Washington State
Department of Transportation

Measures, Markers and Mileposts

The Gray Notebook for the quarter ending
September 30, 2007

WSDOT's quarterly report to the Governor, the Legislature, and the Washington State Transportation Commission on transportation programs and department management

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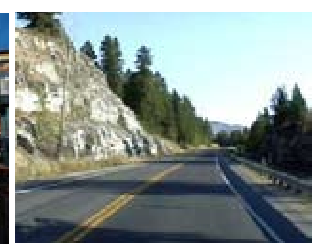
Secretary of Transportation

Measuring Delay and Congestion: Annual Update
Excerpt from the September 30, 2007 Edition



Measuring Delay and Congestion: Annual Update

Introduction

New Jobs, More People, More Trips, More Congestion: Washington's Economy and Population Continues to Thrive

As Washington's robust economy continues to grow, so does congestion. More people want to travel on the same roads at the same time. Between 2004 and 2006, the central Puget Sound population and economy continued to flourish. In 2007, Forbes Magazine ranked Washington state as the 5th best state for business. Between 2004 and 2006, the Puget Sound's transportation system had to absorb 107,000 new residents and 91,000 new jobs.

2007 Report Analyzes the Most Congested Commute Routes

The annual congestion report compares 2004 and 2006 calendar year for the most congested routes in the Puget Sound region. WSDOT archives real-time data for 51 commute routes in the Puget Sound region. This data is collected from over 5,000 loop detectors embedded in the pavement of the 709 center lane miles. For this report, data is analyzed to measure highway congestion on the 38 most congested commute routes and, as such, represents the worst case scenarios. It is not representative of the entire highway system.

The following report's detailed congestion analysis shows where and how much congestion occurs. Commuters are traveling at slower speeds and spending longer periods of time stuck in traffic during morning and evening commutes.

For more information on specific commutes in the central Puget Sound, visit WSDOT's congestion web site at http://www.wsdot.wa.gov/congestion.

Commute Times have increased on Many of the Most Congested Routes

- The average commute time during peak congestion increased on 32 (84%) of the 38 commute routes tracked, from a 1 minute to a 7 minute increase (see pp. 61-69).
- Thirty three (87%) of the routes show a decrease in reliability as the 95% reliable travel time increased, from 1 minute to 10 minute increase (see pp. 61-69).
- Congested periods (duration of peak period) last longer on 34 (89%) of the commute routes, from 5 minute to 1 hour and 35 minute increase (see pp. 61-69).
- Compared to maximum throughput speeds, commuters experienced an average of over 3 million additional hours of delay (18% increase from 2004 to 2006) (see pp. 73-74).

WSDOT Uses Balanced Strategies to Maximize Highway Throughput and Enhance Reliability

Congestion impacts everyone. It can affect how safely we travel; how well we can predict how long it will take to get to work, to day care, to the airport; and how much of our time is taken traveling to those places. WSDOT deploys effective strategies to lessen the duration of congestion, making trips more reliable and safe and improving overall traffic flow. The following table illustrates these strategies and the opportunities to provide more of these solutions if funding is available. In this annual congestion update, the Highway Systems Plan, and in many other publications and presentations, WSDOT emphasizes its key congestion management objectives: maximize system throughput and enhance reliability.

WSDOT's Key Strategies to Fight Congestion

Approach	Strategies to Fight Congestion	Specific Strategies Discussed in this Report
Manage Demand (Provide Options)	WSDOT can reduce demand on the transportation system by providing citizens with options such as HOV lanes, Commute Trip Reduction programs, and Traveler Information.	**HOV Lane Performance:** More people travel through HOV lanes than general purpose lanes on most highways., pp.75-78. **Commute Trip Reduction:** Commute options resulted in 19,200 fewer vehicle trips taken each weekday morning in 2007, p. 80.
Operate Efficiently	WSDOT can make the existing system operate more efficiently by using tools such as ramp meters, synchronized traffic signals, and incident response trucks to clear traffic incidents.	**Signal Synchronization**: Along SR 532 travel times have been reduced by up to 6 minutes, p.81. **Incident Response:** Incident Response Trucks responded to and cleared 13,401 incidents during the 3rd quarter of 2007, pp. 87-91.
Add Capacity Strategically	By March 31, 2007, WSDOT will have completed or started more than half of the 392 capital projects that were funded through the Nickel and Transportation Partnership Agreement (TPA) funding packages. Capital projects improve safety by increasing highway capacity to relieve chokepoints that cause recurring congestion.	**Project Delivery:** WSDOT will have either completed or started construction on over half of the Nickel and TPA capital funding projects, pp. 26-27. **Tacoma Narrows Bridge** has reduced congestion and increased speeds during peak congestion, p. 84.

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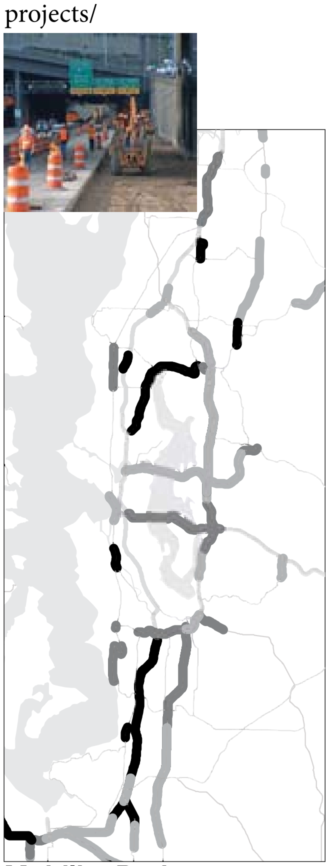
WSDOT's Balanced Strategies to Fight Congestion in Action

Strategically add capacity. The map below shows the segments of highway where WSDOT is delivering $6.5 billion in capital improvement projects to improve safety and increase highway capacity to relieve chokepoints that cause recurring congestion.

33 of the 110 Nickel and TPA capital projects that have been delivered to date add capacity and relieve chokepoints in the central Puget Sound region at a cost of $680.4 million. For more information, go to http://www.wsdot.wa.gov/projects/



Mobility Projects

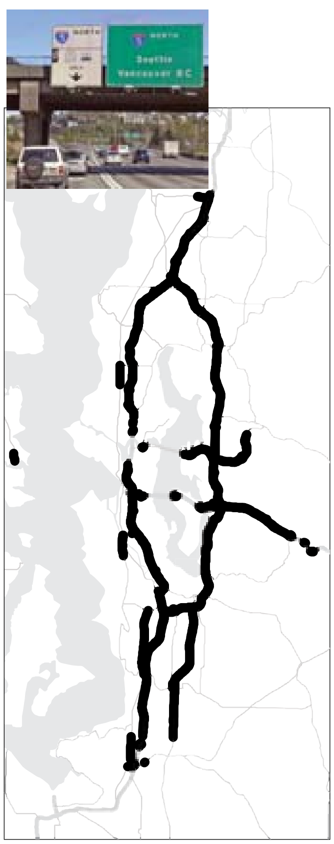
Complete- 33 projects

In Progress- 24 projects

Future- 68 projects

Manage Demand. The map below shows where the 205 miles of HOV lanes are located in the central Puget Sound region. Nearly 100 additional miles of HOV lanes are planned to extend the current system.

The goal of the HOV lane network is to enhance the efficiency of the freeway network by moving more people in fewer vehicles. For more information on the HOV system, go to http://www.wsdot.wa.gov/hov



HOV Lanes

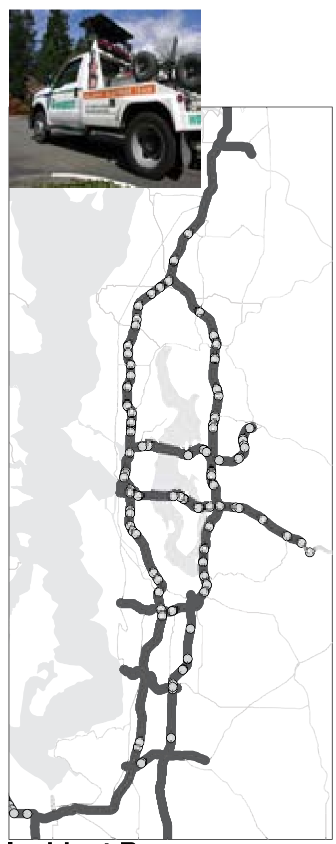
HOV Lanes

Operate Efficiently. The maps below show where WSDOT incident response trucks patrol, where variable message signs provide drivers with travel information, and where ramp meters are located to improve vehicle throughput.

There are 55 incident response vehicles on the freeways to assist drivers and keep traffic flowing when there is an incident. The number of incidents to which WSDOT has responded increased from 17,479 in 2002 to 59,276 in 2006. For more performance information, go to http://www.wsdot.wa.gov/operations/incidentresponse/

Of the 179 variable message signs statewide, 80 are permanently located in the Puget Sound area. These boards have become an important tool for managing traveler expectations. For more information, please go to http://www.wsdot.wa.gov/traffic/seattle/vms/.

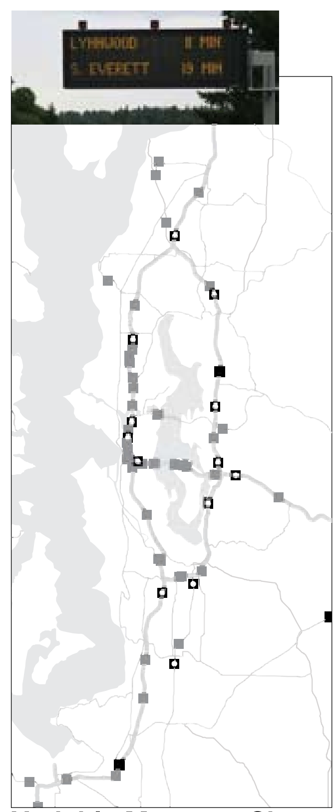
Ramp meters are a proven means of increasing traffic throughput. Since 1981, WSDOT has increased its use of ramp meters in the Puget Sound from 22 to 135 meters.



Incident Response Routes and Ramp Meters

Roving Truck Routes

Ramp Meters- 135



Variable Message Signs

Planned- 13

Current- 80

Display Travel Times- 13

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WSDOT's Balanced Strategies to Fight Congestion in Action

The 2007 annual update on congestion highlights WSDOT's effort to deploy effective strategies to lessen the duration of congestion, making trips more reliable and safe and improving overall traffic flow. Examples of how WSDOT's balanced strategies are working to improve congested conditions in the central Puget Sound region include:

- **Keeping traffic moving during construction.** WSDOT managed demand on I-5 northbound to remove over 57,000 vehicles during construction to maintain maximum throughput by working extensively with local governments, businesses, and transit agencies. See p. 79.
- **Synchronizing signals to improve travel times.** WSDOT retimed lights along SR 532 in Stanwood improved travel times during the morning commute by 2 minutes, and by 6 minutes during the evening commute. See p. 81.
- **Strategically adding capacity to relieve chokepoints and bottlenecks.** WSDOT completed the new eastbound span of the Tacoma Narrows Bridge on July 16, 2007, which has improved speeds during peak congestion from 30-40 MPH to the posted speed limit of 60 MPH. See p. 84.
- **Providing options to commuters.** The new HOV lanes on I-5 from Federal Way to the Pierce County line allow vehicles that travel in those lanes to cut the time it takes to 6-8 minutes, compared to the 14-16 minutes it takes commuters who choose to use the general purpose lanes to complete the same segment. See p. 85.
- **Using intelligent transportation systems to shift travelers away from congested highways.** WSDOT is planning to use Integrated Corridor Management practices between SeaTac and downtown Seattle, which will facilitate shifting travelers from congested highways to parallel routes and transit lines in order to reduce congestion. See p. 83.

For more information on specific commutes in the central Puget Sound, visit WSDOT's congestion web site at http://www.wsdot.wa.gov/accountability/TravelTimes/default and www.wsdot.wa.gov/congestion

Congestion Report Table of Contents

Congestion Performance Audit Recognizes WSDOT as Leader and Suggests Building on Existing Strategies

In October 2007, the State Auditor's Office completed a performance audit of how WSDOT manages the state highway system for maximum throughput and minimal congestion. The audit offered 22 recommendations and acknowledged the Department's proactive efforts to address congestion and its status as a national leader in several areas of congestion management. The audit recommendations included: Elevate Congestion Reduction in Decision Making; Pursue Major Infrastructure Investments and Further Increase Traffic Demand Management Programs.

Congestion is a priority at WSDOT but several recommendations such as tolling and major capacity projects cannot be implemented without new funding or budget priority changes subject to the discretion of the Governor and Legislature. WSDOT has developed an action plan based on the recommendations and is already addressing many of the suggested strategies within WSDOT's control. WSDOT's response to the Congestion Performance Audit is located at: www.wsdot.wa.gov/NR/rdonlyres/4D383DE3-8394-4FCA-AB3D-3023B54DE660/0/WSDOT_Congestion_Response.pdf.

Key Congestion Performance Measures

Measure	Definition
Average Peak Travel Time/Minutes	The average travel time on a route during the peak travel period
95% Reliable Travel Time/Minutes	Travel time with 95% certainty (i.e. on-time 19 out of 20 work days)
Vehicle Throughput	Measures how many vehicles move through a highway segment in an hour
Lost Throughput Productivity/Percent (%)	Percentage of a highway's lost throughput due to congestion
Delay (Hours/Minutes)	The average total daily hours of delay per mile based on maximum throughput speed (51 MPH- 85% of the posted speed, measured annually as cumulative (total) delay
Percent of Days that the Speed Falls Below 35 mph	Percentage of days annually that observed speeds fall below 35 MPH (severe congestion) on key highway segments
Before and After (Travel Time Analysis)	Before and After analysis of performance of selected highway projects and strategies.
Duration of Congestion (Hours/Minutes)	The period when speeds fall below 70% of the posted limits (less than 42 MPH)
Maximum Throughput Travel Time Index (MT³I)	The ratio of peak commute period travel time compared to maximum throughput speed travel time

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Maximum Throughput as a Basis for Congestion Measurement

Travelers perceive delay when they are unable to travel at expected speed, which is typically believed to be the posted speed limit. Many travelers define delay as the difference in the amount of time it should take to get to a destination during off-peak hours and the actual amount of time it takes to get to their destination. Traditionally, delay and other congestion measures have been calculated based on the difference between actual travel times and the travel time that would have been if the traffic was free flowing or moving at the speed limit.

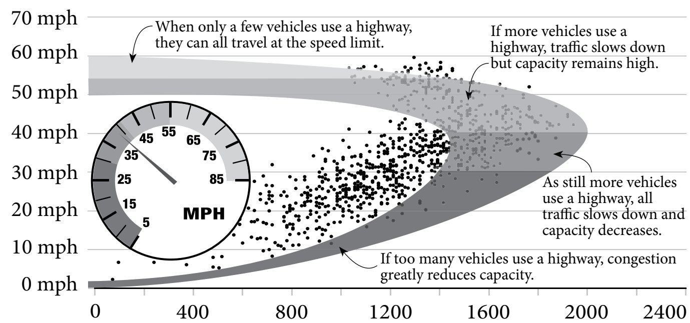
The Highway System Operates at Peak Efficiency When Vehicles Travel at 70-85% of the Posted Speed Limit

From the perspective of operating the highway system as efficiently as possible, speeds at which the most vehicles can move through a highway segment (maximum throughput) is the most meaningful basis of measurement for WSDOT's management needs. It is logical for WSDOT to aim towards providing and maintaining a system that yields the most productivity (or efficiency) versus providing a free flowing system where not as many vehicles are passing through a segment during peak travel periods. Maximum throughput is achieved when vehicles slow to a range between 70-85% of the posted speed, which results in less space between vehicles than what is observed at posted speeds. When vehicle speeds have slowed down into the range where maximum throughput occurs, the segment of highway is operating at peak efficiency because more vehicles are passing through the segment than there would be at posted speeds. This phenomenon is illustrated in the chart to the right. Maximum throughput speeds vary from one highway segment to the next depending on prevailing roadway and traffic conditions, such as lane width, slope, shoulder width, pavement conditions, traffic compositions, conflict traffic movements, presence or lack of median barrier, etc. It should also be noted that maximum throughput speed is not static and can change over time. Currently, maximum throughput speed on a typical freeway segment in the Central Puget Sound region is about 70% to 85% of the posted speed limits. For surface arterials, maximum throughput speeds are difficult to predict due to the fact that they are heavily influenced by conflicting traffic movements at intersections. Ideally, maximum throughput speeds for each highway segment should be determined through comprehensive traffic studies and validated based on field surveys.

An Adaptation of the Speed/Volume Curve: Relating Speed and Volume

I-405 Northbound at 24th NE, 6-11 AM Weekdays in May 2001

Hourly Volume/Lane



Because operating at peak efficiency moves more vehicles through a segment than at any other range of speed, a number of the measures in the annual congestion report are reported in two ways: relative to posted speed limit and relative to maximum throughput speed.

In this 2007 Annual Congestion Update, WSDOT uses maximum throughput as a basis of measurement for the following measures:

- Travel Time Index (Maximum Throughput Travel Time-MT³I)
- Duration of Congestion (measures the length of time when the highway operates at less than 70% of the posted speed)
- Delay (both statewide and for individual corridors)

WSDOT Congestion Thresholds*

Posted speed	52 mph or above (85% of posted speed or higher)	Vehicles are moving through a highway segment at approximately the posted speed. However since there are fewer vehicles on the highway, the highway segment is not reaching its maximum productivity under these conditions.
Maximum throughput	42 - 51 mph (70%-85% of posted speed)	Vehicles are moving slower than the posted speed and the number of vehicles moving through the highway segment is higher. These speed conditions enable the segment to reach its maximum productivity in terms of vehicle volume and throughput.
Congestion	35 - 41 mph (60-70% of posted speed)	Average vehicle speeds are below 70% of the posted speed (~42 MPH) causing drivers to have less than optimal spacing between them, and reducing the number of vehicles that can move through a highway segment. The highway begins to operate less efficiently because fewer vehicles are moving through a highway segment under these conditions than they would at maximum throughput.
Severe congestion	35 mph or below (Less than 60% of posted speeds)	Speeds and spacing between vehicles continue to decline in a highway segment and the highway operates well below maximum productivity.

*Based on a posted speed limit of 60 MPH.

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Travel Time Analysis

WSDOT identifies the worst commutes in the central Puget Sound region and shows how congestion on key commutes have changed over the course of two years. WSDOT uses the following performance measures as part of its travel time analysis: average travel time, 95% reliable travel time, traffic volume, the duration of congestion during the peak periods, and the maximum throughput travel time index. These measures are reported in the travel time tables on pages 62-63. The measures also include the percent of days when speeds fell below 35 mph, which is also known as severe congestion (see stamp graphs on pages 66-67). This report compares calendar year 2006 data with 2004 data for the same routes.

Most Routes Show Increases in Congestion Across All Measures

Average Travel Times Increase on 32 of the 38 Most Congested Commutes

Overall, average travel times increased on 32 commute routes, remained constant on three routes, and improved on three routes. The commute with the largest increase in average travel times (in minutes) was the *Tukwila to Bellevue morning commute*. During the peak commute period, the duration of this commute was seven minutes longer in 2006 than it was in 2004. Other commutes that showed significant increases in average travel times (minutes) include the *Federal Way to Seattle morning commute*, the *Bellevue to Seattle via I-90 evening commute*, the *Everett to Seattle morning commute*, and the *Bellevue to Tukwila evening commute*. The three routes that showed a slight improvement in average travel times were the *Tukwila to Bellevue evening commute*, the *Redmond to Bellevue morning commute*, and the *Bellevue to Seattle via SR 520 morning commute*.

95% Reliable Travel Times Increase on 33 of the 38 of Most Congested Commutes

The 95% reliable travel time performance measure relates to the amount of time necessary to make it to a destination on time on an average of 19 out of 20 work days. For the *Tukwila to Bellevue morning commute*, the 95% reliable travel time increased by 11 minutes between 2004 and 2006. Of the five commute routes that did not show an increase in 95% reliable travel time between 2004 and 2006, two decreased (the *Seattle to Everett evening commute* and the *Redmond to Bellevue morning commute*) and three stayed the same.

Duration of Congestion Increased on 31 of 38 the Most Congested Commutes

The duration of congestion – defined as the period of time in which average speeds fell below 70% of posted speeds, which is the lower limit of the maximum throughput/efficiency range increased for 31 commute routes. On 9 of these 31 commutes, the duration of congestion increased by over one hour. The commute with the longest duration of congestion is the *Bellevue to Tukwila evening commute*. Speeds fall below 70% of the posted speed for 5 hours and 35 minutes during an average evening commute. The commute route that had the largest increase in the duration of congestion was the *Everett to Seattle evening commute*. In 2004, the average duration of congestion was one hour. In 2006, the average duration of congestion on this route had increased to 2 hours 30 minutes. Two routes, the *Seattle to Bellevue via I-90 evening commute* and the *Redmond to Seattle morning commute*, experienced no change in duration of congestion. One route, the *Bellevue to Seattle via SR 520 morning commute*, experienced a 25 minute decrease in duration

National Report Indicates Seattle's Congestion Ranking Remains Stable

The Texas Transportation Institute publishes an annual congestion report ranking all urban areas in the US. The report uses several measures including the Travel Time Index (TTI) and the annual number of hours of delay experienced by travelers during peak congestion. The 2007 report, shows that delay in the Seattle urban area (which combines Tacoma, Seattle, and Everett) is well below the national mean (45 hours per traveler delay compared to 54 hours, the average of similarly-sized urban areas). Seattle's per traveler delay and TTI values have largely remained the same over the past 10 years. For example, TTI was 1.31 in 1997 and 1.30 in 2007. Seattle's rankings relative to other cities has actually improved from being rated the second worst congested urban area in 1999 to 19th in 2007.

The TTI is the average travel time during peak congestion divided by the free flow travel time. Any ratio larger than 1.0 indicates that traffic is moving at speeds lower than free flow, and can be considered congestion. If replicating the TTI measurement approach but using WSDOT's data for the 38 congested Puget Sound commutes, the TTI values would typically fall in the range between 1.5 and 3.1 for all but one route (the Redmond to Bellevue morning commute, which is 1.1). The reason for this difference is that the Texas Transportation Institute measures traffic conditions across the whole Puget Sound area (congested and un-congested areas), while WSDOT only measures the most congested routes in the system. In addition, the statistics reported in the Urban Mobility Report are derived from modeled data, whereas WSDOT uses real time data taken from loop detectors embedded in the roadways. More on the Urban Mobility Report and Spokane's ranking can be found on page 69.

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Travel Time Analysis: Morning Commutes

MORNING: Key Commute Routes: Changes in Travel Time Performance, 2004 to 2006

				Travel Time (in min.)		Average Peak Travel Time, Based on Peak Time (in minutes)			95% Reliable Travel Time (in minutes)			Ratio of Peak Travel Time to Maximum Through-put Travel Time		Traffic Volume Peak Period	Duration of Congestion (hours and minutes that average speed falls below 70% of posted speeds)		
												MT^{3}I					
Route	Route Description	Peak time	Length (Miles)	At Peak Efficiency	At Posted Speed	2004	2006	Change (%)	2004	2006	Change (%)	2004	2006	Change (%)	2004	2006	change (in minutes)
To Seattle																	
I-5	Everett to Seattle	7:25 AM	23.7	28	24	45	50	11%	73	81	11%	1.62	1.80	-3%	1:55	2:30	0:35
I-5	Federal Way to Seattle	7:20 AM	21.8	26	22	40	46	15%	56	66	18%	1.56	1.80	-1%	2:15	2:50	0:35
I-90/I-5	Issaquah to Seattle	7:40 AM	15.5	18	15	22	26	18%	30	39	30%	1.21	1.43	+4%	*	1:20	1:20
SR 520/I-5	Redmond to Seattle	7:50 AM	14.8	17	15	22	22	0%	32	32	0%	1.27	1.27	+1%	0:15	0:15	0:00
I-5	SeaTac to Seattle	7:45 AM	12.9	15	13	23	27	17%	31	37	19%	1.51	1.77	-1%	2:15	3:30	1:15
I-405/I-90/I-5	Bellevue to Seattle	8:05 AM	10.7	13	11	14	16	14%	22	27	23%	1.12	1.28	0%	*	0:10	0:10
I-405/SR 520/I-5	Bellevue to Seattle	7:55 AM	10.5	12	10	19	18	-5%	26	26	0%	1.54	1.46	+1%	1:45	1:20	-0:25
To Bellevue																	
I-5/I-405	Everett to Bellevue	7:30 AM	23.4	28	23	47	51	9%	74	83	12%	1.71	1.85	-3%	2:05	2:45	0:40
I-405	Lynnwood to Bellevue	7:35 AM	16.0	19	16	38	41	8%	64	67	5%	2.02	2.18	-3%	2:20	3:05	0:45
1-405	Tukwila to Bellevue	7:45 AM	13.5	16	13	35	42	20%	52	63	21%	2.21	2.65	-2%	3:25	4:05	0:40
I-5/I-90/I-405	Seattle to Bellevue	8:40 AM	10.6	12	10	16	18	13%	25	27	4%	1.29	1.45	+2%	0:45	1:35	0:50
I-5/SR 520/ I-405	Seattle to Bellevue	8:40 AM	10.1	12	11	20	23	15%	29	33	14%	1.69	1.94	0%	2:30	2:50	0:20
I-90/I-405	Issaquah to Bellevue	7:45 AM	9.5	11	9	17	18	6%	25	27	8%	1.53	1.62	+4%	1:35	2:15	0:40
SR 520/I-405	Redmond to Bellevue	7:45 AM	7.1	8	7	9	8	-11%	12	9	-25%	1.07	0.95	+1%	*	*	*
To Other Locations																	
I-5/SR 520	Seattle to Redmond	8:40 AM	14.7	17	15	25	27	8%	34	38	12%	1.45	1.56	0%	1:40	2:25	0:45
SR 167	Auburn to Renton	7:30 AM	9.8	12	10	16	17	6%	24	30	25%	1.39	1.48	-3%	1:20	2:00	0:40
I-5/I-90	Seattle to Issaquah	8:15 AM	15.7	18	16	19	21	11%	24	30	25%	1.03	1.14	+3%	*	*	*
I-405	Bellevue to Tukwilla	7:40 AM	13.5	16	13	21	22	5%	28	32	14%	1.33	1.39	-2%	0:20	0:40	0:20

Data Source: WSDOT Traffic Operations and the Washington State Transportation Center (TRAC) at the University of Washington
Note: An asterisk (*) indicates that speeds did not fall below 70% of posted speed on a route; and n/a means that no information is available for a route.
2004 figures have been recalculated since their last publication in the 2005 annual congestion update, using a more refined data quality control process.

of congestion. The remaining four routes did not have enough congestion in either 2004 or 2006 for speeds to fall below 70% of the posted limit. These routes are indicated with asterisks in the "duration of congestion" column in the tables on pages 62 and 63.

Maximum Throughput Travel Time Index (MT^{3}I) Increased on 32 of the 38 Commute Routes

The MT^{3}I is a measure that was developed by WSDOT to compare peak travel times to travel times observed at maximum throughput speeds: speeds that allow the largest number of cars to pass along a route at one particular time. For more information on WSDOT's use of maximum throughput as a basis for measuring congestion, please see page 60 and the gray box on page 64. As the MT^{3}I goes higher than 1.0, the efficiency of the road drops: traffic is moving at speeds that are lower than maximum throughput levels, and congestion increases.

The commute route with the highest MT^{3}I is the *Tukwila to Bellevue morning commute*, which is 2.65. This means that during

Travel Time Analysis: Evening Commutes

EVENING: Key Commute Routes: Changes in Travel Time Performance, 2004 to 2006

				Travel Time (in minutes)		Average Peak Travel Time (in minutes)			95% Reliable Travel Time (in minutes)			Ratio of Peak Travel Time to Maximum Through-put Travel Time		Traffic Volume Peak Period	Duration of Congestion (hours and minutes that average speed falls below 70% of posted speeds)		
Route	Route Description	Peak time	Length (Miles)	At Peak Efficiency	At Posted Speed	2004	2006	Change (%)	2004	2006	Change (%)	MT³I 2004	MT³I 2006	Change (%)	2004	2006	change (in minutes)
From Seattle																	
I-5	Seattle to Everett	4:20 PM	23.7	26	22	42	43	2%	65	60	-8%	1.51	1.54	-3%	2:25	2:45	0:20
I-5	Seattle to Federal Way	4:35 PM	22.1	26	33	34	37	9%	49	56	14%	1.31	1.42	0%	1:15	1:55	0:40
I-5	Seattle to SeaTac	4:35 PM	12.9	15	13	18	19	6%	24	28	17%	1.18	1.25	+1%	*	*	*
I-5/I-90/I-405	Seattle to Bellevue	5:30 PM	10.6	12	11	18	18	0%	30	32	7%	1.45	1.45	-1%	0:50	0:50	0:00
I-5/SR 520/I-405	Seattle to Bellevue	5:35 PM	10.1	12	10	19	21	11%	30	32	7%	1.60	1.77	-1%	2:30	2:45	0:15
I-5/SR 520	Seattle to Redmond	5:35 PM	14.7	17	15	29	30	3%	42	44	5%	1.68	1.73	-1%	2:10	3:15	1:05
I-5/I-90	Seattle to Issaquah	5:35 PM	15.7	18	16	23	23	0%	35	37	6%	1.25	1.25	+2%	*	*	*
From Bellevue																	
I-405/I-5	Bellevue to Everett[1]	4:25 PM	23.4	28	23	40	44	10%	56	62	11%	1.45	1.60	-4%	2:35	3:25	0:50
I-405	Bellevue to Lynnwood[1]	5:25 PM	16.0	19	16	28	32	14%	38	44	16%	1.49	1.70	-3%	2:40	3:25	0:45
I-405	Bellevue to Tukwila	4:20 PM	13.5	16	13	28	33	18%	39	45	15%	1.77	2.08	-4%	4:20	5:35	1:15
I-405/I-90/I-5	Bellevue to Seattle	5:20 PM	10.7	13	11	23	28	22%	37	46	24%	1.83	2.23	-1%	2:35	3:50	1:15
I-405/SR 520/I-5	Bellevue to Seattle	5:20 PM	10.5	12	10	25	26	4%	33	38	15%	2.03	2.11	-1%	4:30	4:40	0:10
I-405/I-90	Bellevue to Issaquah	5:30 PM	9.3	11	9	16	19	19%	21	24	14%	1.46	1.74	+1%	2:10	3:20	1:10
I-405/ SR 520	Bellevue to Redmond	5:40 PM	6.8	8	7	14	15	7%	22	24	9%	1.76	1.88	-3%	3:00	3:35	0:35
From Other Locations																	
I-5	Everett to Seattle	3:50 PM	23.7	28	24	37	40	8%	56	62	11%	1.33	1.44	-1%	1:00	2:30	1:30
I-90/I-5	Issaquah to Seattle	5:20 PM	15.5	18	15	24	28	17%	40	46	15%	1.32	1.54	+2%	0:10	1:20	1:10
SR 520/I-5	Redmond to Seattle	5:35 PM	14.8	17	15	35	37	6%	57	62	9%	2.02	2.13	-3%	3:25	3:55	0:30
SR 167	Renton to Auburn	4:20 PM	9.8	12	10	17	20	18%	32	36	13%	1.48	1.74	-1%	2:50	3:10	0:20
I-5	SeaTac to Seattle	5:20 PM	12.9	15	13	20	21	5%	30	35	17%	1.31	1.38	-1%	0:15	1:20	1:05
I-405	Tukwila to Bellevue	5:15 PM	13.5	16	13	21	20	-5%	27	27	0%	1.33	1.26	-1%	0:30	0:35	0:05

Data Source: WSDOT Traffic Operations and the Washington State Transportation Center (TRAC) at the University of Washington
Note: An asterisk (*) indicates that speeds did not fall below 70% of posted speed on a route; and n/a means that no information is available for a route.
[1]Year ends on 11/19/06 due to unavailable data
2004 figures have been recalculated since their last publication in the 2005 annual congestion update, using a more refined data quality control process.
The Lynnwood to Bellevue commute route is an expansion of the Bothell to Bellevue commute route that has been published in prior annual updates. In the 2006 annual update, the Bothell to Bellevue commute route should have been refered to as the Lynnwood to Bellevue commute route.

peak congestion, it takes 2.65 times longer to complete this trip than it would when traveling at 85% of the posted speed. In 2006, six of the 38 commute routes have an MT³I of over 2.0.

Between 2004 and 2006, the MT³I dropped on three routes, stayed the same on three routes, and increased on the 32 remaining routes. The largest percentage increase in MT³I was 22%, on the *Bellevue to Seattle via I-90 evening commute*. The MT³I went down on the *Tukwila to Bellevue evening commute*, the *Redmond to Bellevue morning commute*, and the *Bellevue to Seattle via SR 520 morning commute*.

Measuring Delay and Congestion: Annual Update

Travel Time Analysis

Travel Times Increase While Volume Remains Constant or Drops on Most Commute Routes

Despite the increases observed in travel times, 95% reliable travel times, and MT³I across the most congested commutes in the central Puget Sound, demand on the system in terms of number of vehicle miles traveled stayed relatively constant. Increases in volume were observed on only 11 of the 38 most congested routes. Why has the increase in the central Puget Sound's population and economic growth not caused an overall increase in the number of vehicle miles traveled? Most work-based travel tends to happen during the morning and evening commute times. Discretionary trips to the grocery store or movie theater tend to take place outside peak commute periods. With significant increases in the price of gasoline and longer periods of congestion, a number of these discretionary trips may have been postponed, consolidated, or eliminated. Some of these additional trips may have been absorbed by other modes such as transit or moved to local arterials. WSDOT will need to examine additional data where available to further analyze the relationship between vehicle miles traveled and congestion as well as examine other factors that contribute to congestion such as weather, incidents on the highways, and the impact of construction.

Duration of Congestion in the Morning is Generally Shorter than in the Evening

Congestion on evening commutes generally lasts longer than congestion on morning commutes. During the morning commute, the duration of congestion lasts longer than three hours on three commutes. During the evening commute, the duration of congestion lasts longer than three hours on ten commutes. This is because morning traffic is usually for work or school purposes, while evening traffic is more likely to encompass discretional travel, such as additional travel for shopping or recreational purposes. In the morning, people generally have to be at their destination at a certain time for work or school. By contrast, people generally have more discretion on when they need to arrive at their destinations in the evening; they also generally have more flexibility as to when they leave their office or school sites than when they arrive.

The Duration of Congestion is Getting Longer in the Evening- Especially When Leaving Bellevue

As congestion worsens, travelers are trying to "beat the peak" by leaving earlier or later than their fellow commuters. Thirteen of the twenty evening commutes average more than two hours of conditions where the average speed fell below 70% of the posted speed. An increase of an hour or more in the duration of congestion was observed on seven of the 20 evening commutes. As more people shift their commute times, congestion grows at both the beginning and the end of peak congestion periods, which is often referred to as "peak spreading". The stamp graphs on pages 66 and 67 illustrate how congestion is getting worse at the begining and towards the end of both evening and morning commutes.

Evening commutes leaving Bellevue experience congested conditions longer than commutes leaving any other city in the central Puget Sound. All seven of the evening commutes out of Bellevue experienced conditions in which speeds fell below 70% of the posted speed for over three hours.

Evening Commutes Into Seattle are Getting Worse

Evening traffic into Seattle on all routes shows an increase in average travel time, 95% travel time, severe congestion, MT3I, and duration of congestion. Three of the six commutes with an MT3I, of 2.0 or higher (which means the commute takes twice as long when motorists travel at peak efficiency speeds) are on evening commutes into Seattle. Meanwhile, evening routes into Bellevue are showing mixed results: increases on the Seattle to Bellevue via SR 520 evening commute, but generally staying flat or slightly declining on the Tukwila to Bellevue evening commute and the Seattle to Bellevue via I-90 evening commute.

MT³I Facilitates Comparisons Between Different Routes

When comparing travel times, the MT³I measure enables WSDOT to make "apples to apples" comparisons of travel times between routes of varying distances. For instance, the *Seattle to SeaTac evening commute* and the *Bellevue to Issaquah evening commute* both have average travel times of 19 minutes. However, the first route is 13 miles long and the second is 9; using average travel times alone would not be a very meaningful comparison. By contrast, the MT³I value incorporates the expected travel time under maximum throughput conditions, which takes into account the length of the route. As the MT³I value increases, travel time performance deteriorates. In this example, the *Seattle to SeaTac evening commute* has an MT³I of 1.25, which means that the commute route takes 25% longer than the time it would normally take at maximum throughput speeds. The *Bellevue to Issaquah evening commute* has an MT³I of 1.74, which means that the commute will take 74% longer than the commute route would take at maximum throughput speeds. Therefore, the *Bellevue to Issaquah evening commute* is considered to be the "worse" commute of the two.

Measuring Delay and Congestion: Annual Update

Travel Time Analysis

The Worst Commute of the 38 Commutes Measured by WSDOT in the Central Puget Sound is Between Tukwila to Bellevue

Motorists who use the *Tukwila to Bellevue morning commute* experience the most congested conditions of the commutes measured. The average duration of this commute at the peak travel time is 42 minutes, which is more than twice as long as the peak efficiency travel time of 16 minutes. The result is that this commute has the highest MT^3I ratio of any of the 38 commute routes at 2.65. Between 2004 and 2006, the seven minute increase from 35 to 42 minutes in travel time was the biggest increase observed in the central Puget Sound. This commute also had the largest increase in 95% reliable travel time. From 2004 to 2006, the 95% reliable travel time increased by 11 minutes from 52 minutes to 63 minutes. The duration of congestion for this route is 4 hours 5 minutes, which represents the longest duration of congestion for any morning commute.

As one might presume, the return home commute (*Bellevue to Tukwila evening commute*) is very congested as well. On the average weekday, speeds fall below 70% of the posted speeds for 5 hours 35 minutes during the evening commute, which represents the longest duration of congestion for any commute route in the central Puget Sound. This route was tied with the *Everett to Bellevue evening commute* for the largest decrease in volume for any of the 38 commute routes in the central Puget Sound.

Four Commutes Show Decreases in Travel Times or Remain Steady

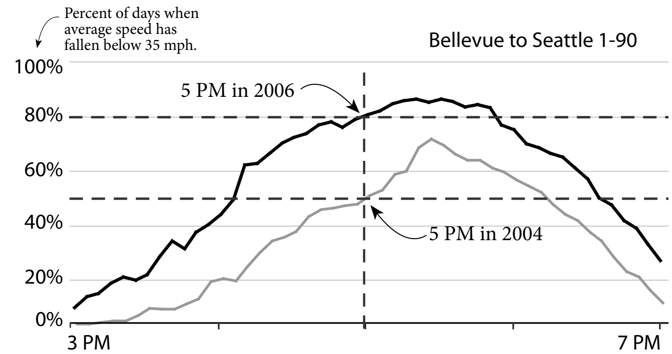
The *Redmond to Bellevue morning commute*, the *Redmond to Seattle morning commute*, the *Bellevue to Seattle via SR 520 morning commute*, and the *Tukwila to Bellevue evening commute* all avoided the dominant trend of increasing congestion across most or all measures. These four commutes showed slight decreases or no growth across most measures. The return home commutes for the three morning routes did in fact show small to moderate increases in congestion across almost all measures. These three morning routes also all overlap on SR 520.

Stamp Graphs Show How the Duration of Peak Congestion is Spreading

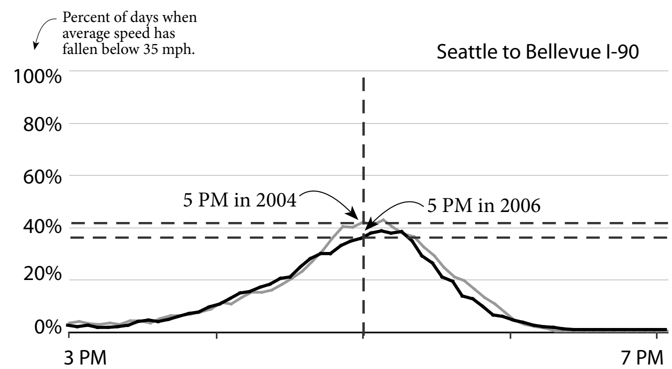
The most visual evidence of peak spreading can be seen in the stamp graphs on the following two pages. The "stamp graphs" that show severe congestion on the 38 central Puget Sound commute routes that are tracked by WSDOT for performance reporting. These graphs, comparing 2004 and 2006 data, show the percentage of days annually that observed speeds which fell below 35 MPH on the key highway segments. For specific information on how to read stamp graphs, see the illustration to the right.

How to Read a Stamp Graph: Percent of Days When Speeds Were Less Than 35 MPH - Thirty-Eight Puget Sound Commutes

How frequently (and when) did the average trip speed drop below 35 mph? How have those conditions changed from 2004 to 2006?



At 5:00 pm in 2004, there was about a 50% chance that traffic would be moving less than 35 mph. In 2006, the situation became worse (black line above the gray line); the chance that traffic would be moving slower than 35 mph was about 80% in 2006.



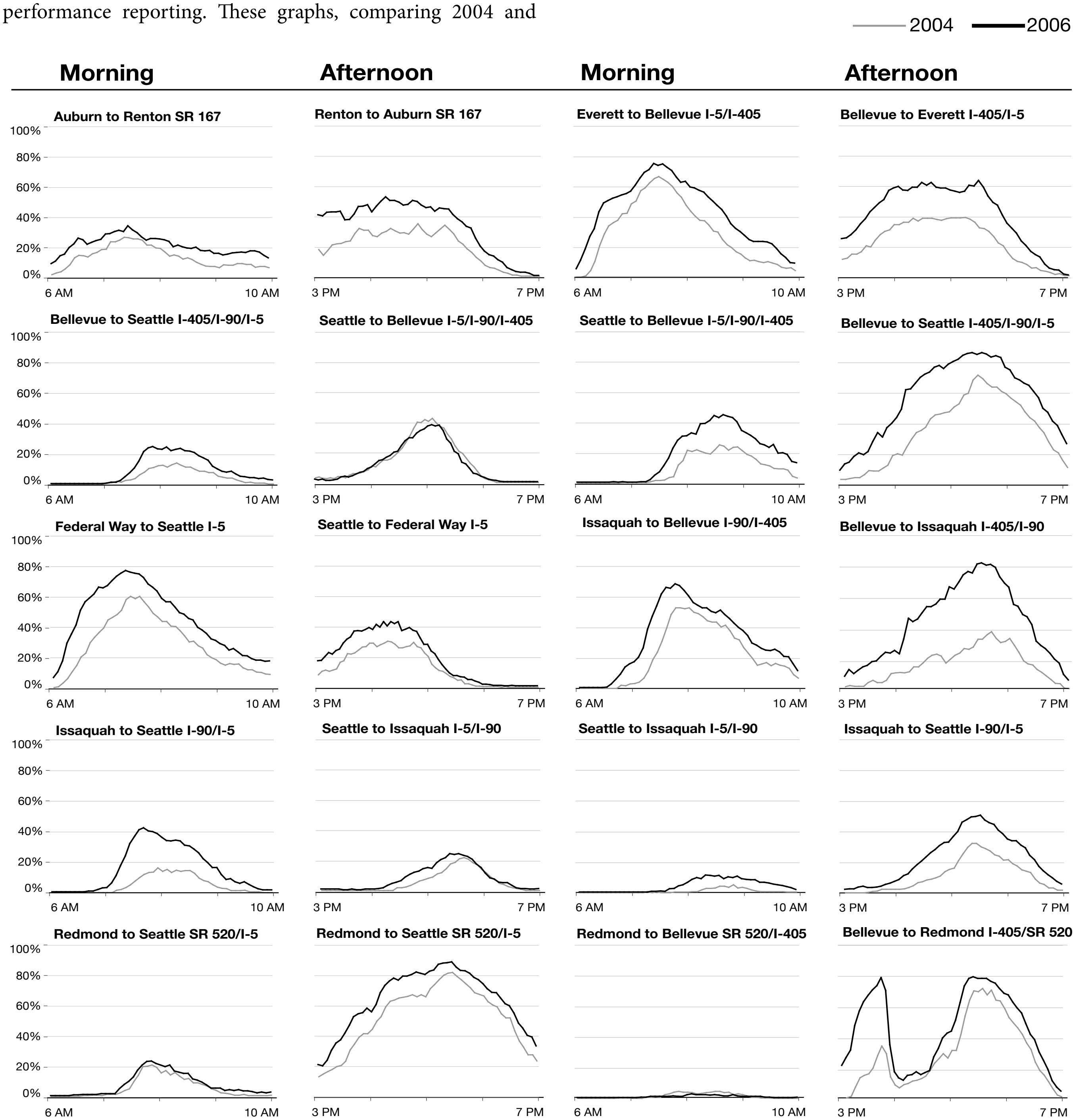
At 5:00 pm in 2004, there was about a 41% chance that traffic would be moving less than 35 mph. In 2006, the situation was better (black line below the gray line); the chance that traffic would be moving slower than 35 mph was about 37%.

Measuring Delay and Congestion: Annual Update

Travel Time Analysis: Stamp Graphs

Percentage of Weekdays with Average Speeds of 35 mph or Below

The "stamp graphs" that show severe congestion on the 38 central Puget Sound commute routes that are tracked by WSDOT for performance reporting. These graphs, comparing 2004 and 2006 data, show the percentage of days annually that observed speeds fell below 35 MPH on the key highway segments. For specific information on how to read stamp graphs, see the illustration below.

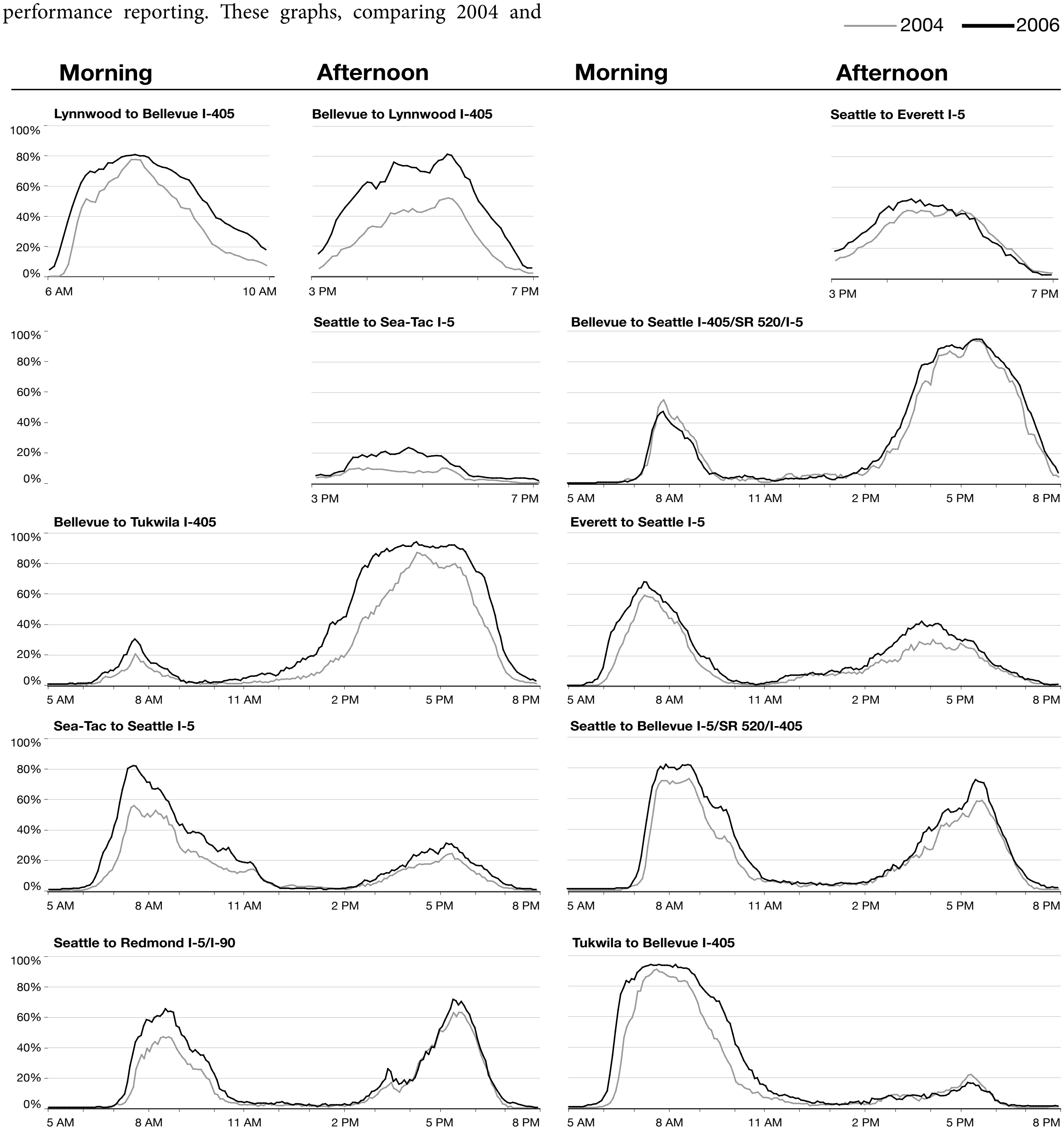


Measuring Delay and Congestion: Annual Update

Travel Time Analysis: Stamp Graphs

Percentage of Weekdays with Average Speeds of 35 mph or Below

The "stamp graphs" that show severe congestion on the 38 central Puget Sound commute routes that are tracked by WSDOT for performance reporting. These graphs, comparing 2004 and 2006 data, show the percentage of days annually that observed speeds fell below 35 MPH on the key highway segments. For specific information on how to read stamp graphs, see the illustration below.

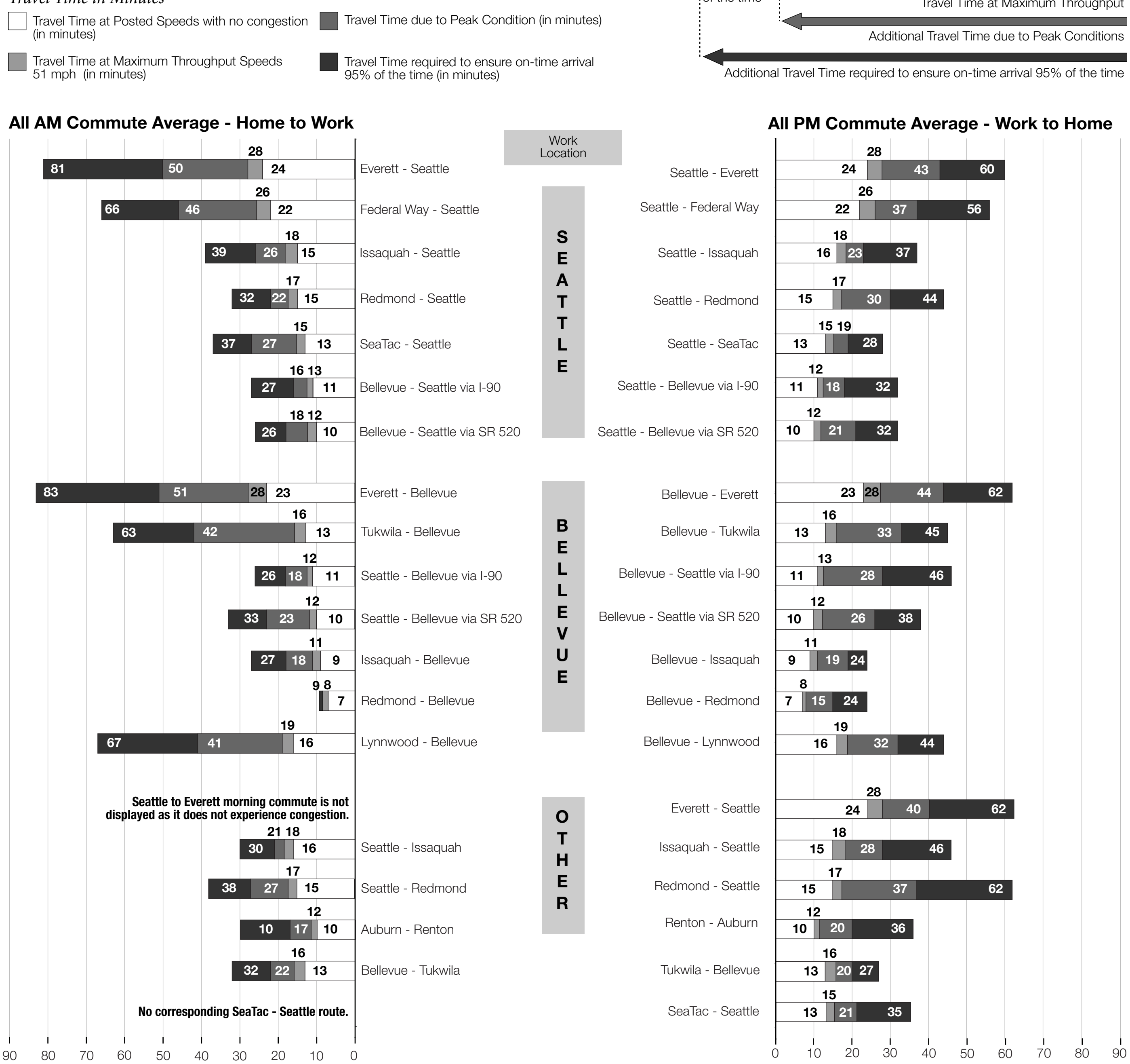


Measuring Delay and Congestion: Annual Update

Travel Time Analysis

Below is a graphical representation of the tables from pp. 62-63, showing four of the reliability performance indicators: travel times at posted speeds, travel time at maximum throughput speeds (51 MPH), average peak travel times, and 95% reliable travel times.

Travel Times at Posted Speeds, Maximum Throughput Speeds, Peak Travel Times, and 95% Reliable Travel Times
Morning and Afternoon Commutes by Work Location
Central Puget Sound Area, 2006
Travel Time in Minutes



Measuring Delay and Congestion: Annual Update

Travel Time Analysis: Key Spokane Commute Routes

Route	Route Description	Peak time	Length (Miles)	Travel Time (in minutes) At Posted Speeds	Average Peak Travel Time in minutes	95% Reliable Travel Time in minutes	Ratio of Peak Travel Time to Maximum Throughput Travel Time	vehicles per day	vehicles per day change (%)	Duration of Peak Period (hours and minutes that average speed falls below 70% of posted speeds) 2005	2006	change (in minutes)
I-90	Argonne Rd. to Division St.	7:50 AM	7.5	7	8	8	1.00	34,780	n/a	*	*	*
I-90	Division St. to Argonne Rd.	5:20 PM	7.5	7	8	9	1.03	36,762	n/a	*	*	*

Source: Spokane Regional Transportation Management Center (a partnership among WSDOT, the Cities of Spokane and Spokane Valley, Spokane County, the Spokane Regional Transportation Council and the Spokane Transit Authority)

Note: This data is gathered from the Performance Measurement System (PeMS), created by Berkeley Transportation Systems. It is a different system than the one used for gathering Puget Sound congestion data. Therefore, a direct comparison of data from the two regions is difficult. Furthermore, the road network in each of the two regions have different characteristics and different capacities, both of which are reflected in the data.
Note: An asterisk (*) indicates that speeds did not fall below 70% of posted speed on a route; and n/a means that no information is available for a route.

Spokane Peak Travel Analysis

Much of the congestion in the Spokane area is incident-related; the average travel times along the corridor are nearly what might be expected with free-flow speeds. Because the corridor is a relatively short segment (7.5 miles), even minor incidents can severely impact expected travel times as there is little opportunity to make up any incurred delay, as shown in the 95% reliable travel times.

2007 Urban Mobility Report Ranks Spokane as the Least Congested Urban Area in the Nation

The Texas Transportation Institute's 2007 Urban Mobility Report ranked Spokane as the least congested urban area in the nation along with Brownsville, Texas, out of the other 85 urban areas covered in the report. According to the report Spokane's travel time index (TTI) dropped from 1.05 in 2003 to 1.04 in 2005. More on the Urban Mobility Report and Seattle's rankings can be found on page 61.

Measuring Delay and Congestion: Annual Update

Lost Throughput Productivity

Lost throughput productivity measures the percentage of a highway's vehicle throughput capacity that is lost due to congestion. Under ideal conditions, the maximum throughput of vehicles moving through a freeway segment can be as high as 2,000 vehicles per lane per hour, when traveling at speeds in the range of 42-51 mph (70%-85% of the posted speed). Under congested conditions, however, the volume of traffic moving through a given freeway segment can be as few as 700 vehicles per lane per hour. For more information on the concept of maximum throughput and why WSDOT uses it as a basis for measuring congestion, please go to page 60.

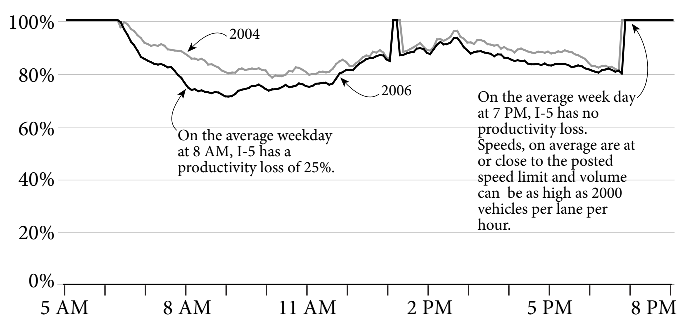
When vehicles are caught in congestion, the highway is serving less vehicles than it is designed to carry. The difference between the optimal capacity of the roadway and the number of vehicles that the road is actually serving is called lost throughput productivity.

New Analysis Compares Actual Capacity to Ideal Capacity

In the past, WSDOT has measured capacity lost based on the ideal capacity of 2,000 vehicles per lane, per hour (vplph). However, not all lanes can achieve a maximum throughput of 2,000 vplph because highway capacity varies depending on prevailing roadway and traffic conditions. For this reason, the ideal throughput of 2,000 vplph has not been observed on all highway segments. This year's analysis compares the ideal capacity of 2,000 vplph to the actual capacity which is defined as the highest five minute flow rate. The example below shows I-5 at I-90 in Seattle. The highest five minute flow rate of 1,938 vplph is used as the basis for measuring productivity loss for this location.

Lost Vehicle Throughput Productivity: Example

Based on 1938 Vehicles per Lane per Hour (based on highest average five minute flow rate) Intersection of I-5 at I-90 in Seattle



Using the Highest Five Minute Flow Rate as a Basis for Measurement

In past editions of the *Gray Notebook*, lost productivity has been calculated by comparing the actual counts to an ideal roadway capacity of 2,000 vplph. There are several factors that directly impact a roadway's actual carrying capacity. These factors include roadway physical features (i.e. lane and shoulder widths, pavement conditions), weather conditions, terrain, the presence of bottlenecks up- or down-stream, and traffic characteristics (i.e. congestion levels or vehicle density, percentage of heavy vehicles).

WSDOT continues to search for the most meaningful measure to gauge lost capacity due to congestion. In this edition of the *Gray Notebook*, lost capacity is estimated two ways:

- Compare observed average flow rates to ideal capacity (2,000 vphpl for freeways). This comparison is designed to reveal lost capacity due to roadway congestion as well as geometric constraints and has been WSDOT's basis for reporting lost throughput productivity in the past.
- Compare the actual average flow rates to the observed highest average five minute flow rate of traffic. This basis of measurement reveals capacity loss primarily due to congestion.

The graphs on the following two pages show the difference between the two measures by comparing lost throughput productivity between 2004 and 2006 at selected locations on central Puget Sound freeways. Lost throughput productivity is shown at a given location using both measures. The lost throughput productivity graph on the left hand side of the following two pages uses actual productivity loss based on the highest average five minute flow rate of traffic as the basis for measurement. The lost throughput productivity graph on the right hand side uses ideal capacity as the basis for measurement. The graph to the left on this page is an example of a lost productivity graph, and provides a basis for interpreting the graphs.

Using the Highest Five Minute Flow Rate Basis of Measurement Isolates the Impact of Congestion on Productivity Loss

All evaluated locations show a decrease in throughput from 2004 to 2006, with the most apparent losses observed on I-5 and I-405. The charts on pages 71 and 72 compare the observed average flow rates to the observed highest average five minute flow rate.

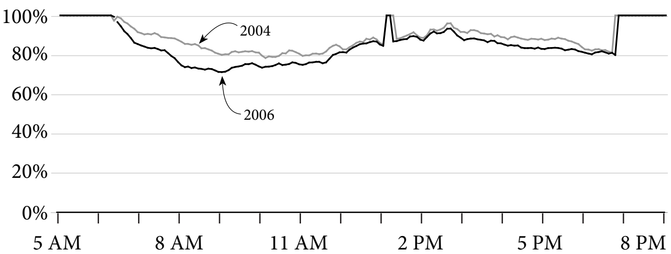
Using the highest average five minute flow rate as the basis for measuring lost throughput productivity directly estimates the capacity loss due to congestion. As expected, the magnitude of capacity loss due to congestion is lower than the compounded effect of both congestion and limiting factors. Close examination of these two sets of charts can provide great insights on the potential return of removing roadway physical constraints and managing demand separately or in combination.

Measuring Delay and Congestion: Annual Update

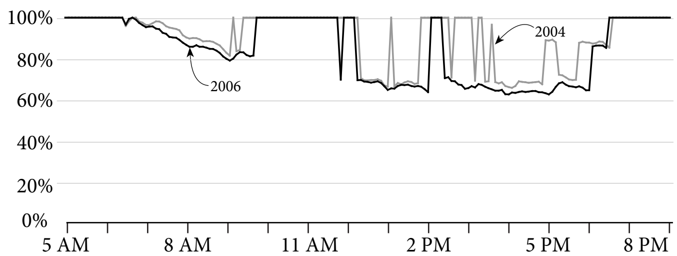
Lost Throughput Productivity

Compare to Actual Capacity (highest average five minute flow rate)

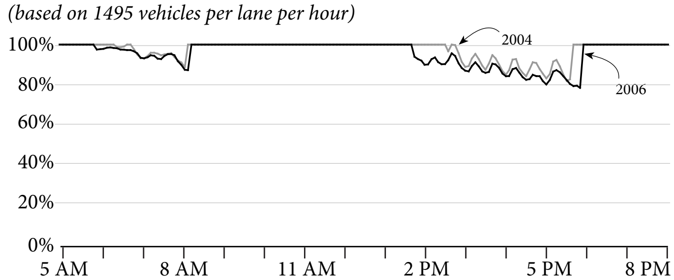
I-5 at I-90
(based on 1938 vehicles per lane per hour)



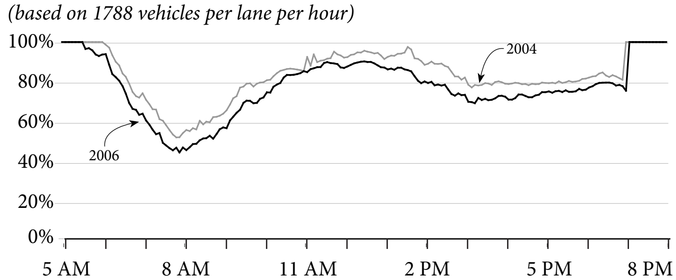
I-5 at NE 103rd St. near Northgate
(based on 1812 vehicles per lane per hour)



SR 167 at 84th Avenue SE
(based on 1495 vehicles per lane per hour)

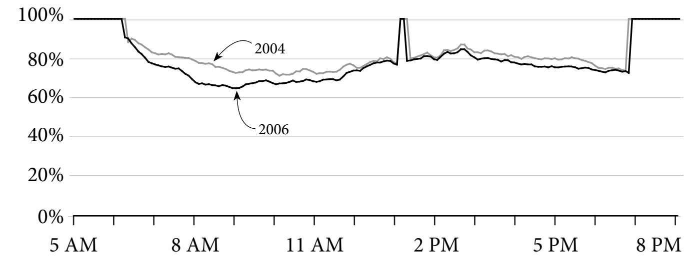


I-405 at SR 169 in Renton
(based on 1788 vehicles per lane per hour)

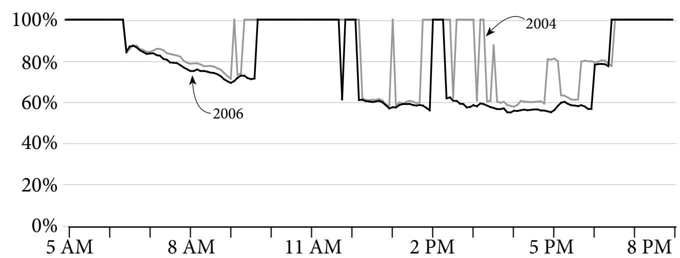


Compare to Ideal Capacity (2000 vehicles per lane per hour)

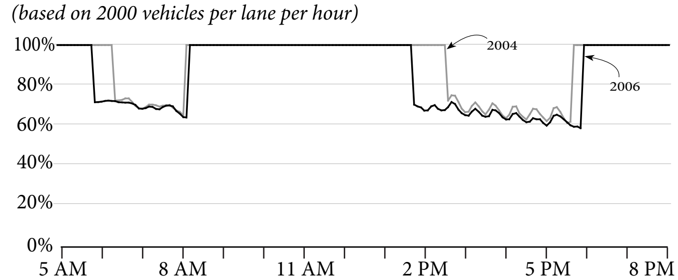
I-5 at I-90
(based on 2000 vehicles per lane per hour)



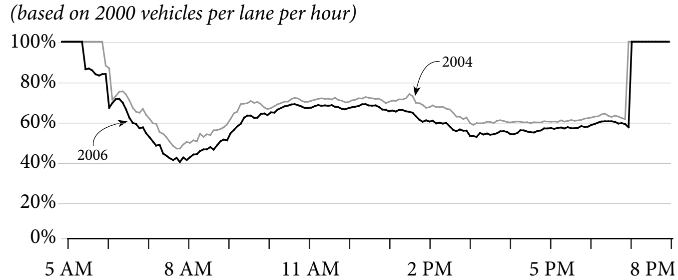
I-5 at NE 103rd St. near Northgate
(based on 2000 vehicles per lane per hour)



SR 167 at 84th Avenue SE
(based on 2000 vehicles per lane per hour)



I-405 at SR 169 in Renton
(based on 2000 vehicles per lane per hour)

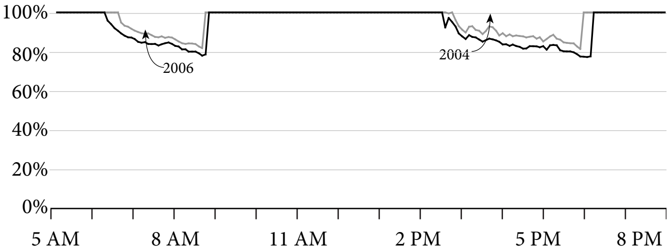


Measuring Delay and Congestion: Annual Update

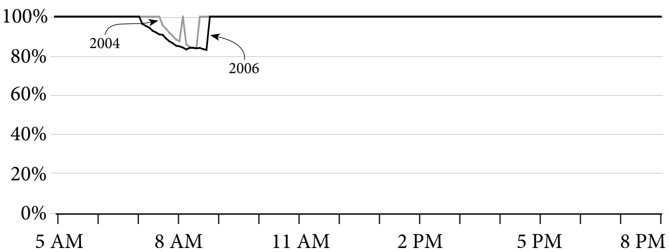
Lost Throughput Productivity

Compare to Actual Capacity (highest average five minute flow rate)

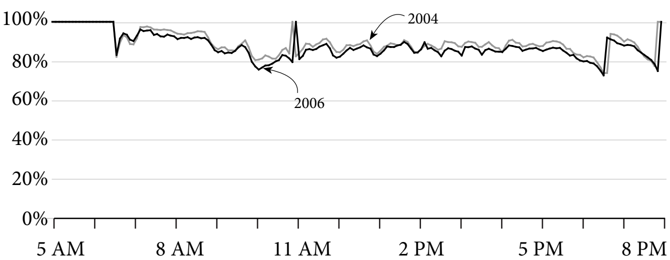
I-5 at S. 188th St. near Sea-Tac
(based on 1750 vehicles per lane per hour)



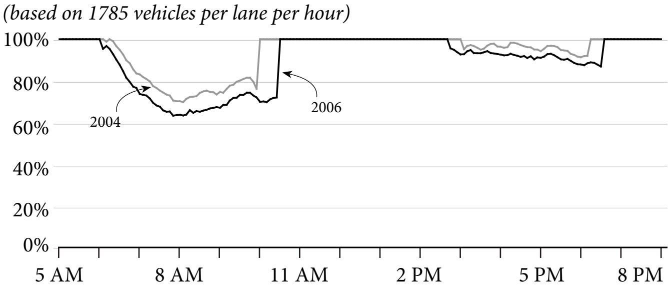
I-90 at SR 900 in Issaquah
(based on 1834 vehicles per lane per hour)



SR 520 Floating Bridge
(based on 1838 vehicles per lane per hour)

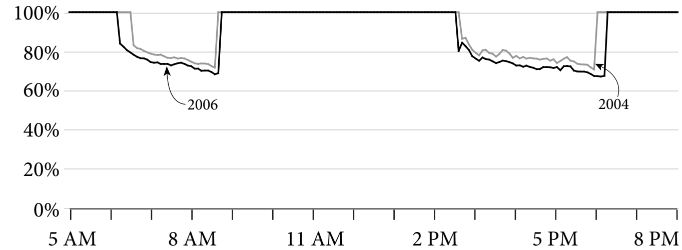


I-405 at NE 160th St in Kirkland
(based on 1785 vehicles per lane per hour)

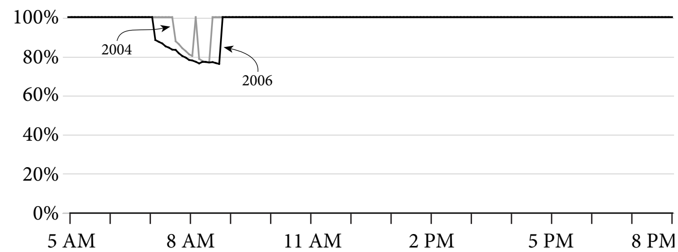


Compare to Ideal Capacity (2000 vehicles per lane per hour)

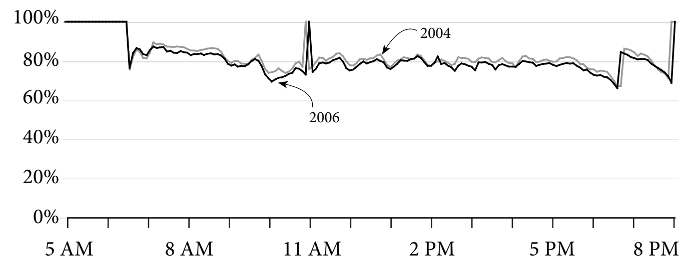
I-5 at S. 188th St. near Sea-Tac
(based on 2000 vehicles per lane per hour)



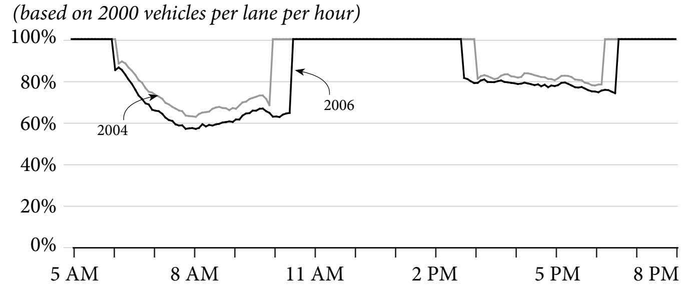
I-90 at SR 900 in Issaquah
(based on 2000 vehicles per lane per hour)



SR 520 Floating Bridge
(based on 2000 vehicles per lane per hour)



I-405 at NE 160th St in Kirkland
(based on 2000 vehicles per lane per hour)



Measuring Annual Delay and Congestion: Annual Update

Measuring Travel Delay

Drivers experience delay when congestion occurs. Simply put, delay is the extra period of time it takes a driver to get to their destination of choice. Delay is typically calculated as the difference between actual travel times and posted speed travel times. WSDOT uses the maximum throughput standard as a basis for measurement to assess delay relative to a highway's most efficient condition. For the purpose of this analysis, delay is reported based on both standards: relative to posted speed limit and relative to maximum flow speed. For both standards, WSDOT measures the sum of vehicle delay (in hours) across an average twenty-four hour day as one of the most basic measures for describing congestion. The measure is used to demonstrate the extent, severity and duration of congestion.

Daily Vehicle Hours of Delay Increases on Washington State Highways

Overall, there has been an increase in the amount of delay on state highways between 2004 and 2006. Statewide delay, relative to posted speed limits and relative to maximum flow speeds, increased by 8.0% and 17.2% respectively. The higher percentage increase relative to maximum throughput speeds indicate that many congested highways got even more congested from 2004 to 2006.

Expanded Approach for Estimating the Cost of Delay

In this edition of the annual congestion update, the cost of delay is calculated by applying monetary values to the estimated hours of delay incurred in passenger and truck travel plus additional vehicle operating costs. The value of time for passenger trips was assumed to be half of the average wage rate. In the September 30, 2006 *Gray Notebook*, cost of delay was calculated by applying values to the estimated hours of delay incurred in passenger and truck travel plus additional vehicle operating cost; and the value of time for passenger trips was assumed to be half of the average wage rate. The current approach considers additional costs from delay that had not been considered in previous editions of the annual congestion update.

Delay increased between 2004 and 2006 in the central Puget Sound while Vehicle Miles Traveled remained unchanged:

On an average day, the number of hours of delay experienced on Washington State highways was 108,100 hours based on optimal flow speeds in 2006.

This is a 35% increase in delay from 2004 on major highways in the central Puget Sound.

The estimated annual cost of delay on Washington State highways was $624 million based on optimal flow speeds in 2006.

The number of vehicle miles traveled (VMT) in the central Puget Sound region remained relatively unchanged between 2004 and 2006.

Congestion, or delay, imposes costs due to lost time of travelers, higher vehicle operating costs from wasted fuel, and other effects of stop and go driving. Truckers and shippers and their customers also bear large costs from traffic delay. It is generally recognized that delay has a variety of direct and indirect impacts:

- Increased travel time for personal travel
- Increased travel time for business travel
- Increased vehicle operating expense
- Direct Shipper/recipient productivity lost
- Indirect (downstream) productivity lost
- Local income/economy suffered from lost opportunities to attract new businesses
- Increased vehicle emissions due to stop and go conditions

All State Highways: Average Weekday Delay Comparison (Daily and Annual) and Estimated Cost of Delay on State Highways (Annual), 2004 and 2006

	DAILY Average Vehicle Hours of Delay (Weekdays)			Total Annual Weekday Vehicle Hours of Delay (in thousands)			ANNUAL Cost of Delay on State Highways (in Millions of 2006 dollars)		
Actual Travel Compared to	2004	2006	Change	2004	2006	Change	2004	2006	Change
Optimal Flow Speeds (Approx 51 mph)	88,500	103,700	17%	22,120	25,940	17%	$531	$624	18%
Posted Speeds	168,100	181,600	8%	42,035	45,390	8%	$1,009	$1,092	8%

Data Source: WSDOT Urban Planning Office

Note: In the 2004 and 2006 annual congestion updates, only the first three items were reflected in this estimation.

Measuring Annual Delay and Congestion: Annual Update

Measuring Travel Delay

Delay Increases on Major Central Puget Sound Corridors

There was an increase in the daily vehicle hours of delay on all major corridors in the central Puget Sound region between 2004 and 2006. Because the sizes (length and width) of these corridors are different, it is not meaningful to compare and rank the corridors. Delay on I-90, SR 167 and I-405 increased significantly in percentage terms. Overall, delay on the five key freeways increased by 20% relative to the posted speed limits, and by nearly 35% relative to the maximum flow speed. The higher percentage increase relative to the maximum free flow speed indicates some of the most congested freeway sections became worse between 2004 and 2006.

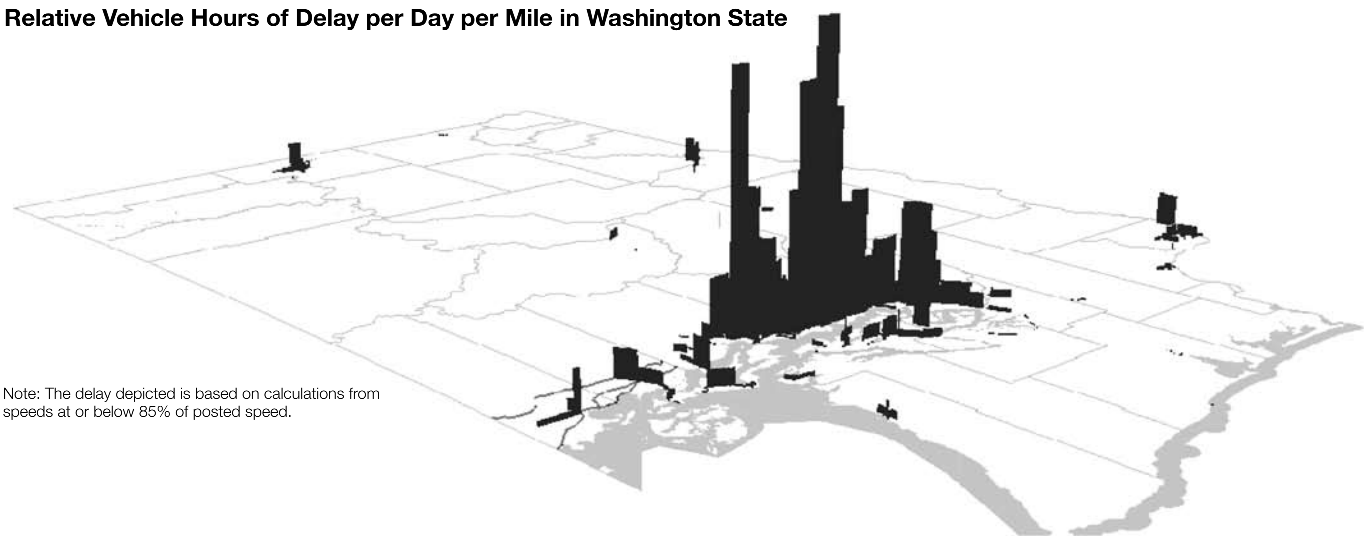
With the exception of I-90, vehicle miles traveled (VMT) between 2004 and 2006 has remained relatively unchanged. This was first observed from 2003 to 2005 (see the September 30, 2006 *Gray Notebook*). This possibly suggests that congestion has worsened to a point that negatively affects the roadway throughput.

Central Puget Sound Freeways: Average Weekday Delay Comparison 2004 and 2006

State Route	Lane Miles	Vehicle Hours of Delay per Day: Relative to 60 mph (posted speed limit)			Vehicle Hours of Delay per Day: Relative to approx. 51 mph (maximum throughput speed)			Vehicle Miles Traveled (1000's)		
		2004	2006	Change	2004	2006	Change	2004	2006	Change
I-5	369	17,260	20,200	17%	7,920	10,490	33%	7,843	7,736	-1%
I-90	95	1,640	2,250	37%	470	870	86%	1,657	1,689	2%
SR 167	41	2,440	3,125	28%	770	970	25%	1,004	1,005	0%
I-405	152	11,650	14,210	22%	6,310	8,730	38%	3,649	3,649	-2%
SR 520	52	3,300	3,680	12%	1,850	2,270	23%	1,049	1,026	-2%
Total	709	36,300	43,460	20%	17,320	23,330	35%	15,203	15,034	-1%

Data Source: WSDOT Urban Planning Office
Note: Because both the lengths and widths of these corridors are different, it is not possible to use the delay numbers to rank the corridors.

Relative Vehicle Hours of Delay per Day per Mile in Washington State



Note: The delay depicted is based on calculations from speeds at or below 85% of posted speed.

Measuring Delay and Congestion: Annual Update

HOV Lane Performance

The goal of the HOV lane network is to enhance the efficiency of the freeway network by moving more people in fewer vehicles. The HOV network is designed to provide a less-congested alternative to general purpose lanes that encourages the use of buses, carpools and vanpools, provides a more reliable travel option, and helps reduce associated environmental effects. Approximately 200 miles of HOV lanes have been constructed in central Puget Sound since 1970, with 58 miles of additional HOV lanes now under construction. More information about the HOV lane system can be found at http://www.wsdot.wa.gov/hov/.

WSDOT monitors two important aspects of HOV lane performance: 1) travel time and reliability benefit to users, and 2) number of people traveling via HOV lanes as compared to the general purpose lanes.

HOV Lane Performance: Reliability

WSDOT and the Puget Sound Regional Council (PSRC) adopted a performance standard for freeway HOV lanes stating that 90% of the time, the HOV lane should be able to maintain an average speed of 45 mph or greater during the peak hour.

Nine HOV Corridors Did Not Meet the Performance Reliability Standard In 2006

The 2006 performance results for the Puget Sound HOV lane system indicate that significant portions of the HOV system are experiencing increased usage and reduced performance during the peak periods, continuing a trend seen during the past few years. Six of the seven HOV corridors in the peak direction during the evening peak period have high enough traffic volumes that the corridors fail the HOV performance standard, and four of the seven corridors in the peak direction during the morning peak period fail the performance standard. In 2004, five corridors failed the standard during the PM peak period, and three in the AM peak period. In addition, every HOV corridor that does not meet the performance standard experienced a decline in travel reliability in 2006 compared to 2004. The accompanying table illustrates which corridors and directions meet or fail the performance standard during the morning peak period and evening peak period.

Speed and reliability of the HOV lanes are monitored and the results are published at http://depts.washington.edu/hov/.

Puget Sound Corridors Meeting HOV Lane Reliability Performance Goal

2004 and 2006, Based on Reliability Goal of the HOV Lane Maintaining a Speed of 45 mph for 90% of the Peak Hour[1]

Did Not Meet the Standard[2] = x

Route	2004 AM	2004 PM	2005 AM	2005 PM	2006 AM	2006 PM
I-5, SR 522 to 112th St. (NB)	99%	75% x	100%	73% x	99%	54% x
I-5, SR 526 to Northgate Way (SB)	58% x	98%	49% x	99%	35% x	96%
I-405, I-5 Interchange (Tukwila) to NE 8th St. (NB)	88%* x	98%	70% x	99%	49% x	100%
I-405, NE 8th St to I-5 Interchange (Tukwila) (SB)	99%	76% x	100%	59% x	99%	44% x
I-90, S Rainier Ave to SR 900 (EB)	100%	100%	100%	100%	100%	100%
I-90, SR 900 to S Rainier Ave (WB)	100%	99%	100%	99%	100%	99%
SR 520, I-405 to West Lake Sammamish Pkwy NE (EB)	99%	99%	98%	99%	96%	97%
SR 520, West Lake Sammamish Parkway NE to 84th Ave NE (WB)	97%	66% x	98%	55% x	97%	61% x
SR 167, 15th St NW to I-405 Interchange (NB)	100%	99%	100%	99%	99%	100%
SR 167, I-405 Interchange to 15th St NW (SB)	100%	99%	100%	98%	100%	93%
I-5, S 320th St to I-90 Interchange (NB)	71% x	97%	61% x	99%	47% x	97%
I-5, I-90 Interchange to S 320th St (SB)	100%	66% x	99%	66% x	99%	46% x
I-405, NE 8th St to I-5 Interchange (Swamp Creek) (NB)	100%	89%* x	100%	81% x	100%	69% x
I-405, I-5 Interchange (Swamp Creek) to NE 8th St (SB)	97%	93%	88%* x	87%* x	70% x	82% x
Number of commutes that did not meet the standard	**8**		**10**		**10**	

Data Source: Washington State Transportation Center (TRAC)
Data Notes: TRAC analyzes performance data for all complete segments of HOV lanes that have a loop detector. In some cases, data is not analyzed for the very beginning and ends of the lanes because there are not detectors at the very beginnings and ends of the HOV lanes.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound
[1]HOV reliability performance standards are based on the peak hour. Peak hour is the one-hour period during each peak period when average travel time is slowest.
[2]Numbers represent the percentage of the peak hour when speeds are above 45 mph.
*Performance on these corridors was close to the standard; the corridor's failed performance was borderline.

Measuring Delay and Congestion: Annual Update

HOV Lane Performance

HOV Lane Performance: Person Throughput[1]

HOV Lanes Continue to be More Effective at Moving People When Compared to GP Lanes

The reduced reliability observed in the HOV lanes is due to their increasing usage. The WSDOT HOV lane monitoring program tracks volume in the HOV and general purpose lanes at 10 locations around the central Puget Sound area that are representative of freeway use on all major freeway corridors in the region. Vehicle and person volumes are measured in both directions for both HOV and general purpose lanes at each of these locations during the peak periods.

Vehicle Volumes Increase for HOV Lanes, Decrease for GP Lanes

During the peak periods in the direction of peak travel volume, all but two of the Puget Sound freeway HOV lanes gained vehicle volume between 2004 and 2006. During that two-year period, vehicle volume in the HOV lanes at the monitoring locations increased by an average of approximately 150 vehicles during the 3-hour morning peak period and approximately 180 vehicles in the 4-hour evening peak period. Traffic volumes measured in the general purpose lanes at those locations declined by an average of nearly 500 vehicles in the morning peak period and approximately 560 vehicles in the evening peak.

The percentage of vehicles that did not meet the HOV occupancy requirement is relatively low compared to other locations around the country. While HOV compliance varies by location in the system, the average observed violation rates were about 4% during the A.M. peak period, and 5% during the P.M. peak period.

[1]Person volume data is based on observation samples. At selected locations, observers standing on overpasses or alongside the road count the number of people in each car. Those samples, along with estimated bus ridership data and vanpool ridership data provided by transit agencies, are used to estimate average vehicle occupancies at those locations. The per-vehicle occupancies are then combined with vehicle counts (from the loop detector data) to get person volume estimates.

HOV Lanes Move 31% of Morning Commuters and 36% of Evening Commuters

HOV lanes are designed to move more people in fewer vehicles, by providing incentives that encourage people to share rides, either in carpools or by using transit. The HOV lane system generally succeeds in attracting large numbers of users, despite consisting of only one lane in each direction on each freeway route. The average HOV lane carries about 31% of the people on the freeway in the morning and almost 36% in the evening.

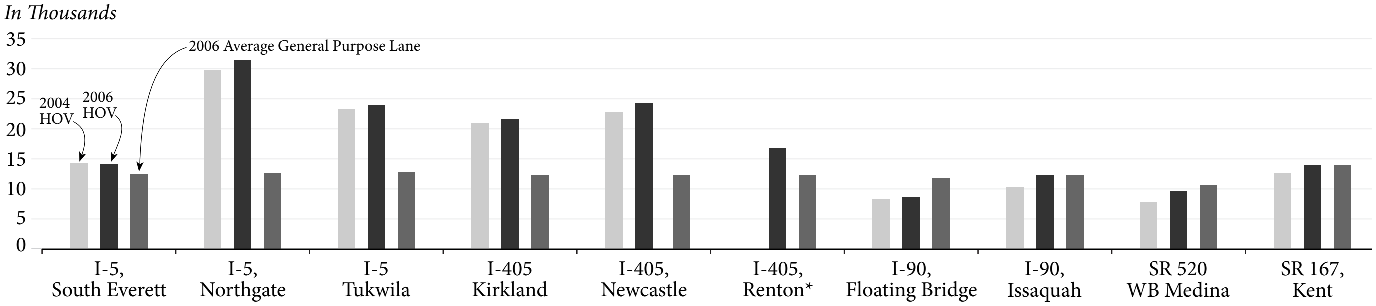
HOV Lanes Are Not Equally Used

HOV lanes are not equally used throughout the region. The highest HOV lane use occurs where HOV lanes have a time advantage over general purpose lanes or where excellent transit service encourages use of the HOV lanes. I-5 near Northgate is an example of the person moving capability of comprehensive transit service. In the morning peak period the southbound HOV lanes move about 14,100 people, or 44% of the people on that section of I-5, in only 21% of the vehicles. The HOV lane carries an average of 3.4 people in each vehicle, making it three times as effective at moving people as the average general purpose lane next to it. While not all HOV lanes in the region carry such high percentages of freeway travelers, nearly every monitoring location has experienced increasing person volumes in HOV lanes from 2004 to 2006, combined with a drop in person volumes in the adjacent general purpose lanes.

From 2004 to 2006, HOV Lane Usage Increases at Four Identified Underperforming Locations

The 2006 annual congestion report noted that HOV lane person throughput was not exceeding general purpose lane throughput at four monitoring locations: the I-90 Floating Bridge, I-90 in Issaquah, SR 520 westbound at Medina, and SR 167 in Kent. However, from 2004 to 2006, these locations have all

2004 and 2006 HOV Lane and General Purpose Lane Person Throughput Comparison
Total of AM and PM Peak Period Volumes
In Thousands



Note: Volumes are for peak period directions only.
Note: * Corresponding 2004 data is not available for this location. In 2005, the monitoring location changed from I-405 Tukwila to I-405 Renton.
Data Source: Washington State Transportation Center (TRAC).

Measuring Delay and Congestion: Annual Update

HOV Lane Performance

experienced an increase in HOV lane usage. On I-90, new or expanded park and ride lots and bus service have been put into place along the corridor during the past few years, providing enhanced access to transit service. The number of persons using the I-90 HOV lane near Issaquah in the peak direction during peak periods has grown by 20% from 2004 to 2006. On SR 167 near Kent, HOV person throughput has grown by 10% during the past two years.

The other two locations that previously did not meet the person throughput goal both have unique facility or operational characteristics that can affect HOV person throughput performance. On I-90's floating bridge, the two-lane HOV/express facility has a limited number of access points, unlike other freeway HOV lanes in the region. That facility also allows single-occupant vehicles to travel between Mercer Island and Seattle. On SR 520 westbound at Medina, a 3+ person occupancy restriction is in effect for safety reasons, reducing the number of vehicles eligible to use that HOV lane. The HOV lane regularly experiences congestion but still provides a travel time savings benefit for transit service on that corridor.

HOV Survey Results: Availability of HOV Lanes Affects Mode Choice

Two surveys were conducted in 2006-2007 to learn more about freeway users and their choices regarding HOV lane use. WSDOT distributed 30,000 surveys to HOV lane users in January 2006 and received 5,700 responses (19%). The WSDOT survey focused on understanding the extent to which HOV lanes encourage various types of ridesharing, and also the characteristics of mid-day ridesharing.[1] In January 2007, the Washington State Transportation Center (TRAC) conducted its periodic survey of freeway travelers as part of its ongoing HOV lane evaluation project for WSDOT. The TRAC survey was distributed to HOV and non-HOV freeway travelers; of the 5,249 surveys distributed, 1,064 (20%) were returned. Although the two surveys had different methodologies, they contained overlapping themes concerning HOV lanes and traveler attitudes.

Both surveys examined the extent to which the HOV lane network influenced travelers' choices about sharing rides, by asking what decisions HOV lane users would make if HOV lanes were no longer available. The WSDOT survey found that 15%-18% of peak period HOV users would probably switch to driving alone in that situation, and that carpoolers would be somewhat more likely to switch than transit and vanpool users.

[1] The September 30, 2006 ***Gray Notebook*** has additional discussion of the WSDOT HOV survey results.

The TRAC survey results showed that approximately 22% of carpoolers, 17% of vanpoolers, and 12% of transit users would probably change their travel mode if there were no HOV lanes. These percentages are consistent with the WSDOT survey results suggesting that transit users and vanpoolers were more likely to continue to use their current mode than carpoolers, if HOV lanes were not available.

The TRAC survey also asked about likely mode choice decisions specifically for commuting between home and work, if HOV lanes were no longer available. The results indicated that between 19% to 32% of carpoolers, vanpoolers, and transit users would drive alone more often than before.[2] These results suggest that respondents who rideshare for their commute are possibly more likely to switch modes than respondents who rideshare for other purposes.

Both surveys asked about HOV users' motivations for choosing to rideshare. In both surveys the leading response was the same: carpoolers mentioned travel time savings most frequently, while transit and vanpool users mentioned saving money most often.

[2] For more discussion about TRAC and WSDOT survey results on this question, see "HOV User Survey: Washington State Freeway System", PRR, September 2007, page 2-9, available at http://wsdot.wa.gov/hov; that document also summarizes the other WSDOT survey results.

Reasons for Ridesharing*

	TRAC Survey (2007)	WSDOT Survey (2006)
Carpoolers		
	1. Travel time savings (64%)	1. Travel time savings (79%)
	T2. Saving money (53%)	2. Convenience (68%)
	T2. Convenience (53%)	3. Saving money (45%)
Transit		
	1. Saving money (82%)	1. Saving money (83%)
	2. Less stressful (79%)	2. Less stressful (64%)
	3. Avoiding parking hassles (75%)	3. Convenience (50%)
Vanpoolers		
	1. Saving money (97%)	1. Saving money (85%)
	2. Concern for the environment (81%)	2. Less stressful (57%)
	T3. Convenience and Travel time savings (both 78%)	3. Travel time savings (54%)

Sources: Washington State Transportation Center (TRAC) and WSDOT Urban Planning Office
*Data Note: Numbers represent the percentage of respondents who chose each reason. The WSDOT survey asked respondents to choose their top three reasons for ridesharing, while the TRAC survey allowed respondents to select as many reasons as they wished. In addition, the list of possible reasons was not identical. Therefore, the percentages from the two surveys are not directly comparable.

Measuring Delay and Congestion: Annual Update

HOV Lane Performance

Other Survey Findings: Majority of SOV and HOV Drivers Support Continued HOV Lane Construction

The WSDOT survey results also showed that employer incentives play a large role in the decision to take shared rides. Eighty-seven percent of bus riders and vanpoolers, and 24% of carpoolers, use employer rideshare incentives such as free bus passes, discounted parking, flextime, etc. Forty to sixty percent (depending on mode) would either discontinue their mode without incentives, or are not sure.

The TRAC survey includes questions about traveler attitudes toward the HOV system. Results showed that 89% of peak-period HOV users and 66% of peak-period SOV drivers thought HOV lane construction should continue. When asked whether HOV lanes should be open to all traffic, all the time, 88% percent of peak-period HOV users and 62% of peak-period SOV drivers disagreed.

The full WSDOT survey results can be found at http://www.wsdot.wa.gov/hov/. The full report of the 2007 TRAC HOV survey results is expected to be available later this year at http://depts.washington.edu/hov/.

WSDOT's HOV Action Plan

WSDOT has initiated an HOV Action Plan which is intended to identify near-term facility improvements and potential operating policy modifications that improve HOV lane speed, reliability and throughput. The study is funded by WSDOT. The Transportation Research Center (TRAC) at the University of Washington has been retained as the principal investigator. Preliminary results are expected in December of 2007. Follow-on work will continue into 2008. The study will focus on I-5 HOV lane performance. The study scope has been crafted to complement WSDOT corridor planning work and ongoing pricing analyses.

WSDOT continually monitors HOV system performance, including measurement of speed, reliability and person throughput. Performance trends show that HOV utilization has steadily increased but peak hour speed and reliability have decreased and often fail to meet the adopted performance standard. An objective of the HOV Action Plan is to determine what near term actions could be taken to bring HOV speed and reliability into conformance with the performance standard. Study elements include:

- Identify and analyze I-5 HOV segments failing to meet performance standards.
- Model future HOV system performance to identify how planned and programmed projects will change HOV system speed, reliability and person throughput.
- Identify and evaluate potential physical modifications that would improve I-5 HOV performance.
- Analyze HOV operating policy options to determine how they would influence HOV performance.
- Review proposed I-5 HOV projects to determine if they remain beneficial.
- Evaluate the existing HOV performance standard to determine if it approximates optimal performance and ascertain whether policy modifications would be beneficial.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Manage Demand

Managing Demand During the I-5/Spokane Street to I-90 Bridge Rehabilitation Project

The 40 year old northbound I-5 bridge from Spokane Street to I-90 south of downtown Seattle exhibited worn-out expansion joints, potholes, poor pavement conditions with heavy rutting, and exposed steel rebar. The project rehabilitated 1.5 miles of bridge deck to "good" condition in addition to providing safe driving conditions to the 125,000 vehicles that travel the segment every weekday.

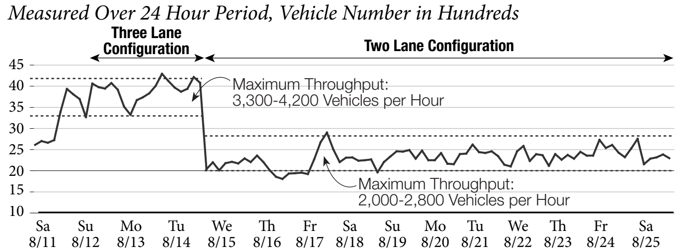
WSDOT pursued an aggressive work-plan concentrated the surface rehabilitation activities in a round-the-clock, 19 day schedule in August (which has lower traffic volumes then other summer months). The project began with an available three lane configuration for traffic which would be reduced capacity to two lanes for the last half of the project. To maximize vehicle throughput and offset lost capacity during construction, WSDOT needed to remove 57,000 vehicles from northbound I-5 each day.

In order to meet this reduction goal, WSDOT worked extensively with local governments, businesses and transit agencies and provided some funding to provide options to help keep traffic moving. These intensive coordination efforts started more than nine months before the major I-5 lane closures began. For example, the City of Seattle designated a lane on Airport Way for trucks, buses, and vanpools, retimed dozens of traffic signals on alternate routes; and provided police officers to direct traffic on the alternate routes. King County Metro added Elliot bay water taxi runs; provided vanpool incentives and together with Pierce Transit adjusted transit routes. WSDOT provided temporary P&R spaces with marketing support from Sound Transit. King County Metro and Pierce Transit adjusted transit routes and provided vanpool incentives and temporary park and ride lots. Local businesses offered alternate work sites, flexible work schedules and encouraged employees to use vacation days. They also rescheduled truck delivery schedules. WSDOT led extensive community and media outreach starting nearly a year in advance of the August construction lane closures.

Achieving Maximum Throughput in the Construction Zone

Using narrowed lanes and reduced shoulder widths, WSDOT was able to maintain an additional lane during each phase of construction, greatly offsetting the throughput reduction. Under the modified conditions, WSDOT estimated that 3,300 to 4,200 vehicles could pass through the three lane configuration each hour, and 2,000-2,800 vehicles could pass through the corridor each hour under the two lane configuration.

Daily Maximum Throughput Levels During Lane Reconfigurations at I-5/Spokane Street to I-90 Rehabilitation Project
August 2007
Measured Over 24 Hour Period, Vehicle Number in Hundreds



Data Source: WSDOT Northwest Region Traffic Office

As the graph above illustrates, WSDOT was able to manage conditions to achieve maximum throughput for all but a few instances during construction. Traffic was able to move expeditiously through the channelized configurations because demand rarely exceeded available capacity: volume was reduced by 34,000 vehicles during the three lane configuration and up to 58,000 during the two lane configuration as the table (above/below) illustrates. WSDOT was only able to account for roughly 2/3 of the displaced vehicles and was unable to account for the remaining 1/3 of the diverted traffic. However, the volume reduction ensured that backups rarely exceeded 10 minutes during the three lane configuration and no more then 60 minutes during the two lane configuration.

Average Number of Vehicles Diverted Away from Construction Zone

	Peak Morning Commute		All Day Commute	
	3 Lanes	2 Lanes	3 Lanes	2 Lanes
Arterials	3,000	4,000	13,000	27,000
I-405	1,000	1,000	5,000	7,000
Transit	3,500	2,500	5,300	4,300
Unknown	4,000	11,000	11,000	20,000
Total Cars Diverted	11,500	18,500	34,300	58,300
Remained on I-5	25,000	18,000	87,000	63,000

Data Source: WSDOT Traffic Office, King County Metro

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Manage Demand

CTR is Effective at Reducing Delay in the Central Puget Sound Region

The Commute Trip Reduction (CTR) Program is one of several demand management strategies aimed at reducing delay statewide. The CTR Program helps to make the state transportation system more efficient by reducing the number of single-occupancy vehicle trips and the level of VMT on the transportation system. A higher proportion of trips made in high-occupancy vehicles, or by walking or bicycling, or avoided altogether during the morning commute means reduced delay for everyone traveling on system when the use of the system is peaking. For more information on CTR see pages 92-95.

In the central Puget Sound region, the Washington State CTR Program plays an important role. Employees commuting to worksites participating in the CTR program in the central Puget Sound made approximately 19,200 fewer vehicle trips each weekday morning in 2007 than they did when these worksites entered the program. This is up from 14,200 fewer vehicle trips reported in 2005.

Many of the reduced trips would otherwise have passed through the region's major traffic chokepoints during peak periods. Their absence has a significant impact on congestion, reducing delay by an estimated 19% during the peak travel period on average mornings in the region. This is a significant increase from 2005, which saw an estimated 11.6% reduction in delay due to CTR.

By providing more options for commuting, the CTR program reduces congestion on the state's busiest corridors. Here Sound Transit's Tacoma Link reduces drive alone trips by transporting commuters from Park and Ride lots through the busy downtown Tacoma corridor.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Operate Efficiently

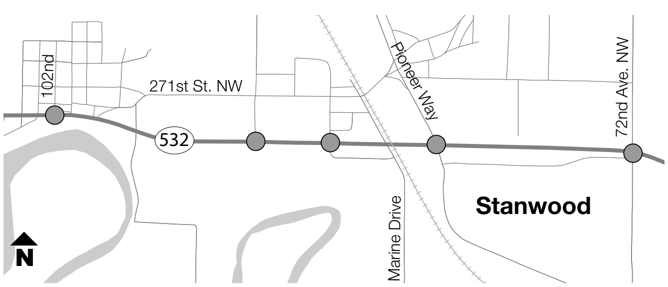
SR 532 Signal Improvements Have Immediate Congestion Benefits

Increasing development and a rise in population along SR 532 in Stanwood has resulted in increased congestion and congestion-related collisions. In the last ten years, traffic has increased by almost 70% in some locations. Some sections of SR 532 now serve an average of 20,000 vehicles per day.

As one of the first components of WSDOT's SR 532 corridor improvement program, the 72nd Ave. to 102nd Ave. signal improvement and interconnect project provided considerable travel time benefits for drivers and provided the necessary equipment to remotely manage these traffic signals during upcoming construction projects. The $60,000 needed for this work was designated as an early action item, and the work was completed in less than six months. WSDOT crews placed video detection at several intersections between Sunrise Blvd. and 72nd Ave. and added connections from these signals to the central Traffic Management Center in Shoreline. This allowed signal engineers to remotely adjust the signal timing to improve traffic flow and monitor intersection performance along the corridor.

Travel time benefits were both significant and immediate, with westbound travelers saving up to six minutes and eastbound travelers saving up to two minutes along this three mile section of roadway. Additional projects planned for the corridor will include additional intersection improvements and replacement of the General Mark W. Clark Memorial Bridge.

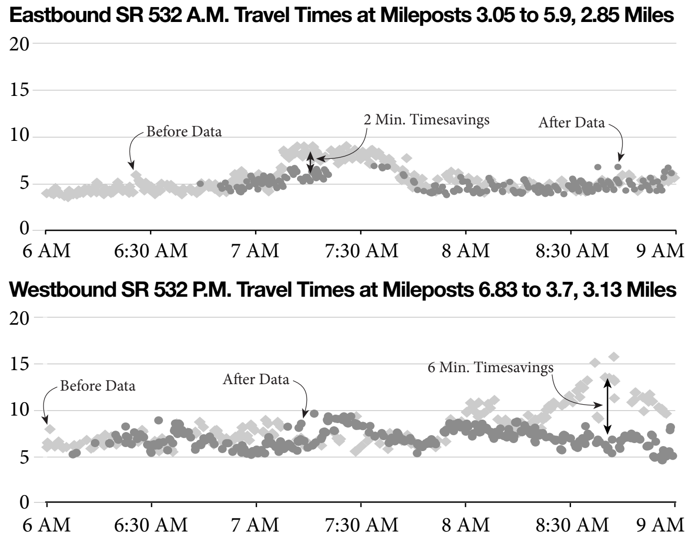
Location of SR 532 Signal Improvements



Signal Improvements
WSDOT interconnected and synchronized the signals to improve traffic flow through the city of Stanwood. Newly added electronic traffic detection devices and five cameras provide up-to-the-minute information on the WSDOT website.

Data Source: WSDOT Northwest Region.

SR 532 Before and After Travel Times
Travel Times in Minutes by Time of Day



Data Source: WSDOT Northwest Region.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Operate Efficiently

Intelligent Transportation Systems (ITS) are important tools to manage highway system efficiency at WSDOT. WSDOT's vehicle detectors and video monitoring systems are the agency's eyes and ears, helping the Traffic Management Center (TMC) assess the system's performance and manage traffic flow accordingly. For instance, staff at the TMC can control the ramp meter system to regulate traffic entering the mainline; this helps eliminate merging conflict and delay or even prevent congestion on the mainline. Meanwhile, tracking and posting travel times measured by vehicle detectors on the web helps commuters schedule their trips to avoid congested times. Posting current travel times on variable message signs (VMSs) en-route helps drivers make real-time decisions to select alternate routes to commute. WSDOT continues to look for new ITS technologies and strategies to manage traffic with greater sophistication and effectiveness. Two such strategies include Integrated Corridor Management and Active Traffic Management. For more information on ITS at WSDOT, see pages 101-102.

Active Traffic Management Offers New Approaches For Maximizing System Efficiency

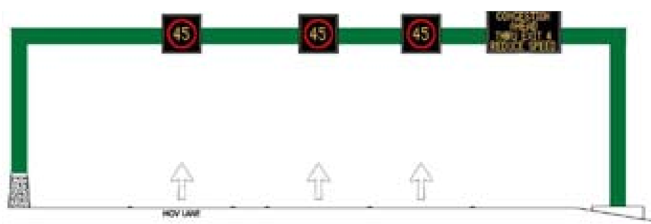
Active Traffic Management (ATM) is the next generation of ITS: a series of improvements to highway technology that provide more sophisticated safety efforts, as well as traffic reliability control that dynamically adapts to the existing levels of congestion. The Federal Highway Administration (FHWA) recently completed a survey of ATM processes used in several European countries; WSDOT participated in this survey and is a candidate to help advance some of these processes in the U.S. ATM tools with potential to be rolled out in the Puget Sound region include queue warning signs to warn drivers of backups ahead, speed harmonization signs instituting slower speeds to help prevent rear-end accidents and to maximize traffic flow on the roads during peak periods, and conversion of the shoulder into a traffic lane temporarily during peak periods. The full FHWA study on ATM can be found at http://international.fhwa.dot.gov/pubs/pl07012/.

WSDOT Receives Two Major Federal Grants for ITS Programs to Improve Mobility

This year, Washington State received major grants from the federal government for two major roadways in the state. Both include money to add additional ITS programs.

Washington State received $138.7 million from the "Urban Partnership Program" to help reduce congestion on SR 520. Potential solutions include adding variable pricing on SR 520 between I-5 and I-405, implementing Active Traffic Management technologies on the roadway, and improving traveler information. WSDOT, the Puget Sound Regional Council (PSRC), and King County will share the responsibility for these improvements.

The federal government also provided $15 million from the "Corridors of the Future" program to Washington for the I-5 Columbia River Bridge Crossing between Vancouver, WA and Portland, OR. This project will include ITS and ATM efforts to improve mobility, as well as a review of the feasibility of variable pricing.



An example of Active Traffic Management: Speed Harmonization and Queue Warning signs dynamically and automatically reduce speed limits approaching areas of congestion, collisions, or special events. This averts accidents and also can prevent or delay congestion breakdown by helping maximize the throughput of vehicles on the road.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

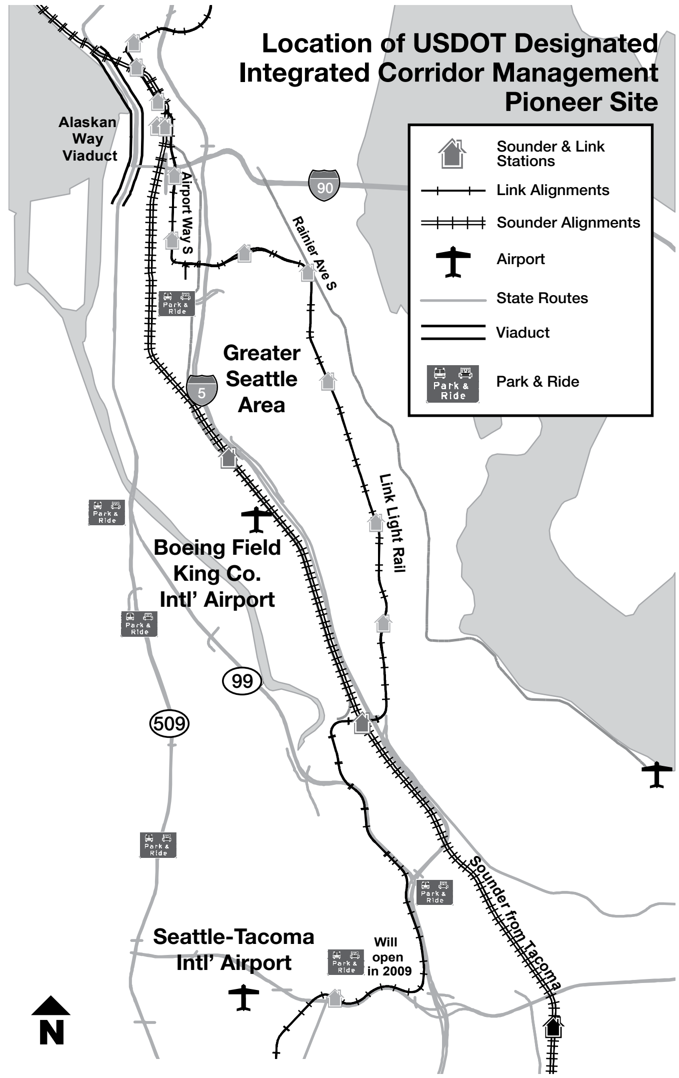
Operate Efficiently

WSDOT Plans Integrated Corridor Management from SeaTac Airport to Downtown Seattle

Nationally, Integrated Corridor Management (ICM) is an emerging function of ITS. In 2006, USDOT chose Seattle as a "pioneer site" for their Integrated Corridor Management pilot program. ICM facilitates shifting travelers from congested highways to parallel routes and transit lines in order to reduce congestion. The cornerstones of the program are comprehensive, accurate, and timely traveler information, coupled with careful coordination between WSDOT and multiple local transportation agencies.

Seattle's ICM corridor is located between SR 518 near the SeaTac Airport and Jackson Street in downtown Seattle (see map). This regionally critical corridor carries thousands of commuters every weekday, as well as significant amounts of freight to and from the Port of Seattle. However, this corridor is geographically constrained and burdened with complex and expensive right-of-way limitations, preventing further highway expansion. While I-5, the main route, experiences increasing daily and peak period congestion, the corridor will face acute strain when a primary parallel route, SR 99, faces major construction work at the location of the Alaskan Way Viaduct.

Multiple alternate highways and transit systems exist that could take the pressure off I-5. Parallel routes such as Airport Way, East Marginal Way, 4th Avenue S., 1st Avenue S., and Rainier Avenue have unused capacity and could carry diverted traffic. In addition, several King County Metro bus routes traverse the corridor, the Sounder commuter train runs parallel to it, and Sound Transit light rail service from the airport to downtown will open in 2009. Further, in 2009, Sound Transit will open a Park and Ride with 600 spaces at SR 99 and 154th Street, to be served by multiple bus routes.



Data Source: WSDOT Traffic Office and Sound Transit.

The corridor recently had a chance to apply several ICM strategies and demonstrated its ability to absorb major traffic disruptions during the August 2007 14-day closure on I-5 northbound. Pre-closure efforts to inform commuters were successful: roughly one-third of commuters moved their peak-period trips from I-5 to buses, the Sounder commuter train, arterials, and I-405. This prevented major back-ups expected from the closure. During construction, the WSDOT traffic management center (TMC) in Shoreline coordinated with local jurisdictions' TMCs, using a network of variable message signs, highway advisory radio transmitters, and the 511 system to broadcast travel time, construction delays, and traffic conditions on the corridor. This helped drivers make choices en-route about their commute route and mode. Arterial signal timings were also adjusted dynamically to accommodate the shifted traffic. More information on the I-5 closure and its results is located on p. 79.

WSDOT plans to replicate these successful ICM practices on other corridors in the region, and also expand it into incident and emergency response and mitigation.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Add Capacity Strategically

The New Tacoma Narrows Bridge Relieves Congestion in Pierce County

When the new eastbound span of the Tacoma Narrows Bridge opened on July 16, 2007, the effect of the added capacity on congestion on SR 16 was profound. While new tolling operations did not seem to have an effect on the volume of traffic using the bridge, the added capacity made it possible for vehicles to travel close to the posted speed limit at all times of the day

Volume Remains Steady Compared to 2006 Traffic

Approximately, 3,215,000 vehicles crossed the Tacoma Narrows Bridge between July 16, 2007 and September 20, 2007. This is roughly 2,000 less vehicles, than the number of vehicles that crossed the bridge during the same time period in 2006. During the month of September, there was a 1.4% increase in the number of vehicles that crossed the bridge compared to September 2006.

Before and After: Volume of Vehicles on the Tacoma Narrows Bridge

	2006 Volume	2007 Volume	Change	% Change
July 16-September 30 (11 weeks)	3,215,000	3,213,000	-2,000	0.0%
Month of September	1,238,000	1,256,000	18,000	1.4%

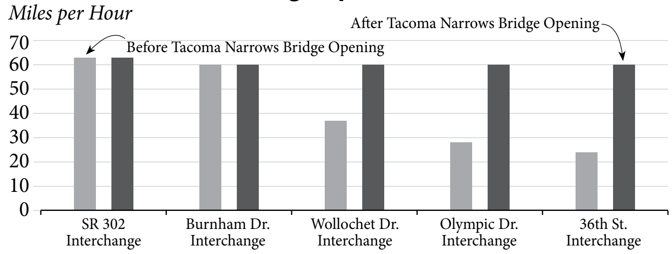
Data Source: WSDOT Olympic Region Traffic Office

Tacoma Narrows Bridge Added Capacity Reduces Delay Between Gig Harbor and Tacoma

Improved, consistent traffic flow marked the opening of the second Tacoma Narrows Bridge. While the number of vehicles crossing the Tacoma Narrows each day remained constant compared to 2006, average speeds across the bridge during peak periods of congestion increased to posted speed with the additional capacity. Prior to opening the new bridge, morning traffic between Gig Harbor's Olympic Drive and the bridge slowed to less than 25 mph between 6 and 10 a.m. Following the new bridge opening, traffic speeds average 60 mph (slightly faster then the 55 mph speed limit) in that same area and time period. See graph below.

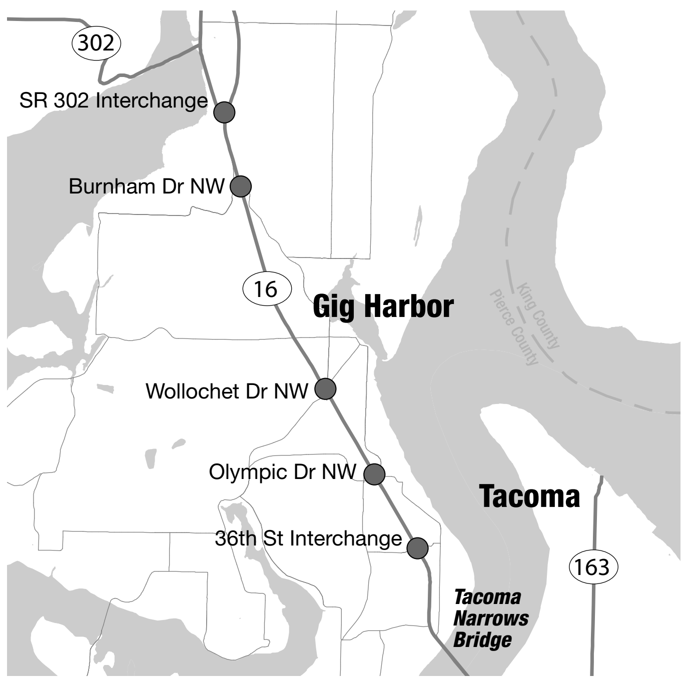
The added capacity has increased average speeds on Eastbound Traffic on SR 16 at all times of the day. Prior to the opening of the new bridge, speeds observed at the 36th Street interchange on SR 16 were consistently less than 50 mph. Since the bridge opened on July 16, speeds have been consistently observed at or near the posted speed at the same location, as shown on the graph to the right.

Eastbound SR 16: Average Speed between 6 and 10 A.M.

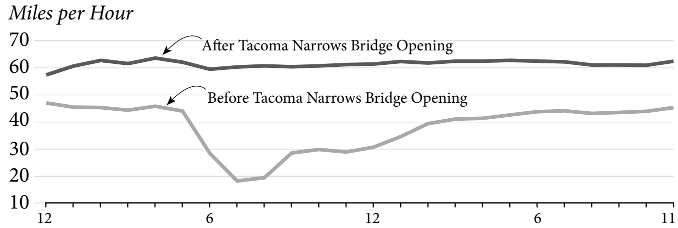


Data Source: WSDOT Tolling Office.

Speed Counters Located on Eastbound SR 16
Approaching Tacoma Narrows Bridge



Eastbound SR 16 and 36th Street Interchange
Average Speed Before and After Tacoma Narrows Bridge Opening



Data Source: WSDOT Tolling Office.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

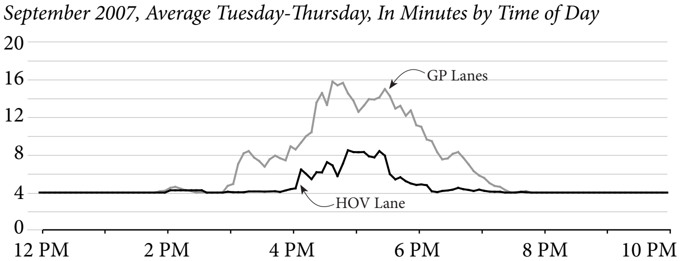
Add Capacity Strategically

I-5 HOV Project, Stage 4: HOV Lane Users See Substantial Travel Times Savings

WSDOT recently extended the HOV lanes on I-5 by four miles through the city of Federal Way. The lanes opened July 16, 2007. The project extended the HOV lane and ITS from S. 320th St. to the Pierce County line. Construction began in Spring 2005. It is the fourth stage of a 13 mile project, I-5 Pierce County line to Tukwila HOV.

During the evening commute, carpoolers, vanpoolers, and transit riders are now saving an average of five minutes on their commute home. On a typical weekday, between 3 p.m. to 7 p.m. approximately 4,300 vehicles - more than 10,000 people - are seeing this benefit. Below is a graph of the southbound I-5 travel times in the general purpose and HOV lanes during the P.M. peak.

I-5 Southbound Travel Times for HOV and General Purpose Lanes
S. 320th St. to the Pierce Co. Line, 3.9 Miles
September 2007, Average Tuesday-Thursday, In Minutes by Time of Day



Data Source: WSDOT Northwest Region.

SR 18 Improvements Provide Congestion and Safety Benefits

WSDOT widened SR 18 to four lanes between Maple Valley and Issaquah Hobart Road. The project separated eastbound and westbound traffic with a 48-foot-wide grass median, built an interchange at 244th Avenue SE, constructed an overpass at SE 200th Street, and removed intersections at 244th Avenue SE, SE 200th Street, and 236th Avenue SE.

These improvements have provided significant travel time and safety benefits to drivers along the corridor. Prior to the project completion, this corridor served approximately 23,000 vehicles a day (March-August 2006 weekday). Now, approximately 29,000 vehicles travel this corridor daily (March-August 2007 weekday). The speed limit through this section is 55 mph and 15% to 18% of the vehicles using the route are trucks.

On August 31, 2006 the new eastbound roadway was opened to traffic, the 244th Avenue interchange was in operation, and the 244th signal was turned off. It was the last signal on SR 18 between I-5 and I-90. A second lane of traffic in both directions was open to drivers by late October of 2006.

The improvements have more than doubled the roadways capacity and increased its reliability and efficiency. The project has eliminated backups through this area. This makes for 15 to 20 minute benefits westbound during the evening peak and 6 to 10 minute benefits eastbound during the morning peak.[1] Due to increased volumes and limited capacity at the I-90 interchange, the eastbound benefits through the area have been offset by a similar increase in delay at the backup approaching I-90 during the morning commute.

The corridor has also seen significant safety benefits as a result of the improvements. Total collision rates and injury collisions in this 4-mile stretch of roadway have dropped by 50%.[2]

1. Travel Time benefits through project area based on floating car travel time studies, travel time impacts approaching I-90 based on constituent reports.

2. Collision rates were compiled for milepost 16-20. Before period: 2001-2005; after period: Nov 2006 – Jul 2007.

Crews turn off the signal at 244th SE - the last signal on SR 18 between I-5 and I-90.

Measuring Delay and Congestion: Annual Update

What WSDOT is Doing About Congestion

Add Capacity Strategically

SR 522 Interchange Improvements Save Morning Commuters an Average of 10 Minutes

The signalized intersection of SR 522 and Fales/Echo Lake Road was a major choke point for commuters traveling from Monroe to Woodinville. Traffic from Monroe commutes westbound on SR 522 in the morning and returns eastbound in the evening. The morning commute had the most significant delay due to travel patterns. With the signal in place, the traffic volumes pick up around 5:30 in the morning and the backup would reach four miles to West Main Street on a regular basis. It would take vehicles approximately 25 minutes to travel the four mile segment between West Main Street and Fales/Echo Lake Road during the morning peak hour (as observed on March 21, 2006).

On August 17, 2006, WSDOT opened the Fales/Echo Lake Road Interchange to traffic and turned off the signal. Initially, in the four mile segment between West Main Street and Fales/Echo Lake Road, vehicle travel times dropped from 25 minutes to 4 minutes during the morning peak hour. After several months, the vehicle volumes through this stretch of roadway had grown, and the morning peak hour travel times grew to 10-15 minutes, as observed on January 25, 2007. There was also a 2-4 minute delay observed at the westbound merge from Fales/Echo Lake Road.

Overall, the interchange provides approximately ten minutes of benefit to commuters traveling on SR 522 westbound during the morning peak hour.

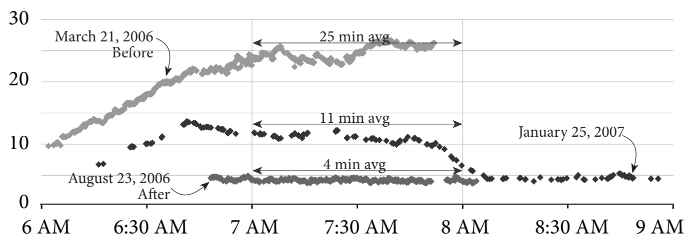
The graph below depicts the observed travel times between West Main Street and Fales/Echo Lake Road on March 21, 2006, August 23, 2006, and January 25, 2007.

The new bridge eliminates the daily bottlenecks on SR 522 at Fales/Echo Lake Road and greatly improves commute times.

SR 522 Interchange Project Initially Improves Travel Times by 21 Minutes

Morning WB Traffic from West Main to Fales-Echo Lake Rd., 4.1 Miles

Travel Times in Minutes by Time of Day



Data Source: Northwest Region.

Data Note: Data gathered using Automated License Plate Recognition (ALPR).