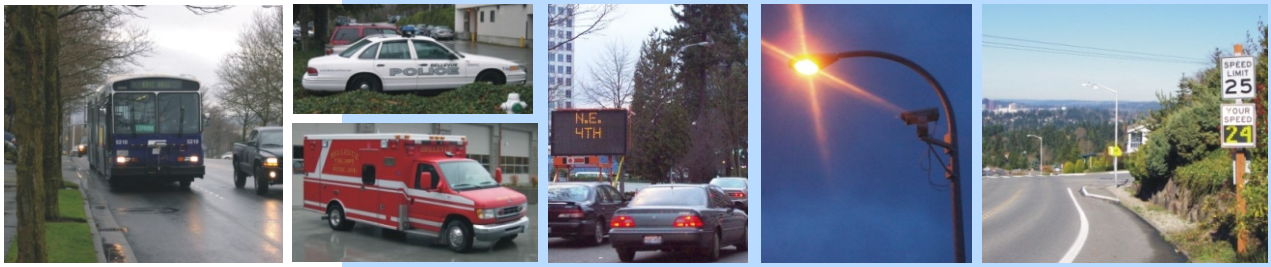
City of Bellevue

ITS Master Plan



"Enhancing Transportation Safety and Efficiency"

Prepared by

DKS Associates

TRANSPORTATION SOLUTIONS

July 28, 2004

DKS Associates
TRANSPORTATION SOLUTIONS

July 28, 2004

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Subject: Bellevue ITS Master Plan P/A No. 03201

Dear Mark:

DKS is pleased to present this ITS Master Plan for the City of Bellevue. The entire body of the report was prepared to meet the ITS planning goals of the City of Bellevue while maintaining consistency with Federal and Puget Sound regional guidelines for preparing an ITS plan.

We would like to thank you for the opportunity to work with Bellevue on this document. We have enjoyed working with the City on this project due to the overwhelming support from the Steering Committee and other Stakeholders in Bellevue. This support will be critical as the City moves into the implementation phase of this project. With this plan in hand, the Traffic Engineering group can search for ways to get the identified projects incorporated into the City's funding cycle and begin to look for outside funding sources such as state and federal grants. It also should be noted that this is a living document. As the conditions, opportunities and needs at the City change, the priority of projects and the project list should be updated.

It has been a pleasure to work with you and others from the City in preparing the ITS Master Plan. Please don't hesitate to contact either me or Dustin Luther with any questions. We look forward to working with you again in the near future.

Sincerely,

***DKS** Associates*

Chris Long, P.E.
Senior Engineer

DKS 25 YEARS

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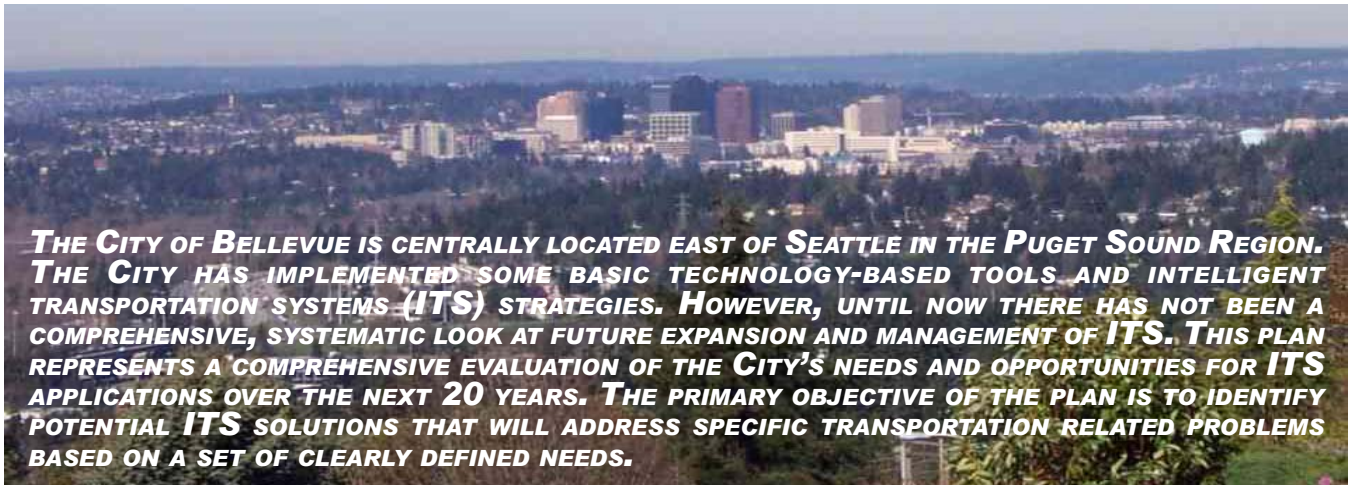
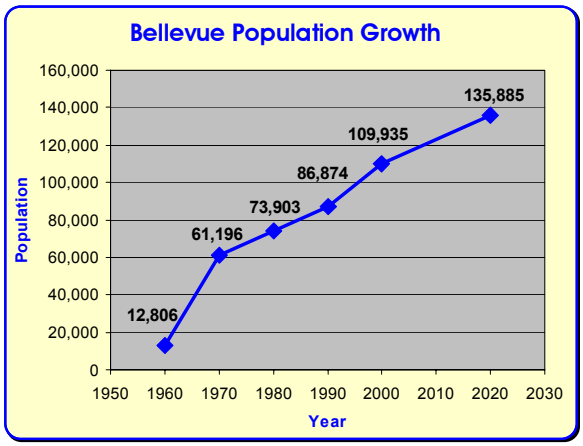
Introduction



The City of Bellevue is centrally located east of Seattle in the Puget Sound Region. The City has implemented some basic technology-based tools and intelligent transportation systems (ITS) strategies. However, until now there has not been a comprehensive, systematic look at future expansion and management of ITS. This plan represents a comprehensive evaluation of the City's needs and opportunities for ITS applications over the next 20 years. The primary objective of the plan is to identify potential ITS solutions that will address specific transportation related problems based on a set of clearly defined needs.

The City of Bellevue has had steady growth in both population and employment over the past thirty years. Since 1970, the population has almost doubled, and by the year 2020, the population is expected to grow another 24 percent. The significant growth, coupled with reliance on the automobile as the primary means of transportation, has placed a tremendous burden on the City's transportation infrastructure. As the City continues to expand, a coordinated, systematic approach will be necessary to effectively manage the transportation infrastructure. By working efficiently and cooperating with other local agencies, the City can build and manage a smarter transportation system using ITS.



What is ITS?

ITS is the application of a range of advanced technologies and proven management techniques to enhance mobility and transportation productivity, enhance safety, conserve energy resources and reduce adverse environmental effects.

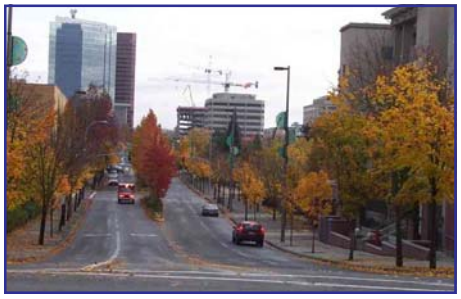
ITS uses real-time information to integrate and manage the components of a conventional transportation system (roads, transit, ramp meters, traffic signals, etc.). ITS can perform the following functions:

- Alert motorists, commercial vehicles, emergency response personnel and transit operators of congestion by collecting, processing and disseminating real-time information.
- Provide real-time transit arrival and departure information to passengers allowing them to time their departure from work or home to transit stops.
- Reduce corridor congestion by rapidly detecting and responding to traffic incidents.
- Reduce response times to incidents and emergencies for City maintenance staff and emergency services personnel through enhanced data and surveillance.

Introduction

In the past, the common belief was that we could meet the demand for mobility by building and expanding highways and bridges. However, as many areas of the country have built out the roadway network, traffic congestion has increased to overfill the infrastructure and we must consider new ways of managing traffic. ITS provides new tools to compliment traditional transportation thinking and the approach is catching on worldwide.

Deployment of ITS tools and strategies, seen as the next major evolutionary stage of surface transportation, is expected to be the focus of implementation efforts early in this century, much like the highway system program was the focus of the last 60 years. ITS is no longer an alternative or option in dealing with congestion and increasing highway travel, but rather it is one of the most cost effective ways to obtain a more efficient transportation system.



What is the Bellevue ITS Plan?

The Bellevue ITS Plan is a road map to implement an integrated system of transportation strategies based on a set of identified opportunities. The plan's purpose is to establish the need for ITS investments in the region, to identify relative priorities to direct ITS investment, and to identify specific projects to be deployed to address identified needs.

Why is the Plan Important?

An ITS plan:

- creates the framework from which ITS benefits can be realized;
- represents a comprehensive analysis of the City's ITS goals;
- ensures that ITS projects in the City will be eligible for Federal ITS funding; and
- prioritizes financial resources for ITS opportunities.

ITS is no longer an alternative or option in dealing with congestion and increasing highway travel. It is one of the most cost effective ways to obtain a more efficient transportation system.

Table E-1. Regional ITS System Engineering Analysis Compliance

System Engineering Analysis	ITS Plan Compliance
1. Description of how project fits into the Regional ITS Architecture	
Review of Applicable Market Packages	Regional Architecture
Regional ITS Integration Strategy	Concept of Operations
Other Stakeholders to Consider	Concept of Operations
Develop a Project Operational Concept	Deployment Plan
Develop a Project ITS Architecture	Concept of Operations
2. Roles and responsibilities of participating agencies	Concept of Operations
3. Requirements definition	Project specific and not part of the regional plan. This will need to be developed at the time of project deployment.
4. Analysis of alternative system configurations and technology options	Project specific and not part of the regional plan. This will need to be developed at the time of project deployment.
5. Procurement options	Project specific and not part of the regional plan. This will need to be developed at the time of project deployment.
6. Applicable ITS standards and testing procedures	Regional Architecture
7. Procedures and resources necessary for operations and management of the system	Project specific and not part of the regional plan. This will need to be developed at the time of project deployment.

This plan was coordinated with regional efforts, such as the Puget Sound Region ITS Architecture, to ensure ITS strategies throughout the region are integrated and complementary. In addition, this coordination helps assure that Bellevue is eligible for Federal ITS funding. During the development of the Regional ITS Architecture, the Puget Sound Regional Council (PSRC) created a document outlining procedures for local agencies to follow to comply with the regional ITS plan and Federal guidelines. The guidance document outlined a "System Engineering Analysis" that should be followed by local ITS projects. Table E-1 summarizes how the System Engineering Analysis was incorporated into the Bellevue ITS Master Plan.

Introduction

How was the ITS Plan Developed?

The development of the ITS plan started with identifying the ITS Vision for Bellevue. This Vision maintains a consistent goal in the identification of future projects, and when coupled with the inventory of the existing ITS conditions, it helped determine the City's ITS related needs.

The data from the needs assessment and the existing conditions inventory were used to develop the Bellevue Regional Architecture, which is a view of ITS in Bellevue displayed in a format developed by the United States Department of Transportation (U.S. DOT). The Regional Architecture helped identify where interagency arrangements will be needed. The interagency relationships are documented in the Concept of Operations. All of these steps help develop the final product, which is the deployment plan. This process is shown graphically in Figure E-1.

Figure E-1. ITS Planning Process

ITS Master Plan Vision

The City of Bellevue Transportation Department Executive Team developed the following four statements to capture the vision of ITS in Bellevue.

Vision Statement #1
Maximize the safety and efficiency of the City's transportation system for residents, business owners, and visitors to the City of Bellevue.

Vision Statement #2
Support Emergency Services in their efforts in saving lives and protecting the City's transportation infrastructure.

Vision Statement #3
Maximize the quality of transportation service provided by the City of Bellevue to residents, business owners, and visitors.

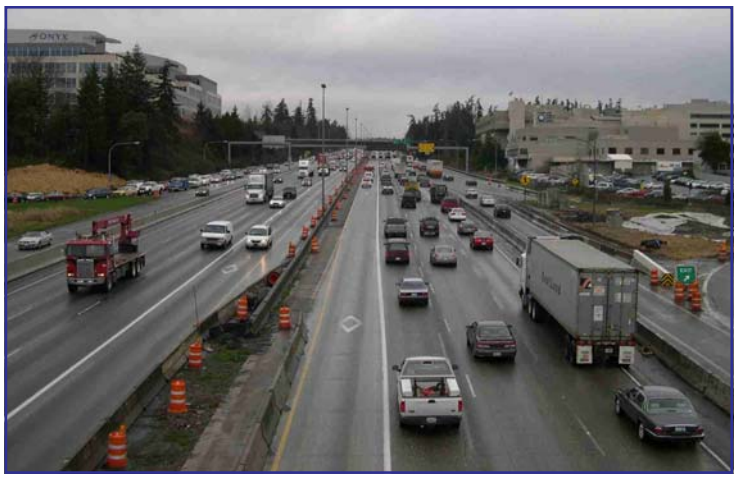
Vision Statement #4
Be active in and support regional ITS initiatives.

Existing Conditions

The existing conditions analysis describes the City's ITS infrastructure as well as planned ITS elements included in other local planning efforts. The benefits of ITS to the City are quite broad, so the implementation of ITS is recommended in a variety of reports including the Bellevue Transit Plan, the Bellevue-Redmond Overlake Transportation Study, the 148th Avenue Mobility Improvements, the Bellevue Capital Investment Program, the Downtown Implementation Plan, the PSRC Regional Architecture, and the Bellevue Emergency Operations Plan.

The ITS related equipment operated by the City includes:

- Traffic signals at 170 intersections (See Figure E-2)
- Approximately 500 system detectors (See Figure E-3)
- Computran central signal system
- Copper traffic signal interconnect (See Figure E-4)
- Traffic management center (TMC)
- Closed Circuit Television (CCTV) cameras at 20 locations
- Fiber optics for communications between the TMC and CCTV cameras (See Figure E-4)
- Portable message signs and highway advisory radio
- Emergency vehicle pre-emption at nearly all signalized intersections
- Transit Signal Priority (TSP) at two signalized intersections
- Driver feedback signs for traffic calming
- Variable speed limit signs at school zones
- 911 and emergency operation centers



The Washington State Department of Transportation (WSDOT) also operates ITS equipment within City boundaries, including:

- CCTV cameras at 31 locations
- Metering at 24 ramps
- Variable message signs at six locations
- Highway Advisory Radio (HAR) at two locations
- Data stations throughout the Bellevue area freeways

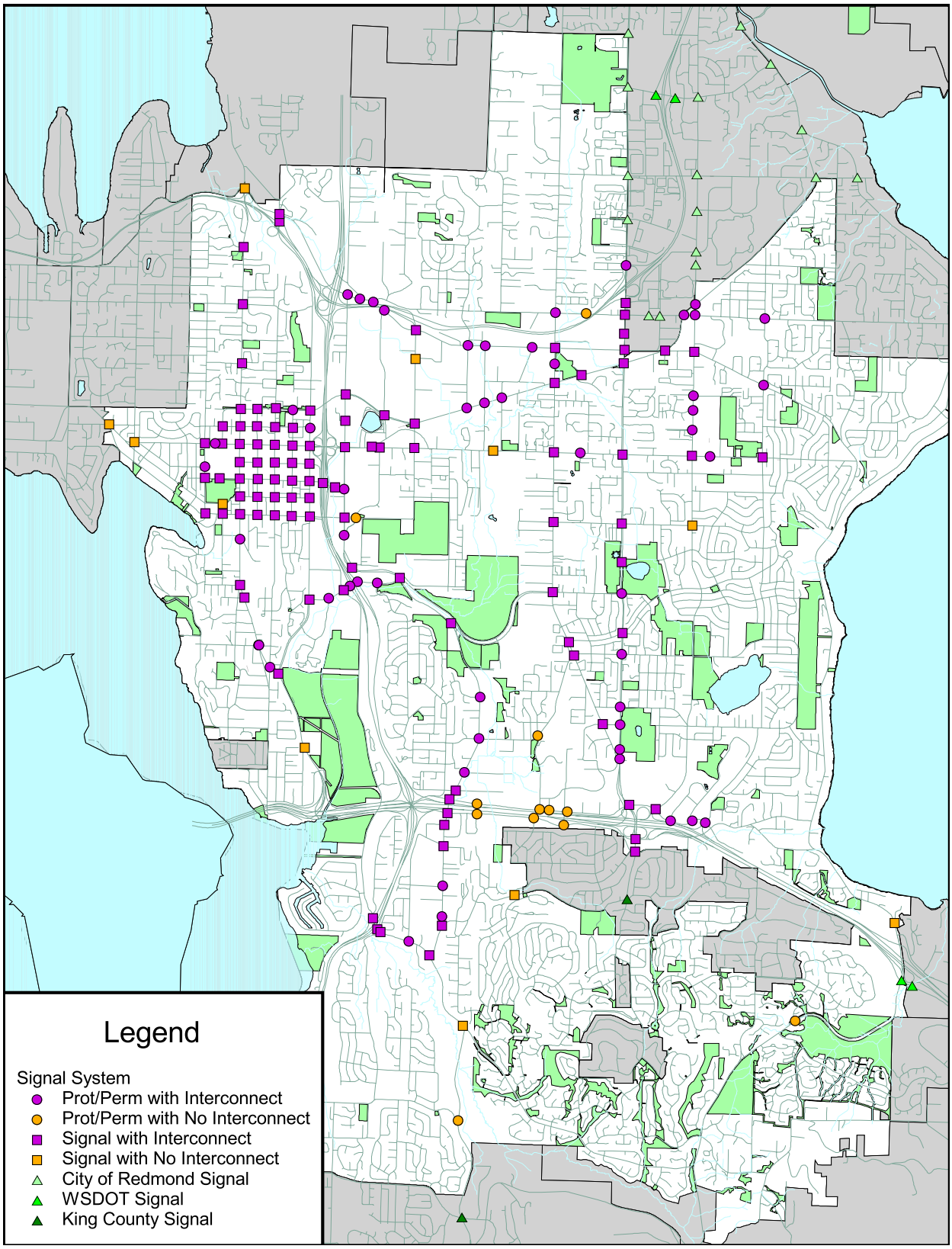


Figure E-2. Existing Traffic Signal Locations

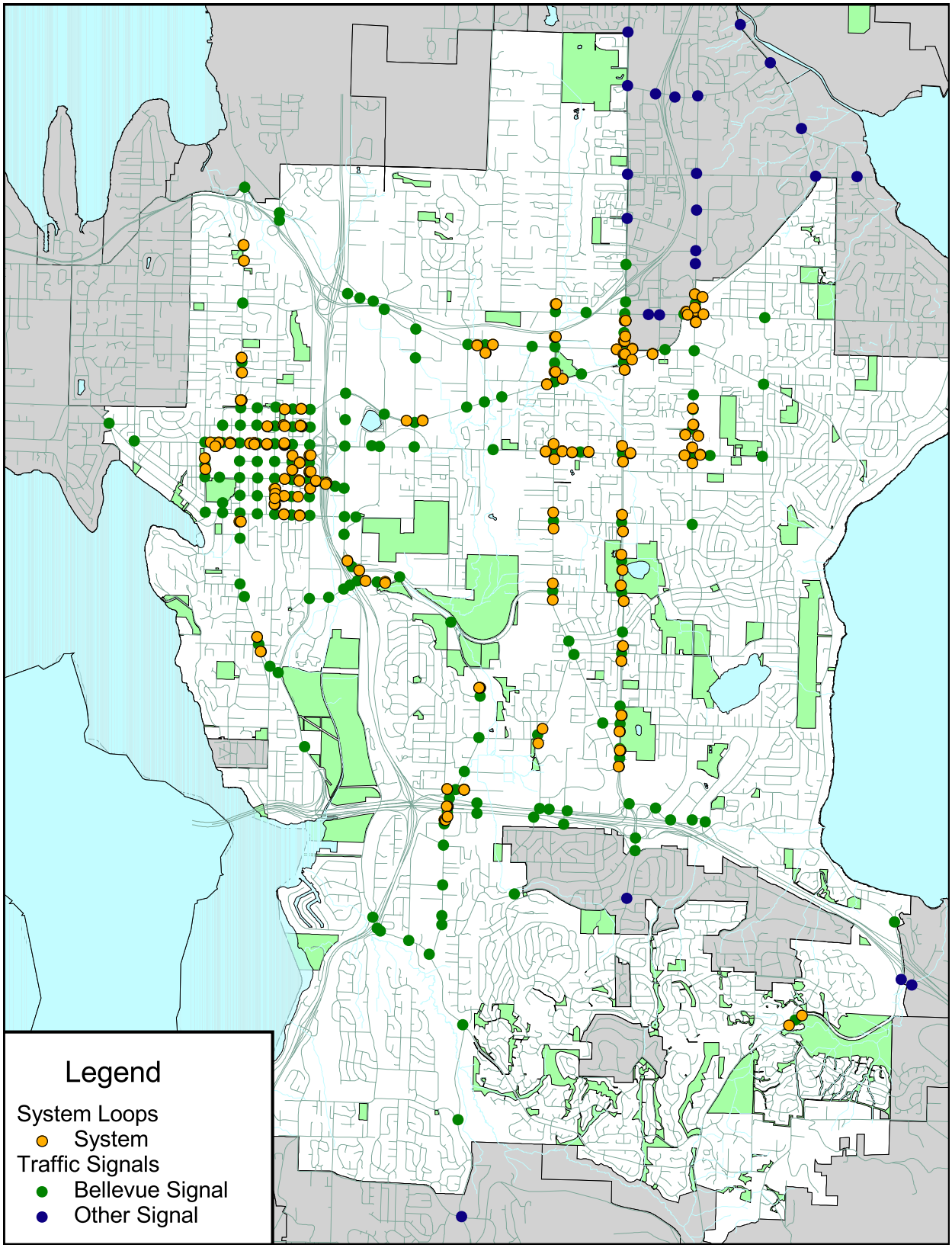


Figure E-3. Existing Data Station Locations

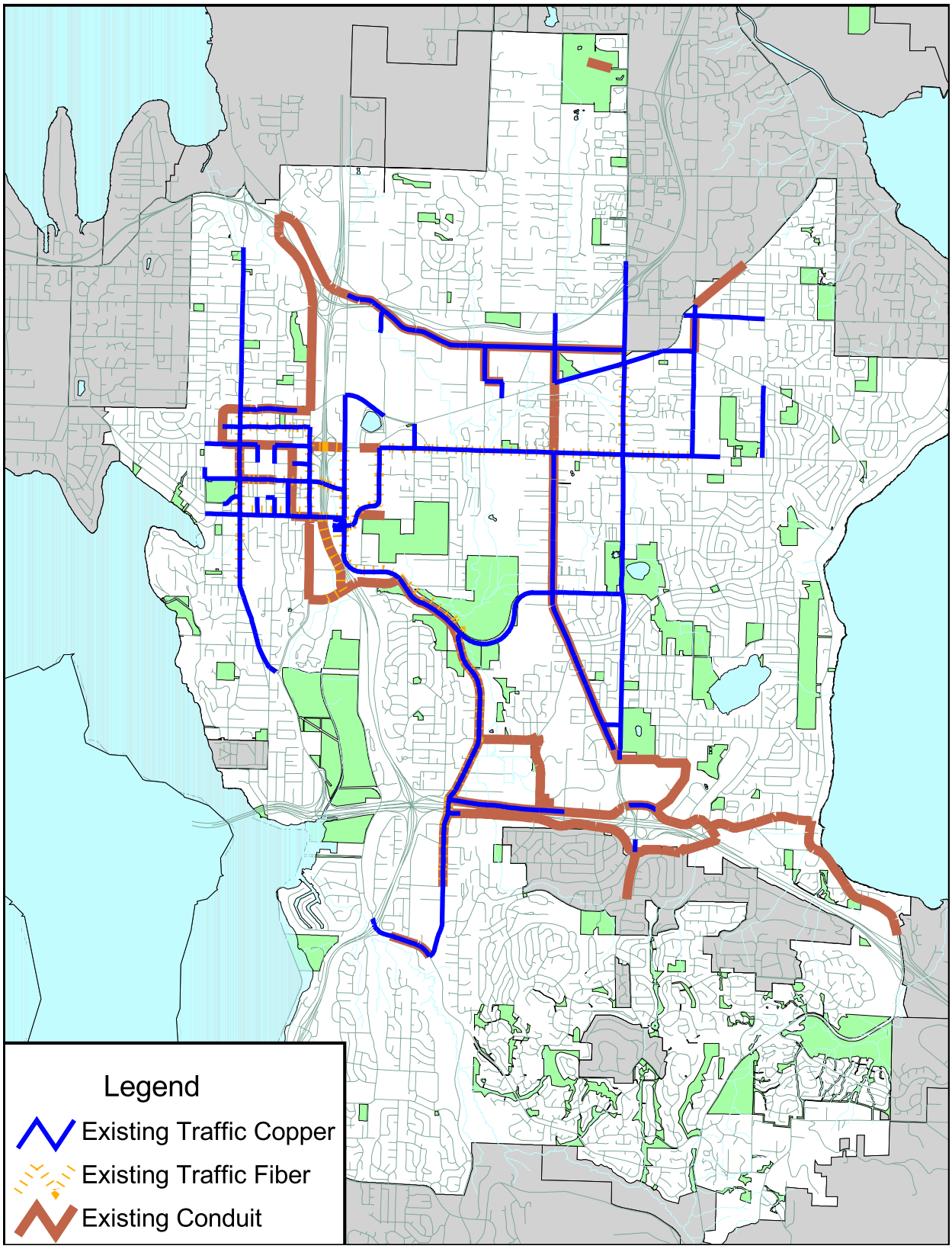


Figure E-4. Existing Communications Infrastructure

Needs Assessment

The Vision statements developed for the Bellevue ITS plan provided a high-level view of the ITS goals in the region, however a more detailed view is needed to determine the specific elements for deployment in the future. Through an interview process with a variety of City departments, the needs assessment identified many potential uses for ITS technology in the City. The groups interviewed included: Traffic Management, Information Technology, Right-of-Way, Planning, Modeling and Forecasting, Maintenance, Fire, Police, Emergency Management and the Transportation Commission.

Table E-2 summarizes the Bellevue ITS needs. These needs are categorized into the five functional areas used throughout this report to manage needs and future projects.

Table E-2. Summary of Needs

	Travel and Traffic Management
	Communications
1	Utilize City's existing communications infrastructure
2	Expand existing traffic operations communications
3	Upgrade communications (multi-mode to single-mode fiber)
	Traffic Operations and Management
4	Pedestrian and bicycle treatment (detection)
5	Expanded video surveillance
6	Enhanced traffic control capabilities
7	Expanded use of driver feedback signs
8	Probe vehicle data
9	Signal pre-empt for police vehicles
10	Center-to-center link to neighboring agencies
11	Red light and speed photo enforcement
12	Procurement of standards based equipment
13	Automatic detection of traffic equipment malfunctions
14	Improved vehicle classification system
15	Expand system detection
16	Traffic management center equipment upgrade
17	Heavy-rail crossing advanced preempt
	Traveler Information
18	Expanded use of VMS (includes additional installation)
19	Dynamic detour route development and management
20	Real-time construction information
21	Web-based traveler information
22	Automated commuter alerts
23	Parking management system
24	Driver information via other agency VMS
25	Highway advisory radio
	Incident Management
26	Incident management system
27	Interagency incident management

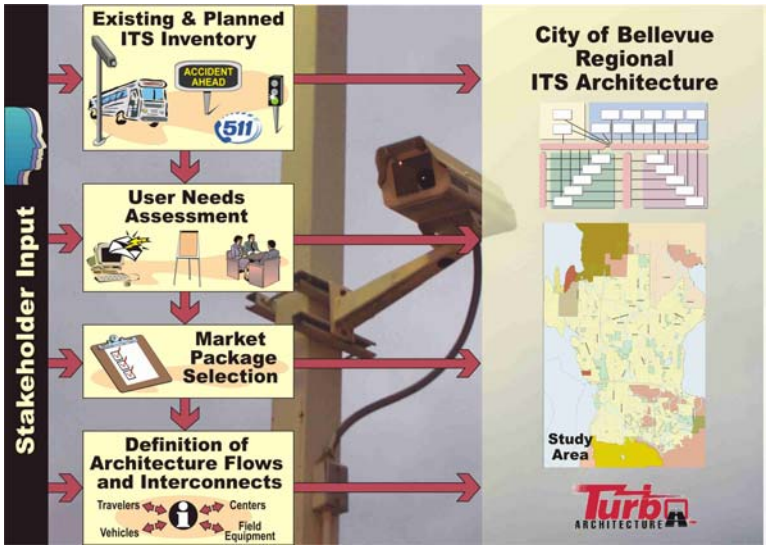
	Public Transit Management
28	Transit signal priority support
29	Real-time transit arrival and departure information

	Emergency Managmeent
30	Remote monitoring
31	CCTV Video at 911 Dispatch, EOC, and Police
32	Automatic incident detection
33	Mobile data terminals for incident management
34	Dynamic route mapping for dispatch center
35	AVL on all emergency vehicles

	Information Management
36	Query-able traffic data
37	Expanded interagency data sharing
38	GIS based equipment management

	Maintainance and Construction
39	Ice and flood detection and weather information
40	Improve traffic management in work zones
41	AVL on maintenance vehicles

Regional Architecture



The U.S. DOT defines a Regional ITS Architecture as a specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region. Simply stated, the Regional Architecture helps define the elements of the ITS system and the standard information that is exchanged between these elements. The guidelines for developing a Regional Architecture are defined in the National ITS Architecture.

The National ITS Architecture is a tool used to create a common framework for planning, defining, and integrating intelligent transportation systems. The architecture was developed to define the following ITS features:

- Functional area of ITS
- The physical entities or subsystems where the functions reside (e.g. roadside or vehicle)
- The information flows that connect the functional areas and subsystems

The creation of a Regional Architecture provides the following benefits:

- Displays a high-level view of the integration of ITS systems within the City of Bellevue.
- Creates a common platform to compare architectures with neighboring regions.
- Permits the identification of jurisdictional and system interconnections that will ultimately be referenced when designing Elements of the ITS Plan.
- Serves as a focal point for discussions among the Stakeholders concerning respective roles and responsibilities.

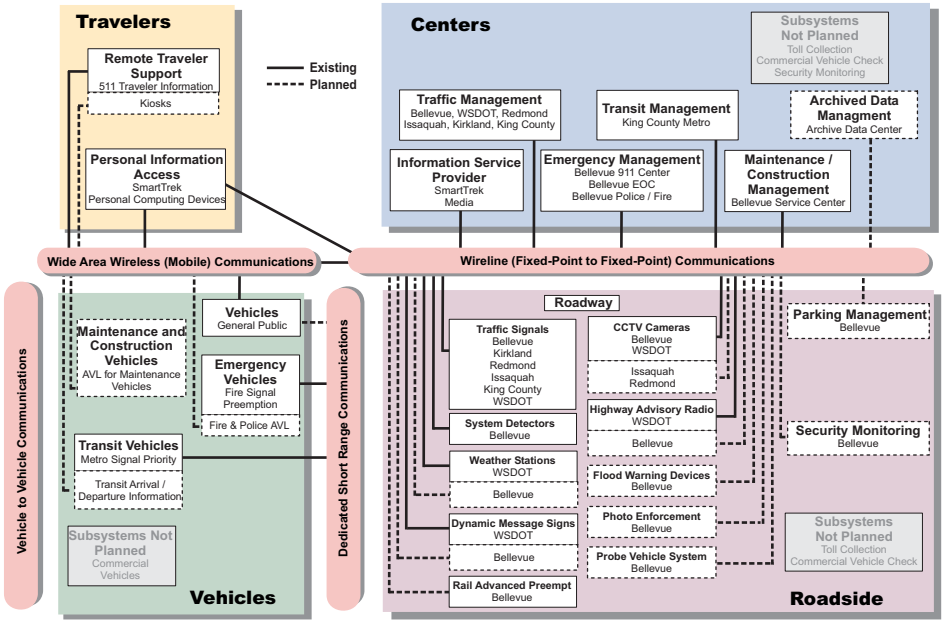


Figure E-5. Bellevue's National ITS Architecture Sausage Diagram

In addition to these benefits, a Regional Architecture must be created to meet the requirements to obtain Federal ITS funding. The Federal Highway Administration (FHWA) Federal-Aid Policy Guide, Title 23, Part 940 states that a Regional Architecture must be developed to show conformance of the region's ITS projects to the National ITS Architecture.

Regional Architecture

A list of the complete inventory of all existing and planned ITS elements was developed. This included their relationship with associated Stakeholders as well as their relationship with the appropriate National ITS Architecture defined subsystem. The subsystems applied to this project are shown in the National ITS Architecture standard "Sausage Diagram" in Figure E-5.

The process of developing a Regional Architecture also helps identify the Market Packages needed in the ITS Plan. A Market Package is a categorization of ITS technologies into individual packages for guiding the design and deployment of ITS. The Market Packages are used in the ITS Plan to organize the interagency ITS concepts of operations and to define projects in the Deployment Plan. Selecting Market Packages also helps identify the ITS standards that should be applied to future projects.

Concept of Operations

ITS strategies often require a high level of coordination and cooperation among multiple agencies in order to realize their maximum benefits. The concept of operations provides an outline of the roles and responsibilities of the many agencies that are Stakeholders in ITS projects within Bellevue.

From the Market Packages identified in the Regional Architecture process, the following packages were recognized as potentially needing interagency cooperation:

■ ITS Data Warehouse, ■ Multi-modal Coordination, ■ Interactive Traveler Information, ■ Network Surveillance, ■ Traffic Information Dissemination, ■ Regional Traffic Control, ■ Traffic Incident Management System, ■ Regional Parking Management, ■ Emergency Management and ■ Construction Management.

For each interagency Market Package identified, both the agency-to-agency relationship and the information exchange is determined. Agency-to-agency relationships range from a one-time consultation to operations and maintenance of another agency's equipment. Information exchange includes video, data, command, data requests and status updates.

Interagency coordination is nothing new to the City as it already has agreements with other cities, counties and the state to share resources such as video feeds, signal equipment and emergency response personnel.

Figure E-6 provides an example of the interagency relationships for the Regional Traffic Control Market Package.

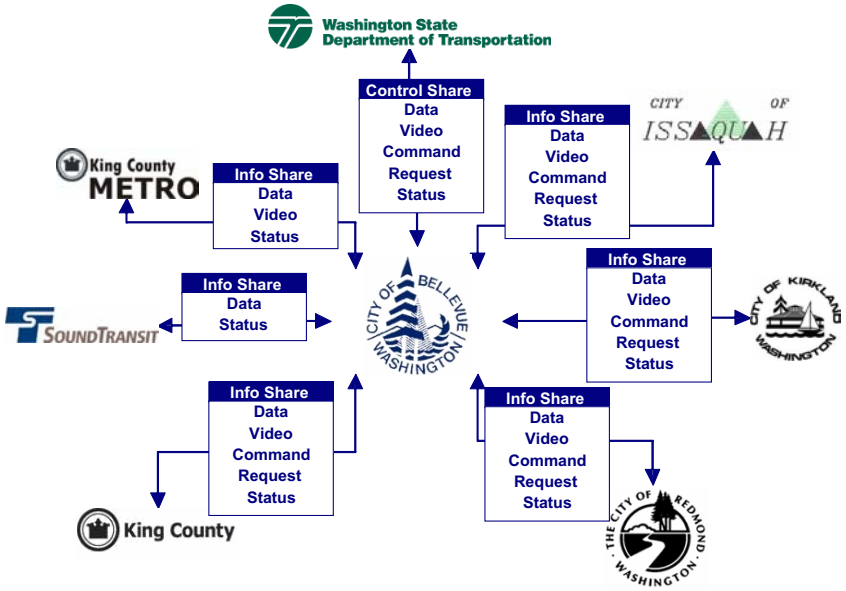


Figure E-6. Regional Traffic Control Interagency Relationship

Deployment Plan

This section summarizes all of the components of the Deployment Plan, which is broken out into three phases: 0 - 5 Year Plan, 6 - 10 Year Plan, and 11 - 20 Year Plan. The capital costs and operations and maintenance costs for each phase are listed in Table E-3. All identified projects and their estimated deployment timeframe are listed in Table E-4 and are described in detail in Table E-5 at the end of this section. The high priority projects scheduled for the 0 - 5 Year Plan are highlighted following Table E-4. Figures E-7 through E-14 illustrate proposed locations for ITS equipment including variable speed limit signs, proposed weather stations, CCTV cameras, dynamic message signs, fiber optic communications, transit signal priority, flood warning sensors and real time transit arrival signs, respectively.

Table E-3. Deployment Cost Summary

Deployment Years	Capital Cost	Operations and Maintenance
0 - 5 Years	$4,500,000	$154,000
6 - 10 Years	$4,600,000	$188,000
11 - 20 Years	$4,600,000	$419,000
TOTAL	**$13,700,000**	**$761,000**

Table E-4. Deployment Schedule

Project ID	Project Title	5-Year Plan					10-Year Plan					20-Year Plan									
	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Travel and Traffic Management																					
TM_01	Bicycle Detection						■	■	■	■	■										
TM_02	911 Computer Aided Dispatch Interface									■	■										
TM_03	Photo Enforcement											■	■	■	■	■	■	■	■	■	■
TM_04	Traffic Management Center Build-out		■	■																	
TM_05	Dynamic Route Guidance											■	■	■	■	■	■	■	■	■	■
TM_06	Automated Commuter Alert System									■	■										
TM_07	Downtown Parking Management System											■	■	■	■	■	■	■	■	■	■
TM_08	Permanent Highway Advisory Radio (HAR)						■														
TM_09	Vehicle Classification Detection						■	■	■	■	■										
TM_10	Driver Feedback Signs	■	■	■	■	■															
TM_11	Rail Crossing Interconnect							■													
TM_12	Traveler Information Kiosks						■	■	■	■	■										
TM_13	Variable Speed Limit Signs	■	■	■	■	■				■	■										
TM_14	City-Wide CCTV Deployment	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
TM_15	Dynamic Message Signs	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
TM_16	City-Wide Communications	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
TM_17	Communications to Isolated Signalized Intersections	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
TM_18	Arterial Congestion Map		■	■																	
TM_19	Central Signal System Replacement								■	■											
TM_20	Center to Center Integration - Redmond and WSDOT		■	■																	
TM_21	Signal System Upgrade for TSP and TRPS	■	■																		
Public Transportation																					
PT_01	Transit Signal Priority	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
PT_02	Smart-Bus TSP Enhancements						■														
PT_03	Real-Time Transit Arrival Signage				■	■															
Emergency Management																					
EM_01	Intra-Agency Video Sharing			■	■																
EM_02	Traffic Information on Mobile Data Terminals						■	■	■	■	■										
EM_03	Remote Monitoring of City Facilities						■														
EM_04	Flood Warning System	■	■				■	■	■												
Information Management																					
IM_01	Traffic Data Query System	■	■																		
Maintenance and Construction																					
MC_01	Roadway Weather Information System		■	■	■	■	■	■				■									
MC_02	Portable Work Zone ITS Equipment							■													
MC_03	Maintenance Vehicle AVL Tracking System												■	■	■	■	■	■	■	■	■

High Priority Projects

High priority projects are identified for deployment within the first five-year timeframe. This section describes each high priority project.

TMC Build Out

This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall.

City-Wide CCTV Deployment

CCTV cameras will be used to monitor traffic conditions, monitor emergency events, optimize signal timing, view high accident locations, and monitor flooding and weather.

Driver Feedback Signs

The City would like to expand the use of Driver Feedback signs in Bellevue as a means of traffic calming. These signs notify the driver of their current speed and flash the speed when they are traveling over the speed limit. The City currently has approximately 20 signs and would like to deploy an additional 10 signs.

Variable Speed Limit Signs

This project will deploy approximately 72 variable speed limit signs in school speed zones on Bellevue streets. These signs will adjust the posted speed by time of day with respect to school schedule. The City deployed their first set of time of day signs at Lake Hills Elementary. The City would like to have the ability in the future to communicate to the signs directly from the TMC.

Dynamic Message Signs

Full function VMS signs and limited state wayfinding signs will be deployed to manage traffic during incidents such as flooding, large freeway accidents and special events in downtown Bellevue. The need for six full function VMS signs and three wayfinding signs has been identified.

Communications to Isolated Signalized Intersections

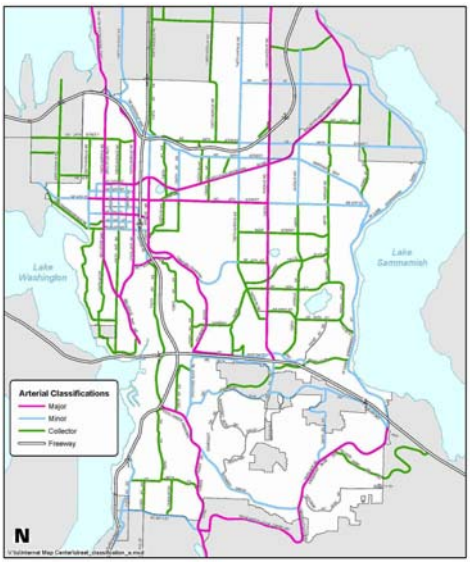
This project will provide communications to all the signalized intersections in the City that are currently isolated from the signal interconnect network.

City-Wide Communications

This project will phase in new fiber optic cables throughout the City to communicate to the new field devices and to upgrade communications to existing field devices.

Arterial Congestion Map

This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has an extensive deployment of system detectors that can initially be used for measuring congestion in the region. It is assumed that GPS data will provide a more accurate measurement in the future, so it is anticipated that the system will eventually migrate to a GPS system.



Deployment Plan

Center-to-Center Integration

This project will implement center-to-center communications with Redmond's future central signal system and will re-establish the connection to WSDOT. The center-to-center communications to WSDOT requires software upgrades on the interface servers.

Washington State Department of Transportation

Signal System Upgrade for TSP and TRPS

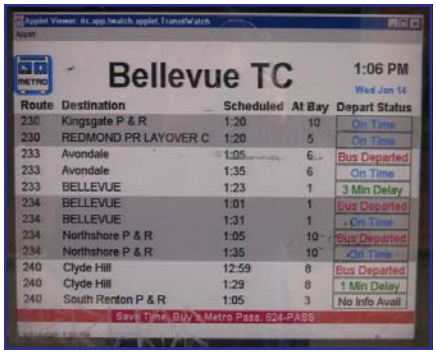
This project will upgrade the City's Computran system to improve traffic responsive pattern selection (TRPS) and TSP operations.

Transit Signal Priority

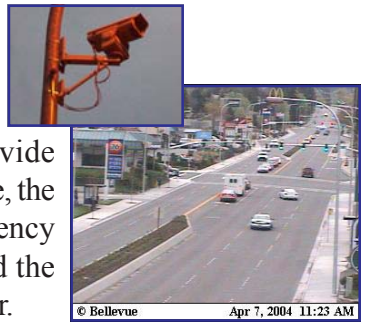
In a joint effort with King County Metro and Sound Transit, The City of Bellevue will deploy new TSP sites near the Bellevue Transit Center as part of the Downtown Access Project. In addition, the City is starting a project to evaluate TSP along the corridor of six of the most heavily traveled transit routes in Bellevue. This project involves a joint effort with King County Metro and Sound Transit to install TSP at up to 120 sites in the next twenty years.

Real-Time Transit Arrival Signage

This project will be a joint effort with King County Metro and Sound Transit to deploy signage at major transit hubs and transfer points to notify travelers of the estimated arrival and departure time for specific transit routes. The high priority locations include the Bellevue Transit Center, Eastgate, South Bellevue, Wilburton and Newport Hill Park and Rides, Factoria Mall, Bellevue Square and the Crossroads Shopping Center.



Intra-Agency Video Sharing



This project will provide video to the Police, Fire, the 911 center, the Emergency Operations Center and the Bellevue Service Center.

Remote Monitoring of City Facilities

This project will monitor City facilities such as Downtown Park or water reservoirs. The monitoring may be via CCTV or other technologies.

Flood Warning System

This project will deploy flood monitoring equipment at six critical locations in Bellevue.

Traffic Data Query System

This project will enhance the loop data management program in the Computran system to improve access to historic system detector data and provide access to automated traffic count information.

Roadway Weather Information System

Weather stations with roadway temperature monitoring will be included at six critical locations.

Road Conditions
- Above 38 F
- 33 F to 38 F
- 32 F and below
- No data

Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
Travel and Traffic Management									
TM_01	Bicycle Detection	This project will install permanent bicycle detection throughout the City on arterials designated as bike routes and on bike trails. This project does not include bicycle detection at signalized intersections. A total of 10 locations are assumed.	M	$50,000	$2,000	Primary: Bellevue	Requires communications through the City-Wide Communications Project (TM_16).	The communication requirements for the bike detectors is minimal so it may be possible to use existing signal interconnect. A larger issue will be bring power to detector sites on bike trails away from existing lighting or traffic signal circuits.	• Reduce staff time needed to set detectors in the field • Increase available data for evaluating bicycle usage in Bellevue • Better meet the needs of the Bellevue biking community
TM_02	911 Computer Aided Dispatch Interface	This project will provide a direct interface with the Bellevue 911 Computer Aided Dispatch system to automatically post incidents related to traffic in the Commuter Alert System.	M	$150,000	$10,000	Primary: Bellevue	Feeds incident data to the Automated Commuter Alert System in TM_06.	The incident reporting system could be a stand alone program. The platform for this program will be evaluated further when the project is in design.	• Increase driver awareness of traffic conditions • Decrease traffic operations staff time • Reduce congestion
TM_03	Photo Enforcement	This project will deploy photo enforcement for speeding and red light running. For this project, it is assumed Bellevue will deploy this equipment at 5 sites.	L	$375,000	$300,000	Primary: Bellevue	None	The City is interested in deploying photo enforcement equipment, but its use will depend on photo enforcement lawmaking in the state. The O&M cost for this project could be significantly reduced if Bellevue contracts with a vendor that installs, operates and maintains the equipment for a percentage of the fines paid by violators.	• Reduce red light running and speeding in the City • Improve driver safety • Reduce accidents at high accident locations
TM_04	Traffic Management Center Build-out	This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall.	H	$300,000	$10,000	Primary: Bellevue	None	Although this is a high priority project, the TMC is functional with the existing equipment leaving the option open for a phased deployment and build out of equipment.	• Replacement of antiquated/failing equipment • Increased flexibility for viewing cameras and signal system maps • Space for multiple operators • Improved emergency management and operation capabilities
TM_05	Dynamic Route Guidance	This system will automatically calculate the ideal route between two points based on real-time roadway congestion data. Initially this project would be used to provide route information for emergency vehicles.	L	$250,000	$15,000	Primary: Bellevue	This project will require congestion data collected in the Arterial Congestion Map project (TM_18).	This system could be mapped using the City's GIS database.	• Decrease in response time for emergency vehicles • Decrease in travel time for motorists
TM_06	Automated Commuter Alert System	This system will automatically alert motorists through e-mail, pagers and other wireless devices of potential issues along their predefined commute route. This system would require the input of real-time incident data into a database that could be queried by the commuter alert system. The incident database could be shared with the media and posted on the internet.	M	$100,000	$5,000	Primary: Bellevue	None	The City would like to expand upon their current e-mail alert system for the Downtown Access project by sending out real time information. The current e-mail system only addresses planned events.	• Availability of real-time incident information • Improved traffic coverage of Bellevue by local media • Reduction in congestion around incident locations
TM_07	Downtown Parking Management System	This project will install active signs around Bellevue Square to direct motorists to parking facilities with available parking. This project assumes monitoring equipment for the west and southeast parking facilities (it already exists for the northeast facility) and four advisory signs.	L	$300,000	$15,000	Primary: Bellevue Secondary: Bellevue Square Management	None	This project will require the cooperation of the Bellevue Square Management.	• Reduce driver frustration during shopping season • Reduce congestion around mall due to circling traffic • More efficient use of parking
TM_08	Permanent Highway Advisory Radio (HAR)	A permanent HAR will be located in Bellevue to notify motorists of incidents or construction in the HAR region.	M	$20,000	$1,000	Primary: Bellevue	None	The frequency and location of the antenna will need to be coordinated with WSDOTs HAR equipment.	• Increase availability of real-time traveler information • Reduce congestion and delay • Increase flexibility for distribution of traveler information

Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_09	Vehicle Classification Detection	This project will deploy detectors strategically around the City to collect vehicle classification information. It is assumed 10 detectors will be deployed.	M	$100,000	$2,000	Primary: Bellevue	None	It is assumed these detectors will be tied to a nearby traffic signal for communications back to central.	• Increase availability of vehicle classification information • Ability to track truck route adherence • Ability to improve traffic signal simulation • More accurate data for pavement design
TM_10	Driver Feedback Signs	The City would like to expand the use of Driver Feedback signs in the City as a means of traffic calming. These signs notify the driver of their current speed and flash the speed when they are traveling over the speed limit. The City has approximately 20 signs and would like to deploy an additional 10 signs.	H	$84,000	$4,000	Primary: Bellevue	In the future the City may want to incorporate these signs into the Photo Enforcement project (TM_03).	None	• Improved safety for motorists, pedestrian and cyclists • Reduce traffic speed • Increase in speed limit adherence • Increase in driver awareness of speed limits and personal driving characteristics • Wide-spread support • Low-impact traffic calming
TM_11	Rail Crossing Interconnect	City would like interconnect to the rail crossing at NE 8th Street to the signal at 116th, and the crossing at SE 1st Street to the adjacent signals at 116th Avenue NE and at Main St. This interconnect will notify the neighboring signals of the approaching train to allow for the clearing of queued vehicles backed up to the tracks. The cost includes interconnect to the nearby signal via a new preempt cable in existing conduit.	M	$50,000	$4,000	Primary: Bellevue Secondary: BNSF	None	To provide enough warning of an arriving train to clear queued vehicles, improvements may need to be made to the train detection system. This rail detection upgrade is assumed in the cost.	• Increase in safety near rail crossings
TM_12	Traveler Information Kiosks	City will support efforts by Metro and the local malls to deploy traveler information kiosks at transit centers, Bellevue Community College (BCC), and major shopping centers.	M	$0	$1,000	Primary: Metro, BCC, and Local Malls Secondary: Bellevue	Bellevue could enhance the kiosks by providing data from the Arterial Congestion Map (TM_18) and the Automatic Commuter Alert System (TM_06).	It is assumed that Metro, BCC and the local malls will furnish, install, operate and maintain the kiosks. The City will probably spend a small amount of time each year addressing data needs for the kiosks.	• Increase availability of traveler information in public places • Decrease congestion and delay
TM_13	Variable Speed Limit Signs	This project will deploy approximately 72 variable speed limit signs within school speed zones on Bellevue streets. These signs will adjust the posted speed by time of day. The City deployed their first set of time of day signs at Lake Hills Elementary. The City would like to have the ability in the future to communicate to the signs from the TMC.	H M	$504,000 $650,000	$12,000 $10,000	Primary: Bellevue	Requires communications through the City-Wide Communications Project (TM_16) when remote communications to the signs is added.	It is unknown if it is possible to interconnect the signs for remote communications. As the deployment of signs continues, this requirement will need to be integrated into the product procurement specification.	• Reduced speeds in school zones • Increased safety for students and drivers • Increase in driver awareness • Decrease in motorist confusion
TM_14	City-Wide CCTV Deployment	High, medium and low priority CCTV locations have been identified throughout the City. These cameras will be used to monitor traffic conditions, monitor emergency events, optimize signal timing, view high accident locations and monitor flooding and weather. • 16 cameras • 23 cameras • 12 cameras	 H M L	 $400,000 $575,000 $300,000	 $16,000 $23,000 $12,000	Primary: Bellevue	Requires communications from the City Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images.	The City's local video switcher will need to be expanded as more cameras are installed.	• Improved signal coordination and real-time signal timing adjustments • Increased information during emergency events and incidents • Increased ability to report congestion information for local arterials • More wide spread driver information

Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_15	Dynamic Message Signs	Full function VMS signs and limited state wayfinding signs will be deployed to manage traffic during incidents such as flooding and large freeway accidents as well as during special events in downtown Bellevue. The following signs will be deployed: • SB 148th Ave NE south of Bel-Red Rd • NB 148th Ave NE north of SE 22nd St. • Wayfinding for diverting around flooding on Factoria Blvd near SE 36th St (3 signs). • WB NE 8th St west of 112th Ave NE • SB Lake Hills Connector north of Richards Road. • WB NE 4th St west of 112th Ave NE • Wayfinding signs for WB I-90 traffic diverting off the freeway at 156th Ave NE (2 signs). • Wayfinding signs for traffic diverting of WB SR-520 at 148th Ave NE (2 signs). • Wayfinding for diverting around flooding on Kamber Road (3 signs).	 H H H H M M L L L	 $50,000 $50,000 $75,000 $50,000 $50,000 $50,000 $50,000 $50,000 $75,000	 $5,000 $5,000 $9,000 $5,000 $5,000 $5,000 $6,000 $6,000 $9,000	Primary: Bellevue	Requires communications from the City-Wide Communications Project (TM_16).	The City does not have any permanent VMSs so they will need to decide how they want to manage the control. It may be possible to integrate the control into the Computran system.	• Improved driver safety during incidents and events • Improved travel time through alternate route and closure advisories • Reduction in staff time needed to deploy temporary signs • Provide motorist information on incident/events more quickly
TM_16	City-Wide Communications	This project will phase in new fiber optics throughout the City to communicate to the new field devices and to upgrade communications to existing field devices.	 H M L	 $1,400,000 $1,400,000 $2,800,000	 $5,000 $5,000 $10,000	Primary: Bellevue	Required for numerous projects in the City.	The City currently uses multi-mode fiber for communications to CCTV cameras. The City may need to gradually switch to single mode fiber cabling as the need for faster speeds and higher bandwidths increases.	• Communication to existing isolated field devices • Communication to new field devices • Improved reliability for communications • Redundancy in communications
TM_17	Communications to Isolated Signalized Intersections	This project will provide remote communications to all the signalized intersections in the City that are currently isolated from the signal interconnect network.	H, M, L	$0	$0	Primary: Bellevue	Relies heavily on the City-Wide Communications project.	Cost built into the City-Wide Communications project.	• More efficient operations of isolated signals • Decrease in staff time needed to maintain these signals • Quicker response time when problems occur with the isolated signals • Ability to obtain data from remote signals
Central Signal System Upgrades									
TM_18	Arterial Congestion Map	This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has an extensive deployment of system detectors that can initially be used for measuring congestion in the region. It is assumed that GPS data will provide a more accurate measurement in the future, so it is anticipated that the system will eventually migrate to a GPS system.	H	$250,000	$15,000	Primary: Bellevue Secondary: KC Metro, Sound Transit, Cell Carriers	Feeds data into the Dynamic Route Guidance project (TM_05) and the Traveler Information Kiosk project (TM_12).	A standard methodology for using system detector data to report congestion has not been developed in the traffic industry. Many agencies are waiting to use GPS or probe vehicle data. The use of GPS data from cell phones has been identified as a possible means of collecting probe vehicle data.	• Increase driver awareness to congested areas • Increase distribution of traffic on parallel arterials • Decreased motorist delay
TM_19	Central Signal System Replacement	The City of Bellevue's central computer for traffic signal control will be due for replacement by 2010. This project will define and procure a new signal system for the City of Bellevue. With this replacement will also come a migration of the signal system to Ethernet communications. The replacement of controller cabinets will be part of the annual cabinet replacement program.	M	$400,000	$15,000	Primary: Bellevue	Could incorporate the 911 Computer Aided Dispatch Interface (TM_02), the Dynamic Route Guidance Project (TM_05), the Automated Commuter Alert System (TM_06) and the Traffic Data Query System (IM_01).		• Decrease in motor vehicle delay • Decrease in emergency vehicle response times • Enhanced system communications • Improved transit speed and reliability

Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_20	Center to Center Integration - Redmond and WSDOT	This project will implement center-to-center communications with Redmond's future central signal system and will re-establish the connection to WSDOT. The center-to-center communications to WSDOT requires software upgrades on the interface servers.	H	$200,000	$10,000	Primary: Bellevue Secondary: Redmond WSDOT	Needs to connect to a common point with the Redmond fiber optic system. The interface point is currently designed for 152nd Avenue NE near NE 24th Street.	WSDOT has recently selected a new central signal system for managing its traffic signals. Additional software design may be required to establish a connection to their new system. $50,000 of the deployment cost was allocated to connect to their old MIST system. The remaining $100,000 is for the connection to Redmond.	• Improved traffic management across jurisdictional boundaries • Increase in information available for traffic management
TM_21	Signal System Upgrade for TSP and TRPS	This project will upgrade the City's Computran system to improve traffic responsive pattern selection (TRPS) and transit signal priority (TSP) operations.	H	$75,000	$5,000	Primary: Bellevue	None	None	• Decrease transit travel time • Increase transit reliability • Decrease in motor vehicle delay • Signal timing adjustments based on real-time traffic conditions
Public Transportation									
PT_01	Transit Signal Priority	In a joint effort with King County Metro and Sound Transit, The City of Bellevue will deploy new TSP sites near the Bellevue Transit Center as part of the Downtown Access Project. In addition, the City is starting a project to evaluate TSP along the corridor of six of the most heavily traveled transit routes in Bellevue. This project involves a joint effort with King County Metro and Sound Transit to install TSP at up to 120 sites in the next twenty years. • 20 sites • 60 sites • 40 sites	 H M L	 $480,000 $360,000 $240,000	 $20,000 $60,000 $40,000	Primary: Bellevue Secondary: Metro Sound Transit	The Signal System software upgrade described in project TM_21 will be beneficial with the deployment of new TSP sites. Future TSP sites can funnel data into the Arterial Congestion Map (TM_18)	King County is in the process of developing new TSP hardware that will use wireless communications from the bus to the controller cabinet to activate TSP. This will reduce the installation cost from roughly $35,000 to $5,000. The High priority location assumed half at the current cost and half at the future cost. All Medium and Low priority projects assumed the future cost.	• Increased transit reliability • Decreased transit travel times • Reduction in transit operation and passenger time cost • Increased transit ridership • Increased travel time information
PT_02	Smart-Bus TSP Enhancements	This project is a joint effort with King County Metro and Sound Transit to improve the use of TSP through the new technology deployed on the future Smart-Buses. The Smart-Buses will have the ability to track ridership and schedule adherence real-time. This project will use this information to prioritize which buses receive TSP.	M	$200,000	$10,000	Primary: Metro, Sound Transit Secondary: Bellevue	This project will use the TSP deployed in PT_01.		• Increase TSP efficiency • Reduction in impact to signal operations
PT_03	Real-Time Transit Arrival Signage	This project will be a joint effort with King County Metro and Sound Transit to deploy signage at major transit hubs and transfer points to notify travelers of the estimated arrival and departure time for specific transit routes. The high priority locations include the Bellevue Transit Center, Eastgate, South Bellevue, Wilburton and Newport Hill Park and Rides, Factoria Mall, Bellevue Square and the Crossroads Shopping Center.	H	$80,000	$2,000	Primary: Metro, Sound Transit Secondary: Bellevue	The sign deployment will require communications deployed through the City-Wide Communications project (TM_16).	It is assumed that this equipment will be operated and maintained by Metro and Sound Transit. The cost only includes the signs and infrastructure for the communications (conduit and junction boxes to the site.) Metro is currently implementing a pilot project on Aurora Avenue N in Seattle.	• Increased ridership • Increase in rider awareness/information
Emergency Management									
EM_01	Intra-Agency Video Sharing	This project will provide video to the Police, Fire, the 911 center, the Emergency Operations Center and the Bellevue Service Center.	H	$30,000	$2,500	Primary: Bellevue	Will be enhanced by the additional cameras included in the City-Wide CCTV Deployment Project (TM_14).	Communication exists to the Bellevue Service Center and communications will be installed in the new City Hall for connections to the EOC and 911 Center. The only expense is the hardware.	• Improved emergency and incident identification, verification, monitoring and management • Reduction in travel time to emergencies • Improved efficiency in the response to maintenance calls and traffic accidents • Increased safety for Bellevue residents

Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
EM_02	Traffic Information on Mobile Data Terminals	This project will provide incident information, the City's congestion map, variable message sign status and video feeds directly to the mobile data terminals in police and fire vehicles in Bellevue.	M	$50,000	$5,000	Primary: Bellevue	Relies on the 911 CAD Interface project (TM_02) for incident data and the development of an Arterial Congestion Map as described in project TM_18.	Data terminals should be installed in all Bellevue emergency response vehicles by the end of the year. This cost could be significantly reduced if the data terminals have access to the internet. All but the VMS status data would be accessible from the web.	• Improved emergency management • Reduction in travel time to emergencies • Reduction in congestion near incidents
EM_03	Remote Monitoring of City Facilities	This project will monitor City facilities such as Downtown Park or water reservoirs. The monitoring may be via CCTV or other technologies.	M	$200,000	$10,000	Primary: Bellevue	It will require communications from the City-Wide Communications project (TM_16).	Ideally, some of the cameras needed to monitor City facilities could be strategically placed to also benefit observation of traffic conditions.	• Increase security at City facilities • Improve response time to incidents at City facilities • Increase staff efficiency
EM_04	Flood Warning System	This project will deploy flooding monitoring equipment at the following locations: • 148th at Larson Lake • Factoria Blvd at SE 36th Street • Kamber Road just east of Richards Road • SE 7th Place just east of Lake Hills Connector • NE 21st St just east of 140th Ave NE • SE 30th Street just east of Richards Road	 H H M M M M	 $50,000 $50,000 $50,000 $50,000 $50,000 $50,000	 $2,500 $2,500 $2,500 $2,500 $2,500 $2,500	Primary: Bellevue	City-Wide Communications (project TM_16) is required to communicate to the flood monitoring devices. These projects will be incorporated with the dynamic message signs identified in project (TM_15).	The City currently has a flood monitoring device deployed on SE 30th Street near Richards Road.	• Increase in flood awareness for the City • Decreased response time for maintenance crews • Decrease in congestion on roadways in flood zones • Increase in safety for drivers • Ability to easily monitor multiple flood locations
Information Management									
IM_01	Traffic Data Query System	This project will enhance the loop data management program in the Computran system to improve access to historic system detector data and provide access to automated traffic count information.	H	$50,000	$10,000	Primary: Bellevue	Could be packaged together with projects TM_18, TM-20 and TM_21 to potentially reduce software development cost.	Database could be integrated with the City's GIS database, with the Computran System, or a hybrid that uses both.	• Increase in staff efficiency and safety • Enhanced management of roadway operations • Better use of existing data
Maintenance and Construction									
MC_01	Roadway Weather Information System	Weather stations with roadway temperature monitoring will be included at the following locations: • Lakemont Boulevard near Fire Station 8. • The two Lakemont Bridges near I-90 • Near Somerset Elementary school. • Lake Hills Connector west of 140th Ave NE • Meydenbauer Bridge on NE Lake Washington Blvd. • NE 12th St bridge over the BNSF railroad tracks.	 H H H M M L	 $25,000 $25,000 $25,000 $25,000 $25,000 $25,000	 $1,000 $1,000 $1,000 $1,000 $1,000 $1,000	Primary: Bellevue	City-Wide Communications (project TM_16) is required to communicate to the weather stations.	The distribution of this weather information should be combined with the information currently collected by WSDOT. Some of the WSDOT weather stations may need to be enhanced to include features such as roadway temperature.	• Better, more efficient response to current weather conditions • Faster response time to ice conditions by roadway maintenance crews • Increase in available local weather information • Increase in driver safety • Increase in staff efficiency
MC_02	Portable Work Zone ITS Equipment	This project will procure portable CCTV cameras, variable speed limit signs and speed detection devices to monitor and control conditions in construction zones.	M	$80,000	$1,000	Primary: Bellevue	None	This equipment can be procured as separate portable devices or as a complete portable ITS unit.	• Increased safety in work zones • Reduction in congestion and delay
MC_03	Maintenance Vehicle AVL Tracking System	This project will track Bellevue maintenance vehicles to enhance dispatch of personnel and equipment to daily events and projects.	L	$150,000	$5,000	Primary: Bellevue			• Decreased maintenance response times • Decreased emergency response times • Increased personnel coordination

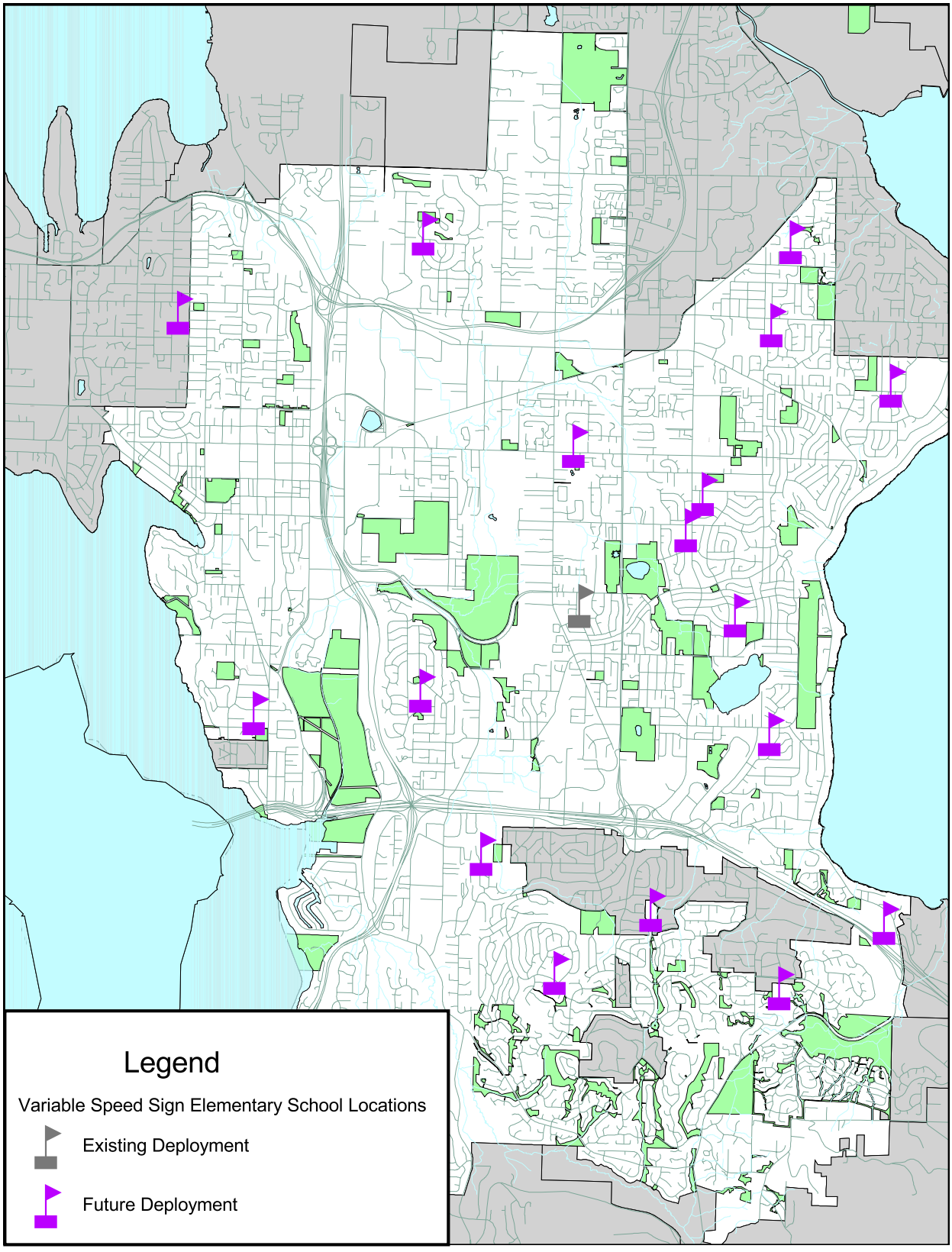


Figure E-7. Proposed Variable Speed Limit Sign Locations

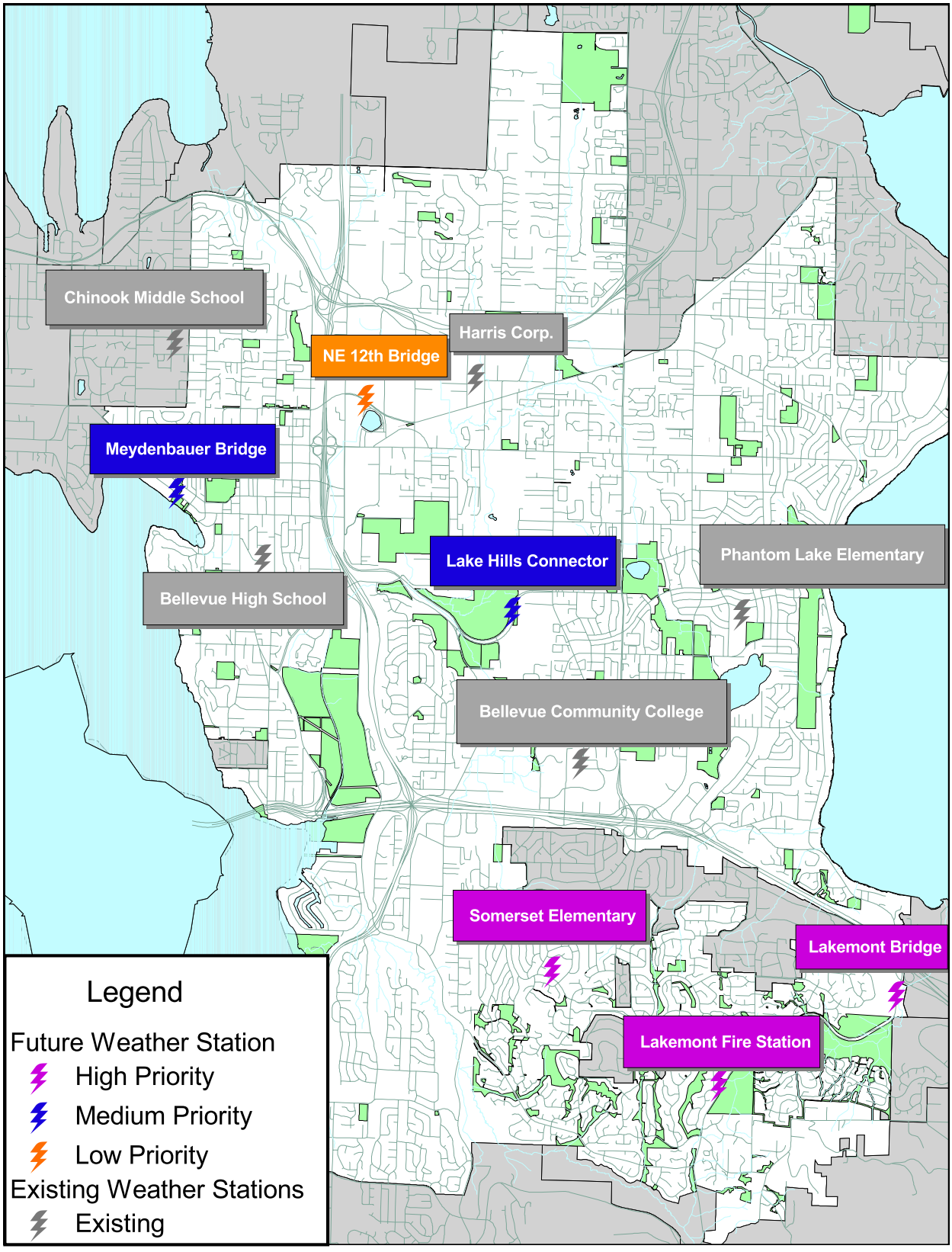


Figure E-8. Proposed Weather Station Locations

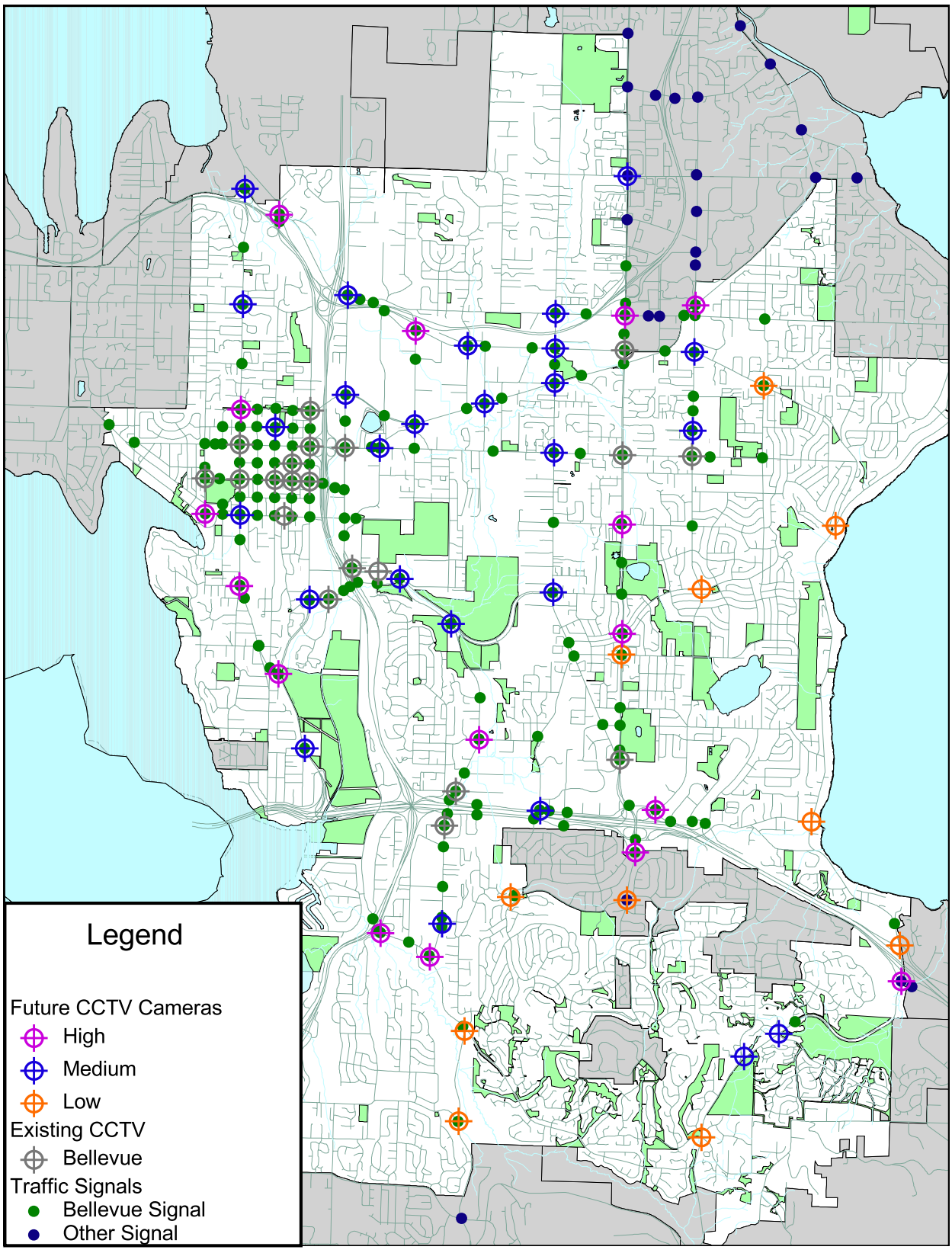


Figure E-9. Proposed City-Wide CCTV Deployment

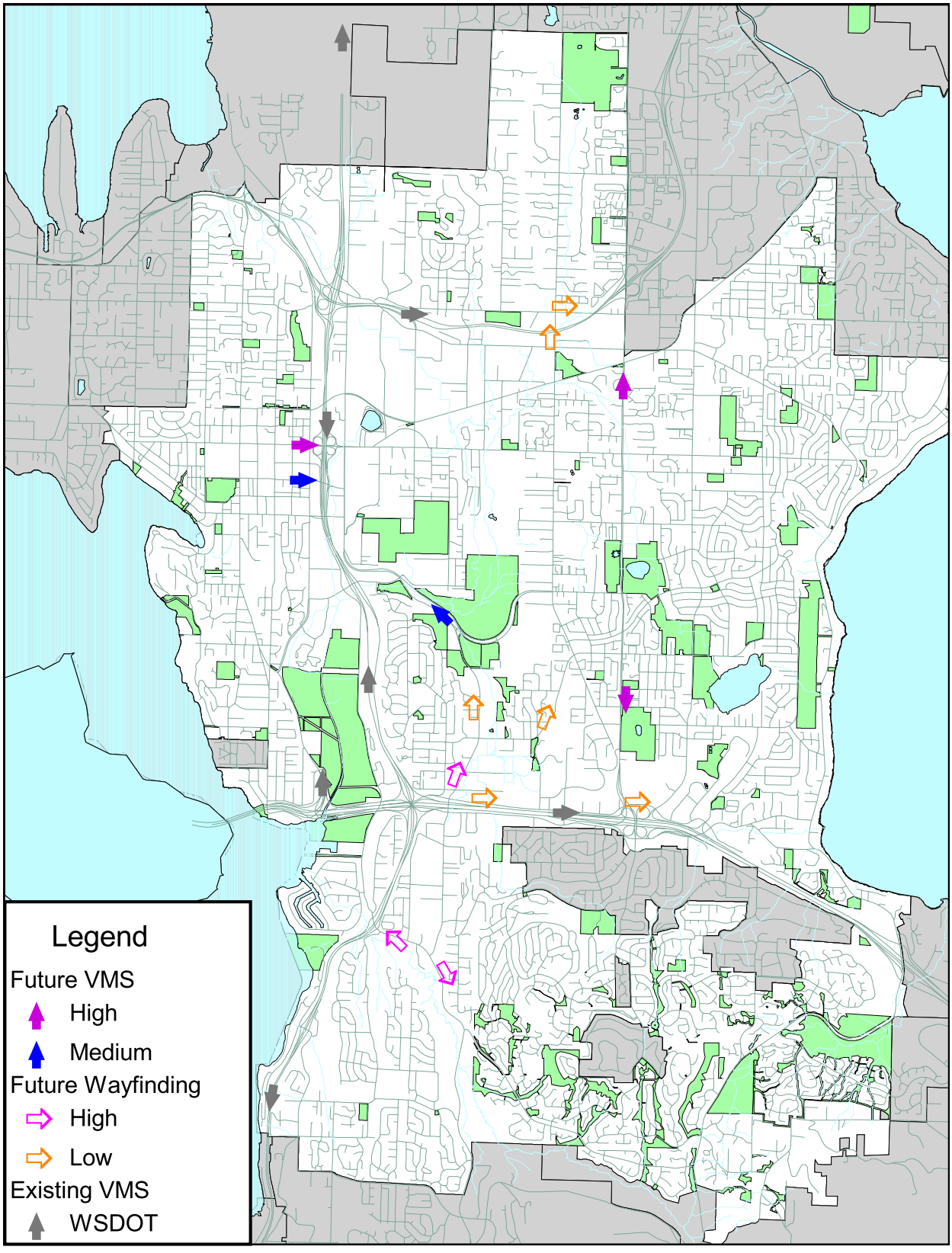


Figure E-10. Proposed Dynamic Message Signs

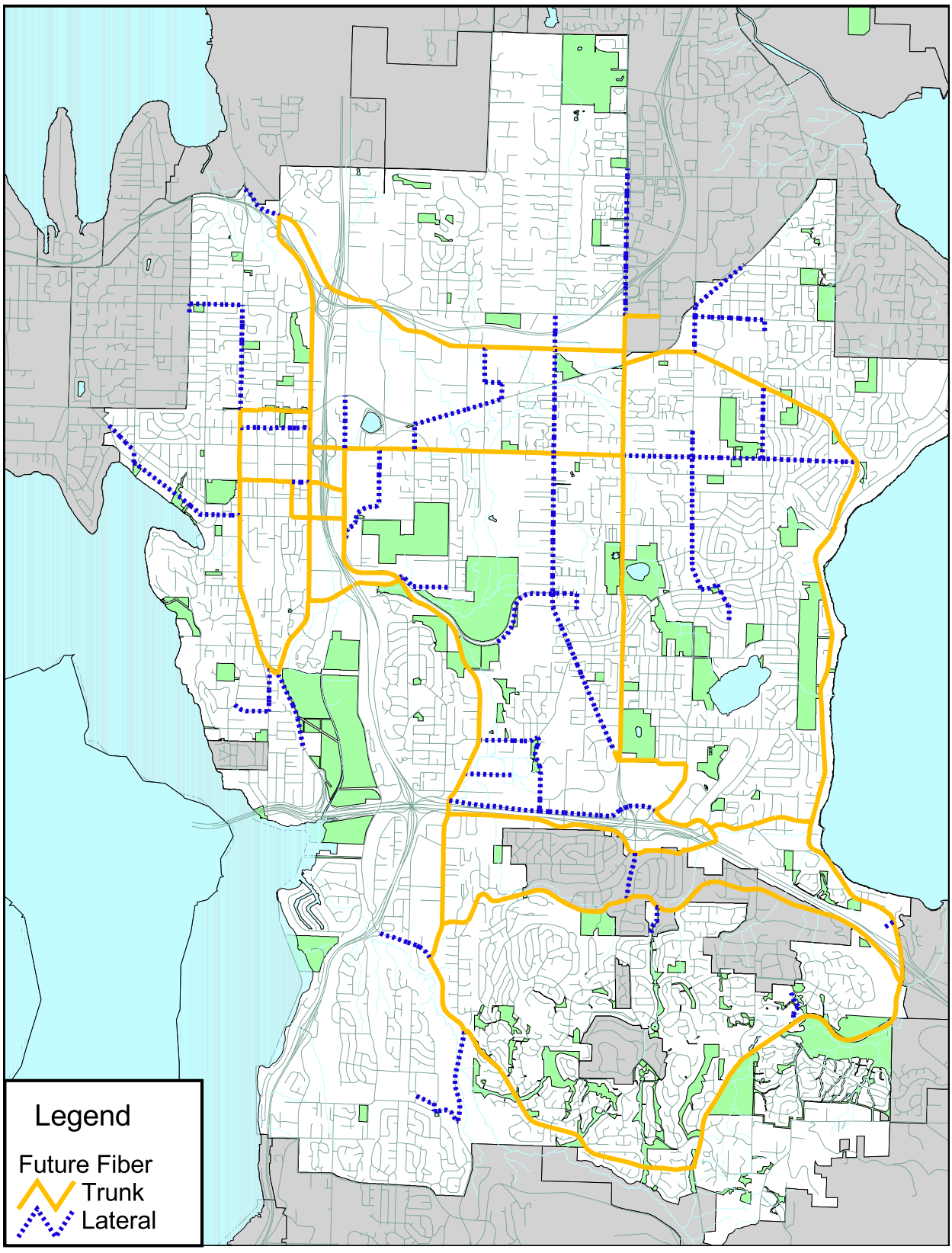


Figure E-11. Proposed Fiber Optic Communications

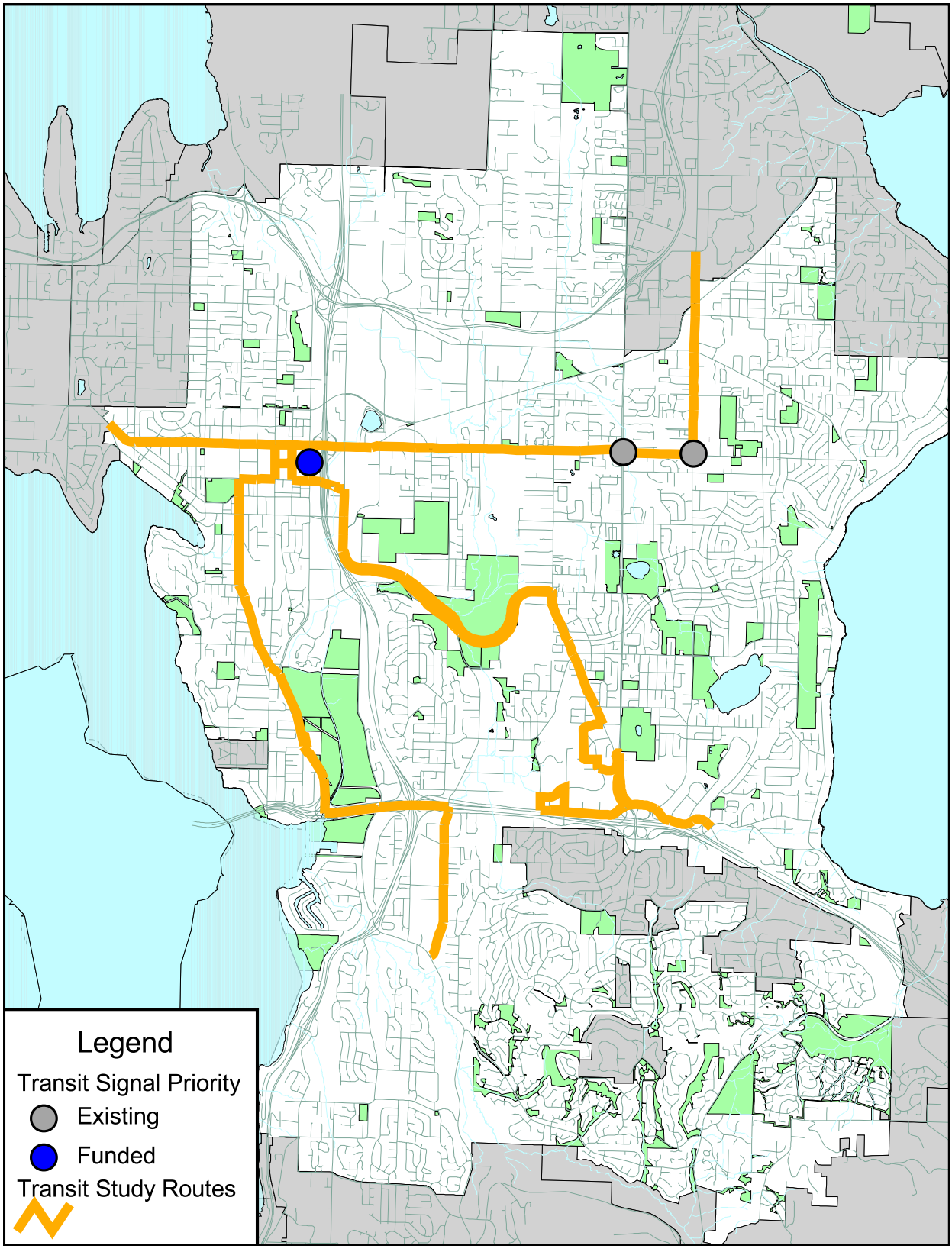


Figure E-12. Proposed Transit Signal Priority

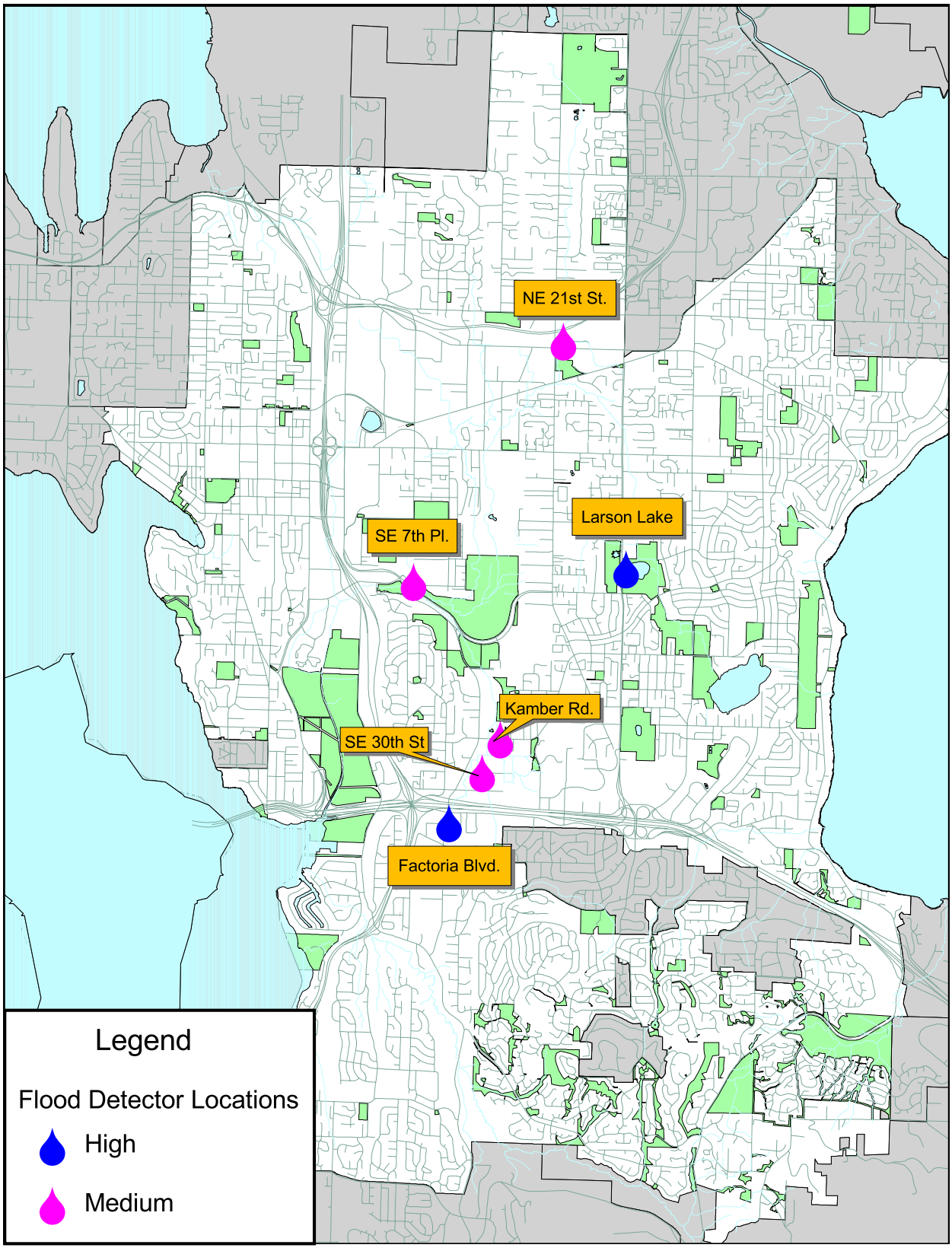


Figure E-13. Proposed Flood Warning Equipment Locations

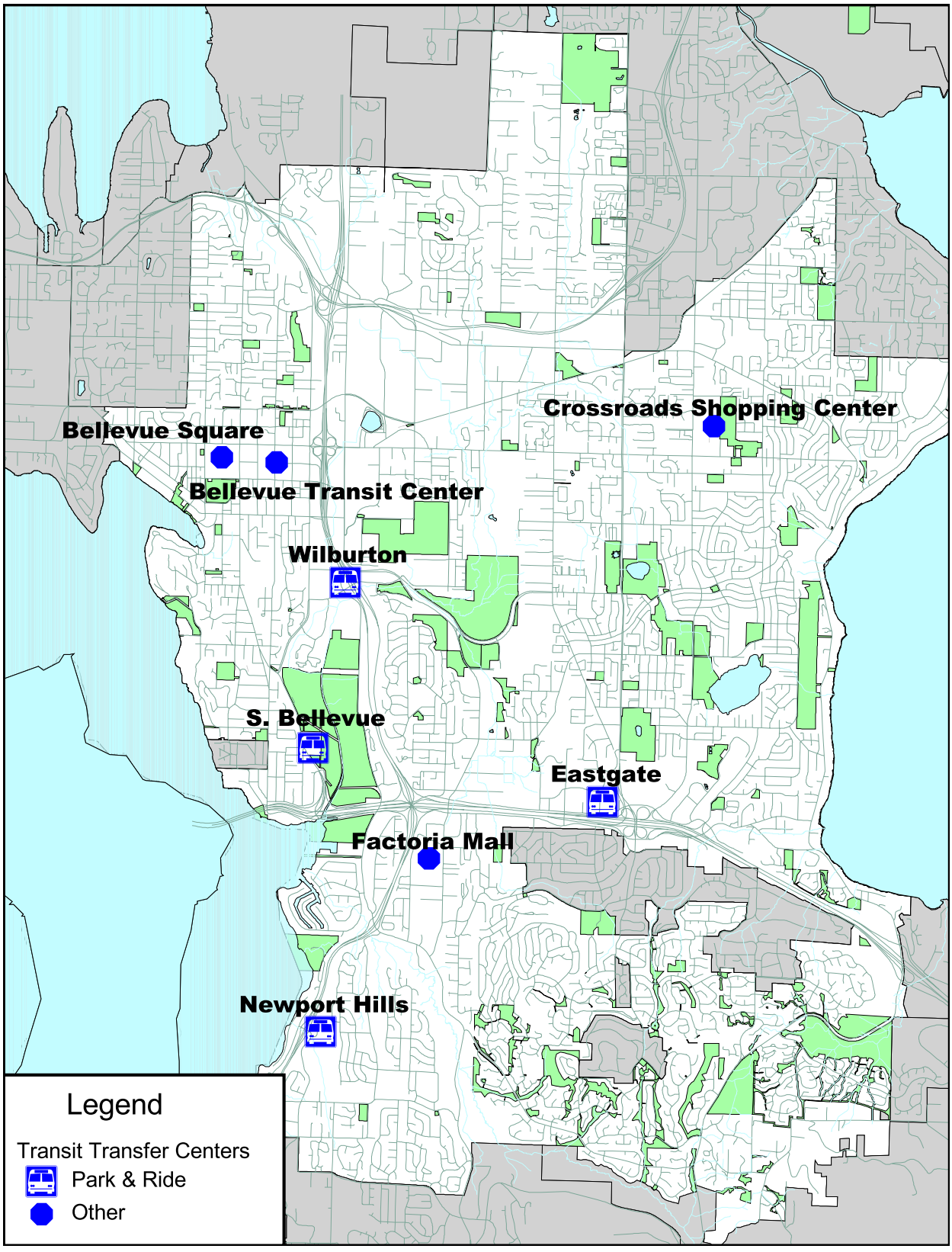
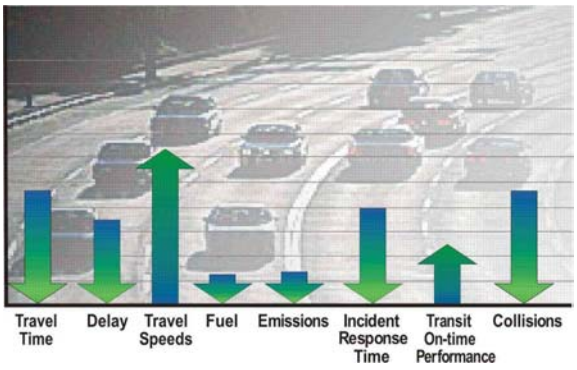


Figure E-14. Proposed Real Time Transit Arrival Signs

ITS Benefits



Implementation of the Bellevue ITS Master Plan has the potential to provide the following benefits to the City:

Improve Vehicle Travel Time

By decreasing the response time of City Staff to incidents such as flooding and icy roads, vehicle travel times can be greatly reduced. In addition, the Signal System Upgrade for TSP and TRPS will provide more options for City Staff to improve network efficiency.

Improve Traveler Safety

Driver feedback signs, variable speed limit signs and photo enforcement will increase safety by reducing vehicle speeds and erratic behavior at signalized intersections. City facility, flood, and weather monitoring will improve the safety of the City's roadways and infrastructure by reducing maintenance response time.

Improve Emergency Management

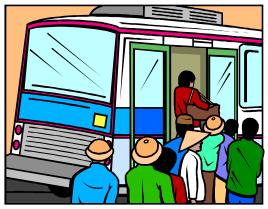
Projects like Intra-Agency Video Sharing, Traffic Information on Mobile Data Terminals, and City-Wide CCTV Deployment provide more critical information to emergency personnel; therefore increase their ability to respond to emergencies.

Improve Communications Coverage and Reliability

Both the City-Wide Communications project and the Communications to Isolated Signalized Intersections project will add scalability and redundancy to Bellevue's communications infrastructure.

Improve Traffic Conditions Awareness

Permanent Highway Advisory Radio, Dynamic Route Guidance, Automatic Commuter Alert System, Dynamic Message Signs and the Downtown Parking Management System all provide information to motorists that can be used to adjust their trip patterns based on real-time information.

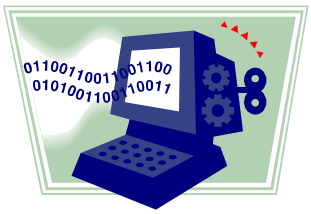


Improve Transit Speed and Reliability

Transit Signal Priority and Smart-Bus TSP Enhancements encourage transit use by decreasing transit travel time.

Improve Interagency Communication

The Center-to-Center Integration with Redmond and WSDOT will provide traffic managers with the traffic data and video necessary to manage traffic effectively near agency boundaries.



Improve Data Management

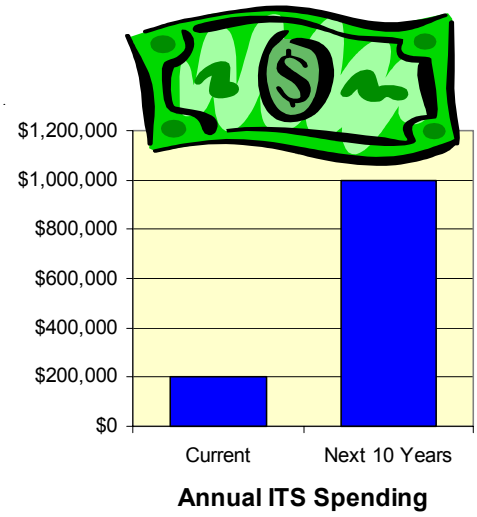
Projects like the creation of a Traffic Data Query System and an Arterial Congestion Map will provide City staff with the data needed to enhance the operations of Bellevue's surface street network.

Improve Staff Efficiency

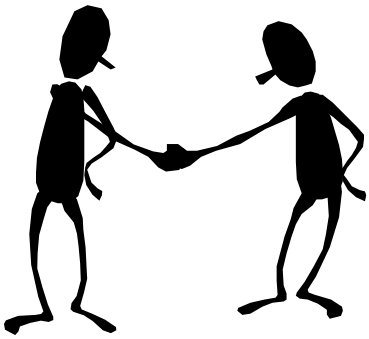
By adding the ability to remotely monitor weather, flooding and arterials, City staff will increase their efficiency to monitor and respond to traffic and weather related incidents and emergencies.

Next Steps

Completion of this plan is just the beginning of the work required to meet the City's ITS vision. The next step is to find ways to fit ITS into the future capital and O&M expenditures for the City. The City currently spends roughly $200,000 a year on ITS related projects. To keep up with the deployment goals developed in this ITS plan, the City will need to increase this value to roughly $1.0M a year for the next ten years.



Annual ITS Spending



Given today's budget conditions, allocating this amount of money into the City's annual budget would be difficult. However, opportunities exist to use a small portion of local funds to match state or federal grant money. Partnering with local transit agencies on ITS projects can also open additional funding doors. There is also homeland security money available from the federal government for projects that enhance emergency management and surveillance.

The future of ITS in Bellevue will also rely on the maintenance of this document. The City should reevaluate it's ITS needs every three to five years and update their list of projects and priorities, as well as the Regional Architecture. An updated and evolving plan will better position the City to take advantage of opportunities to deploy ITS projects.

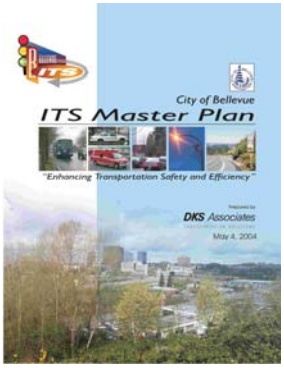
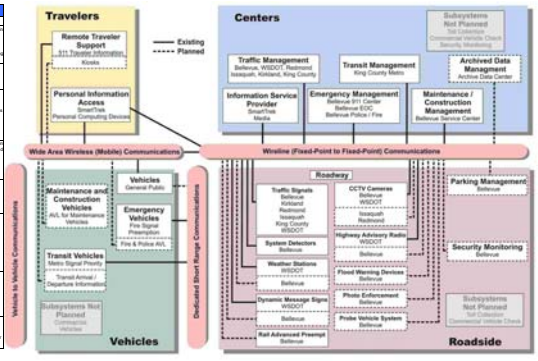


Table E-5. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Responsibility	Funding Source & Other Projects	Other Considerations	Expected Benefits
Travel and Traffic Management									
TM_01	Bicycle Detection	This project will install permanent bicycle detection throughout the City on arterials designated as bike routes and on bike trails. This project does not include bicycle detection at signalized intersections. A total of 10 locations are assumed.	M	$50,000	$2,000	Primary: Bellevue	Requires communications through the City-Wide Communications Project (TM_16).	The communication requirements for the bike detectors is minimal so it may be possible to use existing signal interconnect. A larger issue will be tying power to detector sites on bike trails away from existing lighting or traffic signal circuits.	• Reduce staff time needed to set detectors in the field • Increase available data for evaluating bicycle usage in Bellevue • Better meet the needs of the Bellevue biking community
TM_02	911 Computer Aided Dispatch Interface	This project will provide a direct interface with the Bellevue 911 Computer Aided Dispatch system to automatically post incidents related to the Automated Commuter Alert System.	M	$150,000	$10,000	Primary: Bellevue	Feeds incident data to the Automated Commuter Alert System (TM_08).	The incident reporting system could be a stand alone program. The platform for this program will be evaluated further when the City's ITS Plan is updated.	• Increase driver awareness of traffic conditions • Decrease traffic operations staff time • Improve driver safety
TM_03	Photo Enforcement	This project will deploy photo enforcement for speeding and red light running. For this project, it is assumed Bellevue will deploy this equipment at 5 sites.	L	$375,000	$300,000	Primary: Bellevue	None	The City is interested in deploying photo enforcement equipment, but its use will depend on photo enforcement lawmaking in the state. The O&M cost for this project could be significantly reduced if Bellevue contracts with a vendor that installs, operates and maintains the equipment for a percentage of the fines paid by violators.	• Reduce red light running and speeding in the City • Improve driver safety • Reduce accidents at high accident locations
TM_04	Traffic Management Center Build-out	This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall.	H	$500,000	$10,000	Primary: Bellevue	None	Although this is a high priority project, the TMC is functional with the existing equipment leaving the option open for a phased deployment and build out of equipment.	• Replacement of antiquated/failing equipment • Increased flexibility for viewing cameras and signal system timing • Space for multiple operators • Improved emergency management and operation capabilities
TM_05	Dynamic Route Guidance	This system will automatically calculate the ideal route between two points based on real-time roadway congestion data. Initially this project would be used to provide route information for emergency vehicles.	L	$200,000	$10,000	Primary: Bellevue	This project will require congestion data collected in the Arterial Congestion Map project (TM_18).	This system could be mapped using the City's GIS database.	• Decrease in response time for emergency vehicles • Decrease in travel time for motorists
TM_06	Automated Commuter Alert System	This system will automatically alert motorists through e-mail, pagers and other wireless devices of potential issues along their predefined commute route. This system would require that users enter their commute data into a database that could be queried by the commuter alert system. The incident database could be shared with the media and posted on the internet.	M	$100,000	$5,000	Primary: Bellevue	None	The City would like to expand upon their current e-mail alert system for the Downtown Access project by sending out real time information. The current e-mail system only addresses planned events.	• Availability of real-time incident information • Improved traffic coverage of Bellevue by local media • Reduction in congestion around incident locations
TM_07	Downtown Parking Management System	This project will install active signs around Bellevue Square to direct motorists to parking facilities with available parking. This project assumes monitoring equipment for the west and southeast parking facilities (it already exists for the northeast facility) and four advisory signs.	L	$300,000	$15,000	Primary: Bellevue Secondary: Bellevue Square Management	None	This project will require the cooperation of the Bellevue Square Management.	• Reduce driver frustration during shopping season • Reduce congestion around mall due to circling traffic • More efficient use of parking
TM_08	Permanent Highway Advisory Radio (HAR)	A permanent HAR will be located in Bellevue to notify motorists of incidents or construction in the HAR region.	M	$20,000	$1,000	Primary: Bellevue	None	The frequency and location of the antenna will need to be coordinated with WSDOT's HAR equipment.	• Increase availability of real-time traveler information • Reduce congestion and delay • Increase flexibility for distribution of traveler information



Reevaluate ITS Plan Every 3 - 5 Years: Needs, Prioritized Project List and Regional Architecture

CHAPTER 1 ASSESSMENT OF EXISTING CONDITIONS

1.1 INTRODUCTION

This chapter provides an assessment of existing conditions to determine the extent of intelligent transportation system (ITS) elements in the City of Bellevue. This chapter includes an inventory of existing ITS infrastructure that is currently operated and maintained by the City of Bellevue, planned ITS projects, and a review of recent studies that include ITS components. The assessment of existing conditions is intended for use in the development of the ITS needs for the region. The existing conditions will be reviewed in detail to find holes or deficiencies in the current ITS system.

1.2 EXISTING ITS INVENTORY

This section provides an overview of the existing intelligent transportation related infrastructure that is currently operated and maintained in the City of Bellevue, including the traffic signal systems, communications networks, traffic management center, Closed Circuit Television (CCTV) cameras, portable ITS equipment, regional Washington State Department of Transportation (WSDOT) ITS equipment and emergency management services.

1.2.1 Traffic Signal System

Bellevue's traffic signal system consists of 175 signalized intersections and a Computran central signal system located in the traffic management center in the Leavitt building on the City Hall campus. The Computran central signal system has twisted wire pair communications to 152 of the City's 175 traffic signals. The Computran system uses a server managed control system for performing coordination, traffic responsive plan changes, transit signal priority operations, signal event logs and signal operation surveillance. Bellevue has five work stations available to control the system, four at the Leavitt building and one at the Bellevue Service Center (BSC). Figure 1-1 displays the existing traffic signals within the City of Bellevue. The City of Bellevue operates and maintains traffic signals located on City roadway facilities and at all the WSDOT owned intersections within Bellevue except for the Lakemont Boulevard and Newport Way intersection. The specific traffic signal equipment and the ITS operations used at the signalized intersections are described below.

Traffic Signal Controllers and Coordination

Existing traffic signals within the City of Bellevue are controlled by Traconex 390 and Econolite ASC/2S controllers, which are housed in TS-1 cabinets. The use of the two controllers throughout the city is approximately equal.

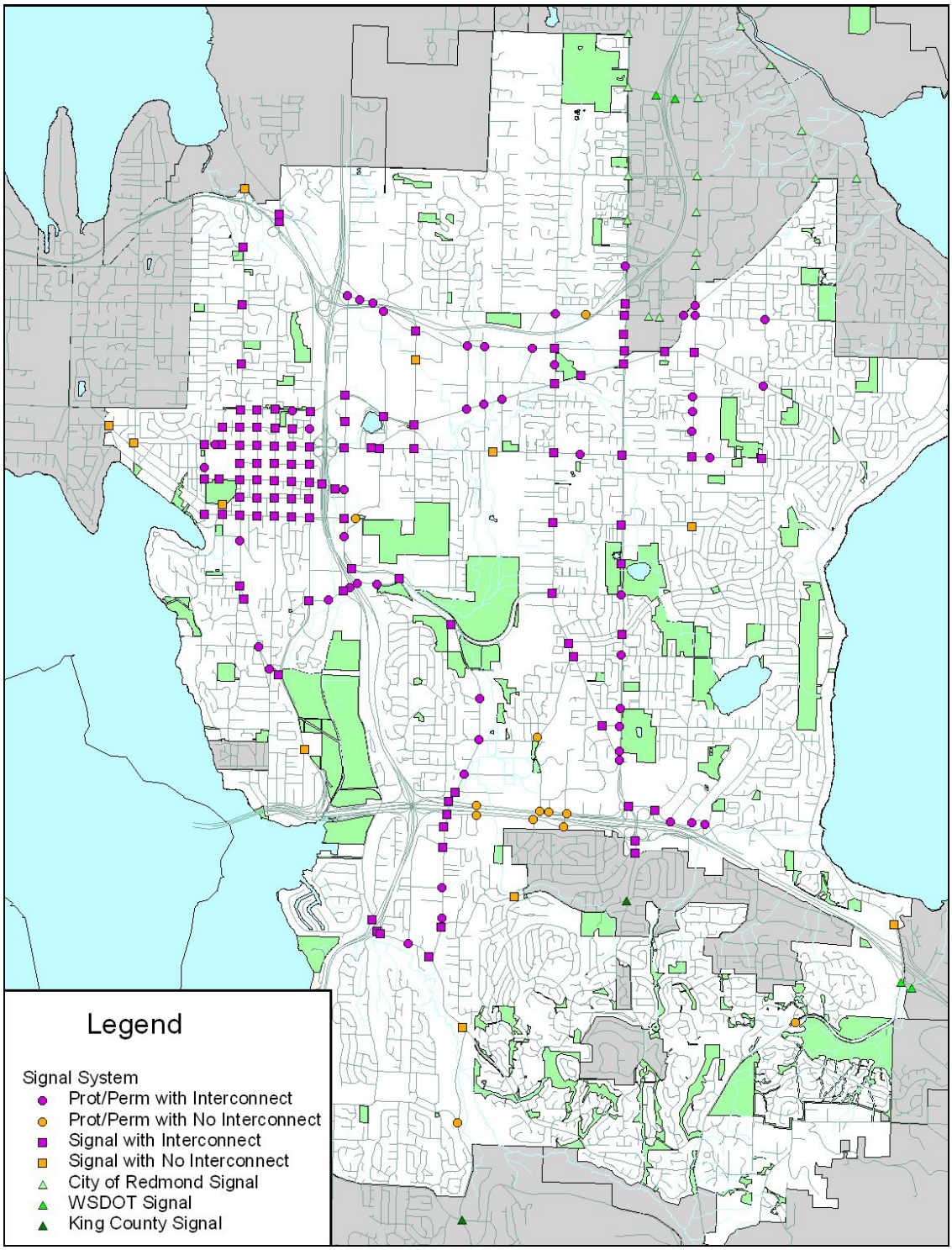


Figure 1-1. Existing Traffic Signals

Time-of-day coordination signal timing and traffic responsive pattern selection is controlled through the central signal system. The Computran system is not the native signal system for either controller so special software and hardware modifications are required to communicate to both controllers. With the Econolite controller, all the command deciphering is done in the controller. The Traconex controllers use a Sonex box for communication translation of time-of-day commands sent from the central system. The commands include hold-on-line, holds, force-offs, and special functions. Traconex controllers are being phased out and replaced with Econolite controllers at a rate of approximately 20 per year.

The intersections that do not communicate with the central system are either running free or change between two maximum split settings by time-of-day.

Emergency Vehicle Preempt

All traffic signals in the City of Bellevue are equipped with emergency vehicle preemption (EVP). EVP allows emergency vehicles to send a message to a traffic signal alerting it of the vehicles pending arrival. The signal will then shut down all movements at the intersection except for the direction that the emergency vehicle is traveling so that the vehicle can decrease response times to incidents. Emergency vehicles are equipped with emitters that send a high intensity light in visible and infrared wavelengths. The light is detected by EVP detectors mounted on the traffic signal mast arms. The detectors communicate through EVP discriminators to notify the traffic signal controller that an emergency vehicle is present. The City of Bellevue does not code block their EVP discriminators to lock out certain emitters, therefore, any emergency vehicle with an emitter can activate a traffic signal preempt in Bellevue.

The Bellevue, Redmond and Kirkland fire departments are the emergency vehicle operators in the region that use Bellevue's preempt most frequently. There is a joint response agreement between these three fire departments. Bellevue fire also operates a fleet of aid vehicles in the City that are equipped with emitters. Bellevue's Police Department has three emitters they are testing for impact to fire and traffic operations.

Transit Signal Priority

The City of Bellevue currently has transit signal priority (TSP) at the intersections of NE 8th Street/148th Ave NE and NE 8th Street/156th Ave NE. TSP antennas detect transit vehicles and either truncate non TSP phases or extend the green time on the TSP phase to reduce transit delay at the signalized intersection. TSP is a major component included in the Bellevue Transit Plan, which identified 82 potential TSP sites that could be implemented in the future.

Data Stations/System Detectors

Bellevue uses inductive loops tied to signalized intersections to collect volume and occupancy information for traffic responsive signal timing and in the future would like to use these detectors to enhance Bellevue's traffic count program as well. The detectors are typically located in one of three possible positions near the signalized intersection: 300 feet in advance of the intersections; 50 to 100 feet downstream of the intersections; or mid-block. There are approximately 500 system detectors in the City limits. Figure 1-2 illustrates the data stations infrastructure in the Bellevue region.

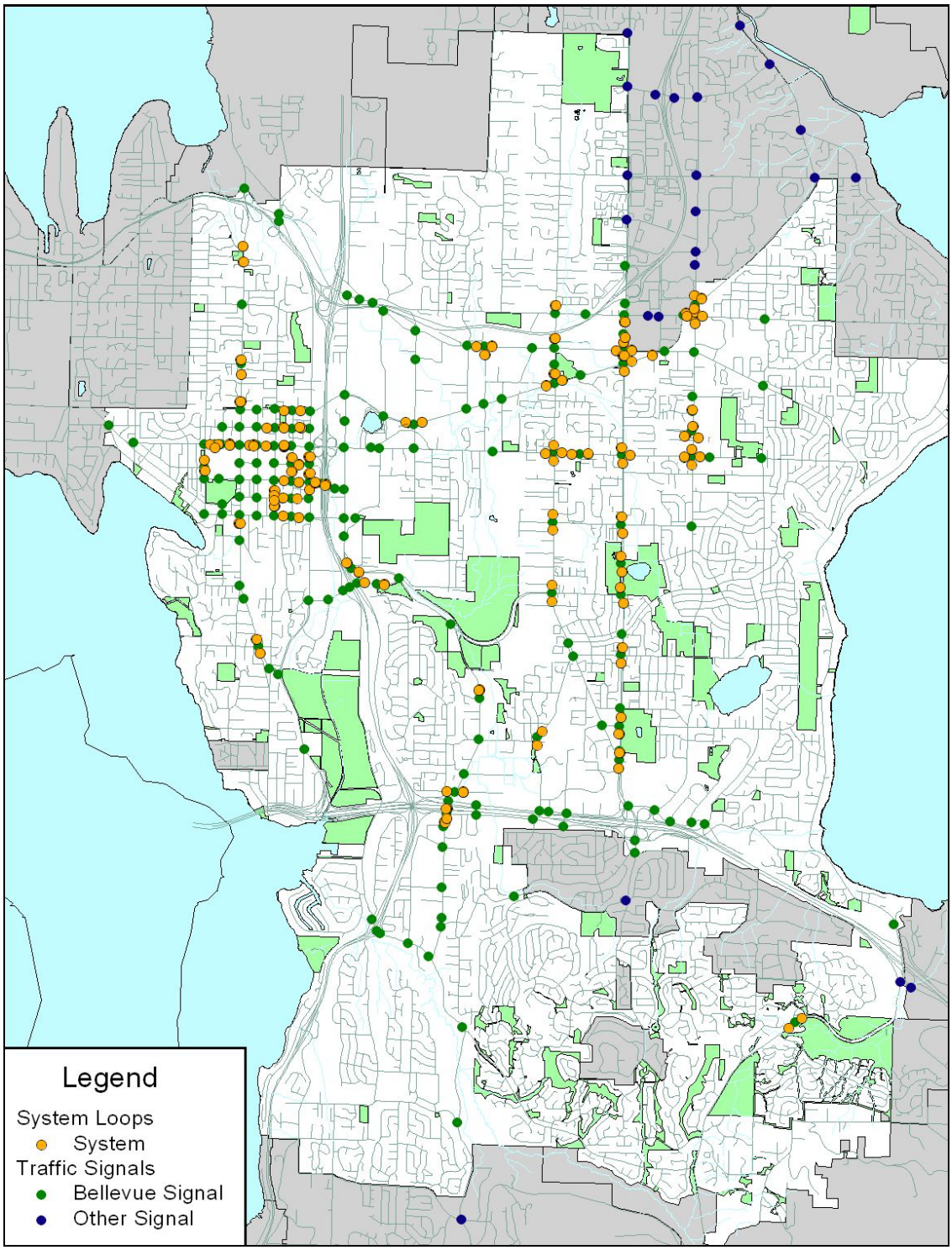
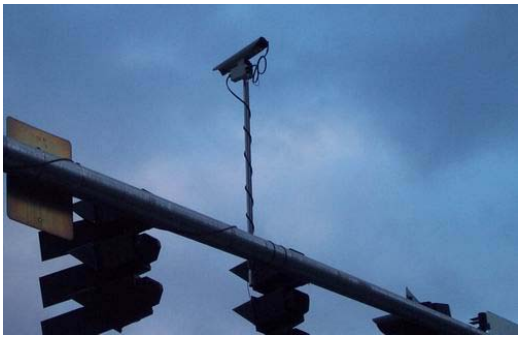


Figure 1-2. Data Station Locations

Other Detection



Bellevue uses inductive loops as their primary vehicle detection method. The City frequently uses video and microwave detectors during construction. The video and microwave detector's ease of installation and removal, as well as the ease to modify detection zones, make these forms of detection ideal for temporary applications.

1.2.2 Communications

One of the most critical components to deploying ITS is the communications system. Bellevue must be able to monitor, control and operate traffic management devices from their workstations to effectively manage the movement of motorists. The City has an extensive communication system already in place for the Traffic Engineering Division and the Information Technology (IT) Department. Bellevue's IT Department has single mode fiber running aerially and underground connecting City Hall to the Bellevue Service Center, the parks office, and fire stations. The Traffic Engineering and IT departments work together to deploy communications in the City. Whenever one department is digging up a street to install conduit, a spare conduit is typically installed for the other department.

Communications for Bellevue's CCTV cameras utilize multi-mode fiber. Traffic signal technicians prefer multi-mode fiber because it is easier to splice. Single-mode fiber requires fusion splicing equipment that can cost up to $15,000, whereas multi-mode fiber can be spliced with mechanical splices that cost roughly $30 per splice. Although multi-mode fiber is cheaper to install and easier to maintain, the City is starting to notice the limitations of its bandwidth and transmission distance. Future fiber deployment for traffic signal operations may require a combination of single-mode and multi-mode.

All traffic signal interconnect in the City uses copper twisted wire pair. No fiber is currently used for signal interconnect.

The Bellevue School District currently uses King County's Institutional Network (I-NET) for communications between schools. I-NET is a leased communication system developed by King County to provide fiber optic communications for public facilities in the County. The fiber is leased from AT&T. Figure 1-3 illustrates the communications infrastructure in the City of Bellevue including signal interconnect, fiber-optic cable, and unused conduit.

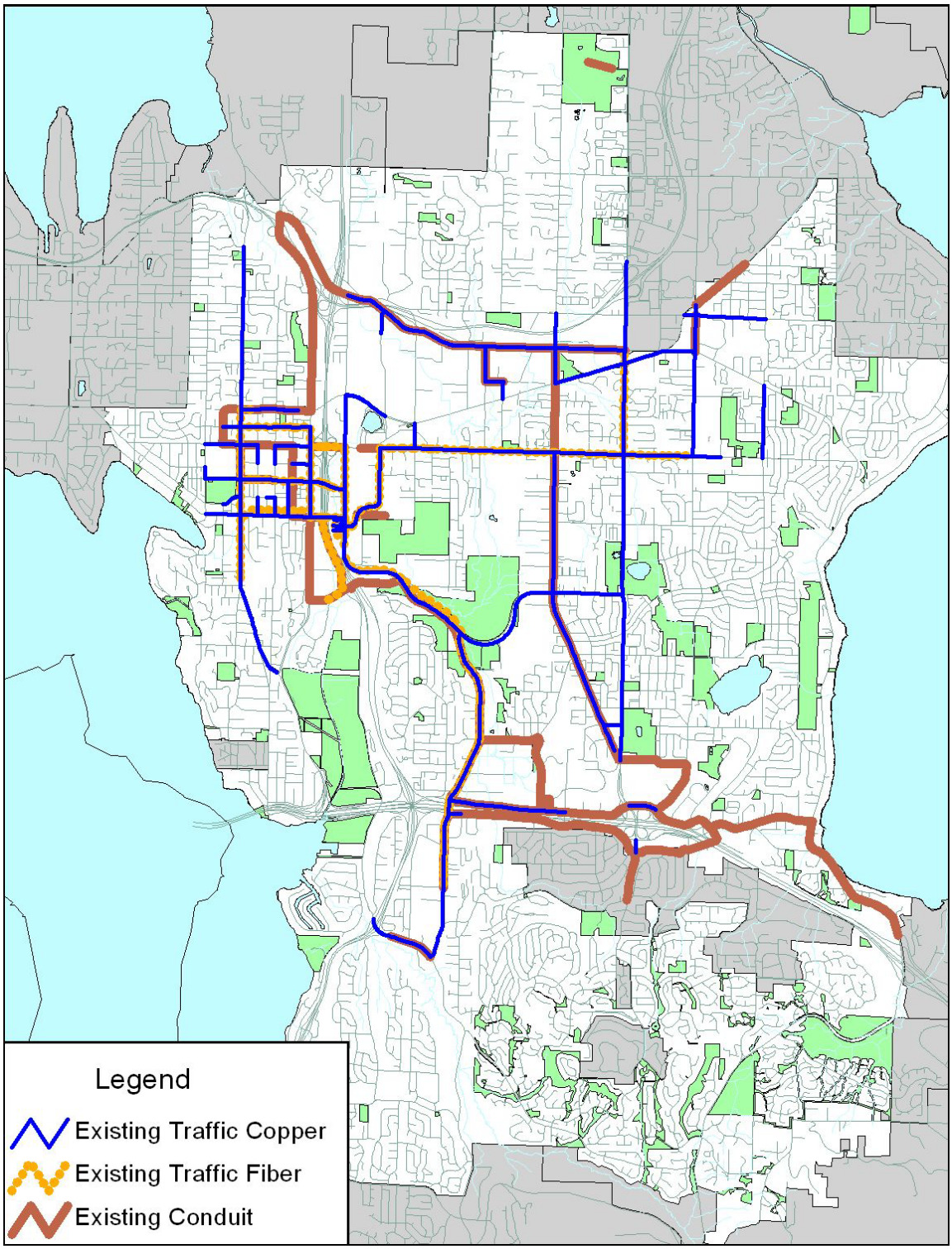


Figure 1-3. Communications Infrastructure

1.2.3 Traffic Management Center

Bellevue's traffic management center (TMC) is located in the Leavitt Building on the City Hall campus and consists of one console for operating the signal systems and camera control equipment, two large front projection monitors, and three small monitors for viewing the CCTV cameras located throughout the City. A new TMC will be provided in the new City Hall, but the ultimate build-out of the new space is still undetermined. The new TMC is discussed further in Section 1.3.1.

1.2.4 CCTV Cameras

The City of Bellevue currently has pan-tilt zoom cameras at 20 key locations throughout the city for viewing and monitoring traffic operations. The City also has the ability to share video with WSDOT and will potentially share with the Fire Department (including the Emergency Operations Center), Police Department, and utility maintenance in the future. The City of Bellevue cameras can be controlled at the TMC as well as the BSC Signal Shop. With their existing video switch, they can support 32 images in and 16 images out, with the capacity to expand to 1280 cameras in and 256 images out by adding more chassis to their 84 inch rack. These cameras are operated using the Cohu NetCAMS software or a standard desktop joystick. Bellevue can send up to 15 video channels to WSDOT for viewing. Currently WSDOT does not have the ability to control or select video channels for viewing; the channels are assigned manually. Bellevue receives one video channel from WSDOT that they can use to select any WSDOT camera; however Bellevue does not have the ability to control the cameras. The existing CCTV locations are depicted in Figure 1-4 along with the WSDOT CCTV locations.

1.2.5 Driver Feedback Signs

The City currently operates approximately 20 driver feedback signs at locations where drivers commonly drive faster than the posted speed limit. The signs work by electronically displaying a driver's speed. When a vehicle exceeds the speed limit, the signs will flash the vehicle's current speed to warn drivers to slow down.

1.2.6 Variable Speed Signs

There are currently only two locations in Bellevue with variable speed signs, although the City envisions a roll out of these signs to 18 elementary schools in the near future. The signs have the ability to change the posted speed limit based on both the day and the time of day. In Bellevue, these signs are used to slow driver's speeds in school zones when students are most likely to be present.

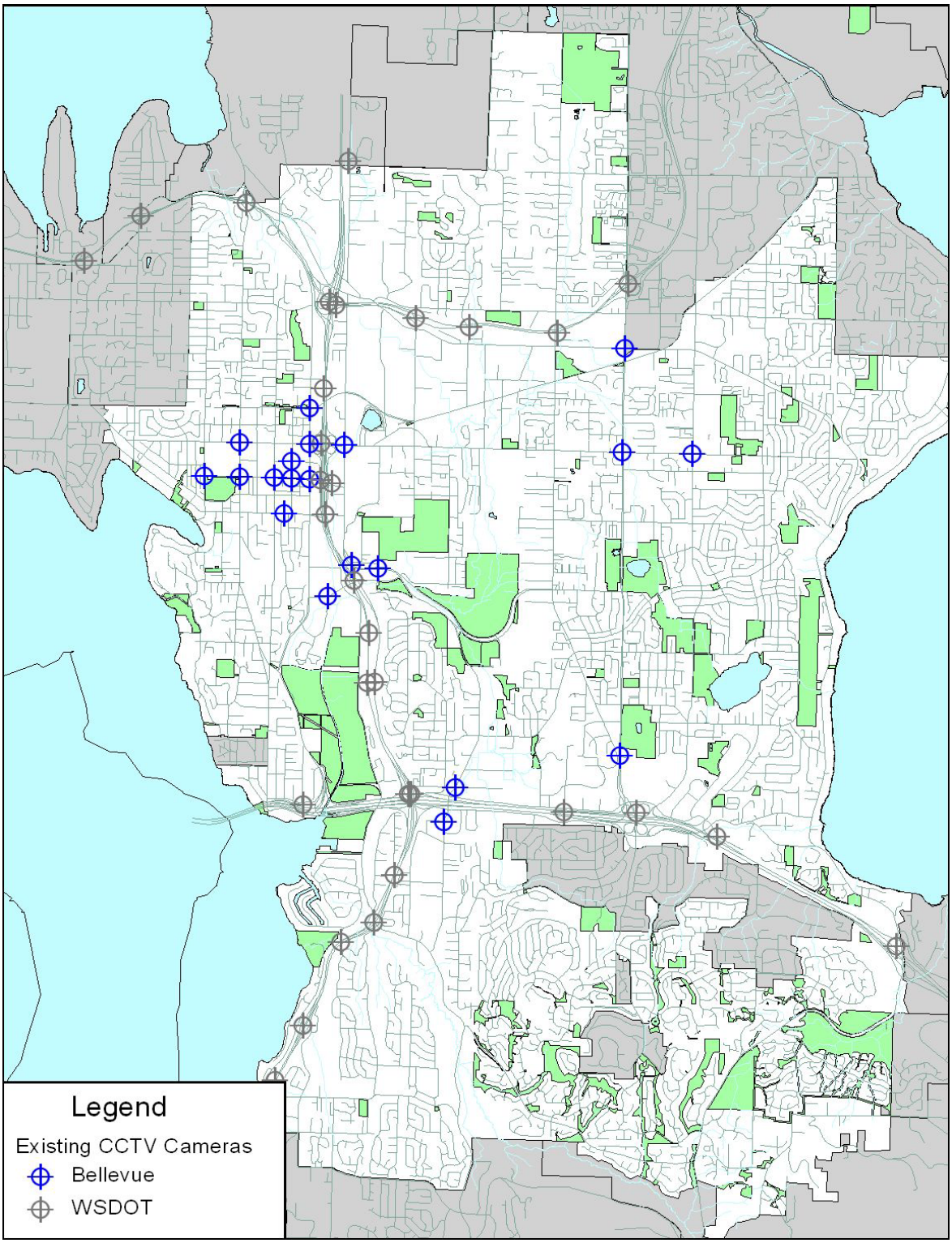


Figure 1-4. Existing CCTV Cameras

1.2.7 Portable ITS Equipment

Bellevue uses portable ITS equipment to provide travelers with traffic information regarding special events such as the holiday shopping season in downtown Bellevue. The city currently operates a portable advisory radio station, licensed for 1270 AM. This device is used to broadcast messages relating to travel, such as road conditions, weather, detour directions, and emergency conditions for motorists. Bellevue has two portable variable message signs used to provide travel information similar to the advisory radio.

1.2.8 Regional WSDOT ITS Equipment

WSDOT has a wide array of ITS equipment within the Bellevue region. WSDOT operates 29 cameras along the three primary WSDOT facilities in Bellevue (SR-520, I-90 and I-405). 17 of these cameras can be viewed from links on the WSDOT traffic conditions website. This site also links to the City of Bellevue's website where views from Bellevue's cameras are posted. The WSDOT cameras are shown with the City cameras in Figure 1-4.

WSDOT operates a total of 24 ramp meters located on the on-ramps to I-90, SR-520, and I-405 in Bellevue. The ramp meter locations are shown in Figure 1-5.

Source: WSDOT website. http://www.wsdot.wa.gov/pugetsoundtraffic/cameras/

WSDOT also operates six variable message signs in Bellevue: two signs are located northbound and southbound on I-405 approaching I-90; one sign is eastbound on I-90 approaching I-405; one is on Bellevue Way southbound approaching I-90; one is westbound on SR-520 approaching I-405; and one is northbound on I-405 approaching SR-520. There is also a sign just north of the city limits on southbound I-405 approaching SR-520. The variable message signs are displayed in Figure 1-6.

There are two WSDOT operated highway advisory radio (HAR) transmitters located in Bellevue, one at the SR-520/I-405 interchange and one at the I-405/I-90 interchange. Figure 1-7 shows the antenna locations and the approximate transmitter coverage for all the WSDOT HARs in the Puget Sound region.

WSDOT also operates numerous data stations on Bellevue area freeways. These data stations are used to collect current traffic volumes, speed and occupancy. The occupancy data is used to show congestion information on the WSDOT website as shown in Figure 1-8.

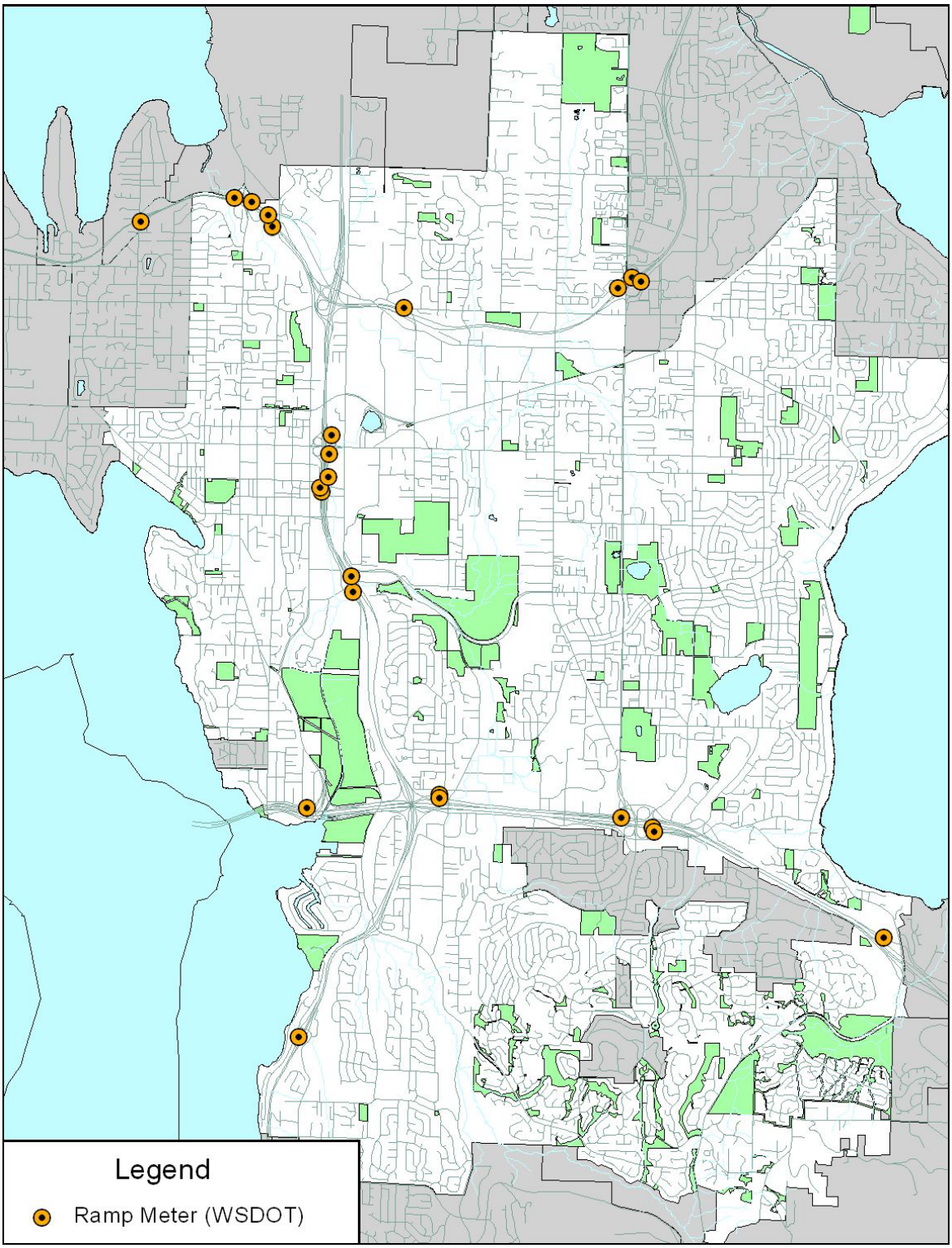


Figure 1-5. Existing Ramp Meters

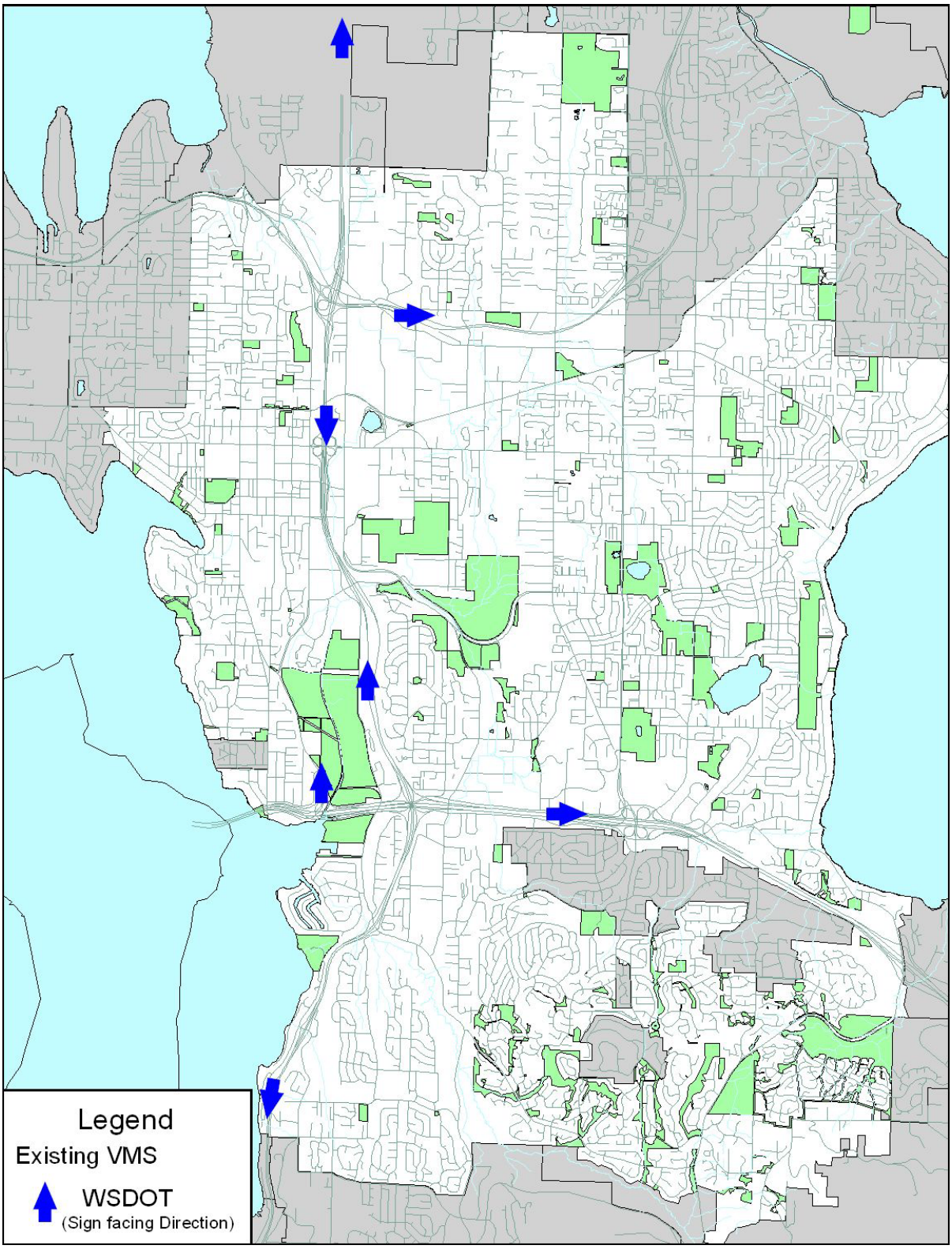


Figure 1-6. Existing Variable Message Signs

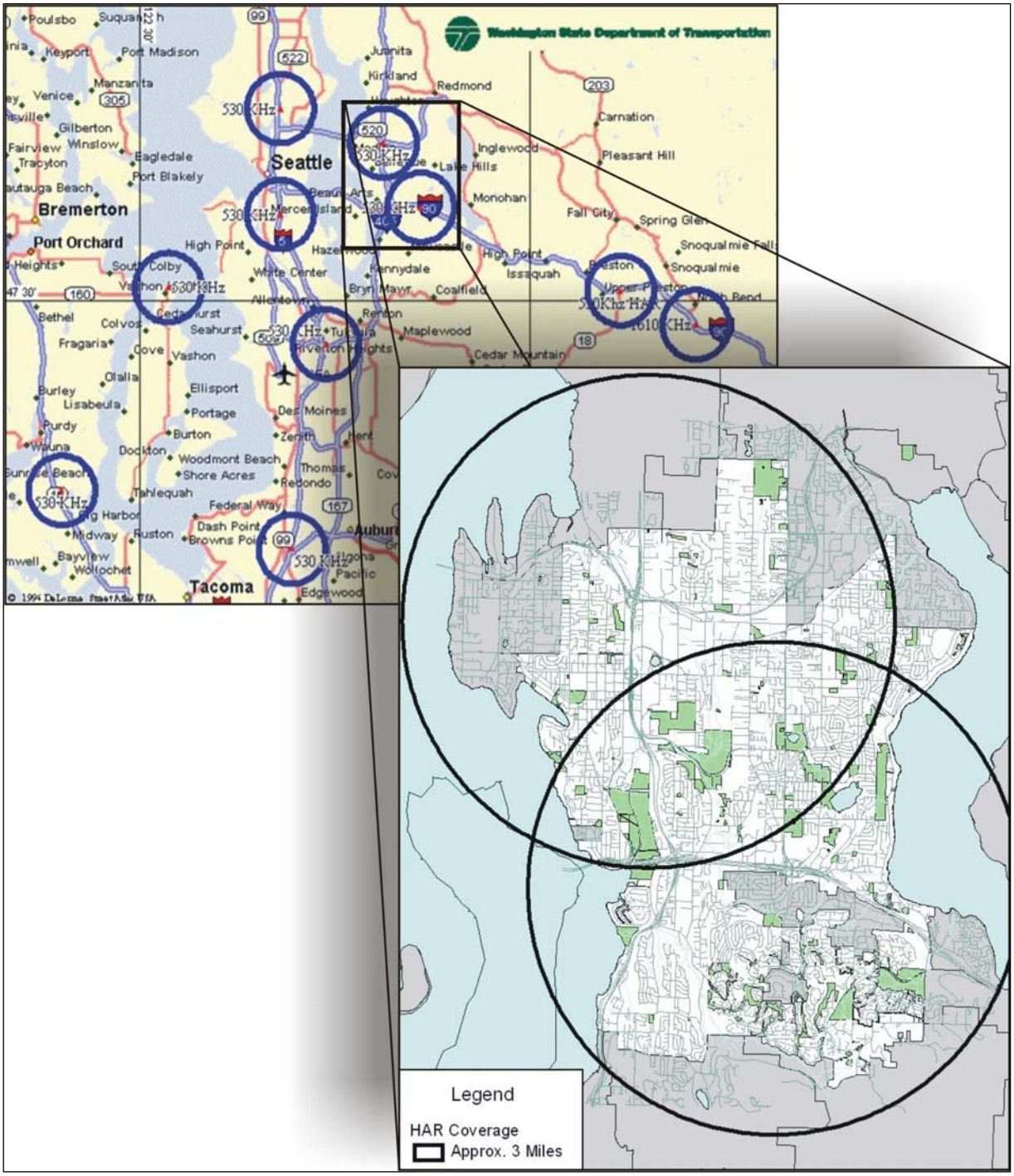
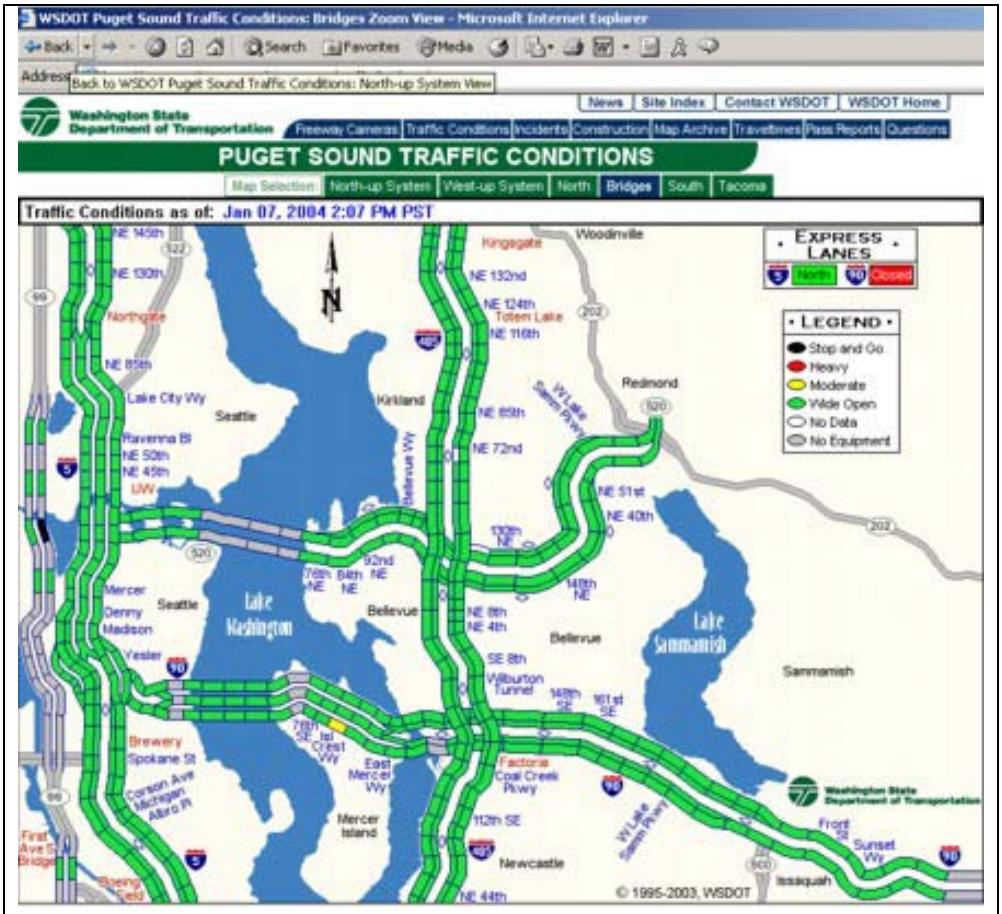


Figure 1-7. Existing Highway Advisory Radios



Source: http://www.wsdot.wa.gov/pugetsoundtraffic/bridges.shtm

Figure 1-8. WSDOT Traffic Conditions Web Page

1.2.9 Other ITS Related Equipment

There are five weather stations deployed in the City of Bellevue for providing weather information via the WSDOT weather website (http://www.wsdot.wa.gov/traffic/weather/) and local TV station websites. These sites provide information such as ambient temperature, wind speed, barometric pressure, rainfall accumulations, and in some locations, roadway temperature. Figure 1-9 gives the location of these sites.

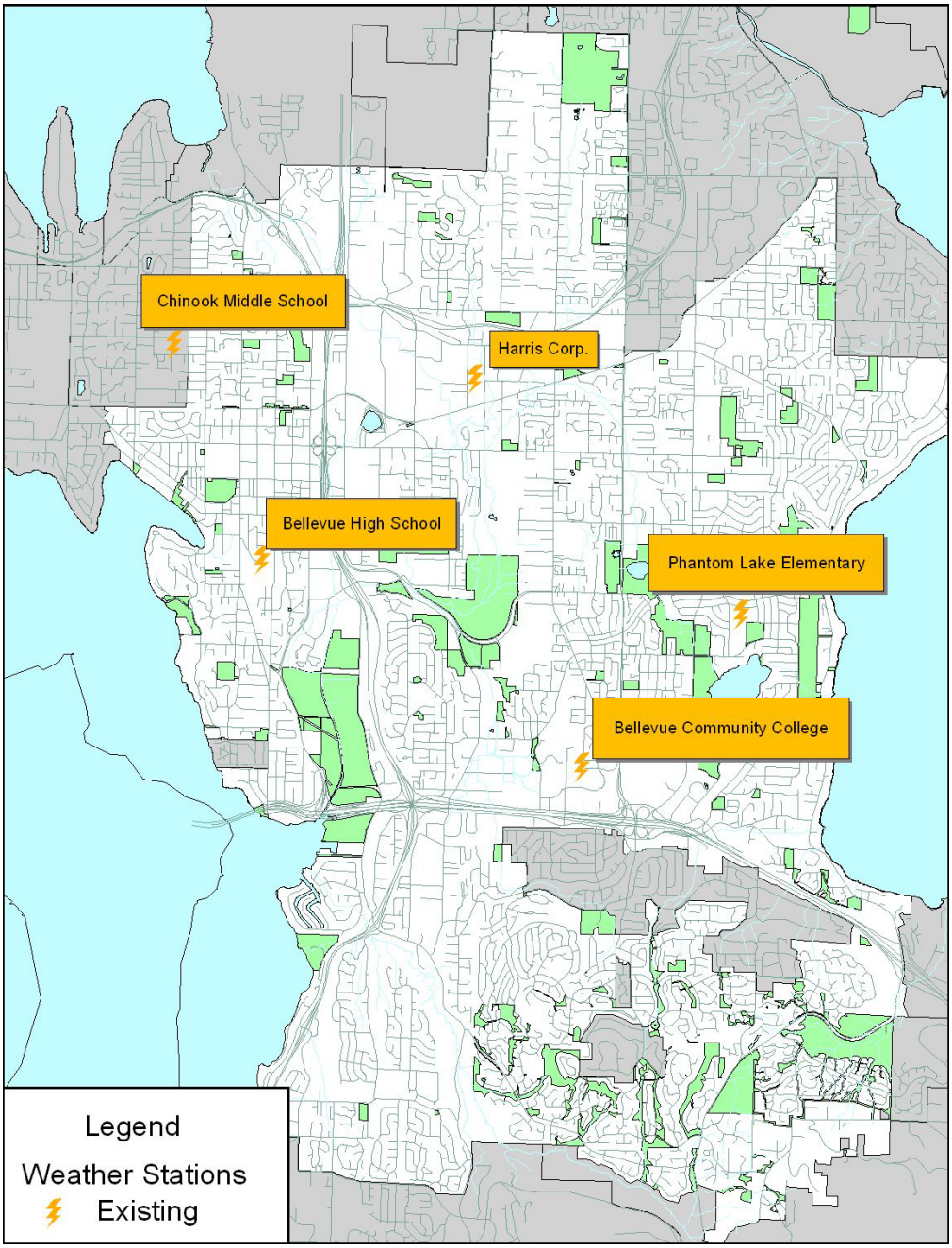


Figure 1-9. Existing Weather Stations

1.2.10 Emergency Management

Bellevue currently operates and maintains various emergency management services that cover a very important aspect of ITS. The City of Bellevue currently operates a 24 hour 911 center and has an Emergency Operations Center (EOC) that is staffed during large emergency situations in the City. The 911 center is equipped with dispatch equipment for communicating with emergency vehicles and will soon have a GPS based system for tracking police and fire vehicle locations. The project providing the GPS equipment will also install mobile data terminals in all Bellevue police and fire vehicles.

The two primary technology features of the EOC are the reverse 911 system and the Emergency Alert System. The reverse 911 system has the capability of placing a pre-recorded call to every home in an operator defined area of Bellevue. The Emergency Alert System provides the EOC the ability to transmit emergency messages to the TV and radio stations in the region.

1.3 PLANNED ITS PROJECTS

1.3.1 New City Hall

Source: City of Bellevue website.
http://www.ci.bellevue.wa.us/page.asp?view=17188

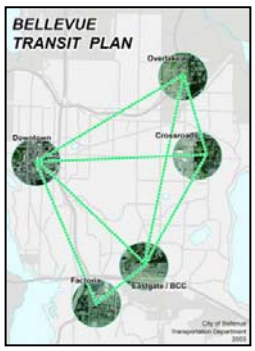
City Hall will move from its current location to 110th Avenue NE/NE 4th Street. The site will provide a new home for Police, the Eastside 911 Communications Center and the city's Emergency Operations Center, resolving critical public safety facility needs. The TMC will also be relocated to the new City Hall in a 500 square foot space on the same floor with the 911 Communication Center. Having these functions adjacent to each other will allow for easier integration of resources and more efficient management of large incidents. The new TMC is significantly larger than the existing one, but currently funding is not available for new TMC equipment. The plan is to move all the existing TMC hardware and furniture into the new space until funding is available. The City is looking into opportunities to obtain Homeland Security grant money to in part provide building infrastructure to share Transportation's CCTV with Fire and Police Departments, and to upgrade existing TMC equipment.

1.3.2 Fiber Replacement Project

The fiber replacement project will replace old 50 micron multi-mode fiber optic cable with new 62.5 micron cable to match the other multi-mode cables in the City. The two different size cables can be spliced together, but it results in a much larger degradation of the signal in one direction. The cable replacement is on NE 8th Street from 140th Avenue NE to 120th Avenue NE and then on 120th Avenue NE to the existing City Hall. The current plan is to replace the cable with a hybrid cable with 12 multi-mode and 6 single-mode fibers. The City may consider installing more strands or possibly using only single-mode fiber depending on the number of future devices identified in this ITS plan. The existing cable is used for CCTV communications. In the future the cable may be used for other devices that may require more bandwidth than the multi-mode cable can support. This fiber run will likely need to support more cameras in the future.

1.4 ITS IN RECENT BELLEVUE TRANSPORTATION STUDIES

1.4.1 Bellevue Transit Plan



The 2003 Bellevue Transit Plan aims to develop transit solutions that will be part of the local and regional transportation system. TSP is included as part of the capital elements to support the recommended transit service to and within Bellevue. An evaluation was performed at Bellevue's signalized intersections (160 at the time) to develop a list of potential TSP candidates. Eighty-two intersections where found to be adequate candidates for TSP.

King County Metro and Sound Transit have begun installing Automatic Vehicle Location (AVL) equipment that transmits bus location to computer systems that can generate bus arrival times at bus stops, transit hubs, and the internet. Monitors with arrival information have been installed at the Bellevue and Northgate Transit Centers. A demonstration project is underway on Aurora Avenue North to test LED arrival signs in bus shelters.

1.4.2 Bellevue Redmond Overlake Transportation Study

The latest Bellevue Redmond Overlake Transportation Study (BROTS), the North/South Corridor study, focuses on the north/south corridors connecting the two agencies. The study area is 148th Avenue NE and 156th Avenue NE from just north of 20th Street/Northup Way to south of NE 60th Street. The goal was to identify near-term and long-term projects that will improve north/south mobility through the study area, and to maintain or improve transit access and reliability in the Overlake neighborhood. The improvements recommended in the study included updating the signal interconnect facilities on 148th Avenue NE. This was identified as a near-team (horizon year 2012) improvement.

1.4.3 148th Avenue Mobility Improvements

Short-term (6 years) and mid-term (12 years) projects were developed to improve mobility along 148th Avenue and to reduce cut-through traffic in neighborhoods. Included in this project were TSP treatments at key transit intersections along 148th Avenue.

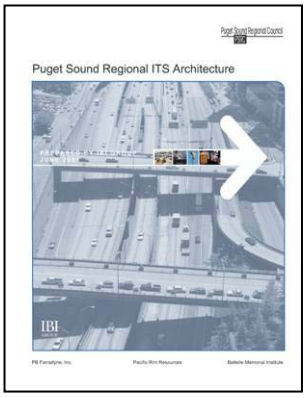
1.4.4 Bellevue Capital Investment Program

The Bellevue Capital Investment Program presents a schedule of major public facility improvements that will be implemented over the next seven years. The following ITS related projects are included in the program: traffic signal equipment upgrades, signal modification, transit signal priority, AVL for dispatchers to track the location of emergency medical, fire, and police resources for the purpose of determining the closest resource to emergency events, and the use of ITS technologies for addressing traffic safety such as radar signs, and flashing crosswalks. The estimated cost of the seven year program is approximately $284 million.

1.4.5 Downtown Implementation Plan

This implementation plan, completed in 2003, aims at improving mobility and circulation and enhancing the livability of downtown Bellevue. The objective of the transportation improvements is to maintain convenient access to downtown via regional transportation systems, mobility between downtown and other parts of the community, and circulation within downtown. The ITS components included in this plan are enhanced signal optimization of principal arterials, improved traveler and transit information, and parking guidance systems for short-term parking garages. Implementation of plan components will continue over the next 20 years.

1.4.6 PSRC Regional Architecture



The key objective of this document is to help provide Puget Sound local agencies with guidance during the development of individual ITS projects, allowing for the development of a comprehensive, integrated transportation management and information system. In doing so, it discusses existing and planned ITS applications, identifies the potential Stakeholders, identifies the operational concepts, (which characterize the existing, planned and potential roles, responsibilities, and interactions among participants in an ITS project) discusses the nature of agreements required, and discusses the ITS standards that should be considered. In general, it introduces a framework for ensuring institutional agreement and technical integrations for the implementation of ITS projects.

Market packages to be deployed in the Puget Sound region are used to help define the operational concept for the Regional ITS Architecture. Through the Stakeholders outreach portion of the Regional Architecture project, a survey was sent to each local, county and state agency to determine what ITS applications were deployed and planned. Bellevue's existing Market Packages include: ITS Data Mart, Network Surveillance, Surface Street Control, and Regional Traffic Control. The Regional Traffic Control component includes a direct communications link to WSDOT with center-to-center interface using the National Transportation Communications for ITS Protocol (NTCIP) standard. The City is also currently sharing video images and traffic information with WSDOT. Links to King County and Redmond are planned.

Bellevue's planned Market Packages include: Broadcast Traveler Information, Dynamic Ridesharing, Interactive Traveler Information, Multi-Modal Coordination (with links to King County Metro), Traffic Information Dissemination, Commercial Vehicle Administrative Processes, Electronic Clearance, and Roadside Commercial Vehicle Operation Safety.

1.4.7 Bellevue Emergency Operations Plan

This plan provides guidelines to the emergency management organization for mitigation, preparedness, response, and recovery operations during emergency situations. This plan also establishes a mutual understanding of authority, responsibilities and functions of local government, and provides a basis for incorporating essential non-government agencies and organizations into the Emergency Management Organization. The Transportation Department's responsibilities include providing adequate traveler information. Bellevue Transportation Department currently operates a portable advisory radio station, licensed for 1270 AM radio, and is capable of transmitting broadcast messages relating to travel, such as road conditions, weather, directions, and emergency conditions for motorists.

CHAPTER 2 NEEDS ASSESSMENT

2.1 INTRODUCTION

The needs discussed in this chapter form the backbone of the ITS Master Plan and will be used to develop appropriate ITS projects. A broad set of ITS-related needs were considered based on the input from a variety of Stakeholders in Bellevue as well as the consultant's ITS experience in other jurisdictions. After the needs were identified, they were organized into groups based on National ITS guidelines ensuring compliance with the National ITS Architecture.

As part of the needs assessment process, the Bellevue ITS Steering Committee developed the ITS plan vision statements and performance criteria, which are addressed at the end of this chapter.

2.2 NEEDS DETERMINATION

A series of stakeholder meetings were held with City staff from a variety of departments in order to obtain a broad view of the ITS needs within the City. Furthermore, the consultant developed additional needs in conjunction with the steering committee based on their experience with other jurisdictions.

2.2.1 Stakeholder Interviews

The project steering committee identified the following departments and contacts to serve as Stakeholders in the Bellevue ITS Master Plan. Below is a list of the project Stakeholders:

- Transportation Department—Traffic Management, Mark Poch, Dirk Mitchell, Mike Whiteaker
- Transportation Department—IT, Cathy Johnson
- Transportation Department—Right-of-Way (ROW), Jon Regalia
- Transportation Department—Planning, Susie Serres
- Transportation Department—Modeling/Forecasting, Mushtaq Rahman
- Transportation Department—E Team, Goran Sparrman, Laurie Gromala, Nora Johnson, Kris Liljeblad, Dave Berg
- City of Bellevue Transportation Commission
- Bellevue Utility Maintenance, Denny Vidmar
- Bellevue Information Technology, Gary Clesson, Dave Kelly
- Bellevue Fire Department, Chief Peter Lucarelli
- Bellevue Police Department, Captain Bill Quinn
- Bellevue Emergency Management, Barb Graff

The consulting team and a representative from the project steering committee held face-to-face interviews with each of the Stakeholders. During the interview process, the Stakeholders were asked the following three questions:

1. What existing projects or efforts is your department leading that are relevant to the ITS Master Plan?

2. What planned/future projects or efforts is your department leading that are relevant to the ITS Master Plan?
3. What, if any, needs does your department have with respect to traffic operations/management?

Table 2-1 on the following page provides a brief summary of the results from the interviews. The needs are described in further detail in Section 2.3.

Table 2-1. Stakeholder Needs Assessment Summary

Department	Existing projects	Future Projects	Needs
Traffic Management			■ Additional CCTV locations for traffic surveillance ■ Pedestrian and bicycle detection ■ Improved vehicle classification system ■ Expanded use of Variable Message Signs (VMS)
Transportation IT	■ Wireless work reporting system pilot project		■ Further development of the City's "Mapster" system to include traffic information
Planning		■ Continued support of Metro's Transit Signal Priority initiatives	■ Commuter alerts via e-mail ■ Enhanced detour route development and management
Modeling/ Forecasting	■ "Data Integration Conceptual Level Development Project"		■ Queryable traffic data from Computran system ■ Probe vehicle data
ROW	■ Bellevue is part of on-line permitting system (mypermit.org)		■ Expansion of on-line permitting system ■ Ice detection systems ■ Construction site camera surveillance ■ On-line public work request system
"E-Team"			■ Web-based traveler information ■ Expanded use of speed enforcement signs ■ Utilize City's existing communications infrastructure ■ Real-time construction information
Commission			■ Adaptive signal control ■ Bicycle treatments
Maintenance	■ Wireless work reporting system pilot project		■ Video surveillance for utility installations ■ Slide location surveillance ■ Ice detection; weather information
IT	■ Current project to inventory all potential pathways for telecommunications ■ Provide fiber to 31 remote sites ■ Wireless work reporting system pilot project	■ Wireless application study	
Police	■ Outfitting police and fire department vehicles with AVL and mobile data terminals (MDT)		■ Video images and camera control ■ Signal pre-empt for police vehicles ■ Driver information via WSDOT VMS ■ HAR
Fire/Emergency Management (EM)	■ Outfitting police and fire department vehicles with AVL and MDTs		■ Non-intrusive traffic calming techniques ■ Video images and camera control

2.2.2 Additional Needs

The stakeholder meetings were the basis for developing the ITS needs for the City of Bellevue. The consultants generated additional needs through additional interaction with ITS Steering Committee members, a review of other City of Bellevue reports that had ITS components, and from their previous work with similar jurisdictions. The needs are listed below:

- Expand existing traffic operations communications
- Upgrade existing communications
- Center-to-center link to neighboring agencies
- Red light and speed photo enforcement
- Procurement of standards based equipment
- Automatic detection of traffic equipment malfunction
- Expand system detection
- Traffic management center equipment upgrade
- Parking management system
- Incident management system
- Interagency incident management
- Real time transit arrival and departure information
- Automatic incident detection
- Mobile data terminal for incident management
- Dynamic route mapping from dispatch center
- AVL on emergency vehicles
- Improved traffic management in work zones
- AVL on maintenance vehicles
- Flood video monitoring and telemetry
- Automated traffic counts program (collected from system detectors)
- Additional weather stations
- Communications to remaining isolated traffic signals (approximately 16)
- Heavy rail crossing advanced preempt

2.2.3 Needs Summary

A complete summary of all the ITS related needs developed for the City of Bellevue is given in Table 2-2.

Table 2-2. Summary of Needs

	Travel and Traffic Management		Public Transit Management
	Communications	28	Transit signal priority support
1	Utilize City's existing communications infrastructure	29	Real-time transit arrival and departure information
2	Expand existing traffic operations communications		
3	Upgrade communications (multi-mode to single-mode fiber)		**Emergency Managmeent**
	Traffic Operations and Management	30	Remote monitoring
4	Pedestrian and bicycle treatment (detection)	31	CCTV Video at 911 Dispatch, EOC, and Police
5	Expanded video surveillance	32	Automatic incident detection
6	Enhanced traffic control capabilities	33	Mobile data terminals for incident management
7	Expanded use of driver feedback signs	34	Dynamic route mapping for dispatch center
8	Probe vehicle data	35	AVL on all emergency vehicles
9	Signal pre-empt for police vehicles		
10	Center-to-center link to neighboring agencies		**Information Management**
11	Red light and speed photo enforcement	36	Query-able traffic data
12	Procurement of standards based equipment	37	Expanded interagency data sharing
13	Automatic detection of traffic equipment malfunctions	38	GIS based equipment management
14	Improved vehicle classification system		
15	Expand system detection		**Maintainance and Construction**
16	Traffic management center equipment upgrade	39	Ice and flood detection and weather information
17	Heavy-rail crossing advanced preempt	40	Improve traffic management in work zones
	Traveler Information	41	AVL on maintenance vehicles
18	Expanded use of VMS (Includes additional Installation)		
19	Dynamic detour route development and management		
20	Real-time construction information		
21	Web-based traveler information		
22	Automated commuter alerts		
23	Parking management system		
24	Driver information via other agency VMS		
25	Highway advisory radio		
	Incident Management		
26	Incident management system		
27	Interagency incident management		

2.3 NEEDS DESCRIPTION

The National ITS Architecture simplifies the development of ITS projects by creating a common set of definitions to be used by all agencies. The ITS needs for the City have been divided into the eight user service bundles defined in the National ITS Architecture. User services are used to define what ITS should do from the user's perspective. The bundles are the logical grouping of these services. A complete list of user services bundles are provided below. The bundles in bold are the ones that apply to the City of Bellevue:

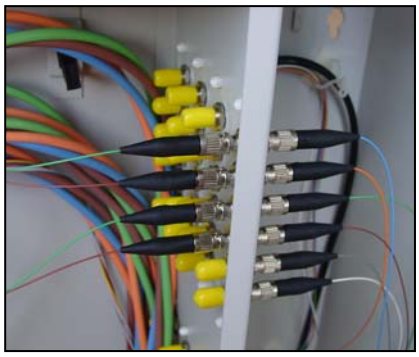
■ **Travel and Traffic Management**	■ **Public Transportation**
■ Electronic Payment	■ Commercial Vehicle Operations
■ **Emergency Management**	■ Advanced Vehicle Safety Systems
■ **Information Management**	■ **Maintenance and Construction Management**

Within each section below is a description of the needs identified in Section 2.2.

2.3.1 Travel and Traffic Management

This user service bundle covers a wide range of topics. To better manage the needs, this bundle has been divided into four categories: Communications, Traffic Operations and Management, Traveler Information and Incident Management.

Communications



Utilize City's Existing Communications Infrastructure

Various private and public communications infrastructure exist in the City of Bellevue. Leveraging existing investments in infrastructure will provide the City with additional capacity to support communications needed for integrated ITS applications.

Expand Existing Traffic Operations Communications

Additional communications will be needed as the City deploys more ITS equipment. There are still 23 traffic signals in the City that are not interconnected. Communications to these sites will also be needed.

Upgrade Existing Communications

Some of the existing communications will not meet the future bandwidth needs. Some multi-mode cable may need to be upgrade to single-mode. Some multi-mode runs may need to be replaced with new multi-mode cable with a higher fiber count. In addition, the City is investigating TS2 and ITS standard cabinets that will lead to more Ethernet based communication to signals, detectors, Opticom, VMS, etc. It is assumed that at some point in the future the cameras will be Ethernet (or some other standard) based, so a transition plan will need to be developed in the future.

Traffic Operations and Management

Pedestrian and Bicycle Treatments (Detection)

The City would like to have bicycle detectors at traffic signals with on-street bike lanes, and along some of the trails throughout Bellevue. Passive pedestrian detection may be considered in the future at some of the City's non-signalized pedestrian crossings.

Expand Video Surveillance

Interviewed Stakeholders expressed the need for more video surveillance locations throughout the City of Bellevue. Cameras should be strategically

placed to view traffic congestion and signal operations as well as high accident locations. Several Stakeholders expressed the need for portable surveillance during construction, road closures, and emergency operations such as flood, snow and other events.

Enhance Traffic Signal Control Capabilities

The City would like to continue to enhance their existing traffic signal system. They are particularly interested in software upgrades that will improve strategies for operating transit signal priority and traffic responsive signal timing.

Expanded Use of Driver Feedback Signs

The City currently utilizes driver feedback signs to notify drivers of their travel speed versus posted speed. Stakeholders recommended the expansion and continued use of these signs.

Probe Vehicle Data

Probe vehicle data has the capability to provide raw travel time data for use in planning, operations, and traffic analysis efforts. This information can also be used to display congestion information on an arterial congestion map.

Signal Pre-empt for Police Vehicles

Currently, City of Bellevue Police Department is considering a proposal to provide police vehicles with the capability to pre-empt traffic signals as is currently provided for Fire Department vehicles.

Center-to-Center Link to Neighboring Agencies

The City is interested in having a center-to-center link for sharing signal operations information with neighboring agencies including Redmond, WSDOT and King County.

Red Light and Speed Photo Enforcement

The use of cameras to enforce red light violators and speeding is being explored in Washington State. The City would like to continue to explore the use of photo enforcement technology to improve safety in Bellevue, and this use will depend on photo enforcement lawmaking in the state.

Procurement of Standards Based Equipment

The City would like to move toward a more interoperable traffic operation system where they are not tied to one specific vendor. For example, as their communication system expands, they would like to specify equipment that met certain protocol requirements, which would allow equipment from multiple vendors to communicate together in the same network.

Automatic Detection of Traffic Equipment Malfunction

The City is interested in the ability to communicate to more of the pluggable devices in the traffic signal controller cabinet (e.g. Opticom discriminators, loop amplifiers and conflict monitors). The City had started developing a system that would provide multiple RS-232 channels to each cabinet for communication to each device. However, newer TS2 and ITS cabinets are better configured for communicating to each pluggable device, so the City is considering moving toward the TS2 cabinet to resolve this need.

Improved Vehicle Classification System

This need is in reference to the lack of vehicle classification data currently available from the City's system of data acquisition. The data is used for City planning and traffic analysis efforts. This need will require new system detection that can support vehicle classification.

Expand System Detection

The City has an extensive system detection network, but there are still gaps that need to be filled. In addition, some equipment will need to be upgraded to collect vehicle classification information and accurate speed data.

Traffic Management Center Equipment Upgrade

The City will be moving into a new TMC at the new City Hall, but there are currently no funds to upgrade the existing dated equipment in the current TMC. The current plan is to move all their existing hardware and furniture into the new space. The City would like to upgrade their video monitoring and control equipment and install more functional workstation furniture.

Heavy-Rail Crossing Advanced Preempt

The City would like to obtain advanced preempt information for the rail crossings of NE 8th Street and SE 1st Street to run a clearance phase of the traffic signals adjacent to these crossings, including NE 8th Street/116th Avenue NE, SE 1st Street/Main Street and SE 1st Street/116th Avenue SE.

Traveler Information

Expand Use of Variable Message Signs

Stakeholders indicated the need for expanded use of VMS on City roadways. This will include both portable and fixed VMS installations. The permanent signs would be strategically placed to support the following: special events like the holiday shopping season and the Bellevue Arts Festival; emergency management for issues such as flooding; traffic re-routing at key decision points in the City; and routing of traffic back to the freeway at key diversion points along parallel arterials. Portable signs would continue to be used to support construction and other special events.

Dynamic Detour Route Development and Management

This need refers to the provision of an integrated detour route management system. The detour route system would be used to divert traffic away from an arterial in the City that may be experiencing unusual congestion or has a blocking incident. As alternate routes become congested, the system could dynamically choose the next best alternative based on congestion data from system detection.

Real-Time Construction Information

The City would like to expand upon its construction impacts website, http://www.cityofbellevue.org/projectsmap, to provide real-time construction information. The site includes information such as: duration, location, closures and detours.

Web-Based Traveler Information

The City would like to expand upon its on-line traveler information website, www.accessdowntown.com, to provide additional information. Currently, the website lists traffic information, transportation projects, construction timelines and commute options. Future improvements could include adding incidents, congestions, and emergency management data in real-time.

Automated Commuter Alerts (e.g., email, personal data assistants (PDA), etc.)

The City would like to expand upon its email system, http://www.cityofbellevue.org/page.asp?view=19243, used to provide Bellevue residents and commuters with traveler and emergency information via various dissemination technologies. Currently the email list is titled "Access Downtown construction & traffic updates" and provides information on planned traffic detours, road closures, events and other news.

Parking Management System

The City would be interested in evaluating a system that would advise motorists of available parking in Downtown Bellevue. Because many parking facilities are private, the system would likely be used for the various lots attached to Bellevue Square. The new garage on the northeast corner of the mall already has a system in place to indicate which levels have available parking. A parking management system may also be used to manage City controlled parking garages.

Driver Information Via Other-Agency VMS

Stakeholders suggested that coordination between agencies be enhanced to include the shared use of roadside driver information equipment. In particular, Stakeholders expressed interest in the use of WSDOT's VMS for arterial information.

Highway Advisory Radio

The City is interested in the use of highway advisory radio for the local area dissemination of traveler information.

Incident Management

Incident Management System

The City has expressed the need for an automated incident management system for responding to recurring incidents and events in the City. The following incidents were identified: holiday shopping traffic in Downtown Bellevue; routing of traffic around flood zones in the City, and diversion routes for traffic facing an incident on the freeway.

Interagency Incident Management

The City is interested in a more integrated traffic management system for managing large incidents that will impact more than one agency. For example, if WSDOT were to divert traffic onto City streets because of a freeway blockage, pre-defined management plans should be ready to respond to the increase in volume. The interaction also should not rely on a phone call between the two agencies to start and stop the incident response plan. Automated features should be in place to notify the local operations engineer that traffic is being diverted onto City streets.

2.3.2 Public Transportation Management

The Public Transportation Management user service bundle covers a wide range of transit related ITS initiatives, however many of them are catered more toward the transit agency. The following two items are transit needs in which Bellevue can more actively participate.

Transit Signal Priority Support

The City would like to continue to support the deployment of transit signal priority in Bellevue. The City is very interested in maintaining transit reliability for its residents and other travelers in the region that use Bellevue as a transit hub. Their current support includes providing communications for the transit signal priority hardware and continuing the deployment of traffic signal controllers that are compatible with the region's signal priority system. The City currently runs TSP at two intersections.

Real-Time Transit Arrival and Departure Information

The City would like to continue to support the Smart Bus system being developed by Metro. The City is particularly interested in deploying arrival and departure information at the various transit centers and park and rides throughout Bellevue. The new Bellevue

Transit Center downtown has begun displaying departure status as shown. In addition, the City would like access to ridership and schedule adherence information. Transit schedule adherence and occupancy information can be integrated with TSP and can result in better TSP operations.

2.3.3 Emergency Management

Remote Monitoring

The Utility Department would be interested in strategically placing CCTV cameras where they can be used to observe traffic as well as monitor City owned structures and facilities. The Utility Department has telemetry to many remote sites, but they would also like video. Examples include water reservoirs, bridges, slide areas, and flood areas.

CCTV Video at 911 Dispatch

Bellevue Police and Fire Departments expressed the need to have access to video images prior to reaching an incident. The departments also requested the ability to control and monitor cameras to allow for detailed assessment of conditions. The sharing of video between departments is anticipated to become feasible once the traffic management center moves onto the same floor with the emergency management center at the new city hall.

Automatic Incident Detection

The City would like to use their system detection to identify anomalies in traffic that could be caused by incidents. If congestion were to suddenly increase at a rapid rate, the signal system could potentially page the operator to notify them of a problem on a local arterial.

Mobile Data Terminals for Incident Management

The police and fire department would like the ability to see congestion information and video images remotely through a mobile device. This will help in real-time coordination of response to incidents.

Dynamic Route Mapping for Dispatch Center

It would be beneficial for dispatchers to have access to local congestion and incident data to provide emergency vehicles with the quickest route to incidents. Ideally the system would automatically provide the optimal route when the destination was entered into the system.

AVL on Emergency Vehicles

The City is interested in having AVL equipment mounted on emergency vehicles in order for the dispatch center to track the progress of each vehicle as it approaches an incident.

2.3.4 Information Management

Query-able Traffic Data

Current data acquisition from system detectors is processed through the Computran system. The fulfillment of this need would provide the data in an "un-aggregated" format to be used in planning and analysis efforts. The data could be used to replace existing mechanical traffic counts.

Expand Interagency Data Sharing

This need refers to the automated exchange of data, such as timing patterns, traffic volumes, and video, between agencies for enhanced traffic operations. The data exchanged could include system detector data, cycle length, split, offset, time of day parameters for neighboring signals, signal phase status, and future congestion map information.

GIS Based Equipment Management

Given the City's existing investment in the Mapster Geographic Information System (GIS) program, Stakeholders expressed interest in developing a tool to integrate Mapster with a field equipment databases.

2.3.5 Maintenance and Construction

Ice and Flood Detection, and Weather Information

Several Stakeholders expressed a need to automatically detect roadway ice and flooding, and provide detailed weather information.

Improved Traffic Management in Work Zones

The City is interested in providing better management of traffic in work zones. Some of the ideas proposed include the following:

- Portable CCTV cameras to monitor traffic conditions.
- Variable speed limit signs that can be remotely updated to decrease speeds during work hours and increase speeds when construction activity has ended for the day.
- Speed monitoring to help enforce lowered speed limits in work zones.

AVL on Maintenance Vehicles

The City would like to track the location of maintenance vehicle to better coordinate the dispatch of personnel to roadway and utility emergencies.

2.3.6 Other

The following items were identified as needs during the interviews, but are elements that don't necessarily fit into an ITS user service bundle. They are important elements to the City, but are recommended for application through other City of Bellevue initiatives.

Coordination with Downtown Bellevue Projects

The City currently has underway two large downtown projects: the Downtown Access and the Downtown Implementation Plan. Each of the projects is comprised of a "suite" of transportation projects. Coordination of these projects will provide opportunities to share resources, expedite schedules, and enhance the overall capabilities of planned systems.

Coordination with these large projects is critical for deployment of ITS downtown, but it does not address a specific ITS need. The ITS plan will look for ways to integrate deployment of ITS in Downtown Bellevue with the development of these projects.

Non-Intrusive Traffic Calming Techniques

Existing traffic calming efforts have resulted in the installation of physical devices that incrementally slow the response of emergency vehicles and transit. The need expressed the desire to employ less physically intrusive methods of traffic calming.

On-Line Public Work Request System

This need has largely been met as the city has instituted an online service request for both signal operations[1] and neighborhood traffic calming[2].

Expansion of On-Line Permitting System

The City is currently part of a multi-agency online permitting system[3]. The current system allows for mechanical, plumbing and minor remodeling permits. A future expansion would allow for the expansion to right-of-way permits.

2.4 BELLEVUE ITS MASTER PLAN VISION

The City of Bellevue's ITS Vision was first presented to a meeting of the Transportation Department's "Executive Team"[4] on March 25, 2002. During that meeting, the ITS Vision was refined based on the department's input. The following four statements form the City's ITS Vision:

[1] http://www.cityofbellevue.org/departments/Transportation/files/frm_trans_service_req.htm
[2] http://www.cityofbellevue.org/departments/Transportation/files/frm_trans_citizen_action_req.htm
[3] http://www.ci.bellevue.wa.us/page.asp?view=16496
[4] The "Executive Team" consists of the Transportation Department director and assistant directors.

Vision statement 1:

"Maximize the safety and efficiency of the City's transportation system for residents, business owners, and visitors to the City of Bellevue."

Vision statement 2:

"Support Emergency Services (ES) in their efforts in saving lives and protecting the City's transportation infrastructure."

Vision statement 3:

"Maximize the quality of transportation service provided by the City of Bellevue to residents, business owners, and visitors."

Vision statement 4:

"Be active in and support regional ITS initiatives."

Preliminary performance criteria for the City's use in ultimate project refinement and evaluation were developed based on the ITS Vision statements. These criteria will ultimately be used to evaluate the success/failure of implemented projects. Preliminary performance criteria are as follows:

Criteria in Support of Vision Statement 1:

"Maximize the safety and efficiency of the City's transportation system for residents, business owners, and visitors to the City of Bellevue."

- Does the project have the potential to reduce the total annual traffic incidents in the City?
- Does the project have the potential to reduce the total annual fatalities and injuries caused by traffic incidents in the City?
- Does the project have the potential to maintain or minimally increase the annual operations and maintenance (O&M) expenditures of the City?
- Does the project have the potential to reduce travel times within the City (passenger vehicle, transit, CV)?
- Does the project have the potential to enhance business and tourism via improved vehicle access and driver information?
- Does the project have the potential to decrease incident response times by City staff and/or provide faster, more reliable information to staff?
- Does the project have the potential to minimize impacts on the environment?

Criteria in Support of Vision Statement 2:

"Support Emergency Services (ES) in their efforts in saving lives and protecting the City's transportation infrastructure."

- Does the project have the potential to reduce the amount of time required for ES to travel to/from incidents?
- Does the project have the potential to improve the response of ES to an incident or emergency?

- Does the project have the potential to improve the accuracy, reliability, and/or availability of the information that is received by ES?
- Does the project have the potential to provide a greater level of integration between traffic management and ES?
- Does the project have the potential to improve the capabilities to monitor the City's infrastructure?

Criteria in Support of Vision Statement 3:

"Maximize the quality of transportation service provided by the City of Bellevue to residents, business owners, and visitors."

- Does the project have the potential to improve current transportation services or provide new transportation services to travelers within the City?
- Does the project have the potential to provide transportation services equal to or better than agencies in the immediate area?
- Does the project have the potential to utilize technology and equipment that has been proven reliable?

Criteria in Support of Vision Statement 4:

"Be active in and support regional ITS initiatives."

- Does the project have the potential to integrate seamlessly with other jurisdictions?
- Does the project have the potential to support the existing regional ITS architecture?
- Does the project have the potential to support existing and emerging national ITS standards?
- Does the project have the potential to leverage local, regional, federal, or other project funding?
- Does the project have the potential to improve regional transportation information or services?

CHAPTER 3 REGIONAL ARCHITECTURE

3.1 INTRODUCTION

This chapter presents the process followed for creating a Regional Architecture specific to the City of Bellevue. It begins with three frequently asked questions regarding building a Regional Architecture. This is followed by a discussion of the approach to building the ITS Architecture using Turbo Architecture. The subsequent sections of this chapter summarize the four areas of a Regional Architecture required for developing an ITS plan and integrating the plan with other regions:

1. User Services
2. Existing and Proposed Physical Architecture
3. Market Packages
4. Standards Requirements

3.1.1 What is a Regional Architecture?

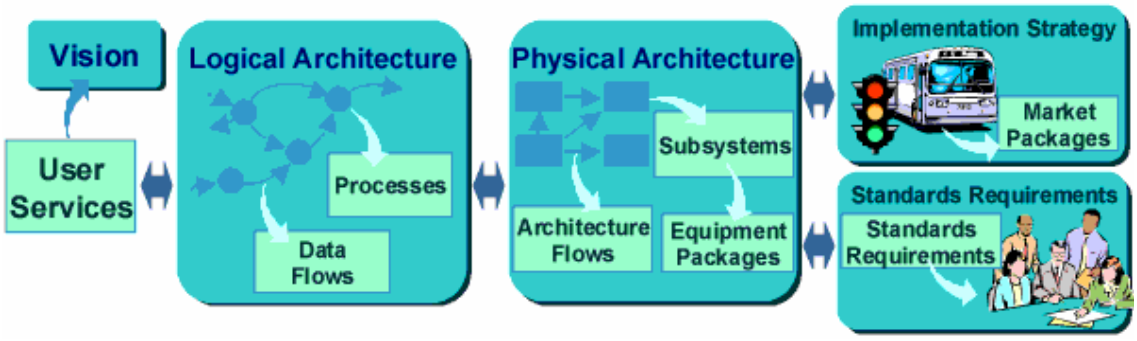
The US Department of Transportation (USDOT) defines a Regional ITS Architecture as a specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region. Simply stated, the Regional Architecture helps define the elements of the ITS system and the standard information that is exchanged between these elements. The guidelines for developing a Regional Architecture are defined in the National ITS Architecture.

3.1.2 What is the National ITS Architecture?

As defined by the USDOT, the National ITS Architecture "provides a common framework for planning, defining, and integrating intelligent transportation systems". It was designed over a five year period by a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.). The architecture was developed to define the following ITS features:

- The functions that are required for ITS, (e.g., gathering of traffic information or requesting a route).
- The physical entities or subsystems where these functions reside, (e.g., the roadside or the vehicle).
- The information flows that connect these functions and physical subsystems together into an integrated system.

The architecture was assembled to easily guide the ITS planner through the steps required to develop an implementation plan. To facilitate the design of the plan, standard elements were identified by the architecture development committee for each step of the planning process.



Source: National ITS Architecture Web Site: http://www.iteris.com/itsarch/

Figure 3-1. National Architecture Process

The flow diagram in Figure 3-1 provides a rough outline of the process followed to develop Bellevue's ITS plan. Following completion of the inventory of existing ITS Elements, Bellevue developed a vision and identified the City's ITS needs. In Section 3.2, these needs will be mapped to "User Services". User Services are National Architecture defined services that describe what the ITS system will do from the user's perspective.

The "Logical Architecture" applies the User Services to "Processes" and "Data Flow" that define the activities or functions of the ITS system and their associated data Elements. An example of a Process is "Process Traffic Sensor Data". This Process has 34 defined data flows. There are over 600 processes defined in the Architecture. This level of detail is typically associated with project specific architecture mapping. For this project, the User Services will be used to feed information directly into the Physical Architecture.

The "Physical Architecture" is the primary focus of this chapter. The Physical Architecture is a representation of the important ITS interfaces and the major system components. Through the use of Turbo Architecture, the "Physical Entities" and "Architecture Flows" of the Physical Architecture are defined. The Physical Entities are the Subsystems and Terminators for the ITS Plan. Figure 3-2 shows the National Architecture Sausage Diagram. This diagram displays the four Subsystem categories with the 22 Subsystems.

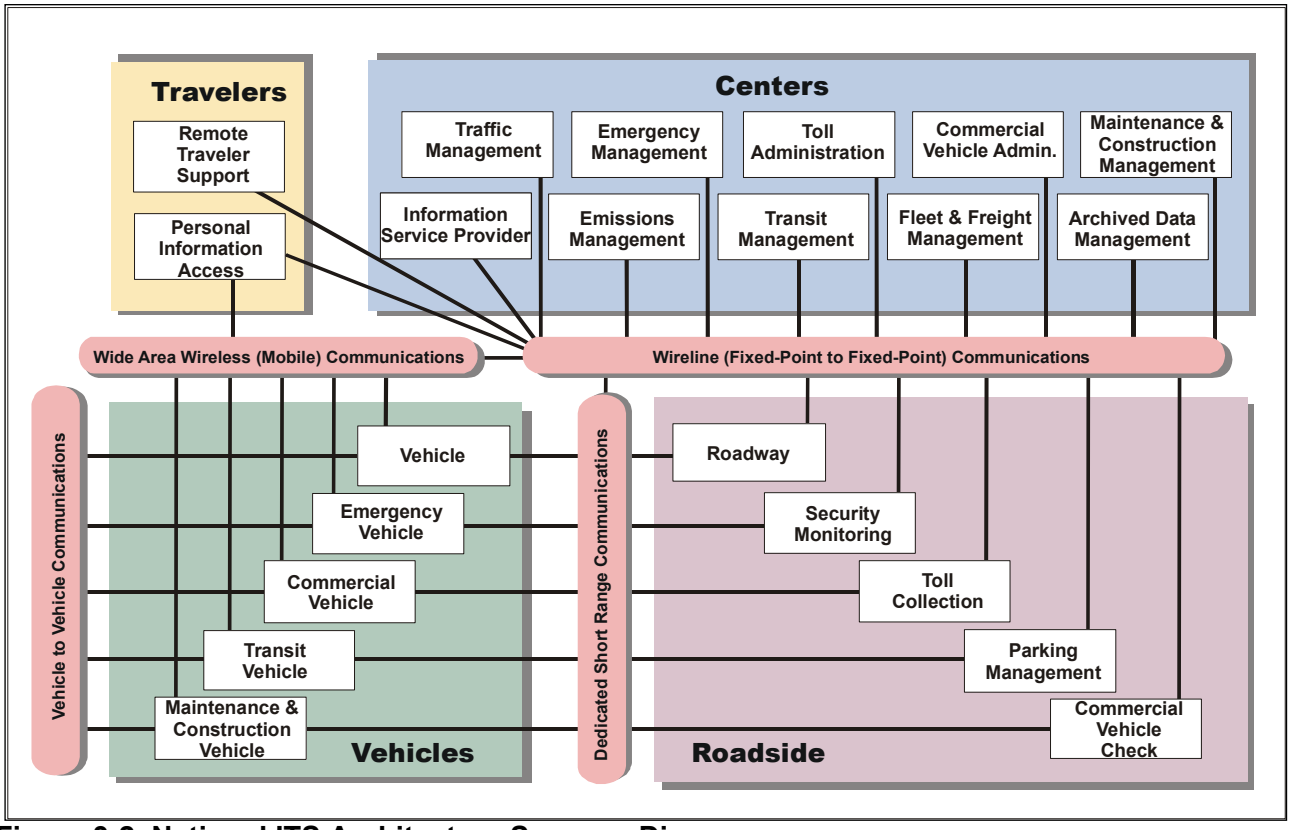


Figure 3-2. National ITS Architecture Sausage Diagram

Subsystems are more specifically defined as the principal structural Elements of the architecture. The Terminators represent the people, systems, and general environment that interface in an ITS system. (A complete list of Terminators is included in Appendix A of this report. The selection of the Subsystems and Terminators are discussed further in Section 3.3.

In addition to creating the Physical Architecture, Turbo Architecture also maps all the project Elements to Market Packages. "Market Packages" are the categorization of ITS technologies into individual packages for guiding the design and deployment of ITS projects. Section 3.4 of this chapter will provide the final Market Packages identified for this project. A complete list of the Market Packages and their definitions is included in Appendix B of this report.

The final portion of the National ITS Architecture as shown in Figure 3-1 is the identification of Standard Requirements. A standards based ITS plan is needed to optimize integration with other agencies in the future. Section 3.5 of this report provides a brief summary of all the national standards that could apply to future Bellevue ITS Elements.

3.1.3 Why must a Regional Architecture be created?

Development of a Regional Architecture provides the following benefits:

- A high-level view of the integration of ITS systems within the City of Bellevue.
- Creates a common platform to compare architectures with neighboring regions.

- Permits the identification of jurisdictional and system interconnections that will ultimately be referenced when designing Elements of the ITS Plan.
- Serves as a focal point for discussions among the Stakeholders concerning respective roles and responsibilities.

In addition to these benefits, a Regional Architecture must be created to meet the requirements to obtain Federal ITS funding. The Federal Highway Administration (FHWA) Federal-Aid Policy Guide, Title 23, Part 940[5] states that a Regional Architecture must be developed to show conformance of the region's ITS projects to the National ITS Architecture. Further guidelines are established in a USDOT document titled *Regional ITS Architecture Guidance, Developing, Using and Maintaining an ITS Architecture for your Region.*[6] The Puget Sound Regional Council (PSRC) has their own guidance document titled *Guidance for Complying with Federal Requirements for Intelligent Transportation System Projects in the Puget Sound Region".*[7] This document summarizes the requirements of the USDOT guidance document and describes how they apply to Puget Sound region projects. It also provides information on how to incorporate a jurisdictional project into the PSRC Regional ITS Plan.

3.1.4 Application of the National ITS Architecture

The National ITS Architecture provides tools to make the Regional Architecture planning approach easier to support. The primary tool used for creating the traceability is a program called Turbo Architecture.

Turbo Architecture is an interactive software program used to assist the ITS Planner in the development of a Regional or Project Architecture. Like Turbo Tax, the program interviews the user to obtain the information needed to assemble the architecture. As the user enters information, the program matches the data provided with its National ITS Architecture databases to provide a tabular and graphical representation of the proposed system. Turbo Architecture requires the following steps to create a Regional or Project Architecture:

Step 1: Interview

To begin the architecture development, the program leads the user through a series of questions that are based around eight categories of ITS: Commercial Vehicle Operations, Emergency Management, Electronic Tolling, Freeway Management, Maintenance and Construction Operations, Public Transportation, Regional Traveler Information and Arterial/Traffic Management. The questions in these categories lead to the identification of the Project Elements[8] and Stakeholders[9]. For example, in the Arterial/Traffic Management Category, the questions start with the following:

[5] *Federal-Aid Policy Guide,* Section 23 Part 940, Intelligent Transportation System Architecture and Standards (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0940.htm)
[6] *Regional ITS Architecture Guidance, Developing, Using and Maintaining an ITS Architecture for Your Region,* National ITS Architecture Team, October 12, 2001.
[7] *Guidance for Complying with Federal Requirements for Intelligent Transportation System Projects in the Puget Sound Region,* IBI Group with PB Farradyne, Pacific Rim Resources and Battelle Memorial Institute, June 5, 2001. (http://www.psrc.org/projects/its/documents/guidance.pdf)
[8] The people, centers, systems and devices that make up the architecture.
[9] All the agencies involved in the project.

1. What is your Arterial/Traffic Management Center name?

The user would input "Bellevue TMC" and note that it is existing.

2. What is the primary Stakeholder?

The user would input "City of Bellevue"

Following this input, Turbo Architecture creates two project Elements:

- Bellevue TMC
- Bellevue TMC_Personnel

The Bellevue TMC_Personnel Element is created to represent the staff operating the TMC.

3. Does your Arterial or Traffic Management Center control signalized intersection?

With a response of "Yes", it will then create a project Element of "Bellevue TMC_Roadside Equipment".

The interview continues with other questions related to Arterial/Traffic Management until it has defined all the possible Elements. Each Element is noted as either existing or planned. For each Element, Turbo Architecture defines the Subsystems, Terminators and Market Packages that best match the Element. Each Element will most likely be associated with more than one Subsystem, Terminator and Market Package.

The interview can help create both a Regional Architecture and Project Architecture. The difference between them is a Project Architecture is developed around a specific project or subset of the Regional Architecture. A Project Architecture was developed for Bellevue to facilitate the integration of this ITS plan into the PSRC Regional Architecture. PSRC did not use Turbo Architecture during the development of the Puget Sound regional plan, but they plan to update the architecture using Turbo Architecture in the future.

Step 2: Inventory

Once the interview is complete, the user can view all the Elements within the architecture and see how the program mapped them to the Terminators and Subsystems. Standard descriptions are created for the Elements through the program, but the inventory step allows these descriptions to be edited. Once the user enters the Inventory step, the modification of the architecture becomes more manual. The interview is no longer accessible, therefore new Elements must be created manually. In the inventory window, the user must determine if all the Elements of the plan have been included and if they agree with the Subsystems and Terminators assigned to each Element.

Step 3: Market Packages

This step allows the user to view how the program mapped the identified project Elements to National Architecture Market Packages. In this window the user can modify which Elements are mapped to which Market Packages and add Market Packages as needed.

Step 4: Build

Once all the project Elements are identified and the Subsystems and Terminators are selected, the program prompts the user to "Build" the architecture. By building the architecture, the program determines what architecture "Flows" will be used between each project Element. An Architecture Flow is the information that is exchanged between Subsystems and Terminators in the Physical Architecture. The result of the build is a table that lists all source and destination Elements and lists the data flows between these Elements.

Step 5: Customization

The final step is to customize the Architecture Flows and the interconnections between project Elements. The user has the option in this step to filter out flows based on predefined categories or remove individual flows based on the desired outcome of the project. New flows that are undefined by the National ITS Architecture can also be added. This final list is used to create the various diagrams and reports that the program offers. All output from the Regional Architecture development process must be presented in the format developed by Turbo Architecture to facilitate FHWA's review of the architecture for approval of Federal funding. There are three diagram options in Turbo Architecture: Sausage, Interconnect and Flow. Samples and definitions of these diagrams can be found in Section 3.3.3.

There are numerous reports that can be created through Turbo Architecture. Each report provides a slightly different means of sorting the project Elements. The report determined to be the most useful for this project was the project Element Inventory report. The Inventory report lists the existing and proposed project Elements and identifies the associated Stakeholders, Subsystems and Terminators. The Inventory report is provided in Sections 3.3.1 and 3.3.3.

3.2 USER SERVICES

As summarized in chapter 2 of the Bellevue ITS Plan, the City of Bellevue went through an exhaustive effort to identify all the City's ITS related needs. These needs were then grouped by User Service Bundle. To begin developing an ITS Architecture for the region, these needs must be mapped to User Services. There are 34 User Services identified in the National ITS Architecture. Table 3-1 provides a summary of the User Services that best met the City's needs. Appendix C shows the exact mapping of each need to the User Services.

Table 3-1. Identified User Services

Service Bundles	User Service	Identified
Travel and Traffic Management	Pre-Trip Travel Information	X
	En-Route Driver Information	X
	Route Guidance	X
	Ride Matching and Reservation	
	Traveler Services Information	X
	Traffic Control	X
	Incident Management	X
	Travel Demand Management	X
	Emissions Testing and Mitigation	
	Highway-Rail Intersection	X
Public Transportation Management	Public Transportation Management	X
	En-Route Transit Information	X
	Personalized Public Transit	
	Public Travel Security	
Electronic Payment	Electronic Payment Services	
Commercial Vehicle Operations	Commercial Vehicle Electronic Clearance	
	Automated Roadside Safety Inspection	
	On-Board Safety Monitoring	
	Commercial Vehicle Administrative Processes	
	Hazardous Materials Incident Response	
	Freight Mobility	
Emergency Management	Emergency Notification and Personal Security	X
	Emergency Vehicle Management	X
	Disaster Response and Evacuation	X
Advanced Vehicle Safety Systems	Longitudinal Collision Avoidance	
	Lateral Collision Avoidance	
	Intersection Collision Avoidance	X
	Vision Enhancement for Crash Avoidance	
	Safety Readiness	
	Pre-Crash Restraint Deployment	
	Automated Vehicle Operation	
Information Management	Archived Data Function	X
Maintenance/Construction Management	Maintenance and Construction Operations	X

3.3 PHYSICAL ARCHITECTURE

The ITS inventory from Chapter 1, the needs from Chapter 2 and the User Services identified in Section 3.2 of this chapter, are the primary data items used to develop the Physical Architecture. The Physical Architecture is built through the interview process in Turbo Architecture. A thorough understanding of the existing ITS infrastructure, the City's needs and User Services are necessary for feeding the correct data into Turbo Architecture. The result of the interview is a list of project Elements and the mapping of these Elements to Physical Architecture Subsystems and Terminators. However, the mapping performed by Turbo Architecture is not always complete. The difficult part of developing the Physical Architecture for this project was determining how far to expand the plan beyond Bellevue. It was determined that the neighboring jurisdictions should be part of the plan to show regional coordination for traffic and emergency management, but these agencies could not be added through the interview process due to the level of detail needed to complete the interview for an agency. It is not feasible to complete the architecture for all applicable jurisdictions without inventorying the ITS equipment in each neighboring jurisdiction or evaluating their needs.

It was decided that the best way to develop the architecture was to create a Regional Architecture that is shown from Bellevue's perspective. This means that the only interconnects and data flows incorporated into the Architecture are the ones connecting to Bellevue Elements. For example, Kirkland may some day feed traffic data to WSDOT, but only the connection between WSDOT and Bellevue was included in the model. The outside agencies added to the architecture were WSDOT, King County Roads, King County Metro, and the cities of Redmond, Issaquah and Kirkland.

Showing the Regional Architecture from Bellevue's perspective will also help with future integration in the overall Puget Sound Architecture. PSRC plans on updating the existing Puget Sound Regional Architecture in Turbo Architecture. By inputting the data into Turbo for Bellevue as a Project Architecture, it can easily be ported into a Regional Architecture for the entire Puget Sound area. Only mapping Elements into Bellevue will help reduce the amount of overlap when Bellevue's plan is imported.

Since neighboring agencies were not included in the interview, they had to be added manually in the inventory review process. Roadside equipment Elements were added for each agency to illustrate that they had data that could be shared. The data flows from the neighboring agency roadside equipment to their TMCs were primarily limited to traffic signal, CCTV and parking data. As previously noted, without intimate knowledge of their systems, it would be difficult to identify all the appropriate data flows.

Elements also had to be manually added to represent the City of Bellevue Emergency Operations Center and Personnel, Bellevue Fire and Police, Bellevue Service Patrol Vehicles, Bellevue Transportation Department, the 511 Traveler Information Number and Smart Trek. All these Elements were required to help incorporate all the needed Market Packages and Physical Architecture Subsystems. Section 3.3.1 and Section 3.3.2 provide a description of the existing and proposed Elements identified for the project.

3.3.1 Existing Elements

The following existing Elements were identified in Turbo Architecture from the ITS inventory developed in Chapter 1 of this report. The description of each Element includes the lead Stakeholder and a list of the Subsystems and Terminators linked to the Element.

511 Traveler Information Number
Associated Stakeholder: WSDOT
Status: Existing
Description: This is the nationally reserved phone number for traveler information. It is assumed that Bellevue will provide data to this number in the future.
Mapped to Entity: Remote Traveler Support

Bellevue 911 Center
Associated Stakeholder: Bellevue Fire and Police Departments
Status: Existing
Description: This the central dispatch for Bellevue Fire and Police.
Mapped to Entity: Other EM
Mapped to Entity: Emergency Management

Bellevue 911 Center_Personnel
Associated Stakeholder: Bellevue Fire and Police Departments
Status: Existing
Description: This Element represents the personnel responsible for operating the Bellevue 911 center.
Mapped to Entity: Emergency System Operator

Bellevue Emergency Operations Center
Associated Stakeholder: City of Bellevue
Status: Existing
Description: This center is made operational only during major events.
Mapped to Entity: Other EM
Mapped to Entity: Emergency Management

Bellevue Emergency Operations Center_Personnel
Associated Stakeholder: City of Bellevue
Status: Existing
Description: This Element represents the personnel required to activate and operate the emergency operations center.
Mapped to Entity: Emergency System Operator

Bellevue Field Maintenance_Personnel
Associated Stakeholder: Bellevue Maintenance Technicians
Status: Existing
Description: These are the maintenance technicians in the field performing routine and emergency maintenance.
Mapped to Entity: Maintenance and Construction Field Personnel

Bellevue Police and Fire
Associated Stakeholder: Bellevue Fire and Police Departments
Status: Existing
Description: This Element represents the City of Bellevue Police and Fire personnel in the field responding to emergencies.
Mapped to Entity: Maintenance and Construction Management
Mapped to Entity: Emergency Personnel
Mapped to Entity: Enforcement Agency
Mapped to Entity: Emergency Management

Bellevue Service Center
Associated Stakeholder: Bellevue Maintenance Technicians
Status: Existing
Description: This is the main dispatch center in Bellevue for all City maintenance.
Mapped to Entity: Maintenance and Construction Center Personnel
Mapped to Entity: Maintenance and Construction Management
Mapped to Entity: Maintenance and Construction Administrative Systems

Bellevue TMC
Associated Stakeholder: City of Bellevue
Status: Existing
Description: All City of Bellevue traveler information and arterial management will be controlled from the Bellevue TMC.
Mapped to Entity: Parking Management
Mapped to Entity: Roadway Environment
Mapped to Entity: Other Traffic Management
Mapped to Entity: Other Information Service Provider (ISP)
Mapped to Entity: Information Service Provider
Mapped to Entity: Other Parking
Mapped to Entity: Archived Data Management Subsystem
Mapped to Entity: Traffic Management
Mapped to Entity: Other Archives

Bellevue TMC_Personnel
Associated Stakeholder: City of Bellevue
Status: Existing
Description: This Element represents the personnel responsible for operating and maintaining the Bellevue TMC.
Mapped to Entity: Traffic Operations Personnel
Mapped to Entity: ISP Operator

Bellevue TMC_Roadside Equipment
Associated Stakeholder: City of Bellevue
Status: Existing
Description: Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic.
Mapped to Entity: Driver
Mapped to Entity: Basic Vehicle
Mapped to Entity: Location Data Source
Mapped to Entity: Other Roadway
Mapped to Entity: Traffic
Mapped to Entity: Roadway Subsystem

Bellevue Transportation Department
Associated Stakeholder: City of Bellevue
Status: Existing
Description: This Element represents all Transportation Department employees outside of the signal operations group, who will want access to roadway data.
Mapped to Entity: Archived Data Management Subsystem
Mapped to Entity: Other Archives
Mapped to Entity: Archived Data User Systems

Emergency Vehicles
Associated Stakeholder: Bellevue Fire and Police Departments
Status: Existing
Description: Emergency vehicles include ITS equipment that provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response.
Mapped to Entity: Emergency Vehicle Subsystem

King County Metro Transit
Associated Stakeholder: King County Metro
Status: Existing
Description: Operates Metro and Sound Transit buses in King County.
Mapped to Entity: Transit Management

King County Roads TMC
Associated Stakeholder: King County Roads
Status: Existing
Description: Center for managing traffic signals and ITS devices in regions operated and maintained by King County Roads. King County currently operates and maintains traffic signals in Issaquah.
Mapped to Entity: Traffic Management
Mapped to Entity: Other ISP
Mapped to Entity: Other Traffic Management
Mapped to Entity: Information Service Provider

King County Roads TMC_Roadside Equipment
Associated Stakeholder: King County Roads
Status: Existing
Description: Traffic signals and ITS equipment operated by King County Roads that Bellevue will want the ability to view.
Mapped to Entity: Roadway Subsystem
Mapped to Entity: Other Roadway

Maintenance and Construction Operation (MCO) Vehicles
Associated Stakeholder: Bellevue Maintenance Technicians
Status: Existing
Description: MCO vehicles include ITS devices that provide the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction.
Mapped to Entity: Other MCO Vehicles
Mapped to Entity: Basic Maintenance and Construction Vehicle
Mapped to Entity: Maintenance and Construction Vehicle

Media
Associated Stakeholder: None
Status: Existing
Description: The Media Element represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.
Mapped to Entity: Media

Smart Trek
Associated Stakeholder: Puget Sound Regional Council
Status: Existing
Description: PSRC regional traveler information website.
Mapped to Entity: Information Service Provider
Mapped to Entity: Other ISP

Transit Vehicles
Associated Stakeholder: King County Metro
Status: Existing
Description: This Element includes all transit vehicles (Metro Buses and Sound Transit Buses) operated in the City of Bellevue. King County is the primary Stakeholder since they operate the buses for both agencies.
Mapped to Entity: Transit Vehicle Subsystem
Mapped to Entity: Transit Driver

User Personal Computing Devices
Associated Stakeholder: None
Status: Existing
Description: This Element refers to equipment an individual owns and can personalize with their choices for information about transportation networks. An Internet-connected PC is an example.
Mapped to Entity: Personal Information Access

WSDOT TSMC
Associated Stakeholder: WSDOT
Status: Existing
Description: Freeway management center for Bellevue area freeways as well as the rest of King and Snohomish counties.
Mapped to Entity: Other Traffic Management
Mapped to Entity: Information Service Provider
Mapped to Entity: Other ISP
Mapped to Entity: Traffic Management

WSDOT TSMC_Roadside Equipment
Associated Stakeholder: WSDOT
Status: Existing
Description: WSDOT cameras, ramp meters, VMSs and HARs that Bellevue will want to be able to view.
Mapped to Entity: Roadway Subsystem
Mapped to Entity: Other Roadway

3.3.2 Planned Elements

The following is a list of the planned Elements for the Bellevue ITS plan. These Elements were primarily generated through the needs assessment.

Archive Data Center
Associated Stakeholder: City of Bellevue
Status: Planned
Description: It is assumed that an agency in the region will take on the responsibility of managing a data warehouse. Until this agency is defined, it will be identified as a generic data center.
Mapped to Entity: Other Archives
Mapped to Entity: Archived Data Management Subsystem
Mapped to Entity: Archived Data User Systems
Mapped to Entity: Archived Data Administrator

Bellevue Parking Lots
Associated Stakeholder: City of Bellevue
Status: Planned
Description: This Element represents all parking lots in Bellevue that would be included in the Parking Management System.
Mapped to Entity: Parking Operator
Mapped to Entity: Parking Management
Mapped to Entity: Other Parking

Bellevue TMC_Kiosks
Associated Stakeholder: City of Bellevue
Status: Planned
Description: Kiosks are public informational displays supporting various levels of interaction and information access.
Mapped to Entity: Remote Traveler Support

Kirkland TMC
Associated Stakeholder: City of Kirkland
Status: Planned
Description: Central location for managing Kirkland area traffic signals and future ITS devices.
Mapped to Entity: Traffic Management
Mapped to Entity: Information Service Provider
Mapped to Entity: Other ISP
Mapped to Entity: Other Traffic Management

Kirkland TMC_Roadside Equipment
Associated Stakeholder: City of Kirkland
Status: Planned
Description: Kirkland area traffic signals and future ITS devices that Bellevue will want the ability to view.
Mapped to Entity: Roadway Subsystem

Issaquah TMC
Associated Stakeholder: City of Issaquah
Status: Planned
Description: Central location for managing Issaquah area traffic signals and future ITS devices.
Mapped to Entity: Traffic Management
Mapped to Entity: Information Service Provider
Mapped to Entity: Other ISP
Mapped to Entity: Other Traffic Management

Issaquah TMC_Roadside Equipment
Associated Stakeholder: City of Issaquah
Status: Planned
Description: Issaquah area traffic signals and future ITS devices that Bellevue will want the ability to view.
Mapped to Entity: Roadway Subsystem

MCO Field Devices
Associated Stakeholder: Bellevue Maintenance Technicians
Status: Planned
Description: MCO Field Devices include sensors, displays, and cameras for observing and controlling traffic near maintenance and construction work zones.
Mapped to Entity: Roadway Subsystem

Redmond TMC
Associated Stakeholder: City of Redmond
Status: Planned
Description: Central location for managing Redmond area traffic signals and future ITS devices.
Mapped to Entity: Traffic Management
Mapped to Entity: Information Service Provider

Redmond TMC_Roadside Equipment
Associated Stakeholder: City of Redmond
Status: Planned
Description: Redmond traffic signals and CCTV cameras that Bellevue will want the ability to view.
Mapped to Entity: Roadway Subsystem
Mapped to Entity: Other Roadway

Vehicles
Associated Stakeholder: None
Status: Planned
Description: A general Element that represents personal automobiles and fleet vehicles that include ITS safety, navigation and traveler information systems.
Mapped to Entity: Vehicle

3.3.3 Element Interconnects and Data Flows

The Subsystem and Terminator mapping along with the Market Package coordination discussed in Section 3.4 create all the input needed to build the final architecture. As discussed in Section 3.1.4, the Build step in Turbo Architecture converts the interview input and the final Element and Market Package inventories into sets of interconnects and data flows. When the build step was complete for this project there were over 80 interconnects and over 500 data flows. In the Customization page, these items were fine-tuned down to 61 interconnects and 336 data flows. There are various diagram and report options in Turbo Architecture for displaying the Interconnects and Data Flows, but even with the fine-tuned quantity it is difficult to present all the items. The optimal graphical representation is the Physical Architecture Sausage Diagram. The overview diagram was shown in Figure 3-2, while Figure 3-3 is a customized version showing the primary project Elements associated with the Subsystems that fit into the Bellevue ITS Plan. The purpose of this diagram is to provide a simplified view of the structural Elements of the Regional Architecture and to identify the existing and proposed communication links between these Elements.

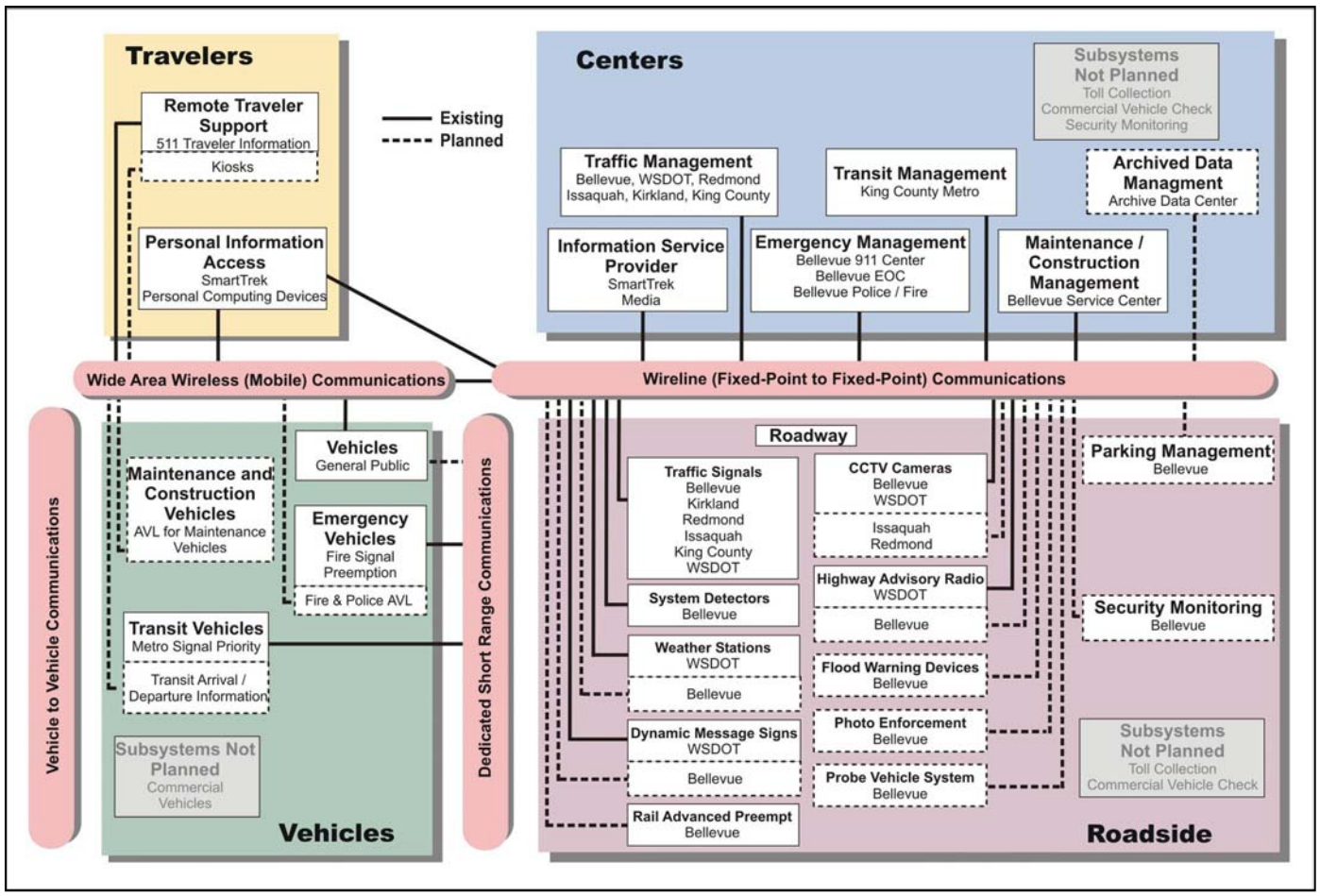
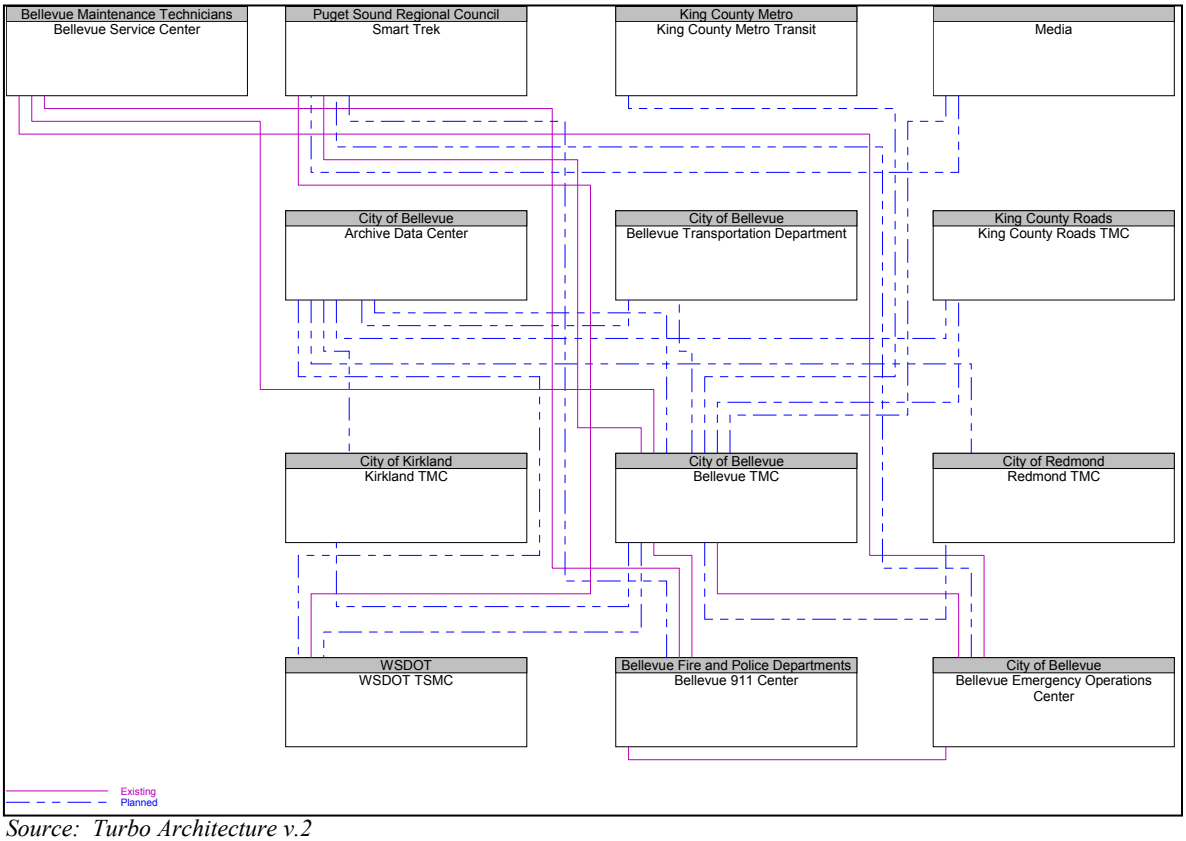


Figure 3-3. Bellevue's National ITS Architecture Sausage Diagram

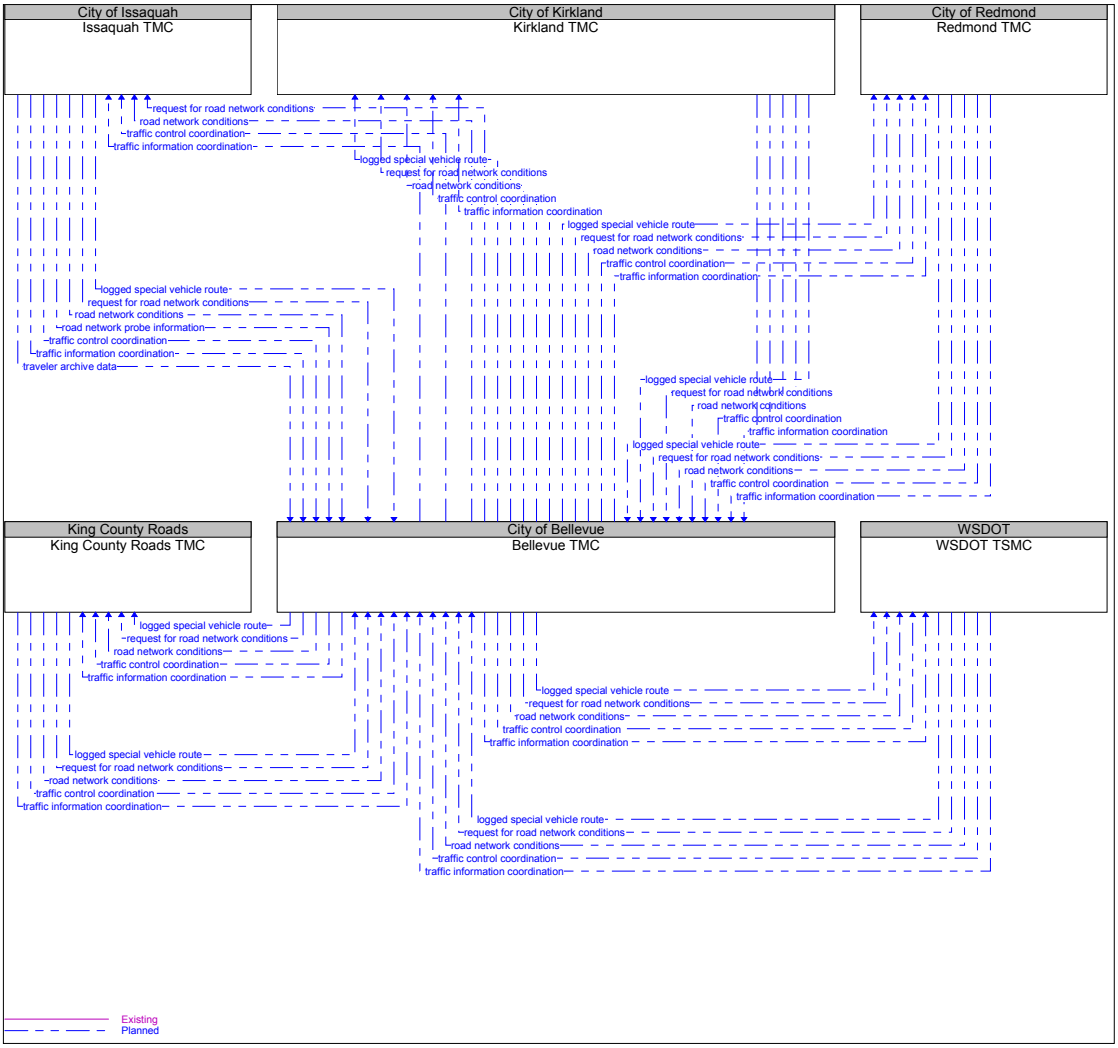
The next level of graphical representation is the Interconnect Diagram. An Interconnect Diagram displays the links between each project Element. As noted, this project has 61 links. Figure 3-4 shows an example of interconnect between the various traffic and emergency management centers and data providers in the region. There are numerous combinations of interconnect diagrams that can be created.



Source: Turbo Architecture v.2

Figure 3-4. Turbo Architecture Interconnect Diagram Sample

The third level of graphical representation is the Architecture Data Flow diagram. These diagrams are similar to the interconnect diagram except instead of showing one line between each Element, there is a separate line for each Data Flow. With over 300 Data Flow in the architecture database, these diagrams can become quite cumbersome and difficult to read. The graphic in Figure 3-5 only includes the Data Flows between the six TMCs identified in the project.



Source: Turbo Architecture v2

Figure 3-5. Turbo Architecture Data Flow Diagram Sample

3.4 MARKET PACKAGES

Market packages play a very important role in developing the Regional Architecture. As each project Element is defined through the interview process and mapped to a Subsystem or Terminator, Turbo Architecture simultaneously maps the project Elements to Market Packages. The Market Package mapping to Elements is primarily based on the Subsystems and Terminators included for each Element. Modifications can be made to the Elements that are mapped to Market Packages, and to the number of Market Packages included. However, Turbo Architecture will only let the user map Elements that are closely related to the Market Package definition. The review of the selected Market Packages serves as an ideal way to back check the inventory.

During the needs assessment development, the Consulting Team determined which Market Packages best matched the needs identified by the Project Stakeholders. This list was then reviewed by the Steering Committee to see if there were any other Market Packages that should be included in the Bellevue ITS Plan

Architecture. Table 3-2 summarizes the Market Packages identified by the Steering Committee. When Turbo Architecture was done mapping Market Packages to project Elements, the list was compared against the packages identified by the Steering Committee. If a Market Package was missing from Turbo Architecture, it meant that either a project Element was not included in the inventory or there was a missing link to a Subsystem. Corrections were made to make the two lists match as much as possible.

The final Market Package mapping in Turbo Architecture included all but seven of the packages identified by the Steering Committee. The following six Market Packages were not included in the Regional Architecture Database because they are new to the ITS Architecture since the release of Version 2.0 of Turbo Architecture.

■ ATMS21 – Roadway Closure Management	■ EM08 – Disaster Response and Recovery
■ EM06 – Wide Area Alert	■ EM09 – Evacuation and Reentry Management
■ EM07 – Early Warning System	■ EM10 – Disaster Traveler Information

The seventh Market Package not included was ATIS8 – Dynamic Ridesharing. It was determined that this Market Package was more of a transit agency responsibility; therefore it would not have a link to a City of Bellevue Element.

Table 3-2. Bellevue ITS Market Package

Service Area	Market Package	Market Package Name	Identified by Steering Committee
Archived Data Management	AD1	ITS Data Mart	X
	AD2	ITS Data Warehouse	X
	AD3	ITS Virtual Data Warehouse	
Public Transportation	APTS1	Transit Vehicle Tracking	
	APTS2	Transit Fixed-Route Operations	
	APTS3	Demand Response Transit Operation	
	APTS4	Transit Passenger and Fare Management	
	APTS5	Transit Security	
	APTS6	Transit Maintenance	
	APTS7	Multi-modal Coordination	X
	APTS8	Transit Traveler Information	X
Traveler Information	ATIS1	Broadcast Traveler Information	X
	ATIS2	Interactive Traveler Information	X
	ATIS3	Autonomous Route Guidance	
	ATIS4	Dynamic Route Guidance	
	ATIS5	ISP Based Route Guidance	
	ATIS6	Integrated Trans. Management/Route Guidance	
	ATIS7	Yellow Pages and Reservations	
	ATIS8	Dynamic Ridesharing	X
	ATIS9	In Vehicle Signing	X
Traffic Management	ATMS01	Network Surveillance	X
	ATMS02	Probe Surveillance	X
	ATMS03	Surface Street Control	X
	ATMS04	Freeway Control	
	ATMS05	HOV Lane Management	
	ATMS06	Traffic Information Dissemination	X
	ATMS07	Regional Traffic Control	X
	ATMS08	Traffic Incident Management System	X
	ATMS09	Traffic Forecast and Demand Management	X
	ATMS10	Electronic Toll Collection	
	ATMS11	Emissions Monitoring and Management	
	ATMS12	Virtual TMC and Smart Probe Data	
	ATMS13	Standard Railroad Grade Crossing	X
	ATMS14	Advanced Railroad Grade Crossing	
	ATMS15	Railroad Operations Coordination	
	ATMS16	Parking Facility Management	X
	ATMS17	Regional Parking Management	X
	ATMS18	Reversible Lane Management	
	ATMS19	Speed Monitoring	X
	ATMS20	Drawbridge Management	
	ATMS21	Roadway Closure Management	X

Table 3-2. Bellevue ITS Market Package (continued)

Service Area	Market Package	Market Package Name	Identified by Steering Committee
Advanced Vehicle Safety System	AVSS01	Vehicle Safety Monitoring	
	AVSS02	Driver Safety Monitoring	
	AVSS03	Longitudinal Safety Warning	
	AVSS04	Lateral Safety Warning	
	AVSS05	Intersection Safety Warning	
	AVSS06	Pre-Crash Restraint Deployment	
	AVSS07	Driver Visibility Improvement	
	AVSS08	Advanced Vehicle Longitudinal Control	
	AVSS09	Advanced Vehicle Lateral Control	
	AVSS10	Intersection Collision Avoidance	
	AVSS11	Automated Highway System	
Commercial Vehicle Operations	CVO01	Fleet Administration	
	CVO02	Freight Administration	
	CVO03	Electronic Clearance	
	CVO04	CV Administrative Processes	
	CVO05	International Border Electronic Clearance	
	CVO06	Weigh-In-Motion	
	CVO07	Roadside CVO Safety	
	CVO08	On-Board CVO Safety	
	CVO09	CVO Fleet Maintenance	
	CVO10	HAZMAT Management	
	CVO11	Roadside HAZMAT Security Detection/Mitigation	
	CVO12	CV Driver Security Authentication	
	CVO13	Freight Assignment Tracking	
Emergency Management	EM01	Emergency Call-Taking Dispatch	X
	EM02	Emergency Routing	X
	EM03	Mayday Support	
	EM04	Roadway Service Patrols	
	EM05	Transportation Infrastructure Protection	
	EM06	Wide-Area-Alert	X
	EM07	Early Warning System	X
	EM08	Disaster Response and Recovery	X
	EM09	Evacuation and Reentry Management	X
	EM10	Disaster Traveler Information	X

Table 3-2. Bellevue ITS Market Package (continue)

Service Area	Market Package	Market Package Name	Identified by Steering Committee
Maintenance & Construction Management	MC01	Maint. and Const. vehicle and Equip. Tracking	X
	MC02	Maint. and Const. vehicle Maintenance	X
	MC03	Road Weather Data Collection	X
	MC04	Weather Information Processing and Distribution	X
	MC05	Roadway Automated Treatment	X
	MC06	Winter Maintenance	X
	MC07	Roadway Maintenance and Construction	X
	MC08	Work Zone Management	X
	MC09	Work Zone Safety Monitoring	X
	MC10	Maint. and Const. Activity Coordination	X

3.5 STANDARDS REQUIREMENTS

An ITS system that is centered around ITS Standards is critical to promote future interoperability between agencies. Assuming that all local agencies follow national ITS standards and have developed command sharing agreements, a traffic engineer in Bellevue will be able to view a WSDOT CCTV camera on I-405 without changing computers or video switcher keypads. Standards also provide a means for a traffic responsive pattern change to be made to signals on both the Redmond and Bellevue signal systems based on detectors in both jurisdictions.

The following national agencies are currently participating in developing ITS standards:

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- National Electrical Manufacturers Association (NEMA)
- Society of Automotive Engineers (SAE)

The Puget Sound Region ITS planning guidance document requires that any relevant standards be identified for each Market Package included in the ITS plan. Table 3-3 on the following pages shows the Market Packages selected for the project on the top of the page and all the ITS standards on the left of the page. Some Market Packages may apply to more than one standard.

Table 3-3. Market Packages vs. ITS Standards

ITS Standards	AD1: ITS Data Mart	AD2: ITS Data Warehouse	APTS7: Multi-modal Coordination	APTS8: Transit Traveler Information	ATIS1: Broadcast Traveler Information	ATIS2: Interactive Traveler Information	ATIS8: Dynamic Ridesharing	ATIS9: In Vehicle Signing	ATMS01: Network Surveillance	ATMS02: Probe Surveillance	ATMS03: Surface Street Control	ATMS06: Traffic Information Dissemination	ATMS07: Regional Traffic Control	ATMS08: Traffic Incident Management System	ATMS09: Traffic Forecast and Demand Management	ATMS13: Standard Railroad Grade Crossing	ATMS16: Parking Facility Management	ATMS17: Regional Parking Management	ATMS19: Speed Monitoring	ATMS21: Roadway Closure Management	EM01: Emergency Call-Taking Dispatch	EM02: Emergency Routing	EM06: Wide-Area-Alert	EM07: Early Warning System	EM08: Disaster Response and Recovery	EM09: Evacuation and Reentry Management	EM10: Disaster Traveler Information	MC01: Maint. and Const. vehicle and Equip. Tracking	MC02: Maint. and Const. vehicle Maintenance	MC03: Road Weather Data Collection	MC04: Weather Information Processing and Distribution	MC05: Roadway Automated Treatment	MC06: Winter Maintenance	MC07: Roadway Maintenance and Construction	MC08: Work Zone Management	MC09: Work Zone Safety Monitoring	MC10: Maint. and Const. Activity Coordination
NTCIP 1101: Simple Transportation Management Framework (STMF)			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 1102: Base Standard: Octet Encoding Rules (OER)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		
NTCIP 1103: Simple Transportation Management Protocol (STMP)			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 1104: CORBA Naming Convention	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 1105: CORBA Security Service	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 1106: CORBA Near-Real Time Data Service	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 1201: Global Object Definitions			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				X		X		X	X		
NTCIP 1202: Object Definitions for Actuated Traffic Signal Controller Units			X								X		X									X															
NTCIP 1203: Object Definitions for Dynamic Message Signs								X				X								X			X												X		
NTCIP 1204: Object Definitions for Environmental Sensor Stations & Roadside Weather Information System																														X		X					
NTCIP 1205: Data Dictionary for Closed Circuit Television (CCTV)									X		X			X						X	X			X											X		
NTCIP 1206: Data Collection & Monitoring Devices										X																											
NTCIP 1207: Ramp Meter Controller Objects													X																								
NTCIP 1208: Object Definitions for Video Switches									X		X			X						X	X			X											X		
NTCIP 1209: Transportation System Sensor Objects									X		X		X	X	X				X																		
NTCIP 1210: Objects for Signal Systems Master			X								X		X									X			X	X											
NTCIP 1211: Objects for Signal Control Priority			X								X		X									X			X	X											
NTCIP 1401: TCIP - Common Public Transportation (CPT) Business Area Standard			X	X											X										X											
NTCIP 1402: TCIP - Incident Management (IM) Business Area Standard			X		X	X											X				X			X	X											
NTCIP 1403: TCIP - Passenger Information (PI) Business Area Standard			X	X		X									X		X	X					X		X	X	X									
NTCIP 1404: TCIP - Scheduling/Runcutting (SCH) Business Area Standard			X	X		X									X										X	X	X									
NTCIP 1405: TCIP - Spatial Representation (SP) Business Area Standard										X																				X							
NTCIP 1406: TCIP - Onboard (OB) Business Area Standard			X	X	X	X				X					X										X					X						
NTCIP 1407: TCIP - Control Center (CC) Business Area Standard			X	X	X	X									X										X	X	X									
NTCIP 1408: TCIP - Fare Collection (FC) Business Area Standard			X	X		X									X												X									
NTCIP 2101: Point to Multi-Point Protocol Using RS-232 Subnetwork Profile			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2102: Subnet Profile for PMPP Over FSK modems			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2103: Subnet Profile for Point-to-Point Protocol using RS 232			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2104: Subnet Profile for Ethernet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		
NTCIP 2201: Transportation Transport Profile			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		

Table 3-3. Market Packages vs. ITS Standards – Continued

ITS Standards	AD1: ITS Data Mart	AD2: ITS Data Warehouse	APTS7: Multi-modal Coordination	APTS8: Transit Traveler Information	ATIS1: Broadcast Traveler Information	ATIS2: Interactive Traveler Information	ATIS8: Dynamic Ridesharing	ATIS9: In Vehicle Signing	ATMS01: Network Surveillance	ATMS02: Probe Surveillance	ATMS03: Surface Street Control	ATMS06: Traffic Information Dissemination	ATMS07: Regional Traffic Control	ATMS08: Traffic Incident Management System	ATMS09: Traffic Forecast and Demand Management	ATMS13: Standard Railroad Grade Crossing	ATMS16: Parking Facility Management	ATMS17: Regional Parking Management	ATMS19: Speed Monitoring	ATMS21: Roadway Closure Management	EM01: Emergency Call-Taking Dispatch	EM02: Emergency Routing	EM06: Wide-Area-Alert	EM07: Early Warning System	EM08: Disaster Response and Recovery	EM09: Evacuation and Reentry Management	EM10: Disaster Traveler Information	MC01: Maint. and Const. vehicle and Equip. Tracking	MC02: Maint. and Const. vehicle Maintenance	MC03: Road Weather Data Collection	MC04: Weather Information Processing and Distribution	MC05: Roadway Automated Treatment	MC06: Winter Maintenance	MC07: Roadway Maintenance and Construction	MC08: Work Zone Management	MC09: Work Zone Safety Monitoring	MC10: Maint. and Const. Activity Coordination
NTCIP 2301: Application Profile for Simple Transp. Manage. Framework (STMF)			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2302: Application Profile for Trivial File Transfer Protocol			X					X	X	X	X	X	X	X	X				X	X	X	X	X	X						X		X		X	X		
NTCIP 2303: Application Profile for File Transfer Protocol (FTP)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		
NTCIP 2304: Application Profile for Data Exchange ASN.1 (DATEX)	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 2305: Application Profile for Common Object Request Broker Archt.	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 2501: Information Profile for DATEX	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
NTCIP 2502: Information Profile for CORBA	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X			X	X		X	X			
ITE TM 1.03: Standard for Functional Level Traffic Management Data Dictionary (TMDD)	X	X			X	X			X	X		X	X	X	X					X	X	X		X	X	X	X			X	X		X	X			
ITE TM 2.01: Message Sets for External TMC Communication (MS/ETMCC)	X	X			X	X			X	X		X	X	X	X					X	X	X		X	X	X	X			X	X		X	X			
SAE J2354: Message Set for Advanced Traveler Information System (ATIS)			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2369: Standard for ATIS Message Sets Delivered Over Bandwidth Restricted Media					X	X																															
SAE J2630: Converting ATIS Message Standards from ASN.1 to XML			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2540: Messages for Handling Strings and Look-Up Tables in ATIS Standards			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2540-1: RDS (Radio Data System) Phrase List			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2540-2: ITIS (International Traveler Information Systems) Phrase Lists			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2540-3: National Names Phrase List			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2529: Rules for Standardizing Street Names and Route IDs			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
SAE J2374: National Location Referencing Information Report			X	X	X	X	X		X	X		X		X	X		X	X		X	X	X	X		X		X						X	X			
DSRC 5GHz: Dedicated Short Range Communication at 5.9 GHz Standards Group			X					X		X							X					X														X	
DSRC 915MHz: Dedicated Short Range Communication at 915 MHz Standards Group			X					X		X							X					X														X	
IEEE Std 1455-1999: Standard for Message Sets for Vehicle/Roadside Communications								X		X							X																				X	
IEEE 1512-2000: Standard for Common Incident Management Message Sets (IMMS) for use by EMCs				X	X	X						X		X	X						X	X		X	X	X	X						X	X			
IEEE 1512.1-2003: Standard for Traffic Incident Management Message Sets for Use by EMCs				X	X	X						X		X	X						X	X		X	X	X	X						X	X			
IEEE P1512.2: Standard for Public Safety IMMS for use by EMCs				X	X	X						X		X	X						X	X		X	X	X	X						X	X			
IEEE 1512.3-2002: Standard for Hazardous Material IMMS for use by EMCs				X	X	X						X		X	X						X	X		X	X	X	X						X	X			

CHAPTER 4 CONCEPT OF OPERATIONS

4.1 INTRODUCTION

This chapter presents the Concept of Operations for the City of Bellevue ITS Master Plan. It includes an overview of the existing institutional relationships between the local, regional and state transportation agencies and the City of Bellevue, and describes proposed future relationships. The purpose of the Concept of Operations is to define the roles and responsibilities for maintenance and operation of ITS and also to identify the level of information sharing, status and control between agencies.

4.1.1 Approach

In June 2001, the Puget Sound Regional Council created a document[10] to facilitate ITS planning throughout the region. This guidance document outlines a method for creating a Concept of Operations that is closely followed in this report. The Concept of Operations defines the relationships and responsibilities among the organizations required for the deployment and operation of ITS Systems. For this project, the program areas are defined by Market Packages as described in Section 4.2. Every relationship between the City of Bellevue and each surrounding agency is divided into two parts:

1. Agency-to-Agency Relationship: Defining the responsibilities for each relationship, and
2. Information Exchange: The type of information shared in that relationship.

The definition for each term used in these relationships is given in Table 4-1. Section 4.2 will identify the Market Packages that will require coordination, and will provide a table and graphic to describe the inter-jurisdictional relationship.

[10] *Guidance for Complying with Federal Requirements for Intelligent Transportation System Projects in the Puget Sound Region,* IBI Group with PB Farradyne, Pacific Rim Resources and Battelle Memorial Institute, June 5, 2001. (http://www.psrc.org/projects/its/documents/guidance.pdf)

Table 4-1. Interagency Relationship and Information Exchange Definitions

AGENCY-TO-AGENCY RELATIONSHIPS	INFORMATION EXCHANGES
Consultation: One party confers with another party, in accordance with an established action and then keeps that party informed about actions taken. **Cooperation**: The parties involved in carrying out the planning and/or project development processes work together to achieve a common goal or objective. **Coordination:** The comparison of the transportation plans, programs, and schedules of one agency with related plans, programs and schedules of other agencies and adjustment of plans, programs and schedules to achieve general consistency. **Information Sharing:** The exchange of data and device status information between parties, for the purpose of coordinated responses, planning and analysis. **Control Sharing:** The ability, through operational agreements, to allow for one party to control another party's field devices to properly respond to incident, event, weather, or traffic conditions. **Operations:** One party fully operates field equipment of a second party, typically because the second party does not operate a control center. **Maintenance**: One party maintains the field equipment of a second party.	**Video:** The dissemination of live video and still images from one party's field cameras to another party. **Data:** The dissemination of data gathered from one party's field devices to another party. Data can include, but is not limited to, traffic data, weather data, parking data and transit data. **Command:** The ability for one party to control a second party's field devices. Command can include, but is not limited to changing VMS messaging, changing traffic signal timings and camera control.[1] **Request:** The ability for one party to solicit either data or a command change, such as a VMS messaging or signal timings, from another party. **Status:** The ability for one party to monitor another party's field devices and receive such information as current signal timing/response plan and current message sets.
Note: (1) Local agencies will always have overriding control of their local devices included in a command exchange interagency relationship.	

Source: Guidance for Complying with Federal Requirements for Intelligent Transportation System Projects in the Puget Sound Region, June 2001

4.1.2 Existing Agreements

The City of Bellevue currently takes part in a variety of formal and informal agreements related to ITS with local, regional and state jurisdictions. The agreements are described below:

- **WSDOT Signal Maintenance and Operations:** The City maintains and operates all state owned intersection signals, except at the interchange at Lakemont Boulevard.
- **WSDOT Video Sharing Agreement:** The City and WSDOT have established a communication link to share video feeds. They can view each others cameras, but cannot control them.
- **148th Corridor:** Because the boundaries between Bellevue and Redmond run up the middle of 148th Avenue NE, an agreement was reached between the two cities where Bellevue owns and maintains the signals from NE 29th Street southward, while Redmond owns and maintains the signals north of NE 29th Street.
- **Metro TSP Agreement:** This agreement defines the operations and maintenance between Bellevue and King County Metro for the two existing transit signal priority test sites on NE 8th Street.
- **Regional Disaster Plan:** This plan involves all the cities in the county to coordinate resources during major disasters.
- **Bellevue 911 Center Dispatch:** Agreements have been reached with the Clyde Hill Police department and 13 Eastside fire departments to have their vehicles dispatched from the Bellevue 911 Center.

- **WA State Fire Resource Mobilization Plan:** This plan supports regional coordination in case of a major fire.
- **Inter-Jurisdictional Emergency Response:** There is an informal understanding that the closest emergency vehicle will respond to the emergency event regardless of agency boundaries. For example, if there is a fire in Issaquah near Issaquah Station A, but Station A is occupied somewhere else in the City, a Bellevue Fire station will respond if it is closer than Issaquah Station B. For the Eastside, this jurisdictional overlap works well because all the fire departments are dispatched from the Bellevue 911 center, but this arrangement also works between all nineteen 911 centers in King County.

4.2 CONCEPT OF OPERATIONS

It is suggested in the Puget Sound ITS Architecture Guidance document that interagency relationships be identified by Market Package. Table 4-2 lists all the Market Packages that were identified for the Regional ITS Architecture. The Market Package identification was performed in a four step process:

1. After the City identified all their needs, the Consultant Team mapped the needs to Market Packages.
2. The list of mapped Market Packages was then reviewed by the Bellevue ITS Steering Committee to determine if there were any additional packages that should be included.
3. When Turbo Architecture was used to create the Regional Architecture, Market Packages were identified by the program based on the interview process.
4. The final step was to compare the packages identified by the Steering Committee to the results of the Turbo Architecture analysis. The two lists of packages were combined to make the list in Table 4-2.

Of the 37 Market Packages identified for the Bellevue ITS Plan, 17 are recommended for interagency coordination. Many of the emergency management as well as maintenance and construction management Market Packages identified are very similar in coordination requirements; therefore they have been lumped together under the headings of “Emergency Management” and “Construction Management”. The following sections of this report define the interagency relationship proposed for each Market Package. Each section provides the following: a definition of the Market Package; a description of the information that will be exchanged; identification of the agencies involved; and identification of the agency-to-agency relationship.

The agencies selected for the Concept of Operations definition and a summary of all the information exchange for each Market Package is provided in Table 4-3.

Table 4-2. Bellevue ITS Market Packages

Identified ITS Market Packages		Requires Interagency Coordination
AD1	ITS Data Mart	
AD2	ITS Data Warehouse	X
APTS7	Multi-modal Coordination	X
APTS8	Transit Traveler Information	
ATIS1	Broadcast Traveler Information	
ATIS2	Interactive Traveler Information	X
ATIS8	Dynamic Ridesharing	
ATIS9	In Vehicle Signing	
ATMS01	Network Surveillance	X
ATMS02	Probe Surveillance	
ATMS03	Surface Street Control	
ATMS06	Traffic Information Dissemination	X
ATMS07	Regional Traffic Control	X
ATMS08	Traffic Incident Management System	X
ATMS09	Traffic Forecast and Demand Management	
ATMS13	Standard Railroad Grade Crossing	
ATMS16	Parking Facility Management	
ATMS17	Regional Parking Management	X
ATMS19	Speed Monitoring	
ATMS21	Roadway Closure Management	X
EM01	Emergency Call-Taking Dispatch	
EM02	Emergency Routing	X
EM06	Wide-Area-Alert	X
EM07	Early Warning System	X
EM08	Disaster Response and Recovery	X
EM09	Evacuation and Reentry Management	X
EM10	Disaster Traveler Information	X
MC01	Maint. and Const. vehicle and Equip. Tracking	
MC02	Maint. and Const. vehicle Maintenance	
MC03	Road Weather Data Collection	
MC04	Weather Information Processing and Distribution	
MC05	Roadway Automated Treatment	
MC06	Winter Maintenance	
MC07	Roadway Maintenance and Construction	
MC08	Work Zone Management	X
MC09	Work Zone Safety Monitoring	
MC10	Maint. and Const. Activity Coordination	X

Table 4-3. Information Exchange of ITS Market Packages by Agency

Market Package Name	Bellevue	Issaquah	Kirkland	Redmond	WSDOT	King County	King County Metro	Sound Transit
ITS Data Warehouse (AD2)	D R	D R	D R	D R	D R	D R		
Multi-modal Coordination (APTS7)	D V C R						D V C R	D C R
Interactive Traveler Information (ATIS2)	D V				D V		D	D
Network Surveillance (ATMS01)	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S		
Traffic Information Dissemination (ATMS06)	D R S	D R S	D R S	D R S	D R S	D R S		
Regional Traffic Control (ATMS07)	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V	D
Traffic Incident Management System (ATMS08)	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V S	D S
Regional Parking Management (ATMS17)	D V R C S				D V R C S		D V R S	D R S
Emergency Management	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D R C S
Construction Management	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	D V R C S	V S	S

Note: D = Data, V = Video, C = Command, R = Request, S = Status

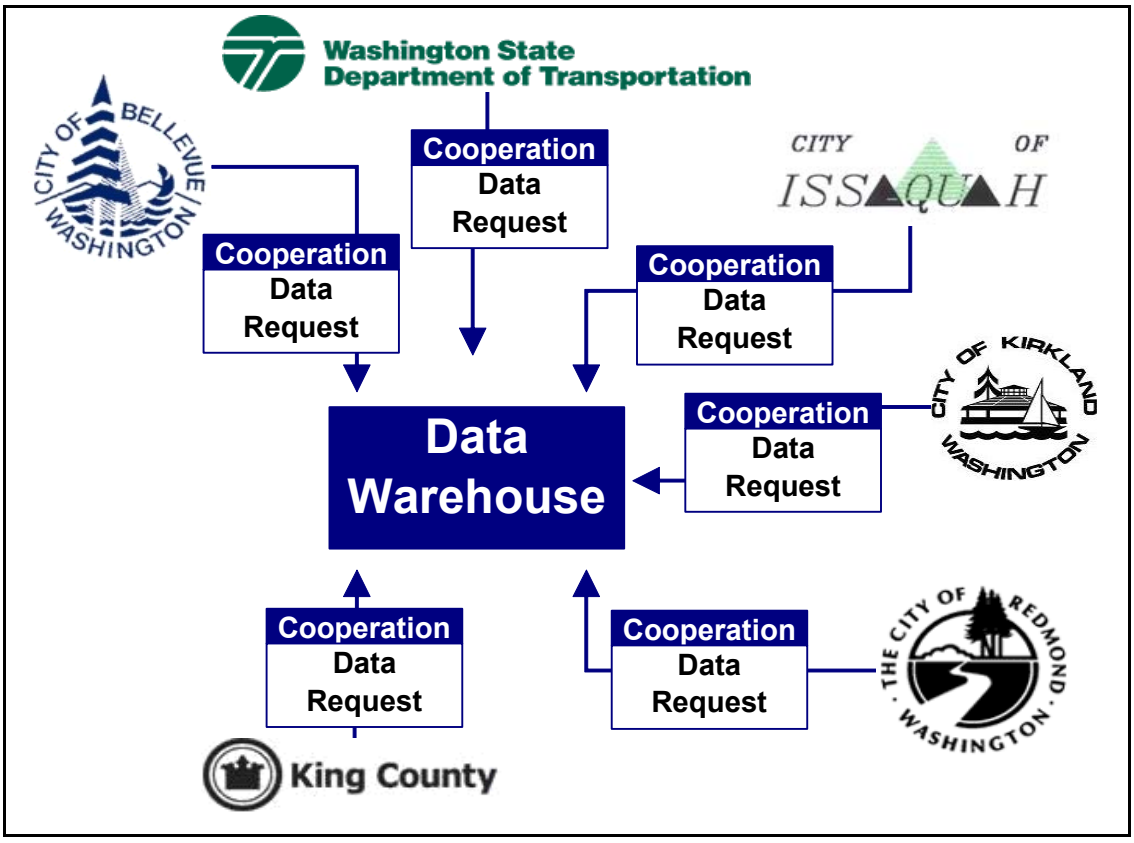
4.2.1 ITS Data Warehouse (AD2)

This Market Package serves as a data collection and management center for multiple agencies. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Data	Data such as traffic volume and occupancy will automatically be pulled or pushed to the data warehouse from Bellevue and other surrounding agencies.
Video	N/A
Command	N/A
Request	All agencies can request data from the warehouse.
Status	N/A

This Market Package adds the functionality and interface definitions that allow collection of data from multiple agencies, such as WSDOT, King County, and the cities of Bellevue, Issaquah, Kirkland, and Redmond. The ITS Data Warehouse performs the data management features that are necessary to compile this data in a single repository in a consistent format.



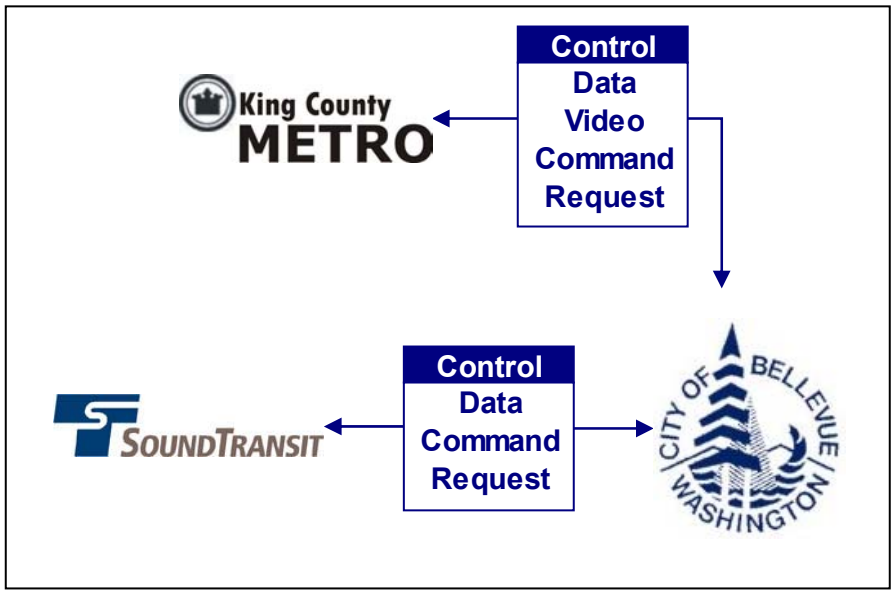
4.2.2 Multi-modal Coordination (APTS7)

This Market Package establishes two way communications between multiple transit and traffic agencies to improve service coordination. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- King County Metro, and
- Sound Transit.

Data	Exchange real-time bus location, ridership and schedule adherence for TSP operations.
Video	Transit agencies to use Bellevue video to observe TSP operations.
Command	Bellevue to control TSP operations.
Request	Transit vehicles request priority at traffic signals.
Status	N/A

Multi-modal coordination between the two transit agencies and the City can increase traveler convenience at transit transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. Coordination between the transit vehicle and the individual intersection in Bellevue for TSP is also supported by this package.



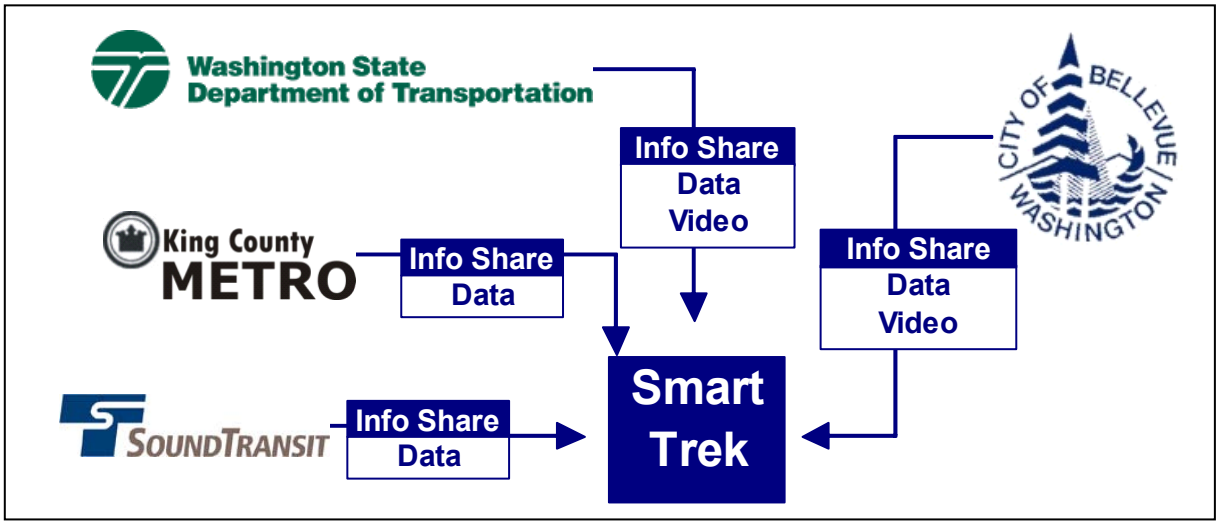
4.2.3 Interactive Traveler Information (ATIS2)

This Market Package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. It is assumed that PSRC's Smart Trek website will be the center of interactive traveler information. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- King County Metro, and
- Sound Transit.

Data	Post WSDOT and Bellevue roadway speed and volume data and occupancy information. Transit agencies to provide real-time arrival and departure data to post on traveler information systems.
Video	Post WSDOT or Bellevue video feeds.
Command	N/A
Request	N/A
Status	N/A

It is anticipated that other surrounding agencies will also participate in a traveler information system, but these are the agencies that most closely impact the residents of Bellevue. When built-out, this package would allow a traveler to seamlessly access roadway and transit conditions throughout the region from a unified source. A variety of interactive devices, such as PDAs and in-vehicle guidance systems may be used by the traveler to access this information either prior to a trip or en route.



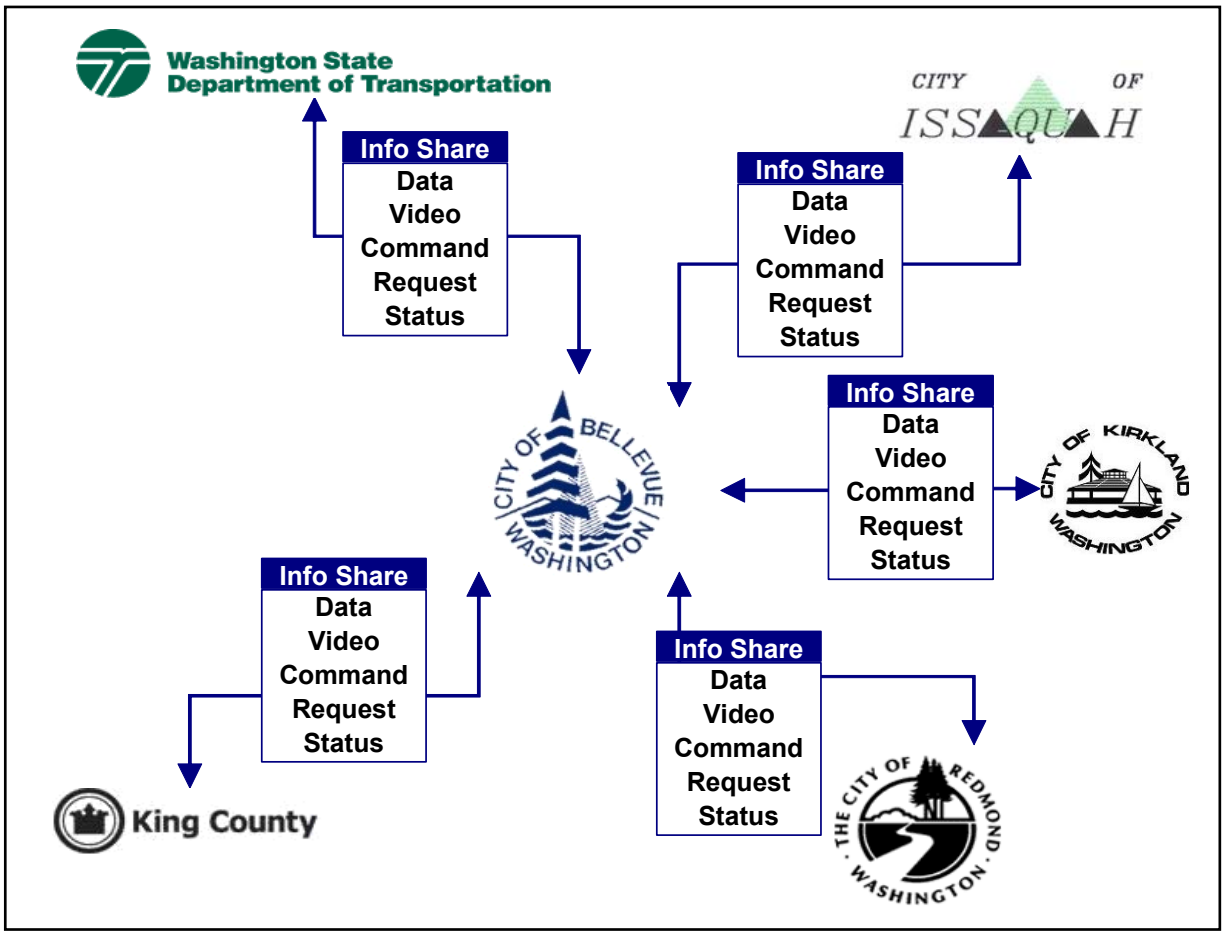
4.2.4 Network Surveillance (ATMS01)

This Market Package includes traffic detectors and other surveillance equipment, and communications media required to transmit the collected data back to the Traffic Management Center. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Data	Share speed, volume and occupancy data with other agencies.
Video	Share video feeds with other agencies.
Command	Share camera control with other agencies.
Request	The ability for agencies to request congestion data and video.
Status	Bellevue to check status of other agencies' roadways.

The intent of this Market Package is to provide the City of Bellevue traffic operations engineers with the ability to monitor and view traffic in other jurisdictions to help improve inter-jurisdictional traffic operations.



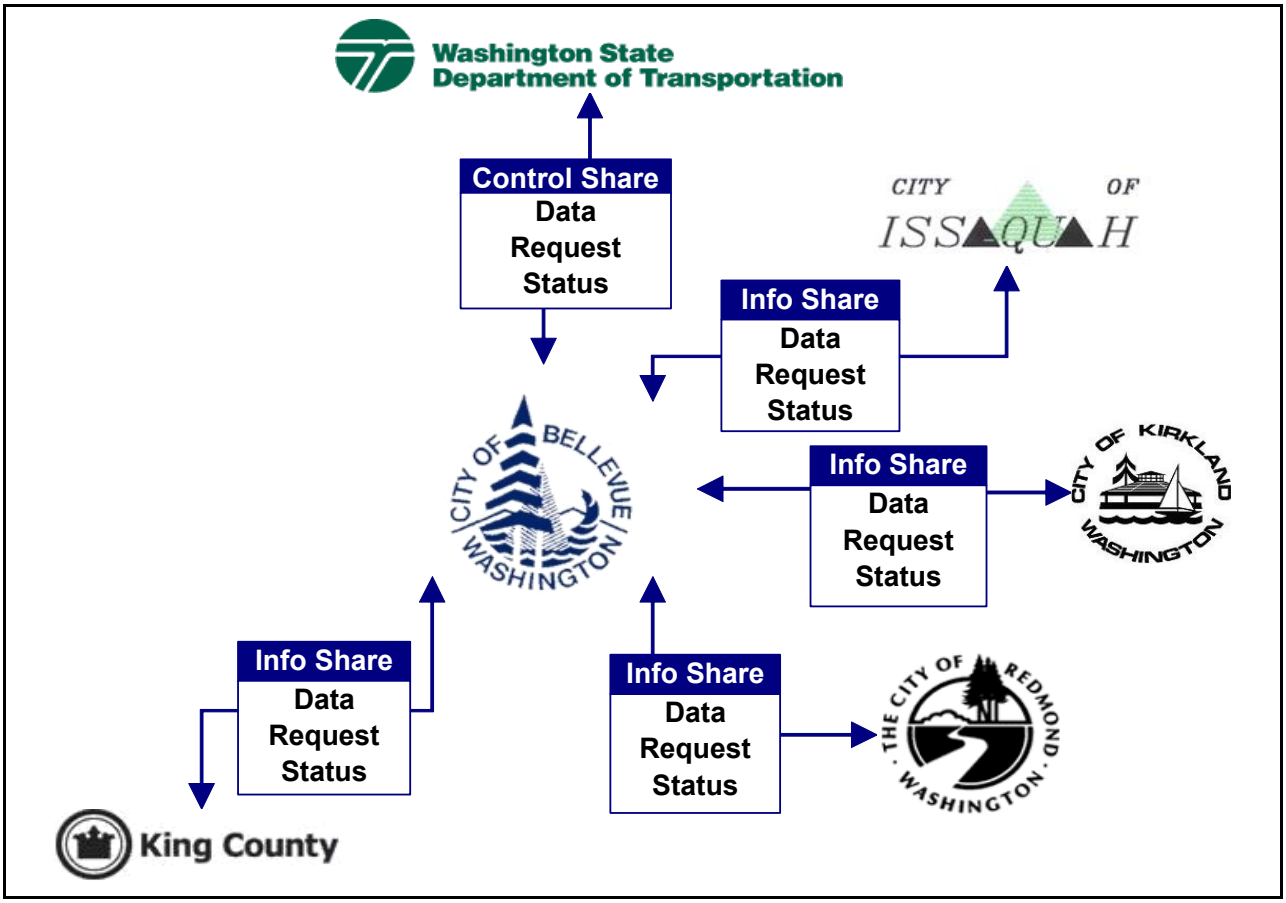
4.2.5 Traffic Information Dissemination (ATMS06)

This Market Package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Data	VMS and HAR message data
Video	N/A
Command	N/A
Request	The ability for one agency to request VMS and HAR data from another agency.
Status	The status of VMS's and HAR's in other jurisdictions.

A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package will provide agencies with the ability to check the status of dynamic message signs and highway advisory radios in another jurisdiction. This will facilitate responses to incidents and events that impact multiple agencies.



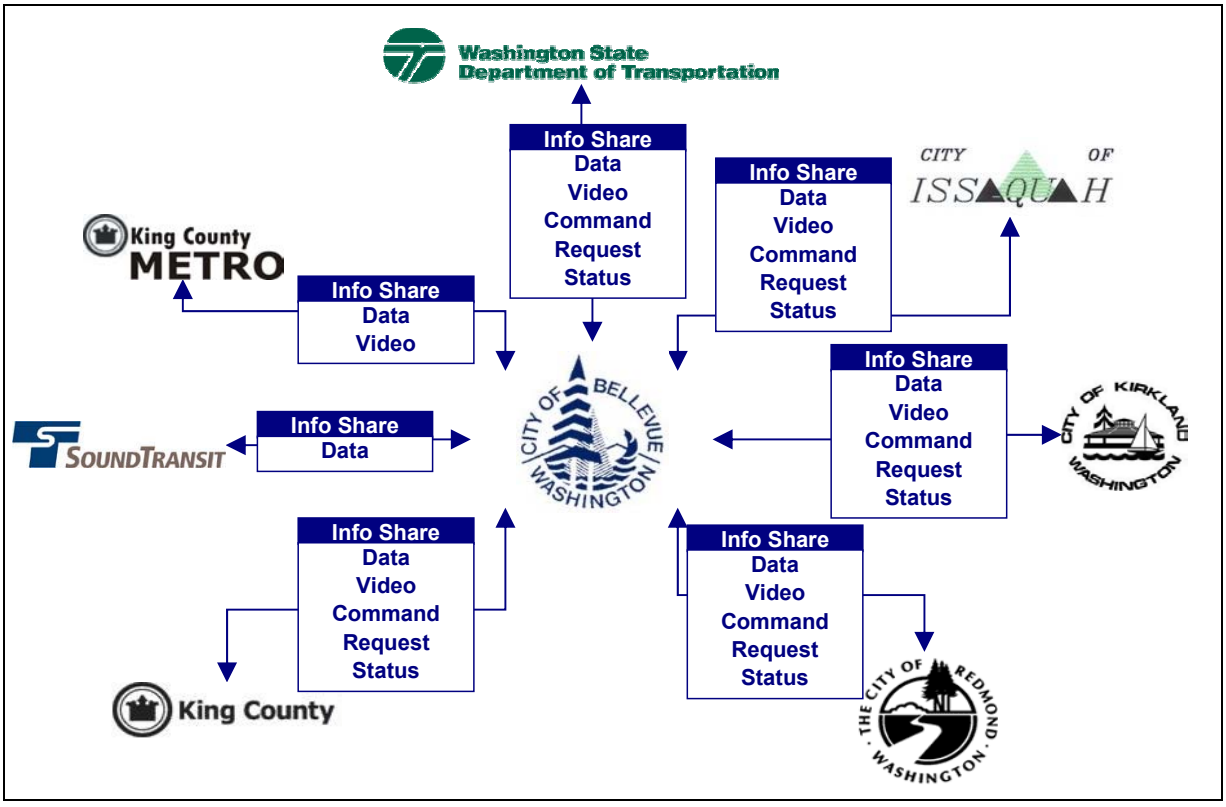
4.2.6 Regional Traffic Control (ATMS07)

This Market Package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- Sound Transit,
- King County Metro,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Data	Share traffic signal and signal priority data with other agencies.
Video	Share video feeds with other agencies.
Command	Send commands for time of day pattern changes to other agencies.
Request	One signal will place a pattern change request with another.
Status	The signal system will be able to share traffic signal status information.

This Market Package will be used to implement traffic management strategies across jurisdictional boundaries. An example would be the City of Bellevue implementing traffic responsive signal control on 148th Avenue NE using system detectors in Bellevue to change cycle lengths and offsets in Redmond. It is assumed initially that all relationships will fall under the Information Sharing category (excluding camera control), but the goal should be to eventually allow for Control Sharing for interagency signal operations. The transit agencies will probably stay under the Information Sharing category. Their primary stake in this Market Package will be the sharing of TSP data.



4.2.7 Traffic Incident Management System (ATMS08)

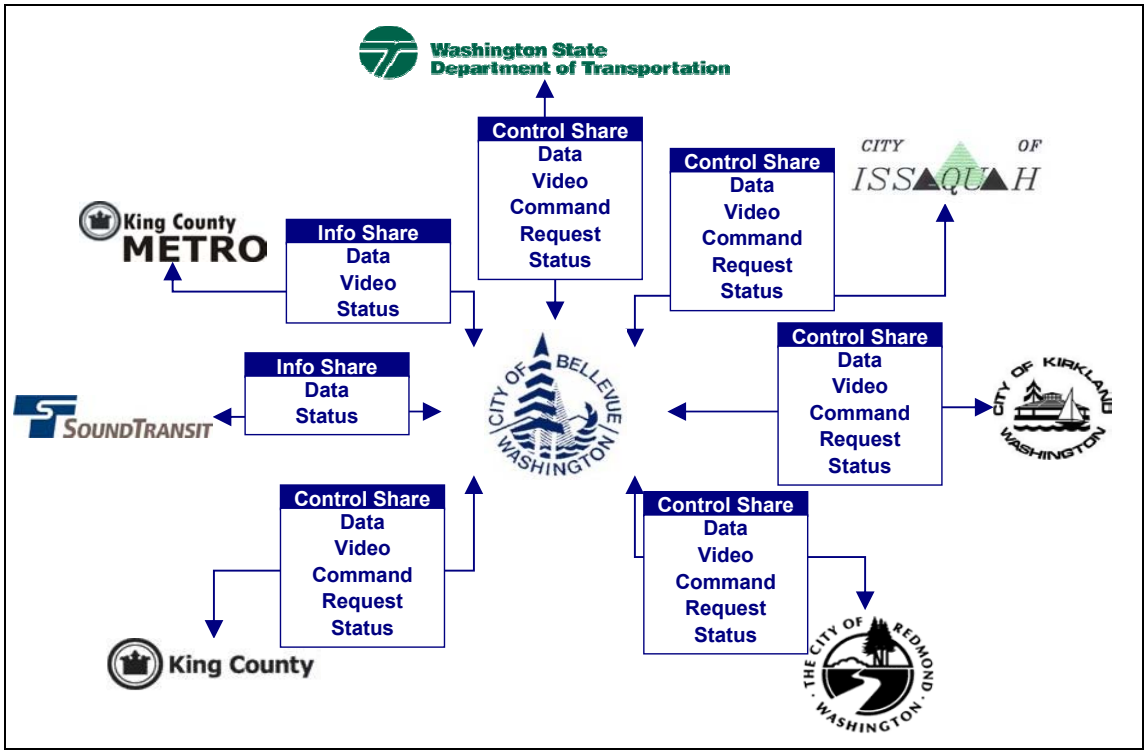
This Market Package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- Sound Transit,
- King County Metro,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Data	Share data to detect and verify planned and unplanned incidents.
Video	Share video feeds.
Command	Send signal operation and possibly VMS control share communications to neighboring agency for regional management.
Request	Other agencies to request information regarding planned and unplanned incidents.
Status	Check status of incidents.

This Market Package provides incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other management centers. The response may include traffic control strategy modifications, resource coordination between management centers or broadcasts to travelers.

The goal for this Market Package is to allow control sharing between agencies for the implementation of a predefined incident management plan. The agency with control could vary depending on the incident location. The transit agencies will interface the system to monitor incidents that may impact their service.



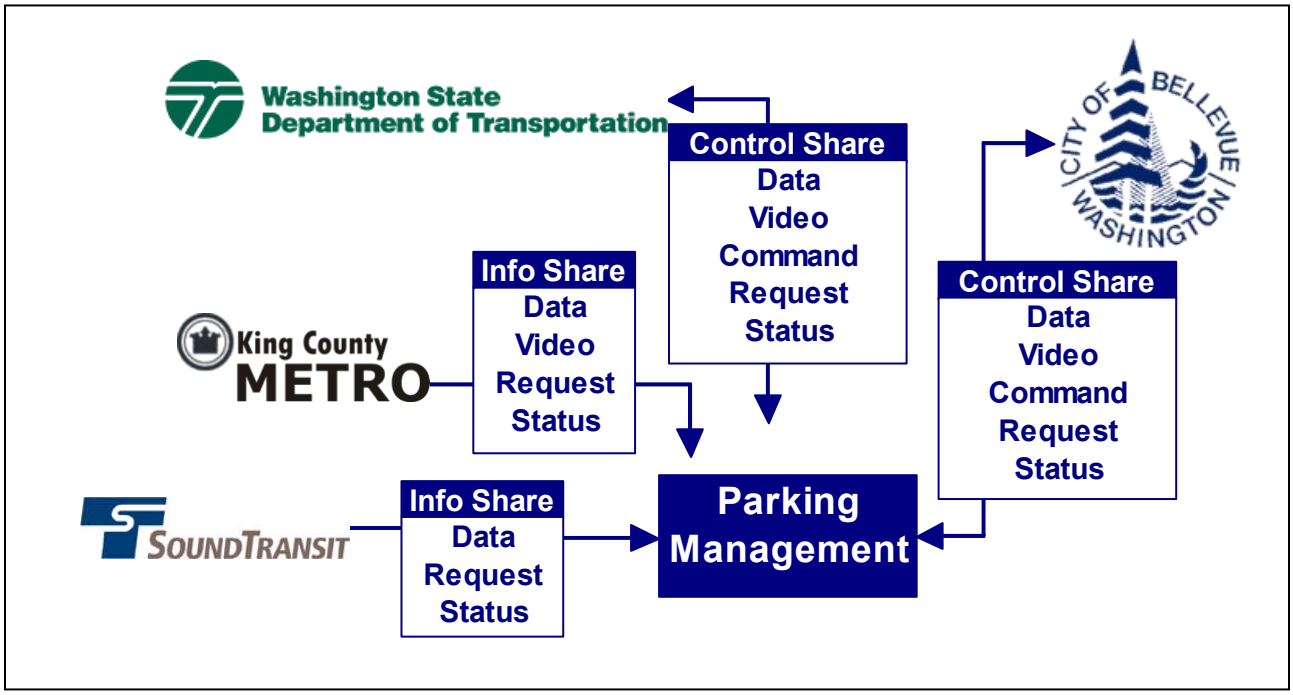
4.2.8 Regional Parking Management (ATMS17)

This Market Package supports coordination between agencies managing parking operations. The relevant agencies entering relationships with the City of Bellevue for this Market Package will likely be:

- Washington State Department of Transportation,
- Sound Transit, and
- King County Metro.

Data	Parking information from parking facilities.
Video	Video could be used to monitor parking lot occupancy.
Command	Ability to update/adjust other agency's parking guidance signs and control another agency's cameras.
Request	Request parking information from adjacent regional facilities.
Status	Check parking status of regional parking facilities.

This Market Package collects current parking status and shares this data with a centralized database. This Market Package supports communication and coordination between equipped parking facilities within the City and also supports regional coordination between parking facilities and traffic and transit management systems. It is envisioned that Metro and Sound Transit will work together with Bellevue and WSDOT to display park and ride capacity information on interactive roadside signs along the freeways and surface streets leading to the park-and-ride facilities. It is assumed that Bellevue will have a parking management system in the future for City-owned and possibly privately owned parking facilities downtown, but this would probably not be the same system used for the transit facilities. The two systems would probably not be integrated other than for sign control because one caters toward commuters while the other is for retail access.



4.2.9 Emergency Management

The following seven Market Packages have been combined for the purpose of the Concept of Operations because they will all require similar agency-to-agency relationships and information exchanges:

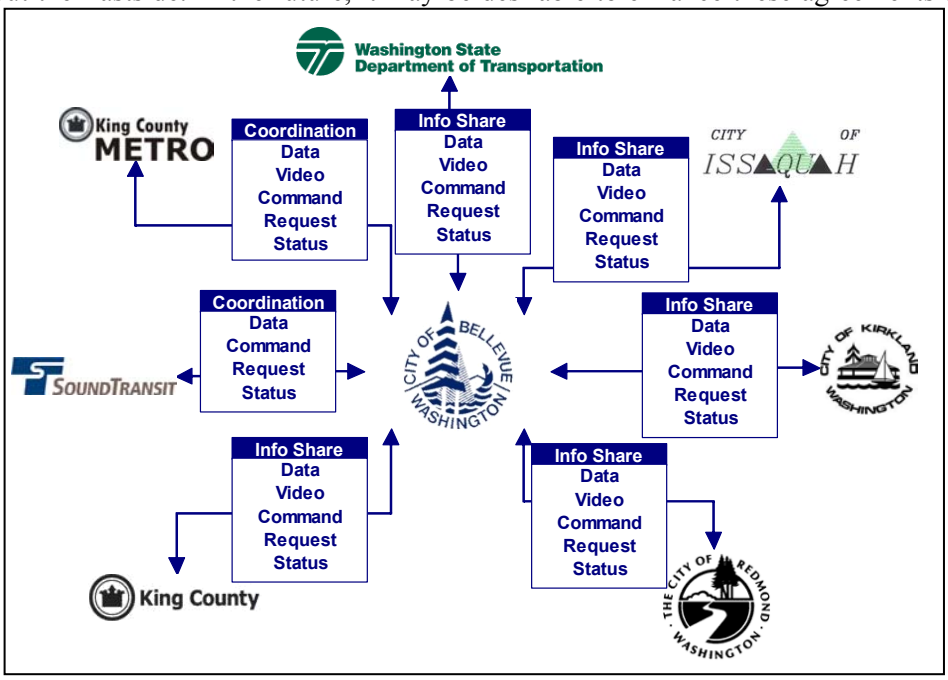
- Emergency Routing (EM02)
- Surface Street Control (ATMS03)
- Wide-Area Alert (EM06)
- Early Warning System (EM07)
- Disaster Response and Recovery (EM08)
- Evacuation and Reentry Management (EM09)
- Disaster Traveler Information (EM10)

Data	Exchange incident, congestion and emergency response plan data
Video	Share video for observation of incidents by multiple agencies
Command	Control of another agency's CCTV cameras
Request	One agency may request emergency response plan information from another.
Status	Agencies will have the ability to view the status of broadcast or emergency management data in another jurisdiction.

The relevant agencies entering relationships with the City of Bellevue for this operational concept will likely be:

- Washington State Department of Transportation,
- Sound Transit,
- King County Metro,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Currently, the City of Bellevue has agreements with many local agencies to either provide or coordinate emergency services throughout the Eastside. In the future, it may be desirable to enhance these agreements to include additional services. It is anticipated that this concept of operation would provide communications between the various local emergency operation centers to enhance regional emergency management.



4.2.10 Construction Management

The following three Market Packages have been combined for the purpose of the Concept of Operations because they will all require similar agency-to-agency relationships and information exchanges:

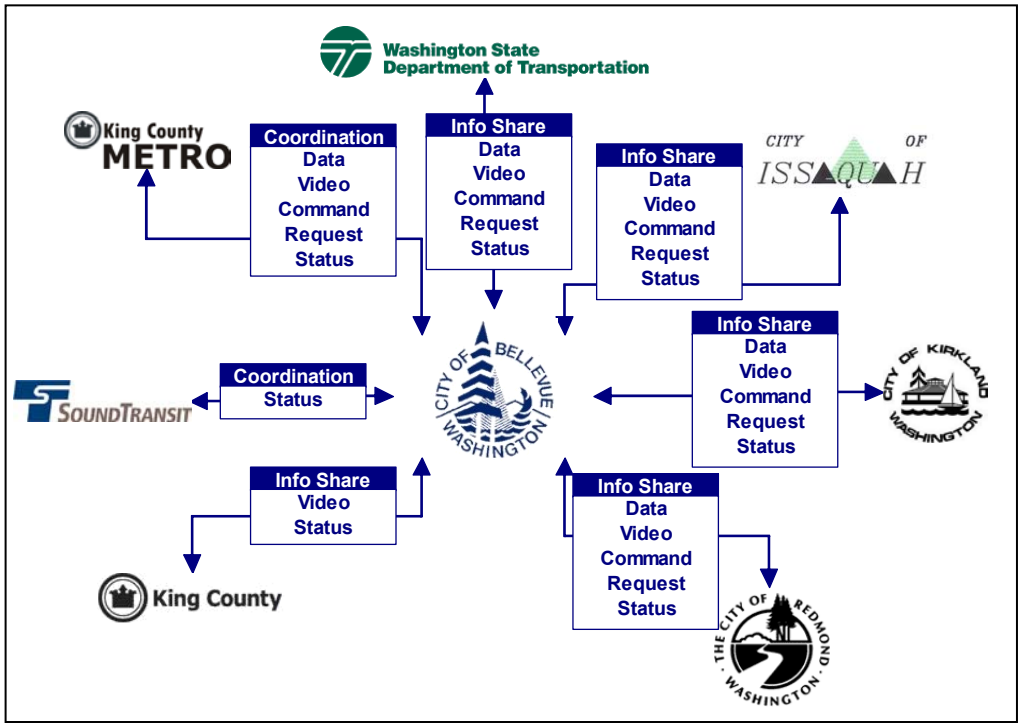
- Roadway Closure Management (ATMS21)
- Work Zone Management (MC08)
- Maintenance and Construction Activity Coordination (MC10)

Data	In the future work zones may be monitored with video detection cameras to track vehicle speeds and volume in the construction area.
Video	Portable video cameras may be used to monitor conditions in work zones.
Command	Control of Bellevue portable CCTV cameras.
Request	An outside agency may request work zone speed and volume data.
Status	Status of work zone conditions will be broadcast to other agencies.

The relevant agencies entering relationships with the City of Bellevue for this operational concept will likely be:

- Washington State Department of Transportation,
- Sound Transit,
- King County Metro,
- King County,
- City of Issaquah,
- City of Kirkland, and
- City of Redmond.

Construction on a major Bellevue arterial connecting a neighboring agency can significantly impact traffic patterns beyond Bellevue. It is anticipated that neighboring agencies will want access to future work zone monitoring equipment to observe how changes in construction or travel patterns are impacting their roadways. This concept of operations will allow other agencies to view work zone video and access work zone data.



CHAPTER 5 DEPLOYMENT PLAN

5.1 INTRODUCTION

This chapter provides a conclusion to the entire ITS plan development process by taking all the information gathered and evaluated in the first four chapters and compiling them in a Deployment Plan. Chapter 1 of the ITS Plan presented an inventory of the existing ITS equipment deployed in the City. The graphical representation of this information helped to clarify the holes in the existing ITS infrastructure. Chapter 2 assessed the City's needs. The needs identified were used as a starting point for creating potential projects. Chapter 3 used the existing conditions and needs evaluations to develop the Regional Architecture. This process helped identify the Market Packages applicable to the ITS Plans and subsequently the ITS Standards that should be used in the deployment of future Bellevue ITS projects. Chapter 4 outlined the concept of operations for Bellevue, which helped identify the relationships to other agencies that should be included in the future projects.

The results of the Deployment plan are a list of potential ITS projects that the City shall consider for deployment over the next 20 years. The projects have been prioritized as High, Medium or Low. This prioritization directly corresponds to the deployment time frames of 0 to 5 years, 6 to 10 years and 11 to 20 years. Section 5.2.1 provides a complete list of all the projects proposed for deployment in Bellevue. In addition, detailed project descriptions are provide for each of the high priority projects.

5.1.1 Project Development

The future projects and their associated priority level were developed through a working group session with the Bellevue ITS Steering Committee. The Consultant Team developed an initial list of projects based on the information gathered through the drafting of the first four ITS Plan chapters. During the working group session, the Steering Committee refined the list of projects and placed future field equipment locations on a map. The location of each proposed ITS device (camera, weather station, VMS, flood monitor, etc.) was analyzed in detail to refine the location and determine if it should be considered a High, Medium or Low priority project element. The same was done for all the software and TMC based projects on the project list.

The final list of projects is presented under the headings originally used to categorize the needs identified for the City. These categories match the User Service Bundles identified by the National ITS Architecture. The categories are as follows:

■ Travel and Traffic Management (TM)	■ Public Transportation (PT)
■ Emergency Management (EM)	■ Information Management (IM)
■ Maintenance and Construction Management (MC)	

5.2 ITS PROJECTS

This section presents the selected projects in four different formats. Section 5.2.1 provides a complete summary of all the identified projects in a tabular format. Section 5.2.2 takes the high priority projects

and develops detailed project descriptions along with maps of the project elements where applicable. Section 5.2.3 displays the proposed deployment period of the projects in a schedule format to provide an idea of how much ITS work will be under development and implementation at the same time. Finally, Section 5.2.4 summarizes the implementation and operation and maintenance cost for all the projects.

5.2.1 Project Summary Table

The project summary table (Table 5-1) provides the following information for each project identified by the City of Bellevue ITS Steering Committee.

- Project ID: This is a unique identifier created for referencing each project.
- Project Title: This is the title assigned to the project.
- Description: This column provides a two to three sentence description of the project.
- Priority: Each project was ranked by the Steering Committee as a High, Medium or Low priority project. The rankings refer to the proposed deployment period of 0-5 years, 6-10 years or 11-20 years.
- Stakeholders: For most projects, Bellevue is the primary and only stakeholder, however in a few cases such as the Smart-Bus TSP Enhancement project (PT_02) King County Metro and Sound Transit will be leading the project.
- Capital Cost: This is a ballpark estimate of the cost to deploy the equipment or software included in the project. This cost is based on experience with related equipment in the City and the ITS Unit Cost Database prepared by FHWA[11]. The cost associated with each project includes a 20% markup for design.
- O&M Cost: This is the estimated cost to provide staff and parts/equipment to operate and maintain the identified equipment or software on an annual basis. The FHWA ITS Unit Cost Database also includes estimated O&M costs, and was used as a reference.
- Relationship to Other Projects: This column identifies data sharing or support that will be required between projects.
- Other Considerations: This column provides other miscellaneous information regarding the project such as technology constraints, interagency assumptions, deployment issues and further cost information.
- Expected Benefits: This element provides a bullet list of the expected benefits for each project.

[11] *ITS Cost Database*, Federal Highway Administration, September 30, 2003. (http://www.benefitcost.its.dot.gov/its/benecost.nsf/images/Reports/$File/costelements.pdf)

Table 5-1. Project Summary Table

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
Travel and Traffic Management									
TM_01	Bicycle Detection	This project will install permanent bicycle detection throughout the City on arterials designated as bike routes and on bike trails. This project does not include bicycle detection at signalized intersections. A total of 10 locations are assumed.	M	$50,000	$2,000	Primary: Bellevue	Requires communications through the City-Wide Communications Project (TM_16).	The communication requirements for the bike detectors is minimal so it may be possible to use existing signal interconnect. A larger issue will be bring power to detector sites on bike trails away from existing lighting or traffic signal circuits.	• Reduce staff time needed to set detectors in the field • Increase available data for evaluating bicycle usage in Bellevue • Better meet the needs of the Bellevue biking community
TM_02	911 Computer Aided Dispatch Interface	This project will provide a direct interface with the Bellevue 911 Computer Aided Dispatch system to automatically post incidents related to traffic in the Commuter Alert System.	M	$150,000	$10,000	Primary: Bellevue	Feeds incident data to the Automated Commuter Alert System in TM_06.	The incident reporting system could be a stand alone program. The platform for this program will be evaluated further when the project is in design.	• Increase driver awareness of traffic conditions • Decrease traffic operations staff time • Reduce congestion
TM_03	Photo Enforcement	This project will deploy photo enforcement for speeding and red light running. For this project, it is assumed Bellevue will deploy this equipment at 5 sites.	L	$375,000	$300,000	Primary: Bellevue	None	The City is interested in deploying photo enforcement equipment, but its use will depend on photo enforcement lawmaking in the state. The O&M cost for this project could be significantly reduced if Bellevue contracts with a vendor that installs, operates and maintains the equipment for a percentage of the fines paid by violators.	• Reduce red light running and speeding in the City • Improve driver safety • Reduce accidents at high accident locations
TM_04	Traffic Management Center Build-out	This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall.	H	$300,000	$10,000	Primary: Bellevue	None	Although this is a high priority project, the TMC is functional with the existing equipment leaving the option open for a phased deployment and build out of equipment.	• Replacement of antiquated/failing equipment • Increased flexibility for viewing cameras and signal system maps • Space for multiple operators • Improved emergency management and operation capabilities
TM_05	Dynamic Route Guidance	This system will automatically calculate the ideal route between two points based on real-time roadway congestion data. Initially this project would be used to provide route information for emergency vehicles.	L	$250,000	$15,000	Primary: Bellevue	This project will require congestion data collected in the Arterial Congestion Map project (TM_18).	This system could be mapped using the City's GIS database.	• Decrease in response time for emergency vehicles • Decrease in travel time for motorists
TM_06	Automated Commuter Alert System	This system will automatically alert motorists through e-mail, pagers and other wireless devices of potential issues along their predefined commute route. This system would require the input of real-time incident data into a database that could be queried by the commuter alert system. The incident database could be shared with the media and posted on the internet.	M	$100,000	$5,000	Primary: Bellevue	None	The City would like to expand upon their current e-mail alert system for the Downtown Access project by sending out real time information. The current e-mail system only addresses planned events.	• Availability of real-time incident information • Improved traffic coverage of Bellevue by local media • Reduction in congestion around incident locations
TM_07	Downtown Parking Management System	This project will install active signs around Bellevue Square to direct motorists to parking facilities with available parking. This project assumes monitoring equipment for the west and southeast parking facilities (it already exists for the northeast facility) and four advisory signs.	L	$300,000	$15,000	Primary: Bellevue Secondary: Bellevue Square Management	None	This project will require the cooperation of the Bellevue Square Management.	• Reduce driver frustration during shopping season • Reduce congestion around mall due to circling traffic • More efficient use of parking
TM_08	Permanent Highway Advisory Radio (HAR)	A permanent HAR will be located in Bellevue to notify motorists of incidents or construction in the HAR region.	M	$20,000	$1,000	Primary: Bellevue	None	The frequency and location of the antenna will need to be coordinated with WSDOTs HAR equipment.	• Increase availability of real-time traveler information • Reduce congestion and delay • Increase flexibility for distribution of traveler information

Table 5-1. Project Summary Table (continued)

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_09	Vehicle Classification Detection	This project will deploy detectors strategically around the City to collect vehicle classification information. It is assumed 10 detectors will be deployed.	M	$100,000	$2,000	Primary: Bellevue	None	It is assumed these detectors will be tied to a nearby traffic signal for communications back to central.	• Increase availability of vehicle classification information • Ability to track truck route adherence • Ability to improve traffic signal simulation • More accurate data for pavement design
TM_10	Driver Feedback Signs	The City would like to expand the use of Driver Feedback signs in the City as a means of traffic calming. These signs notify the driver of their current speed and flash the speed when they are traveling over the speed limit. The City has approximately 20 signs and would like to deploy an additional 10 signs.	H	$84,000	$4,000	Primary: Bellevue	In the future the City may want to incorporate these signs into the Photo Enforcement project (TM_03).	None	• Improved safety for motorists, pedestrian and cyclists • Reduce traffic speed • Increase in speed limit adherence • Increase in driver awareness of speed limits and personal driving characteristics • Wide-spread support • Low-impact traffic calming
TM_11	Rail Crossing Interconnect	City would like interconnect to the rail crossing at NE 8th Street to the signal at 116th, and the crossing at SE 1st Street to the adjacent signals at 116th Avenue NE and at Main St. This interconnect will notify the neighboring signals of the approaching train to allow for the clearing of queued vehicles backed up to the tracks. The cost includes interconnect to the nearby signal via a new preempt cable in existing conduit.	M	$50,000	$4,000	Primary: Bellevue Secondary: BNSF	None	To provide enough warning of an arriving train to clear queued vehicles, improvements may need to be made to the train detection system. This rail detection upgrade is assumed in the cost.	• Increase in safety near rail crossings
TM_12	Traveler Information Kiosks	City will support efforts by Metro and the local malls to deploy traveler information kiosks at transit centers, Bellevue Community College (BCC), and major shopping centers.	M	$0	$1,000	Primary: Metro, BCC, and Local Malls Secondary: Bellevue	Bellevue could enhance the kiosks by providing data from the Arterial Congestion Map (TM_18) and the Automatic Commuter Alert System (TM_06).	It is assumed that Metro, BCC and the local malls will furnish, install, operate and maintain the kiosks. The City will probably spend a small amount of time each year addressing data needs for the kiosks.	• Increase availability of traveler information in public places • Decrease congestion and delay
TM_13	Variable Speed Limit Signs	This project will deploy approximately 72 variable speed limit signs within school speed zones on Bellevue streets. These signs will adjust the posted speed by time of day. The City deployed their first set of time of day signs at Lake Hills Elementary. The City would like to have the ability in the future to communicate to the signs from the TMC.	H M	$504,000 $650,000	$12,000 $10,000	Primary: Bellevue	Requires communications through the City-Wide Communications Project (TM_16) when remote communications to the signs is added.	It is unknown if it is possible to interconnect the signs for remote communications. As the deployment of signs continues, this requirement will need to be integrated into the product procurement specification.	• Reduced speeds in school zones • Increased safety for students and drivers • Increase in driver awareness • Decrease in motorist confusion
TM_14	City-Wide CCTV Deployment	High, medium and low priority CCTV locations have been identified throughout the City. These cameras will be used to monitor traffic conditions, monitor emergency events, optimize signal timing, view high accident locations and monitor flooding and weather. • 16 cameras • 23 cameras • 12 cameras	H M L	$400,000 $575,000 $300,000	$16,000 $23,000 $12,000	Primary: Bellevue	Requires communications from the City Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images.	The City's local video switcher will need to be expanded as more cameras are installed.	• Improved signal coordination and real-time signal timing adjustments • Increased information during emergency events and incidents • Increased ability to report congestion information for local arterials • More wide spread driver information

Table 5-1. Project Summary Table (continued)

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_15	Dynamic Message Signs	Full function VMS signs and limited state wayfinding signs will be deployed to manage traffic during incidents such as flooding and large freeway accidents as well as during special events in downtown Bellevue. The following signs will be deployed: • SB 148th Ave NE south of Bel-Red Rd • NB 148th Ave NE north of SE 22nd St. • Wayfinding for diverting around flooding on Factoria Blvd near SE 36th St (3 signs). • WB NE 8th St west of 112th Ave NE • SB Lake Hills Connector north of Richards Road. • WB NE 4th St west of 112th Ave NE • Wayfinding signs for WB I-90 traffic diverting off the freeway at 156th Ave NE (2 signs). • Wayfinding signs for traffic diverting of WB SR-520 at 148th Ave NE (2 signs). • Wayfinding for diverting around flooding on Kamber Road (3 signs).	H H H H M M L L L	$50,000 $50,000 $75,000 $50,000 $50,000 $50,000 $50,000 $50,000 $75,000	$5,000 $5,000 $9,000 $5,000 $5,000 $5,000 $6,000 $6,000 $9,000	Primary: Bellevue	Requires communications from the City-Wide Communications Project (TM_16).	The City does not have any permanent VMSs so they will need to decide how they want to manage the control. It may be possible to integrate the control into the Computran system.	• Improved driver safety during incidents and events • Improved travel time through alternate route and closure advisories • Reduction in staff time needed to deploy temporary signs • Provide motorist information on incident/events more quickly
TM_16	City-Wide Communications	This project will phase in new fiber optics throughout the City to communicate to the new field devices and to upgrade communications to existing field devices.	H M L	$1,400,000 $1,400,000 $2,800,000	$5,000 $5,000 $10,000	Primary: Bellevue	Required for numerous projects in the City.	The City currently uses multi-mode fiber for communications to CCTV cameras. The City may need to gradually switch to single mode fiber cabling as the need for faster speeds and higher bandwidths increases.	• Communication to existing isolated field devices • Communication to new field devices • Improved reliability for communications • Redundancy in communications
TM_17	Communications to Isolated Signalized Intersections	This project will provide remote communications to all the signalized intersections in the City that are currently isolated from the signal interconnect network.	H, M, L	$0	$0	Primary: Bellevue	Relies heavily on the City-Wide Communications project.	Cost built into the City-Wide Communications project.	• More efficient operations of isolated signals • Decrease in staff time needed to maintain these signals • Quicker response time when problems occur with the isolated signals • Ability to obtain data from remote signals
				Central Signal System Upgrades					
TM_18	Arterial Congestion Map	This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has an extensive deployment of system detectors that can initially be used for measuring congestion in the region. It is assumed that GPS data will provide a more accurate measurement in the future, so it is anticipated that the system will eventually migrate to a GPS system.	H	$250,000	$15,000	Primary: Bellevue Secondary: KC Metro, Sound Transit, Cell Carriers	Feeds data into the Dynamic Route Guidance project (TM_05) and the Traveler Information Kiosk project (TM_12).	A standard methodology for using system detector data to report congestion has not been developed in the traffic industry. Many agencies are waiting to use GPS or probe vehicle data. The use of GPS data from cell phones has been identified as a possible means of collecting probe vehicle data.	• Increase driver awareness to congested areas • Increase distribution of traffic on parallel arterials • Decreased motorist delay
TM_19	Central Signal System Replacement	The City of Bellevue's central computer for traffic signal control will be due for replacement by 2010. This project will define and procure a new signal system for the City of Bellevue. With this replacement will also come a migration of the signal system to Ethernet communications. The replacement of controller cabinets will be part of the annual cabinet replacement program.	M	$400,000	$15,000	Primary: Bellevue	Could incorporate the 911 Computer Aided Dispatch Interface (TM_02), the Dynamic Route Guidance Project (TM_05), the Automated Commuter Alert System (TM_06) and the Traffic Data Query System (IM_01).		• Decrease in motor vehicle delay • Decrease in emergency vehicle response times • Enhanced system communications • Improved transit speed and reliability

Table 5-1. Project Summary Table (continued)

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
TM_20	Center to Center Integration - Redmond and WSDOT	This project will implement center-to-center communications with Redmond's future central signal system and will re-establish the connection to WSDOT. The center-to-center communications to WSDOT requires software upgrades on the interface servers.	H	$200,000	$10,000	Primary: Bellevue Secondary: Redmond WSDOT	Needs to connect to a common point with the Redmond fiber optic system. The interface point is currently designed for 152nd Avenue NE near NE 24th Street.	WSDOT has recently selected a new central signal system for managing its traffic signals. Additional software design may be required to establish a connection to their new system. $50,000 of the deployment cost was allocated to connect to their old MIST system. The remaining $100,000 is for the connection to Redmond.	• Improved traffic management across jurisdictional boundaries • Increase in information available for traffic management
TM_21	Signal System Upgrade for TSP and TRPS	This project will upgrade the City's Computran system to improve traffic responsive pattern selection (TRPS) and transit signal priority (TSP) operations.	H	$75,000	$5,000	Primary: Bellevue	None	None	• Decrease transit travel time • Increase transit reliability • Decrease in motor vehicle delay • Signal timing adjustments based on real-time traffic conditions
Public Transportation									
PT_01	Transit Signal Priority	In a joint effort with King County Metro and Sound Transit, The City of Bellevue will deploy new TSP sites near the Bellevue Transit Center as part of the Downtown Access Project. In addition, the City is starting a project to evaluate TSP along the corridor of six of the most heavily traveled transit routes in Bellevue. This project involves a joint effort with King County Metro and Sound Transit to install TSP at up to 120 sites in the next twenty years. • 20 sites • 60 sites • 40 sites	 H M L	 $480,000 $360,000 $240,000	 $20,000 $60,000 $40,000	Primary: Bellevue Secondary: Metro Sound Transit	The Signal System software upgrade described in project TM_21 will be beneficial with the deployment of new TSP sites. Future TSP sites can funnel data into the Arterial Congestion Map (TM_18)	King County is in the process of developing new TSP hardware that will use wireless communications from the bus to the controller cabinet to activate TSP. This will reduce the installation cost from roughly $35,000 to $5,000. The High priority location assumed half at the current cost and half at the future cost. All Medium and Low priority projects assumed the future cost.	• Increased transit reliability • Decreased transit travel times • Reduction in transit operation and passenger time cost • Increased transit ridership • Increased travel time information
PT_02	Smart-Bus TSP Enhancements	This project is a joint effort with King County Metro and Sound Transit to improve the use of TSP through the new technology deployed on the future Smart-Buses. The Smart-Buses will have the ability to track ridership and schedule adherence real-time. This project will use this information to prioritize which buses receive TSP.	M	$200,000	$10,000	Primary: Metro, Sound Transit Secondary: Bellevue	This project will use the TSP deployed in PT_01.		• Increase TSP efficiency • Reduction in impact to signal operations
PT_03	Real-Time Transit Arrival Signage	This project will be a joint effort with King County Metro and Sound Transit to deploy signage at major transit hubs and transfer points to notify travelers of the estimated arrival and departure time for specific transit routes. The high priority locations include the Bellevue Transit Center, Eastgate, South Bellevue, Wilburton and Newport Hill Park and Rides, Factoria Mall, Bellevue Square and the Crossroads Shopping Center.	H	$80,000	$2,000	Primary: Metro, Sound Transit Secondary: Bellevue	The sign deployment will require communications deployed through the City-Wide Communications project (TM_16).	It is assumed that this equipment will be operated and maintained by Metro and Sound Transit. The cost only includes the signs and infrastructure for the communications (conduit and junction boxes to the site.) Metro is currently implementing a pilot project on Aurora Avenue N in Seattle.	• Increased ridership • Increase in rider awareness/information
Emergency Management									
EM_01	Intra-Agency Video Sharing	This project will provide video to the Police, Fire, the 911 center, the Emergency Operations Center and the Bellevue Service Center.	H	$30,000	$2,500	Primary: Bellevue	Will be enhanced by the additional cameras included in the City-Wide CCTV Deployment Project (TM_14).	Communication exists to the Bellevue Service Center and communications will be installed in the new City Hall for connections to the EOC and 911 Center. The only expense is the hardware.	• Improved emergency and incident identification, verification, monitoring and management • Reduction in travel time to emergencies • Improved efficiency in the response to maintenance calls and traffic accidents • Increased safety for Bellevue residents

Table 5-1. Project Summary Table (continued)

Project ID	Project Title	Description	Priority	Capital Cost	O&M Cost	Stakeholders	Relationship to Other Projects	Other Considerations	Expected Benefits
EM_02	Traffic Information on Mobile Data Terminals	This project will provide incident information, the City's congestion map, variable message sign status and video feeds directly to the mobile data terminals in police and fire vehicles in Bellevue.	M	$50,000	$5,000	Primary: Bellevue	Relies on the 911 CAD Interface project (TM_02) for incident data and the development of an Arterial Congestion Map as described in project TM_18.	Data terminals should be installed in all Bellevue emergency response vehicles by the end of the year. This cost could be significantly reduced if the data terminals have access to the internet. All but the VMS status data would be accessible from the web.	• Improved emergency management • Reduction in travel time to emergencies • Reduction in congestion near incidents
EM_03	Remote Monitoring of City Facilities	This project will monitor City facilities such as Downtown Park or water reservoirs. The monitoring may be via CCTV or other technologies.	M	$200,000	$10,000	Primary: Bellevue	It will require communications from the City-Wide Communications project (TM_16).	Ideally, some of the cameras needed to monitor City facilities could be strategically placed to also benefit observation of traffic conditions.	• Increase security at City facilities • Improve response time to incidents at City facilities • Increase staff efficiency
EM_04	Flood Warning System	This project will deploy flooding monitoring equipment at the following locations: • 148th at Larson Lake • Factoria Blvd at SE 36th Street • Kamber Road just east of Richards Road • SE 7th Place just east of Lake Hills Connector • NE 21st St just east of 140th Ave NE • SE 30th Street just east of Richards Road	 H H M M M M	 $50,000 $50,000 $50,000 $50,000 $50,000 $50,000	 $2,500 $2,500 $2,500 $2,500 $2,500 $2,500	Primary: Bellevue	City-Wide Communications (project TM_16) is required to communicate to the flood monitoring devices. These projects will be incorporated with the dynamic message signs identified in project (TM_15).	The City currently has a flood monitoring device deployed on SE 30th Street near Richards Road.	• Increase in flood awareness for the City • Decreased response time for maintenance crews • Decrease in congestion on roadways in flood zones • Increase in safety for drivers • Ability to easily monitor multiple flood locations
Information Management									
IM_01	Traffic Data Query System	This project will enhance the loop data management program in the Computran system to improve access to historic system detector data and provide access to automated traffic count information.	H	$50,000	$10,000	Primary: Bellevue	Could be packaged together with projects TM_18, TM-20 and TM_21 to potentially reduce software development cost.	Database could be integrated with the City's GIS database, with the Computran System, or a hybrid that uses both.	• Increase in staff efficiency and safety • Enhanced management of roadway operations • Better use of existing data
Maintenance and Construction									
MC_01	Roadway Weather Information System	Weather stations with roadway temperature monitoring will be included at the following locations: • Lakemont Boulevard near Fire Station 8. • The two Lakemont Bridges near I-90 • Near Somerset Elementary school. • Lake Hills Connector west of 140th Ave NE • Meydenbauer Bridge on NE Lake Washington Blvd. • NE 12th St bridge over the BNSF railroad tracks.	 H H H M M L	 $25,000 $25,000 $25,000 $25,000 $25,000 $25,000	 $1,000 $1,000 $1,000 $1,000 $1,000 $1,000	Primary: Bellevue	City-Wide Communications (project TM_16) is required to communicate to the weather stations.	The distribution of this weather information should be combined with the information currently collected by WSDOT. Some of the WSDOT weather stations may need to be enhanced to include features such as roadway temperature.	• Better, more efficient response to current weather conditions • Faster response time to ice conditions by roadway maintenance crews • Increase in available local weather information • Increase in driver safety • Increase in staff efficiency
MC_02	Portable Work Zone ITS Equipment	This project will procure portable CCTV cameras, variable speed limit signs and speed detection devices to monitor and control conditions in construction zones.	M	$80,000	$1,000	Primary: Bellevue	None	This equipment can be procured as separate portable devices or as a complete portable ITS unit.	• Increased safety in work zones • Reduction in congestion and delay
MC_03	Maintenance Vehicle AVL Tracking System	This project will track Bellevue maintenance vehicles to enhance dispatch of personnel and equipment to daily events and projects.	L	$150,000	$5,000	Primary: Bellevue			• Decreased maintenance response times • Decreased emergency response times • Increased personnel coordination

5.2.2 High Priority Projects

This section provides a more elaborate project description for each High Priority project identified in Table 5-1. These expanded project descriptions provide more detail regarding the functionality of the project as well as maps and photos of proposed equipment. Additional information is provided regarding the purpose of the project and the associated Market Packages and standards.

Traffic Management Center Build-Out

Project TM_04

Deployment Timeframe: 0 to 5 years

Purpose

To improve traffic operation functionality in the Traffic Management Center.

Existing Problems

- Outdated equipment limits ability to integrate new technologies.
- Outdated equipment limits benefits and functionality of the TMC.
- Limited space for multiple users.

Stakeholder(s)

Primary: Bellevue

Description

Much of the equipment in Bellevue's existing TMC is old and quickly becoming outdated. New and updated video displays, switching equipment, and consoles would allow for increased efficiency and additional functionality for controlling and viewing field equipment. The current TMC has workstations and camera control capabilities for one operator. For large incidents, or in the case of multiple incidents, space for more than one operator is essential. In addition, video access at the workstation level is also needed for more efficient operations. Large and multiple screens are beneficial when collaborating on an incident, and personal screens improve the speed and efficiency of monitoring multiple items. The move of the TMC to the new City Hall at the end of 2005 will provide a logical opportunity to purchase and install new equipment.

The cost for this updated TMC primarily reflects the cost to furnish and install new hardware. It is assumed the general room build out (cabling, ventilation and power) is included in the City Hall relocation cost.

Relationships to Other Projects

None

Other Considerations

Although this is a high priority project, the TMC is functional with the existing equipment leaving the option open for a phased deployment and build out of equipment.

Cost

Project Deployment	$300,000
Annual Ops & Maintenance	$10,000

Market Packages/ITS Standards

Market packages:

- Surface Street Control (ATMS03)

ITS Standards:

- NTCIP 1201, 1205, 1208

Benefits

- Replacement of antiquated/failing equipment
- Increased flexibility for viewing cameras and signal system maps
- Space for multiple operators
- Improved emergency management and operations capabilities

Driver Feedback Signs

Project TM_10

Deployment Timeframe: 0 to 5 years

Purpose

To improve traffic safety, driver awareness, and speed limit adherence by providing real-time travel speed information.

Existing Problems

Speeding on low speed residential streets and collectors.

Stakeholder(s)

Primary: Bellevue

Description

The driver feedback signs work by notifying drivers of their current speed and flashing when drivers are going over the posted speed limit. In general, this technology is well received by the public and safety officials as a traffic calming device because it has been proven effective yet has very little impact on roadway configuration.

Since 1999, the City has had a limited deployment of this technology and found the signs to be successful in improving traffic safety, increasing driver awareness, and decreasing speeds. This project will expand the program to specific, high priority locations to be determined in the near future. The estimated deployment cost of $84,000 assumes that 10 signs will be deployed in the short-term (0 to 5 years) although additional signs in the medium (5-10 years) and long (10-20 years) will likely be identified at additional cost. The cost per sign is estimated to be $7,000 for the sign and power connection and $1,400 for the design.

Relationships to Other Projects

In the future, the City may want to incorporate these signs into the Photo Enforcement project TM_03.

Other Considerations

None

Market Packages/ITS Standards

Market packages:

- Speed Monitoring (ATMS19)

ITS Standards:

- NTCIP 1209

Cost (10 signs)

$84,000	Project Deployment
$4,000	Annual Ops & Maintenance

Benefits

- Improve safety for motorist, pedestrian, and cyclist
- Reduce traffic speed
- Increase driver awareness of speed limits and personal driving characteristics
- Increased speed limit adherence
- Wide-spread support
- Low-impact traffic calming

Variable Speed Limit Signs

Project TM_13

Deployment Timeframe: 0 to 10 years

Purpose

To improve traffic safety , driver awareness and school speed limit adherence around elementary schools within Bellevue.

Existing Problems

- Existing school speed signs are vague and hard to read while driving
- Higher speeds near schools

Stakeholder(s)

Primary: Bellevue

Description

Variable speed signs near schools adjust the posted speed limit by time-of-day and day-of-week to promote slower vehicle speeds when students are likely to be in the area. The City has received positive feedback from its first installation of variable speed signs near Lake Hills Elementary School and would like to expand the program to include all the school zones near elementary schools in Bellevue. For the short-term build-out (0-5 years), the City has identified 72 locations near 18 elementary schools where they would like to install variable speed signs. Figure 5-1 provides the locations of all the schools that will receive variable speed limit signs.

The current installation and near term deployment will all be controlled by a local controller. In the future, the City would like to be able to communicate with these signs remotely to reduce the time needed to update the clocks in each sign and change the time-of-day plans. Currently each sign is programmed once per year. Remote communications would provide the flexibility to adjust the clock more frequently and make changes to the school calendar. The remote communications is included as a medium priority project.

Relationships to Other Projects

This project will require communications through the City-Wide Communications Project (TM_16) when remote communications to the signs is added.

Market Packages/ITS Standards

Market packages:

- Speed Monitoring (ATMS19)

ITS Standards:

- NTCIP 1209

Other Considerations

It is unknown if it is possible to interconnect the signs for remote communications. As the deployment of signs continues, this requirement will need to be integrated into the product procurement specification.

Benefits

- Reduced speeds in school zones
- Increased safety for students and drivers
- Increase driver awareness
- Decrease motorist confusion

Cost

Priority Level	Capital	O&M/yr
High (18 Schools)	$504,000	$12,000
Medium (Interconnect)	$650,000	$10,000

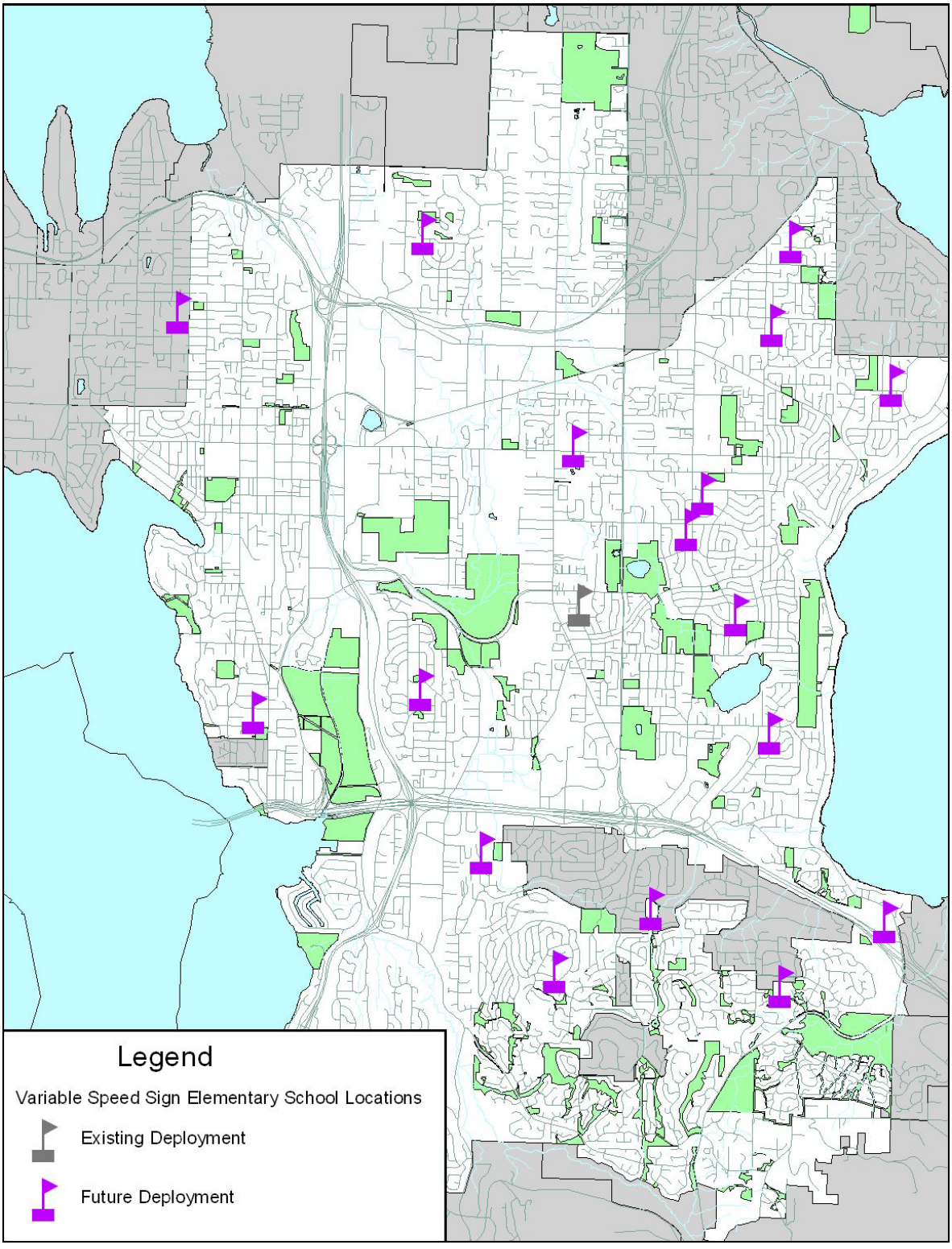


Figure 5-1. Proposed Variable Speed Limit Sign Locations

City-Wide CCTV Deployment

Project TM_14

Deployment Timeframe: 0 to 20 years

Purpose

To reduce delays, better respond to emergencies/incidents, verify conditions instantaneously, reduce incident response times, and provide wide spread traveler information.

Existing Problems

Limited monitoring reduces ability to efficiently implement real-time signal adjustments and to instantaneously verify traffic emergencies and weather related conditions.

Stakeholder(s)

Primary: Bellevue

Description

CCTV cameras are used to instantaneously monitor traffic, emergencies, produce real-time signal timing adjustments, and monitor flooding and other weather related problems. The City currently has installed CCTV cameras at 20 locations within the city while WSDOT has installed CCTV cameras at 29 freeway locations. As a general rule, cameras are placed to optimize the number of intersections and/or roadway segments that can be viewed. See Figure 5-2 for the proposed CCTV locations.

CCTV cameras require the largest bandwidth of all ITS field equipment to communicate with the TMC. The City currently communicates with CCTV equipment via multi-mode fiber. However, the City has shown interest in moving to single-mode fiber and Ethernet based communications standards that allow for increased flexibility, redundancy, and a larger bandwidth. Because of the high expense of each CCTV camera installation, the deployment of CCTV cameras will be incremental based on the following three categories – High (16 cameras), Medium (23 cameras), and Low (11 cameras). The deployment and O&M costs for this project only include the costs associated with the cameras and do not include the cost of providing communications to the cameras locations. These costs are accounted for in the City-Wide Communication project (TM_16).

Relationships to Other Projects

CCTV cameras will require communications from the City Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images.

Other Considerations

The City's local video switcher will need to be expanded as more cameras are installed.

Market Packages/ITS Standards

Market packages:

- Network Surveillance (ATMS01)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1205, 1208, 1209, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03, 2.01
- SAE J2540-3, J2529, J2374

Cost

Priority Level	Capital	O&M/yr
High (16 cameras)	$400,000	$16,000
Medium (23 cameras)	$575,000	$23,000
Low (11 cameras)	$300,000	$12,000

Benefits

- Improve signal coordination and timing adjustments
- Increased information and decrease in response time during emergency events and incidents
- Increase ability to report congestion information for local arterials
- More wide spread driver information

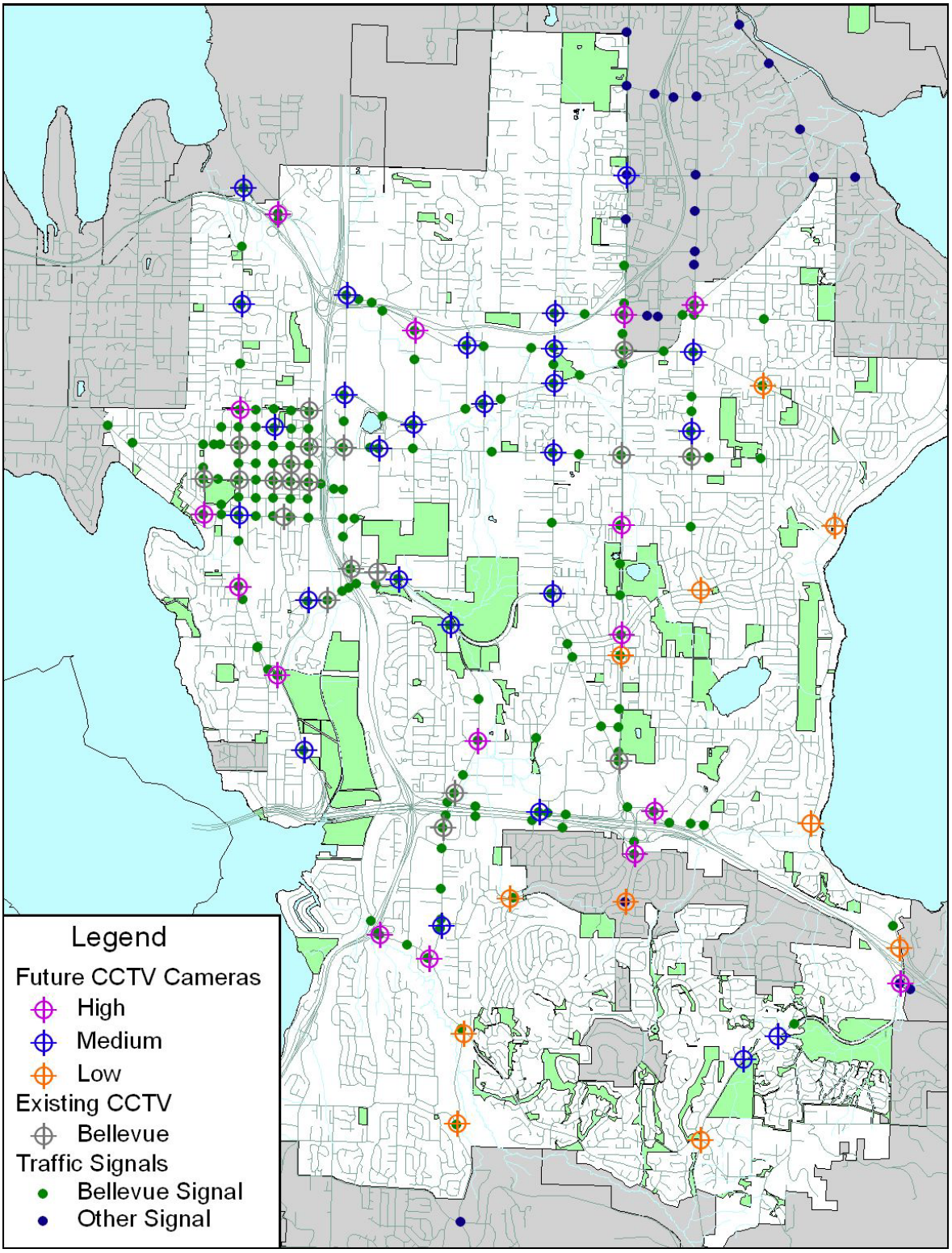


Figure 5-2. Proposed City-Wide CCTV Deployment

Dynamic Message Signs

Project TM_15

Deployment Timeframe: 0 to 20 years

Purpose

To provide travelers with real-time information such as incident locations and alternative route advisories. This information will help reduce travel time and improve safety.

Existing Problems

- The City has no en-route driver information to notify motorists of large incidents in the region.
- Reoccurring flooding events require significant staff hours to deploy signs

Stakeholder(s)

Primary: Bellevue

Description

This project includes two types of Dynamic Message Signs (DMS), full function VMS and limited state Wayfinding Signs. Full function VMSs are an excellent way to direct and control vehicle traffic during incidents and large events. Within Bellevue, DMS could be used to manage traffic during flooding, accidents, emergency evacuation, holidays and special events. The Location of DMS signs are critical to their success because they must be placed before incident event locations when drivers still have the option to take alternative routes. Three signs have been selected as high priority locations and one as a medium priority. The sign locations are provided in Figure 5-3.

Wayfinding signs are used similarly to VMSs, however they typically only have one or two fixed messages that can be displayed. They are a low cost alternative to VMSs. They are typically used to guide traffic back to the freeway or around a reoccurring incident. This project has selected four wayfinding sign deployment areas. Wayfinding signage for traffic diverting around flooding on Factoria Boulevard has been given a high priority mark. Low priority deployments of Wayfinding signage have also been included for traffic diverting off of eastbound I-90 at Eastgate, from eastbound SR-520 at 148th Avenue NE and to divert traffic around flooding on Kamber Road.

Because the TMC staff would like to change the messages remotely, communications to the signs is also critical to the deployment. Consequently, successful DMS deployment depends on a suitable communications infrastructure. The deployment and O&M costs for this project only include the costs associated with the signs, and do not include the cost of providing communications to the sign locations. These costs are accounted for in the City-Wide Communications project TM_16.

Dynamic Message Signs (continued)

Relationships to Other Projects

Dynamic message signs will require communications from the City-Wide Communications Project (TM_16).

Other Considerations

The City does not have any permanent DMS signs so they will need to decide how they want to manage the control. It may be possible to integrate the control into the Computran system.

Market Packages/ITS Standards

Market packages:

- Traffic Information Dissemination (ATMS06)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1203, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03, 2.01
- SAE J2354, J2630, J2540, J2540-1, J2540-2, J2540-3, J2529, J2374
- IEEE 1512-2000, 1512.1-2003

Cost

Priority Level	Capital	O&M/yr
High (4 sites)	$225,000	$24,000
Medium (2 sites)	$100,000	$10,000
Low (3 sites)	$175,000	$21,000

Benefits

- Improve driver safety during incidents and events
- Improve travel time through alternate route and closure advisories
- Reduction in staff time needed to deploy temporary signs
- Provide motorist information on incidents/events more quickly

Sign Locations

High	■ SB 148th Ave NE south of Bel-Red Road. ■ NB 148th Ave NE north of SE 22nd Street. ■ Wayfinding for diverting around flooding on Factoria Blvd near SE 36th St (3 signs). ■ WB NE 8th St west of 112th Ave NE
Medium	■ SB Lake Hills Connector north of Richards Road. ■ WB NE 4th St west of 112th Ave NE
Low	■ Wayfinding signs for WB I-90 traffic diverting off the freeway at 156th Ave NE (2 signs). ■ Wayfinding signs for traffic diverting of WB SR-520 at 148th Ave NE (2 signs). ■ Wayfinding for diverting around flooding on Kamber Road (3 signs).

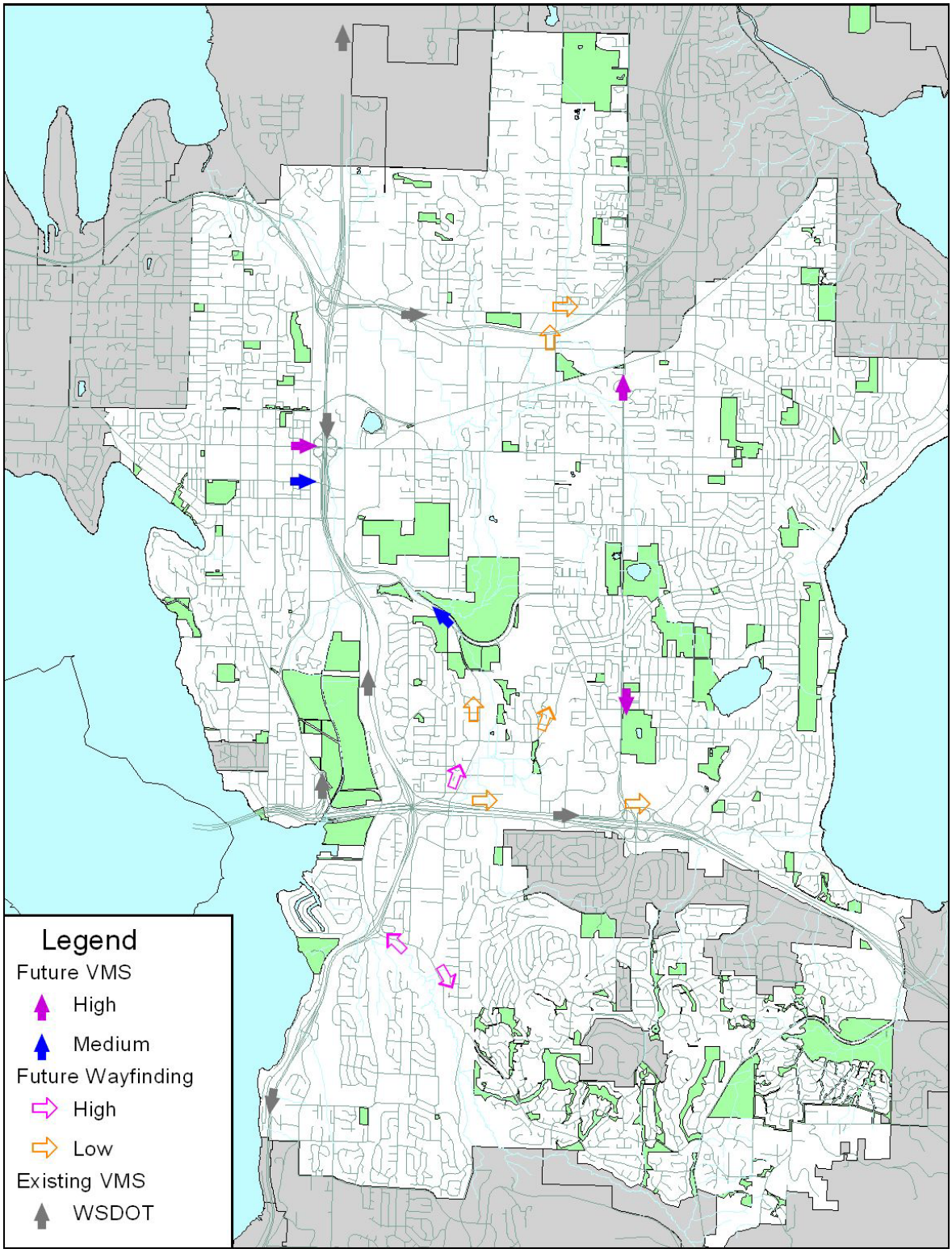


Figure 5-3. Proposed Future Dynamic Message Signs

City-Wide Communications

Project TM_16

Deployment Timeframe: 0 to 20 years

Purpose

To expand the existing communications infrastructure throughout the city of Bellevue to allow for more efficient system operations.

Existing Problems

- The existing communications infrastructure cannot support the future field equipment for this project.
- There are existing traffic signals that are isolated from the communications backbone.

Stakeholder(s)

Primary: Bellevue

Description

This project is unique in that the communications infrastructure forms the backbone of nearly all the other traffic management related projects. Planning for a system that will provide bandwidth for all of the proposed devices will be critical to the success of ITS in the City. Consequently, this overview of a potential communications system will not replace the benefits that would be received from a detailed communications plan.

The City currently uses both copper wire (low bandwidth) and fiber (high bandwidth) at locations throughout the city. The copper is primarily used for communications to traffic signals, while the fiber is used for CCTV communications. The copper may continue to meet the City's needs for traffic signal communications; however the cost of fiber is becoming so low that all future signal connections are planned for fiber optics. Fiber will also be used to communicate to new CCTV cameras, VMSs, weather station and flood monitoring equipment. The City's communications network topology currently uses a point-to-point layout. This means each device communicates straight back to the TMC. As is typical with this topology, the City's communications infrastructure is radial with the largest trunk line near the City's TMC, and extending to all other major devices.

The City is investigating the possible use of Ethernet for all future communications. Should the City ever decide to adopt Ethernet based communications protocol, a more redundant (or web-like) infrastructure will need to be developed. As shown in the following Communication Map (Figure 5-5), the fiber will be laid out in multiple connecting paths, resulting in redundant paths.

In addition to migrating toward Ethernet, the City is also evaluating opportunities to share fiber with the City's Information Technology Department. Because sharing opportunities and communications protocol are still unknown, it is difficult to prioritize fiber routes. For this project, the fiber was broken into two categories, "Trunk" and "Lateral". A trunk route is a high capacity route used to bring large quantities of devices back to central. These routes also provide the redundancy in the network. The lateral runs provide connections to devices isolated off the trunk lines. Until a more detailed communications plan can be developed, the cost for the fiber has been equally spread over the 20 year deployment of the project. A quarter of the cost was applied to the 0-5 and 6-10 year time frames and the remaining half of the cost was applied to the 11-20 year time frame. The cost takes into account existing empty conduit identified on the existing communication map (Figure 5-4). Conduit gaps in the future fiber system are shown in Figure 5-6.

City-Wide Communications (continued)

Relationships to Other Projects

City-wide communications is required for numerous projects in the City, including projects such as City-Wide CCTV Deployment (TM_14), Communications to Isolated Signalized Intersections (TM_17), Center-to-Center Integration (TM_20) and Remote Monitoring of City Facilities (EM_03).

Market Packages/ITS Standards

Market packages:

- Surface Street Control (ATMS03)

ITS Standards:

- NTCIP 1101, 1102,1103, 1201, 1202, 2101, 2102, 2103, 2104, 2201, 2202, 2301, 2302, 2303

Other Considerations

The City currently uses multi-mode fiber for communications to CCTV cameras. The City may need to migrate to single-mode fiber as the need for faster speeds and higher bandwidth increases.

Benefits

- Communications to existing isolated field devices
- Communications to new field devices
- Improved reliability for communications
- Redundancy in communications

Cost

Priority Level	Capital	O&M/yr
High	$1.4M	$5,000
Medium	$1.4M	$5,000
Low	$2.8M	$10,000

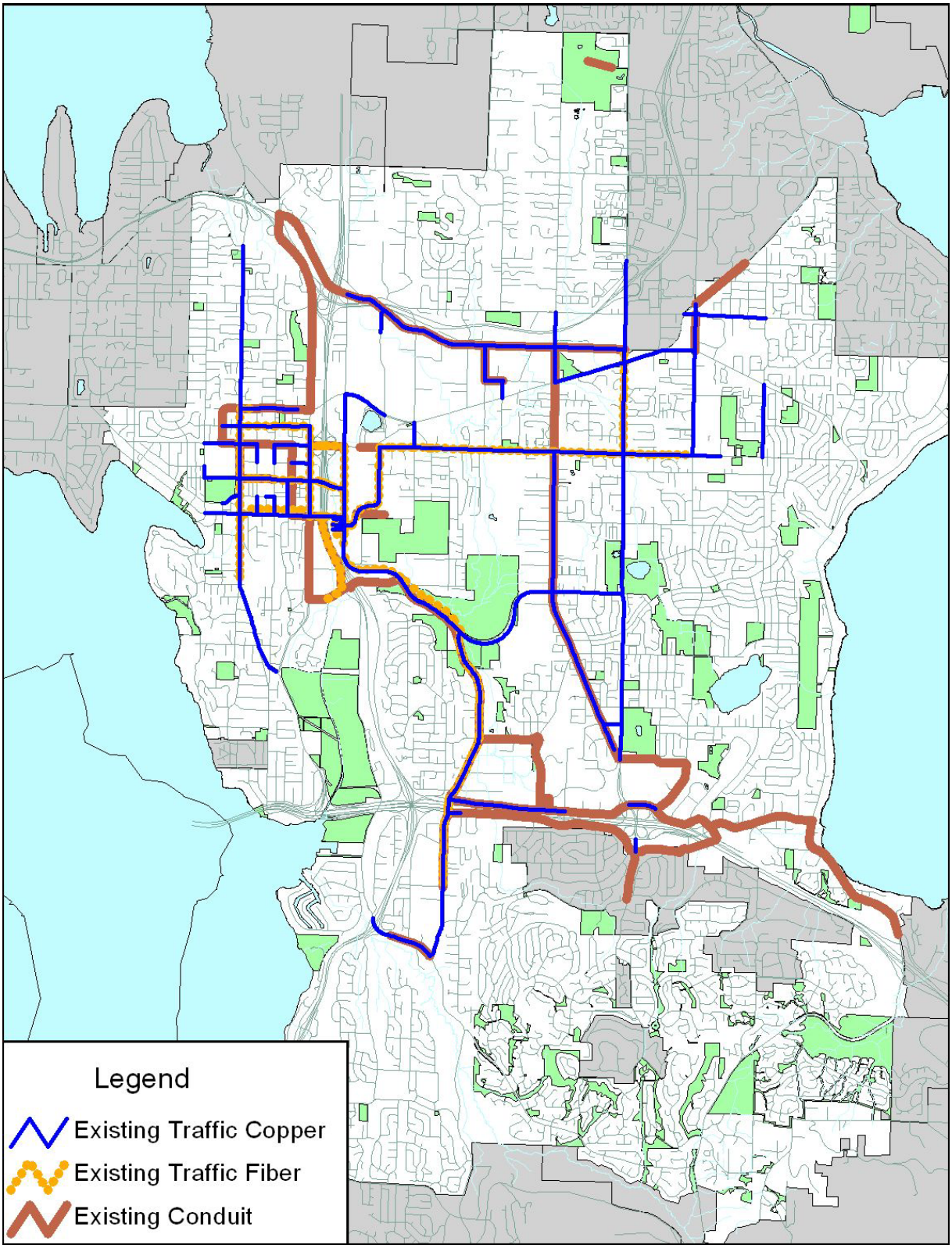


Figure 5-4. Existing Traffic Communications

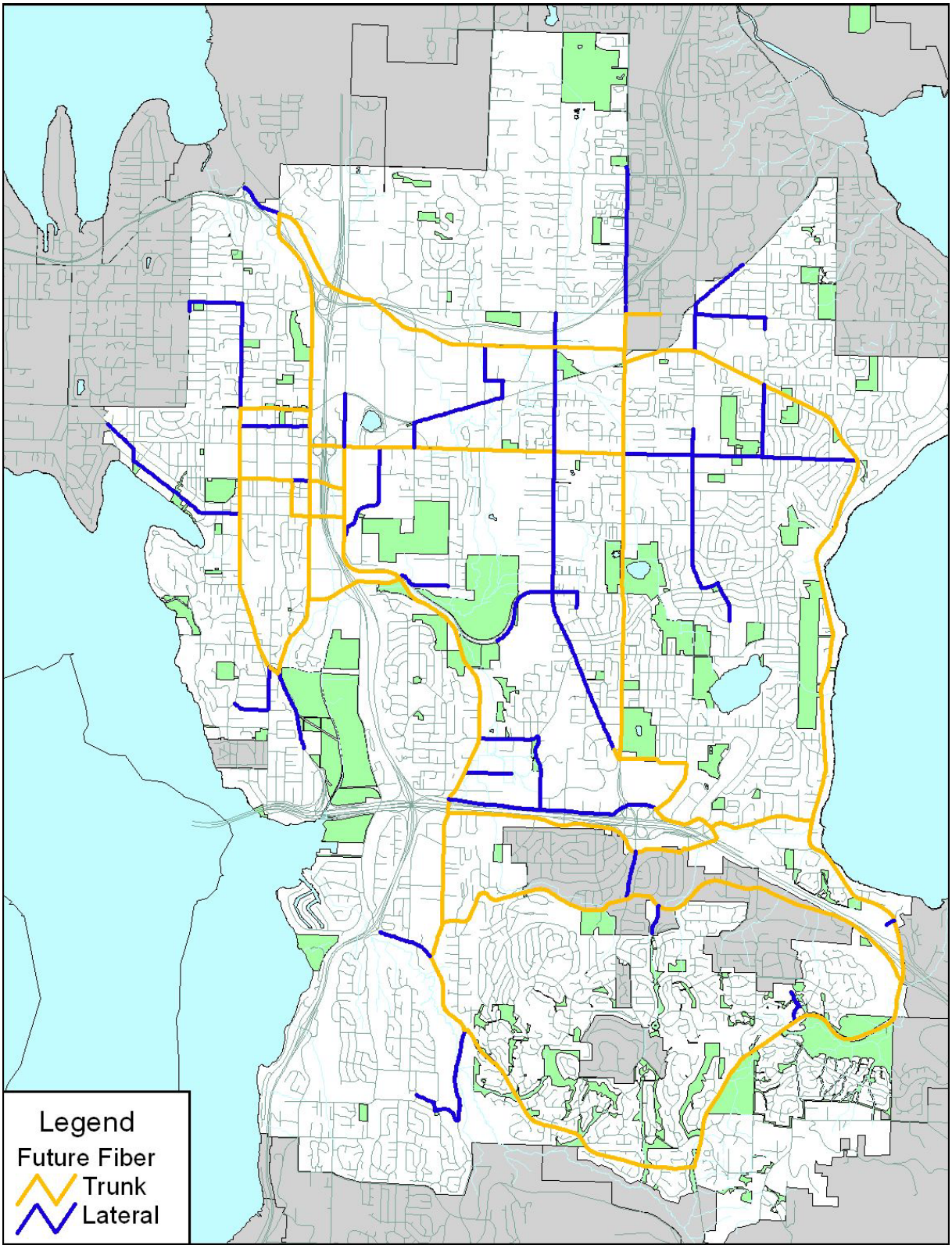


Figure 5-5. Proposed Fiber Optic Communications

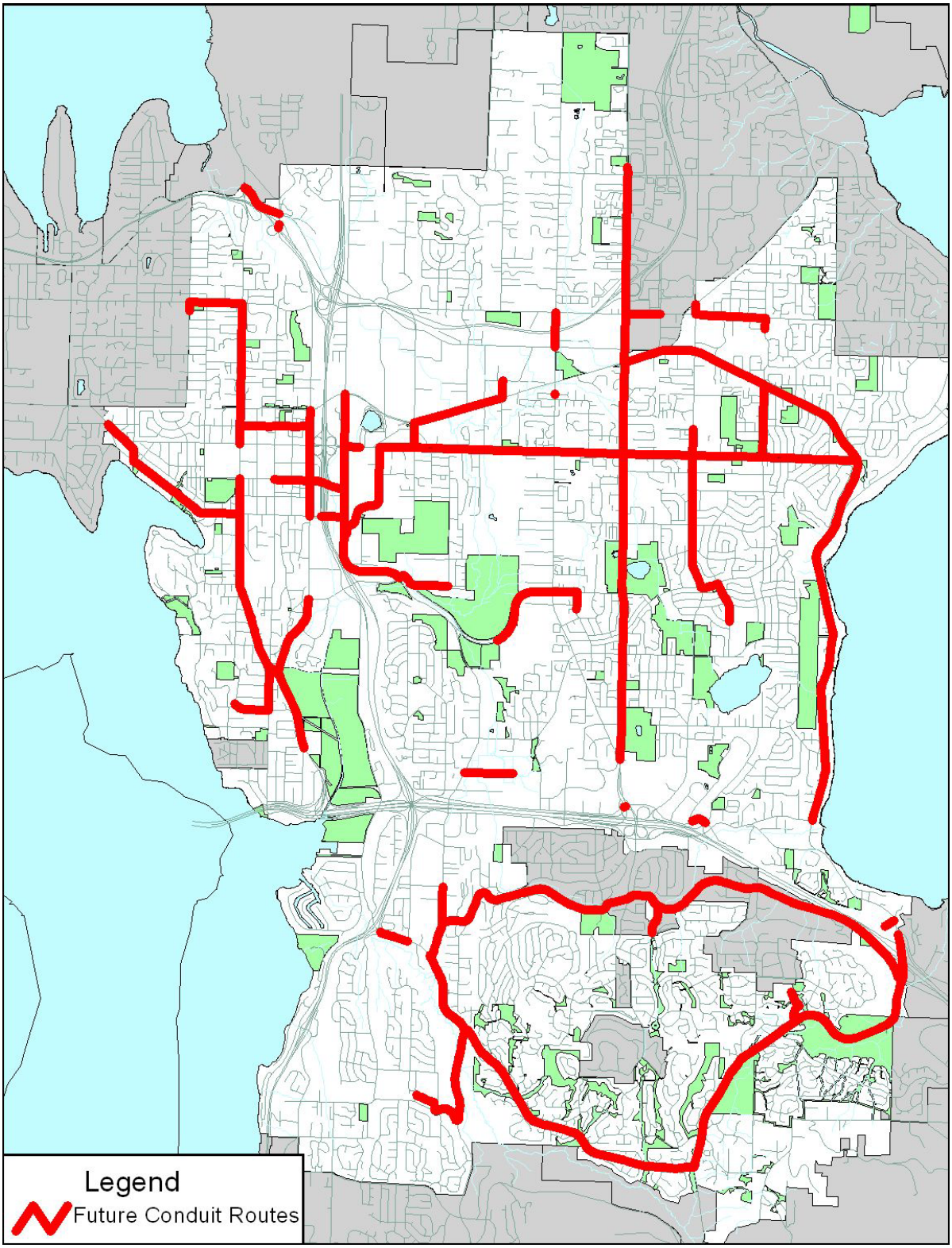


Figure 5-6. Conduit Gaps in Future Fiber System

Arterial Congestion Map

Project TM_18

Deployment Timeframe: 0 to 5 years

Purpose

To provide a graphical display of real-time traffic conditions on major arterials in the City of Bellevue.

Existing Problems

There is limited information available to drivers regarding conditions on Bellevue's local arterials. This leads to both over and under utilized routes. Motorist could adjust routes given adequate information.

Stakeholder(s)

Primary: Bellevue
Secondary: King County Metro, Sound Transit, Cell Carriers

Description

This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has over 500 system detectors covering most of the major corridors in Bellevue. This project will develop a way to use these system detectors to measuring congestion on local arterials. Currently there is not an industry standard way of using this data, especially since loop locations vary at each intersection. Time will need to be spent developing algorithms specific to Bellevue to measure congestion.

In the future, it is estimated that GPS data will be available for measuring travel time. There are two potential sources of this data anticipated for the region.

Source: WSDOT Congestion Map, http://www.wsdot.wa.gov/PugetSoundTraffic/

The most likely source is through future Smart Bus technology implemented by King County Metro and Sound Transit. The two agencies are working together to identify all the ITS technology needed on the next fleet of buses in the region. This technology will include improved vehicle location tracking equipment. The GPS data collected by the bus will only be relayed back to the transit operations center once per minute; however it is anticipated that future TSP technology used with these buses could collect location information on a second by second basis. As noted in project PT_01, the cost to deploy TSP will greatly decrease with the new technology, resulting in the ability to deploy more equipment around the region. This equipment could help track travel time between each intersection on major arterials throughout Bellevue.

The other possible source of GPS data is from cell carriers. Investigations are continuing on ways of tracking cell phones without encroaching on the user's privacy.

Arterial Congestion Map (continued)

Relationships to Other Projects

This project will feed data into the Dynamic Route Guidance project (TM_05) and the Traveler Information Kiosk project (TM_12). Data will be needed from the Transit Signal Priority Project (PT_01).

Other Considerations

A standard methodology for using system detector data to report congestion has not been developed in the traffic industry. Many agencies are waiting to use GPS or probe vehicle data.

Market Packages/ITS Standards

Market packages:

- Interactive Traveler Information (ATIS2)
- Surface Street Control (ATMS03)

ITS Standards:

- NTCIP: 1101, 1102, 1104, 1105, 1106, 1202, 1209, 1211, 1404, 1405, 2104, 2202, 2303, 2304, 2501, 2502,

Cost

Project Deployment	$250,000
Annual Ops & Maintenance	$15,000

Benefits

- Increase driver awareness to congested areas
- Increase distribution of traffic on parallel arterials

Center to Center Integration – Redmond and WSDOT

Project TM_20

Deployment Timeframe: 0 to 5 years

Purpose

To improve traffic management and control.

Stakeholder(s)

Primary: Bellevue / Secondary: Redmond; WSDOT

Existing Problems

- Lack of interagency signal operation.
- Inability for WSDOT to monitor status of State owned/Bellevue operated signals.

Description

This project will develop the software interface needed for Bellevue and Redmond to share traffic data and video as well as re-establish the existing outdated connection between Bellevue and WSDOT. Redmond and Bellevue have numerous corridors in the Overlake area that share or cross between jurisdictions. A link between signal systems will provide an enhanced ability to coordinate across jurisdictional boundaries and will provide each agency with the ability to monitor signal conditions in the other's jurisdiction.

Through the North Seattle ATMS project, Bellevue was providing a link to WSDOT for signal data sharing. This link has not been operational for a few years because of software compatibility issues with WSDOT's interface servers. This project will upgrade WSDOT's software to re-establish the interagency link. This link will allow WSDOT to monitor conditions at the traffic signals it recently turned over to Bellevue to operate and maintain.

Relationships to Other Projects

The City-Wide communications will need to connect to a common point with the Redmond fiber optic system. The interface point is currently designed for 152nd Avenue NE near NE 24th Street.

Other Considerations

WSDOT has recently selected a new central signal system for managing its traffic signals. Additional software design may be required to establish a connection to their new system. $50,000 of the deployment cost was allocated to connect to their old MIST system. The remaining $100,000 is for the connection to Redmond.

Cost

Project Deployment	$200,000
Annual Ops & Maintenance	$10,000

Market Packages/ITS Standards

Market packages:

- Regional Traffic Control (ATMS07)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1202, 1209, 1210, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03, 2.01

Benefits

- Improved traffic management across jurisdictional boundaries
- Increase in information available for traffic management

Signal System Upgrade for TSP and TRPS

Project TM-21

Deployment Timeframe: 0 to 5 years

Purpose

To improve TSP and Traffic Responsive Pattern Selection (TRPS) by enhancing the City's control of local traffic signals.

Stakeholder(s)

Primary: Bellevue

Existing Problems

- The existing traffic signal system does not allow for TSP operations when the intersection is offline.
- The existing Traffic Responsive Pattern Selection (TRPS) lacks error checking functionality and the ability to display which loop is driving the pattern change.

Description

The City's existing signal system has the capability to effectively run TSP and TRPS, but there are a few enhancements that would make both systems operate more efficiently. Prior to the expiration of the City's existing signal system, they would like to see some of these enhancements incorporated. The cost of this project assumes upgrade to their existing Computran system.

For TSP, the existing system would be improved to allow TSP to operate during free operation and when a controller is not talking to the central signal system. For the TRPS system, the City would like the ability to determine which system detector reached its threshold to cause a pattern change. They would also like the system to be able to perform error checking to determine if the system loops are functioning properly.

Relationships to Other Projects

None.

Market Packages/ITS Standards

Market packages:

- Surface Street Control (ATMS03)

ITS Standards:

- NTCIP: 1202, 1211

Other Considerations

None.

Benefits

- Decrease transit travel time
- Increase transit reliability
- Decrease in motor vehicle delay
- Signal timing adjustments based on real-time traffic conditions.

Cost

Project Deployment	$75,000
Annual Ops & Maintenance	$5,000

Transit Signal Priority

Project PT_01

Deployment Timeframe: 0 to 5 years

Purpose

To provide signal priority for transit vehicles in order to increase speed and reliability at key locations throughout the City of Bellevue.

Existing Problems

- Without TSP, Bellevue can not allocate priority to buses on the street system
- Corridors experience varying levels of congestion affecting bus reliability
- Buses have difficulty progressing on coordinated signal corridors without being delayed at traffic signals because they service bus stops between intersections

Stakeholder(s)

Primary: Bellevue

Secondary: King County Metro; Sound Transit

Description

Through the implementation of TSP around King County, Metro has proven that TSP is extremely effective at reducing transit travel times and increasing transit reliability. TSP has been deployed at two locations in Bellevue and the City plans to implement TSP at an additional site near the Bellevue Transit Center as part of the Downtown Access project. This is the start of a potentially much more elaborate TSP system in Bellevue. Bellevue is a major hub for numerous Sound Transit and Metro buses. Bellevue recently completed a City-Wide Transit Plan that identified the need for TSP at 82 signalized intersections in the City. This is almost half of Bellevue's signals. The City and Metro are beginning work on a project to reduce the 82 locations identified in the Transit Plan to a list of high priority locations. This project assumes TSP will be installed at a total of 20 high priority locations within the next five years. The map in Figure 5-7 shows the two existing locations, the two sites planned near the Bellevue Transit Center, and the corridors initially targeted for high priority TSP.

The future costs associated with implementing TSP at each intersection are expected to drop considerably. Using current technologies, the cost is $35,000 per installation. However, King County Metro expects that they will move toward a wireless technology by 2007 that does not require a separate reader cabinet and antenna located upstream of the intersection. Consequently, the hardware costs are expected to drop to $5,000 per installation. This significant drop in cost will likely lead to more wide spread implementation of TSP in Bellevue. In the future, the equipment will also be able to send real-time travel time results for transit buses back to central on a second-by-second basis. This information will be integral for estimating corridor travel time. As the need for travel time information increases, the deployment of TSP will also increase. With the drop in cost, and the dual need for the equipment, it is estimated that an additional 60 intersections will receive TSP in the 6-10 year time frame. Another 40 intersections could receive TSP by the end of the 20 year deployment period.

Transit Signal Priority (continued)

Relationships to Other Projects

The Signal System software upgrade described in project TM_21 will be beneficial with the deployment of new TSP sites. Future TSP sites can funnel data into the Arterial Congestion Map (TM_18)

Other Considerations

The cost for the high priority TSP sites assumes half will use the existing TSP technology and the other half will use the future technology. All Medium and Low priority sites will use the future technology.

Market Packages/ITS Standards

Market packages:

- Surface Street Control (ATMS03)

ITS Standards:

- NTCIP 1211

Cost

Priority Level	Capital	O&M/yr
High (20 sites)	$480,000	$20,000
Medium (60 sites)	$360,000	$60,000
Low (40 sites)	$240,000	$40,000

Benefits

- Increased transit reliability
- Decreased transit travel times
- Reduction in transit operation and passenger time cost
- Increased transit ridership
- Increased travel time information

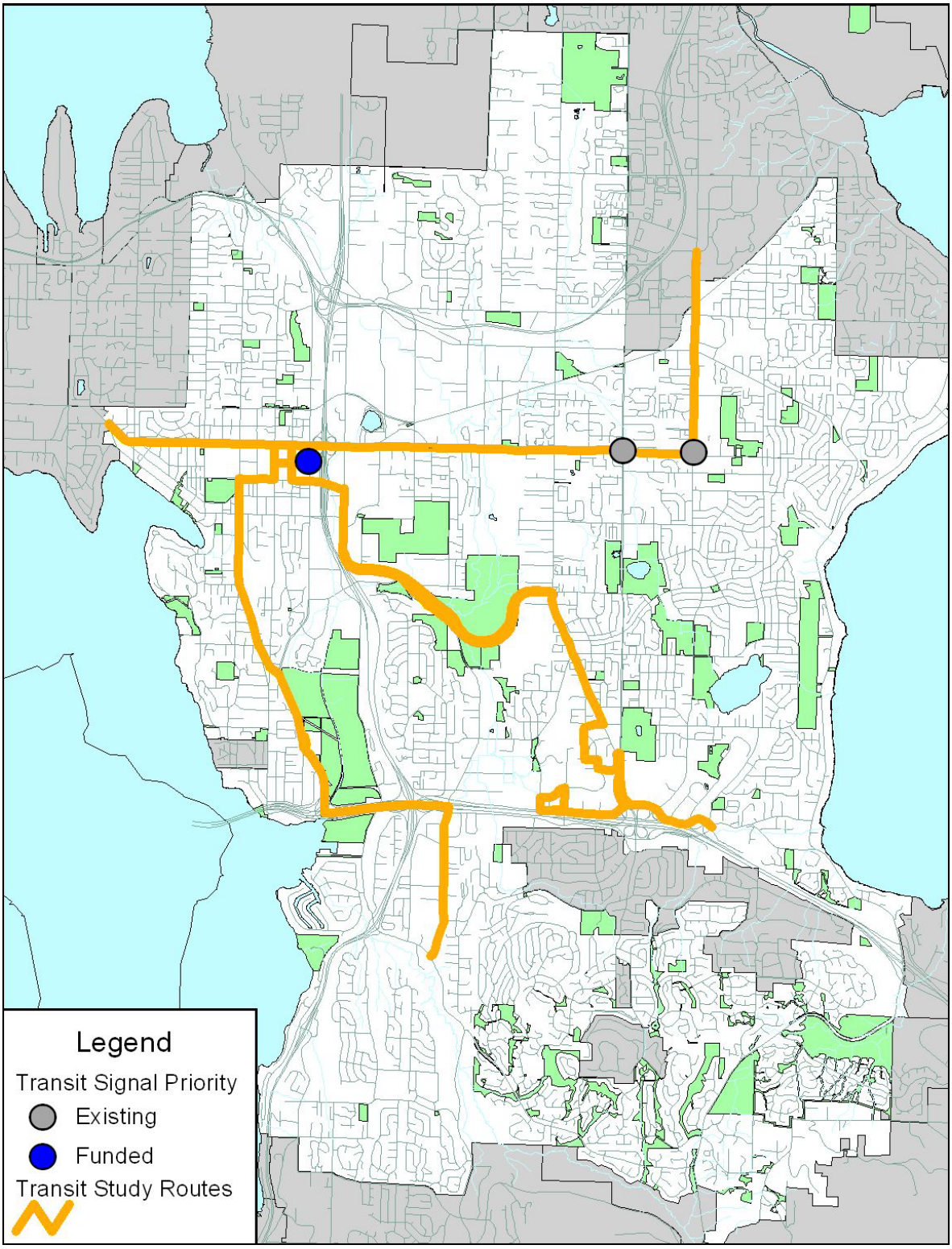


Figure 5-7. Proposed Transit Signal Priority

Real-Time Transit Arrival Signage

Project PT_03

Deployment Timeframe: 0 to 5 years

Purpose

To provide transit riders with real-time traveler information.

Existing Problems

Limited or no accurate information is available at the park and rides and transit centers regarding the status of arriving buses.

Stakeholder(s)

Primary: King County Metro; Sound Transit

Secondary: Bellevue

Description

This project will be a joint effort between the City and King County Metro and Sound Transit. The project will deploy electronic signs at major transit hubs and transfer points to notify travelers of the estimated arrival and departure times of specific transit routes. By providing additional information to transit users, the agencies will be encouraging more people to use transit, thereby increasing the efficiency of the transportation system as a whole.

This project only includes the near-term (0 to 5 years) implementation locations, which include the Bellevue Transit Center, the Eastgate, South Bellevue, Wilburton and Newport Hills Park and Rides, as well as the Factoria Mall, Bellevue Square and Crossroads Shopping Center. Medium-term (6 to 10 years) and long-term (11 to 20 years) locations have not been identified. These sites will likely be determined based on an evaluation of this project.

A cost has been provided for deploying this equipment. However, the transit agencies will likely cover the majority of the cost to purchase, install, operate & maintain the signs. The cost does not include the communication between the bus and the transit operations center, or the central software that processes the bus location data.

Relationships to Other Projects

The sign deployment will require communications deployed through the City-Wide Communications project (TM_16).

Other Considerations

It is assumed that this equipment will be operated and maintained by King County Metro and Sound Transit. Most of the cost shown will most likely be incurred by King County Metro and Sound Transit. King County Metro is currently implementing a pilot project on Aurora Avenue N in Seattle.

Market Packages/ITS Standards

Market packages:

- Transit Vehicle Tracking (APTS 1)
- Transit Traveler Information (APTS8)

ITS Standards:

- NTCIP 1102, 1104, 1105, 1106, 1401, 1404, 1406, 1407, 2104, 2202, 2303, 2304, 2305, 2501, 2502
- IEEE 1512-2000

Cost

Project Deployment (8 locations)	$80,000
Annual Ops & Maintenance	$2,000

Benefits

- Increased ridership
- Increase in rider awareness/information

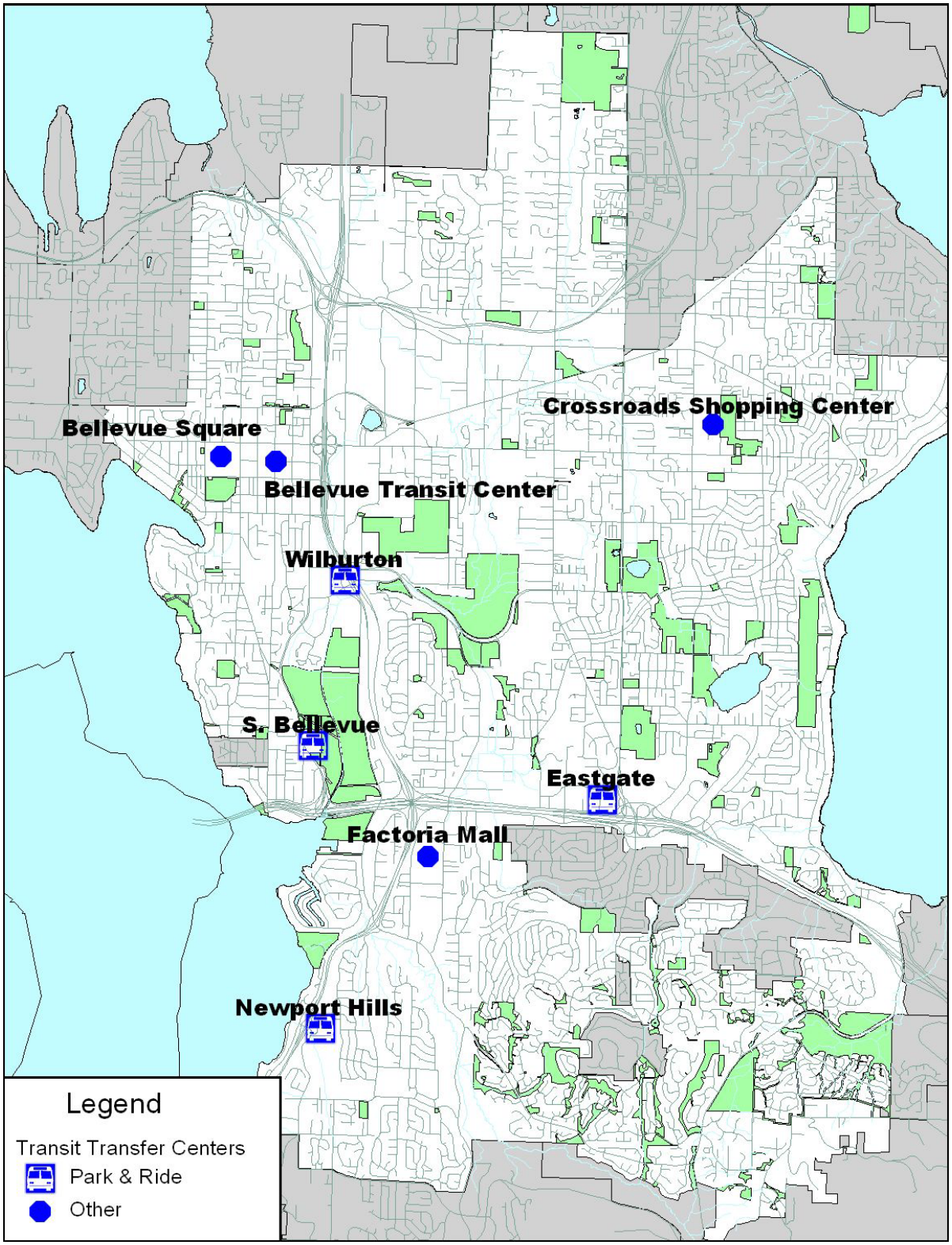


Figure 5-8. Proposed Real-Time Transit Arrival Sign Locations

Intra-Agency Video Sharing

Project EM_01

Deployment Timeframe: 0 to 5 years

Purpose

To provide CCTV control and viewing capabilities to all interested departments in the City.

Existing Problems

- Emergency response dispatchers do not have the ability to view incidents in the field prior to dispatching maintenance or emergency response personnel.
- All potential video users must now access the video from the TMC limiting availability.

Stakeholder(s)

- Primary: Bellevue

Description

The widespread deployment of CCTV cameras throughout the City could have many beneficial applications outside of the Transportation Department. The Police Department, Fire Department, 911 Center, Emergency Operations Center and the Bellevue Service Center have all shown interest in receiving video feeds from and control of the CCTV cameras. Potential applications of these shared video feeds are for the Police and Fire Departments to identify and verify emergencies and incidents as well as better routing of emergency vehicles by the 911 center.

The move to the new City Hall building at the end of 2005 provides a logical time for implementing this project as a communications plan is developed for the new building. Significant cost savings could be realized if this project is incorporated into the new City Hall renovation. The costs associated with this project include new video monitors, camera control keypads and video networking equipment.

Relationships to Other Projects

This project will be enhanced by the additional cameras included in the City-Wide CCTV Deployment Project (TM_14).

Market Packages/ITS Standards

Market packages:

- Network Surveillance (ATMS01)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1205, 1208, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502

Other Considerations

Communication exists to the Bellevue Service Center and it is assumed to be installed in the new City Hall for connections to the EOC and 911 Center, although a video backbone for the new City Hall is currently unfunded. Another expense is hardware.

Benefits

- Reduction in travel time to emergencies
- Improved efficiency in the response to maintenance calls and traffic accidents
- Increased safety for Bellevue residence
- Security surveillances possibilities
- Improved emergency and incident identification, verification, monitoring and management

Cost

Project Deployment	$15,000
Annual Ops & Maintenance	$1,000

Flood Warning System

Project EM_04

Deployment Timeframe: 0 to 10 years

Purpose

To improve deployment of traffic control measures during flooding events.

Existing Problems

- Reoccurring flood locations with no monitoring equipment
- Lack of real-time flood information causes staff to rely on continuous manual checking of conditions
- Traffic congestions/confusion near flood locations due to lack of information

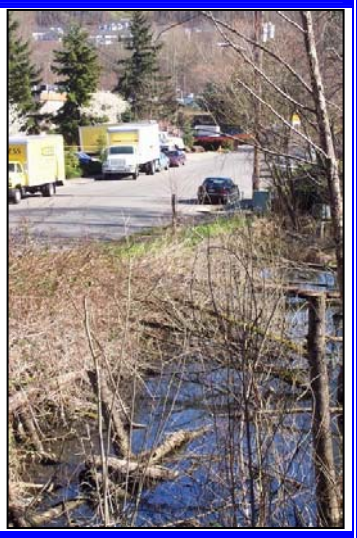
Stakeholder(s)

Primary: Bellevue

Description

The City will be able to remotely monitor the status of reoccurring flood locations by deploying flood monitoring devices. These monitors will increase the efficiently with which City staff can perform the following during flooding conditions: monitor multiple locations; better coordinate field crews; change signal timing patterns; and activate variable message signs to reroute traffic to alternative roads.

The flood monitoring will be phased with high priority locations receiving first installations. Two sites have been identified for short-term (0 to 5 years) installation, while four sites have been identified for medium-term (6 to 10 years) installation. Figure 5-9 shows the proposed flood warning system locations.



Relationships to Other Projects

City-Wide Communications (project TM_16) is required to communicate to the flood monitoring devices. These projects will be incorporated with the variable message signs identified in project (TM_15).

Other Considerations

The City currently has a flood monitoring device located on SE 30th Street near Richards Road.

Market Packages/ITS Standards

Market packages:

- Road Weather Data Collection (MC03)

ITS Standards:

- NTCIP 1101, 1102,1103, 1104, 1105, 1106, 1201, 1204, 1205, 1405, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03, 2.01

Flood Warning System (continued)

Cost

Priority Level	Capital	O&M/yr
High (2 sites)	$100,000	$5,000
Medium (4 sites)	$200,000	$20,000

Benefits

- Increase in flood awareness for the City
- Ability to easily monitor multiple flood locations
- Decreased response time for maintenance crews
- Decrease in congestion on roadways in flood zones
- Increase in safety for drivers

Flood Monitoring Sites

High

- 148th at Larson Lake
- Factoria Blvd at SE 36th Street

Medium

- Kamber Road just east of Richards Road
- SE 7th Place just east of Lake Hills Connector
- NE 21st St just east of 140th Ave NE
- SE 30th Street just east of Richards Road

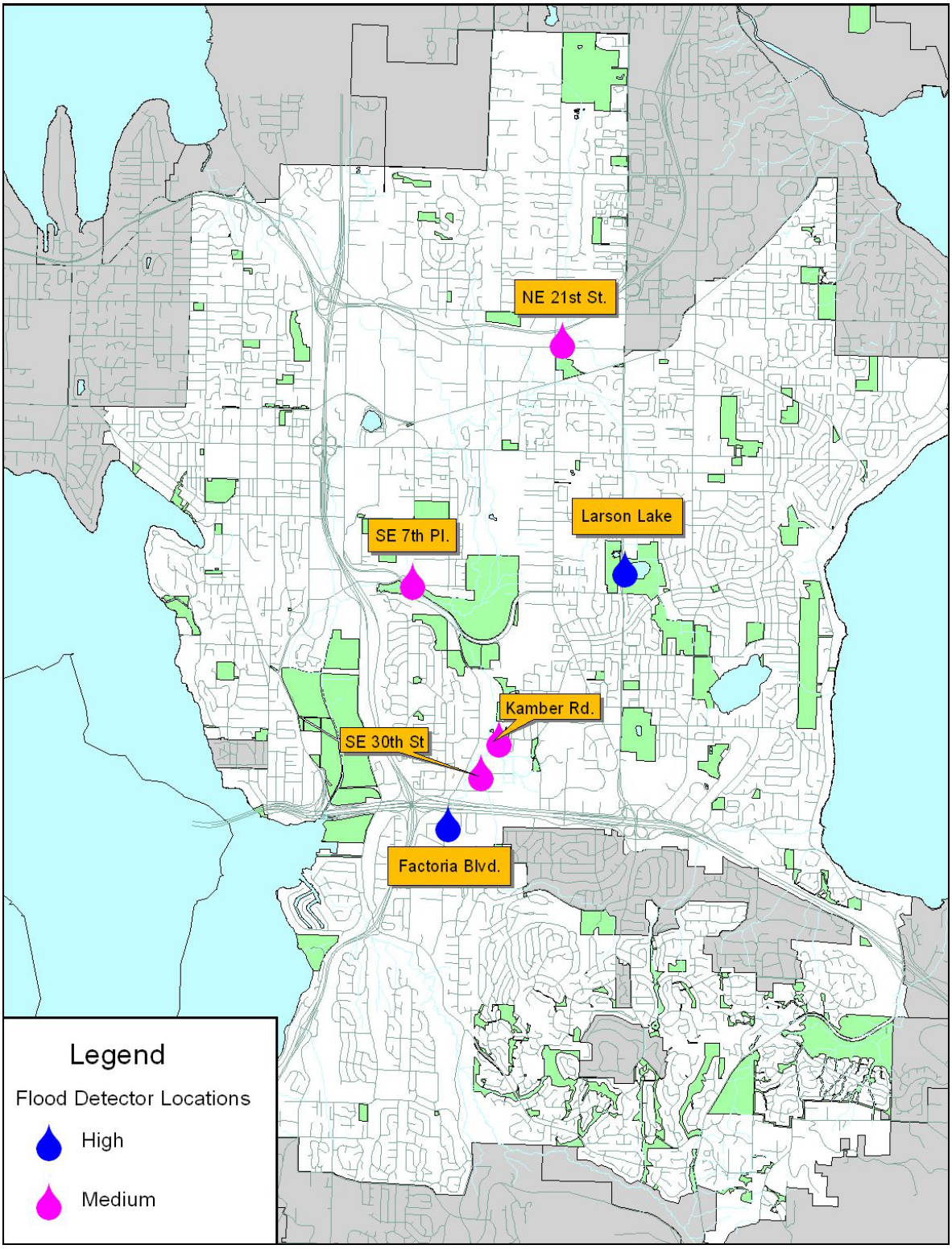


Figure 5-9. Proposed Flood Warning Equipment Locations

Traffic Data Query System

Project IM_01

Deployment Timeframe: 0 to 5 years

Purpose

To streamline the process of extracting system detector data for compiling traffic count information.

Existing Problems

- Lack of a database mechanism for traffic data causes valuable information to be effectively lost.
- Traffic planning would be improved through better data.
- Significant exposure of traffic technicians to moving traffic.

Stakeholder(s)

Primary: Bellevue

Description

The City has collected a wealth of information regarding vehicle volumes on roadways throughout the City through its approximately 500 system detectors. While the data would be useful in a number of traffic planning applications, the information is currently "lost" because there is no database software in place to store and analyze the data. This project will implement a loop data management program in the Computran System so that the data could be made available to other applications, and possibly replace counts currently done with mechanical counters.

Relationships to Other Projects

This project could be packaged together with projects TM_18, TM-20 and TM_21 to potentially reduce software development cost.

Other Considerations

Database could be integrated with the City's GIS database, with the Computran System, or a hybrid that uses both.

Market Packages/ITS Standards

Market packages:

- Traffic Forecast and Demand Management (ATMS09)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1209, 1401, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03
- SAE J2540-3, J2529, J2374

Cost

Project Deployment	$50,000
Annual Ops & Maintenance	$10,000

Benefits

- Better use of existing data
- Increase in staff safety
- Increase in staff efficiency
- Enhanced management of roadway operations

Roadway Weather Information System

Project MC_01

Deployment Timeframe: 0 to 20 years

Purpose

To obtain real-time weather information at potentially hazardous locations. This facilitates an increase in efficiency and response time of roadway maintenance crews.

Existing Problems

Lack of real-time weather information decreases the ability of the City to predict and respond to traffic sensitive weather conditions on a daily basis.

Stakeholder(s)

Primary: Bellevue

Description

Weather stations can improve transportation-related operations by increasing the efficiency with which City staff can gather data on severe weather conditions. Weather stations with CCTV cameras and pavement temperature sensors can alert staff to poor conditions without requiring a field visit. Real-time weather information could also be made available to motorists via the web.

The City will phase in the implementation of new weather stations based on the severity of reoccurring weather-related problems in the area and the available communications infrastructure. Three sites have been identified for near-term (0 to 5 years) deployment, two sites for medium-term (6 to 10 year) deployment and one site for long-term (11 to 20 year) deployment. In addition, the transportation department would like to upgrade some of the existing weather stations located in Bellevue managed by other agencies to include transportation-related sensors, such as pavement temperature sensors. Figure 5-10 shows the existing and proposed weather station locations.

The cost assumed for this project only includes the installation of new weather stations and do not include either retrofitting existing stations or providing communications infrastructure to the planned devices.

Relationships to Other Projects

City-Wide Communications (project TM_16) is required to communicate to the weather stations.

Market Packages/ITS Standards

Market packages:

- Road Weather Data Collection (MC03)
- Weather Information Processing and Distribution (MC04)

ITS Standards:

- NTCIP 1101, 1102, 1103, 1104, 1105, 1106, 1201, 1204, 1405, 2101, 2103, 2104, 2201, 2202, 2301, 2302, 2303, 2304, 2305, 2501, 2502
- ITE TM 1.03, 2.01

Roadway Weather Information System (continued)

Other Considerations

The distribution of this weather information should be combined with the information currently collected in Bellevue. Some of the weather stations may need to be enhanced to include features such as roadway temperature.

Cost

Priority Level	Capital	O&M/yr
High (3 sites)	$75,000	$3,000
Medium (2 sites)	$50,000	$5,000
Low (1 site)	$25,000	$6,000

Benefits

- Better and more efficient response to current weather conditions
- Faster response time to ice conditions by roadway maintenance crews
- Increase in available local weather information
- Increase in driver safety
- Increase in staff efficiency

Weather Station Sites

High

- Lakemont Boulevard near Fire Station 8
- The two Lakemont Bridges near I-90
- Near Somerset Elementary school

Medium

- Lake Hills Connector west of 140th Ave NE
- Meydenbauer Bridge on NE Lake Washington Blvd

Low

- NE 12th St bridge over the Burlington Northern-Santa Fe (BNSF) railroad tracks

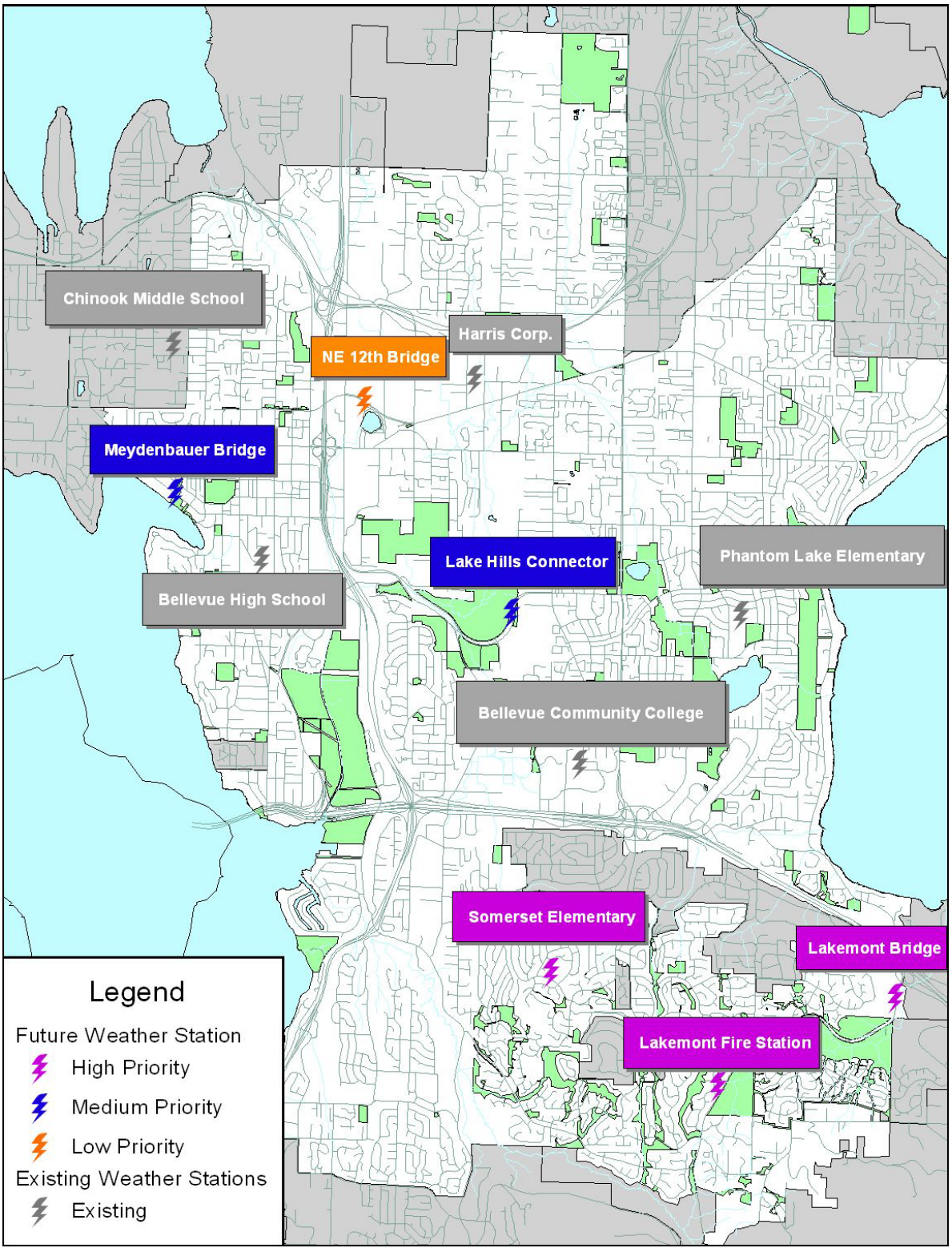


Figure 5-10. Proposed Weather Station Locations

5.2.3 Deployment Schedule

Figure 5-11 provides a Gant Chart view of the ITS Plan project deployment. The potential start date for each project was estimated based on a number of factors including the timing of other associated projects, priority, and anticipated benefits. For projects that do not rely heavily on other projects, and for low priority projects, it was difficult to determine when the project would begin and end. The deployment of these projects was spread out over the entire proposed deployment era.

5.2.4 ITS Deployment Estimate

Table 5-2 summarizes the total Capital and Operations and Maintenance Cost noted for each project in Table 5-1. This table provides a rough estimate of the funding needed to deploy the entire ITS Plan.

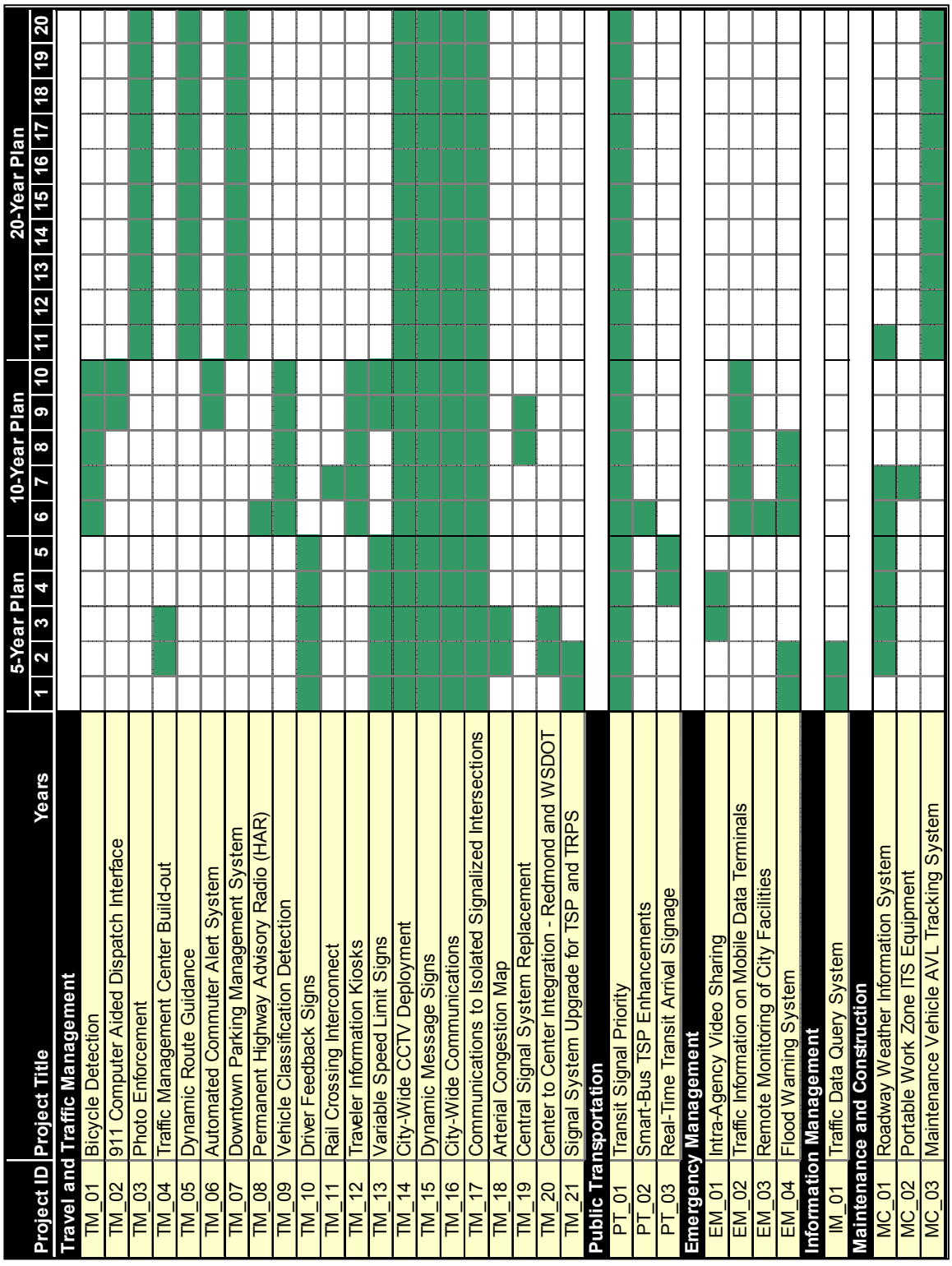


Figure 5-11. Deployment Schedule

Table 5-2. Cost Estimate for ITS Deployment

Project ID	Project Title	Capital Cost	O&M Cost
	High Priority (0-5 years)		
TM_04	Traffic Management Center Build-out	$300,000	$10,000
TM_10	Driver Feedback Signs	$84,000	$4,000
TM_13	Variable Speed Limit Signs	$504,000	$12,000
TM_14	City-Wide CCTV Deployment	$400,000	$16,000
TM_15	Dynamic Message Signs	$225,000	$24,000
TM_16	City-Wide Communications	$1,400,000	$5,000
TM_17	Communications to Isolated Signalized Intersections	$0	$0
TM_18	Arterial Congestion Map	$250,000	$15,000
TM_20	Center to Center Integration - Redmond and WSDOT	$200,000	$10,000
TM_21	Signal System Upgrade for TSP and TRPS	$75,000	$5,000
PT_01	Transit Signal Priority	$480,000	$20,000
PT_03	Real-Time Transit Arrival Signage	$80,000	$2,000
EM_01	Intra-Agency Video Sharing	$30,000	$2,500
EM_03	Remote Monitoring of City Facilities	$200,000	$10,000
EM_04	Flood Warning System	$100,000	$5,000
IM_01	Traffic Data Query System	$50,000	$10,000
MC_01	Roadway Weather Information System	$75,000	$3,000
	Subtotal	**$4,453,000**	**$153,500**
Project ID	**Project Title**	**Capital Cost**	**O&M Cost**
	Medium Priority (6-10 years)		
TM_01	Bicycle Detection	$50,000	$2,000
TM_02	911 Computer Aided Dispatch Interface	$150,000	$10,000
TM_06	Automated Commuter Alert System	$100,000	$5,000
TM_08	Permanent Highway Advisory Radio (HAR)	$20,000	$1,000
TM_09	Vehicle Classification Detection	$100,000	$2,000
TM_11	Rail Crossing Interconnect	$50,000	$4,000
TM_12	Traveler Information Kiosks	$0	$1,000
TM_13	Variable Speed Limit Signs	$504,000	$12,000
TM_14	City-Wide CCTV Deployment	$575,000	$23,000
TM_15	Dynamic Message Signs	$100,000	$10,000
TM_16	City-Wide Communications	$1,400,000	$5,000
TM_17	Communications to Isolated Signalized Intersections	$0	$0
TM_19	Central Signal System Replacement	$400,000	$15,000
PT_01	Transit Signal Priority	$360,000	$60,000
PT_02	Smart-Bus TSP Enhancements	$200,000	$10,000
EM_02	Traffic Information on Mobile Data Terminals	$50,000	$5,000
EM_03	Remote Monitoring of City Facilities	$200,000	$10,000
EM_04	Flood Warning System	$200,000	$10,000
MC_01	Roadway Weather Information System	$50,000	$2,000
MC_02	Portable Work Zone ITS Equipment	$80,000	$1,000
	Subtotal	**$4,589,000**	**$188,000**
	Low Priority (11-20 years)		
TM_03	Photo Enforcement	$375,000	$300,000
TM_05	Dynamic Route Guidance	$250,000	$15,000
TM_07	Downtown Parking Management System	$300,000	$15,000
TM_14	City-Wide CCTV Deployment	$300,000	$12,000
TM_15	Dynamic Message Signs	$175,000	$21,000
TM_16	City-Wide Communications	$2,800,000	$10,000
TM_17	Communications to Isolated Signalized Intersections	$0	$0
PT_01	Transit Signal Priority	$240,000	$40,000
MC_01	Roadway Weather Information System	$25,000	$1,000
MC_03	Maintenance Vehicle AVL Tracking System	$150,000	$5,000
	Subtotal	**$4,615,000**	**$419,000**
	Total	**$13,657,000**	**$760,500**

CHAPTER 6 ITS PLANNING COMPLIANCE

6.1 INTRODUCTION

As previously noted in Chapter 3, to obtain federal funding for ITS projects, an ITS plan must be developed following the guidelines provided in the FHWA Federal-Aid Policy Guide, Title 23, Part 940. Further guidelines are established in a USDOT document titled "*Regional ITS Architecture Guidance, Developing, Using and Maintaining an ITS Architecture for your Region"*. In 2001 the PSRC prepared a Regional Architecture for the entire Puget Sound region. Along with the Regional Architecture they also prepared their own ITS planning guidance document titled *"Guidance for Complying with Federal Requirements for Intelligent Transportation System Projects in the Puget Sound Region"*. PSRC guidance document was based on the FHWA requirements with minor modifications to show compliance with the Puget Sound Region ITS Architecture.

In preparing the Bellevue ITS plan, the goal was to follow the guidance provided by both the FHWA and PSRC to assure the City's eligibility for future federal funds and to promote interagency cooperation with the Puget Sound region. Section 6.2 below describes how the Bellevue ITS plan met the FHWA and PSRC requirements and Section 6.3 describes how the Bellevue Architecture fits into the PSRC Regional Architecture.

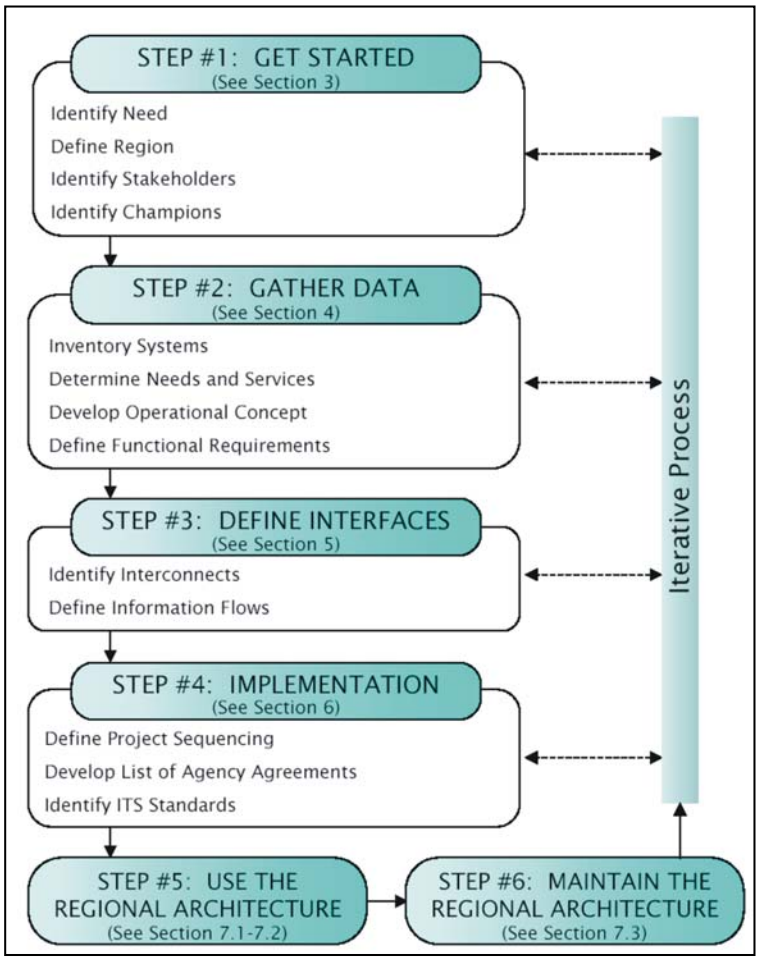
6.2 FHWA/PSRC REQUIREMENTS

Figure 6-1 shows the steps outlined by the USDOT for preparing an ITS plan. These steps incorporate the System Engineering process defined in the FHWA Policy Guide and the PSRC guidance document. The System Engineering requirements are as follows:

1. Description of how projects fit into the Regional ITS Architecture
2. Roles and responsibilities of participating agencies
3. Requirements definitions
4. Analysis of alternative system configurations and technology options
5. Procurement options
6. Applicable ITS standards and testing procedures
7. Procedures and resources necessary for operations and management of the system

Many of the System Engineering steps occur during the design of specific projects and not necessarily during the planning. The sections below describe how each step of the USDOT outline was addressed in the Bellevue ITS plan and notes how each planning level System Engineering requirement fits in.

Figure 6-1. Federal Architecture Outline



Source: *Regional ITS Architecture Guidance*, USDOT

Step 1: Get Started *(Identify need, region, Stakeholders and champions)*

The first step to "Getting Started" is to identify the ITS needs in Bellevue. By making the decision to develop an ITS Master Plan, the City has shown that there is a need to expand upon their existing ITS infrastructure. Chapter 2 of this report covers the topic of Stakeholders. The Stakeholders within the City of Bellevue were interviewed to identify their ITS needs. This plan is specific to the City of Bellevue so a description of the region is not necessary. Based on the existing ITS infrastructure currently deployed in Bellevue, it is very evident there are numerous ITS champions in the City.

Step 2: Gather Data *(System Inventory, Needs and Services, Concept of Operations and Functional Requirements)*

In Chapter 1, the existing ITS conditions in Bellevue were documented and mapped. Chapter 2 identified all the ITS needs based on interviews with the City of Bellevue Stakeholders, and the User Services were selected as part of the Regional Architecture process in Chapter 3. Chapter 3 also helped identify the functional requirements for the plan by showing which subsystems were selected as shown in the sausage diagram in Figure 3-3. Further functional requirement detail will be needed when specific projects move into the design phase. Chapter 4 presents the Concept of Operations for the project.

The majority of PSRC requirement #1 (description of how project fits into the Regional ITS Architecture) is met through the work required in Step 2. Requirement #1 includes the following items:

- Review of Applicable Market Packages: To be discussed in Section 6.3.1 below.
- Regional ITS Integration Strategy: To be discussed in Section 6.3.2 below.
- Other Stakeholders to Consider: Discussed in the Concept of Operations, Chapter 4.
- Develop a Project Operational Concept: Discussed in Chapter 4.
- Develop a Project ITS Architecture. Discussed in Chapter 3.

PSRC requirement #2 (roles and responsibilities of participating agencies) is also covered under this step through the Concept of Operations discussed in Chapter 4.

Step 3: Define Interfaces *(Identify Interconnects, Define Information Flows)*

The interfaces between departments within the City of Bellevue and to other agencies are all defined through the Turbo Architecture work described in Chapter 3. Through the interview questions asked in Turbo Architecture, the program automatically maps all the interconnects and determines the data flows. The interconnect and data flows where then manually refined to better match the needs of the City of Bellevue.

Step 4: Implementation *(Define Project Sequencing, Develop List of Agency Agreements and Identify ITS Standards))*

Figure 5-11 in Chapter 5 provides a rough graphical representation of the project sequencing. Each project was assigned a priority of High, Medium or Low. This priority was directly related to the deployment periods of 0-5 year, 6-10 years and 11-20 years, respectively. Figure 5-11 provides an estimation of the duration of each project.

A list of future agency agreements were not developed in this project because the other agencies discussed in the Concept of Operations were not involved in the development of this ITS plan. However, the Concept of Operations does estimate the cooperation level and type of data that will be needed between agencies for the inter-jurisdictional Market Packages selected for the Bellevue ITS Master Plan.

Chapter 5 notes the ITS standards that should be considered for each of the High Priority projects. The ITS standards are constantly evolving so the list should be considered a starting point. The applicable standards for each project should be re-evaluated as they enter the design phase. This discussion of ITS standards also meets the requirements of Item 6 of the PSRC Guidelines.

Steps 5 and 6: Use and Maintenance of the Regional Architecture

With the Regional Architecture complete, the City must start looking for ways to incorporate the findings of this project into other planning and design efforts in Bellevue. The City must also recognize that this is a living document that should be updated on a regular basis. As communications is deployed and opportunities for ITS deployment become available, priorities of projects can change. In addition, new and more efficient ways of deploying various ITS elements are constantly being developed. Elements that may seem expensive now may be more obtainable in the future. These future steps in the application of ITS are not specifically addressed in this document but should become part of the City's regular transportation planning routine.

The following requirements of the PSRC guidelines are also considered future steps to deploying ITS:

1. Requirements Definitions: This step requires identifying the functional, performance and technical requirements of ITS projects. This step will be performed when a project moves into the design phase.
2. Analysis of Alternative System Configurations: This analysis will be performed when preparing the RFP or procurement specification for a future ITS system component.
3. Procurement Options: When each project moves to design, one of the first steps will be to determine how the ITS elements will be procured.
4. Procedures and Resources Necessary for Operations and Management of the System: This is another step that will occur during the design and installation of each future ITS element.

6.3 PSRC REGIONAL ARCHITECTURE COORDINATION

Requirement 1 of the PSRC guidelines requires a description of how a project fits into the PSRC Regional ITS Architecture. The following two sections describe the Market Packages included for Bellevue in the PSRC Regional Plan and how Bellevue meets the requirements of the "ITS Integration Strategy[12]" report prepared by PSRC.

6.3.1 Market Packages

Table 6-1 provides a comparison of the Market Packages identified by PSRC in the Puget Sound Regional ITS Plan and the ones identified by the City of Bellevue. As shown, there are numerous Market Packages that need to be added to the next update of the PSRC plan. There were only three Market Packages identified by PSRC that were not included by Bellevue. These all related to commercial vehicle operations. The City may install a few detector stations that can classify vehicles to monitor truck traffic volumes, but the City does not intend to monitor electronic clearance or commercial vehicle safety on City streets; therefore these Market Packages were not included.

[12] *ITS Integration Strategy,* Puget Sound Regional Council, IBI Group, April 6, 2001.

Table 6-1. PSRC vs. Bellevue Identified Market Packages

Service Area	Market Package	Market Package Name	Identified (PSRC)	Identified (Bellevue)
Archived Data Management	AD1	ITS Data Mart	X	X
	AD2	ITS Data Warehouse		X
Public Transportation	APTS7	Multi-modal Coordination	X	X
	APTS8	Transit Traveler Information		X
Traveler Information	ATIS1	Broadcast Traveler Information	X	X
	ATIS2	Interactive Traveler Information	X	X
	ATIS8	Dynamic Ridesharing	X	
	ATIS9	In Vehicle Signing		X
Traffic Management	ATMS01	Network Surveillance	X	X
	ATMS02	Probe Surveillance		X
	ATMS03	Surface Street Control	X	X
	ATMS06	Traffic Information Dissemination	X	X
	ATMS07	Regional Traffic Control	X	X
	ATMS08	Traffic Incident Management System		X
	ATMS09	Traffic Forecast and Demand Management		X
	ATMS13	Standard Railroad Grade Crossing		X
	ATMS16	Parking Facility Management		X
	ATMS17	Regional Parking Management		X
	ATMS19	Speed Monitoring		X
	ATMS21	Roadway Closure Management		X
Commercial Vehicle Operations.	CVO 3	Electronic Clearance	X	
	CVO 4	CV Administrative Process	X	
	CVO 7	Roadside CVO Safety	X	
Emergency Management	EM01	Emergency Call-Taking Dispatch		X
	EM02	Emergency Routing	X	X
	EM06	Wide-Area-Alert		X
	EM07	Early Warning System		X
	EM08	Disaster Response and Recovery		X
	EM09	Evacuation and Reentry Management		X
	EM10	Disaster Traveler Information		X
Maintenance & Construction Management	MC01	Maint. and Const. vehicle and Equip. Tracking		X
	MC02	Maint. and Const. vehicle Maintenance		X
	MC03	Road Weather Data Collection		X
	MC04	Weather Information Processing and Distribution		X
	MC05	Roadway Automated Treatment		X
	MC06	Winter Maintenance		X
	MC07	Roadway Maintenance and Construction		X
	MC08	Work Zone Management		X
	MC09	Work Zone Safety Monitoring		X
	MC10	Maint. and Const. Activity Coordination		X

6.3.2 Integration Strategy

The PSRC Integration Strategy was developed to "provide guidance for the region in the management and investment of ITS applications to achieve a regionally integrated system". The PSRC Integration Strategy is composed of nine components for meeting the objective of the strategy. Below is a description of how Bellevue will address each component.

1. **Use the Smart Trek ITS Backbone as the initial mechanism for the sharing of real-time transportation system and other related information among jurisdictions and private ISPs.**

   The ITS Backbone is a program developed by the University of Washington to transfer regional traffic management data between agencies. The City is currently using the ITS backbone to obtain loop data from WSDOT ramp detectors. This data is coming to the City over the internet. The City has modified their Computran software to provide signal timing and system detector data to the ITS Backbone, but the ITS Backbone interface equipment installed in their TMC is outdated which is preventing them from sharing this data on the network.

2. **Transition to structured, emerging NTCIP center-to-center interfaces among transportation management systems for the future sharing of information and device control coordination.**

   The deployment plan includes integration with the WSDOT and Redmond traffic signal systems. Both will use the NTCIP center-to-center protocol for developing the communications.

3. **Continued sharing of common ITS applications and systems among regional transit agencies and build links to other traffic management and other information sources.**

   The City has three projects included in the deployment plan that show their continuing support of cooperation with the region's transit agencies. The transit related projects included are the following: Transit Signal Priority, Smart-Bus TSP Enhancement and Real-Time Transit Arrival Signage.

4. **Build information interfaces between transportation management systems and emergency management centers.**

   The City has a project titled "Intra-Agency Video Sharing" that will provide video to the City's Emergency Operations Center, 911 Center, Police and Bellevue Service Center. In addition the "Dynamic Route Guidance" project will provide route congestion information to the 911 Center for facilitating the routing of emergency vehicles.

5. **Connect local commercial vehicle regulatory functions to the Washington State deployment of the Commercial Vehicle Information Systems and Networks .**

   The City does not intend to perform any commercial vehicle monitoring functions.

6. **Use Smart Trek as basis for the deployment of a regional multi-modal traveler information system and the new three-digit traveler information telephone number (511) to provide basic traveler information to the general public.**

   As more traveler information comes on-line in Bellevue, the data will be made available to the Smart Trek website and the 511 system.

7. **Accommodate the electronic flow of information to private ISPs through the deployment of a common interface standard via the ITS Backbone.**

This integration is the responsibility of the ITS Backbone managers. Bellevue has assumed that this link would not be direct to their TMC.

8. **Build electronic links to other transportation Stakeholders including ports, rail operators, clean air agency, toll agencies, and freight management organizations.**

   The City currently has little need to share information with any of the aforementioned Stakeholders. There is no tolling in Bellevue and very limited rail and freight traffic impacting City streets. The City also does not plan on collecting any of their own emissions data.

9. **Capture and archive real-time transportation system data for future analysis and to support transportation planning.**

   The deployment plan includes a high priority project to improve the access to volume and occupancy data collected from the City's 500+ system detectors.

Appendix A
Physical Architecture Terminators

National ITS Architecture Terminators

Environment	Environment (X18)
	Potential Obstacles (X39)
	Roadway Environment (X41)
	Secure Area Environment (X42)
	Traffic (X45)
	Vehicle Characteristics (X57)
Human	Archived Data Administrator (X70)
	Commercial Vehicle Driver (X06)
	Commercial Vehicle Operation (CVO) Inspector (X10)
	Driver (X12)
	Emergency Personnel (X15)
	Emergency System Operator (X14)
	Emissions Management Operator (X98)
	Fleet-Freight Manager (X07)
	Information Service Provider (ISP) Operator (X63)
	Maintenance and Construction Center Personnel (X75)
	Maintenance and Construction Field Personnel (X76)
	Parking Operator (X36)
	Pedestrians (X38)
	Toll Administrator (X44)
	Toll Operator (X43)
	Traffic Operations Personnel (X46)
	Transit System Operators (X49)
	Transit Vehicle Operator (X52)
	Traveler (X56)
Other System	Other Archives (X68)
	Other Comercial Vehicle Admin. (X59)
	Other Emergency Management (X30)
	Other ISP (X31)
	Other Maintenance/Construction Management (X78)
	Other Maintenance/Construction Vehicle (X90)
	Other Parking (X73)
	Other Roadway (X74)
	Other Toll Administration (X94)
	Other Traffic Management (X35)
	Other Transit Management (X33)
	Other Vehicle (X34)

National ITS Architecture Terminators - continue

System	Alerting and Advisory Systems (X95)
	Archived Data User Systems (X69)
	Asset Management (X79)
	Basic Commercial Vehicle (X08)
	Basic Maintenance and Construction Vehicle (X87)
	Basic Transit Vehicle (X51)
	Basic Vehicle (X03)
	Care Facility (X93)
	CVO Information Requestor (X65)
	Department of Motor Vehicles (X64)
	Emergency Telecommunications System (X13)
	Enforcement Agency (X62)
	Equipment Repair Facility (X89)
	Event Promoters (X19)
	Financial Institution (X21)
	Freight Equipment (X99)
	Government Reporting Systems (X72)
	Intermodal Freight Depot (X60)
	Intermodal Freight Shipper (X01)
	Location Data Source (X26)
	Maintenance and Construction Administrative Systems (X88)
	Map Update Provider (X23)
	Media (X27)
	Multimodal Crossings (X29)
	Multimodal Transportation Service Provider (X02)
	Other Data Sources (X71)
	Rail Operations (X67)
	Shelter Providers (X97)
	Storage Facility (X91)
	Surface Transportation Weather Service (X77)
	Telecommunications System for Traveler Information (X100)
	Trade Regulatory Agencies (X92)
	Traveler Card (X61)
	Wayside Equipment (X66)
	Weather Service (X58)
	Yellow Pages Service Providers (X24)

Appendix B
Market Packages

National ITS Architecture Market Packages		
Market Package		**Description**
Advanced Data		
AD1	ITS Data Mart	A focused archive that houses data.
AD2	ITS Data Warehouse	Data Mart plus ability that allows collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries.
AD3	ITS Virtual Data Warehouse	ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives.
Advanced Public Transportation System		
APTS1	Transit Vehicle Tracking	Automated Vehicle Location System to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.
APTS2	Transit Fixed-Route Operations	Performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services.
APTS3	Demand Response Transit Operations	Transit Fixed-Route Operations with demand response transit services.
APTS4	Transit Passenger and Fare Management	Allows for the management of passenger loading and fare payments on-board vehicles using electronic means.
APTS5	Transit Security	Provides for the physical security of transit passengers.
APTS6	Transit Maintenance	Automatic maintenance scheduling and monitoring through on-board sensors.
APTS7	Multi-modal Coordination	Establishes two way communications between multiple transit and traffic agencies to improve service coordination.
APTS8	Transit Traveler Information	Provides transit users at transit stops and on-board transit vehicles with ready access to transit information
Advanced Traveler Information Systems		
ATIS1	Broadcast Traveler Information	Provides the user with a basic set of ATIS services; its objective is early acceptance.
ATIS2	Interactive Traveler Information	Provides tailored information in response to a traveler request.
ATIS3	Autonomous Route Guidance	In-vehicle sensory and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information.
ATIS4	Dynamic Route Guidance	Offers user advanced route planning and guidance, responsive to current conditions.
ATIS5	ISP Based Route Guidance	Different than the Dynamic Route Guidance Market Package, moves the route planning function from the user device to the information service provider.

National ITS Architecture Market Packages		
Market Package		**Description**
ATIS6	Integrated Transportation Management/Route Guidance	Continuously optimize the traffic control strategy based on near-real time information on intended routes for a proportion of the vehicles.
ATIS7	Yellow Pages and Reservation	Enhances the Interactive Traveler Information package by making infrastructure provided yellow pages and reservation services available to the user.
ATIS8	Dynamic Ridesharing	Enhances the Interactive Traveler Information package by adding an infrastructure provided dynamic ridesharing/ride matching capability.
ATIS9	In Vehicle Signing	Distribution of traffic/travel advisory info. to drivers through in-vehicle devices.
Advanced Traffic Management Systems		
ATMS01	Network Surveillance	Includes traffic detectors, other surveillance equipment, the supporting field equipment, and wire line communications to transmit the collected data to a TMC.
ATMS02	Probe Surveillance	Wireless communications between the vehicle and Information Service Provider or TMC to communicate current vehicle location and status (e.g. travel time, location)
ATMS03	Surface Street Control	Provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control.
ATMS04	Freeway Control	Provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways.
ATMS05	HOV Lane Management	Manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals.
ATMS06	Traffic Information Dissemination	Dissemination of traffic information to drivers and vehicles using DMSs or HAR.
ATMS07	Regional Traffic Control	Integrated Interjurisdictional traffic control.
ATMS08	Incident Management System	Manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized.
ATMS09	Traffic Forecast and Demand Management	Includes advanced algorithms and storage capabilities to support historical evaluation, real-time assessment, and forecast of roadway network performance.
ATMS10	Electronic Toll Collection	Ability to collect tolls electronically and detect and process violators.

National ITS Architecture Market Packages		
Market Package		**Description**
ATMS11	Emissions Monitoring and Management	Monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data.
ATMS12	Virtual TMC and Smart Probe Data	Rural road systems. Instead of a central TMC, the traffic management is distributed over a very wide area.
ATMS13	Standard Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., rail speeds < 80 mph).
ATMS14	Advanced Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g. where rail speeds > 80 mph).
ATMS15	Railroad Operations Coordination	Used to develop forecast HRI closure times and durations which may be used in advanced traffic control strategies or to enhance the quality of traveler information.
ATMS16	Parking Facility Management	Provides enhanced monitoring and management of parking facilities.
ATMS17	Regional Parking Management	Coordination between parking facilities to enable regional parking management.
ATMS18	Reversible Lane Management	Provides for the management of reversible lane facilities.
ATMS19	Speed Monitoring	Monitors the speeds of vehicles traveling through a roadway system.
ATMS20	Drawbridge Management	Manages drawbridges at rivers and canals and other multi-modal crossings.
ATMS21	Roadway Closure Management	Closes roadways to vehicular traffic during maintenance and other unsafe conditions.
Advanced Vehicle Safety Systems		
AVSS01	Vehicle Safety Monitoring	Diagnose critical components of vehicle and warn the driver of potential dangers.
AVSS02	Driver Safety Monitoring	Determine the driver's condition, and warn the driver of potential dangers.
AVSS03	Longitudinal Safety Warning	Allows for longitudinal warning. It utilizes safety sensors and collision sensors.
AVSS04	Lateral Safety Warning	Allows for lateral warning. It utilizes safety sensors and collision sensors.
AVSS05	Intersection Safety Warning	Determine the probability of a collision in an equipped intersection and provide timely warnings to drivers in response to hazardous conditions.

National ITS Architecture Market Packages		
Market Package		**Description**
AVSS06	Pre-Crash Restraint Deployment	Provides in-vehicle sensors to monitor the vehicle's local environment, determine collision probability and deploy a pre-crash safety system.
AVSS07	Driver Visibility Improvement	Enhance driver visibility using on-board display hardware.
AVSS08	Advanced Vehicle Longitudinal Control	Automates the speed and headway control functions on board the vehicle.
AVSS09	Advanced Lateral Control	Automates the steering control on board the vehicle.
AVSS10	Intersection Collision Avoidance	Determines the probability of an intersection collision and provide timely warnings to approaching vehicles.
AVSS11	Automated Highway System	Enables "hands-off" operation of the vehicle on the automated portion of the highway system.
Commercial Vehicle Operations		
CVO01	Fleet Administration	Provides the capabilities to manage a fleet of commercial vehicles.
CVO02	Freight Administration	Tracks cargo and the cargo condition.
CVO03	Electronic Clearance	Provides for automated clearance at roadside check facilities.
CVO04	CV Administrative Processes	Provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing.
CVO05	International Border Electronic Clearance	Provides for automated clearance specific to international border crossings.
CVO06	Weigh-In-Motion	Provides for high speed weigh-in-motion with or without AVI attachment.
CVO07	Roadside CVO Safety	Provides for automated roadside safety monitoring and reporting.
CVO08	On-board CVO Safety	On-board commercial vehicle safety monitoring and reporting.
CVO09	CVO Fleet Maintenance	Supports maintenance of CVO fleet vehicles through close interface with on-board monitoring equipment and AVLS capabilities within Fleet Management System.
CVO10	HAZMAT Management	Integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.
CVO11	Roadside HAZMAT Security Detection and Mitigation	Provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology.

National ITS Architecture Market Packages		
Market Package		**Description**
CVO12	CV Driver Security Authentication	Provides the ability for Fleet and Freight Management to detect unauthorized commercial vehicle drivers.
CVO13	Freight Assignment Tracking	Provides for the planning and tracking of commercial vehicle shipments.
Emergency Management		
EM01	Emergency Response	Provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency.
EM02	Emergency Routing	Supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s).
EM03	Mayday Support	Allows the user to initiate a request for emergency assistance and enables Emergency Management System to locate user and determine appropriate response.
EM04	Roadway Service Patrols	Supports roadway service patrol vehicles that monitor roads by aiding motorists and offering rapid response to minor incidents.
EM05	Transportation Infrastructure Protection	Monitors transportation infrastructure such as bridges, tunnels and management centers for potential threats, control access during and after an incident, or mitigate impact of an incident.
EM06	Wide-Area Alert	Uses ITS driver and traveler information systems to alert the public in emergency situations.
EM07	Early Warning System	Monitors and detects potential, looming, and actual disasters.
EM08	Disaster Response and Recovery	Enhances the ability of the surface transportation system to respond to and recover from disasters.
EM09	Evacuation and Reentry Management	Supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area.
EM10	Disaster Traveler Information	Uses ITS to provide disaster-related traveler information to the general public.

National ITS Architecture Market Packages		
Market Package		**Description**
Maintenance and Construction Management		
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities.
MC02	Maintenance and Construction Vehicle Maintenance	Performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment.
MC03	Road Weather Data Collection	Collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway.
MC04	Weather Information Processing and Distribution	Processes and distributes the environmental information collected from the Road Weather Data Collection market package.
MC05	Roadway Automated Treatment	Treats a roadway section automatically based on environmental or atmospheric conditions.
MC06	Winter Maintenance	Supports winter road maintenance including snow plow operations, roadway treatments, and other snow and ice control activities.
MC07	Roadway Maintenance and Construction	Supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way.
MC08	Work Zone Management	Directs activity in work zones, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity for better coordination management.
MC09	Work Zone Safety Monitoring	Includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles.
MC10	Maintenance and Construction Activity Coordination	Supports the dissemination of maintenance and construction activity to centers, or to the Information Service Providers.

For additional information, see the Market Package descriptions on the Internet at http://itsarch.iteris.com/itsarch/html/mp/mpindex.htm

Appendix C
Mapping of Needs to User Services

	Travel and Traffic Management	Pre-Trip Travel Information	En-Route Driver Information	Route Guidance	Ride Matching and Reservation	Traveler Services Information	Traffic Control	Incident Management	Travel Demand Management	Emissions Testing and Mitigation	Highway-Rail Intersection	Public Transportation Management	Public Transportation Management	En-Route Transit Information	Personalized Public Transit	Public Travel Security	Electronic Payment	Electronic Payment Services	Commercial Vehicle Operations	Commercial Vehicle Electronic Clearance	Automated Roadside Safety Inspection	On-Board Safety Monitoring	Commercial Vehicle Administrative Processes	Hazardous Materials Incident Response	Freight Mobility	Emergency Management	Emergency Notification and Personal Security	Emergency Vehicle Management	Disaster Response and Evacuation	Advanced Vehicle Safety Systems	Longitudinal Collision Avoidance	Lateral Collision Avoidance	Intersection Collision Avoidance	Vision Enhancement for Crash Avoidance	Safety Readiness	Pre-Crash Restraint Deployment	Automated Vehicle Operation	Information Management	Archived Data Function	Maintenance/ Construction Management	Maintenance and Construction Operations
Communications																																									
Utilize City's existing communications infrastructure							◆																																		
Expand existing traffic operations communications							◆																																		
Upgrade communications (multi-mode to single-mode fiber)							◆																																		
Traffic Operations and Management																																								
Expanded video surveillance		◆					◆	◆																																	◆
Enhanced traffic control capabilities							◆																																		
Pedestrian and bicycle treatment (detection)							◆																																		
Expanded use of dynamic speed enforcement signs							◆																																		
Probe vehicle data							◆																																		
Signal pre-empt for police vehicles																											◆														
Center-to-center link to neighboring agencies							◆	◆																															◆		
Red light and speed photo enforcement							◆																																		
Procurement of standards based equipment																																								◆
Automatic detection of traffic equipment malfunctions							◆																																		◆
Improved vehicle classification system																																							◆		
Expand system detection		◆					◆																																◆		
Traffic management center equipment upgrade							◆																																		
Traveler Information																																								
Expanded use of VMS			◆	◆		◆	◆	◆																																	
Dynamic detour route development and management		◆	◆	◆		◆	◆	◆	◆																			◆													
Real-time construction information		◆	◆			◆																																		◆
Web-based traveler information		◆				◆																																		
Automated commuter alerts		◆	◆			◆																																		
Parking management system			◆																																					
Driver information via other agency VMS			◆	◆		◆	◆	◆																																	
Highway advisory radio			◆	◆		◆	◆	◆																			◆		◆												
Incident Management																																								
Incident management system							◆	◆																			◆		◆												
Interagency incident management			◆				◆	◆																			◆		◆												
Public Transportation																																								
Transit signal priority support							◆					◆																														
Real-time transit arrival and departure information		◆											◆																													
Emergency Management																																								
Remote monitoring								◆																				◆													
CCTV Video at 911 Dispatch								◆																																	
Automatic incident detection							◆	◆																																	
Mobile data terminals for incident management								◆																				◆													
Dynamic route mapping for dispatch center								◆																				◆													
AVL on all emergency vehicles																												◆													
Information Management																																								
Query-able traffic data																																							◆		
Expanded interagency data sharing																																							◆		
GIS based equipment management																																							◆		◆
Maintenance and Construction																																								
Ice and flood detection and weather information																																									◆
Improve traffic management in work zones			◆				◆																																		◆
AVL on maintenance vehicles																																									◆
Other																																								
Coordination with Downtown Bellevue Projects																																								
Non-intrusive traffic calming techniques																																								
Online public work request system																																								
Expansion of online permitting system																																								

Not Applicable to the ITS Architecture

Appendix D
Glossary of Acronyms

AD	Archive Data
AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
APTS	Advanced Public Transportation System
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
ATMS	Advanced Transportation Management System
AVL	Automated Vehicle Location
AVSS	Advanced Vehicle Safety System
BCC	Bellevue Community College
BSC	Bellevue Service Center
BNSF	Burlington Northern Santa Fe
BROTS	Bellevue Redmond Overlake Transportation Study
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign
EB	Eastbound
EM	Emergency Management
ES	Emergency Services
EOC	Emergency Operations Center
EVP	Emergency Vehicle Preemption
FHWA	Federal Highway Administration
GIS	Geographical Information System
GPS	Global Positioning System
H	High Priority
HAR	Highway Advisory Radio
IEEE	Institute of Electrical and Electronics Engineers
IM	Information Management
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IT	Information Technology
L	Low Priority
M	Medium Priority
MC	Maintenance & Construction
MCO	Maintenance & Construction Operation
MDT	Mobile Data Terminal
NB	Northbound
NE	Northeast
NEMA	National Electrical Manufacturers Association
NTCIP	National Transportation Communications for ITS Protocol
O&M	Operations and Maintenance
PSRC	Puget Sound Regional Council
PT	Public Transportation
ROW	Right-of-Way
SAE	Society of Automotive Engineers

SB	Southbound
SE	Southeast
TM	Travel & Traffic Management
TMC	Traffic Management Center
TRPS	Traffic Responsive Pattern Selection
TSP	Transit Signal Priority
USDOT	United States Department of Transportation
VMS	Variable Message Sign
WB	Westbound
WSDOT	Washington State Department of Transportation