Forty percent changed their route based on the information that was available; 20 percent did not. Forty-one percent expressed other opinions (see Appendix D, page D.14).

When asked if they have ever relied on this information to plan a trip, but found the conditions to be significantly different while traveling, 55 percent did not find any notable differences, 21 percent did and 24 percent noted in comments (see Appendix D). Most respondents viewed the construction and travel alerts on the website. They

indicated their experience navigating the page was easy (41%), adequate (33%) or needed improvement (26%). Most liked the ability to look at the view from multiple cameras (86%) and indicated the camera usually (54%) or always (6%) pointed in the direction they were interested in.

The complete survey results and narrative response can be found in Appendix D.

Cost, Operations and Maintenance

The project cost approximately $1,400,000 to implement.

- Wireless Detection
  critical life = 8 years
  annual maintenance = $1,725
  replacement cost = $11,000 per approach

Architecture and Standards

ITS database and data formatting standards were used.

Lessons Learned

The following lessons were learned on this project:

- SDOT was not aware that real-time detector data could not be retrieved from its central traffic signal system software. When the project scope of work is being developed, data sources should be carefully assessed to determine whether they will fit the needs of the project.

- The scope of work, schedule, and budget were carefully tracked throughout the project. As a result of some cost savings, SDOT was able to add additional features to the website congestion map. Without this careful tracking of expenses, this additional work would not have been possible.

APPENDIX A: INTERVIEW/QUESTIONNAIRE TEMPLATE

A. Project Background

   a. Describe your position

   b. How were you involved with this project?

   c. What were the primary issues that prompted the development of this project?

   d. What were the primary objectives of this project?

   e. Were there other participants in this project besides WSDOT?

      i. What were their roles in the project?

   f. What was the approximate cost of the project?

   g. Do you have any information on operating, maintenance or life-cycle costs?

B. System Features

   a. What existed before?

      i. If something existed, how was it incorporated into the new system?

   b. What was originally planned to be built?

   c. What was actually built?

C. System Operations

   a. How is the system used?

   b. Who uses it?

   c. How often is it used?

   d. Who operates and maintains the system?

   e. What levels of staff support and funding are required for O&M?

D. System Usefulness

    a. Does the system meet its original objectives?

    b. Are all parties satisfied with the system?

    c. What are the strengths and weaknesses of the system?

        i. Was anything done to improve the weaknesses?

E. Public Response

    a. Does the public have access to system?

        i. If so, are data available on usage?

    b. Have there been any comments from the public concerning the project?

F. Project Management

    a. Have there been any project management issues that affected the scope, budget or schedule?

        i. If so, what are they?

    b. Was the project completed on time and within budget?

        i. If not, why not?

    c. Were any ITS standards used on the project?

    d. Was the ITS architecture used in the planning, development or deployment of the project?

G. Lessons Learned

    a. Is there anything you would have done differently on this project?

    b. Are there any suggestions for those considering future projects of this type?

        i. Is there anyone else that we should interview about this project?

APPENDIX B: PREVIOUS EVALUATIONS OF THE WSDOT ROAD AND WEATHER INFORMATION SYSTEMS PROGRAM

Boon, C.B., and Cluett, C. March 2002. *Road Weather Information Systems: Enabling Proactive Maintenance Practices in Washington State*. Washington State Department of Transportation. WA-RD 529.1

Cluett, C., Kitchener, F., Frevert, B., and Conger, S. November 2003. *Evaluation of Rural ITS Information Systems along U.S. 395, Spokane, Washington.* U.S. Department of Transportation ITS Joint Programs Office, Report 13955.

Senn, L., and Boselly, E. *ARROWS Evaluation*. February 2005. Washington State Department of Transportation. WA-RD 608.1

APPENDIX C: FEATURE SETS*

1.1 Feature Sets: The following is a list of features that have been developed and approved by the personnel from the traffic management centers of the six WSDOT regions. The feature sets are categorized in the following areas:

- Messaging
- Scheduler
- Status
- Logs
- Maps
- Beacons
- Security, Site and System
- Software
- Hardware

Each of these is explained below.

1.1.1 Messaging

1.1.1.1 Features such as stop, pause, playback, delete, import, append, cut, paste, copy, convert, rewind and fast-forward. In message preparation, the operator should be able to use software controls that are similar to those on any standard cassette recorder.

1.1.1.2 Text to speech software, concatenated synthesis. Use of text to speech would allow consistent audio to be delivered to each HAR. There are unique Native American location names in Washington state; the speech engine shall pronounce these names correctly. Hyphenation, misspelling, or any distortion of the actual spelling of the names will not be allowed. New names added to the library shall be available to each operator.

* Note that this is an edited version of the original that was provided to vendors.

1.1.1.3 Automatic message assembly and activation by various sensory inputs (third party generated text files). This function, used in conjunction with text to speech software, would allow messages to be automatically sent to the appropriate HAR. The placement of the message at the appropriate HAR should be automatic, with or without operator assistance. In all instances, the operator shall be allowed override capabilities.

1.1.1.4 Uniform library based on repetitive incidents. The library database shall be structured for ease of message preparation and editing. The library shall be manipulated from sources such as a relational database or any other means to provide consistency. The library will allow for the addition of new messages and the editing or deletion of any message.

1.1.1.5 Multiple message combining. Allows different events to be grouped together. The system shall allow the combination of messages of different content that can be sent to an associated HAR.

1.1.1.6 Message multicasting. Allows broadcast of the same message over multiple selected HARs (Amber Alerts). The system should be able to send the same message to a selected number of HARs simultaneously. The addition or deletion of a HAR from the selection shall be possible.

1.1.2 Scheduler

1.1.2.1 Automatic station ID. As required by the FCC, all HARs will be identified by their call sign at half-hour intervals beginning at the top of the hour. This identification message should be generated by a device at the HAR or by a system function. It should not interfere with the message broadcast. A voice ID should be an option.

1.1.2.2 Extended calendar for advance scheduling. The system shall include an intuitive calendar that is the system calendar at each workstation which allows the scheduling of a date and time for messages to be broadcast.

1.1.3 Status

1.1.3.1 Current message being broadcast. The system shall have the capability of showing the current message being broadcast on the selected HAR.

1.1.3.2 Real-time HAR operational status. The condition of the HAR should be able to be assessed by some method. Operational checks would be performed to determine such things as transmitted or reflected power, condition of the charging source, whether the cabinet door is open, etc.

1.1.3.3 Deactivation of any HAR when not in use and seamless reactivation. Individual HARs should be capable of being turned off by the TMC operator. In the event of a loss of audio, creating a dead carrier, the deactivation of the HAR should be automatic when the transmitter is on for over 30 minutes to adhere to FCC regulations.

1.1.3.4 Actual broadcast message monitoring in TMC. The TMC should be capable of monitoring the actual message being broadcast.

1.1.4 Logs

1.1.4.1 Historical archiving of messages, operational events, user access, etc. The system should allow pertinent information to be saved for further use. Such record keeping should allow for the verification of the message transmitted by a particular HAR at some specified time. Additional information, such as user access and whether the log was turned on or off, should also be available.

1.1.4.2 Historical archiving of technical status of individual HARs. The system should archive any additional functions that would provide a history of the HAR performance or any recorded failures.

1.1.5 Maps

1.1.5.1 Region map showing HAR and beacon locations. Each of the six regions should have a scalable map showing the locations of each HAR and its associated beacons.

1.1.5.2 Mouse-over showing text box of exact HAR station and beacon location and status. Each workstation in the system should be capable of showing the status of a particular HAR by simply running the mouse over the location on the screen.

1.1.5.3 Click-on for HAR station control, programming and scheduling. Each workstation in the system should, when the mouse is clicked on a particular site, bring up a menu to use for programming and other functions.

1.1.5.4 Regional interactions and monitoring of other regions. The system should provide for interaction with other regions as well as a centralized WSDOT point to be determined. This will allow data sharing. This interaction shall not be disruptive when used for informational purposes. The ability to control one region's HARs from another shall be available. This will allow flexibility when using the HARs during an emergency.

1.1.6 Beacons

1.1.6.1 Beacons should be able to be controlled independently, as a group, or tagged to a schedule or message. Flexibility in beacon activation should be available.

1.1.6.2 Transmitting operational status. The system should be able to monitor certain functions of a beacon, such as the loss of power, malfunction of lights, etc.

1.1.7 Security, Site and System

1.1.7.1 Site security monitoring and reporting of unauthorized intrusion. The system should have a feature that can send alarms to the TMC in the event of an unauthorized entry.

1.1.7.2 Password access for operational and technical control, level dependent. The system shall provide level-dependent access.

1.1.7.3 Encryption requirements if IP protocol used. Vendors shall provide detailed information, if available, on how to provide proper protection of the system from outside access.

1.1.8 Software

1.1.8.1 Operates in standard Microsoft Windows environment. The system shall operate using Microsoft Windows 2000 and Microsoft Windows XP

1.1.8.2 User defined screen configurations. The system should allow individual operators to configure screens for things such as color, size, etc., according to personal preferences.

APPENDIX D

TRAVELER INFORMATION SYSTEM SEATTLE

SURVEY

WebQ

Traveler's Information Map

Summary Build Results Preview

View Statistics

Back to results

Total submissions: 154

Multiple choice - multiple answers (check)

Question

How did you locate the Traveler's Information Map?

Total responses (N): 136 Did not respond: 18

Numeric value	*Answer*	*Frequency*	*Percentage*
1	link from WSDOT (http://www.wsdot.gov/)	39	28.68%
2	link from City of Seattle (http://www.seattle.gov/)	55	40.44%
3	link from local online media (television, newspaper, blog)	21	15.44%
4	other source	33	24.26%

Multiple choice - multiple answers (check)

Question

What other sources provide information to you about Seattle transportation?

Total responses (N): 136 Did not respond: 18

Numeric value	*Answer*	*Frequency*	*Percentage*
1	television	69	50.74%
2	radio	73	53.68%
3	newspaper (print or online)	45	33.09%
4	blogs	28	20.59%
5	other source	37	27.21%

Short response

Question

Describe how you use the travel time information.

Total responses (N): 111 Did not respond: 43

Multiple choice - one answer (button)

Question

Based on the travel time information that is available, have you changed your route?

Total responses (N): 133 Did not respond: 21

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	53	39.85%
2	no	26	19.55%
3	Please explain:	54	40.60%

Multiple choice - one answer (button)

Question

The Traveler's Information Map lists construction and travel alerts on the right side of the Web page. Do you rely on this information when planning your travel within Seattle?

Total responses (N): 132 Did not respond: 22

Numeric value	*Answer*	*Frequency*	*Percentage*
1	daily	12	9.09%
2	often	29	21.97%
3	occasionally	68	51.52%
4	not at all	23	17.42%

Multiple choice - one answer (button)

Question

Have you ever relied on this information to plan a trip, but found the conditions to be significantly different while traveling?

Total responses (N): 132 Did not respond: 22

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	28	21.21%
2	no	73	55.30%
3	please describe	31	23.48%

Multiple choice - multiple answers (check)

Question

Which route travel times do you most frequently use?

Total responses (N): 77 Did not respond: 77

Numeric value	Answer	Frequency	Percentage
1	15th Ave NW @ NW 85th St to . . . • Capitol Hill via Denny Way • I-5 SB via Denny Way • Interbay • Lower Queen Anne • Seattle Center	22	28.57%
2	15th Ave W @ N End of Ballard Br (Leary to . . . • Crown Hill)	7	9.09%
3	15th Ave W @ S End of Ballard Br (Emerson to . . . • Capitol Hill via Denny Way • I-5 SB via Denny Way • Lower Queen Anne	15	19.48%
4	1st Ave S @ Edgar Martinez Dr S to . . . • Boeing Field via East Marginal • Georgetown	9	11.69%
5	1st Ave S @ S Lucile St to . . . • Boeing Field • Stadiums	10	12.99%
6	35th Ave SW @ SW Snoqualmie St to . . . • 1st Ave Off Ramp • 4th Ave Off Ramp • I-5 NB/SB • SR-99 Off Ramp • Stadiums via 1st Ave • Stadiums via 4th Ave	7	9.09%
7	4th Ave S @ Edgar Martinez Dr S to . . . • Boeing Field via East Marginal • Georgetown • Spokane Street	7	9.09%
8	4th Ave S @ S Lucile St to . . . • Boeing Field • Spokane Street • Stadiums	9	11.69%
9	4th Ave S @ WSB touchdown to . . . • Georgetown • Stadiums	4	5.19%
10	Airport Way S @ S Atlantic St to . . . • Boeing Field • Georgetown	5	6.49%
11	Airport Way S @ S Lucile St to . . . • Boeing Field • International District	5	6.49%
12	Airport Way S @ S Norfolk St to . . . • Georgetown • International District	6	7.79%
13	Denny Way @ Dexter to . . . • Capitol Hill • I-5 SB • Lower Queen Anne	20	25.97%
14	Denny Way @ Stewart to . . . • Ballard • Crown Hill • Lower Queen Anne • Seattle Center	13	16.88%
15	Marginal Way S @ S Lucile St to . . . • Boeing Field	6	7.79%
16	E Marginal Way S @ S Norfolk St to . . . • Georgetown via 1st Ave • Georgetown via 4th Ave • Georgetown via East Marginal • Stadiums via 1st Ave • Stadiums via 4th Ave	9	11.69%
17	EB SW Admiral Way @ 34th Ave SW to . . . • 1st Ave Off Ramp • 4th Ave Off Ramp • I-5 NB/SB • SR-99 Off Ramp • Stadiums via 1st Ave • Stadiums via 4th Ave	13	16.88%
18	Elliott Ave W @ W Harrison St to . . . • Ballard • Capitol Hill via Denny Way • Crown Hill • I-5 SB via Denny Way • Seattle Center	9	11.69%
19	Fauntleroy Way SW @ 38th Ave SW to . . . • 1st Ave Off Ramp • 4th Ave Off Ramp • I-5 NB/SB • SR-99 Off Ramp • Stadiums via 1st Ave • Stadiums via 4th Ave	17	22.08%

Question Short response

What other routes would you find most useful if travel time information was available?

Total responses (N): 61 Did not respond: 93

Multiple choice - one answer (button)

Question

Additional resources are listed on the lower right side of the Web page (e.g., links to Puget Sound freeway conditions, Seattle Streetcar, Amtrak, Seattle Monorail, Metro Transit). Is it helpful to have these links on the map site?

Total responses (N): 128 Did not respond: 26

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	108	84.38%
2	no	20	15.62%

Multiple choice - one answer (button)

Question

Are the links to additional resources described well?

Total responses (N): 121 Did not respond: 33

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	87	71.90%
2	no	34	28.10%

Multiple choice - one answer (button)

Question

Do the links point you to the information you're trying to find?

Total responses (N): 117 Did not respond: 37

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	83	70.94%
2	no	34	29.06%

Matrix - one answer per row (button)

Question

How does Traveler Information Map compare to other transportation sites around the greater Puget Sound area?

Row 1

WSDOT (http://www.wsdot.gov/)

Total responses (N): 105 Did not respond: 49

Numeric value	Answer	Frequency	Percentage
1	better	18	17.14%
2	about the same	45	42.86%
3	not as good	42	40.00%

Row 2

King County (http://www.kingcounty.gov/)

Total responses (N): 84 Did not respond: 70

Numeric value	Answer	Frequency	Percentage
1	better	28	33.33%
2	about the same	45	53.57%
3	not as good	11	13.10%

Row 3

Sound Transit (http://www.soundtransit.org/)

Total responses (N): 71 Did not respond: 83

Numeric value	Answer	Frequency	Percentage
1	better	20	28.17%
2	about the same	40	56.34%
3	not as good	11	15.49%

Row 4

Community Transit (http://www.commtrans.org/)

Total responses (N): 68 Did not respond: 86

Numeric value	Answer	Frequency	Percentage
1	better	21	30.88%
2	about the same	37	54.41%
3	not as good	10	14.71%

Row 5

Washington State Ferries (http://www.wsdot.wa.gov/ferries/)

Total responses (N): 77 Did not respond: 77

Numeric value	Answer	Frequency	Percentage
1	better	18	23.38%
2	about the same	43	55.84%
3	not as good	16	20.78%

Multiple choice - one answer (button)

Question

Describe your experience navigating this page.

Total responses (N): 123 Did not respond: 31

Numeric value	Answer	Frequency	Percentage
1	easy to use	51	41.46%
2	adequate	40	32.52%
3	confusing or needs improvement	32	26.02%

Multiple choice - one answer (button)

Question

Are the map legends in the area labeled "Before You Go" easy to read and understand?

Total responses (N): 103 Did not respond: 51

Numeric value	Answer	Frequency	Percentage
1	yes	70	67.96%
2	no	33	32.04%

Matrix - one answer per row (button)

Question

Please rank the following features in the order of importance to you when you are trying to determine what current traffic conditions are like.

Row 1

congestion map (road colors)

Total responses (N): 123 Did not respond: 31

Numeric value	Answer	Frequency	Percentage
1	1 (most important)	77	62.60%
2	2	35	28.46%
3	3	10	8.13%

4	4 (least important)	1	0.81%

Row 2

cameras

Total responses (N): 124 Did not respond: 30

Numeric value	*Answer*	*Frequency*	*Percentage*
1	1 (most important)	72	58.06%
2	2	31	25.00%
3	3	17	13.71%
4	4 (least important)	4	3.23%

Row 3

SDOT traffic alerts

Total responses (N): 121 Did not respond: 33

Numeric value	*Answer*	*Frequency*	*Percentage*
1	1 (most important)	32	26.45%
2	2	43	35.54%
3	3	40	33.06%
4	4 (least important)	6	4.96%

Row 4

additional information links

Total responses (N): 116 Did not respond: 38

Numeric value	*Answer*	*Frequency*	*Percentage*
1	1 (most important)	10	8.62%
2	2	13	11.21%
3	3	24	20.69%
4	4 (least important)	69	59.48%

Multiple choice - one answer (button)

Question

When you click on (select) a clustered group of cameras (icon with a + sign), do you find it helpful to be able to see multiple cameras in a group?

Total responses (N): 122 Did not respond: 32

Numeric value	Answer	Frequency	Percentage
1	yes	104	85.25%
2	no	18	14.75%

Multiple choice - one answer (button)

Question

When you view the cameras, do they point in the direction of traffic you are interested in?

Total responses (N): 121 Did not respond: 33

Numeric value	Answer	Frequency	Percentage
1	always	7	5.79%
2	usually	65	53.72%
3	sometimes	46	38.02%
4	rarely	3	2.48%

Multiple choice - multiple answers (check)

Question

Which Internet browser do you use most often to view transportation pages?

Total responses (N): 126 Did not respond: 28

Numeric value	Answer	Frequency	Percentage
1	Microsoft Internet Explorer	61	48.41%
2	Firefox	49	38.89%
3	Safari	19	15.08%
4	Opera	2	1.59%
5	Chrome	15	11.90%
6	other Internet browser	7	5.56%

Multiple choice - multiple answers (check)

Question

If you use more than one Internet browser to access this page, which one displays (renders) the information best?

Total responses (N): 97 Did not respond: 57

Numeric value	Answer	Frequency	Percentage
1	Microsoft Internet Explorer	28	28.87%
2	Firefox	19	19.59%

3	Safari	6	6.19%
4	Opera	2	2.06%
5	not applicable; no noticeable differences	37	38.14%
6	comments	10	10.31%

Multiple choice - one answer (button)

Question

Have you used the map feedback form?

Total responses (N): 126 Did not respond: 28

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	7	5.56%
2	no	119	94.44%

Multiple choice - one answer (button)

Question

Did you receive a satisfactory response?

Total responses (N): 48 Did not respond: 106

Numeric value	*Answer*	*Frequency*	*Percentage*
1	yes	9	18.75%
2	no	4	8.33%
3	did not receive a reply	18	37.50%
4	please describe	17	35.42%

Multiple choice - multiple answers (check)

Question

How much time elapsed before you received a reply?

Total responses (N): 20 Did not respond: 10

Numeric value	*Answer*	*Frequency*	*Percentage*
1	less than a day	4	20.00%
2	less than a week	2	10.00%
3	less than a month	3	15.00%
4	please describe your experience	11	55.00%

Long response

Question

Is there other information you feel would be useful to add to this Web page?

Total responses (N): 51 Did not respond: 103

LEARNING & SCHOLARLY TECHNOLOGIES
UNIVERSITY of WASHINGTON

Questions or comments?
Contact us or email catalysthelp@uw.edu

Describe how you use the travel time information.

- adjusting
- avoid delays
- avoid problem areas
- avoid traffic jams going home from work
- before leaving to choose route
- cameras
- Can't... no info on your site today.. no map...
- change routes
- Check road conditions to get to work
- Check Roadways for incidents and travel times during all weather conditions
- check to see if I should leave 10 minutes early/late
- checking road conditions (snow)
- checking wait times during snow storm
- choose route
- choose the fastest route
- COMMUTE
- commute
- commute to and from work
- commute to and from work.
- commuting to work
- Consider alternate route
- daily
- Decide when to leave work in the evening
- determine alternate route or if need to go
- Determine route
- Determine traffic and time to destination
- Determine when to leave work. If things are jammed, I'll stay and work longer and wait for things to clear up.
- Determine when to make a trip, if I have options: if I don't have a flexible schedule, I use it to arrive on time for appointments. I also use it to determine whether bike, bus or car is my best travel option.
- DISPATCH TRUCKS
- Do not use
- don't
- don't
- dont - walk to work
- don't use
- driving purposes
- evaluate alternate routes
- evaluate traffic to find best way
- fastest route
- Figuring out if there are traffic problems.

- Figuring out which route to go to work and when to leave
- find another route or plan my travel time due to road situations.
- for commuting to school & work
- For rerouting
- for trips to the seattle metro area and to western washington
- gauge traffic when going in to the city
- Good
- good
- Guide my commute
- how early i have to leave for work
- How much time to allow
- I check the real-time cams before leaving home to plan my route. Today I checked to see if there was snow on the ground in other places.
- I do not use the travel time
- I don't.
- I look at the map before I go somewhere to make sure there are no red or black spots.
- I look for color coding of traffic congestion and plan my route accordingly. I also use cameras to see how bad the mess really is. Timely updating and a time/date stamp is important. I have looked at Alerts and other info, but they often do not apply for my routes, and I still wonder if they are accurate.
- I only use it during inclement weather.
- i take a look at travel times, road conditions to determine whether to work from home; figure out where to avoid traffic
- if I do travel, I want to see how long it would take
- If I should leave now or wait until later. Or if I should take 99 or I-5.
- Informational for commuting
- I've never used it.
- Just snoopy
- just to get an imppression / approximation of how heavy traffic is
- looking around the city for traffic congesting
- looking at delays
- Navigate around known traffic issues
- plan departure time
- Plan route and departure time
- Plan route and departure times
- plan trip, try to avoid heavy traffic/alternate routes
- Plan which way to go
- planning anything I do that involves traveling
- Planning drive route, checking for snow accumulation
- planning on when to leave

- planning trips/routes
- Possible routnings to West Seattle
- prepare myself for slowness
- Reroute delivery vehicles
- route selection,
- router planning before walking out the door
- see if conditions are normal
- street conditions, travel conditions
- temp? snow
- There's travel time information? Didn't see it until I went back to look for it. The page's nav leaves a lot to be desired. Dump the Flash, too, please. Doesn't work on the popular mobile devices.
- this is my first time on the site
- to advance plan the best route to avoid congestion
- To avoid all the construction boondoggles
- to avoid getting stuck in traffic
- to avoid gridlock
- To determine which route to take
- To get places in a timely fashion.
- To Get Where I'm Going
- To guess how bad traffoc really is
- to keep family informed
- To plan my commute
- To plan my trips when traveling moren than 15 miles from home.
- to plan routes to and from places
- to see if Montlake is blocked
- travel routes for work
- Travel to and from work
- Travel to school
- Traveling outside the city
- trying now
- understand what's ahead, or plan departure time
- Usually just to see where traffic is bad and avoid it (take more side streets from freeway)
- very bad website
- view road conditions and weather conditions and congestion when determining if i should travel now, or what method i should travel. particularly use this during winter or during holidays or parade times
- Watch traffic cams
- weather, commute
- What is travel time information is it available like onestopaway.org
- work commute

Based on the travel time information that is available, have you changed your route?

- At times.
- Avoided accident on I-5
- bare road light traffic
- Can't make a decision when there is no information provided
- change route based on other data
- decided it was safe to make trip
- depends on traffic
- Didn't need to
- DISPATCH CONCRETE TRUCKS
- do not know how to read the travel times
- Do not use
- don't drive
- Don't use that feature.
- Either go or no go
- find alternate route
- have taken alternate routes
- haven't had to yet
- haven't used travel time function
- I avoid congestion
- I can't, the bridge is the only option
- I changed my route by looking at traffic patterns while driving
- I go early on Sunday
- I have adjusted start time more than the route
- I have taken an alternate route that is faster
- I look at the pictures, not the time
- I sometimes vary my route.
- I usually have at least 2 options to get from point A to point B, and travel time info helps
- if certain roads are closed, I need to re map my route
- if the freeway's backed up, I use surface streets
- Just switching the roads I use and leaving 10 minutes earlier - nothing major
- Limited alternative routes available
- make own judgement based on volume of traffic in the cam
- new job allows me to use transit to Pioneer Square - can use ride-free zone downtown for meetings.
- New user
- No, as everything I looked at says "not available." This whole thing seems like it's not quite ready for prime time.
- not aware of time projections site is visually bloated

- not relevant, i use the map with cameras to see what is going on
- Once I am on my way, I don't have access to travel times - but I try to pay attention to the information when I know there are problems
- Retired
- retiured, seldom go out of West Seattle
- Sometimes I decide to wait to go somewhere until another time when the traffic is better. Usually, changing my route doesn't help, because there are not enough route options to make a difference.
- Stupid questions! To get around traffic clogs.
- surface street or I-5
- take back roads with traffic lights
- the cams aren´t video streaming
- they often are wrong
- this is my first time on the site
- Used alternate side roads trying to avoid major delays on highway.
- walk across st to work
- when the freeway is slow i go another route or leave early
- will drive hills in snow
- Yes, see response to Question 3
- yes, use local renton streets, not freeways

"What other routes would you find most useful if travel time information was available?"

- #7 Bus Route
- 100th & Aurora to downtown
- 16th/14th ave bridge south park
- 175th NE (Shoreline) to James St. or to I-90
- 1st Ave S bridge to Seneca, Mercer via SR99
- 23RD AVE
- 23rd Ave E > U District, 45th Ave between U District and Ballard
- 25th Avenue NE and/or 35th Avenue NE between Lake City Way and Montlake Blvd
- 35th NE; 25th NE; 40th NE; 24 Ave. NE
- 405 and I-90
- 520 bridge
- 99 from north seattle to downtown
- ALL
- Anything along the NE side of the city would help. Montlake to downtown, NGT to downtown via Roosevelt, etc.
- Around freeway entrance/exit
- around Montlake Blvd / SR - 520
- Aurora / 99 / Bat St Tunnel
- Aurora Ave
- Aurora Avenue North
- aurora vs i-5
- Aurora/99 both directions
- Beacon Hill and Columbia Wy to I-5
- both floating bridges
- children's hospital to georgetown
- Do not use.
- Downtown-Lake City
- Eastside
- five points to Montlake
- from I-405 to and from SeaTac Airport
- From West Seattle, heading S/SE (toward Southcenter)
- Greenwood Ave N, Northgate Way N and NE
- Hwy 99 @ Northgate Way to Downtown Seattle
- I-5, 405, Aurora.
- Int'l district down rainier ave s to Alaska and to Henderson and back. Also East marginal to Cloverdale
- lake city way
- Lake City Way to West Seattle Bridge
- Mercer Mess; Aurora Ave
- Mercer PL at Elliott ave W to I-5
- Montlake Blvd
- Montlake Blvd

- MONTLAKE BOULEVARD!!!!!!! The NE is always gunnysacked, and you have little or no coverage of it.
- N 45th St Ballard to UW
- Olson Way/1st South to downtown
- only accesses the web cams for snow conditions
- s end ballard b thru fremont to i5,
- sand point & UW area
- seattle to bellevue
- Seattle to Bellevue via 520 or 90
- South Bound 405 from the I-5/Lynnwood
- SR-99 from Battery Street Tunnel to Aurora Bridge
- times on the Alaskan way viaduct
- Travel throughthe city via I-5 can be a problem when something happens on a street below.
- travel time on the viaduct
- u-dist to cap hill and rainier valley to downtown or cap hill
- UW to Northgate, UW to Boeing Field
- UW-Montlake-520-405
- viaduct/99 aurora, greenwood, ravena
- west sea to u dist
- West Seattle bridge & 1st Ave S bridge & SR99

"Is there other information you feel would be useful to add to this Web page?"

- a way to search visually: a color map to scan thru route +/- Map webcams 'n' POV direction. a bit like sitemap (not seen)roadwork forcast?
- "additional cameras in more directions would be useful. thanks."
- average wait times or how long my delay will be.
- Cameras showing conditions of: West Seattle and 1st Ave S bridges; SR99; Spokane street / I5 exit
- Can you add BNSF cameras and or congestion information to your map?
- "First thing to ask: ""Did your browser render the web page correctly""?...Without that basic info the entire survey is useless."
- group camera/infor to area, ie ballqrd area, belltown area, capitol hill area, then subset the camera within are
- "Have a page where all cameras are displayed in thumbnail images.
- Have a list of cameras from North to South."
- http://www.seattle.gov/transportation/ The map needs to be linked to http://web5.seattle.gov/travelers/ on the top of that website needs taps on top with getting around Seattle links on the first link above.
- I can't find the map that I used to always use to locate the cameras. I don't like to scroll though a long list of text to find the cameras.
- I couldn't find the map. The only thing I found was an alphabetical list of the avalailable cameras. I have used the map in the past - where is it now?
- I don't know that I've used this page that much. I usually use other sites. I think I landed here because I was trying to figure out which roads were closed - so some of my answers here are probably not helpful.
- I go to this site for traffic information that I need right away. A Simpler page with just up to date traffic flow maps and cameras would be great. I unified map in conjunction with WSDOT would be a dream come true.
- I have no idea how to find out which direction the traffic is going. It is nice to know if the freeway is congested or not, but it would be much more helpful if I knew whether it was congested going North vs. South, etc. The traffic cameras only help if I am familiar with the area I am looking at and can hence figure out what direction the traffic is in. Thank you for providing this service to the city of Seattle. We appreciate all you do!
- I ma on the transit buses in kc metro transit buses in seattle..
- I use the cameras and maps every day. They are extremely important to me. I wouldn't take the time to answer this survey if they weren't.
- "Icons on the map need a legend. Eg, icon with >> in it is not defined.
- Seems like at least one camera is not working when I check. As of this typing: 85 and 87 and Aurora not working."

- Instead of listing the cameras alphabetically, show an area map w/camera icons, like wsdot.
- It's great
- legends for multiple alerts is not clear at all
- link to west Seattle bridge cam as not been loading for a few weeks, although I can access that camera from the westseattle blog traffic page
- lots of cameras
- Make an app for mobile devices please!!!!! or make it mobile friendly!
- make it smartphone accessible and timely
- many of the traffic cameras are not up and running or do not work, those are some i need to see based on my commute
- might be nice for this survey to have cutesy little screen shots when asking questions about the specific areas of the website. I don't always remember who is hosting a certain page when I'm clicking around on my way out the door - I look for congestion, then pursue deeper if I think there is a traffic factor to consider. I might or might not be on SDOT/ WADOT/ etc without caring.
- More Cameras
- New page is basically useless for those without a T1 connection. Takes 2+ minutes to load via DSL. Old pages were much better. I'd much rather have icons for individual cameras than wait and wait and wait for the multi-camera icons to render.
- not at this time
- Not information - the page is HORRIBLE to try to get around, navigate, use. Clunky. Not intuitive.
- Not yet
- note : I used this site once before survey, to look for snow. I walk to work
- pictures of traffic on the viaduct
- Please bring the site's design out of the 1990s, OK?
- "Please install more cameras."
- quit wasting money on gadgets that don't do anything.
- Realtime bar charts that move up or down with the volume level of traffic at certain locations. Seeing a snapshot does not give a good representation of the cars waiting behind or in front of the camera. Having a simple bar chart that rises with traffic congestion and changes color from green to yellow to red would be very helpful. Thank you for your help with all of this.
- Superimpose an arrow showing which direction cameras looking relative to North
- That tv traffic reporters stop using the term "typical". What is typical?
- The cameras along Montlake Boulevard seem to have frequent problems, including placement/view. The camera at Montlake cut hasn't changed views in two days, and is often wind-blown to face useless areas. The camera at Montlake Blvd and 25th NE has had the same image on it for two and a half months! (October 19th) Doesn't anybody bother checking this stuff?? Also, Montlake needs an additional camera, preferably mounted on one of the

UW walkway overpasses to the parking lot, with views both north and south. his will be increasing critical when the new 520 Bridge construction begins. But why wait?

- The larger display and ability to choose subsections of the region on the WSDOT traffic map is easier to use.

- The map would be better if it were more interactive so users could get more detail on areas of interest--more like the state map.

- The navigation of the map is anachronistic (see MapQuest for a bad example).

- There are cameras all over the city, but I can only view some of them. I would like to view all cameras.

- too optimized for IE, weird page display on Firefox and Chrome

- Two main points: a time/date stamp is necessary so that the traveler knows if the views are current. Second, the cameras are not very reliable - sometimes they display and sometimes they aren't functioning, and sometimes their image is from another day (in spite of refreshing the page). BUT OVERALL, I AM VERY GLAD TO HAVE THIS TOOL. SOME OF THE STREETS SHOWN ON THE MAP ARE VERY IMPORTANT TO MY TRAVELS AND THE WSDOT SITE DOES NOT SHOW THEM (E.G. ALASKAN WAY VIADUCT). I REALIZE THAT TRAFFIC.COM HAS MAP INFO ON THEIR SITE BUT I HAVE DIFFICULTY VIEWING THEIR SITE.

- "Very local peak times such as: When Port of Seattle trucks are in convoy crossing 99 south of the viaduct blocking it. When UPRR is scheduled to cross 99 and block it. When the trucks are crossing 99. When specific plant sites end shift and dump a clump of traffic onto the streets."

- "When searching for the SDOT traffic page, it takes two clicks. Searching by ""SDOT Traffic"" brings up the traffic camera page and then a link to the traffic flow page. Tighten it up so that a search brings up the traffic flow as first click.

- Make it more friendly for mobile devices. WSDOT has a separate mobile site. SDOT needs to better develop the site for mobile use.

- Include more information (cameras, wait times, queues, etc) on Montlake Blvd.

- joseph.b.clare@mwhglobal.com"

- where did the map go?

- "why the new sdot website is very confusing

- when the cams were in a list was very better

- this new website is vry bad

- i don´t want to see several cams in a time i want to see them in video rotating format"

- wsdot's traffic map is pretty primitive compared to yours, but it's much bigger and hence easier to use. Why is the seattle info map confined to a wide, short box? It makes for a lot of panning around.