SEATTLE TO PORTLAND
INTER-CITY IVHS CORRIDOR
STUDY AND COMMUNICATION PLAN

TECHNICAL MEMORANDUM NUMBER 1 :

SEATTLE TO PORTLAND CORRIDOR TRANSPORTATION NEEDS

Prepared for the
Washington State Department of Transportation

Prepared by

David Evans and Associates, Inc.

in association with

Parsons, Brinckerhoff, Quade and Douglas, Inc
Farradyne Systems, Inc.,
IBI Group, Inc.
CTS, Engineers, Inc.
Pacific Rim Resources

August 31, 1994

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1 .0 INTRODUCTION

1.1 OVERVIEW

This document is the first in a series of technical memorandums provided as part of the Seattle to Portland Inter-City IVHS Corridor Study and Communications Plan. The work consists of conducting an Intelligent Vehicle Highway System (IVHS) corridor study and developing a communications plan for the inter-city corridor from Portland to Seattle. There are two primary purposes for this project. The first is to develop a recommended plan for implementing appropriate IVHS technology to address corridor transportation needs over the next twenty years. The goal of IVHS is to provide safer roadways, better informed travelers, improved traffic management, and the increased efficiency of commercial goods movements by applying advanced technology to the transportation system.

The second purpose is to develop a communications plan that supports the IVHS corridor plan, accounts for WSDOT communication requirements in the corridor, and provides a framework for a Statewide WSDOT communications network.

The technical memorandum documents existing information on current and future transportation conditions in the corridor and identifies transportation issues and concerns. This assessment shall serve as a baseline for determining IVHS needs and estimating the potential benefit of any recommended IVHS applications.

Information compiled involved existing data; reports, and interviews with transportation officials along the corridor. Data collected included:

- Forecasted Person Trips;
- Forecasted Inter-City Person Trip Origins and Destinations;
- Current and Forecasted Commercial Trips;
- Current and Forecasted Vehicle Volumes;
- Current and Forecasted Vehicle Classification;
- Accidents;
- Roadside Assistance Calls and Citations;
- Roadway Capacity;
- Current and Predicted Levels of Congestion;
- Weather Conditions;
- Programmed and Planned Highway Improvements;
- Planned Inter-City Transit and Passenger Railroad Improvements; and
- Current and Planned IVHS Programs and Projects.

Information was obtained from a wide range of agencies including: Washington Department of Transportation (both Headquarters and the three Regions located along the corridor), Washington State Patrol, Washington State Department of Licensing, Washington State Trucking Association, Washington State Tourism Development Division, Washington Public Ports Association, Oregon Department of Transportation, Portland Metro, and the Cities of Seattle, Tacoma, Olympia, Chehalis, Centralia, Kelso, Vancouver, and Portland.

1.2 CORRIDOR LOCATION

The inter-city corridor from Seattle to Portland stretches along interstate 5 (I-5) for nearly 180 miles from Seattle in the north to the Washington-Oregon Border at the Columbia River to the south. Figure 1-1 shows the location of the corridor within western Washington. The Cascade Mountain Range is to the east. The route generally follows the southeast shore of Puget Sound in the north, proceeds south from Olympia, joins the Columbia River at Kelso, and continues south to Portland. This transportation corridor serves a wide range of transportation demands including urban travel in the Puget Sound and Portland-Vancouver Regions, inter-city passenger movements through the major cities, and goods movements along this main west coast route.

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The corridor connects most of the state's larger cities such as Seattle, Tacoma, Olympia, Centralia, Kelso, and Vancouver. Table 1-1 provides the current and project populations for the seven counties along the corridor. As expected the majority of the population is found in the northern portion of the county in King and Pierce County where the cities of Seattle and Tacoma are located. The population density increases again at the southern end of the corridor in Clark County in Washington and Multnomah County in Portland. Overall, 3.42 million persons live in the corridor counties. Projections for the year 2000 indicate an anticipated increase to 3.64 million.

Table 1-1
Current and Project Population for Seattle to Portland Corridor Counties

County	1992	2000
King	1,621,337	1,704,502
Pierce	648,113	696,572
Thurston	161,238	177,361
Lewis	59,358	62,326
Cowlitz	82,819	87,778
Clark	238,053	249,956
Multnomah (OR	6 14,065	662,392
TOTAL	**3,426,964**	3,642,876

1.3 ORGANIZATION OF THE TECHNICAL MEMORANDUM

Following this introduction, the technical memorandum is divided into the following four sections:

- Current and Future Transportation Infrastructure: Provides a description of the current and planned highway, transit, rail, and port system along the corridor.

- IVHS infrastructure: Describes the range of current and future IVHS projects and programs taking place within the corridor.

- Current and Future Conditions: Presents current and future travel demand, volumes, and congestion; freight movements; safety information including accidents and emergency response; and weather.

- Initial Identification of IVHS User Service Needs: Provides a preliminary identification of IVHS user services that could be provided along the corridor.

2.0 CURRENT AND FUTURE TRANSPORTATION INFRASTRUCTURE

The Seattle to Portland transportation corridor stretches for nearly 180 miles and provides a significant range of transportation modes including highway, local transit, inter-city bus, freight rail, inter-city passenger rail, ports and airports. Figure 2-l illustrates this range of transportation infrastructure provided along the length of the corridor. The map shows the location of:

- Train Stations;
- Rest Stops;
- Washington State Patrol (WSP) Facilities;
- Ports;
- Major Visitor Information Centers;
- Washington State Department of Transportation (WSDOT) Facilities;
- Weight Stations; and
- Permanent Traffic Recorders.

The remainder of this section describes the current and future transportation infrastructure within the corridor.

2.1 HIGHWAY SYSTEM

2.1 .1 Existing Highway System

The backbone of this transportation corridor is Interstate 5. This freeway serves as the primary highway connection between Seattle and Portland and is a segment of this major interstate route which runs from Canada to Mexico along the west coast of the United States. Figure 2-2 is a reproduction of the Washington Official State Highway Map showing the highway network along the corridor. Table 2-1 provides the geometric characteristics of Interstate 5 from the Columbia River (milepost 0.0) in the south of the corridor to the King-Snohomish County Boundary in the north at milepost (MP) 177.

Starting in the south, I-5 provides a direct north-south route through the Portland Metropolitan area. Approximately 13 miles south of the downtown Portland, I-205 begins an eastern loop around the Portland acting as an import bypass route around the central core of the city. I-84 begins in downtown Portland at I-5 approximately 8 miles south of the Columbia River. I-84 then proceeds east along the south side of the Columbia River. I-84 is the major southern highway route through the Cascade Mountain Range to the east.

I-5 travels through downtown Portland and crosses the Columbia River (state line) via two three-lane bridges entering Clark County. A visitor information center is located just north of this crossing in the northbound direction. I-205 crosses the Columbia six miles to the east of I-5. Washington State Route 14 (SR 14) and SR 500 connects both interstate facilities along the north shore of the Columbia River. I-205, SR 14, and SR 500 could provide diversion routes for traffic from I-5 in response to incidents on the interstate on the north side of the Columbia River.

WDOT0060

SEATTLE TO PORTLAND INTER-CITY IVHS CORRIDOR STUDY
COMMUNICATIONS PLAN

MEMORANDUM

TO: Steering Committee Members

FROM: Bart Cima
Project Manager
David Evans and Associates, Inc.
Bellevue, WA
TELEPHONE NUMBER: 206-455-357 1
FAX NUMBER: 206-455-306 1

DATE: August 31, 1994

SUBJECT: TECHNICAL MEMORANDUM NUMBER 1: SEATTLE TO PORTLAND CORRIDOR TRANSPORTATION NEEDS

Enclosed is a copy of the first Technical Memorandum for this study effort. This document identifies current and future transportation needs with a view toward how IVHS technology can address these needs. This memorandum will serve as the focus of our discussions at the steering committee meetings next week.

I look forward to seeing you soon.

Table 2-1
I-5 – Columbia River to Seattle Geometric Characteristics

SR MP		Project Description		Lanes		TOTL WDTH		MEDIAN		TOTL PAVED RDWY WDTH	CLASS.	SPEED LIMIT
Begn	End	From	To	SB	NB	SB	NB	WD/S	BR			
0.00	0.46	State Line	GORE (S500029)	3	3	36	36	24 Thru 44	JE	72	U5	50
0.46	1.54	GORE (S500029)	End SU Lane	3	3	36	36	24/A	JE	72	U5	55
1.54	1.98	End SU Lane	End SU Lane	4	3	48	36	24/A	JE	84	U5	55
1.98	2.77	End SU Lane	Main St.	3	3	36	36	24/A	JE	72	U5	55
2.77	2.89	Main St.	Uxing	3	2	24	24	16/A	JE	48	U5	55
2.89	7.92	Uxing	GORE (R100803)	2	2	24	24	12 Thru 16	JE	48	U5	55
7.92	8.03	GORE (R100803)	SR 205	2	3	24	36	48/S	DE	60	U5	55
8.03	9.51	SR 205	SR 502	3	3	36	36	48/S	DE	72	U5	55
9.51	40.23	SR 502	Allen St.	3	3	36	36	46 Thru 37	JE,DE,GR	72	R5	55
40.23	40.39	Allen St.	N Kelso Ave	4	4	48	48	48/S	DE	120	U5	55
40.39	40.46	N Kelso Ave	End SU Lane	3	4	36	48	62/S	DE	108	U5	55
40.46	55.15	End SU Lane	MP Marker 55	3	3	36	36	15 Thru 25	JE,DE,GR	72	U5,R5	55
55.15	56.00	MP Marker 55	MP Marker 56	3	2	36	24	15/A	GR	60	R5	55
56.00	100.52	MP Marker 56	Tumwater (City Limit)	2	2	24	24	11 Thru 40	JE,DE,GR	48	U5,R5	55
100.52	101.39	Tumwater (City Limit)	Airdustrial Way	2	2	24	24	40/S	JE,DE	48	U5	55
101.39	101.47	Airdustrial Way		2	3	24	36	16/A	JE	60	U5	55
101.47	104.59		Capitol Lake	3	3	36	36	4 Thru 22	JE	72	U5	55
104.59	106.10	Capitol Lake	Plum St.	3	4	36	48	4 Thru 22	JE	84	U5	55
106.10	107.93	Plum St.	College St	4	4	48	48	22/A	JE	96	U5	55
107.93	108.81	College St	Martin Way	4	3	48	36	22/A	JE	84	U5	55
108.81	123.90	Martin Way	Thorn Ln (On Ramp)	3	3	36	36	12 Thru 48	JE,DE,GR	72	U5	55
123.90	123.94	Thorn Ln (On Ramp)	Thorn Ln (Off Ramp)	3	4	36	48	12/A	JE	84	U5	55
123.94	131.34	Thorn Ln (Off Ramp)	SBCD Lane (On Ramp)	4	4	48	48	12 Thru 16	JE	96	U5	55
131.34	131.35	SBCD Lane (On Ramp)	SBCD Lane (Off Ramp)	3	4	36	48	16/A	JE	84	U5	55
131.35	132.12	SBCD Lane (Off Ramp)	Pedestrian Xing	3	3	36	36	16/A	JE	72	U5	55
132.12	135.26	Pedestrian Xing	Pyullaup River	4	3	48	36	16/A	JE	84	U5	55
135.26	154.67	Pyullaup River	Southcenter Blvd	4	4	48	48	16 Thru 30	JE,DE,GR	96	U5	55
154.67	155.80	Southcenter Blvd	End SU Lane	5	4	60	48	37 Thru 12	JE,DE	144	U5	55
155.80	162.57	End SU Lane	Spokane St (Off Ramp)	4	4	48	48	22 Thru 12	JE,DE,GR	96	U5	55
162.57	162.79	Spokane St (Off Ramp)	Spokane St (On Ramp)	4	3	48	36	30/S	JE	107	U5	55
162.79	163.96	Spokane St (On Ramp)	End SU Lane	3	3	36	36	30/O	JE	108	U5	55
163.96	164.80	End SU Lane	End SU Lane	2	3	22	36	22 Thru 30	JE	69	U5	55
164.80	165.29	End SU Lane	NB Express Lane	3	3	36	36	22/O	JE	72	U5	55
168.29		NB Express Lane		2	3	26	36	20 Thru 22	JE	74	U5	55

Compiled: 30-Aug-94
Source WSDOT – Freeway Lane Summary

At MP 2.9, I-5 is reduced from six lanes to four lanes until it merges with I-205 at MP 8.0, where it expands to six lanes again. Northbound and southbound rest areas are located on I-5 at approximately MP 1 1, and a northbound Washington State weigh station that serves as a port of entry for commercial trucks is found at MP 15.9.

Crossing the Clark County line into Cowlitz County, I-5 remains a six-lane facility. At MP 21, access to the southern portion of the Mount Saint Helens National Volcanic Monument is provided via SR 503. A southbound weigh station is located at MP 44.1 south of Castle Rock. In the Kelso and Longview area, SR 41 could provide a diversion route for I-5 traffic between MP 36 and 49. Exit 49 links I-5 to SR 504 which leads to the Mount Saint Helens National Volcanic Monument and the new Coldwater Visitor Center on the west side of the volcano.

At MP 56 near the Cowlitz-Lewis County boundary, I-5 is reduced from six lanes to four lanes. Four lanes are maintained until south of Olympia at MP 101. This segment of the corridor is the most rural in nature but the volume of traffic it serves keeps the corridor from having the isolated rural road character found on many western interstates east of the Cascade Mountain Range and west of the Rocky Mountains. Rest areas for northbound traffic are found at MP 54 and 90 and for southbound traffic at 54 and 93. SR 503 (Exit 63) links to SR 504 which leads to the Coldwater Visitor Center at Mount Saint Helens for traffic coming from the north. At Exit 68, US 12 links the Windy Rtdge Viewpoint on the east side of the volcano and provides access to the southern entrance to Mount Rainier National Park. US 12 also provides access to White Pass and via SR 123 and 410 to Cayuse and Chinook Passes through the Cascade Mountain Range. These roads are generally two lane rural highways without controlled access. In Lewis County, Chehalis (MP 77) and Centralia (MP 82) are largest towns along this stretch of four lane interstate. SR 507 offers some potential as a diversion route in this segment.

Thurston County begins at MP 85 and ends at MP 1 14 on I-5 and include the cities of Tumwater, Olympia, and Lacey. The Thurston County Department of Public Works has developed a extensive set of I-5 detour routes. These routes cover all the exits from I-5 in the County. Maps showing these detour routes are provided in Appendix A to this technical memorandum. I-5 is a four-lane facility until MP 101 where it widens to a six lane facility. Auxiliary lanes are provided at several locations as shown in Table 2-1 which widen I-5 to four lanes in a single direction for these specific segments. Rest areas for northbound traffic are found at MP 91 and for southbound at MP 93. Exit 88 to US 12 provides a western route to the Pacific Ocean coastal areas. US 101 at Exit 104 is the primary land route to the Olympic Peninsula in northwest Washington. The Olympic Peninsula area includes the Olympic National Park and numerous state parks. Exit 104 also provides access to the ocean beaches. Exit 1 11 to SR 510 is one route to SR 706 which leads east to the southern entrance of Mount Rainier National Park.

Pierce County begins at MP 114 and ends at MP 139 and is the southern county of the Puget Sound Region. Tacoma is the major city in this county. A more detailed map of the area is provided in Figure 2-3. Weigh stations in both the northbound and southbound directions are found at MP 1 17. At the Puyallup River Bridge (MP 135), I-5 expands to an eight lane facility.

Potential I-5 detour points and concerns as indicated by the Olympic Region of WSDOT include:

- MP 1 16 to MP 124: No local parallel roads available because I-5 is passing through the Fort Lewis Military Reservation.
- MP 124 to MP 139: In generally, detours could be provided via local streets.
- Exit 127: SR 512 provides a freeway route to SR 167 and the city of Puyallup. SR 167 is a parallel four-lane freeway facility to the east of I-5 and leads north to I-405 at the south end of Lake Washington.
- Exit 135: SR 167 begins here as an at-grade roadway with intersections. Seven miles to the southwest it links with SR 512 and becomes a controlled access facility.
- Exit 137: SR 99 offers a parallel facility to the west of I-5.

All of these exits and the SR 7 exit (MP 133) offer links to SR 706 and the southern entrance of Mount Rainier National Park. SR 16 at Exit (132) links Kitsap County and the Olympic Peninsula over the Tacoma Narrows Bridge. The Tacoma Dome (enclosed sports and exhibition hall) is located at Exit 133.

The northernmost county in the corridor is King County, which begins at MP 139 and ends at MP 178. The cities of Seattle, Bellevue, Renton, Federal Way, SeaTac, Tukwila and others are located here. As shown in Figure 2-3, the area includes an extensive network of freeways and highways. Major controlled access facilities include:

- SR 18 (MP 142) from I-5 to east of Auburn;
- SR 516 (MP 149) from I-5 to SR 167;
- SR 167, parallel to the east of I-5;
- I-405 (MP 154) provides a bypass route around downtown Seattle to the east around Lake Washington and rejoins I-5 at MP ,182;
- SR 518 (MP 1541 offers access to SeaTac International Airport to the west of I-5;
- SR 509, parallel to the west of I-5 from 188th Street to SR 99;
- SR 599 (MP 156) to SR 99;
- I-90 (MP 164), a major east-west interstate route with a passage through the Cascade Mountain range 52 miles to the east. I-90 also crosses Lake Washington and intersects with I-405. It provides a major connection to the eastern suburbs of Seattle.
- SR 520 provides the northern crossing of Lake Washington and intersects with I-405.

Currently, HOV lanes are provided or under construction on many of these freeways. Almost all of I-5 from MP 147 to MP 183, I-90 from the I-5 interchange west past the I-405 interchange, I-405 from the southern I-5 interchange to north of I-90, and SR 167 south of I-405 for approximately 4 miles have HOV lanes or they are being constructed now.

Major detour points would include:

- Exit 142: SR 18 offers a link to SR 99 which parallels I-5 to the west and SR 167 which parallels to the east. SR 99 is not a controlled access facility in this area.

- Exit 149: SR 516 provides connections to both SR 99 and SR 167.

- Exit 154: I-405 provides a by-pass route to the east and SR 518 offers links to the west.

- Exit 164: I-90 furnishes an eastern link to I-405 over Lake Washington.

- Exit 168: SR 520 provides a route over Lake Washington to I-405.

- Exit 182: This is the northern interchange with I-405.

WSDOT also operates the largest ferry fleet in the United States. This 25-boat ferry system provides passenger and auto service throughout Puget Sound and carries over 23 million passengers per day. The busiest of the 20 different ports served by the ferry system is located in downtown Seattle at the Colman Dock. Access to Colman Dock from I-5 is at Exit **164.**

2.1.2 Planned Improvements

Table 2-2 provides a summary of the programmed highway improvements along the I-5 corridor from the Columbia River to Seattle. The first -page of the table provides the improvements for the WSDOT Southwestern Region (formerly District 4). This region includes the counties of Clark, Cowlitz and Lewis along the I-5 corridor from MP 0.0 to MP 85.5. Major projects of interest in this WSDOT region include:

- Widening the four-lane section from MP 2.61 to MP 8.25 to six lanes;
- Widening the four-lane section from six lanes from MP 55.5 to 85.5;
- Addition of Surveillance, Control and Driver Information (SC&DI) on I-5 from the Columbia River (MP 0) to MP 7.92 and I-205 from the Columbia River to the interchange with I-5.

Table 2-2
Seattle to Portland Programmed Highway Improvements

FUTURE PROJECTS SUMMARY – I-5 CORRIDOR

Mile Post		Juris.	Project Description	Project Category				Constr	Work Description
Beg.	End.	(Distr)		IVHS	SC&DI	HOV	Other	Date	
0.00	0.00	4	Woodland Park & Pool Lot			X		1995	Construct Park & Pool Lot
0.00	0.00	4	District Wide Rocker Bearing Replacement				X	1994	Rocker Bearing Repair
0.40	0.40	4	SR 14 Pedestrian U-xing				X	1994	Construct Pedestrian U-xing
0.00	0.27	4	Or. State Line to N. Pvmt Seat of Int. Bridge		X			Future	HAR, CCTV, VMS, CMS
1.30	1.30	4	Visitor Information Center				X	1994	Parking Revisions and New Access
0.27	1.36	4	Interstate Bridge to Mill Plain		X		X	Future	Ramp Widening, Metering, Bike Route
0.27	83.35	4	Interstate Bridge Approach Repair				X	1994	Restore Bridge End Profiles
1.36	1.79	4	Mill Plain SB Off Ramp to Fourth Plain Blvd		X			Future	HAR, CCTV, VMS, Bike Route
1.92	2.02	4	SR 501 Off Ramp to 33rd Street U-xing		X			Future	HAR, CCTV, VMS, Metering, Bike Route
2.02	2.77	4	33rd Street U-xing to Main St. NB Off Ramp				X	Future	Add NB Lane, Bike Lane
2.61	3.38	4	Burnt Creek Bridge to RR Crossing				X	1995	Widening
2.77	3.00	4	Main St. U-xing Vicinity		X			Backlog	Metering, VMS, Retrofit, CCTV, HAR, Bike Lane
3.00	7.92	4	Main St. Vicinity to SR 205 Vic.		X		X		CCTV, VMS Retrofit, Control Center, Widening P&R Lot, Bike Lane
3.38	4.91	4	RR Crossing to 78th Street				X	1997	Widening and I/C Reconstruction
4.38	6.32	4	NE 78th to Salmon Creek Bridge		X	X	X	Backlog	P&R Lot, Bike Path, Metering, Bypass
4.91	78.38	4	Interstate Rutting Repair				X	1994	Grinding and Paving
2.00	12.5	4	33rd Street U-xing to Carty Rd. U-xing		x		X		Interchange, Med. Barrier, Widening, Metering, Guar Rail, Weigh Station, Slope Rehabilitation
6.3	8.25	4	Salmon Creek to SR 205				X	1999	Widening, Lane Reconstruction
8.25	9.53	4	SR 205 On Ramp to SR 502 Bridge			X	X	Future	I/C Reconstruction, P&R, Aux. Lane, Bike Path
11.00	13.00	4	Gee Creek RV Dump Rehabilitation				X	1994	Improve Dump Station
13.50	13.20	4	Gee Creek Slide Repair				X	1994	Slope Slide Repair
15.04	15.56	4	Ridgefield Weigh Station				X	1995	Parking, Lighting, New Off Ramp
15.50	23.50	4	Weigh Station Vic. To Dike Road Vic.				X		Slope Flattening
18.37	19.87	4	E. Fork Lewis Road to N. Fork Lewis Road				X	1994	PCCP Pavement Rehabilitation
27.50	36.00	4	Todd Road Vic. To Owl Creek Bridge Vic.				X	Future	Median Barrier
38.00	42.00	4	Coweman Road Br. to Pacific Ave. RR Oxing				X	Future	Slope Flattening, Guard Rail
44.50	48.50	4	Weigh Sta. Vic. To Huntington Avenue Vic.				X	Future	Slope Flattening, Guard Rail
55.50	67.50	4	Toutle River Rest Area to SR 12				X	Future	Widening, Bridge Replacement I/C Reconstruction, Guard Rail
72.50	85.50	4	Rush Road Vic. To Lewis/Thurston Co. Line		X		X	Future	Widening, I/C Reconstruction, Signals, Guard Rail, Slope Rehabilitation

Compiled: 28-Aug-94
Source: WSDOT Program Listings

Table 2-2 (cont.)
Seattle to Portland Programmed Highway Improvements

FUTURE PROJECTS SUMMARY – I-5 CORRIDOR

Mile Post		Juris.	Project Description	Project Category				Constr	Work Description
Beg.	End.	(Distr)		IVHS	SC&DI	HOV	Other	Date	
0.00	0.00	3	128th St. SW – 8th to I-5				X	1994	Bike Path, Flyer Stop, Added Ramp Lanes
88.09	95.21	3	SR 12 to Maytown Rd O-xing				X	1996	Pavement Overlay
90.44	95.21	3	Maytown/Scatter Creek Rest area				X	1996	Rest Area Sewer Installation
95.21	93.6	3	Maytown I/C to 93rd I/C				X	Future	Construct Additional Lanes
109.19	116.72	3	Martin Way O-xing to Vic. Mounts/SB				X	1997	PCC Slab Rehabilitation
109.21	111.54	3	Martin Way O-xing to Vic. Mounts/NB				X	1995	PCC Slab Rehabilitation
116.70	135.54	3	Mounts Rd. to Port of Tacoma I/C HOV				X	Future	HOV Widening
119.00	119.02	3	NB ON-OFF Ramps @ Dupont I/C			X		1995	Signalize Intersection
125.60	139.50	3	Tacoma Vicinity TSM Phase I		X			1994	Traffic Systems Management
125.60	139.50	3	Tacoma Vicinity TSM Phase II		X			1994	VMS and Data Stations
125.60	139.50	3	Tacoma Vicinity TSM Phase III		X			Future	Complete Traffic Management Center
125.60	139.50	3	Tacoma Vicinity TSM Phase IV		X			Future	VMS, CMS, Swing Gates, Data Stations
131.08	135.6	3	Interstate Ramps				X	1994	Pavement Repair and Overlay
134.98	135.54	3	Interstate Bridge deck I-5/456 E				X	1994	Bridge Deck Overlay and Railing Repair
135.17	135.54	3	Tacoma Vicinity Bridges				X	1994	Seismic Retrofit
135.52	139.50	3	Puyallup River Bridge to King Co. Line				X	1994	Mainline Overlay
135.54	143.83	3	P. of Tac.I/C to 272nd Vic. NB/320th SB HOV			X		Future	HOV Widening
136.00	139.00	3	Interstate Br. Deck I-5/457 & SR99/400				X	1994	Bridge deck Overlay
136.09	137.92	3	Fife Vicinity - Bridge				X	1994	Seismic Retrofit

Compiled: 28-Aug-94
Source: WSDOT Program Listings

Table 2-2 (cont.)
Seattle to Portland Programmed Highway Improvements

FUTURE PROJECTS SUMMARY – I-5 CORRIDOR

Mile Post		Juris.	Project Description	Project Category				Constr	Work Description
Beg.	End.	(Distr)		IVHS	SC&DI	HOV	Other	Date	
139.50	154.00	1	Overhead Sign and Sign Structure Repair				X	1995	Inspection, Repair, Replace Sign Str. (Stage 2)
139.50	154.00	1	Pierce CL to Tukwila HOV & Climbing Lanes			X	X	1994	Construct HOV and Climbing Lanes
139.50	154.00	1	Pierce CL to Tukwila HOV & Climb.Lns St. 1			X	X	1994	S 188th to Tukwila SB HOV & Truck Climbing Lanes
139.50	154.00	1	Pierce CL to Tukwila HOV Lanes Stage 2			X		1994	SR 516 to S 188th SB Slow Moving Veh. & HOV Lanes
139.50	154.00	1	Pierce CL to Tukwila HOV Lanes Stage 3			X		1995	S 320th to SR 516 SB HOV Lane
139.50	154.00	1	Pierce CL to Tukwila HOV Lanes Stage 4			X		1995	Pierce Co. Line to SR 272nd NB/to S 320th SB
139.50	154.00	1	Pierce CL to Tukwila HOV Lanes Stage 5			X		1997	S 272nd to S 200th NB HOV Lane Rebuild, St. 1
139.50	154.00	1	Pierce CL to Tukwila HOV Lanes Stage 6			X		1996	S 200th to Tukwila I/C NB HOV Lane
140.16	141.19	1	Sea-Tac NB and SB Weigh Stations				X	1994	Improve Weigh Stations
143.33	143.83	1	Federal Way P&R Bus Loading			X		1994	Constr. Aux. Lane, Load. Platform, Exp. Hold. Area
143.33	143.83	1	Federal Way P&R Lot			X		1995	Select Site for P&R Lot #2
143.83	152.50	1	S 320th to E-N Ramp Military Rd-Br. Deck				X	1995	Bridge Deck Overlay
147.64	147.60	1	Star Lake P&R Lot Erosion Cntrl/Revegetate				X	1994	Install Irrigation, Planting and Erosion Control
153.94	155.98	1	Tukwila to Lucille Street (Stage 3)		X	X		1995	HOV, SC&DI, Both Directions
154.00	154.40	1	Tukwila I/C Slope Stability Study				X	Backlog	Slope Stability Study
154.40	161.00	1	Tukwila to Albro Place SC&DI		X	X		Backlog	Constr. SC&DI, HOV Bypass
155.98	158.32	1	Tukwila to Lucille St. HOV, SC&DI (Stage 2)		X	X		1994	HOV, SC&DI Both Dir. (Interurban Ave to Boeing Acc)
158.32	161.85	1	Tukwila to Lucille St. HOV, SC&DI (Design)		X	X		Backlog	HOV, SC&DI SB Only
158.32	161.85	1	Tukwila to Lucille St. HOV, SC&DI (Stage 1)		X	X		1994	HOV, SC&DI SB (Boeing Acc to Lucille St.)
160.70	161.21	1	Swift Ave S and Graham Street Signals		X			1995	Traffic Signal Construction and Rebuild
162.24	173.15	1	Bridge 5/535W SB Viad. to NE 117th Bridge				X	1996	Resurface Selected Bridges on SR 5
165.29	172.41	1	Cherry to NE 103rd – Swing Gates, Signing		X			1995	Replace Swing gates & Signs on Rev. Roadway (St.2)

Compiled: 28-Aug-94
Source: WSDOT Program Listings

The second page of Table 2-2 shows the improvements for the WSDOT Olympia Region (formerly District 3). This region includes the counties of Thurston and Pierce along the I-5 corridor from MP 85.5 to MP 139.5. Significant projects include:

- Widening the four-lane section of I-5 from MP 85.5 to MP 93.6
- Construction of HOV lanes from MP 116.7 to MP 143.8 on I-5
- Installation of SC&DI from MP 125 through MP 139.5 on I-5
- Establishment of a WSDOT Olympia Region Transportation Systems Management Center (TSMC) in Tacoma

The Washington Statewide Multimodal Transportation Plan (November 1993) calls for the widening all of I-5 from MP 85.5 to MP 101 from four lanes to six lanes over the next 20 years.

The programmed improvements for WSDOT Northwest Region (formerly District 1) are provided on the third page of Table 2-2. This region includes King County from MP 139.5 to MP 177 at the King-Snohomish County Border. Major projects include the completion of the SC&DI and HOV network in the region. A more complete description of the SC&DI system is found in the next section of thus memorandum.

The HOV network, when completed over the next 20 years, will be quite extensive. HOV lanes are completed or planned for the length of I-5 within the corridor, I-405, I-90, and SR 167. The Puget Sound HOV Pre-Design Study is currently examining the final elements of this significant transportation investment. This study is investigating the following areas: direct access to the HOV lanes along I-5, I-405 and I-90, freeway-to-freeway connections, and the provision of HOV lanes on SR 509 and SR 522.

2.3 Transit Systems

Bus service between the major cities along the corridor is provided by Trailways, Greyhound, and other smaller carriers. Local transit service is provided for the urbanized areas along the corridor. Table 2-3 lists the transit providers and their service areas. The listed transit providers provide only bus service. Inter-City bus service supplied by these transit providers is found between Seattle and Tacoma and Portland and Vancouver. However, two efforts are underway within the corridor which may result in the addition of light rail and commuter rail service.

In the Puget Sound Region, the newly formed Regional Transit Authority is in the process of finalizing funding and implementation plans for a regional light rail and commuter rail system. Various options are under consideration. All three options under consideration include commuter rail service from Everett south through Seattle to Lakewood, which is south of Tacoma. This service would be provided using the existing rail line (See Figure 2-l). Light rail service is also proposed under the three options, but in various configurations. All options include service south from Seattle to SeaTac. These new rail services would provide increased transit alternatives for urban commuters along the I-5 corridor in the Puget Sound region.

Table 2-3
Seattle to Portland Corridor Transit Properties

Transit Property	Service Area
Metro	Seattle and King County including service to Tacoma
Pierce Transit	Tacoma and Pierce County including service to Seattle
Regional Transit Authority	King, Pierce and Snohomish County (finalizing funding and implementation plans)
Intercity	Olympia and Thurston County
Twin Cities Transit	Centralia and Chehalis
Community Urban Transit Service	Kelso and Longview
CETRAN	Vancouver and Clark County including service to Portland
Tri-Met	Portland and Multnomah County, OR

In the Portland-Vancouver region, a study effort is under way to extend the light rail service **from** Portland to Vancouver, Washington. This service would cross the Columbia River and provide a new transit alternative for travelers between these-two communities.

2.4 Rail System

2.4.1 Passenger Rail Service

The U.S. Department of Transportation (USDOT) has designated the rail corridor from Eugene, Oregon to Vancouver, British Columbia as one of the five national high speed rail corridors for passenger trains. WSDOT has taken the lead in seeking funding, the participation of railroads (Burlington Northern and AMTRAK) and local jurisdictions in upgrading the rail infrastructure, terminals and service in the corridor, particularly from Seattle to Vancouver, BC and Seattle to Porttand. Over $40 million will be spent between 1993 and 1995 within Washington State for improvements along the length of the rail corridor. An additional $200 million has been requested through 1999.

Currently, there are four round trips per day between Seattle and Portland with an increase to six per day planned by 1999. Stations are located, from north to south at the following cities:

- Seattle;
- Tacoma;
- Olympia (Lacey);
- Centralia;
- Kelso;
- Vancouver; and
- Portland.

Figure 2-1 shows the locations of these stations. This inter-city passenger rail service is provided on the same tracks as the proposed commuter rail service in the Puget Sound Region. For each of these stations, the railroad has given local jurisdictions the title to these facilities. These stations are being converted into multi-modal terminals to link rail service to other locally available transit service. As noted above, each of these cities has existing bus transit systems in operation. This improved rail service will provide an attractive alternative for inter-city travelers in the Seattle to Portland corridor.

2.4.2 Freight Rail Service

The State of Washington is served by two major rail carriers: Burlington Northern (BN) and Union Pacific Railroad (UP). While both railroads operate within the state, the state's mainline rail system is primarily owned by the BN with UP given rail operating rights on key sections. The BN-Seattle to Portland route is basically a double-track railroad of 186 miles in length. The maximum current timetable speed for freight trains is 50 mph and there are over 140 at-grade crossings. Figure 2-l shows this main rail line. This rail link is the most heavily used in the state with over 60 mlllion gross tons per mile annually. The amount of through freight, local freight, yard operations, and passenger service place heavy demands on this line.[1]

2.5 Ports

As expected, the State of Washington is the site of many excellent port facilities. Figure 2-l shows their location of these key freight transportation facilities which include:

- Seattle;
- Tacoma;
- Olympia;
- Centralia;
- Chehalis;
- Longview;
- Kalama;
- Woodland;
- Ridgefield;
- Vancouver; and
- Portland.

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[1] **<u>1991 Washington Ports and Transportation Systems Study, Technical Report,</u> prepared for the Washmgton Public Ports Association and the Washington State Department of Transportation by BST Associates.**

The ports are and will remain a significant generator of freight traffic along the corridor. In 1990, the Ports of Seattle, Tacoma, and Portland accounted for a total of 29.5 percent of all the west coast container shipments with growth expected at up to 4.7% per year. In 1990, the Puget Sound ports generate 1 .1 million truck movements and this is expected to grow to nearly 1.4 million by 2010. Movements by rail are also significant. For the Puget Sound ports, there were 272,000 railcars movements in 1990. These movements are forecasted to reach between 556,000 and 667,000 by 2010. Direct and adequate access by both rail and highway will remain a key issue in maintaining the viability of these ports.

3.0 IVHS INFRASTRUCTURE

The Washington State Department of Transportation (WSDOT) is a recognized leader in the development and implementation of advanced technology for transportation. Building upon these early efforts, WSDOT has developed a strategic plan for implementing IVHS within the state. The implementation of this plan is the goal of a program called ***Venture Washington.*** This statewide program promotes the application of advanced technology to the tasks of improving highway safety, personal mobility, environmental quality, and roadway operating efficiency. The strategic plan addresses the next twenty years and beyond. Many of the actions planned are continuations of existing efforts and others will be developed and implemented over the next twenty years. This project is one effort under the Venture Washington program.

The remainder of this section briefly describes the current and near-term planned IVHS activities which have a direct bearing to the Seattle to Portland corridor. This section will not cover all of the various IVHS projects and research efforts underway by WSDOT'. Figure 3-1 provides a summary of regional IVHS components for the entire state as well as the corridor. This figure demonstrates the wide range of IVHS activities currently underway throughout the state.

3.1 PUGET SOUND REGION

The Puget Sound Region has been the traditional location for the majority of WSDOT IVHS efforts. This is a natural evolution of their initial efforts at freeway traffic management in Seattle and the surrounding communities. The IVHS Strategic Plan calls for a focus on projects in this region which support traffic management and encourage the use of alternative modes. The highest rated elements of the IVHS action plan for this region include:

- Traffic Control;
- Pre-Trip Planning;
- En Route Trip Guidance;
- Incident Detection and Management;
- Freeway Ramp Metering;
- Transportation Demand Management Support; and
- Road Pricing Support.

The Regional IVHS Action Plan for Central Puget Sound is found in Appendix B.

3.1 .1 WSDOT Activities

The basis of the current WSDOT Northwest Region IVHS efforts center around its extensive surveillance, control and driver information (SC&DI) system. The SC&DI system includes roadway loop detectors, ramp metering, closed circuit television (CCTV), variable message signs (VMS), and highway advisory radio (HAR). Figure 3-2 shows the current, planned, and

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[2] **Those seeking a more detailed descriptlon of all WSDOT IVHS activities are referred to the monthly Venture Washington status report which is available from the Advanced Technology Branch at 206-543-3331.**

recommended coverage for the Puget Sound Region freeway system. Figure 3-3 provides the location for each VMS in the region and Figure 3-4 indicates the sites of HAR installations.

The system is controlled from a central computer located at the **Traffic Systems Management Center (TSMC)** in north Seattle. The customized software running on the VAX computer provides operators with real time roadway sensor data and the ability to access and control the various elements of the SC&DI system. Ramp metering and data collection sites are locally linked to Type 170 controllers in roadside cabinets. The central computer polls each of these locations every 20 seconds to retrieve volume, occupancy, and status data.

As shown on Figure 3-2, the SC&DI network will be expanded south along I-5 into Pierce County over the next several years. This segment of I-5 is within the **WSDOT Olympic Region.** Figure 3-5 shows initial system for I-5 in the Tacoma area. A second TSMC will be constructed in Tacoma for the management of traffic in this WSDOT region. The TSMC in Tacoma will be connected to the TSMC in Seattle to facilitate the sharing of information and data.

The logical expansion of the current system is to develop links between the TSMC freeway based system and adjacent traffic control systems to share loop and operational data to improve operations across jurisdictional boundaries and between adjacent systems. The **North Seattle Advance Traffic Management** System will obtain data from both freeway and arterial traffic control systems in the I-5/SR 99 corridor in north King County and south Snohomish County. The data will be collected by a separate microcomputer through communications links with street traffic control masters or centralized traffic control computers. This WSDOT project is scheduled to be completed in two years.

A prototype microcomputer-based system has been developed to receive real-time traffic data from the TSMC and to display this information to show travel time by route. The system , called **Traffic Reporter,** is being expanded to include coverage of all the Seattle-area freeways and to include separate travel time data for HOV lanes. This system provides the beginnings of a pre-trip information system for travelers.

IVHS Backbone Design and Demonstration Project has designed a demonstration architecture for a regional IVHS backbone for the Puget Sound area and will demonstrate how different types of data gathered from different agencies can be integrated into a single application. The system architecture follows a open systems model that supports a distributed computing environment. Links have been developed to the WSDOT TSMC and transit bus Automatic Vehicle Location (AVL) system operated by Seattle Metro. Applications have been developed to display congestion and AVL information on an Xterminal anywhere on the Internet. This WSDOT-sponsored system could serve as the regional model for sharing travel information.

3.1.2 Advanced Public Transportation Systems

The Puget Sound Region has developed and is planning several advance public transportation systems to improve bus fleet operations and to provide riders with information on transit services. Projects of interest include:

- **Metro Automatic Vehicle Location (AVL) System:** The Metro AVL system marries a geographic information system (GIS) with signpost-mounted transmitters and route schedule information. The system polls the bus fleet every 30 seconds to retrieve odometer and the identification code of the last transmitter encounters. This information is used to determine the location of the bus.

- **Automated Customer Trip Planning:** Metro is in the process of designing and implementing a computerized system to assist customers in planning public transportation trips throughout King, Pierce and Snohomish Counties. Customers would be able to directly access transit and other ridesharing information via kiosks and personal computers.

- **Puget Sound Automatic Vehicle Identification System for Transit Signal Priority:** Metro is leading a procurement effort to design, procure, deploy, and test an AVI system to support transit signal priority on arterial streets. One goal of the project is to reach a regional consensus on an AVI system for King, Pierce and Snohomish Counties. Notice to proceed is scheduled to be issued in late 1994.

- **Community Transit Bus Priority System:** Snohomish County, through its transit authority, Community Transit, was awarded $1.5 million to expand its bus priority signal system. This project will be coordinated with the **North Seattle** ATMS project where they both overlap along SR 99.

- **Bellevue Smart Traveler:** This project has developed a prototype traveler information center designed to increase the use of transit and ridesharing by downtown Bellevue office workers. Users can access the system through touch-tone telephone, electronic mail and pagers. This project also experimented with dynamic ridesharing where Carpool opportunities could be offered or requested in real time over the system.

3.1.3 Demonstration Projects

The Federal Highway Administration (FHWA) periodically solicits proposals from public and private consortiums to participate in its IVHS Operational Test Program. This program is designed to evaluate computer system concepts, technologies, and institutional and financial arrangements that hold the promise of improving mobility and transportation productivity, enhancing safety, and reducing congestion on the Nation's highways. WSDOT has been selected to participate in the following three test programs:

- **TRAVELAID:** Thrs project is designed to enhance safety on freeways through the display of variable speed limits and other safety messages on traffic and roadway conditions. These messages will be presented on variable message signs and in-vehicle equipment. The system will be installed on 40-mile section of I-90 approximately 40 miles east of Seattle. The demonstration is scheduled to be operational during 1995.

- **PuSHme (Puget Sound Help Me):** The primary goal of this operational test is to assess the operational, institutional, and technological requirements for the implementation of a regional mayday system that allows a driver to send an immediate notification of a problem, car's location and the need for assistance to a response center. Additionally, this test will assess the requirements for a response center to provide timely and appropriate levels of assistance and the feasibility for implementation on a statewide or national basis. Field testing should occur during 1995.

- **SWIFT (Seattle Wide-area Information For Travelers:** This project will test the use of FM sideband data system to deliver traffic and transit information to a variety of electronic devices. Devices will include watch pagers, special car radios, and personal digital assistants. Testing is scheduled for 1995.

3.1.4 Public Private Initiatives in Transportation

Substitute House Bill 1006 (SHB 1006) provides for WSDOT to allow private entities to plan, design, develop, finance, acquire, Install, construct, improve, operate, and maintain capital related transportation systems and facility projects. In response to a solicitation for potential projects, WSDOT received 14 proposals from 11 private consortiums. In August, 1994, six of the projects were chosen for further consideration. Five of these projects involve the tolling of Puget Sound area highways. Figure 3-6 shows their location. One project involves the converting existing underutilized HOV lanes to "Fare Lanes." Buses and Carpools will continue to ride free while low occupancy vehicles may make use of excess capacity by paying a toll. Each project will make extensive use of AVI technology to collect these tolls. All of these projects are just starting and must go through the same approval process as any other state transportation project. The implication for IVHS in the Puget Sound Region are:

- The majority of regional vehicles could eventually be equipped with AVI devices which would allow them to be used as traffic probes.
- Congestion pricing could be implemented.
- Additional SC&DI coverage will most likely be provided as part of the project.

3.2 PORTLAND-VANCOUVER REGION

The Portland-Vancouver region includes the two states of Washington and Oregon and the attendant double set of planning, programming, and implementation requirements. Both WSDOT and Oregon Department of Transportation (ODOT) are working together to coordinate their efforts on either side of the Columbia River.

3.2.1 WSDOT Activities

The Washington State IVHS Strategic Plan in this region calls for a focus on projects which support traffic management and provision of better information to travelers. The highest rated elements of the IVHS action plan for this region include:

- Traffic Control;
- Pre-Trip Planning;
- En-Route Trip Guidance;
- Incident Detection and Management; and
- Freeway Ramp Metering.

The Regional IVHS Action Plan for Vancouver is found in Appendix C. This action plan calls for close cooperation with activities in Portland and that the improved flow of commercial goods across the border and from the Port of Vancouver will benefit from IVHS technology.

Current plans call for the addition of SC&DI on I-5 from the Columbia River (MP 0) to MP 7.92 (north of I-205 interchange) and on I-205 from the Columbia River to the interchange with I-5. A TSMC would most likely be established at the WSDOT Southwestern Region offices in Vancouver.

3.2.2 Portland Regional ATMS

In 1993, a regional planning effort was undertaken to develop master plan for the implementation of a Portland Regionwide Advanced Traffic Management System (ATMS). The project steering committee Included representatives of from ODOT, WSDOT, FHWA, Portland, and METRO (Metropolitan Planning Organization). ATMS integrates the management of various roadway functions including freeway SC&DI and arterial signal control. This project develop an 18-year implementation plan reproduced from the study report as Figure 3-7. The plan called for the establishment of a centralized Traffic Management Operation's Center (TMOC). The TMOC would be the center for communications among agencies in both Washington and Oregon. The regional Transportation Improvement Plan has allocated $6.25 million for implementation of all aspects of this plan.

3.2.3 Advanced Public Transit Systems

Tri-Met has begun projects involving traveler information systems, transit priority in signal operations, and a system wide AVL system. The Tri-Met AVL system will employ GPS technology instead of the signpost beacon approach used by Metro in Seattle. All Tri-Met buses will be equipped with AVL devices. Besides providing transit bus location information, the GPS technology will be able to provide speed Information. Tri-Met's buses could be used as traffic probes, particularly on express routes.

3.3 INTER-CITY

IVHS requirements for an inter-city or rural setting vary considerably from the urban areas of Washington. The Washington State IVHS Strategic Plan supports a different focus centered around the following elements:

- Incident Detection and Management;
- En-Route Trip Guidance;
- Pre-Trip Planning;
- Freight and Fleet Regulatory Support; and
- Traveler Safety and Security.

The IVHS Action Plan for Inter-City/Rural areas is found in Appendix D.

These conclusions have been reenforced by two recent rural IVHS studies. Interim results from a FHWA study on Rural Advanced Traveler Information Systems (ATIS)[3] indicated that travelers were most concerned with receiving information while en-route when a problem arises. They were interested in the ability to signal for help during an emergency (mayday) and to be warned of approaching hazards. The second rated area of interest was pre-trip planning information with a desire to obtain information on trip routing, road conditions, travel time, weather and en-route facilities. The need for information en-route when no problems were encountered was a distant third.

As part of the Minnesota Rural IVHS Scoping Study[4], an assessment of rural Minnesota travelers' needs was conducted. The study matched IVHS user services against traveler needs identified during nine regional meetings held throughout the state. The effort indicated a traveler interest in safety related services and equipment, en-route driver advisory information, and commercial vehicle operation services.

3.4 COMMERCIAL VEHICLE OPERATIONS

Commercial vehicle operations (CVO) look to advanced technology to increase safety, improve productivity, and speed regulatory compliance. Washington was one of the participants in the first FHWA sponsored operational test of a CVO application under the multi-state Heavy Vehicle Electronic License Plate (HELP) program. The Crescent Demonstration Project deployed weigh-in-motion (WIM), AVI, and automatic vehicle classification (AVC) at over 40 sites from British Columbia along I-5 through California and then eastward along I-10 into Texas. Nearly 4,200 trucks were equipped with AVI devices during the demonstration period. The project confirmed to both the public and private sector the utility, of allowing AVI equipped commercial vehicles to have their safety status, credentials and weight checked at mainline speeds. Vehicles within the weight limits and with proper credentials could then bypass the weigh stations without stopping. A quasi-public institution called HELP, Inc has

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[3] Rural ATIS Study: Interim Findings, Prepared for FHWA by JHK & Associates, January. 1994.

[4] An Assessment of Rural Minnesota Traveler's Needs, FInal Report, Prepared for Minnesota Guidestar by Castle Rock Consultants, April, 1994.

been formed to market this and other CVO services to the trucking industry for a fee. The initial mainline pre-clearance are being installed at several California weigh stations.

Oregon Department of Transportation and Public Utility Commission have been testing a wide range of technologies to improve the operation and regulation of commercial vehicles traveling in Oregon. The strategic plan for CVO in Oregon calls for the construction and operations of automated heavy vehicle monitoring system at the weigh stations, port of entry and other highway locations. The system would allow pre-cleared vehicles to by-pass these check points and avoid delay. The State would improve safety and reduce tax evasion.5

Beyond these primarily government lead actions, many private shipping firms have invested in fleet management and shipment tracking systems to enhance the productivity and competitiveness of their operation. The United Parcel Service (UPS) and Federal Express package tracking systems are two often cited examples. One of the tenants at the Port of Seattle, American Presidential Line (APL) has used AVI technology to track the location of cargo containers within their storage yards. However, APL's application was not used to track shipments once they left the yard.

3.5 OTHER TRAVELER SERVICES

A significant portion of the travelers in the corridor are taking advantage of the recreational opportunities found within Western Washington. As described in Section 2.2 Highway System, the corridor provides access to Rainier National Park, Olympic National Park, Mount Saint Helens National Volcanic Monument, Pacific Ocean beaches and numerous state and private camping grounds. Tourism is a significant source of income for the counties along the corridor. Table 3-2 provides the esttmated dollars spent by tourist in each county by type of accommodation and for the entire state. King County, as expected, is the largest generator of tourism and travel dollars in the corridor and the state with a total of $3.3 billion in 1991. Camping-represents a significant generator of income all of the counties and almost equals hotel related income in Lewis County. Finally, informal surveys by the Tourism Development Division has found that the majority of tourists are from the State of Washington. Information that aids travelers in finding accommodations, shopping and local attractions could be of significant value.

The State of Washington has begun a pilot test program to provide better access to government information and records. The Washington Information Network (WIN) provides full time, self service access to information from more than 20 government agencies though interactive kiosks. This kiosks resemble ATM machines and provide easy to use touch screens with graphics and sound to guide the user through the system. Information is provided on such topics as recreation, vehicle registration information, education, employment, health and social services. Ten kiosks have just been deployed across the state. After this pilot program, the plan is to deploy additional kiosks in shopping malls, grocery stores, libraries, government-offices and some schools across the state. This network could offer another mechanism to provide traveler information.

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5 **Strateglc Plan IVHS/CVO In Oregon, Prepared by the Oregon Department of Transportation and Public Utility Commisslon, July, 1993.**

Table 3-1

1991 Travel Expenditures by Type of Accommodation

County	Hotel	Campground	Private Home	Day Travel	Unallocated	Total
King	$1,192,675	$27,278	$413,480	$387,424	$1,319,956	$3,340,813
Pierce	$104,738	$16,224	$161,876	$73,747	$11,206	$367,791
Thurston	$20,630	$10,458	$33,308	$20,171	$5,270	$89,837
Lewis	$17,352	$15,891	$22,664	$16,187	$47	$72,141
Cowlitz	$24,967	$7,573	$31,281	$17,535	$317	$81,673
Clark	$42,034	$1,636	$49,624	$26,265	$364	$119,923
Corridor Total	$1,402,396	$79,060	$712,233	$541,329	$1,337,160	$4,072,178
	34.44%	1.94%	17.49%	13.29%	32.84%	100.00%
State Total	$2,310,700	$436,200	$1,336,100	$1,032,400	$1,459,100	$6,574,500

Source. Washington State: Travel Impacts 1992, prepared for the Department of Trade and EconomicDevelopment, Tourism Development Division, by Dean Runyan Associates,November, 1993

4.0 CURRENT AND FUTURE CONDITIONS

This section describes the current and future conditions on the Seattle-to-Portland corridor including traffic volumes, levels of congestion, truck traffic, corridor safety including accidents, roadside assistance, and emergency response, weather, and the availability of other traveler service providers in the corridor. This section is intended to provide a framework for assessing the IVHS needs of the corridor as they relate to transportation operations.

4.1 CURRENT TRAVEL DEMAND

4.1 .1 Puget Sound Area

Within the limits of the project, traffic volumes are the highest in the Puget Sound region. The Puget Sound portion of the study area stretches from Olympia on the south to the King/Snohomish County line on the north. This portion of the project is about 73 miles in length and passes through the following cities:

- Olympia
- Lacey
- Fort Lewis
- Tacoma
- Fife
- Federal Way
- Kent
- Des Moines
- SeaTac
- Tukwila
- Seattle

This section of the corridor traverses three counties: Thurston, Pierce, and King.

Current average annual daily traffic (AADT) volumes (1993) range from 202,000 vehicles per day near the SR 518 interchange (MP 155.1) to 94,000 vehicles per day at the SR 101 interchange (MP 104.8). Directionally, daily traffic volumes on this section of the corridor are evenly split north and southbound. Table 4-l gives the monthly variations for three urban permanent traffic recorder (PTR) locations along the corridor.

Table 4-1
Monthly Variations - Daily Traffic Volumes
Puget Sound Area

	PTR 837 MP 136.8 Puvalluo	PTR 809 MP 148.1 SR 516	PTR P3 MP 176.8 NE 175th St.
Jan	91.7%	92.6%	94.3%
Feb	96.2%	98.0%	102.0%
Mar	101.0%	103.1%	105.3%
Apr	102.0%	105.3%	107.5%
May	103.1%	105.3%	107.5%
Jun	107.5%	108.7%	109.9%
Jul	111.1%	112.4%	111.1%
Aug	111.1%	113.6%	112.4%
Sep	106.4%	107.5%	108.7%
Oct	102.0%	104.2%	105.3%
Nov	101.0%	101.0%	101.1%
Dec	96.2%	98.0%	97.1%
1993 AADT -	**151,000**	160,000	

The PM peak hour is the highest hourly volume on a typical weekday. In the Puget Sound region, the PM peak hour occurs in the 3:30-6:30 PM time frame. PM peak hour volumes range from a high of 17,170 vehicle per hour at the SR 5 'I 8 interchange to 9,306 vehicles per **hour** at the SR 101 interchange. PM peak hour volumes in this section of the corridor represent about 8.5 percent of the AADT volumes. Directionally, north of Tacoma and south of Seattle, 64 percent of the peak hour volume is in the southbound direction during the PM peak hour.

1993 AADT and PM peak hour traffic volumes along the corridor are shown in Figures 4-1 and 4-2. The directional factor 'D' is also given. It represents the percent of traffic for the highest volume direction. Although not given, it is reasonable to assume that direction is away from the city centers.

A typical way to measure the operational characteristics of a roadway is to examine the relationship of the traffic volume using the road to its capacity. The resulting volume to capacity (v/c) ratio can then be used to quantify the congestion on the corridor. Low v/c ratios signify low congestion and few operational problems. With a low v/c, travel speeds remain at or near the posted speed limit, maneuvering or lane-switching is unimpeded, and driver comfort is high. High v/c ratios would indicate that significant congestion would be present and that operational difficulties would exist. A v/c of 1 .O signifies capacity (although it can be greater than 1 .O under forced flow). When capacity is exceeded, travel speeds are very low, stop and go traffic conditions can prevail, maneuvering is difficult, and minor perturbations to the system, such as accidents or stalled vehicles, can cause total system failure. During such periods, driver comfort is low.

The capacity of a freeway is dependent prrmarily on the number of lanes and their widths, the design speed of the facility, the terrain through which the road is traveling (a road with steep grades has less capacity than one which is flat), the presence of heavy vehicles in the traffic stream, and the types of drivers using the road (a road used primarily by commuters has higher capacity than one used by non-commute traffic). Table 4-2 correlates the v/c ratio with the level of service and degree of congestion.

Table 4-2
V/C Ratio & Level of Service

Level of Service	V/C Ratio	Congestion Level
LOS A	<30%	Uncongested
LOS B	<45%	Slightly Congested
LOS c	< 65%	Moderately Congested
LOS D	<85%	Congested
LOS E	<95%	Highly Congested
LOS F	>95%	Extremely Congested

The WSDOT Transportation Planning Section has calculated the v/c ratio at large number of points along the corridor. These calculations were done using the 1990 design hour (PM Peak) volumes and therefore should be considered conservative. Figure 4-3 and 4-4 shows the v/c ratio at selected locations along the corridor.

As can be seen from Figures 4-3 and 4-4, there are numerous locations within the Puget Sound area where the capacity of the roadway is exceeded. Most significant 1990 congestion occurred north of SR 512 as evidenced by the preponderance of v/c ratios exceeding 0.95. Although some roadway improvements have taken place along the corridor since then, it is likely that the 1993 v/c ratios are similar or slightly worse.

The worst v/c ratio occurs at near the NE 145th Street interchange (MP 175.1) where the 1990 DHV v/c ratio was 1.46. Presumably this is in the northbound direction where the PM peak hour traffic exiting the I-5 express lanes merges the normal northbound- I-5 traffic stream. Significant congestion occurs regularly in this area. The best v/c ratios occur at the southern end of the Puget Sound area north of the Plum Street interchange (MP 106.2) where the v/c ratio is 0.54.

4.1.2 Inter-City

The inter-city portion of the project is defined by the SR 101 interchange (MP 104.8) on the north and the City of Kelso (MP 40) on the south. This section of the project contains the lowest traffic volumes in the corridor. The inter-city section of the project is about 64 miles in length and passes through the following cities:

- Kelso
- Castle Rock
- Chehalis
- Centralia
- Tumwater

This section of the corridor traverses three counties: Cowlitz, Lewis, and Thurston.

Current average annual daily traffic (AADT) volumes (1993) range from 50,000 vehicles per day near the SR 121 interchange (MP 99.7) to 33,000 vehicles per day at the SR 504 interchange (MP 50.4). Directionally, daily traffic volumes on this section of the corridor are evenly split north and southbound. Table 4-3 gives the monthly-variations for one permanent traffic recorder (PTR) location along this section of the corridor. As can be seen by comparing the monthly variation for the inter-city location with those in Figure 4-3 for the Puget Sound area, traffic volumes on this section of the corridor are much more seasonal and peak during the summer months.

Table 4-3
Monthly Variations - Daily Traffic Volumes
Inter-City Area

	PTR R-19 MP 86.3 SR 12
Jan	76.3%
Feb	81.3%
Mar	86.2%
Apr	90.1%
May	92.6%
Jun	100.0%
Jul	103.1%
Aug	107.5%
Sep	97.1%
Oct	91.7%
Nov	94.3%
Dec	84.8%
1993 AADT	44,700

PM peak hour volumes range from 5,341 vehicles per hour at the 13th Street interchange in Chehalis (MP 77.0) to 3,597 vehicles per hour at the SR 504 interchange. PM peak hour volumes in this section of the corridor represent about 10.9 percent of the AADT volumes. Directionally, 59 percent of the peak hour volume is traveling in the peak direction.

1993 AADT and PM peak hour traffic volumes along the inter-city section of corridor are shown in Figure 4-5. The directional factor 'D' is also given. It represents the percent of peak hour traffic for the highest volume direction, which probably is away from the city centers.

As with the Puget Sound area, v/c ratios for this section of corridor was plotted versus the mileposts. This data is shown in Figure 4-6. As can be seen from this figure, the roadway is operating well below capacity for most of the section. In the north Tumwater area (MP 104.1), the v/c ratio is 0.91, which is the highest in this section. For the most part, this section of the corridor operates at level of service C or better. Since 1990 traffic volumes have increased and it is likely that the 1993 v/c ratios are slightly worse.

4.1.3 Portland-Vancouver Area

The Portland-Vancouver area is defined on the north by the City of Kelso (MP 40) and on the south by the Washington/Oregon State Line IMP 0.0). This section of the project contains the moderate traffic volumes in its north section and high traffic volumes in its south end. The Portland-Vancouver section of the project is about 40 miles in length and passes through the following cities:

- Kalama
- Woodland
- Vancouver

This section of the corridor traverses two counties: Cowlitz, and Clark.

Current (1993) average annual daily traffic (AADT) volumes range from 35,000 vehicles per day south of the SR-205 interchange (MP 8.0) to 105,170 vehicles per day at the Washington/Oregon State Line (MP 0.0). Directionally, daily traffic volumes on this section of the corridor are evenly split north and southbound. For instance, at PTR 45 (MP 20.7), the northbound AADT volume in 1993 was 23,887 vehicles per day while the southbound AADT was 22,600 vehicles per day. Table 4-4 gives the monthly variations for this permanent traffic recorder (PTR) location along with another PTR located on a nearby interstate bypass route, I-205. This PTR is located a short distance east of I-5 in the Vancouver Metropolitan area. Comparing the monthly variation of the two shows that the freeway system in the Portland-Vancouver area is much more commute oriented based upon the fairly flat differences between months. Traffic at PTR R-45 has a much more rural nature in that peaking occurs during the summer months, when recreational travel is high.

Table 4-4
Monthly Variations - Daily Traffic Volumes
Portland-Vancouver Area

	PTR R-45 MP 20.7 SR 503	PTR 51 SR 205 MP 29.09 Vancouver
Jan	75.8%	90.9%
Feb	81.3%	96.2%
Mar	88.5%	100.0%
Apr	89.3%	101 .0%
May	91.7%	103.1%
Jun	99.0%	106.4%
Jul	108.7%	109.9%
Aug	111.1%	111 .1%
Sep	99.0%	106.4%
Oct	91.7%	103.1%
Nov	93.5%	101 .0%
Dec	86.2%	102.0%
1993 A-ADT	45,200	67,700

PM peak hour volumes range from 7,560 vehicles per hour at the State Line to 3,780 vehicles per hour south of the SR 205 interchange. PM peak hour volumes in this section of the corridor represent about 10.8 percent of the AADT volumes. Directionally, 5 1 percent of the peak hour volume is traveling in the peak direction, although at the state line 61 percent of the peak hour travel is in the peak direction.

1993 AADT and PM peak hour traffic volumes in the Portland-Vancouver section of corridor are shown in Figure 4-7. The directional factor ‘D’ is also given. It represents the percent of peak hour traffic for the highest volume direction,,which probably is away from the city centers.

As with the other areas, v/c ratios for this section of corridor was plotted versus the mileposts. This data is shown in Figure 4-8. Based-upon the 1990 v/c ratios, this section of the corridor is operating well below capacity. The highest v/c ratio occurs at MP 2.8 where about 80 percent of the capacity is utilized. In most other areas, level of service C or better during the design hour is the norm.

4.2 FUTURE TRAVEL DEMAND

4.2.1 Puget Sound Area

The WSDOT Transportation Planning Section estimates that in the next 20 years, traffic in the Seattle area will grow at about 2.7 percent per year, the Tacoma area traffic would grow at about 2.9 percent per year, and traffic in the Olympia-Lacey area would grow at a rate of 3.2 percent per year. This is slightly higher than the rate which was derived in the *High Speed Ground Transportation Study,* Gannett-Fleming, 1992. That study predicted that automobile traffic on the I-5 corridor would grow about 1.7 percent per year, without HSGT, through the year 2020. This growth rate is also higher than that predicted in the *FEIS Regional Transit System Plan,* March 1993. The RTP projects a 78 percent growth in traffic between 1990 and 2020, an annual growth rate of 1.9 percent.

Figures 4-9 and 4-10 show the projected year 2012 daily and PM peak hour traffic volumes in the Puget Sound area. The highest project daily volumes on this section of the corridor would occur at near the SR 518 interchange in Tukwila where the 2012 AADT would be about 337,200 vehicles per day. This location would also have a PM peak hour volume of 29,460 vehicles per hour (total roadway). In general, traffic volumes along the corridor would increase dramatically. The lowest AADT in the year 2020 for this section of the corridor would be south of the SR 101 interchange in the Olympia area with-a volume of 170,300 vehicles per day. This volume exceeds the majority of the current AADT's in the Puget Sound region.

Figures 4-l 1 and 4-12 plot the year 2012 v/c ratios against mileposts. During the 2012 PM peak hour, the complete Puget Sound area of the I-5 corridor would operate well beyond capacity. With v/c ratios as high as 2.24 (MP 133.5), significant congestion would occur with spreading of the peak hours throughout the afternoon a certainty. It should be noted that the capacities used are for the current road system. Future improvements to the system would occur, boosting the capacity and lowering the v/c ratio.

High speed ground transportation, high speed rail, regional transit service, improved passenger rail, and additional air service may alleviate some of the traffic growth by offering alternative modes of travel. For example, the HSGT study predicts that by the year 2020 about 2.6 percent of automobile trips on the corridor would divert to HSGT (185 mph vehicle speed) if it was available. Similar mode shifts would occur with new or increased service on the other alternative modes. However, it is unlikely that the decrease in automobile traffic would be sufficient to lower traffic volumes significantly.

4.2.2 Inter-City

In the inter-city area, traffic-volumes are predicted to grow by about 2.4 percent per year in the Kelso/Longview area, by 2.1 percent per year between Castle Rock and Tumwater, and by 3.2 percent per year in the Tumwater area. Figure 4-13 shows the year 2012 daily and PM peak hour traffic volumes for the inter-city portion of the corridor.

In 2012, the daily traffic volume at the SR 121 interchange (MP 99.7) would be about 74,630 vehicles per day. The PM peak hour volume at this location would be about 7,190 vehicles per hour. The lowest daily volume would occur near the SR 504 interchange (MP 50.4) where about 51,650 vehicles per day would exist in 2012. At that location in the PM peak, there would be 4,320 vehicle per hour using I-5.

Figure 4-14 shows the year 2012 v/c ratios for this section of the corridor. In general, 2012 v/c ratios would be less than 0.95 for most of this section. Portions of I-5 between Chehalis and Centralia and in the Tumwater area would operate near or over capacity. In those locations significant congestion would occur, however it would be likely be of short duration since the v/c's are generally less than 1.2. It should also be noted that plans exist for adding a third lane to those sections which are not currently three lanes wide.

As with the Puget Sound region, development of alternative modes has the potential to reduce the future traffic volumes on the I-5 corridor. High speed ground transportation, high speed rail, improved passenger rail, and additional air service may alleviate some of the traffic growth. The HSGT study predicts that by 2020 as much as 2.6 percent of automobile trips on the corridor would divert to HSGT if it was available. Similar mode shifts would occur with increased service on the other modes. However, it is unlikely that the decrease in automobile traffic would be sufficient to lower traffic volumes significantly.

4.2.3 Portland-Vancouver Area

Traffic in the Portland-Vancouver area is projected to increase by about 3.2 percent from the State Line to MP 20.8 and then by about 2.4 percent per year north of that point. Figure 4-l 5 shows the 2012 daily and PM peak hour volumes in the Portland-Vancouver area of the corridor. These growth rates are slightly higher than those predicted in the *Bi-State Transportation Study,* Kittleson and Associates, Inc., November 1992. That document predicts that traffic across the Columbia River at Vancouver would increase at a rate of about 1.9 percent per year.

The highest volumes would continue to exist at the State Line (MP 0.0) where the daily volume would be about 190,550 vehicles per day with a PM peak hour volume of 12,820 vehicles per hour. The lowest volume would exist south of the SR 205 interchange with a daily volume of 63,410 vehicle per day and 7,1 10 vehicles per hour in the PM peak.

Figure 4-l 6 shows the plot of 2012 v/c ratio for this section of the corridor. As can be seen, the north 35 miles of this section would operate under capacity in 2012. South of MP 5.0, peak hour traffic volumes would in places exceed the capacity of the roadway, leading to congestion and delay.

As with the other sections, development of alternative modes has the potential to reduce the future traffic volumes on the I-5 corridor in the Portland-Vancouver area. High speed ground transportation, high speed rail, regional transit service, improved passenger rail, and additional air service may alleviate some of the traffic growth. In particular, the Tri-Met light rail system that currently exists in the Portland area has the potential for extension into Vancouver.

However this system, or the other alternative modes, are unlikely that the decrease in automobile traffic would be sufficient to lower traffic volumes significantly.

4.3 FREIGHT MOVEMENTS

4.3.1 Traffic Volumes

The I-5 Seattle-to-Portland Corridor carries a significant amount of freight traffic. Both Seattle and Portland are major industrial centers with international ports. There are also many other smaller ports along the corridor as well as cities with significant industry. In addition, I-5 provides for international freight movement with a border crossing to Canada about 100 miles north of Seattle.

There are significant truck volumes using the corridor. Truck percentages range from 6.3 percent to as much as 30.2 percent of the total traffic using the corridor. Table 4-5 lists the truck percentages at key interchanges along the corridor. The number and percentage of trucks by direction for seven locations along the corridor are shown in Figure 4-17 for daily traffic and in Figure 4-18 for PM peak hour traffic. As can be seen by comparing these figures, truck travel is heavier off-peak than during the peak hours as evidenced by lower truck percentages for the peak than for daily.

Table 4-5
Truck Percentages

Location	MP	Truck Percentage
State Line	0.0	8.3%
SR 205	8.0	13.1%
SR 501	14.5	21.0%
SR 503	22.2	24.5%
N. Kelso Ave (Old SR 431)	40.3	28.1%
SR 411	49.3	21.9%
SR 506	59.2	21.9%
SR 506	60.4	21.9%
SR 505	63.9	30.2%
SR 508	71.5	23.4%
SR 507	82.1	20.1%
SR 12	88.0	21.5%
SR 121	95.2	19.7%
SR 101 /Custer Way	104.8	11.7%
SR 510	11 1.4	13.4%
SR 509/SR 7 Pacific Ave.	133.3	10.2%
SR 705/SR 7	134.2	8.1%
SR 167	135.0	8.1%
SR 99	137.5	8.6%
SR 18 WB	142.4	8.7%
SR 516	149.2	7.3%
SR 518/Southcenter Rd.	155.1	6.3%'
SR 900	157.7	7.7%

It is anticipated that truck volumes would increase in pace with increases in general truck volumes, although according to the *7997 Washington Ports and Transportation Systems Study* in rural areas, such as the Inter-city area of the corridor, truck volumes may increase faster than overall traffic volumes due to lower levels of development and lower commute trips. In the Puget Sound area, cargo trucked to and from ports is expected to increase by about 28 percent over 1990 levels.

4.3.2 Weigh Stations

There are 6 weigh stations along the corridor. Three are provided for each direction. They are located at MP's 15.9, 1 17.1, and 140.6 northbound and at MP's 44.1, 1 17.5, and 140.8 southbound. Table 4-6 lists the number of trucks weighed at each station over the first six months of 1994. For the six month period beginning January 1, 1994, about 828,900 trucks traveled across the scales at these stations. All currently have static scales and are manned by Washington State Patrol personnel.

TABLE 4-6
Truck Volumes at Weigh Stations

	Direction	MP	Total
Ridgefield	NB	15.9	37 1,869
Fort Lewis	NB	117.1	40,433
Federal Way	NB	140.6	94,177
Kelso (Ostrander)	SB	44.1	48,801
Federal Way	SB	117.5	19,229
Bow Hill	SB	140.8	254,369
TOTAL			828,878

Data collected at the Kelso Weigh Station (MP 44.1 SB) for the 1997 *Washington Ports and Transportation Systems Study* shows that between 25 percent and 35 percent of all trucks are overweight. Overweight trucks cause increased pavement wear, and is often a safety concern also.

4.3.3 Ports

There are 11 ports which take direct access from the I-5 corridor within the study limits. They are:

- Port of Seattle
- Port of Tacoma
- Port of Olympia
- Port of Centralia
- Port of Chehalis
- Port of Longview
- Port of Kalama
- Port of Woodland

- Port of Ridgefield
- Port of Vancouver
- Port of Portland

Table 4-7 describes the linkages between the Ports and I-5.

TABLE 4-7
Port Access Routes

Port	Access Routes
Seattle	I-90 Spokane St. Mercer St. SR 900
Tacoma	SR 705 Portland Ave. Port of Tacoma Rd. Taylor Way
Olympia	Plum St.
Centralia	Reynolds Ave.
Longview	SR 4 SR 432
Kalama	W. Kalama River Rd.
Vancouver	W. 39th St. W. 4th St. Plain Blvd. Columbia Ave. W. 15th St.' .

* proposed

According to the 199 I *Washington Ports and Transportation Systems Study*, truck tonnage at the Lower Columbia River Ports such as Longview, Kalama, Woodland, Ridgefield, and Vancouver would increase by about 8.3 percent (0.4 percent per year) over 1990 levels through the year 20 10, mostly due to a substantial declines in log and wood products. Truck tonnage at Puget Sound Ports such as Olympia, Tacoma, and Seattle would increase by about 28 percent over 1990 levels by the year 2010.

4.4 CORRIDOR SAFETY

4.4.1 Accidents

WSDOT has compiled accident data for the entire corridor. For the five-year period ending November 30, 1993, there were 24,224 accidents from milepost 0.0 to milepost 176, Of these, 21,435 were classified as urban accidents, while the remaining 2,789 accident were classified as rural accidents. Accidents were considered rural if they occurred between MP 8 and MP 35, MP 41 and 74, MP 85 and 100, or MP 113 and MP 118. For the 85 miles of rural area, the average number of accidents per mile is about 33. For the 90 miles urban area, the average is 238 accidents per mile.

Figure 4-19 presents a plot of the number of accidents by milepost. According to the WSDOT 1994 Priority Analysis, there are 57 Hazardous Accident Locations (HAL), Hazardous Accident Corridors (HAC) and Hazardous Accident Miles (HAM) along the study corridor. Table 4-8 displays the location, direction and average societal cost for each hazardous accident area.

These areas are clustered in seven areas: MP 0.20 to 4.5, Vancouver area just north of the State Line; MP 82.7 to MP 84.0, Centralia, just north of the SR 507 interchange; MP 104.2 to 109.2, Olympia-Lacey between SR 101 and Martin Way; MP 125.8 to MP 129.7, Tacoma north and south of the SR 512 interchange; MP 137.4 to 137.6, Fife, at the 54th Avenue E interchange; MP 142.0 to 149.3, Federal Way/Des Moines/SeaTac, from SR 18 to SR 516; MP 151.1 to MP 154.5, Tukwila, Military Road to SR 405; and MP 162.5 to MP 174.6, Seattle, Michigan Street to NE 145th Street. In each of the three districts of the corridor, the HAL's coincide with areas which have high v/c's and in many cases, ones which are at or over capacity.

Figure 4-19a displays accidents involving large trucks by milepost. Peaks of truck accidents coincide with peaks of all accidents and are within designated high accidents locations.

Table 4-9 gives a breakdown of all accidents by urban and rural and sorts the accidents by roadway condition, severity, and hazardous materials involvement. The number of accidents as well as the percentage of the total accidents for each accident type is shown.

Table 4-8
Hazardous Accident Areas

SR MP		SIDE	LENGTH	SAFETY	AVERAGE SOC
Begin	End		Miles	CATEGORY	$/Mile/Year
0.01	0.35	L	0.34	HAL	$672,059
0.39	0.53	L	0.14	HAL	$682,143
1.52	1.75	L	0.23	HAL	$523,913
2.00	12.50	NA	10.50	HAC	$164,148
4.30	4.41	R	0.11	HAL	$681,818
4.37	4.47	L	0.10	HAL	$485,000
15.50	23.50	NA	8.00	HAC	$170,326
27.50	36.00	NA	8.50	HAC	$202,144
38.00	42.00	NA	4.00	HAC	$219,458
44.50	48.50	NA	4.00	HAC	$191,597
55.50	67.50	NA	12.00	HAC	$213,574
72.50	85.50	NA	13.00	HAC	$241,128
82.67	82.83	L	0.16	HAL	$509,375
82.68	82.83	R	0.15	HAL	$503,333
83.86	84.37	R	0.51	HAL	$1,246,569
85.50	89.00	NA	3.50	HAC	$153,333
91.50	96.00	NA	4.50	HAC	$171,457
98.50	102.50	NA	4.00	HAC	$171,319
104.17	104.41	R	0.24	HAL	$506,250
104.20	104.44	L	0.24	HAL	$396,875
104.50	105.50	NA	1.00	HAM	$465,056
107.44	107.54	R	0.10	HAL	$462,500
109.02	109.25	L	0.23	HAL	$175,000
113.00	114.00	NA	1.00	HAM	$130,833
119.50	122.00	NA	2.50	HAC	$314,933
125.75	125.96	L	0.21	HAL	$726,190
126.00	127.00	NA	1.00	HAM	$413,000
127.39	127.73	L	0.34	HAL	$1,265,441
127.82	129.18	L	1.36	HAL	$601,287
129.39	129.89	L	0.50	HAL	$402,000
132.50	134.00	NA	1.50	HAC	$1,714,481
137.25	137.55	R	0.30	HAL	$1,118,333
137.31	137.50	L	0.19	HAL	$694,737
137.50	140.00	NA	2.50	HAC	$459,711
141.90	142.20	L	0.30	HAL	$410,833
141.97	142.15	R	0.18	HAL	$929,167
143.61	144.00	L	0.39	HAL	$413,462
145.00	146.50	NA	1.50	HAC	$373,000
146.70	146.95	R	0.25	HAL	$765,000
148.91	149.33	R	0.42	HAL	$798,810
149.11	149.42	L	0.31	HAL	$726,613
150.93	151.30	R	0.37	HAL	$723,649
153.00	154.00	NA	1.00	HAM	$956,944
154.35	154.72	L	0.37	HAL	$1,270,946
156.50	157.50	NA	1.00	HAM	$306,278
159.00	160.50	NA	1.50	HAC	$240,963
162.12	163.40	R	1.28	HAL	$571,680
163.75	164.23	R	0.48	HAL	$1,127,604
164.43	165.75	R	1.32	HAL	$398,864
164.96	167.84	L	2.88	HAL	$842,708
166.61	167.32	R	0.71	HAL	$468,662
167.88	168.72	L	0.84	HAL	$626,786
168.88	170.35	L	1.47	HAL	$515,816
170.48	171.35	L	0.87	HAL	$360,345
172.20	172.97	L	0.77	HAL	$449,675
172.99	173.55	L	0.56	HAL	$1,326,339
174.38	174.88	L	0.50	HAL	$494,000

Table 4-9
Accident Breakdown

Type	Total	Wet Roadway	Icy Roadway	Fatality or Injury	Hazardous Materials
Urban	21,435	6,548 (30.5%)	885 (4.1%)	9,419 (43.9%)	24 (0.1%)
Rural	2,789	656 (23.5%)	437 (15.7%)	1,058 (37.9%)	8 (0.3%)

Source: WSDOT

As can be seen from Table 4-8, accidents on wet roadways are more prevalent in the urban sections than in the rural areas as measured by percent of total accidents. The incidence of accidents involving wet roadways in urban areas appears to be fairly uniform in respect to total accidents. Slightly higher than average occurrence rates were noted near areas of congestion, such as the State Line, through the cities of Kelso, Chehalis and Centralia, and at major interchanges such as SR 101 in Olympia/Tumwater, at the Tillicum interchange near Fort Lewis, at the SR 512 and SR 16 interchanges in Tacoma, at the S 320th Street interchange in Federal Way, and at the SR 900, Corson Street, and Spokane Street interchanges in Seattle. In rural areas, the percentage of accidents involving wet roadways is lower, and there appears to be some correlation between wet roadway accidents and locations of bridges. Bridges which were found to have higher than average accident occurrence involving wet roadways include the Burlington Northern Railroad Bride at MP 25, the Kalama River Bridge at MP 31, the Pacific Avenue Bridge at MP 42, the Toutle River Bridge at MP 51, the Cowlitz River Bridge at MP 59, and the Lacamas Creek Bridge at MP 61. Figure 4-20 presents a plot of the number of accidents involving wet roadways by milepost.

According to the data, accidents involving icy roadways occur about 3 times as often on the rural sections than on the urban sections of the corridor. Again, the incidence of accidents involving icy roads appears to correlate well with the locations of bridges. Locations that were found to have higher than average accident occurrence involving wet roadways include the Columbia River Bridge at MP 0.0, the Lewis River Bridge at MP 18, the SR 503 interchange at MP 22, the Burlington Northern Railroad Bride at MP 25, the Todd Road interchange at MP 27, the Kalama River Bridge at MP 31, the Toutle River Bridge at MP 51, the Cowlitz River Bridge at MP 59, the rest area at MP 55, the Lacamas Creek Bridge at MP 61, and the Nisqually River Bridge at MP 29.2. There appears to be more accidents involving icy roadways south of the Cowlitz River Bridge. In the urban sections of the corridor, accidents involving icy roadways also appear to be linked to locations of bridges or underpasses. Locations with high incidences of icy roadway accidents include the Dillenbaugh Creek Bridge at MP 77, the Burlington Northern Railroad Bridge at MP 83, the Deschutes Parkway Bridge at MP 104, the Puyallup River Bridge at MP 135, the SR 516 interchange at MP 149, the S 188th Street interchange at MP 152, and the NE 45th Street interchange at MP 170. Figure 4-21 presents a plot of the number of accidents involving icy roadways by milepost.

In the urban area, about 44 percent of the total accidents involved injuries or fatalities. The percentage of injury accidents in the rural sections was about 38 percent. Figures 4-22 presents a plot of the number of accidents involving injuries or fatalities by milepost.

For a more in-depth analysis of accident data, the study corridor was broken down, by milepost, into five study areas:

		From MP	To MP
■	Area 1	0.0	8.31
■	Area 2	8.31	35.3
■	Area 3	35.3	74.3
■	Area 4	74.3	85.7
■	Area 5	85.7	100.3
■	Area 6	100.3	175

Area 1 stretches from the Washington-Oregon State border to just south of the SR 502 interchange. Area 1 is considered urban. Area 2 ranges from the SR 502 interchange to just south of the City of Longview. This area is significantly larger than Area 1 and is mostly considered rural. Starting at the City of Longview and ending just south of the City of Chehalis, Area 3 is similar in nature to Area 2 and is also considered rural. Area 4 continues from the City of Chehalis to the City of Centralia. This stretch is considered mostly urban. Area 5 stretches from just north of the City of Centralia to the City of Tumwater and is considered rural. Area 6 continues from the City of Tumwater to the end of the corridor at the King-Snohomish county line. Area 6 has both rural and urban areas.

Trends in types of accidents, causes of accidents, and surrounding conditions were examined in each area for accidents that occurred during the years 1989 through 1993. Table 4-10 shows this breakdown for each area except Area 6. Since there already have been many accident analyses in the Seattle-Olympia corridor, only truck accidents were examined in Area 6.

As shown in Table 4-10, the majority type of accidents in Area 1 were rear-ends. This type of accident is prevalent near the state line where there are heavy volumes of traffic suffering from slow or stop and go conditions approaching the Columbia River Bridge. In all other areas, striking a fixed object was the greatest type of accident. This is characteristic of higher speeds and lower traffic volumes in these areas. Striking a non-domestic animal was small percentage in the rural areas and non-existent in the urban areas.

The greatest cause of accidents in all areas was driving too fast for conditions. Drivers falling asleep was a small factor in the rural areas, ranging from 7 to 9 percent, but not in the urban areas. Alcohol was consistent throughout the corridor at around 7 percent. This is below the 1992 state average of 10 percent as reported by the *Washington State Highway Accident Report, 1992*. Data for the cause of accidents was unavailable for Area 5.

Surface conditions varied only slightly for each area with the exception of Area 4. Area 4 had 40 percent of the accidents occur on wet pavement. Areas 3 and 4 had the highest

Table 4-10
Accident Breakdown

	Area 1	Area 2	Area 3	Area 4	Area 5
Total Number of Accidents:	731	936	1237	647	509
Type of Accident					
Rear-End	40%	10%	12%	25%	23%
Sideswipe	24%	13%	11%	11%	12%
Striking a Fixed Object	22%	29%	36%	42%	23%
Overturned	4%	16%	16%	7%	20%
Striking an Animal	-	7%	7%	0%	6%
Caused By					
Driving Too Fast For Conditions	26%	31%	39%	44%	-
Alcohol	7%	8%	7%	6%	-
Apparently Asleep	1%	7%	9%	5%	-
Inattention	6%	8%	10%	11%	-
Surface Conditions					
Dry	61%	55%	51%	45%	65%
Wet	29%	23%	24%	40%	26%
Ice	7%	19%	18%	11%	6%
Weather					
Clear/Cloudy	73%	83%	69%	57%	77%
Raining	23%	11%	20%	32%	18%
Snowing	3%	3%	7%	5%	3%
Foggy	1%	3%	3%	6%	2%
Drivers Originating From Over 15 Miles From Accident Scene	-	65%	74%	-	-

percentage of icy conditions at 18 and 19 percent, respectively. Specific incident locations for icy and wet roadway conditions are stated previously in this section.

Weather does not appear to be a factor in any of the areas although Area 4 has the highest percentage of accidents occurring in the rain at 32 percent. This is consistent with the highest percentage of wet surface conditions.

Table 4-11 shows the trend breakdown for trucks in Area 6.

Table 4-11
Truck Accident Trend Breakdown For Area 6

	Percent of All Accidents
Type of Accident	
Sideswipe	51%
Rear-end	23%
Striking a fixed object	6%
Caused By	
Data not available	
Surface Conditions	
Dry	70%
Wet	26%
Icy	3%
Weather	
Clear/cloudy	77%
Rain	20%
Snow	2%
Fog	1%

The majority of truck-related accidents were sideswipes. Neither wet nor icy surface conditions were a prevalent factor in these accidents.

4.4.2 Emergency Response

The Washington State Patrol (WSP) has the primary responsibility for emergency response and enforcement on State Highways in Washington State. Additional emergency response is provided by fire districts, and police and sheriff departments. There are 8 WSP offices located along the corridor. At any one time, from 5 to 25 WSP Troopers are patrolling the corridor.

The WSP has supplied a record of assists/calls for service which includes disabled vehicles, accidents, and other emergencies. This data covers the period from 8/1/93 to 7/31/94. Figure 4-23 present the number of assists/calls for service by milepost for the one year period.

In the one year period, there was about 221,646 assists/calls for service. This averages about 1,245 assists per mile per year, or 3.4 assists per mile per day. Higher than average assists occur in the Vancouver area, near the rest areas at MP 11 and MP 55, in the cities of Woodland, Kelso, and Chehalis, and in the entire Puget Sound area north of Tumwater.

4.4.3 Hazardous Material Shipments

The number of accidents classified as involving hazardous materials is low. Of the 24,224 accidents on the corridor, only 32 or about 0.1 percent were hazardous materials accidents. There were three locations where more than 1 hazardous materials accident occurred: the Military Road interchange at MP 151 with 2 accidents; the Spokane Street interchange at MP 163 with 2 accidents; and the Downtown Seattle area from MP 165 to MP 166, where 5 accidents occurred.

4.4.4 Enforcement

The WSP patrols the corridor and for the most part is responsible for issuing citations to motorists along the corridor. According to information supplied by the WSP for the period of 8/1/93 through 7/31/94, the WSP issued 78,728 citations. This equates to 442 citations per mile per year or about 1.2 citations per mile per day. Figure 4-24 shows the number of citations per mile for the one year period. Locations where higher than average citations were issued include the Vancouver area, the cities of Kelso and Chehalis, and the Puget Sound region.

4.5 WEATHER

Weather conditions can influence traffic safety and roadway capacity. The presence of rain, snow, and ice reduces the surface friction of the roadway resulting in increased stopping distances and thus possibly increasing the potential for accidents. Rain and fog reduce driver visibility which both reduces both sight distances and sometimes speeds. This section discusses information on weather conditions along the corridor from Seattle to Portland. Historical data on temperature, precipitation, and sky conditions (sunny, cloudy, etc.) are presented from six weather stations located at:

- Seattle, Washington;
- Tacoma, Washington;
- Olympia, Washington;
- Centralia, Washington;
- Longview, Washington; and
- Portland, Oregon.

This information represents data collected at each of these six weather stations. Localized conditions at other points may be different, but can be approximated from these intermediate stations along the corridor.

4.5.1 Temperature

The Pacific Northwest is known for its moderate temperatures and Figures 4-25 and 4-26 illustrate this point for the six selected weather stations. Figure 4-25 provides the normal daily maximum temperature by month and Figure 4-26 shows the normal daily minimum temperature. The normal daily maximum temperatures begin in the middle forty degree range in January and rise to their highest in July. The highest temperatures in all six locations occur in July. Portland has the highest normal daily maximum at 79.2 degrees and Seattle the lowest at 75.2 degrees. The others range in between with Centralia the next highest at 78 degrees. The maximum temperature then declines to the middle forties in December.

The lowest daily minimum temperature for all six locations occurs in January. The lowest average minimum temperature occurs in Olympia at 30.8 degrees. Longview is the next lowest at 32.8 degrees and Seattle and Tacoma are the highest at 34.3 and 35 degrees respectively. The average daily minimum temperatures for most of six locations stay in the middle thirties into March and increase to the low fifties by July. Olympia remains the coolest with average daily minimum temperature of 48.7 degrees in July. The daily minimum temperatures decrease to the middle thirties by December.

Temperatures below the freezing point of water (32 degrees) present a greater concern for highway conditions because of the potential for ice formation on the roadway surface. Table 4-12 provides the average number of days per year when the maximum and minimum temperature were below 32 degrees. The number of days where the average maximum temperature is below 32 degrees is small. The number of days that minimum temperature falls below 32 degrees is low in Seattle and Tacoma, higher in Centralia, Longview and Portland, and the highest in Olympia. These low temperatures occur overnight and gradually increase during the day. These low temperatures and the resulting chance of icing can have a significant impact on morning peak period traffic. This is particularly true on bridges and overpasses, which tend to ice up first because of a lack of temperature regulation on the underside of the structure, which on a normal roadway is provided by the ground.

Figure 4-27 further illustrates this point by depicting the number of days the minimum temperature falls below 32 degrees by month. As expected, these days cluster in January, February, March, November and December. Olympia has the most with nearly half of the days in December and January having minimum temperatures below freezing.

Table 4-12
Average Number of Days Per Year with Temperatures Below 32 Degrees

City	Number of Days That Maximum Temperature Was Below 32 Degrees	Number of Days That Minimum Temperature Was Below 32 Degrees
Seattle	2.7	30.7
Tacoma	2.0	33.0
Olympia	3.0	85.5
Centralia	2.0	59.0
Longview	2.0	56.0
Portland	3.8	42.2

Icy conditions regularly occur during the winter at several of the major river crossings along the corridor including:

- Green River (Milepost 156)
- Puyallup River (Milepost 135)
- Nisqually River (Milepost 117)
- Cowlitz River (Milepost 58 and south of Milepost 46)
- Toutle River (Milepost 52)
- Kalama River (Milepost 31)
- Lewis River (Milepost 16)

4.5.2 Precipitation

Average annual precipitation for the six cities is shown in Figure 4-28. While Seattle and Tacoma may have a national reputation as rainy places, average annual precipitation of 38.6 and 37.2 inches, respectively, places them below New York City (44.1 inches) and Washington, DC (39.1 inches) in annual rainfall. However, the three Washington cities to the south (Olympia, Centralia, and Longview) have higher annual precipitation. Olympia has the highest average annual precipitation with nearly 51 inches.

Figure 4-29 depicts normal monthly precipitation. The majority of the precipitation in the corridor falls between October and April. The wettest months are October, November, December and January. These are also the months when the temperatures are the coldest. During June, July and August, monthly precipitation drops to below two inches per month along the entire corridor.

The number of days with precipitation over 0.1 inches is pictured in Figure 4-30. In Seattle, Olympia, and Portland from October to March over half of the days during the month experience precipitation over 0.1 inches. Tacoma has the least number of days with precipitation over 0.1 with 88 days per year versus 162 days per year in Olympia, which is the highest.

4.5.3 Sky Conditions

Data on the sky conditions is only collected at a limited number of weather stations. In this corridor, data is available for Seattle, Olympia, and Portland. Figures 4-31, 4-32, and 4-33 indicate the average percentage of time the sky is clear, partly cloudy, cloudy by month for Seattle, Olympia, and Portland. This data mirrors the information for the number of days with precipitation over 0.1 inches. For all three locations, cloudy conditions predominate from October through June. The clearest month is July.

Figure 4-34 presents the average number of days per month with heavy fog where visibility is less than one quarter of a mile for Seattle, Portland and Olympia. This information reflects data at this specific locations. Heavy fog conditions exist at all three locations in October through February. This is the time of year when colder air from the Pacific Ocean interacts with the warmer area bodies of water to cause fog. Olympia has the most days with fog.

4.5.4 Other Weather Related Concerns

WSDOT Regional staff have identified several other locations where weather related problems have occurred. These include:

- Milepost 99 to 101.3 (93rd Avenue to Airdustrial Way): During heavy rain fall, water runs across the three lanes and shoulder to the outside drainage ditch.
- Milepost 115 to 112 (Nisqually River to Fort Lewis): Snow and ice accumulation during colder weather.
- Milepost 135.3 (Puyallup River Bridge): Vapors from oxygen generation plan adjacent to the Puyallup River Bridge contribute to icing on the bridge during colder weather.
- Milepost 50 to 60 (Toutle Hill): Ice accumulation during colder weather.
- Milepost 88 to 72 (Centralia Area): Flooding has occurred upon occasion.

5.0 CONCLUSIONS

5.1 TRANSPORTATION ISSUES AND CONCERNS

In the previous sections of this report, the existing transportation and IVHS infrastructure were discussed and current and future conditions were presented. Several key conclusions can be made at this time:

- Congestion along the corridor will continue to increase over the next twenty years especially in the Puget Sound and Vancouver areas. The significance of providing information, better access, improved operations and increased availability of alternatives to single occupant vehicles cars will increase the urban areas of the corridor. The addition of a third lane in each direction in the middle segment of the corridor should reduce congestion and accidents in this segment.

- The investment in multimodal terminals and improved inter-city rail service along the corridor offers the opportunity to provide better information to travelers concerning alternatives to driving.

- As traffic volumes grow, the ability to signal, detect, respond to, and manage accidents, breakdowns and other incidents will increase in importance along the entire length of the corridor.

- There is a noticeable number of accidents at bridges and overpasses when the roadway is icy.

- There is a limited number of parallel roads which can serve as detour routes for I-5 particularly in the middle part of the corridor.

- Truck volumes as a percentage of corridor traffic is high due to the primary role of I-5 as a major commercial route along the entire West Coast. The number of hazardous material incidents is small. Truck related accidents are proportional to their share of the traffic stream.

- The current and planned SC&DI system in the two major urban areas will provide solid basis for expansion to other IVHS applications.

- However, because multiple organizations are developing IVHS systems to serve their local and modal needs, there will be a néed to coordinate and integrate these efforts.

- The emergence of AVI based toll collection, CVO applications and transit priority signal systems points to the need for the establishment of AVI standards for the state.

5.2 INITIAL IDENTIFICATION OF CORRIDOR IVHS USER SERVICE NEEDS

The results of this effort will be used match these transportation issues and concerns against IVHS capabilities. Over the past year, the IVHS community has moved from a technology based division of IVHS capabilities to a definition based upon potential user services. Currently, there 28 user services divided into the following six broad categories:

- Travel and Traffic Management
- Public Transportation Management
- Electronic Payment
- Commercial Vehicle Operations
- Emergency Management
- Advanced Vehicle Safety Systems

These services are viewed to collectively define IVHS. Detailed definition of each user service in found in Appendix E. The next project task is to match these user services against corridor transportation issues and concerns to determine how IVHS technology can help.

Table 5-1 provides an initial identification of IVHS user needs by corridor area. This matrix shows both primary and secondary user service candidates for future consideration during the study. Primary candidates generally build upon committed or planned activities and directly meet corridor transportation needs. Secondary candidates address aspects of corridor issues or require private sector involvement. This is particularly true for CVO applications and advanced vehicle safety systems. For the latter, the motor vehicle manufacturing companies will be developing and equipping vehicles with these advanced technologies as the market dictates. This table serves as an initial starting point defining projects along the corridor as part of the IVHS implementation plan during the remainder of this study.

Table 5-1
Initial Identification of Seattle to Portland Corridor IVHS User Needs

IVHS USER SERVICES	Corridor Area		
	Puget Sound Region	Intercity	Portland - Vancouver Region
Travel and Traffic Management			
Pre-Trip Travel Information	●	●	●
En-Route Driver Information	●	●	●
Traveler Services Information	●	●	●
Route Guidance	●	●	●
Ride Matching and Reservation	●		●
Incident Management	●	●	●
Travel Demand Management (TDM)	●		●
Traffic Control	●	□	●
Public Transportation Management			
En-Route Transit Information	□	□	□
Public Transportation Management	●		●
Personalized Public Transit	□	□	□
Public Travel Security	●		●
Electronic Payment			
Electronic Payment Services	●	□	□
Commerical Vehicle Operations			
Commercial Vehicle Electronic Clearance	●	●	●
Automated Roadside Safety Inspections	□	□	□
Commercial Vehicle Administrative Processes	●	●	●
On-Board Safety Monitoring	□	□	□
Commercial Fleet Management	□	□	□
Hazardous Material Incident Notification	□	□	□
Emergency Management			
Emergency Vehicle Management	●	●	●
Emergency Notification and Personal Security	●	●	●
Advanced Vehicle Safety Systems			
Longitudinal Collision Avoidance	□	□	□
Lateral Collision Avoidance	□	□	□
Intersection Crash Warning and Control	□	□	□
Vision Enhancement for Crash Avoidance	□	□	□
Safety Readiness	□	□	□
Pre-Crash Restraint Deployment	□	□	□
Automated Vehicle Operation	□	□	□

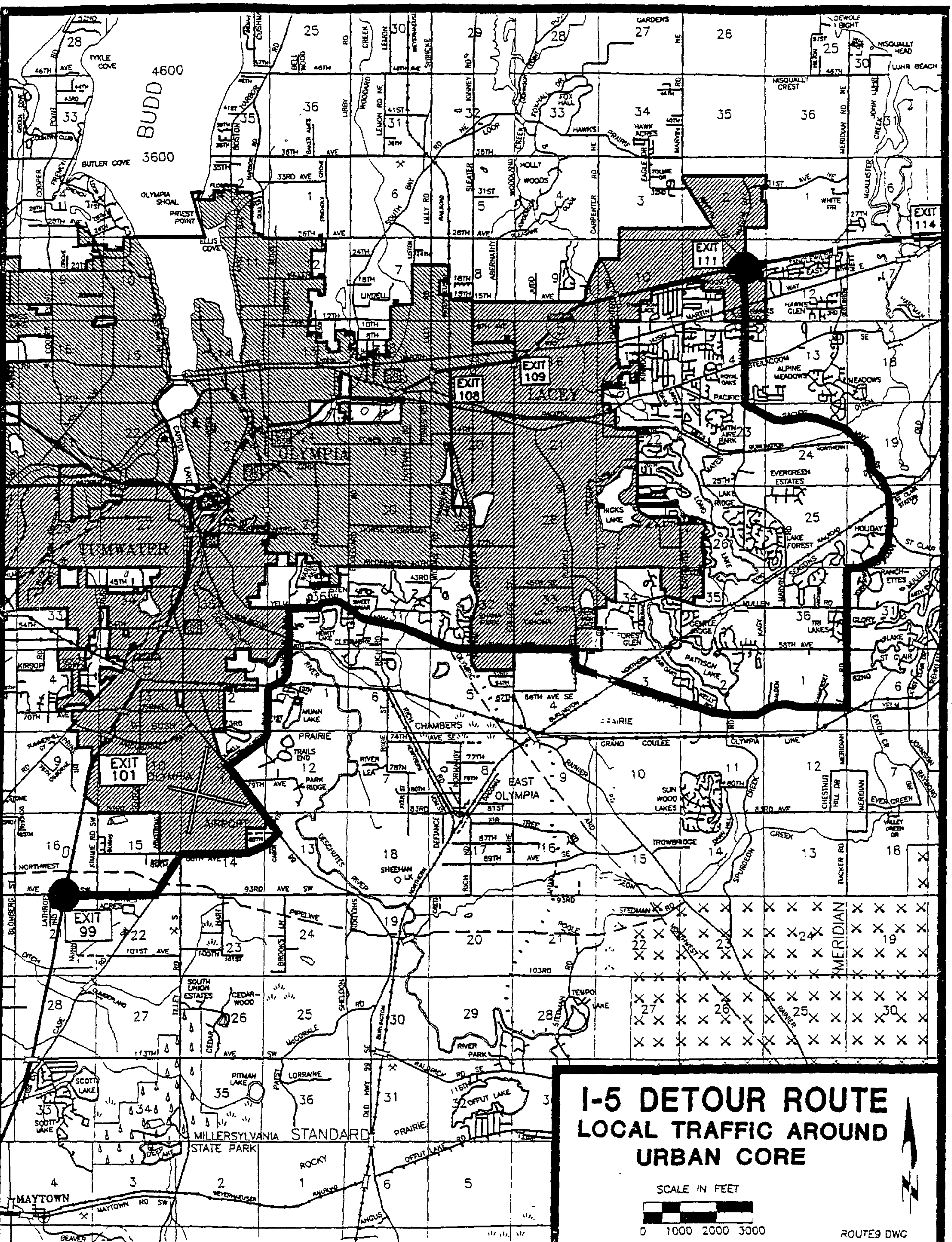
Legend:
Primary Candidate for Future Consideration ●
Secondary Candidate for Future Consideration □

APPENDIX A

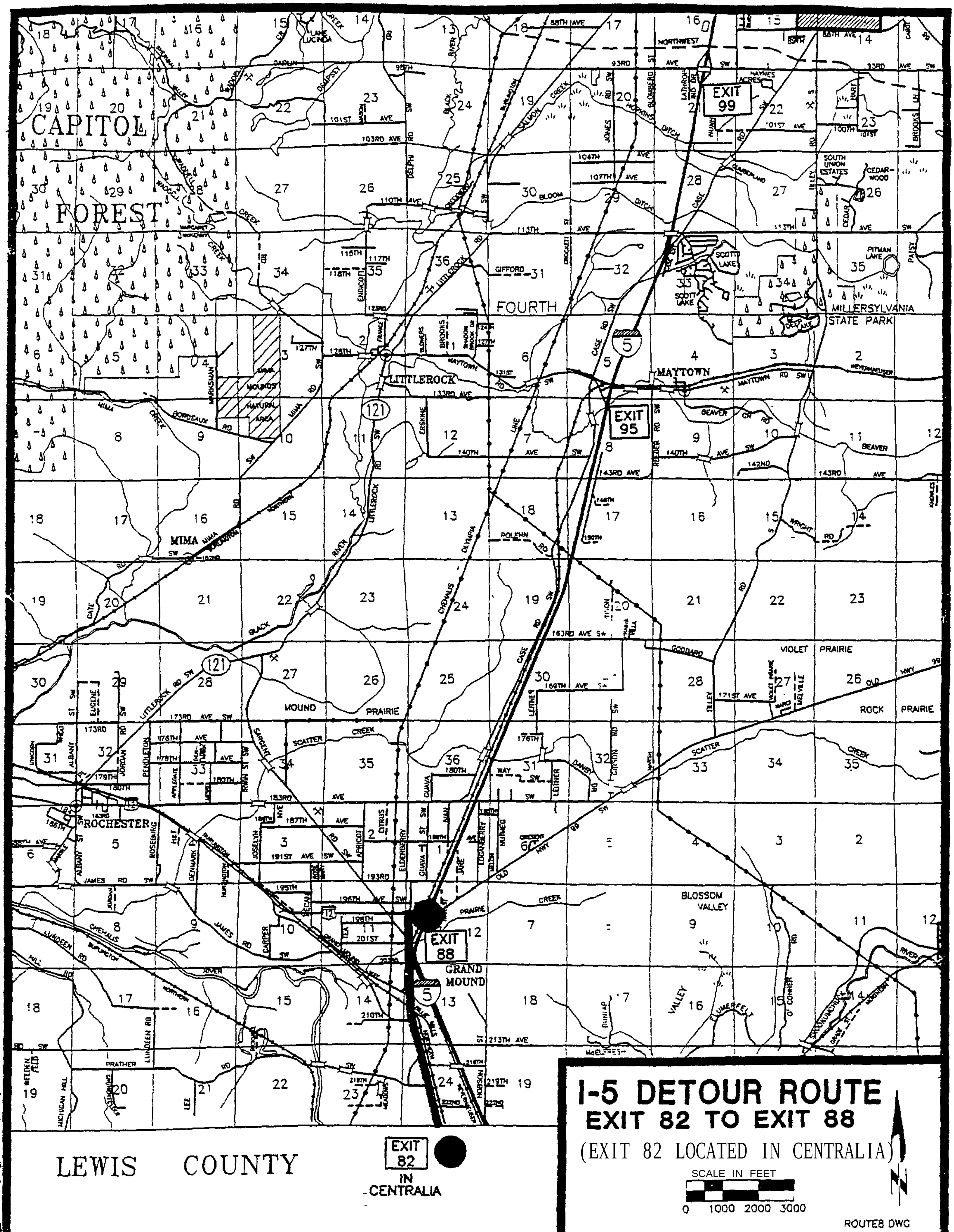
i-5 DETOUR ROUTES IN THURSTON COUNTY

PROVIDED BY THE

THURSTON COUNTY DEPARTMENT OF PUBLIC WORKS


I-5 DETOUR ROUTE
LOCAL TRAFFIC AROUND
URBAN CORE
SCALE IN FEET
0 1000 2000 3000
ROUTE9 DWG
EXIT 99
EXIT 101
EXIT 108
EXIT 109
EXIT 111
EXIT 114
TUMWATER
OLYMPIA
LACEY
EAST OLYMPIA
BUDD
MAYTOWN
MILLERSYLVANIA STATE PARK
AIRPORT

ATTACHMENT C



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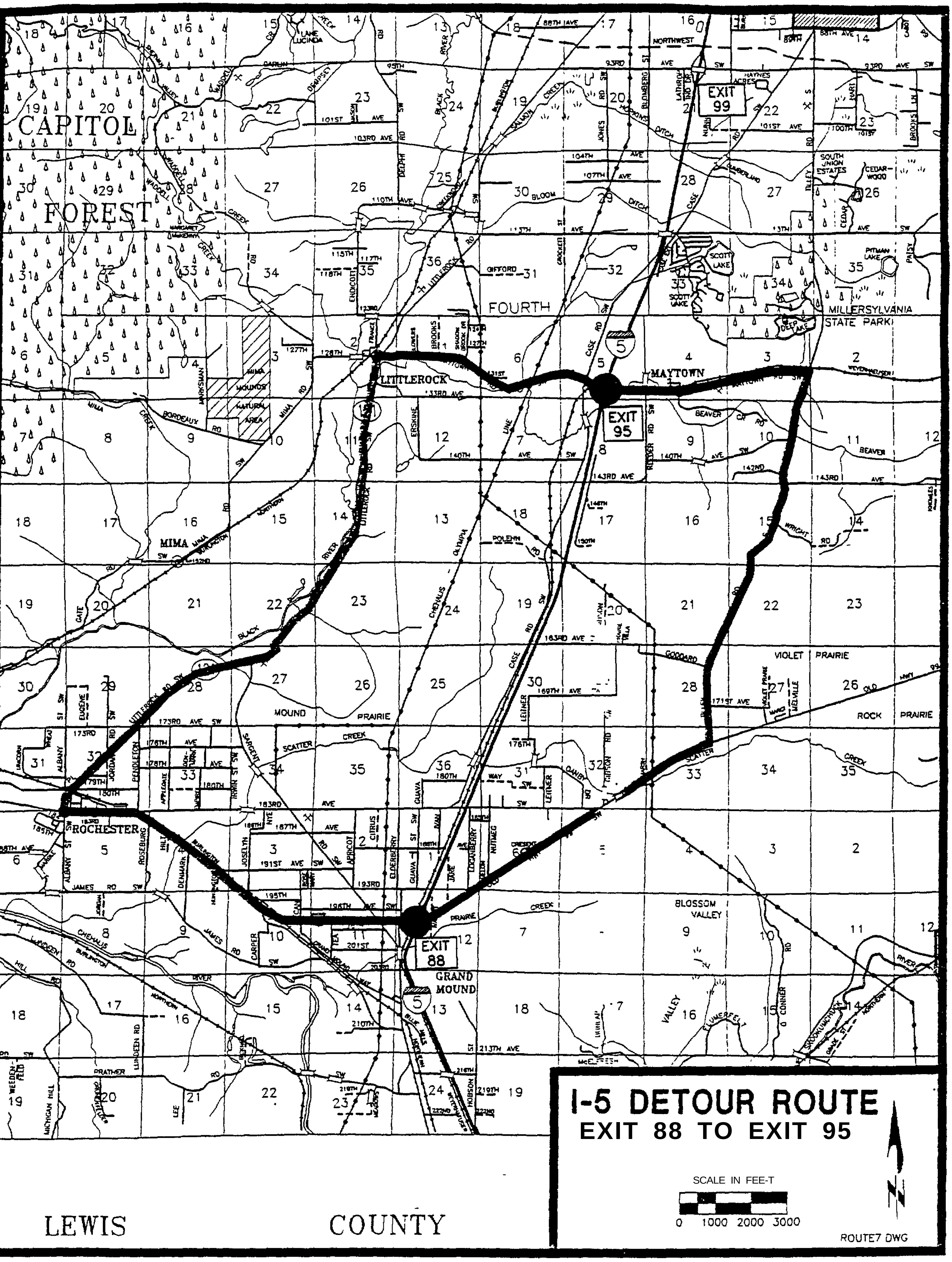

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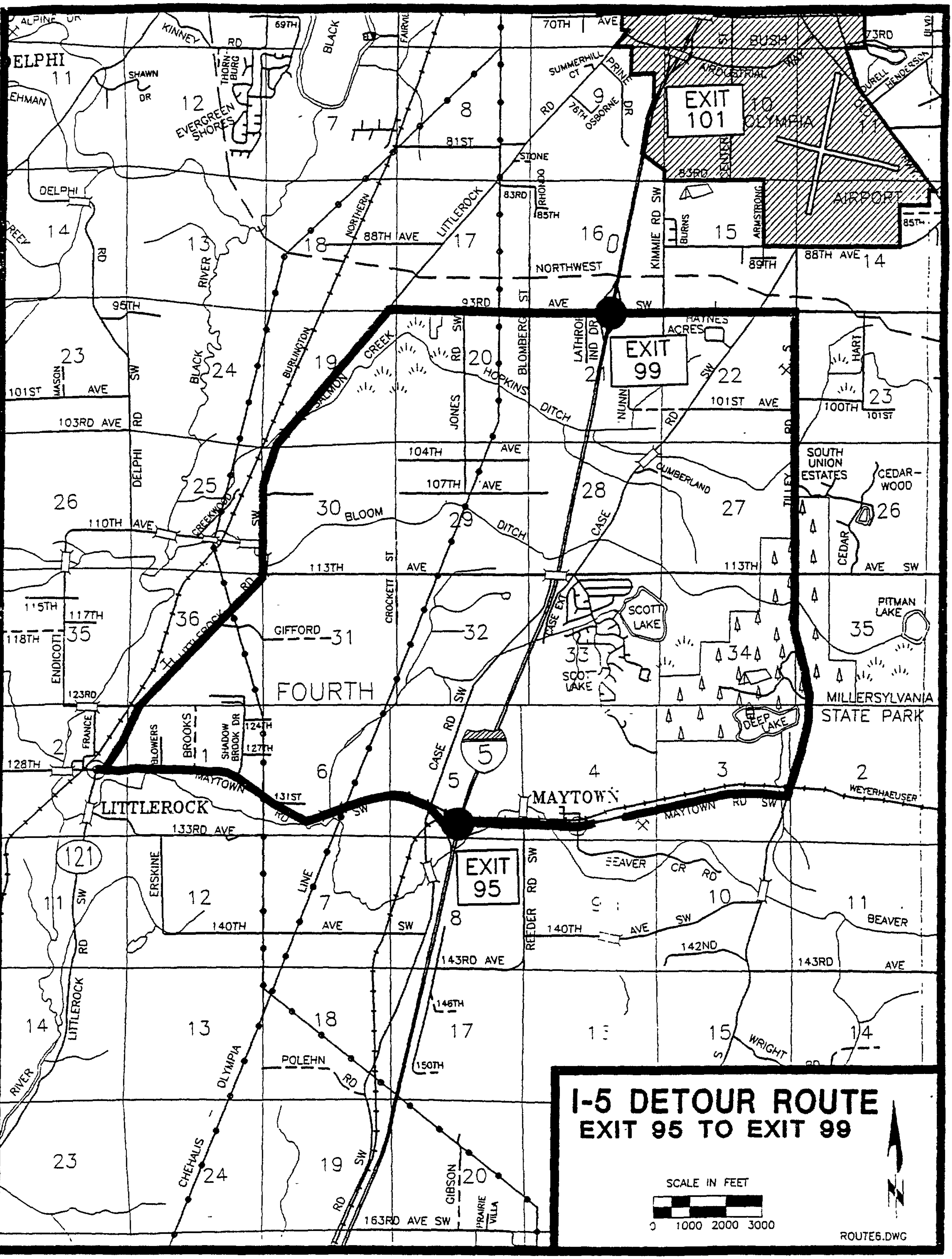
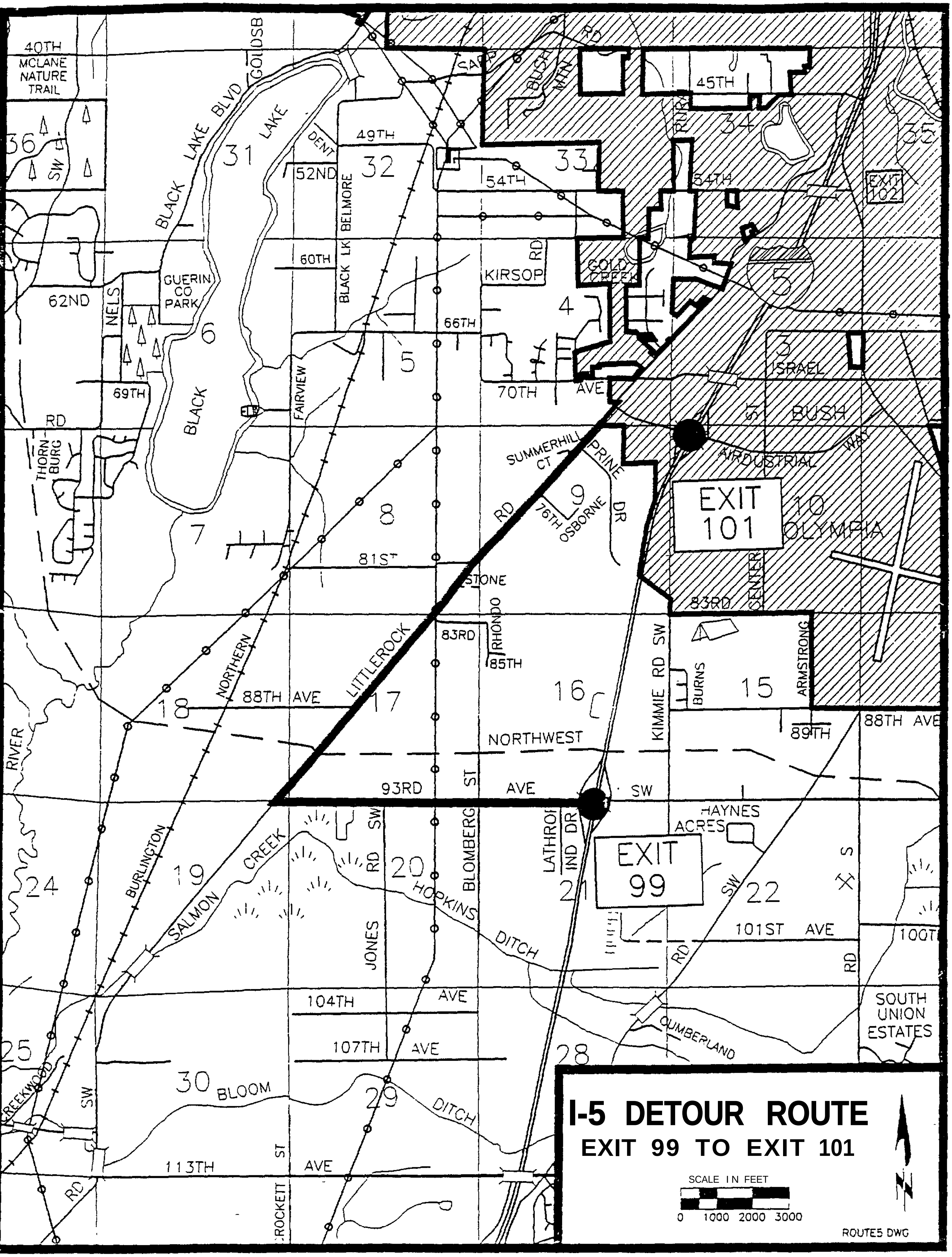
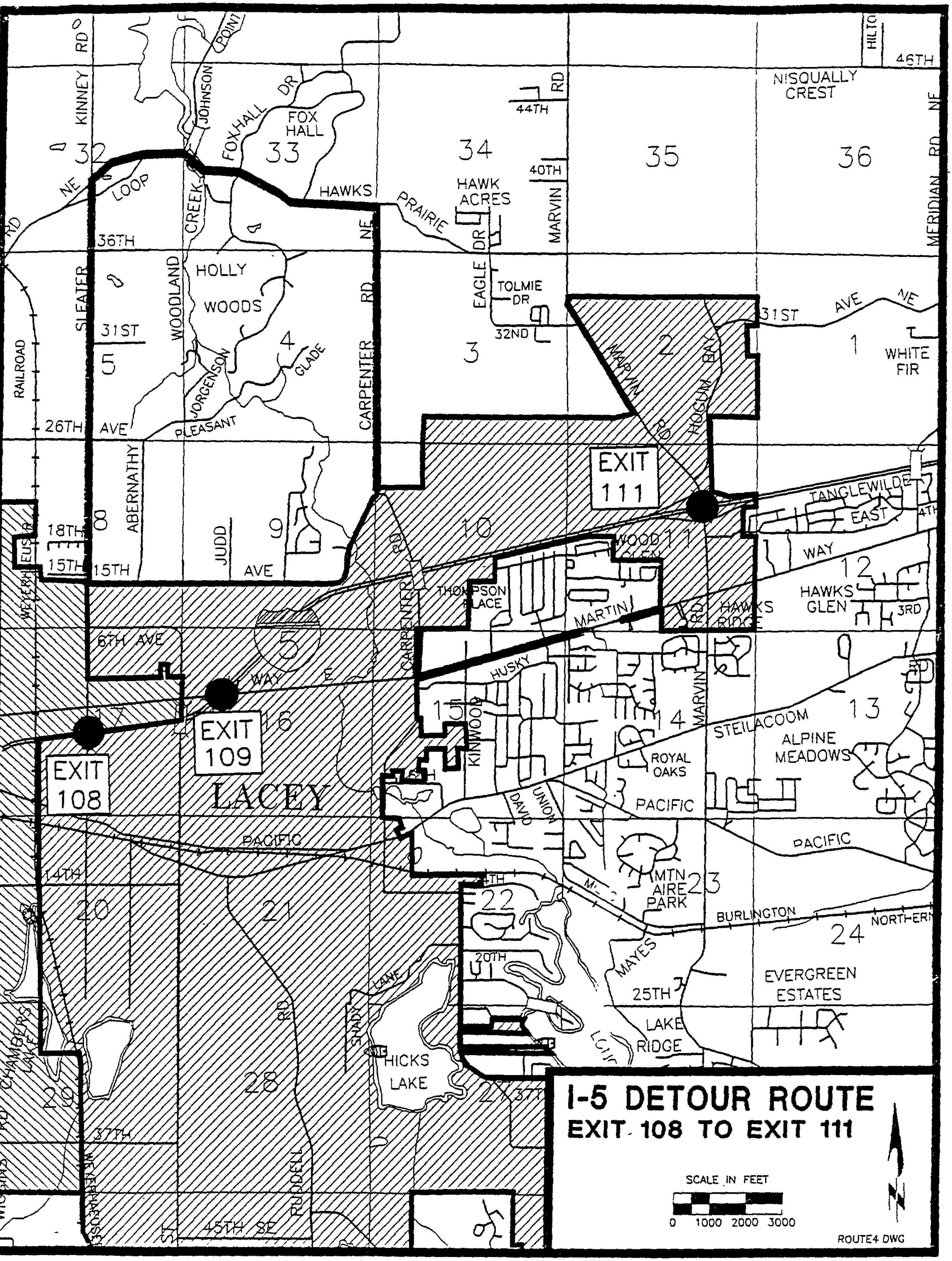
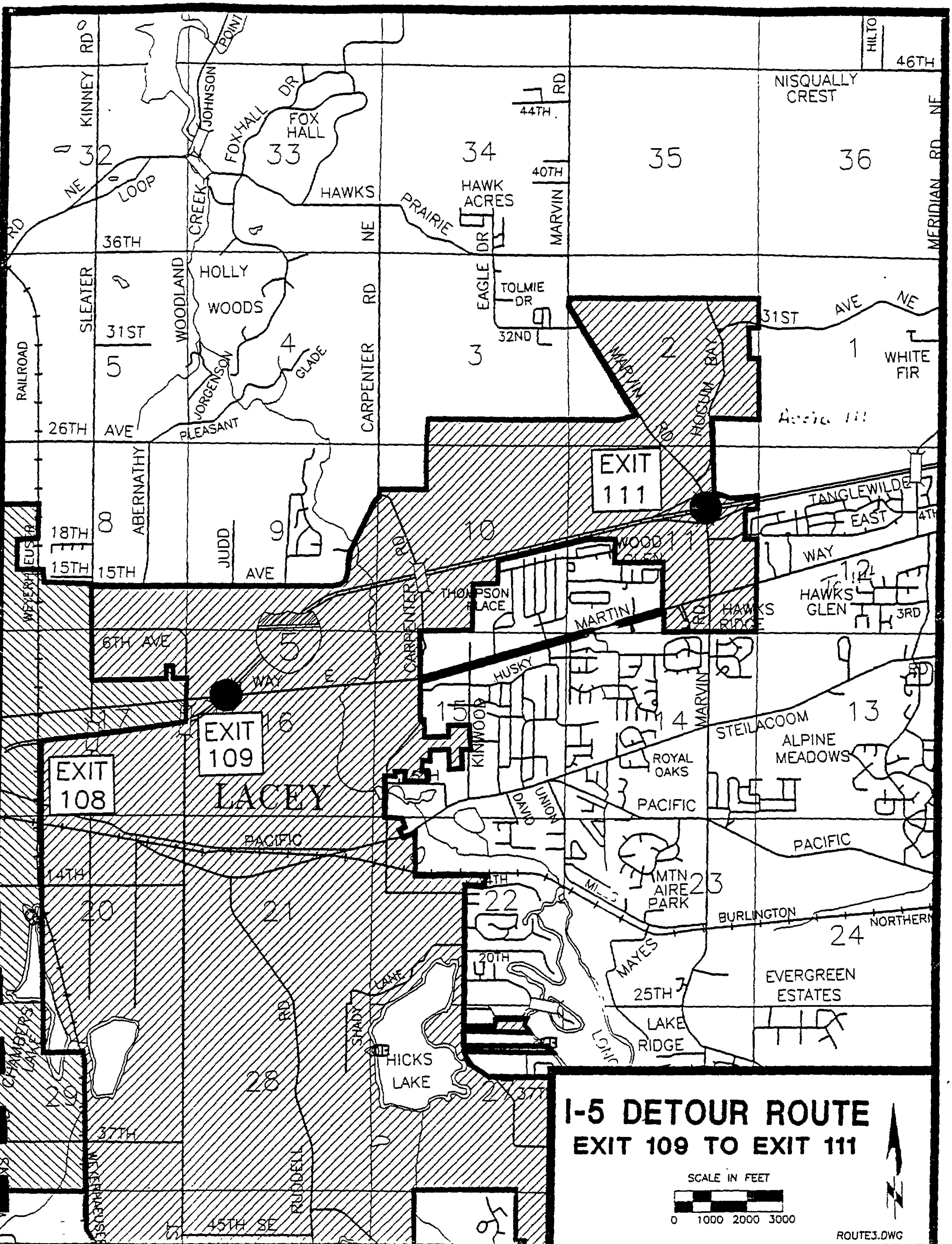



I-5 DETOUR ROUTE
EXIT 99 TO EXIT 101
SCALE IN FEET
0 1000 2000 3000
ROUTE5 DWG
EXIT 101
EXIT 99
EXIT 102
OLYMPIA
BLACK LAKE BLVD
LITTLEROCK RD
93RD AVE SW
88TH AVE
NORTHWEST
KIMMIE RD SW
BLOMBERG ST
HOPKINS DITCH
SALMON CREEK
BLOOM DITCH
113TH AVE
104TH AVE
107TH AVE
101ST AVE
SOUTH UNION ESTATES
HAYNES ACRES
CUMBERLAND
INDUSTRIAL WAY
ISRAEL RD
KIRSOP RD
70TH AVE
81ST
83RD
GUERIN CO PARK
MCLANE NATURE TRAIL


I-5 DETOUR ROUTE
EXIT 108 TO EXIT 111
SCALE IN FEET
0 1000 2000 3000
ROUTE4 DWG
EXIT 108
EXIT 109
EXIT 111
LACEY

ATTACHMENT C



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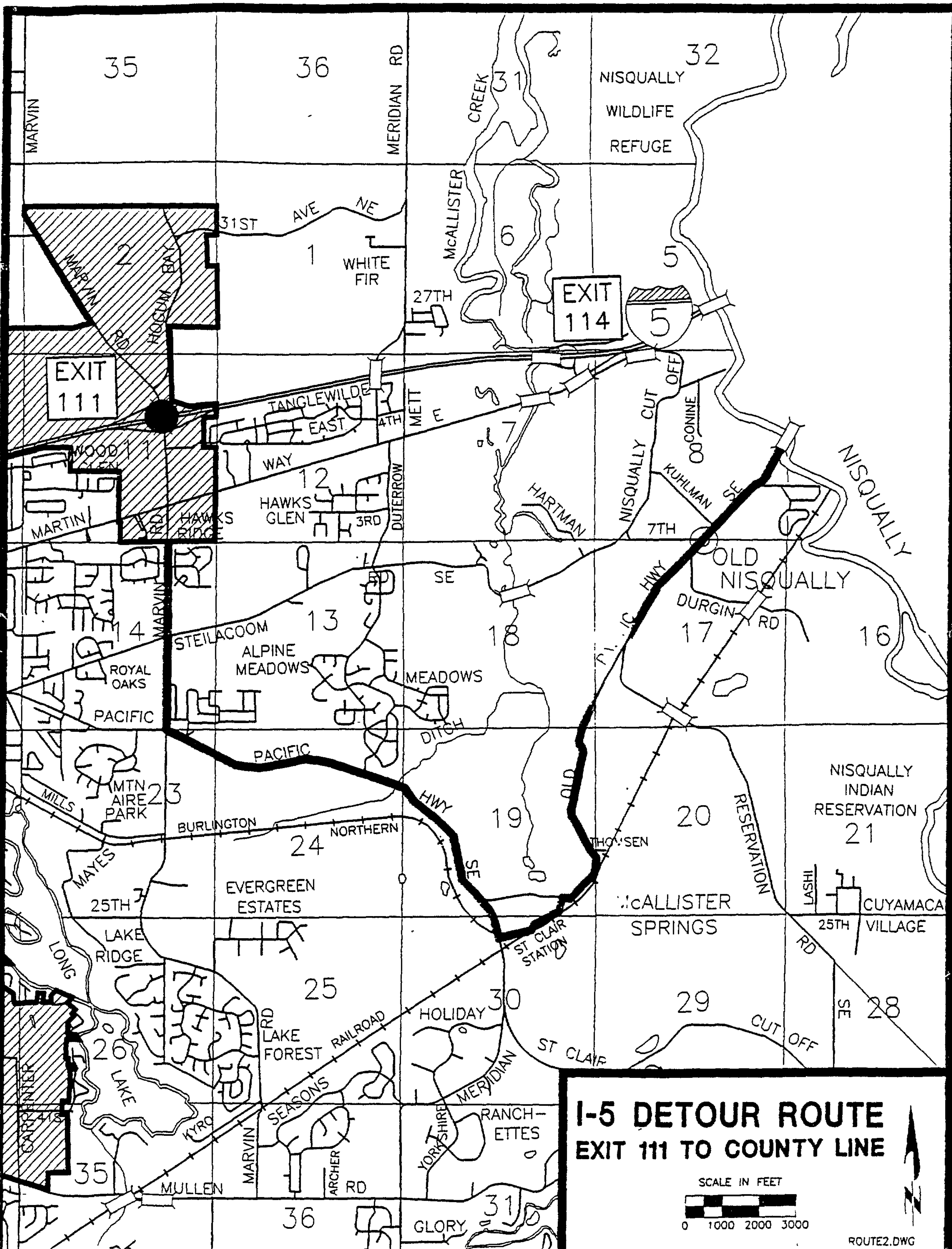

APPENDIX B

IVHS REGIONAL ACTION PLAN FOR CENTRAL PUGET SOUND

Source: Final Report: IVHS Strategic Plan for Washington State, November 1993

AREA CENTRAL PUGET SOUND 1

IVHS VISION:

Central Puget Sound will have a fully integrated information system which is easily accessible to all potential users- personal travelers, service providers, freight and fleet operators, and others. The information will include all modes of travel--transit, carpools, trucks, ferries, private vehicles etc., to provide users with real-time choices regarding travel options in support of ***Vision 2020.*** The information for residents and visitors will be available through a variety of sources-- at home, office; in-vehicle, through hand-held devices in order to provide flexibility in travel behavior. Various travel modes will share information to provide smooth intermodal transfers of goods and people. Supporting this information accessibility will be a complete traffic management system which will provide for safe and efficient movement of people and commercial vehicles on the highway and transit system Incidents on the highway system will be immediately identified and quick response teams will clear the roads to minimize delay. Arterial signals will be closely coordinated with freeway operations to create “smart” transportation corridors. Transit system operations will be greatly improved since operators will have real-time knowledge of vehicle locations, condition, and locations of congestion. Real-time routing of buses and other HOV’s will also improve efficiency. Consumers will use smart cards to make efficient financial transactions for transit, ferries, and parking, thus making use of alternate modes more at&active. Agencies will have greatly improved information on regional travel movements. Trucks will pass freely through the area with minimal disruption to other highway users. Vehicle safety and efficiency will be greatly improved by in-vehicle sensors and warning devices to minimize incidents and to enhance roadway capacity. Regional air quality will be improved by use of automatic vehicle exhaust emissions monitoring and pricing to encourage the use of “clean” vehicles.

CURRENT SYSTEM:

Central Puget Sound is the focus for IVHS activities. An extensive surveillance and control system on the freeways is aggressively expanding along with improved incident detection and response. Information systems are being developed for coordination with Traffic System Management Centers in Seattle and Tacoma. Various research and pilot tests for transit and demand management improvements are underway, along with efforts to integrate arterial signal systems across jurisdictions and in coordination with freeway operations.

FACTS & FIGURES 3

POPULATION:	EMPLOYMENT:
1990: 2,800,000	1990: 1,500,000
2010: 3,700,000	2010: 2,100,000

VEHICLE MILES OF TRAVEL:	MODAL SHARES (1990):\
1990: 13,705M	Drive Alone: 73 %
2010: N/A	HOV: 12%
	Transit: 6 %
	Other: 9 %

IVHS FOCUS:

Much of the focus of IVHS activities in the Central Puget Sound Region is on projects which support traffic management and encourage the use of alternative modes. The highest rated programs elements were the following:

- Traffic Control-- Arterial traffic signal and freeway-arterial interconnection
- Pre-Trip Planning -- Static and Real- Time displays in various venues
- En-Route Trip Guidance – Smart Traveler Information centers, In-Vehicle display and signing
- Incident Detection and Management -- Automated detection and management
- Freeway Ramp Metering-- Control of freeway traffic flows
- Transportation Demand Management Support -- Automated support for employer and public sector TDM programs. Includes dynamic ridesharing, shared-ride taxi, and employer-based TDM incentives
- Road Pricing Support -- Automated methods of detection and payment to support congestion pricing scheme.

KEY ACTIONS:

NEAR TERM PROJECTS

Public Transit/TDM

Completion of Metro and Ferry AVL systems. Initial (20%) AVL coverage on other transit systems.

Automatic Passenger Counting on key transit routes throughout region.

Transit Systems Integration Project (Metro) -- Integrates APC, Smart Card Fare Collection, Central Logic Unit on Buses.

AREA: CENTRAL PUGET SOUND 3

Public Transit/TDM (Continued)

- Transit Operations Center-- Seattle
- HOV Signal Priority- Complete Kitsap test. Expand to North Seattle ATMS project along SR 99, and to Rainier Avenue. Design demonstration projects in Snohomish Co., Bellevue, Tacoma.
- Test Dynamic Ridesharing-- Smart Traveler
- Employer Commute Trip Reduction Database Development
- AVI probes expansion-- Seattle/Tacoma
- Ferry Management System-- Design AVL system for fleet surveillance. Design automated reservation system, and traveler information.

Traveler Information

- Complete FLOW and Traffic Reporter maps for: Seattle. Extend to District 3 (Tacoma, Olympia).
- Bellevue Smart Traveler Test and expand within Seattle
- Traveler Information test-- Implement on Bainbridge Island, Bellevue, elsewhere
- Traveler information system architecture development, including database-transit, employer commute trip reduction programs.
- Real-Time Transit and Ferry information to Bellevue Smart Traveler Kiosks.
- Complete changeable message signs and Highway Advisory Radio on Freeways.

Traffic Management

- Aggressive completion of freeway surveillance system--data monitoring for traveler information-- 90% complete Seattle freeways, 30% Tacoma freeways,
- Incident Management-- Freeway Service Patrols on all freeways.
- Ramp Metering-- 90 % freeways (Dist 1),30% freeways (Dist 3)
- Traffic Systems Management Center (District 1)- Upgrade software. Integration with District 3
- Interim TSMC (District 3)
- Arterial Interconnect Test-- North Seattle, Green River Valley. Develop specifications for other areas.
- Complete communications system and data fusion design
- Design highly instrumented freeway research and development segment

AREA: CENTRAL PUGET SOUND 4

Freight and Fleet Management

- AVI/AVI, stations on I-5- District 1 nearly complete; Dist 3 initial stages
- HAZMAT data- monitor vehide positions with AWAVL
- Weigh In Motion-- 2 sites equipped with on-highway, at-speed weigh stations
- Vehicle fleets implement electronic record keeping and safety monitors

Additional Services

- Emergency Services- test AVL on fleets in Seattle; Develop test databases and algorithms
- Enforcement Systems- Expand MCN to larger fleet along freeways in Seattle and Tacoma
- Traveler Safety/Security-- Simple in-vehicle sensors, mayday on 5 % new vehicle fleet; Test AVL locator on fleet vehicles.

MIDTERM/PROJECTS

Public Transit/TDM

- Expansion of AVL to other transit agencies and Ferry system
- Transit Operations Centers for all agencies
- Automatic Payment System complete on Metro, expanded to other systems
- Expand UPASS concept to major employers in region
- Initiate AVI access to HOV facilities and parking
- Conduct Tests of Dynamic Ridesharing
- Expand AVI Signal Priority to key arterial routes
- Complete automation of Ferry Reservation System

Traveler Information

- Expand Smart Traveler to key centers in Seattle, Tacoma
- Initiate In-Home and in-office interactive services
- Add Tacoma freeways and arterial routes to Traffic Reporter
- Real-time transit information to Smart Traveler kiosks
- Expand databases for CTR employers and traveler services
- Test personal communications devices and in-vehicle signing

Traffic Management

- Full freeway SC&DI in District 1; 70 % coverage in District 3
- Integrated Smart corridor pilot test
- Completed Research Test Bed
- Expanded arterial traffic signal interconnections
- Interconnect TSMC's in Districts 1 and 3
- Real-time Incident detection data provided to Freeway Service Patrols

Freight and Fleet Management

- Expand AVI stations along freeway system
- Expand HAZMAT tracking
- Support Port Access Projects

Additional Services

- Expand Mobile Communication Network; begin integration of local enforcement systems

LONG TERM PROJECTS

Public Transit/TDM

- Complete Ferry System AVL and automatic reservation system
- Integrate dynamic ridesharing at kiosks and other venues
- Implement shared ride taxi program
- Test HOV Automated highway lane
- HOV AVI access to HOV lanes and priority parking
- Fully automated support of employer TDM programs
- Implement congestion management system support in selected corridors

Traveler Information

- Fully integrated traveler information database (traffic, modes, employers, visitor services)
- Traffic FLOW map for all freeways and 50% arterials
- Expand in-vehicle and portable traveler displays
- Smart Traveler expanded to key activity centers and in-home interactive services

AREA: CENTRAL PUGET SOUND 6

Traffic Management

- Fully automated Incident detection on freeways and 50% arterials
- SC&DI on 100% freeways and 50% arterials
- Ramp Metering on all freeways
- Fully integrated Traffic Systems Management Centers in Districts 1 and 3
- Arterial Traffic Signal Interconnections on major arterial systems
- Freeway-Arterial interconnection along major corridors

Freight-and Fleet Management

- Integrated modal planning capability
- Integration of port access with *freeway-arterial* traffic management
- Full HAZMAT location and identity knowledge
- Fully automated on-highway, at-speed weigh stations

Additional Services

- Integrated state and local mobile communications network
- MAYDAY option on most vehicles
- Automated accident "reconstructor" for police assistance

APPENDIX C

IVHS REGIONAL ACTION PLAN FOR VANCOUVER

Source: Final Report: IVHS Strategic Plan for Washington State, November 1993

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AREA: VANCOUVER

1

IVHS VISION:

Vancouver holds a unique position in the State given its close proximity to the Portland, Oregon region. As such, residents, visitors and freight travel frequently across the border. Cross-border travelers will benefit from real-time traffic and modal information to better plan trip making. Visitors will be greeted by a travel information center and in-vehicle displays providing route selection and guidance to major regional and statewide destinations. Alternate mode information will also be provided. Information for residents will be available through a variety of sources-- at home, office; in-vehicle, through hand-held devices in order to provide flexibility in travel behavior. The information database will be coordinated with similar data in Portland, while a Traffic Systems Management Center will coordinate traffic flows within the bi-state region. A real-time traffic management system along I-5, I-205, and key arterials will provide safe and efficient movement of people and commercial vehicles. Incidents on the highway system will be immediately identified and quick response teams will clear the roads to minimize delay. Arterial traffic signals will be closely coordinated with freeway operations. CTRAN Transit system operations will be greatly improved since operators will have real-time knowledge of vehicle locations, condition, and locations of congestion. Demand responsive paratransit service will enhance mobility for rural residents. Rural residents and travelers will also benefit from mayday devices and real-time emergency vehicle dispatch. Consumers will begin to use smart cards to make efficient financial transactions for transit and parking, thus making use of alternate modes more attractive. Trucks will pass freely through the area and to/from the border and Port of Vancouver with minimal disruption and with one-stop credential checking capabilities. Vehicle safety will be greatly improved by in-vehicle sensors and warning devices to minimize incidents.

CURRENT SYSTEM:

Vancouver has limited IVHS experience to date. WSDOT is in the early stages of developing an SC&DI system on I-5, in coordination with ODOT efforts in Portland. The City is working to upgrade the arterial signal system

FACTS & FIGURES

POPULATION:
1990: 250,000
2020: 347,000

EMPLOYMENT:
1990: 118,000
2010: N/A

VEHICLE MILES OF TRAVEL:
1990: 94SM
2010: N/A

MODAL SHARES (1990):
Drive Alone: 81%
HOV: 11%
Transit: 2 %
Other: 6%

2

AREA: VANCOUVER

IVHS FOCUS:

IVHS activities in Vancouver will focus on improved traffic management and provision of better information to travelers. The highest rated programs elements were the following:

- Traffic Control-- Arterial traffic signal and freeway-arterial interconnection
- Pre-Trip Planning -- Static and Real- Time displays in various venues
- En-Route Trip Guidance -- Smart Traveler Information centers--In-Vehicle display and signing
- Incident Detection and Management -- Automated detection and management
- Freeway Ramp Metering-- Control of freeway traffic flows

These focus areas also relate closely to the improvement of commercial goods flows across the border and to/from the Port of Vancouver

KEY ACTIONS:

NEAR TERM PROJECTS

Public Transit/TDM

- Design AVL Monitoring System on CTran
- Design automatic fare collection using Smart Cards
- Test use of smart-cards and AVI at major employment sites to support TDM

Traveler Information

- Partial freeway Changeable Message Signs
- Develop traveler information database-- transit, employer commute trip reduction programs, tourist data.
- Design Communications System

AREA VANCOUVER

Traffic Management

- Develop Action Plan for freeway surveillance system on key segments
- Integrate communications interties and joint operating agreements with ODOT
- Incident Management- Incident response teams and state patrol beats
- Design Ramp Metering on I-5 and I-205 .
- Upgrade arterial signal control system in City of Vancouver
- Design Interim Traffic Systems Management Center. Link to transit

Freight and Fleet Management

- Design AVI stations on I-5 & I-205
- Design AVI HAZMAT monitoring
- Design on-highway, at-speed weigh stations
- Automate I-5 and I-205 border preclearance for trucks

Additional Services

- Enforcement Systems- Test MCN
- Traveler Safety/Security-- Simple in-vehicle sensors, mayday on 5% new vehicle fleet;

MIDTERM PROJECTS

Public Transit/TDM

- Implement partial AVL within CTran fleet
- Design Transit Operations Center
- Automatic Payment System expanded
- Test UPASS concept at major employers in region
- Initiate AVI access to HOV facilities and parking
- Conduct Tests of Dynamic Ridesharing and personalized pickup
- Test Signal Priority on key arterial routes

Traveler Information

- Test Smart Traveler program at key centers in Vancouver.Test real-time transit information for selected AVL routes
- Initiate In-Home and in-office interactive services
- Initiate real-time Traffic Reporter system on freeways
- Expand databases for CTR employers and traveler services

AREA VANCOUVER

4

Traffic Management

- Freeway SC&DI on most freeway segments--Integrate with Portland (ODOT)
- Expand arterial traffic signal interconnections
- Test Real-time Incident detection data provided to Freeway Service Patrols
- Design Smart Corridor along I-5

Freight and Fleet Management

- Pilot real time dispatch for commercial vehicles
- Expand AVI stations along freeway system
- Expand HAZMAT tracking
- Design multi-state permits process
- Test integration of port access with arterial traffic management system

Additional Services

- Expand Mobile Communication Network
- Mayday available on many new vehicles

LONG TERM PROJECTS

Public Transit/TDM

- AVL system on most of CTran fleet
- Implement shared ride taxi program
- Integrate dynamic ridesharing and personalized pickup service at kiosks and other venues
- Complete automatic fare collection system
- HOV AVI access to HOV lanes and priority parking facilities
- Fully automated support of major employer TDM programs
- Expand traffic signal priority on arterials

Traveler Information .

- Integrated traveler information database (traffic, modes, employers, visitor services)
- Traffic FLOW map for all freeways and 30% arterials
- Expand in-vehicle and portable traveler displays for enroute information
- Smart Traveler expanded to key activity centers and in-home interactive services

AREA 5 VANCOUVER

Traffic Management

- Fully automated Incident detection on freeways and 50% arterials
- SC&DI on 100% freeways and 50% arterials
- Ramp Metering on all freeways
- Permanent Traffic Systems Management Center
- Arterial Traffic Signal Interconnections on major arterial systems
- Freeway-Arterial Smart Corridor implemented along I-5
- Integrated freeway/arterial and transit management center

Freight and Fleet Management

- Integrated modal planning capability
- Full HAZMAT location and identity knowledge
- Fully automated on-highway, at-speed weigh stations
- Integrated credentials checking with Idaho border crossing

Additional Services

- Integrated state and local mobile communications network
- MAYDAY option on most vehicles
- Automated **accident** "reconstructor" for police assistance

APPENDIX D

IVHS REGIONAL ACTION PLAN FOR INTERCITY/RURAL

Source: Final Report: IVHS Strategic Plan for Washington State, November 1993

AREA: INTERCITY/RURAL

1

IVHS VISION:

Outside of the urban areas of the state, the primary transportation focus is on intercity travel movements and provision of safe and efficient travel within rural communities. Travelers in this domain will enjoy improved safety and security, improved travel information (both regionally and for intercity travel), and more efficient movement of goods and services. Safety will be enhanced through in-vehicle sensors and warning devices, while vehicles equipped with mayday devices will provide security to rural residents and intercity travelers. Hazardous roadway segments will be monitored on key intercity routes and motorists will be immediately informed of conditions. Weather sensors will warn of adverse conditions on grades. Travel information for residents and visitors will include all modes of travel-- private vehicles, transit modes (including intercity), trucking, rail, and ferry in order to provide users with real-time choices regarding travel options. Tourist information for statewide and regional attractions and accommodations will be readily available to visitors. Traveler information data will be available through a variety of sources-- at home, office; information centers; in-vehicle displays, and through hand-held devices. A statewide communications plan will exist to coordinate this information. Incidents on the highway system will be quickly identified so that the roads may be cleared to minimize delay. Real-time transit dispatch capabilities will make personalized pickup services more attractive to residents living in low density areas. Trucks will pass freely throughout the state, taking advantage of paperless credential tracking, automated weigh stations, and pre-clearance at state and national borders.

CURRENT SYSTEM:

The small urban areas have very limited IVHS activities to date. Several transit agencies are working to upgrade paratransit dispatch capabilities, while signal systems have been improved in some communities. Intercity and cross-border trucking operations are being investigated through the HELP/Crescent project. WSDOT has installed several weather/pavement sensors in rural areas and is implementing the Travelaid project on I-90 across Snoqualmie Pass. Travel information centers are being upgraded.

FACTS & FIGURES

POPULATION:
1990: 650,000

EMPLOYMENT:
1990: 350,000

VEHICLE MILES OF TRAVEL:
Rural: 6,513M (26% of State)
State: 24,900M

AREA INTERCITY/RURAL

IVHS FOCUS:

The Intercity/Rural market for IVHS varies considerably from the urban areas of the state. The focus of activity will be on the provision of improved information for travelers, efficient handling of incidents, traveler safety, and freight regulatory support. The highest rated programs elements were the following:

- Incident Detection and Management – Automated detection and management
- En-Route Trip Guidance- In-vehicle information displays, route selection, and variable speed control. Specific attention to the Canadian Border Crossing.
- Pre-Trip Planning – Static and Real- Time displays in various locations
- Freight and Fleet Regulatory Support-- Streamlined border crossings, paperwork reduction
- Traveler Safety and Security--MAYDAY devices on vehicles

KEY ACTIONS:

NEAR TERM PROJECTS

Public Transit/TDM

- Emergency Communications on transit vehicles
- Study automated ferry reservation system for San Juan Islands

Traveler Information

- Selective Highway Advisory Radio
- Travelaid Test of Variable Speed Limits and in-vehicle signing on Snoquahnie Pass
- Initiate Statewide traveler information database-- Statewide road status, employer commute trip reduction programs, tourist data.
- Improved static information at tourist centers
- Canadian Border crossing advisory signs (I-5)

AREA INTERCITY/RURAL

3

Traffic Management

- I-5 Corridor Communications Plan (Seattle-Portland). Segments of Statewide communications links
- Rural Town Traffic Signal systems
- Expand HPMS data collection sites
- Study hazardous safety locations for IVHS applications
- Install Weather/environmental sensors
- Incident Management-Improve emergency response coordination

Freight and Fleet Management

- Design on-highway, at-speed weigh stations
- Expand truck AVI stations on Freeways
- Upgrade Canadian Border Crossing preclearance system
- Test HAZMAT AVI monitoring system
- Electronic data interchange among states (IRP, IFTA Members) using VISTA

Additional Services

- Test emergency service vehicle AVL systems
- Install portable changeable message signs
- Enforcement Systems- Expand Mobile Communications Network (MCN) applications
  - -Test Truck scale evasion enforcement
- Traveler Safety/Security-- Simple in-vehicle sensors
  - -Design Countywide MAYDAY test

MIDTERM: PROJECTS

Public Transit/TDM

- Test Automatic Payment Systems on selected rural bus fleets
- Implement automated ferry reservation system in San Juan Islands
- Design personalized pickup (paratransit) service

AREA: INTERCITY/RURAL

Traveler Information

- Partial freeway Changeable Message Signs
- Expand statewide traveler databases, *including red-time* travel time data.
- Install interactive traveler kiosks at visitor travel information centers
- Expand Travelaid (in-vehicle display and signing) to other corridors
- Test *red-time* border crossing information

Traffic Management

- Expand urban I-5 SC&DI on priority freeway segments
- Develop mobile Traffic Systems Management Centers--emergency response
- Complete statewide communications plan and integration needs
- Continue traffic signal system upgrades in other rural towns
- Design freeway-arterial interconnects
- Test variable speed control applications (tied to Travelaid)

Freight and Fleet Management

- Expand AVI stations along freeway system
- Install HAZMAT tracking using AVI
- Test speed/weight monitoring on steep grades
- Implement multi-state/province permits process
- Install advanced truck enforcement stations

Additional Services

- Expand AVL tracking of emergency vehicles; add real-time dispatch
- Expand Mobile Communication Network
- Conduct MAYDAY pilot test

LONG TERM PROJECTS

Public Transit/TDM

- Expand automated payment for transit fleets
- Implement automated paratransit programs (i.e. rural dial-a-ride)
- Test dynamic ridesharing concept at major employers
- Partially automated support of major employer TDM programs
- Automated ferry reservation system

AREA: 5

Traveler Information

- Integrated statewide traveler information database (statewide road information, status, traffic, modes, employers, visitor services)
- Integrated real-time tourist information
- Expand Travelaid to other areas
- Test in-vehicle and portable traveler displays for enroute information
- Install Smart Traveler at key activity centers and in-home interactive services

Traffic Management

- Fully automated Incident detection on most major inter-city routes ,
- Continue hazard treatments
- Limited expansion of SC&DI to priority freeway segments
- Traffic Signal system upgrades in ten towns
- Implement freeway-arterial interconnects on priority routes

Freight and Fleet Management

- Full Integrated modal planning capability
- HAZMAT location and identity knowledge on key roadway segments
- Fully automated on-highway, at-speed weigh stations throughout state
- Integrated credentials checking with border crossings.

Additional Services

- Integrated state and local mobile communications network
- MAYDAY option on most vehicles. System expansion throughout state.
- Automated accident "reconstructor" for police assistance

APPENDIX E

IVHS USER SERVICES

Source: IVHS Architecture Development Plan, Interim Status Report, U.S. Department of Transportation, April, 1994.

USER SERVICES

To achieve IVHS goals, a number of capabilities, or "user services" have been identified There are currently 28 services in the broad areas of Travel and Traffic Management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, and Advanced Vehicle Safety Systems. While still evolving, these services collectively define near, mid, and long term capabilities that will likely comprise IVHS. Consequently, each architecture alternative will address all of the following 28 user services.

Travel and Traffic Management

PRE-TRIP TRAVEL INFORMATION

Provides information for selecting the best departure times, transportation modes, and routes.

Travelers access a complete range of intermodal transportation information at home, work, and other major sites where trips originate. For example, timely information on transit routes, schedules, transfers and fares, and ride matching services are included. Real-time information on accidents, road construction, alternate routes, traffic speeds along given routes, parking conditions, event schedules, and weather information complete the service. Based on this information, the traveler can select the best departure time, route and modes of travel, or decide to postpone or not to make the trip at all. Reducing congestion and improving mobility benefits all potential travelers.

EN-ROUTE DRIVER INFORMATION

Driver advisories and in-vehicle signing improve convenience and safety.

Driver advisories are similar to pre-trip planning information, but are provided once travel begins. Driver advisories convey information about traffic conditions, incidents, construction, transit schedules, and weather conditions to drivers of personal, commercial and public transit vehicles. This information allows a driver to select the best route, or shift to another mode mid-trip if desired.

In-vehicle signing, the second component of en-route driver information, would provide the same types of information found on physical road signs today, directly in the vehicle. The service could be extended to include warnings of road conditions and safe speeds for specific types of vehicles (e.g., autos, buses, large trucks), but potential users include drivers of all types of vehicles. This service might be especially useful to elderly drivers, or in rural areas with large numbers of tourists and unusual or hazardous roadway conditions.

TRAVELER SERVICES INFORMATION

Provides a reference directory, or "yellow pages", of service information.

Provides quick access to travel related services and facilities. Examples of information that might be included are the location, operating hours, and availability of food, parking, auto repair, hospitals, and police facilities. Traveler services information would be accessible in the home, office or other public locations to help plan trips, and might also be available en route. When fully deployed, this service will connect users and providers interactively, to request and provide needed information. A comprehensive, integrated service could support financial transactions like automatic billing for purchases.

IVHS User Services

Travel and Traffic Management
- Pre-Trip Travel Information
- En-Route Driver Information
- Traveler Services Information
- Route Guidance
- Ride Matching and Reservation
- Incident Management
- Travel Demand Management
- Traffic Control

Public Transportation Management
- En Route Transit Information
- Public Transportation Management
- Personalized Public Transit
- Public Travel Security

Electronic Payment
- Electronic Payment Services

Commercial Vehicle Operations
- Commercial Vehicle Electronic Clearance
- Automated Roadside Safety Inspection
- Commercial Vehicle Administrative Processes
- On-Board Safety Monitoring
- Commercial Fleet Management
- Hazardous Material Incident Notification

Emergency Management
- Emergency Vehicle Management
- Emergency Notification and Personal Security

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

ROUTE GUIDANCE

Provides travelers with simple instructions on how to reach their destinations.

Provides a suggested route to reach a specified destination. Early route guidance systems will be based on static information about the roadway network, transit schedules, etc. When fully deployed, route guidance systems will provide travelers with directions to their destinations based on real-time information about the transportation system. The route guidance service will consider traffic conditions, status and schedule of transit systems, and road closures in developing the best route. Directions will generally consist of simple instructions on turns or other upcoming maneuvers. Users of the service include not only drivers of all types of vehicles, but also non-vehicular travelers, such as pedestrians or bicyclists, who could get specialized route guidance from a hand-held device.

RIDE MATCHING AND RESERVATION

Makes ride sharing more convenient.

Provides real-time ride matching information and reservations to users in their homes, offices or other locations, and assists transportation providers with vehicle assignments and scheduling. The service will also provide a clearinghouse for financial transactions. This will expand the market for ridesharing as an alternative to single occupant automobile travel, and will provide for enhanced alternatives for special population groups, such as the elderly or the handicapped. Convenient ride sharing is especially important to commuters.

INCIDENT MANAGEMENT

Helps officials quickly identify incidents and implement a response to minimize their effects on traffic.

Enhances existing capabilities for detecting incidents and taking the appropriate actions in response to them. The service will help officials quickly and accurately identify a variety of incidents, and to implement a response which minimizes the effects of these incidents on the movement of people and goods. Traffic movement adjustments over a wide area would be executed through the Traffic Control user service, while decisions at the site of the incident will be made by police agencies. In addition, the service will help officials to predict traffic or highway conditions so that they can take action in advance to prevent potential incidents or minimize their impacts. While the users of this service are primarily public officials, commercial and transit operators, and the traveling public all benefit from improved incident management capabilities.

TRAVEL DEMAND MANAGEMENT

Supports policies and regulations designed to mitigate the environmental and social impacts of traffic congestion.

Generates and communicates management and control strategies that support the implementation of programs to (1) reduce the number of individuals who choose to drive alone, especially to work, (2) increase the use of high occupancy vehicles and transit, (3) reduce the impacts of high polluting vehicles, and (4) provide a variety of mobility options for those who wish to travel in a more efficient manner, for example in non-peak periods. The service allows employers to better accommodate the needs and lifestyles of employees by encouraging alternative work arrangements such as variable work hours, compressed work weeks, and telecommuting. Travel demand management strategies could ultimately be applied dynamically, when congestion or pollution conditions warrant For example, disincentives such as increased tolls and parking fees could be applied during pollution alerts or when major incidents occur, while transit fares would be lowered to accommodate the increased number of travelers changing modes from driving alone. Such strategies will reduce the negative impacts of traffic congestion on the environment and overall quality of life.

TRAFFIC CONTROL

Manages the movement of traffic on *streets and highways.*

Integrates and adaptively controls the freeway and surface street systems to improve the flow of traffic, give preference to transit and other high occupancy vehicles, and minimize congestion while maximizing the movement of people and goods. Through appropriate traffic controls, the service will also promote the safety of non-vehicular travelers, such as pedestrians and bicyclists. This service gathers data from the transportation system, fuses it into usable information, and uses it to determine the optimum assignment of right-of-way to vehicles and pedestrians. The real-time traffic information collected by the Traffic Control service also provides the foundation for many other user services.

While the actual users of the service will generally be public transportation officials, drivers of all types of vehicles, transit riders, pedestrians, bicyclists, and other travelers benefit from improved traffic flow.

Public Transportation Management

EN ROUTE TRANSIT INFORMATION

Provides information to travelers using public transportation after they begin their trips.

Provides the same type of information as pre-trip planning services, once public transportation travel begins. Real-time, accurate transit service information on board the vehicle helps travelers make effective transfer decisions and itinerary modifications as needed while a trip in underway.

PUBLIC TRANSPORTATION MANAGEMENT

Automates operations, planning, and management functions of public transit systems.

Computer analysis of real-time vehicle and facility status will improve operations and maintenance. The analysis identifies deviations from schedule and provides potential solutions to dispatchers and drivers. Integrating this capability with the Traffic Control Service can help maintain transportation schedules and assure transfer connections in intermodal transportation. Information regarding passenger loading, bus running times, and mileage accumulated will help improve service and facilitate administrative reporting. Automatically recording and verifying performed tasks will enhance transit personnel management. Improved efficiency benefits transit providers and customers alike.

PERSONALIZED PUBLIC TRANSIT

Flexibly routed transit vehicles offer more convenient service to customers.

Small publicly or privately operated vehicles operate on-demand assignments to pick up passengers who have requested service and deliver them to their destinations. Route deviation schemes, where vehicles would leave a fixed route for a short distance to pick up or discharge passengers, is another way of improving service under certain conditions. These transit vehicles can consist of small buses, taxicabs, or other small shared ride vehicles. They can essentially provide "door-to-dooi' service, expanding a route's coverage area in less populated locations and neighborhoods. This service can potentially provide transportation at lower cost and with greater convenience than conventional fixed route transit.

PUBLIC TRAVEL SECURITY

Creates a secure environment for public transportation patrons and operators.

Systems monitor the environment in transit stations, parking lots, bus stops, and transit vehicles and generate alarms either automatically or manually as necessary. This improves security for both transit riders and operators. Transportation agencies and authorities can integrate this user service with other anti-crime plans.

Electronic Payment

ELECTRONIC PAYMENT SERVICES

Allow travelers to pay for transportation services electronically with "smart cards"

Will foster intermodal travel by providing a common electronic payment medium for all transportation modes and functions, including tolls, transit fares, and parking. A common service fee and payment structure, employing multi-use "smart cards", could integrate all modes of transportation including roadway pricing options. The flexibility electronic payment services offer will have an impact on travel demand management. In particular, they will enable relatively easy application of road pricing policies and could significantly influence departure times and mode selection. Electronic payment's primary benefit is convenience for all travelers and transportation providers.

Commercial Vehicle Operations

COMMERCIAL VEHICLE ELECTRONIC CLEARANCE

Facilitates domestic and international border clearance, minimizing stops.

This service will enable transponder-equipped trucks and buses to have their safety status, credentials, and weight checked at mainline speeds. Vehicles that are safe and legal and have no outstanding out-of-service citations will be allowed to pass the inspection/weigh facility without delay.

By working with Mexico and Canada, a more efficient traffic flow would be provided at border crossings and the deployment of technologies in these countries could ultimately prevent overweight, unsafe, or improperly registered vehicles from entering the United States. Truckers, shippers, and regulators will all benefit from improved productivity.

AUTOMATED ROADSIDE SAFETY INSPECTION

Automated roadside inspections would allow "real-time" access at the roadside to the safety performance record of carriers, vehicles, and drivers. Such access will help determine which vehicle or driver should be stopped for an inspection, as well as ensuring timely correction of previously identified problems.

Facilitates roadside inspections.

It would, for example, allow for more rapid and accurate inspection of brake performance at the roadside. Through the use of sensors and diagnostics, it would efficiently check vehicle systems and driver requirements and ultimately driver alertness and fitness for duty. Improved safety benefits truckers, shippers and regulators.

COMMERCIAL VEHICLE ADMINISTRATIVE PROCESSES

Electronically purchasing credentials would provide the carrier with the capability to electronically purchase annual and temporary credentials via computer link. It will reduce burdensome paperwork and processing time for both the states and the motor carriers.

Provides electronic purchasing of credentials and automated mileage and fuel reporting.

For automated mileage aud fuel reporting and auditing, this service would enable participating interstate carriers to electronically capture mileage, fuel purchased, trip, and vehicle data by state. It would also automatically determine mileage traveled and fuel purchased in each state, for use by the carrier in preparing fuel tax and registration reports to the states. Currently, the administrative burden on carriers to collect and report mileage and fuel purchased within each state is significant. This service would significantly reduce the cost for collecting both types of data

ON-BOARD SAFETY MONITORING

Senses the safety status of a commercial vehicle, cargo, and driver.

On-board systems would monitor the safety status of a vehicle, cargo, and driver at mainline speeds. Vehicle monitoring would include sensing and collecting data on the condition of critical vehicle components such as brakes, tires, and lights, and determining thresholds for warnings and countermeasures. Cargo monitoring would involve sensing unsafe conditions relating to vehicle cargo, such as shifts in cargo while the vehicle is in operation. Driver monitoring is envisioned to include the monitoring of driving time and alertness using non-intrusive technology and the development of warning systems for the driver, the carrier, and the enforcement official. A warning of unsafe condition would first be provided to the driver, then to the carrier and roadside enforcement officials and would possibly prevent an accident before it happens. This service would minimize driver and equipment-related accidents for participating carriers.

COMMERCLAL FLEET MANAGEMENT

The availability of real-time traffic information and vehicle location for commercial vehicles would help dispatchers to better manage fleet operations by helping their drivers to avoid congested areas and would

Provides communications between drivers, dispatchers, and intermodal transportation providers.

also improve the reliability and efficiency of carriers' pickup-and-delivery operations. The benefits from this service would be substantial for those intermodal and time-sensitive fleets that can use these IVHS technologies to make their operations more efficient and reliable.

HAZARDOUS MATERIALS AND INCIDENT NOTIFICATION

Provides immediate notification of an incident and immediate request for assistance.

Enhances the safety of shipments of hazardous materials by providing enforcement and response teams with timely, accurate information on cargo contents to enable them to react properly in emergency situations. The system would focus on determining when an incident involving a truck carrying hazardous material occurs, the nature and location of the incident, and the material or combination of materials involved so that the incident can be handled properly.

Emergency Management

EMERGENCY VEHICLE MANAGEMENT

Reduces the time it takes to respond to incident notification.

This user service includes three capabilities: fleet management, route guidance, and signal priority. Fleet management will improve the display of emergency vehicle locations and help dispatchers efficiently task the units that can most quickly reach an incident site. Route guidance directs emergency vehicles to an incident location. Signal priority clears traffic signals in an emergency vehicle's route. Primary users include police, fire, and medical units.

EMERGENCY NOTIFICATION AND PERSONAL SECURITY

Provides immediate notification of an incident and an immediate request for assistance.

This service includes two capabilities: driver and personal security and automatic collision notification. Driver and personal security capabilities provide for user initiated distress signals for incidents like mechanical breakdowns and carjackings. Automatic collision notification identifies a collision and automatically sends information regarding location, nature, and severity to emergency personnel.

Advanced Vehicle Safety Systems

LONGITUDINAL COLLISION AVOIDANCE

Helps prevent head-on and rear-end collisions between vehicles and other objects or pedestrians

Helps reduce the number and severity of collisions. It includes the sensing of potential or impending collisions, prompting a driver's avoidance actions, and temporarily controlling the vehicle.

LATERAL COLLISION AVOIDANCE

Helps prevent collisions when vehicles leave their lane of travel.

Provides crash warnings and controls for lane changes and road departures. It will help reduce the number of lateral collisions involving two or more vehicles, or crashes involving a single vehicle leaving the roadway.

For lane changes, a situation display can continuously monitor the vehicle's blind spot- and drivers can be actively warned of an impending collision. If needed, automatic control can effectively respond to situations very rapidly. Warning systems can also alert a driver to an impending road departure, provide help in keeping the vehicle in the lane, and ultimately provide automatic control of steering and throttle in dangerous situations.

INTERSECTION COLLISION AVOIDANCE

Helps prevent collisions at intersections.

Warns drivers of imminent collisions when approaching or crossing an intersection that has traffic control (e.g. stop signs or traffic signals). This service also alerts the driver when the right-of-way at the intersection is unclear or ambiguous.

VISION ENHANCEMENT FOR CRASH AVOIDANCE

Improves the driver's ability to see the roadway and objects that are on or along the roadway.

Improved visibility would allow the driver to avoid potential collisions with other vehicles or obstacles in the roadway, as well as help the driver comply with traffic signs and signals. This service requires vehicle equipment for sensing potential hazards, processing this information, and displaying it in a way that is useful to a driver.

SAFETY READINESS

Provides warnings regarding the condition of the driver, the vehicle, and the roadway.

In-vehicle equipment could unobtrusively gauge a driver's condition and provide a warning if he or she is drowsy or otherwise impaired. This service could also internally monitor critical components of an auto beyond the standard oil pressure and engine temperature lights. Equipment within the vehicle could also detect unsafe road conditions, such as bridge icing and standing water on a roadway, and provide a warning to the driver.

PRE-CRASH RESTRAINT DEPLOYMENT

Anticipates an imminent collision and activates passenger safety systems prior to collision.

Identifies the velocity, mass, and direction of the vehicles and objects involved in a potential crash and the number, location, and major physical characteristics of any occupants. Responses include tightening lap-shoulder belts, arming and deploying air bags at an optimal pressure, and deploying roll bars.

AUTOMATED VEHICLE OPERATION

Provides a fully automated, "hands off" operating environment.

Automated vehicle operations are a long term goal of IVHS which would provide vast improvements in safety by creating a nearly accident free driving environment. Drivers could buy vehicles with the necessary instrumentation or retrofit an existing vehicle. Vehicles that are incapable of automated operation, during some transition period, will drive in lanes without automation.