Washington State Department of Transportation

2018

Corridor Capacity Report

The 17th edition of the annual *Congestion Report*

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Roger Millar, Secretary of Transportation, PE, FASCE, FAICP

WSDOT's comprehensive annual analysis of multimodal state transportation system performance

Developed in partnership with

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Table of Contents

Fast-paced economy has Washington commuters hitting the brakes

Washington state's growing economy means more job opportunities, which translates into more people driving to and from work each weekday.

The Corridor Capacity Report (CCR) helps the state better analyze congestion on the transportation system and determine usable capacity on state highways, transit, ferries and passenger rail. The CCR digs into the ways that congestion impacts the transportation system and translates these impacts in ways commuters can understand: effects on the climate and on drivers' wallets.

WSDOT is working to improve transportation system performance by using a Practical Solutions approach to help evaluate options, set performance goals, and collaborate with community partners to implement efficient and cost-effective multimodal improvements. The agency uses the Corridor Sketch Initiative (see https://www.wsdot.wa.gov/planning/corridor-sketch-initiative) and the CCR as tools to analyze the state's system performance. These tools also help WSDOT identify key strategies to improve mobility on the state transportation system.

The CCR promotes a robust discussion between WSDOT, the Legislature, external stakeholders, businesses, research institutions and the public. The publication aims to help improve understanding of congestion and inform congestion-related decision-making at all levels.

This report consists of the 2018 Corridor Capacity Report, the 2nd edition of the Handbook for Corridor Capacity Evaluation, and a data appendix.

WSDOT, MPOs establish final MAP-21 performance targets

The Moving Ahead for Progress in the 21st Century Act and the Fixing America's Surface Transportation Act (collectively referred to as MAP-21 throughout this report) aim to transform the federal-aid program for transportation projects by establishing new performance requirements that help ensure the most efficient investment of these funds.

WSDOT collaborated with Metropolitan Planning Organizations (MPOs) from around the state to set new performance targets for highway system performance, freight, and congestion mitigation and air quality on May 20, 2018.

WSDOT's Baseline Performance Period Report was accepted by the Federal Highway Administration (FHWA) on November 1, 2018 (see p.6 for more information).

WSDOT to conduct CCR engagement process

WSDOT will initiate a Corridor Capacity Report engagement process to capture the state's evolving needs in multimodal transportation system analysis, evaluation and performance management. The process will have two goals: to align the CCR with WSDOT's strategic plan while accommodating the federal, state and agency reporting requirements; and to meet the needs of WSDOT engineers, planners and executive leadership as well as those of external partners such as Metropolitan Planning Organizations, transit agencies, and Legislative staff.

Interactive Corridor Capacity Report maps help readers visualize data

Corridor Capacity Report readers can explore each corridor's performance data through interactive online maps (marked with the icon at right). To view the statewide map, visit bit.ly/agolCCR18statewidemap.

On the cover: vehicles on I-5 head towards Seattle. (Photo courtesy of Eric Knigge and Shravan Aeneni)

Executive Summary

A summary of statewide and regional multimodal travel indicators

Washington state saw an increase in drivers on the road in 2017. Passenger vehicle registrations increased 7.2% while licensed drivers increased 4.9% between 2015 and 2017.

- More drivers in 2017 contributed to a 3.0% increase in the number of vehicle miles traveled (VMT) on all public roadways, up from 59.653 billion miles in 2015 to a new high of 61.420 billion miles.
- More drivers also had a hand in a 3.9% increase in VMT exclusively on state highways, which hit a new high of 34.627 billion in 2017, up from 33.335 billion in 2015.
- Statewide per person VMT on all public roads dropped 0.5% from 8,471 in 2015 to 8,448 in 2017.
- Total VMT on the five major highway corridors in the central Puget Sound region (I-5, I-405, SR 520, I-90 and SR 167) increased by 1.9% between 2015 and 2017.

Higher VMT—likely due to the growing economy, increased population, and a stronger job market—led to increased congestion on many major corridors throughout the state.

Total congestion on the five monitored freeway corridors in the central Puget Sound region increased by 7.3% between 2015 and 2017 (2017 statewide delay data was unavailable at the time of this publication).

- Three of the five monitored freeway corridors in the central Puget Sound region, I-405, I-90 and SR 520, saw decreases in weekday delay— drops of 1.3%, 28.7% and 33.3%, respectively.
- The other two monitored corridors in the central Puget Sound region saw increases in delay—15.6% on I-5 and 27.4% on SR 167.
- HOT and ETL lanes help manage congestion for all road users. For updated toll facilities performance reports, visit http://www.wsdot.wa.gov/Tolling/

In 2017, approximately 38% of all person miles traveled on freeways in the central Puget Sound region were in HOV lanes, which make up 27% of the region's lane miles.

- Travel times are shorter and person throughput is higher in HOV lanes than in general purpose (GP) lanes (see appendix pp. 27-29). For example, the HOV lane on I-5 at Northgate moved nearly 2.85 times as many people as each of the adjacent GP lanes. Similarly, average and reliable travel HOV lane times were faster than parallel GP lane travel times by up to 14 and 23 minutes, respectively.

WSDOT Incident Response teams responded to 23.5% more incidents (61,913 total) in 2017 than in 2015, with average clearance times of 12.5 minutes.

- Proactive work by Incident Response teams resulted in nearly $96.6 million in economic benefit in 2017, a 20.4% increase from 2015.

Urban transit ridership increases

Transit ridership on urban commute corridors in King and Snohomish counties during daily peak periods increased 14%, from roughly 93,201 in 2015 to 106,645 in 2017.

- Transit on I-5 between Federal Way and Everett moved 59,724 people during peak periods on average weekdays. Without transit, more than 5.1 additional GP lanes would be needed to meet demand on this stretch of I-5.
- The number of miles passengers traveled using transit during daily peak periods on urban commute corridors in King and Snohomish counties increased 10.7%, from 1.21 million miles in 2015 to 1.34 million miles in 2017.
- Daily greenhouse gas emissions avoided due to transit ridership during peak periods in King and Snohomish counties improved by over 16%, from 595,310 pounds avoided in 2015 to 690,945 pounds avoided in 2017.

Ferries ridership continues to grow

While annual ferries ridership grew, annual vehicle capacity utilization decreased by one percentage point, dropping from 62% in 2015 to 61% in 2017 (see pp. 48-49).

- Annual ferries ridership increased more than 2.4%, going from 23.9 million in 2015 to 24.5 million in 2017.
- Annual ferry trip reliability declined from 99.5% in 2015 to 99.0% in 2017.
- Ferries on-time performance dropped 1.9 percentage points from 2015 to 92.5% in 2017.

Amtrak Cascades ridership grows in 2017

Passenger miles traveled on Amtrak Cascades increased by 8.4%, going from 106.9 million passenger miles in 2015 to 115.9 million passenger miles in 2017. Capacity utilization also went up by 5.3 percentage points over the same period (See p. 50)

- Ridership rose 8.3% from approximately 672,000 in 2015 to 728,000 in 2017.
- Amtrak Cascades annual on-time performance dropped by 22.7 percentage points between 2015 and 2017, from 73.0% to 50.3%.

Dashboard of Indicators

2018 *Corridor Capacity Report* Dashboard of Indicators[1]	2013	2014	2015	2016	2017	Difference '15 vs. '17[1]
Demographic and economic indicators						
State population (in millions)	6.88	6.97	7.06	7.18	7.31	3.5%
Gasoline price per gallon (annual average)[2]	$3.83	$3.68	$2.79	$2.52	$2.85	2.0%
Washington total employment (in thousands of workers)[3]	2,986	3,065	3,154	3,244	3,325	5.7%
Taxable retail sales (in billions of dollars)[2]	$123.3	$129.3	$140.0	$149.50	$155.6	11.2%
International trade through Washington state (in billions of dollars)[2]	$0.13	$0.14	$0.14	$0.13	$0.13	-8.2%
Statewide multimodal performance measures						
Drive alone commuting rate[4]	72.7%	72.4%	72.4%	72.1%	71.7%	-0.7%[5]
Carpool commuting rate[4]	10.1%	10.1%	9.8%	9.9%	10.2%	0.4%[5]
Bicycling and walking commuting rate[4]	4.3%	4.5%	4.7%	4.6%	4.1%	-0.6%[5]
Public transit commuting rate[4]	6.3%	6.3%	6.2%	6.4%	6.5%	0.3%[5]
Transit ridership[6] (in millions)	221.2	227.2	227.4	233.3	237.1	4.3%
WSDOT Ferries ridership[6,7] (in millions)	22.5	23.2	23.9	24.2	24.5	2.4%[1]
Amtrak Cascades ridership[8] (in thousands)	694	700	672	735	728	8.3%
Statewide congestion indicators						
Vehicle miles traveled						
All public roads vehicle miles traveled (VMT) (in billions of miles)	57.211	58.060	59.653	60.851	61.420	3.0%
All public roads VMT per person (in miles)	8,313	8,332	8,448	8,471	8,402	-0.5%
State highways VMT (in billions of miles)	31.649	32.177	33.335	33.335	34.627	3.9%
State highways VMT per person (in miles)	4,599	4,618	4,721	4,765	4,737	0.3%
Congestion on state highway system						
Total state highway lane miles	18,662	18,680	18,699	18,715	18,711	0.1%
Percent of state highway system congested[9]	5.5%	5.8%	N/A	N/A	N/A	N/A
Total delay and cost of delay on state highways						
Total vehicle hours of delay (in millions of hours)[10z]	32.5	32.3	N/A	N/A	N/A	N/A
Cost of delay on state highways (in millions)[2,10]	$823	$834	N/A	N/A	N/A	N/A
Results Washington system performance measures						
Throughput productivity[11]	95.2%	94.6%	94.1%[15]	93.1%	93.9%	-0.2%[5]
Reliability index[11]	1.19	1.24	1.26	1.30	1.29	2.4%
Reliability index—% difference from 3-year average[12]	3.2%	6.4%	5.1%	5.5%	1.6%	-3.5%[5]
Corridor-specific congestion indicators (88 commutes statewide)[13]						
Annual Maximum Throughput Travel Time Index (MT^3I)[14]	1.34	1.38	1.42	1.47	1.45	2.1%
Number of commute routes with $MT^3I > 1$[14]	61	66	68	71	72	5.9%
WSDOT congestion relief projects (cumulative)						
Number of completed Nickel and Transportation Partnership Account mobility projects as of December 31 each year	94	98	99	103	105	6.1%
Project value (in millions of dollars)	$3,985	$4,287	$4,669	$5,058	$7,763	66.3%

Data sources: Washington State Office of Financial Management, U.S. Energy Information Administration, Bureau of Labor Statistics – Consumer Price Index, Washington State Employment Security Department, Washington State Department of Revenue, WSDOT State Highway Log, U.S. Census Bureau - American Community Survey, National Transit Database, Washington Department of Ecology, WSDOT Ferries Division, WSDOT Rail, Freight and Ports Division, WSDOT Capital Program Development and Management Division, WSDOT Multimodal Planning Division.

Notes: N/A = Not available. **1** Due to rounding, some percentages are not computable based on numbers in the table. **2** These dollar values are inflation-adjusted using the Consumer Price Index, and are reported in 2017 dollars. **3** Employment only includes non-agricultural workers. **4** Based on 1-year estimates from the American Community Survey, commuting rates are of workers age 16 and older. Totals do not equal 100 because "Other" and "Worked at home" categories not included. **5** Difference in percentage points, not percent change. **6** Ridership is the number of boardings, also called unlinked passenger trips. **7** Ferries ridership figures are for calendar years, and therefore may differ from numbers in other publications which use fiscal years. **8** These figures include riders on Washington segments only. **9** Based on below 70% of posted speed. **10** Based on maximum throughput speed threshold (85% of posted speed). Statewide delay data for 2015, 2016 and 2017 was unavailable at the time of this publication. **11** See p. 7 for descriptions of these measures. **12** This measure has been updated since the publication of the 2016 *Corridor Capacity Report*. This measure is now the percentage difference between the value of the reliability index in a given year and the average of the value of the reliability index in the three preceding years. **13** Does not include Tri-Cities data. **14** The MT^3I is the average peak travel time divided by the travel time at maximum throughput speed (see p. 5). An MT^3I greater than one means the commute route experiences congestion.

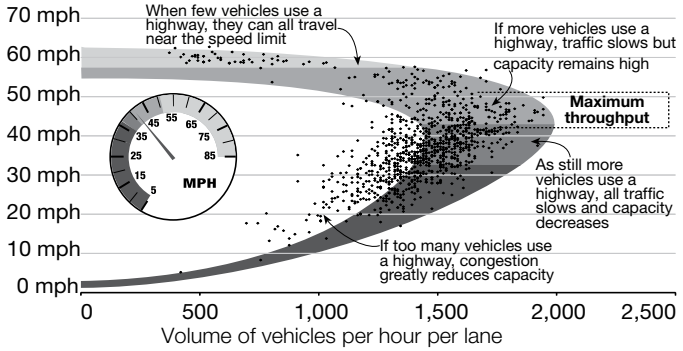
Maximum Throughput and Other Key Concepts

Maximum Throughput occurs at 70-85% of posted speeds

WSDOT aims to provide and maintain a transportation system that maximizes capacity, productivity and efficiency. WSDOT uses maximum throughput speed (the speed at which the largest number of vehicles can pass through a roadway segment) as the baseline speed for congestion and capacity performance measurement on highways. Maximum throughput is achieved on highways when vehicles travel at 70% to 85% of the posted speed limit (42 to 51 mph for a 60 mph speed limit). At maximum throughput speed, vehicles can travel closer together than they can at posted speeds, allowing more vehicles to pass through a segment.

Maximum throughput: adapted speed/volume curve

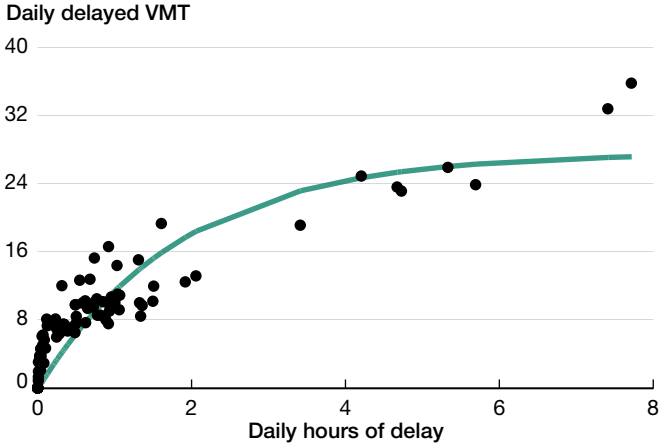
Speed limit 60 mph; Maximum throughput speed ranges between 70%-85% of posted speed



Data source: WSDOT Northwest Region Traffic Office.

I-5 northbound delay increases while delayed vehicle miles traveled[1] levels off

Daily hours of delay and daily delayed VMT in thousands



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Note: **1** Delayed vehicle miles traveled (VMT) refers to miles traveled at speeds below the maximum throughput speed threshold.

Delay accumulates faster than delayed vehicle miles traveled

Delay measures the hours during which speeds are below 50 mph (threshold speed). Delayed VMT refers to the vehicle miles traveled at speeds below that threshold.

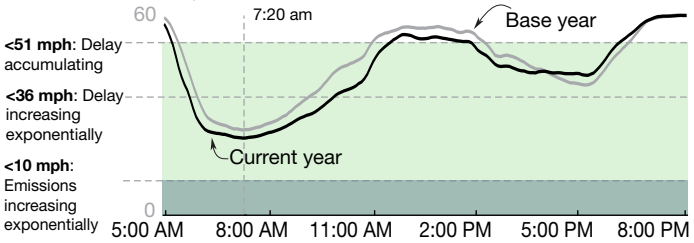
While it is impossible to have delayed vehicle miles traveled (VMT) without delay, the two measures do not have a linear relationship. Delayed VMT and vehicle hours of delay increase hand in hand until congestion becomes so severe that even though delay continues to accumulate, delayed VMT begins to level off (see graph at left). To use an extreme example, consider what happens when traffic stops dead for an hour: delay will increase by one hour, but no additional VMT will be recorded because the vehicles on the highway are not moving.

GHG emissions influenced by speed as well as fuel economy

For speeds slower than 10 mph, greenhouse gas emissions from vehicles quickly escalate. However, there is little variation in emissions per vehicle mile traveled between 35 and 60 mph, the typical range of highway speeds. For this reason, emissions often hold steady even as delay begins to accumulate. In addition, vehicle fuel economy improves each year, negating marginal changes in emissions caused by slower speeds or, on some corridors, leading to decreased emissions. The Puget Sound Regional Council provides WSDOT with the factors used to calculate the greenhouse gas emissions measures in this report.

Speeds on I-5 from Federal Way to Seattle not low enough to trigger increases in emissions between years[1]

Base and Current year; Northbound; Speed in miles per hour



Data sources and analysis: WSDOT Multimodal Planning Division, Puget Sound Regional Council and WSDOT Office of Strategic Assessment and Performance Analysis.

Note: **1** Average speeds did not drop below 10 mph, the speed at which greenhouse gas emissions start rising exponentially. While emissions begin to rise around 25 mph, this is offset by lower emissions factors in current year due to improved efficiency of vehicles on the roadway. At 7:20 a.m. (the 5-minute peak), the average speed in current year was 23.1 mph, down from 25.5 mph in base year.

See the 2nd edition of WSDOT's Handbook for Corridor Capacity Evaluation for details on WSDOT's measurement and analysis approach for these and other system evaluation metrics.

Performance-Based Transportation System Management (Federal and State Requirements)

WSDOT, MPOs establish performance targets

In collaboration with Metropolitan Planning Organizations, WSDOT finalized MAP-21 targets for highway system performance, freight and Congestion Mitigation and Air Quality (CMAQ) on May 20, 2018. WSDOT's Baseline Performance Period Report was accepted by the Federal Highway Administration (FHWA) on November 1, 2018. As recipients of federal aid transportation funds, WSDOT and MPOs must make transportation investments that show progress toward the following national goals:

- Congestion reduction – To achieve a significant reduction in congestion on the National Highway System
- System reliability – To improve the efficiency of the surface transportation system
- Freight movement and economic vitality – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
- Environmental sustainability – To enhance the performance of the transportation system while protecting and enhancing the natural environment.

Important dates for PM3 performance measures

January 1, 2018	*Performance Period starts for 2018*[1]
May 20, 2018	*States set Performance Targets for 2018*
October 1, 2018	*Baseline Performance Period Report due*
October 1, 2020	Mid-Performance Period Progress Report due (2-year)
December 31, 2021	Performance Period ends[1]
October 1, 2022	Full-Performance Period Progress Report due (4-year)

Note: **1** The performance period for the CMAQ measures runs from October 1, 2017 to October 1, 2022. Performance periods for all other measures are as indicated above.

Requirements related to data, thresholds, metrics, and measure calculation methods are stipulated by FHWA and USDOT. The WSDOT/MPO technical team used historic trend data and the average compound annual growth to set the 2-year and 4-year highway performance targets (see chart below).

Washington's MAP-21 targets will be reviewed and can be revised (with FHWA approval) for the Mid-Performance Period Progress Report due October 1, 2020.

MAP-21 performance measures by program area	Current data	2-year target[1,2]	4-year target[1,2]
Combined Rule (PM3) 23 CFR Part 490 ID No. 2125-AF54			
Highway System Performance (Congestion)			
Percent of person-miles traveled on the Interstate System that are reliable	73%	70%	68%
Percent of person-miles traveled on the Non-Interstate NHS that are reliable	77%	N/A[3]	61%
National Freight Movement Program			
Truck Travel Time Reliability (TTTR) Index	1.63	1.70	1.75
Congestion Mitigation & Air Quality Program			
Non-Single Occupancy Vehicle (SOV) travel in Seattle urbanized area (NHS)	32%	32.8%	33.2%
Peak hours of Excessive Delay per capita in Seattle urbanized area (NHS)	23	N/A[3]	28
All Pollutants (kg/day)[2]	1,658.640	366.285	658.300
Carbon Monoxide (CO) (kg/day)[2]	313.160	309.000	309.060
Particulate Matter less than 10 microns (PM_{10}) (kg/day)[2]	435.690[4]	0.305[4]	224.000[4]
Particulate Matter less than 2.5 microns ($PM_{2.5}$) (kg/day)[2]	36.820	2.100	8.700
Nitrogen Oxides (NOX) (kg/day)[2]	872.970	54.880	116.540

Notes: Federal rule allows state and MPOs to adjust four-year targets during the mid-performance progress report. There are no monetary penalties involved with PM3. **1** Two-year and four-year target periods for PM3 end October 1, 2020, and October 1, 2022. **2** Base emissions are for the four-year period 2013-2016 as reported in the CMAQ Public Access System. **3** These targets are not required for the 2-year Mid-Performance Period Progress Report. **4** PM_{10} reductions vary greatly between project types; baseline and 4-year targets represent projects with large reductions.

WSDOT establishes greenhouse gas measure

WSDOT voluntarily establishes greenhouse gas measure

The Federal Highway Administration (FHWA) finalized the PM3 rule, which included a greenhouse gas (GHG) measure on the National Highway System (NHS), on January 18, 2017. Subsequently, on May 31, 2018, FHWA revoked the GHG performance measure sections of the rule.

WSDOT is voluntarily establishing a performance measure for GHGs on the NHS according to the method outlined in the original rule, including setting targets for 2019 and 2021.

WSDOT sets greenhouse gas targets
2015-2021; Baseline and target emissions for Washington

Year	Emissions value in million metric tons (MMT)
CO_2 Baseline – 2015	18.1
CO_2 Baseline – 2016	18.2
CO_2 Baseline – 2017	Data not yet available.
CO_2 2-year Target – 2019	17.6 MMT, -3.6% below 2016 values (to be updated to 2017 when data is available)
CO_2 4-year Target – 2021	16.3 MMT, -10.7% below 2016 values (to be updated to 2017 when data is available)

Data source: WSDOT Environmental Services Office.

Results Washington emphasizes performance and accountability

Results Washington, the state's performance management system, outlines Gov. Jay Inslee's priorities for the state. WSDOT manages Results Washington performance measures related to Sustainable, Efficient Infrastructure. The measures related to multimodal highway system performance focus on alternative commute methods, travel and freight reliability, and highway system efficiency.

WSDOT also has an interest in the clean transportation measures (which focus on reducing transportation-related GHG emissions) that fall under the Sustainable Energy and A Clean Environment goal area. Visit results.wa.gov for more information.

Alternative Commute Methods: Increase the percentage of Washingtonians using alternative transportation commute methods to 29% by 2020.

In 2017, 28.3% of Washington workers age 16 years and older used an alternative commute method (including teleworking) to get to work. This figure increased 0.7% over 2015, but still fell short of the goal. Data for this measure comes from the American Community Survey.

Increasing the use of alternative modes of transportation helps maximize capacity on the entire transportation system, improves mobility and accessibility, and reduces greenhouse gas emissions.

Reliability: Ensure travel and freight reliability on strategic corridors does not deteriorate beyond 5% through 2020.

As of April 2017, this measure is based on the percentage difference between the value of the reliability index in the current year and the average value of the index in the three previous years. In 2017, the reliability index was 1.6% higher than the average of 2014, 2015 and 2016, meeting the target of staying below 5%.

A reliability index greater than 1.0 indicates that the highway system is delayed during the daytime travel period (5 a.m. to 8 p.m.); an increase in the index over time indicates worsening delay and less reliable travel times.

System Efficiency: Operate strategic corridors at 90% efficiency or higher through 2020.

For 2017, Washington operated strategic corridors at 93.9% efficiency, meeting the goal of 90% or higher (see table below). However, system efficiency has worsened steadily since 2009; increased economic activity means more people and freight on the roads, and as demand exceeds capacity efficiency decreases.

An increase in throughput productivity indicates that system efficiency has improved, meaning more people and/or goods are being moved along Washington freeway corridors.

Reliability and efficiency decline since 2013
Reliability based on 80th percentile travel times for 5 a.m. to 8 p.m.; Throughput productivity averages weighted by average daily volume per lane

Year	Reliability index	% Difference from 3-year rolling average[1,2]	Throughput productivity %[2]
2013	1.19	3.2%	95.2%
2014	1.24	6.4%	94.6%
2015	1.26	5.1%	94.1%
2016	1.30	5.5%	93.9%[3]
2017	1.29	1.6%	93.9%

Data source: WSDOT Office of Strategic Assessment and Performance Analysis.
Notes: **1** The percentage difference between the value of the reliability index in one year and the average value of the reliability index in the three preceding years. **2** Results Washington performance measure.
3 Updated since publication of the 2017 *Corridor Capacity Report*.

Statewide Congestion Indicators

Statewide vehicle miles traveled reach new high in 2017

Statewide vehicle miles traveled (VMT) on all public roads (including but not limited to state highways) in Washington state reached a new high of 61.420 billion miles in 2017, an increase of 3.0% from 59.653 billion in 2015. Similarly, VMT on state highways alone reached a new high at 34.627 billion miles, an increase of 3.9% from 2015 (33.335 billion). In 2017, VMT on all public roads and on state highways saw one-year increases of 0.9% and 1.2% over 2016 levels, respectively.

Per person vehicle miles traveled decline between 2015 and 2017

In 2017, per person (per capita) VMT on all public roads in Washington declined for the first time since 2012, indicating that the state's population growth outpaced the growth in VMT. In 2017, per-person VMT was 8,402 miles—about 46 miles (or 0.5%) below the 2015 figure (8,448 miles), and 69 miles (or 0.8%) below the 8,471 miles recorded in 2016. This decrease is likely attributable in part to higher gasoline prices, which in 2017 also reversed a trend that had held since 2012 (see p. 10)

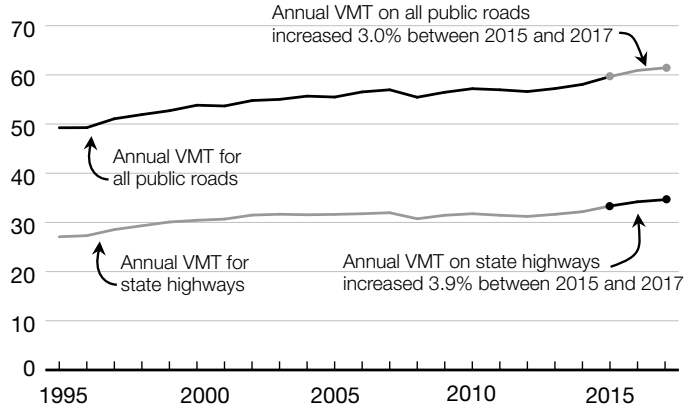
Population grows faster than vehicle miles traveled (VMT) on Washington public roads in 2017
2013 through 2017; Population in thousands

	Total vehicle miles traveled (billions)		Vehicle miles traveled per person	
Year (population)	All public roads	State highways	All public roads	State highways
2013 (6,882)	57.211	31.649	8,313	4,599
2014 (6,968)	58.060	32.177	8,332	4,618
2015 (7,061)	59.653	33.335	8,448	4,721
2016 (7,183)	60.851	34.227	8,471	4,765
2017 (7,310)	61.420	34.627	8,402	4,737
Δ 2017 vs. 2015	1.767	1.292	-46	16
%Δ 2017 vs. 2015	3.0%	3.9%	-0.5%	0.3%

Data sources: WSDOT Multimodal Planning Division and Washington State Office of Financial Management.

On state highways alone, per-person VMT also dropped 28 miles (or nearly 0.6%) between 2016 and 2017, going from 4,765 miles to 4,737. However, between 2015 and 2017, the change in VMT on state highways per Washingtonian increased by 16 miles (or 0.3%) from 4,721 miles to 4,737 miles.

Record high statewide vehicle miles traveled in 2017
1995 through 2017; Miles in billions

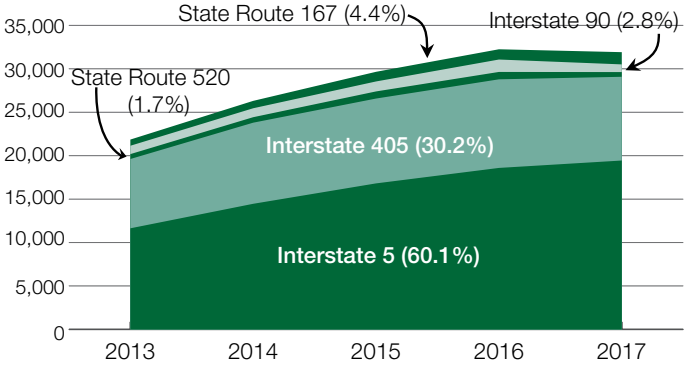


Data sources: WSDOT Multimodal Planning Division.

Delay on I-405, I-90 and SR 520 drops while I-5 and SR 167 see increases

Average daily weekday delay in general purpose (GP) lanes on freeway corridors (Interstate 5, I-405, I-90, State Route 520 and SR 167) in King and Snohomish counties grew roughly 7.3% from 29,747 daily vehicle hours of delay in 2015 to 31,918 hours in 2017. Despite the overall increase, three of the corridors in the region, I-405, I-90 and SR 520, saw decreases in GP delay—of 1.3%, 28.7% and 33.3%, respectively. WSDOT projects expanded managed lanes (HOV or Express Toll Lanes) between 2015 and 2017 on all three of these corridors. The other two corridors in the central Puget Sound region saw increases (15.6% on I-5 and 27.4% on SR 167) in daily vehicle hours of GP lane delay between 2015 and 2017.

I-5 accounts for the most delay on major urban freeways in the central Puget Sound region
2013 through 2017; Vehicle hours of delay per weekday (and percent of total delay) by major urban freeway



Data source: WSDOT Multimodal Planning Division.
Notes: The central Puget Sound region includes King and Snohomish counties. Percentages may not add to 100% due to rounding.

Multiple economic factors affect congestion levels in Washington

Average daily weekday delay on major central Puget Sound freeways
2013 through 2017; Vehicle hours of delay per day

Corridor	2013	2014	2015	2016	2017	2015 vs. 2017
I-5	11,638	14,389	16,823	18,590	19,442	**15.6%**
I-405	7,978	9,427	9,764	10,200	9,640	**-1.3%**
SR 520	564	633	813	850	542	**-33.3%**
I-90	963	1,064	1,242	1,430	885	**-28.7%**
SR 167	712	863	1,105	1,180	1,408	**27.4%**
Total	**21,855**	**26,376**	**29,747**	**32,250**	**31,918**	**7.3%**

Data source: WSDOT Multimodal Planning Division.
Notes: To make accurate comparisons, the 2015 data was recalculated for this report. To learn why delay and miles traveled do not increase hand in hand, see p. 10 of the 2nd edition of the *Handbook for Corridor Capacity Evaluation*. See the lane mile inventory on p. 4 of the Appendix for delay context.

The five-year trend also shows a significant delay increase, at 46.0% more delay in 2017 than in 2013 (which had 21,855 average daily vehicle hours of delay, and was the fourth year of growth in delay after the low point of 13,058 daily vehicle hours at the height of the recession in 2009).

Major urban highways continue to experience delay

In general, urban highways in Washington that were congested during weekday commutes in 2015 continued to be congested during weekday commutes in 2017. While most corridors experienced some change in delay (ranging from moderate to significant) between the two years, none of these changes were enough to change a highway segment's status from "congested" to "not congested" or vice versa.

Cleaner fleet decreases emissions on high-demand urban commute corridors

In 2017, the weekday annual greenhouse gas emissions from vehicles on high-demand commute corridors in urban areas statewide were estimated to be 2.66 million metric tons (or 5.87 billion pounds) of carbon dioxide equivalents (CO2e)—1.6% less than in 2015. Although VMT and delay on these corridors both increased from 2015 to 2017, emissions improved due to increased efficiency of vehicles and the non-linear relationship between VMT, delay and emissions (see p. 5 of this report, and p. 10 and p. 16 of the 2nd edition of the Handbook for Corridor Capacity Evaluation).

Economic Indicators

Congestion, travel time and delay are influenced by multiple factors, including the number of people commuting (which increases as the economy improves), the distances they must travel to get to work (which tend to increase with housing prices), and how many of them are driving alone. Detailed evaluations of each corridor begin on p. 11 and more statewide indicators data appears in the Appendix (pp. 3-4).

Increased employment:

Non-farm employment in Washington reached 3.33 million workers in 2017, a 5.7% increase from 2015. Washington's unemployment rate dropped to 4.8% in 2017, from 5.7% in 2015.

While the statewide unemployment rate is at a 10-year low and continues to approach the pre-recession rate of 4.7%, this is likely due in part to discouraged workers giving up on finding a job. Washington's labor force participation rate has declined from 66.2% in 2007 to 63.7% in 2017 (up slightly from 62.9% in 2015) because the labor force (the population currently working or actively seeking work) has not increased as quickly as the working age population. Additionally, average weekly hours worked by all private-sector Washington employees

The cost of climate change

The social cost of carbon represents the cost, in today's dollars, of future damage caused by climate change. Estimates of the cost vary; Washington state currently uses a cost of about $70 per metric ton (MT).
In 2013, the most recent year for which data is availabe, Washington's on-road transportation produced about 29 million metric tons of greenhouse gas emissions. Those emissions will cause about $2.0 billion in damages. Other sources, other locales, and other years also contribute emissions.
Costs of these damages will be unevenly spread out over the world and over time; the costs to Washington state and to WSDOT over time are unknown.

Alternative commute rate and gas prices rise in 2017

increased by 1.2% (about 24 minutes) between 2015 and 2017, but remains below 2007 levels, indicating a lingering shift toward part-time employment.

In the Seattle-Bellevue-Everett metropolitan area, employment grew 5.6% between 2015 and 2017, and the unemployment rate fell to a 10-year low of 4.1%. The labor force participation rate increased slightly to 67.7%

Retail sales: Washington state retail sales (adjusted for inflation) increased by 11.2% between 2015 and 2017. Because retail stores must be supplied with goods, an increase in taxable retail sales likely indicates an increase in freight truck traffic on Washington public roads.

Rising gas prices: Gas prices in Washington increased by 2.0% (accounting for inflation) between 2015 and 2017, from an average of $2.79 per gallon in 2015 to $2.85 in 2017. The 2017 increase in gas prices marks the first rise in Washington's gas prices since 2012, when the average gas price was $4.09 (in 2017 dollars). When gas prices rise, driving becomes more expensive and people are less likely to drive alone rather than using alternative commute modes such as transit or carpools. As gas prices go up, the use of alternative transportation (modes other than single-occupancy vehicle) tends to increase and per-person VMT tends to decrease, as they did in Washington in 2017. However, due to the overall increases in population and employment in the state, these changes did not result in a net decrease in total VMT (see chart on p. 8).

More drivers and vehicles in the state: Washington's driving age population (age 16 and older) increased 3.7% between 2015 and 2017, reaching 5.84 million and exceeding the growth rate of total state population (3.5%) over the same period. In the frequently congested Seattle-Bellevue-Everett metropolitan area, the driving age population increased by 4.6% between 2015 and 2017, from 2.92 million to 3.06 million people. In 2017, 5.79 million Washingtonians were licensed drivers (all types), up 4.9% from 2015 (see table at right).

The number of passenger vehicles registered in Washington state increased by 7.2% between 2015 and 2017, going from 4.81 million in 2015 to 5.15 million in 2017. This translates to about 0.89 passenger vehicles per licensed driver in 2017, up from 0.87 in 2015.

Alternative commutes: According to the American Community Survey, 71.7% of working Washingtonians over the age of 16 drove alone to work in 2017, a decrease from 72.4% in 2015. The decline in the percentage of workers driving to work alone seems to come from increases in the percentages commuting by public transit, by carpool, and working from home. In 2017, 10.2% of Washington workers carpooled (up from 9.8% in 2015), 6.5% took public transportation (up from 6.2% in 2015) 4.1% walked or rode a bicycle (down from 4.7% in 2015), 6.3% worked at home (up from 5.6% in 2015) and the remainder used other forms of transportation (such as motorcycle or taxi) to get to work. While the 0.7% increase in the alternative commute rate is significant, the number of people employed in Washington state grew 5.7% over the same period. As a result, even though the percentage of Washingtonians getting to work by driving alone went down between 2015 and 2017, the absolute number doing so went up over the same period.

Home prices: Median home prices in Washington rose 16.3% (accounting for inflation) between 2015 and 2017. Because the highest home prices are often in high-density urban and job centers, a general increase in home prices can make it unaffordable for people to live near their jobs. This increases the distance people travel to get to work. Like growth in the number of drivers on the road, increases in commute distance lead to more vehicle miles traveled—and consequently more congestion.

Summary of Washington's economic indicators
2015 and 2017

Indicator	2015	2017	%Δ	Trend Actual	Trend Desired
Employment (millions of workers)	3.15	3.33	5.7%	↑	↑
Unemployment rate	5.7%	4.8%	-0.9%[3]	↓	↓
Taxable retail sales[1] (billions of dollars)	$140.0	$155.6	11.2%	↑	↑
Gasoline price per gallon[1]	$2.79	$2.85	2.0%	↑	N/A
Population age 16 and over (in millions)	5.64	5.84	3.7%	↑	N/A
Licensed drivers (millions)[2]	5.52	5.79	4.9%	↑	N/A
Passenger vehicle registrations (millions)	4.81	5.15	7.2%	↑	N/A
Median home price (thousands)[1]	$296.1	$344.4	16.3%	↑	N/A

Data sources: Washington State Office of Financial Management, U.S. Bureau of Labor Statistics, Washington State Department of Revenue, U.S. Energy Information Administration, Washington State Department of Licensing, Washington Center for Real Estate Research.
Note: **1** Adjusted for inflation and reported in 2017 dollars. **2** For fiscal years (July 1-June 30) 2015 and 2017; previous editions reported this figure for calendar years. **3** Difference in percentage points, not percent change.

Visit bit.ly/agolCCR18CentralSoundmap for this article's interactive map.

Interstate 5 Corridor Capacity Analysis

Annual GP person miles traveled
2015 vs. 2017: 2,583 → 2,651 in millions of miles (▲ 2.6%)

Annual GP vehicle delay[1]
2015 vs. 2017: 4,390 → 5,074 in thousands of hours (▲ 16%)

Annual GP GHG emissions
2015 vs. 2017: 2,010 → 2,015 in millions of pounds of CO_2 equivalents (▲ 0.2%)

Annual passenger miles traveled on transit
2015 vs. 2017: 202.8 → 235.3 in millions of miles (▲ 16%)

Capacity savings due to transit
2015 vs. 2017: 4.2 → 5.1 in number of lanes (▲ 21%)

Percent transit seats occupied
2015 vs. 2017: 73% → 74% on average during peak periods (▲ 1%)

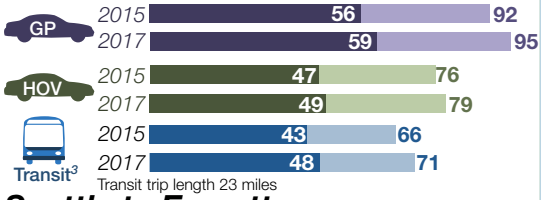
Percent park and ride spaces occupied
2015 vs. 2017: 92% → 93% on average during peak periods (▲ 1%)

Commute travel times

2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[2] travel times for general purpose lane (GP), high occupancy vehicle (HOV) and transit[3] trips.

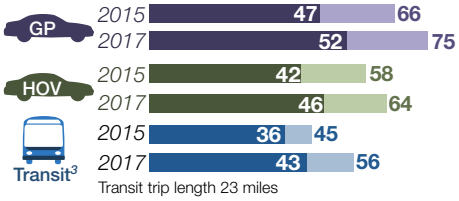
Average GP · Reliable GP · Average HOV · Reliable HOV · Average transit · Reliable transit

Everett to Seattle
Morning; 7:20 a.m.; Trip length 24 miles



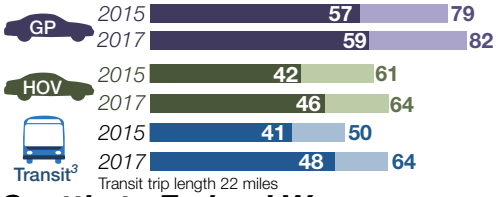
Transit trip length 23 miles

Seattle to Everett
Evening; 4:10 p.m.; Trip length 23 miles



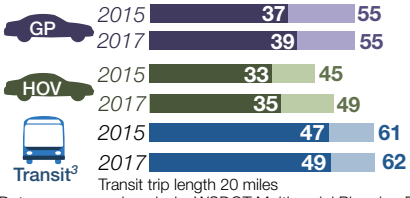
Transit trip length 23 miles

Federal Way to Seattle
Morning; 7:10 a.m.; Trip length 22 miles



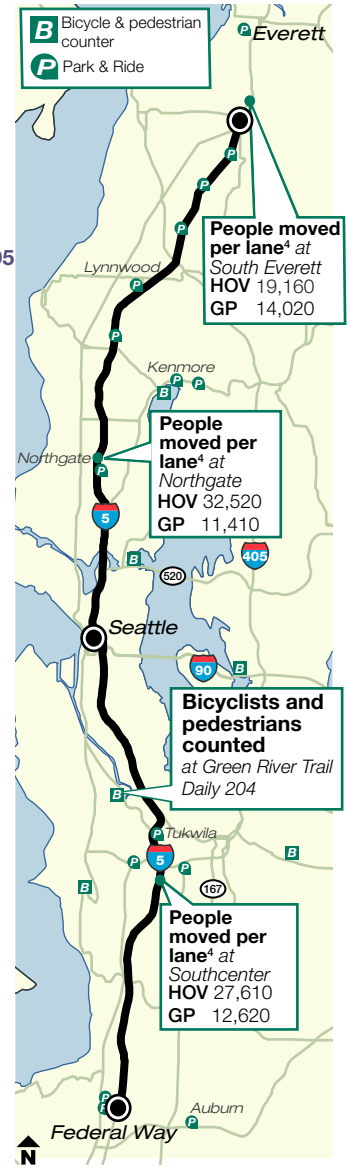
Transit trip length 22 miles

Seattle to Federal Way
Evening; 4:10 p.m.; Trip length 22 miles



Transit trip length 20 miles

See Appendix pp. 5-21 for more commute routes



Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[3] peak periods; Ridership and percent of available seats occupied on select commutes

By commute

	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	2015	2017	2015	2017
Everett to Seattle	10,941	11,774	71%	69%
Federal Way to Seattle *Includes Tacoma to Seattle transit routes	6,562	6,483	71%	65%
SeaTac to Seattle	5,734	8,939	92%	104%
Evening (3-6 p.m.)				
Seattle to Everett	10,713	10,596	68%	67%
Seattle to Federal Way *Includes Seattle to Tacoma transit routes	5,390	5,139	65%	59%
Seattle to SeaTac	6,622	10,233	103%	111%

Park & ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations); Rates over 100% denote vehicles parked in unmarked spaces

Everett-Seattle commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Ash Way (1,039)	106%	106%
Kenmore area (693/696)	101%	100%
Lynnwood Transit Ctr. (1,364)	100%	100%
S. Everett Freeway Station (397)	100%	100%
Northgate area (902)	100%	98%
Mountlake Terrace (878)	99%	99%
Mariner (636)	74%	68%
Everett Station (1,107)	65%	82%

Federal Way-Seattle commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Sumner train station (302)	101%	101%
Auburn area (633)	100%	100%
Tukwila area (867)	99%	99%
Kent area (996)	98%	98%
Tacoma Dome (2,337)	95%	99%
Puyallup area (583)	98%	99%
Lakewood area (1,093/1034)	87%	90%
Federal Way area (2,067)	74%	71%

Data sources and analysis: WSDOT Multimodal Planning Division, WSDOT Northwest Region Traffic Office, WSDOT Public Transportation Division, Sound Transit, Pierce Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-5 corridor between Everett and Federal Way for GP trips only. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **3** Transit travel times by bus and Link light rail may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel to stops. WSDOT attempts to match transit trips as closely as is practical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **4** Person throughput values include morning (6-9 a.m.) and evening (3-7 p.m.) traffic.

I-5 has the most delay in the Puget Sound region

Interstate 5 (I-5) is one of the key commute and economic corridors in the central Puget Sound region. More than 2.6 billion person miles were traveled between Federal Way and Everett in 2017, a 2.6% increase over 2015. Highway capacity constraints vary based on the presence of managed lanes and multimodal travel options; parts of the I-5 corridor in the central Puget Sound region are served by Link light rail, Sounder commuter rail, transit buses and high occupancy vehicle (HOV) lanes. In 2017, the I-5 HOV lane at Northgate moved more than two and a half times as many people as each adjacent general purpose (GP) lane. This speaks to the efficiency of the HOV network and transit options on the corridor in moving more people.

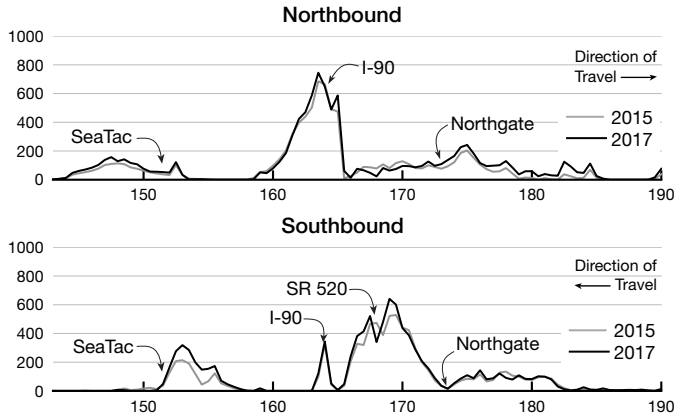
Despite these efficiencies, traffic in several locations on the corridor worsened from 2015 to 2017, with morning and evening weekday commutes experiencing severe congestion on a daily basis. Delay increased 16% on I-5 between Federal Way and Everett. To learn why delay and miles traveled do not increase hand in hand, see p. 5. In addition to delaying commuters, this congestion directly impacted the movement of goods in Washington, as trucks accounted for 6% of the total daily traffic volume on the corridor in 2017.

Growing economy increases traffic

As employment in the Seattle area continues to increase, more people are commuting on the area's highways, including I-5, every day. Additionally, many people who work in Seattle have been pushed out of the city by its high-priced housing market, and now commute into the city on I-5. It is also important to note that many of the highways that cross I-5 also face significant congestion during the peak commute periods. Congestion on nearby corridors such as SR 520, I-90, I-405 and major city off-ramps creates backups that overflow onto I-5 and create additional congestion on a regular basis. Greenhouse gas (GHG) emissions remained steady between 2015 and 2017. For more information on the relationship between GHG emissions and delay, see p. 5.

Delay along the I-5 corridor (Federal Way to Everett)

2015 and 2017; Average daily vehicle hours of delay by milepost



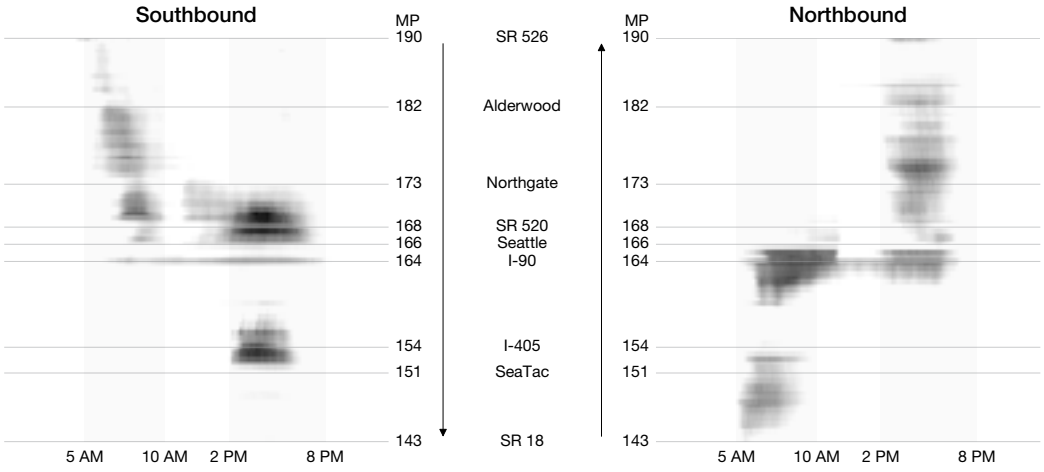
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Corridor delay: Vehicle delay on the I-5 corridor in the central Puget Sound region between Federal Way and Everett was higher in 2017 than in 2015, with the magnitude of the difference varying by location and direction of travel (see graph above). In 2017, the worst vehicle delay on the I-5 corridor occurred northbound between the I-90 interchange and Northgate (including around downtown Seattle), as well as southbound at SeaTac and the SR 520 interchange.

I-5 delay between Federal Way and Everett

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017, delay was prevalent throughout the Seattle area in both directions throughout the entire day. Northbound morning delay was most intense approaching approaching Seattle, while northbound evening delay extended from the I-90 interchange to Everett. Delay on the southbound morning commute extended from Everett past Seattle. Southbound evening delay was most intense from 2-6 p.m., particularly between Seattle and Northgate and just north of SeaTac.



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Much of I-5 is routinely congested during peak periods

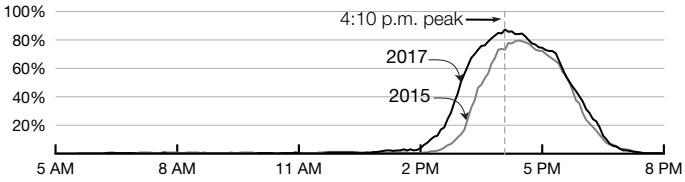
The amount of delay significantly increased between 2015 and 2017 at several locations on the I-5 corridor, including: northbound from Northgate to I-405 (up 48%), southbound at the I-90 interchange (up 12%) and in both directions near SeaTac (up 49%). The heat map graph on p. 12 shows the intensity of delay by time of the day and location in 2017.

Delay would have been worse without transit. Even with conservative assumptions, transit ridership along the I-5 corridor translates to a capacity savings equivalent to 4.9 additional lanes of traffic during peak commute periods (see p. 14 for more information on transit ridership).

A focus on hot spots: Commuters driving from Seattle to Everett on I-5 drove in severely congested conditions (speeds of 36 mph or less) more often in 2017 than in 2015 (see severe congestion chart below). For example, at 4:10 p.m. speeds on this commute were below 36 mph on 86% of weekdays in 2017—up from 78% of weekdays in 2015.

Severe congestion on the Seattle to Everett commute

2015 and 2017; Northbound; Percent of days the average speed was slower than 36 mph

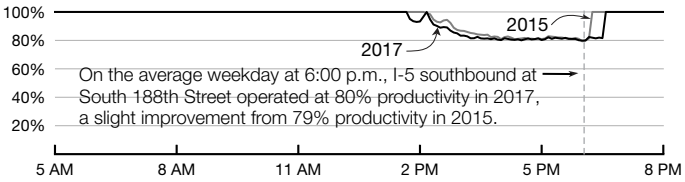


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on I-5 in the central Puget Sound region, WSDOT analyzed vehicle throughput at three locations: near South 188th Street, near Northeast 103rd Street and at the I-90 interchange. In 2015 and 2017, vehicle throughput at these locations ranged from 69% to 85% of maximum throughput at their most congested times. Throughput productivity varies by direction of travel, location and time of day. For example, throughput productivity at South 188th Street, was quite similar at 6 p.m. in 2015 and 2017—20% of the freeway's capacity was unavailable due to congestion in 2017 (see graph below left), and 19% in 2015—the 2017 congested period lasted until 6:30 p.m., 20 minutes later than in 2015.

Throughput productivity on southbound I-5 at South 188th Street

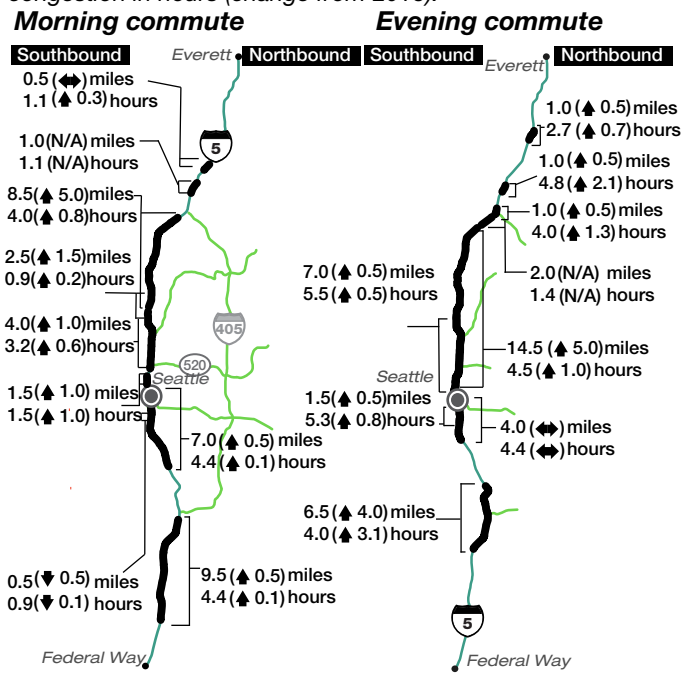
2015 and 2017; Based on the highest observed 5-minute flow rate of 1,520 vehicles per hour per lane = 100%



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Routinely congested segments of I-5

2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (change from 2015).



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Note: See pp. 7-8 in the Appendix for all central Puget Sound region routinely congested segment data. Each black segment represents a 2017 routinely congested segment, noted by the extent of congestion in miles and the hours of duration. Change in miles and hours from 2015 are shown in parentheses. Segments where the duration of congestion was less than 50 minutes are not shown on the map.

Routinely congested segments: The worst routine congestion on the I-5 corridor between Federal Way and Everett in 2017 occured on the segments approaching downtown Seattle (from both directions). Overall, the locations where routine congestion occurred increased by 14.3% (9.5 miles) between 2015 (66.5 miles total) and 2017 (76.0 miles total; see map above).

In 2017, 16.5 miles of the 22-mile morning commute between Federal Way and Seattle, and 18 miles of the 24-mile Everett to Seattle morning commute experienced routine congestion. Similarly, 19.5 miles of the Seattle to Everett evening commute and eight miles of the southbound evening commute from Seattle to Federal Way experienced routine congestion in 2017.

Transit saves over 5 lanes of highway capacity on I-5

What does congestion mean for travel times on the corridor?

General purpose lane trips: Capacity constraints impacted the Seattle to Everett northbound commute from Northgate to Alderwood and the Seattle to Federal Way southbound commute in the SeaTac area, resulting in increased average and reliable travel times during the evening peak period (2-8 p.m.) for several commutes. The average peak travel time for the Seattle to Everett commute increased by five minutes (11%) and the reliable travel time increased by seven minutes (14%). Similarly, the average evening peak travel time from Seattle to SeaTac increased to 25 minutes in 2017, up two minutes (9%) from 2015, while reliable travel time increased by four minutes (12%). Increased average and reliable travel times were observed for morning commutes into Seattle, but none of the average travel times increased by more than 5%.

The SeaTac to Seattle morning commute, a portion of the Federal Way to Seattle morning commute, has the highest maximum throughput travel time index (MT3I) of the 12 commutes that WSDOT tracks on I-5 in the central Puget Sound region. The route's MT3I of 2.25—a slight improvement from 2.30 in 2015—means the commute takes more than twice as long as it would if traffic was moving at maximum throughput speed (50 mph). WSDOT uses this index to compare the severity of congestion across commutes.

Transit trip travel times: Along the I-5 corridor, commuters can bypass bottlenecks in the corridor's GP lane by riding light rail or commuter rail, or by using a carpool or transit bus to travel in an HOV lane. For example, in 2017 the average and reliable transit travel times for the commute from Federal Way to Seattle in the morning were 48 and 64 minutes—11 and 18 minutes faster than the corresponding GP travel times. These transit travel times are seven minutes slower than the average (41 minutes) and 14 minutes slower than the reliable (50 minutes) transit travel times in 2015. See p. 11 for a comparison of transit trips to GP and HOV trips.

Transit ridership and GHG emissions avoided: Transit moved roughly 59,700 riders on the I-5 corridor during the peak periods on an average weekday in 2017, a 21% increase over 2015 (about 49,500 riders).

Peak period transit ridership on the I-5 corridor in the central Puget Sound region was equal to 5.1 extra lanes of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement). Approximately 74% of available seats on transit on I-5 commutes were occupied during the morning and evening peak periods in 2017—an increase over 2015, when 73% of seats were occupied. Of the 1,022 daily peak period transit trips in 2017, 131 were at over 90% of seating capacity on a typical weekday. Transit use during peak periods avoided roughly 473,511 pounds of GHG emissions per day on the I-5 central Puget Sound corridor in 2017, a 25.5% improvement over 2015 (377,239 pounds).

Why did ridership increase on SeaTac commutes?
On the I-5 corridor map on p. 11, the commutes between SeaTac and Seattle show large increases in ridership between 2015 and 2017. These increases come entirely from Sound Transit's Link light rail, which saw between 3,000 and 3,500 more riders daily on each commute in each direction in 2017 than in 2015. Link added seven more trips during the morning peak period and six more during the evening peak period.

Park and ride: Along the I-5 corridor in the central Puget Sound region in 2017, park and ride (P&R) utilization rates ranged from 68% to 106%, with 13 out of 16 having utilization rates above 85%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. Park and ride lots along the corridor serve a wide variety of commuters, including carpoolers, vanpoolers, transit riders, commuter rail passengers, bicyclists and pedestrians. Park and ride locations are essential for transit riders and carpoolers, and must have high utilization rates to be considered successful. Targeted outreach efforts from transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the central Puget Sound region.

How much is congestion costing you?

Costs due to congestion on I-5 in 2017 varied by commute trip. A commuter who made the 47-mile round trip between Everett and Seattle daily had congestion costs (measured in wasted time and gas for travel below maximum throughput speed) of about $3,000 per person annually in 2017, while one who made the 44-mile round trip between Federal Way and Seattle daily had congestion costs of about $2,700 annually.

Visit bit.ly/agolCCR18CentralSoundmap for this article's interactive map.

Interstate 405 Corridor Capacity Analysis

Annual GP person miles traveled
2015 vs. 2017
1,133 vs. 1,129
in millions of miles

Annual GP vehicle delay[1]
2015 vs. 2017
2,548 vs. 2,515
1.3%
in thousands of hours

Annual GP GHG emissions
2015 vs. 2017
898.9 vs. 874.9
2.7%
in millions of pounds of CO_2 equivalents

Annual passenger miles traveled on transit[4]
2015 vs. 2017
19.7 vs. 24.4
24%
in millions of miles

Capacity savings due to transit
2015 vs. 2017
0.5 vs. 0.6
in number of lanes

Percent transit seats occupied
2015 vs. 2017
66% vs. 67%
1%
on average during peak periods

Percent park and ride spaces occupied
2015 vs. 2017
101% vs. 98%
3%
on average during peak periods

This section refers to general purpose (GP) lanes on the full corridor, and excludes the express toll lanes (ETL) and high occupancy vehicle (HOV) lanes unless specifically referenced.

Interstate 405 (I-405) is one of the key commute and economic corridors in the central Puget Sound region, running parallel to I-5 between Tukwila and Lynnwood. Over 1.1 billion person miles were traveled on I-405 in 2017, a decrease of 0.4% from 2015. Greenhouse gas emissions on I-405 decreased by 2.7% between 2015 and 2017.

Highway capacity constraints vary based on the presence of managed lanes and multimodal travel options; the I-405 corridor in the central Puget Sound region is served by high occupancy vehicle (HOV) lanes, transit and, as of September 27, 2015, express toll lanes. In 2017, the I-405 HOV lane at Newcastle moved nearly twice as many people as each adjacent GP lane (see map at right).

Although morning and evening weekday commutes in both directions on I-405 experienced severe congestion on a daily basis, overall delay on the corridor decreased by 1% between 2015 and 2017. To learn why delay and miles traveled do not increase hand in hand, see p. 5.

In addition to delaying commuters, congestion on I-405 directly impacted the movement of goods in Washington, as trucks accounted for 5% of the corridor's total daily traffic volume.

See Appendix pp. 5-21 for more commute routes

Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[2] peak periods; Ridership and percent of available seats occupied on select commutes

By commute	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	2015	2017	2015	2017
Everett to Bellevue	745	783	95%	100%
Lynnwood to Bellevue	1,018	1,729[4]	72%	76%
Tukwila to Bellevue	780	843	66%	57%
Evening (3-6 p.m.)				
Bellevue to Everett	735	1,034[4]	88%	85%
Bellevue to Lynnwood	888	1,150[4]	69%	74%
Bellevue to Tukwila	737	889	65%	65%

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations); Rates over 100% denote vehicles parked in unmarked spaces.

Lynnwood-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Kingsgate (502)	107%	107%
Ash Way (1,042)	106%	106%
Kenmore area (696)	101%	100%
Canyon Park (302)	99%	98%
Bothell (220)	98%	98%
South Kirkland (833)	98%	98%
Brickyard (443)	95%	91%

Tukwila-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
South Bellevue (519)[5]	106%	104%
Wilburton (186)	99%	96%
Renton Munipical (150)	76%	77%
Renton (150)	97%	79%
Newport Hills (275)	84%	75%

Data sources and analysis: WSDOT Multimodal Planning Division, WSDOT Northwest Region Traffic Office, Sound Transit, Pierce Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

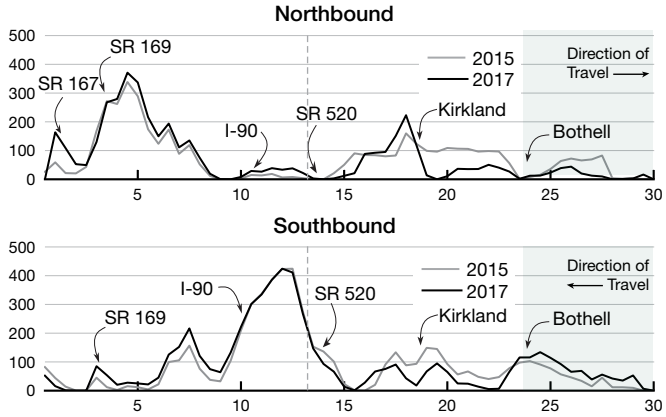
Notes: Measures at the top of the page are only for GP trips on the I-405 corridor between Tukwila and Lynnwood. See travel time information for the Bellevue-Tukwila commute on p.17. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Transit travel times by bus may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel to stops. WSDOT attempts to match transit trips as closely as is practical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **3** Person throughput values include morning (6-9 a.m.) and evening (3-7 p.m.) traffic. **4** Several commutes on I-405 were served by many more transit trips in 2017 than in 2015 (see p.18) **5** South Bellevue P&R closed at the end of May 2017; the 2017 percentage reported is an average for the first five months of 2017.

I-405 has second-most delay in Puget Sound region

Corridor delay: Overall delay on the I-405 corridor between Tukwila and Lynnwood decreased by 1% between 2015 and 2017. This decrease in corridor-wide delay is the result of slight-to-moderate increases in delay on most of the corridor balanced out by a significant decrease between Kirkland and Bothell following the implementation of the ETLs (see graph below).

Delay on the I-405 corridor

2015 and 2017; Average daily vehicle hours of delay by milepost



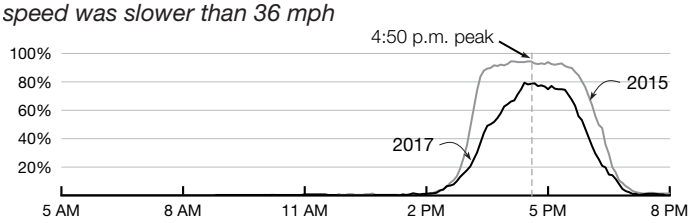
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.
Notes: The highlighted section represents the section of I-405 which has one ETL and two GP lanes in each direction. The dotted line represents the southern endpoint of the section of I-405 that has two ETLS and three GP lanes in each direction. The section of I-405 to the left of the dotted line has one HOV lane and three GP lanes in each direction.

Vehicle delay along the I-405 corridor was higher at most locations in 2017 than in 2015, except for the section between Kirkland and Bothell, where delay decreased substantially in both directions, and the northbound section north of Bothell. Delay on the I-405 corridor increased from 2015 to 2017 between SR 167 and I-90 in both directions (up 20%), and northbound between SR 520 and Kirkland (up 32%). Delay decreased by 58% over the same period between Kirkland and Bothell. Northbound delay north of Bothell also decreased, likely due to the opening of the peak use shoulder lane in fall 2017. The heatmap at the bottom of the page shows the intensity of delay by the time of day and location in 2017.

A focus on hot spots: The I-405 ETLs helped to relieve congestion on the adjacent GP lanes in 2017. The Bellevue to Lynnwood evening commute was severely congested (36 mph or below) on fewer weekdays in 2017 than in 2015 (see chart below). For example, at 4:50 p.m. during the evening commute, the percent of days speeds were below 36 mph was 78% in 2017 compared to 93% in 2015.

Severe congestion between Bellevue and Lynnwood

2015 and 2017; Northbound; Percent of days the average speed was slower than 36 mph



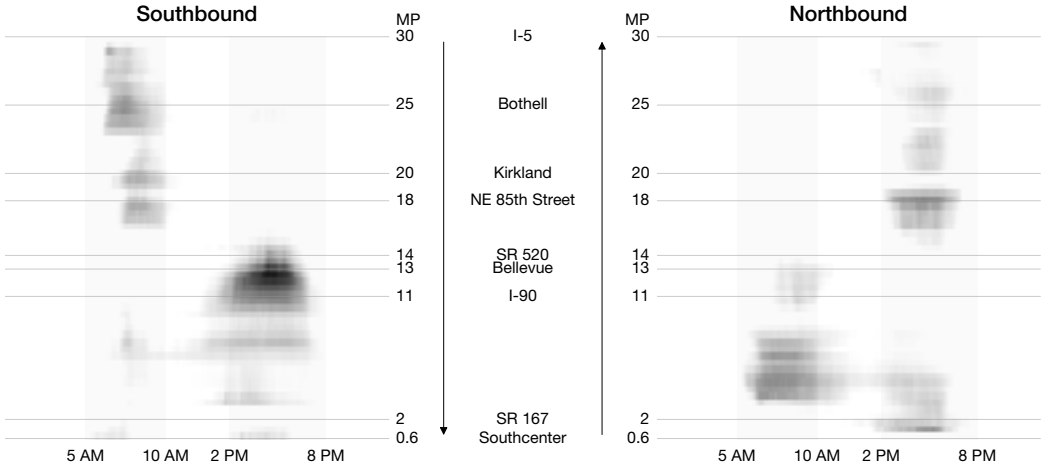
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on I-405 in the central Puget Sound region, WSDOT analyzed vehicle throughput at two locations: near SR 169 in Renton, and at NE 160th Street in Kirkland. In 2015 and 2017, productivity at these locations ranged from 35% to 92% at their most

I-405 delay between Tukwila and the Lynnwood I-5/I-405 interchange

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 on southbound I-405, the most intense delay extended from SR 520 past I-90, and lasted from 3-6:30 p.m. There was also southbound delay during the morning commute from I-5 to the NE 85th Street exit. On northbound I-405, the worst delay occurred during the morning peak period north of the SR 167 interchange. There were pockets of delay near SR 167 and from SR 520 to I-5 during the evening commute.

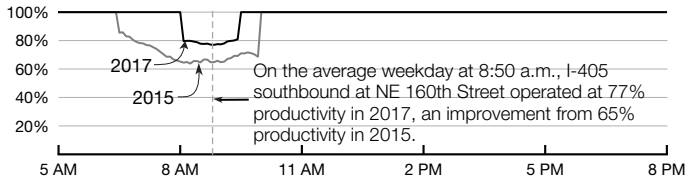


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Routine congestion on I-405 decreases in 2017

Throughput productivity on southbound I-405 at NE 160th Street

2015 and 2017; Based on the highest observed 5-minute flow rate of 1,820 vehicles per hour per lane = 100%



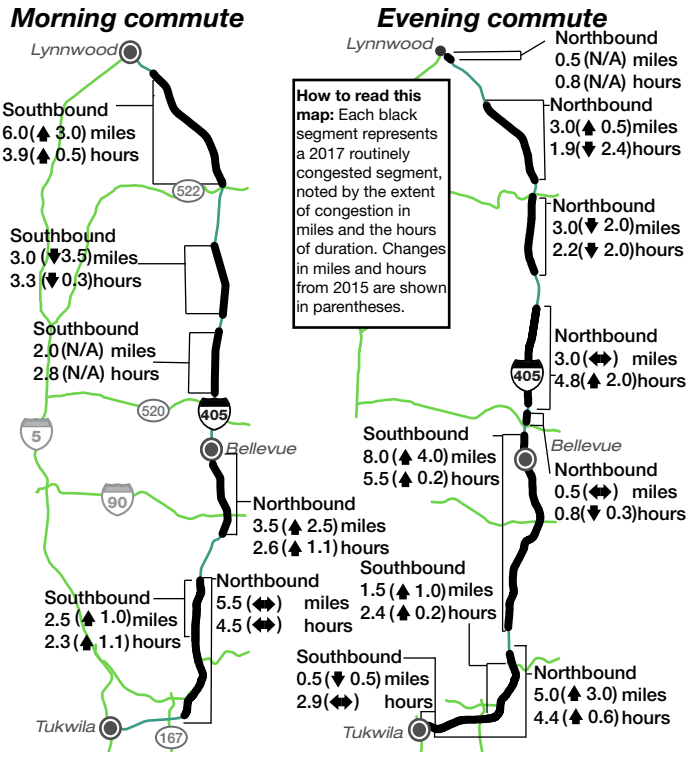
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

congested. The graph above shows how productivity on southbound I-405 at NE 160th Street improved from 2015 to 2017 with the implementation of the ETLs.

Routinely congested segments: Approximately 86% of peak-direction (southbound in the morning and northbound in the evening) lane miles on I-405 were routinely congested in 2017. Despite this, the locations where routine congestion occurred decreased between 2015 and 2017, going from 52 miles to 50 miles (see map below).

Routinely Congested Segments

2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Direction of travel; Length of backup in miles; Daily duration of congestion in hours (change from 2015).



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

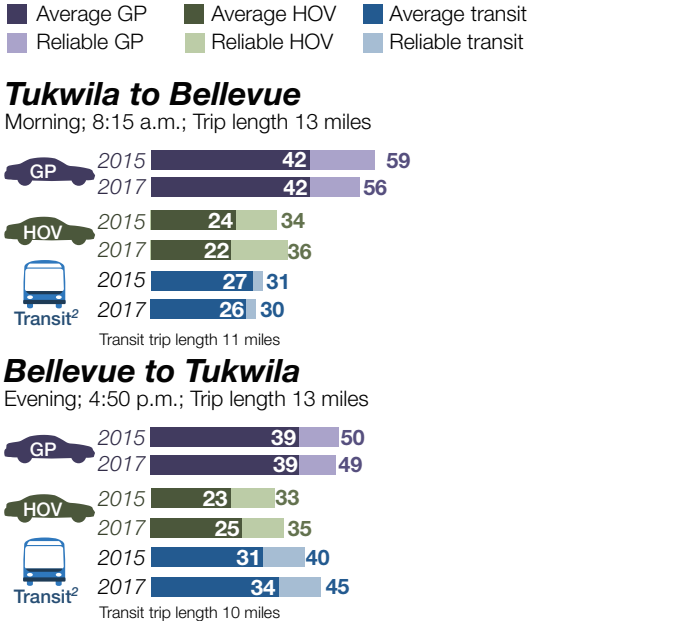
Note: See pp. 7-8 in the Appendix for all central Puget Sound region routinely congested segment data. The introduction of ETLs on I-405 changed traffic characteristics and the locations where routine congestion usually forms, making comparison between 2015 and 2017 RCS challenging in some locations; in these cases changes are shown as N/A.

What does congestion mean for travel times on the corridor?

General purpose lane trips: The average GP lane travel times between Bellevue and Tukwila on I-405 stayed constant from 2015 to 2017, with both the northbound morning and southbound evening peak average travel times staying the same, at 42 minutes and 39 minutes, respectively. Despite the increases in overall delay on this section of the corridor (which mostly occurred before or after the peak), the peak reliable travel times improved between 2015 and 2017. For example, the reliable peak travel time decreased by three minutes from 2015 to 2017, going from 59 minutes to 56 minutes.

Commute travel times

2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[1] travel times for general purpose lanes (GP), high occupancy vehicle (HOV) and transit[2] trips.



Data sources and analysis: WSDOT Multimodal Planning Division, King County Metro, Pierce Transit, Sound Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: In fall 2015, WSDOT opened express toll lanes (ETLs) on I-405 between Bellevue and Lynnwood. For ETL performance information, see http://www.wsdot.wa.gov/tolling/publications.htm **1** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **2** Transit travel times by bus may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel to stops. WSDOT attempts to match transit trips as closely as is practical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak.

The evening peak travel time from Bellevue to Lynnwood decreased by six minutes (15%) from 40 minutes in 2015 to 34 minutes in 2017, and the reliable travel time decreased two minutes (4%) from 52 minutes to 50 minutes.

Transit ridership increases by 27% from 2015 to 2017

I-405 Express Toll Lane Performance
Performance information for the I-405 ETLs is reported on the fiscal year rather than the calendar year.
A Before and After Analysis of I-405 ETL peformance that compares fiscal year (FY) 2015 and FY2017 begins on p.19 of the 2017 Corridor Capacity Report.

For the most up-to-date performance information on the I-405 ETLs, see http://www.wsdot.wa.gov/tolling/405/reporting-and-measuring-performance.

The morning Tukwila to Bellevue commute has the highest maximum throughput travel time index (MT3I) of the commutes tracked on I-405. The route's MT3I of 2.61 means that the commute takes more than two-and-a-half times as long as it would if traffic were moving at maximum throughput speed (50 mph). WSDOT uses this index to compare the severity of congestion across commutes.

Transit trip travel times: On I-405, managed lanes such as the new express toll lanes (north of Bellevue) and HOV lanes (south of Bellevue) allow transit vehicles to bypass highway capacity constraints in the corridor's GP lanes. For the 2017 morning commute from Tukwila to Bellevue, the average and reliable transit travel times were 26 minutes and 30 minutes, respectively. Both measures showed improvements from 2015, when they were 27 minutes and 31 minutes. In 2017, both reliable and average transit travel times were 16 minutes faster than the corresponding GP travel times. Although the transit commute is two miles shorter than the GP commute, the differences between transit and GP travel times are so large that they must also be reflecting the impact of the HOV lanes on transit travel times. See p. 15 for a comparison of transit trips to GP and HOV trips.

Transit ridership and GHG emissions avoided: Transit moved approximately 6,761 riders during the peak periods on an average weekday in 2017, a 27% increase from 2015 (about 5,314 riders). Transit passenger miles traveled increased by 24% over the same time period. Both of these changes are likely related to the increase in the number of trips on this corridor, which went from 169 in 2015 to 202 in 2017.

Peak period transit ridership on the I-405 corridor in the central Puget Sound region was equal to over half an extra lane of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement).

Approximately 67% of available transit seats on I-405 commutes were occupied during the morning and evening peak periods in 2017. Of the 202 daily transit trips during the peak periods, 46 were at or over 90% of seating capacity on a typical weekday. Transit use during peak periods avoided roughly 45,300 pounds of GHG emissions per day on the I-405 corridor in 2017, a 16% improvement over 2015 (37,000 pounds).

Park and ride: Along the I-405 corridor in the central Puget Sound region in 2017, park and ride (P&R) utilization rates ranged from 75% to 107%, with eight out of 12 having utilization rates at or above 95%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders and carpoolers. To be considered effective, P&R lots must also have high utilization rates. Targeted outreach efforts from transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the central Puget Sound region.

How much is congestion costing you?

In 2017, commuters making round trips in the general purpose lanes on I-405 between Tukwila and Bellevue experienced substantial costs due to congestion (measured in wasted time and gas for travel below maximum throughput speed). For example, congestion on the 27-mile roundtrip between Tukwila and Bellevue cost an average driver about $2,900 annually.

Visit bit.ly/agolCCR18CentralSoundmap for this article's interactive map.

State Route 520 Corridor Capacity Analysis

Annual GP person miles traveled
2015 vs. 2017
239.8 vs. 241.2
in millions of miles
▲ 0.6%

Annual GP vehicle delay[1]
2015 vs. 2017
212.3[2] vs. 141.5[2]
in thousands of hours
▼ 33%[2]

Annual GP GHG emissions
2015 vs. 2017
183.1 vs. 178.2
in millions of pounds of CO_2 equivalents
▼ 2.7%

Annual passenger miles traveled on transit
2015 vs. 2017
40.7 vs. 31.9
in millions of miles
▼ 21%

Capacity savings due to transit
2015 vs. 2017
1.5 vs. 1.5
in number of lanes
0%

Percent transit seats occupied
2015 vs. 2017
68% vs. 63%
on average during peak periods
▼ 5%

Percent park and ride spaces occupied
2015 vs. 2017
89% vs. 93%
on average during peak periods
▲ 4%

Commute travel times

See Appendix pp. 5-29 for more commute routes

2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[3] travel times for general purpose (GP), high occupancy vehicle (HOV) and transit[4] trips.

Average GP | Reliable GP | Average HOV | Reliable HOV | Average transit | Reliable transit

Bellevue to Seattle
Morning; *8:35 a.m.*;
Trip length 10 miles

	2015	2017
GP	19 / 29	23 / 35
HOV	16 / 22	19 / 27
Transit[4]	20 / 26	15 / 18[6]

Transit trip length 9 miles

Seattle to Bellevue
Evening; 5:25 p.m.;
Trip length 10 miles

	2015	2017
GP	18 / 26	18 / 26
HOV	16 / 21	17 / 24
Transit[4]	18 / 25	16 / 17[5]

Transit trip length 8 miles

Redmond to Seattle
Morning; 8:30 a.m.;
Trip length 13 miles

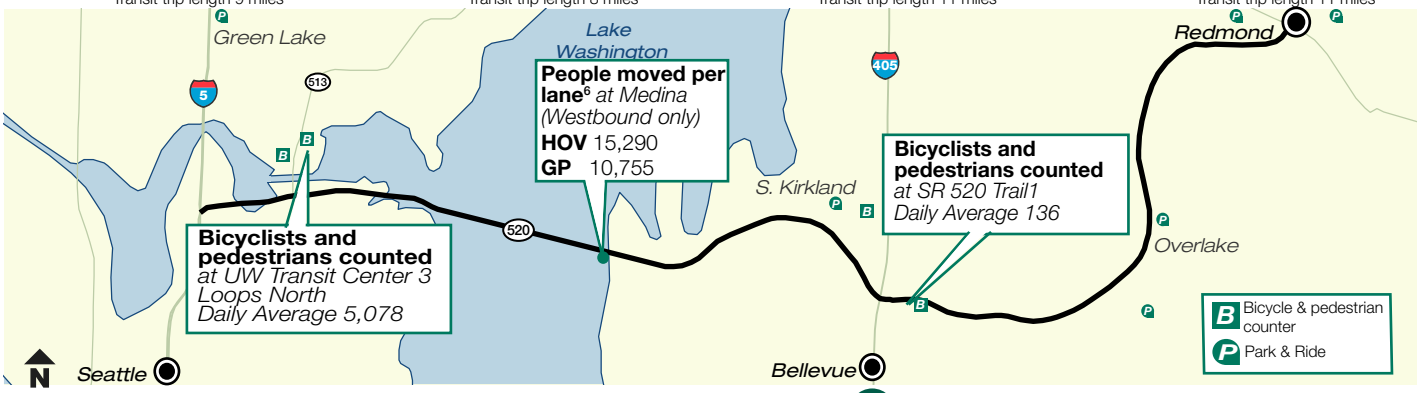
	2015	2017
GP	22 / 33	27 / 40
HOV	20 / 26	23 / 31
Transit[4]	29 / 35	25 / 31[5]

Transit trip length 11 miles

Seattle to Redmond
Evening; 5:30 p.m.;
Trip length 13 miles

	2015	2017
GP	18 / 25	19 / 26
HOV	17 / 22	18 / 24
Transit[4]	29 / 37	22 / 24[5]

Transit trip length 11 miles



Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[4] peak periods; Ridership and percent of available seats occupied on select commutes

By commute	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	2015	2017	2015	2017
Redmond to Seattle	4,703	4,956	87%	78%
Seattle to Redmond	2,037	1,666	57%	54%
Bellevue to Seattle	1,038	978	63%	56%
Evening (3-6 p.m.)				
Seattle to Redmond	4,387	4,698	80%	75%
Redmond to Seattle	1,932	1,842	63%	57%
Seattle to Bellevue	904	1,009	60%	50%

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations); Rates over 100% denote vehicles parked in unmarked spaces.

Seattle-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Greenlake (411)	102%	102%
South Kirkland (833)	98%	98%

Redmond-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Overlake Transit Center (222)	103%	103%
Redmond (377)	100%	98%
Bear Creek (283)	98%	98%
Overlake (203)	35%	51%

Data sources and analysis: WSDOT Multimodal Planning Division, WSDOT Northwest Region Traffic Office, Sound Transit, Pierce Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for GP trips only on the SR 520 corridor between Seattle and Redmond. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Due to concerns about the quality of data collected at some locations on SR 520, these figures should be treated as approximations. **3** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **4** Transit travel times by bus may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel. WSDOT attempts to match transit trips as closely as is pratical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **5** Transit travel times in 2017 saw improvments due to the expansion of the HOV lane system on SR 520 (see box on p. 20 and transit travel times section on p. 22) **6** Person throughput values include morning (6-9 a.m.) and evening (3-7 p.m.) traffic.

Westbound HOV lane moves 42% more people at Medina

State Route 520 (SR 520) is a key commute and economic corridor in the central Puget Sound region, connecting Seattle to Eastside suburbs and I-5 to I-405. Over 241 million person miles were traveled on the corridor in 2017, a 0.6% increase over 2015. Greenhouse gas emissions on the corridor dropped by 2.7% over the same period.

SR 520 has two major destination points: I-5 and I-405, both of which are typically congested during the peak commute periods. As a result, traffic is slow to enter I-5 or I-405, which in turn increases congestion on SR 520. In addition to delaying commuters, congestion on SR 520 directly impacted the movement of goods in Washington, as trucks accounted for 4% of the total daily traffic volume on the corridor in 2017.

Highway capacity constraints vary based on the presence of managed lanes and multimodal travel options. Parts of the SR 520 corridor were served by high occupancy vehicle (HOV) lanes in 2015 and 2017, although HOV lanes did not span the entire corridor and lane configurations changed between the two years (see box at right). The westbound HOV lane at Medina on this corridor moved 42% more people in 2017 than each adjacent general purpose (GP) lane.

Corridor delay: WSDOT estimates with high certainty that vehicle delay on the SR 520 corridor trended downward from 2015 to 2017. However, data quality issues resulting from construction activities and the replacement of the Evergreen Point Floating Bridge required the agency to estimate delay on parts of the corridor that lacked reliable loop detector data (indicated by dotted lines in the graph at right). As a result, the magnitudes of the delay estimates and the percent change published at the top of p. 19 should be treated as the agency's best approximations.

The addition of HOV lanes across the bridge decreased delay on both the eastbound and westbound approaches. It also shifted the westbound bottleneck from Medina to the west side of the bridge (approaching Montlake Blvd.), which is now the most congested location on the corridor (see graphs below). WSDOT will make improvements to this congested section of

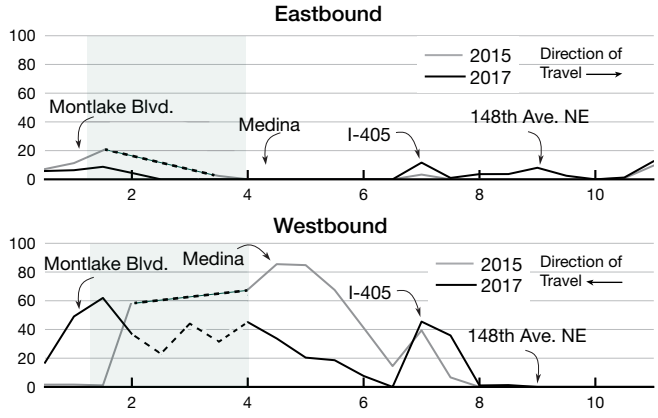
New bridge added HOV lanes in 2016

In April 2016, WSDOT completed construction of the new SR 520 floating bridge over Lake Washington. In combination with the Eastside Transit and HOV project (completed in 2015), the new bridge means that all of SR 520 between Bellevue and Montlake Blvd. now includes two GP lanes and one 3+ HOV lane in each direction. Previously, HOV lanes in both directions ended before reaching the floating bridge and those between the bridge and I-405 were located on the right side of the road, causing congestion due to merging traffic.

The new lane configuration has improved the overall flow of traffic on SR 520, contributing to the reduction in corridor delay. Other impacts of these projects between 2015 and 2017 include a shift in the westbound bottleneck from east of the bridge to the west side (at Montlake Blvd.), where the new HOV lane now ends.

Delay along the SR 520 corridor

2015 and 2017; Average daily vehicle hours of delay by milepost

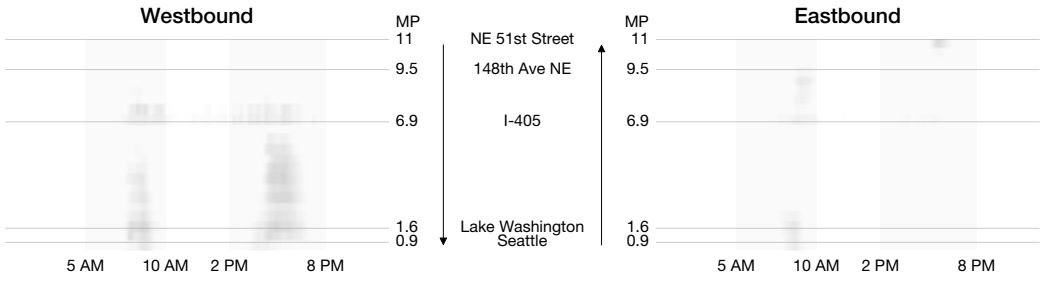


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.
Notes: Dotted lines represent WSDOT's best estimates of delay over areas in which adequate loop detector data was not available.The highlighted section represents the SR 520 floating bridge.

SR 520 delay between Seattle and Redmond

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 eastbound SR 520 saw delay between 7a.m. and 10 a.m., primarily near Seattle and east of I-405.
On westbound SR 520, delay extended from the I-405 interchange to Seattle during the morning and evening commutes, with the most intense delay occurring between 4:00 p.m. and 6:30 p.m.



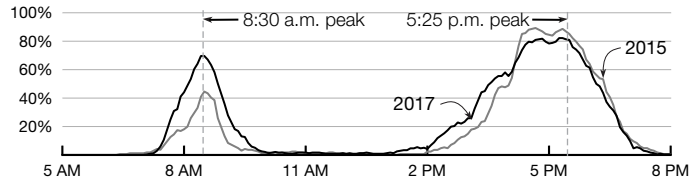
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

“Rest of the West” aims to reduce SR 520 congestion

SR 520 between the Evergreen Point Floating bridge and I-5, which currently has two GP lanes and no HOV lanes, during its “Rest of the West” project.” This $1.6 billion project will improve interchange connections between SR 520, Montlake and I-5, add bicyclist and pedestrian facilities (including a bicyclist/pedestrian land bridge over SR 520), and add a new bridge to carry three lanes of eastbound traffic at the Montlake Cut.

Severe congestion on the Redmond to Seattle commute

2015 and 2017; Westbound; Percent of days the average speed was slower than 36 mph

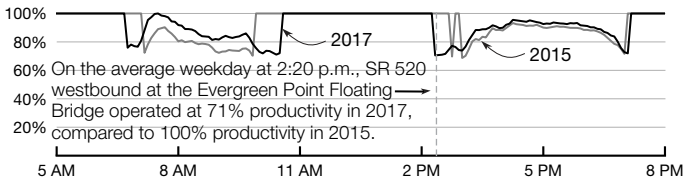


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

A focus on hot spots: Commuters driving between Redmond and Seattle encountered varying amounts of severe congestion (36 mph or less) depending on the time of day. For example, at 8:30 a.m. the percent of days that speeds were below 36 mph worsened from 45% in 2015 to 70% in 2017 (see graph above). In contrast, evening commuters encountered slightly improved conditions; at 5:25 p.m. the percent of days speeds were below 36 mph improved from 87% in 2015 to 81% in 2017.

Throughput productivity on westbound SR 520 at the Evergreen Point Floating Bridge

2015 and 2017; Based on the highest observed 5-minute flow rate of 2,030 vehicles per hour per lane = 100%

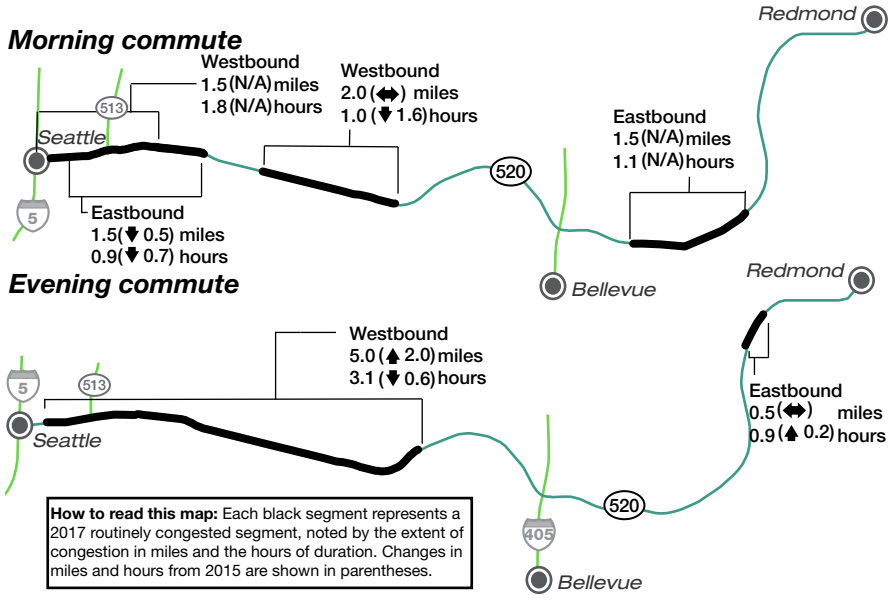


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on SR 520 in the central Puget Sound region, WSDOT analyzed vehicle throughput at the SR 520 Evergreen Point Floating Bridge across Lake Washington. While peak productivity losses did not change substantially at this location between 2015 and 2017, the amount of time during which productivity was lost each day increased noticeably, with both morning and evening periods of productivity loss beginning earlier and ending later in 2017 than in 2015 (see throughput graph above).

Routinely congested segments of SR 520

2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (change from 2015).



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: See pp. 7-8 in the Appendix for all central Puget Sound region routinely congested segment data.

Routinely congested segments: The length of the routinely congested segments on SR 520 between Redmond and Seattle increased by five miles (45%) between 2015 and 2017. In 2017, the majority of the routine congestion on SR 520 occurred on and just west of the bridge, with some additional eastbound congestion between Bellevue and Redmond.

Transit ridership saves 1.5 lanes of capacity on SR 520

What does congestion mean for travel times on the corridor?

General purpose lane trips: Capacity constraints impacted the SR 520 corridor between Seattle and Redmond most heavily between I-5 and I-405 (westbound), at the I-5 interchange (both directions), and between I-405 and Redmond (eastbound). This resulted in longer average and reliable travel times during the morning peak period for westbound commuters to Seattle. The average travel time for the morning SR 520 commute from Bellevue to Seattle increased by four minutes (up 21%) from 2015 to 2017, while reliable travel time increased by six minutes (up 21%).

The Redmond to Bellevue evening commute had the highest maximum throughput travel time index (MT3I) of the 12 tracked commutes on SR 520 between Seattle, Bellevue and Redmond in 2017. The route's MT3I of 2.35 means that the commute takes more than twice as long as it would if traffic were moving at maximum throughput speed (50 mph). WSDOT uses this index to compare the severity of congestion across commutes.

Transit trip travel times: On SR 520, HOV lanes allow transit vehicles to bypass highway capacity constraints in the corridor's GP lanes. WSDOT made several improvements to the HOV lane system on SR 520 between 2015 and 2017 (see box on p. 20), and the effects of these improvements are visible in the changes in transit travel times between the two years. For example, in 2017 the average and reliable transit travel times for the SR 520 morning commute from Bellevue to Seattle were 15 and 18 minutes, respectively. This is five and eight minutes faster than the average (20 minutes) and reliable (26 minutes) transit travel times in 2015. Additionally, in 2017 the average and reliable transit travel times on this commute were eight and 17 minutes faster than the corresponding GP average (23 minutes) and reliable (35 minutes) travel times. See p. 19 for a comparison of transit trips to GP and HOV trips.

Transit ridership and GHG emissions avoided: Transit moved roughly 17,447 riders during the morning and evening peak periods on an average weekday in 2017, holding steady from 2015 (17,455 riders). Transit passenger miles traveled declined by 21% over the same period (see box above right).

Why did transit passenger miles traveled decrease while ridership held steady in 2017?
While overall ridership levels on the SR 520 corridor held steady between 2015 and 2017, this is not true of the individual commutes on that corridor. Some commutes saw increases in ridership, while others saw decreases. The bulk of the decreases took place on the longer commutes—the largest decrease in ridership (a drop of 18%) occurred on the evening Seattle to Redmond commute, one of the longest on the corridor. Because passenger miles traveled (PMT) is dependent on distance (unlike ridership), the increases on the shorter commutes did not balance out the decreases on the longer commutes, leading to an overall drop in PMT.

Peak period transit ridership on the SR 520 corridor in the central Puget Sound region was equal to nearly 1.5 extra lanes of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement). Approximately 63% of available transit seats on SR 520 commutes were occupied during the morning and evening peak periods in 2017. Of the 597 daily transit trips during the peak periods, 107 were over 90% of seating capacity on a typical weekday. Transit use during peak periods avoided approximately 56,132 pounds of GHG emissions per day on the SR 520 corridor in 2017, a 24% decrease from 2015 (74,311 pounds).

Park and ride: Along the SR 520 corridor in the central Puget Sound region in 2017, park and ride (P&R) utilization rates ranged from 51% to 103%, with five out of six having utilization rates above 95%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders and carpoolers. To be considered effective, P&R lots must also have high utilization rates. Targeted outreach efforts by transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the central Puget Sound region.

How much is congestion costing you?

Drivers making trips between Seattle and Redmond paid tolls to cross the Evergreen Point Floating Bridge. For travel east of the bridge (between Bellevue and Redmond), the additional cost due to congestion (measured in wasted time and gas for travel below maximum throughput speed) was approximately $480 per passenger vehicle annually in 2017.

Visit bit.ly/agolCCR17CentralSoundmap for this article's interactive map.

Interstate 90 Corridor Capacity Analysis

Annual GP person miles traveled
2015 501.2 vs. 2017 501.1 in millions of miles — 0%

Annual GP vehicle delay[1]
2015 324.1 vs. 2017 231 in thousands of hours — 29%

Annual GP GHG emissions
2015 388.5 vs. 2017 364.8 in millions of pounds of CO_2 equivalents — 6%

Annual passenger miles traveled on transit
2015 39.2 vs. 2017 37.1 in millions of miles — 5%

Capacity savings due to transit
2015 1.3 vs. 2017 1.3 in number of lanes — 0%

Percent transit seats occupied
2015 92% vs. 2017 86% on average during peak periods — 4%

Percent park and ride spaces occupied
2015 100% vs. 2017 100% on average during peak periods — 0%

Commute travel times

2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[2] travel times for general purpose (GP), high occupancy vehicle (HOV) and transit[3] trips.

See Appendix pp. 5-29 for more commute routes

Average GP | Reliable GP | Average HOV | Reliable HOV | Average transit | Reliable transit

Bellevue to Seattle
Morning; 8:25 a.m.; Trip length 10 miles

	2015	2017
GP	20 / 30	21 / 30
HOV	14 / 28	12 / 16
Transit[3]	29 / 34	12 / 16

Transit trip length 8.4 miles[4]

Seattle to Bellevue
Evening; 4:50 p.m.; Trip length 11 miles

	2015	2017
GP	15 / 22	17 / 27
HOV	11 / 15	10 / 14
Transit[3]	26 / 30	18 / 20

Transit trip length 8.3 miles[4]

Issaquah to Seattle
Morning; 8:15 a.m.; Trip length 15 miles

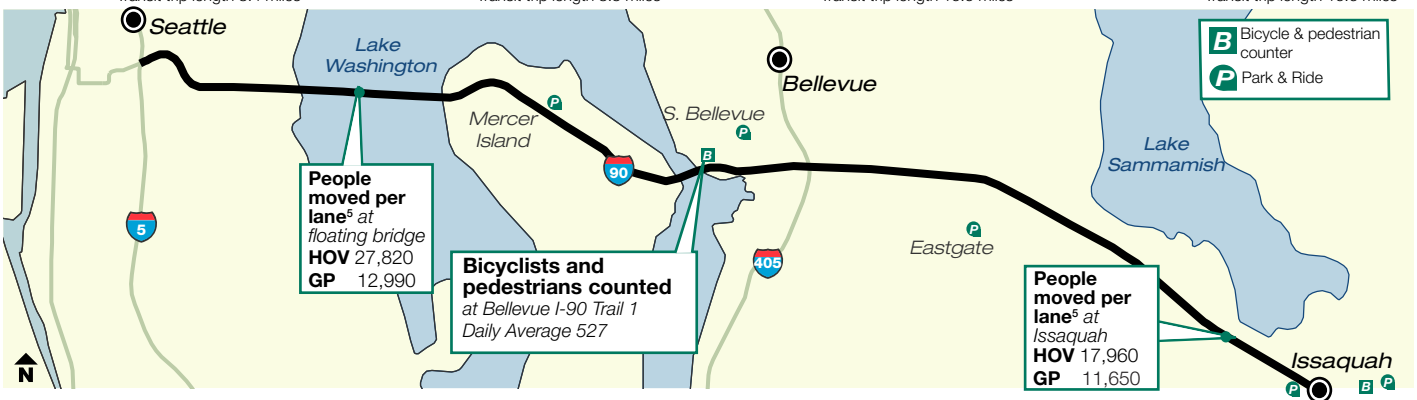
	2015	2017
GP	30 / 46	30 / 45
HOV	18 / 31	17 / 22
Transit[3]	26 / 31	22 / 30

Transit trip length 15.5 miles[4]

Seattle to Issaquah
Evening; 5:15 p.m.; Trip length 16 miles

	2015	2017
GP	22 / 32	23 / 35
HOV	16 / 22	17 / 21
Transit[3]	25 / 28	20 / 22

Transit trip length 15.6 miles[4]



Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[3] peak periods; Ridership and percent of available seats occupied on select commutes

By commute

	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	2015	2017	2015	2017
Issaquah to Seattle	3,495	4,209	105%	89%
Bellevue to Seattle	2,512	2,316	97%	94%
Issaquah to Bellevue	331	248	71%	61%
Evening (3-6 p.m.)				
Seattle to Issaquah	3,129	2,260	97%	82%
Seattle to Bellevue	2,437	2,255	94%	96%
Bellevue to Seattle	990	926	90%	94%

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations); Rates over 100% denote vehicles parked in unmarked spaces.

Seattle-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
South Bellevue (519)	106%	104%
Mercer Island (447)	100%	100%

Issaquah-Bellevue commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Eastgate (1,614)	100%	100%
Issaquah Transit Center (819)	99%	99%
Issaquah Highlands (1,010)	99%	96%

Data sources and analysis: WSDOT Multimodal Planning Division, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.
Notes: Measures at the top of the page are for the I-90 corridor between Seattle and Issaquah for GP trips only. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **3** Transit travel times by bus may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel. WSDOT attempts to match transit trips as closely as is practical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **4** Transit trip length for these trips increased between 2015 and 2017 (see p. 26) **5** Person throughput values include morning (6-9 a.m.) and evening (3-7 p.m.) traffic. 6 The Issquah to Seattle morning commute was served by 59 trips in 2015 and 98 trips in 2017.

New I-90 HOV lanes contribute to decrease in delay

Interstate 90 (I-90) runs parallel to SR 520 across Lake Washington, and is a key commute and economic corridor connecting I-5 and I-405 in the central Puget Sound region. The I-90 floating bridge is the non-tolled alternative to SR 520 across Lake Washington. Around 500 million person miles (approximately twice the person miles traveled on SR 520) were traveled on the corridor each year in both 2015 and 2017. Corridor-wide greenhouse gas (GHG) emissions decreased by 6% in 2017 compared to 2015.

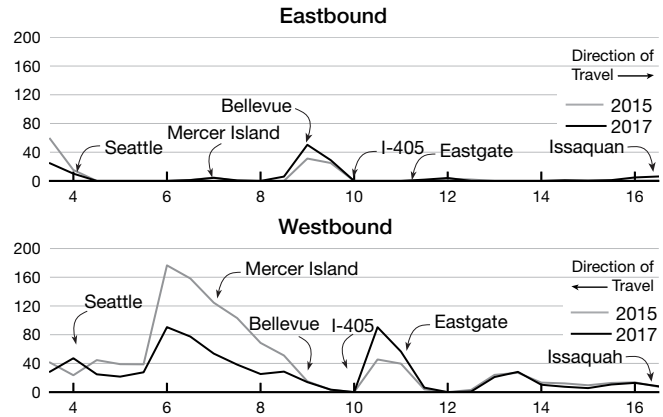
WSDOT opened new High Occupancy Vehicle (HOV) lanes on I-90 between Seattle and Bellevue on June 1, 2017, after the agency closed the I-90 express lanes to make room for Sound Transit's light rail East Link Extension project. Unlike the express lanes, the HOV lanes are open in both directions 24 hours a day, and appear to have significantly improved travel time reliability for HOV lane users (people traveling by carpool, vanpool, or transit). Given the 29% drop in delay in the I-90 general purpose (GP) lanes between 2015 and 2017, the new HOV lanes appear to have also significantly relieved GP lane congestion during their first six months of operation.

Highway capacity constraints vary based on the presence of managed lanes and multimodal travel options. In 2017, the HOV lanes on the floating bridge west of Mercer Island and in Issaquah moved 114% and 54% more people than each adjacent general purpose (GP) lane, respectively.

Corridor delay: The I-90 corridor in the central Puget Sound region between Seattle and Issaquah experienced an overall reduction in vehicle delay of 29% between 2015 and 2017 (see graph above right). Locations on eastbound and westbound I-90 saw decreases in delay between 2015 and 2017, including westbound I-90 at Mercer Island (down 49%) and eastbound I-90 at Seattle (down 58%). However, westbound delay at the I-405 interchange was

Delay along the I-90 corridor

2015 and 2017; Average daily vehicle hours of delay by milepost

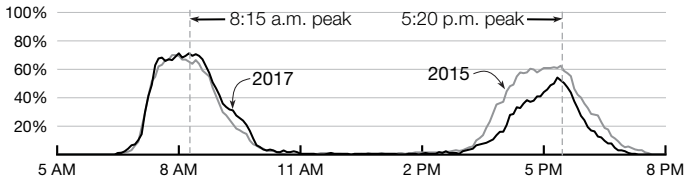


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

43% higher in 2017 than in 2015. The heatmap graph at the bottom of the page, which displays delay by time of day and milepost, shows that eastbound delay was generally less intense than delay in the westbound direction.

Severe congestion on the Issaquah to Seattle commute

2015 and 2017; Westbound; Percent of days the average speed was slower than 36 mph



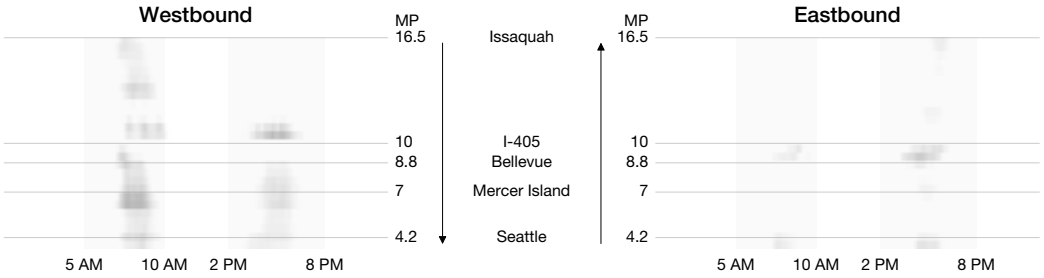
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

A focus on hot spots: In 2017, commuters driving from Bellevue to Seattle via I-90 drove in severely congested conditions (36 mph or less) more often in the morning and less often in the evening than they did traveling the same route in 2015 (see graph above). For example, at around 8:15 a.m. during the morning commute from

I-90 delay between Seattle and Issaquah

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 on eastbound I-90, there were pockets of delay during both peak periods from Seattle to Issaquah. On westbound I-90, morning delay extended along the entire corridor. Delay during the evening commute extended from the I-405 interchange to Seattle, with the most intense delay occurring from 3-6 p.m.

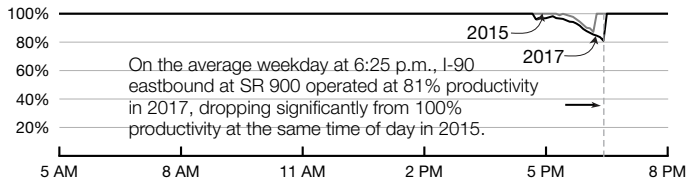


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

New I-90 HOV lanes help alleviate routine congestion

Issaquah to Seattle, the percent of days that speeds were below 36 mph worsened from 67% in 2015 to 71% in 2017. In contrast, at 5:20 p.m. the percent of days speeds were below 36 mph dropped from 62% to 51%.

Throughput productivity on eastbound I-90 at SR 900
2015 and 2017; Based on the highest observed 5-minute flow rate of 1,850 vehicles per hour per lane = 100%



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge lost productivity on I-90 in the central Puget Sound region, WSDOT analyzed vehicle throughput at SR 900 near Issaquah. In 2017, the loss of throughput productivity at this location was slightly more severe than in 2015. It also began earlier and lasted longer in 2017 than in 2015 (see graph above).

Routinely congested segments: The segments of the I-90 corridor between Seattle and Issaquah that saw the most routine congestion in 2017 were on the I-90 floating bridge, at Mercer Island and near the I-405 interchange. Overall, the locations where routine congestion occurred decreased from 14 miles in 2015 to 13 miles in 2017. This improvment is likely attributable to the addition of the 24-hour HOV lanes.

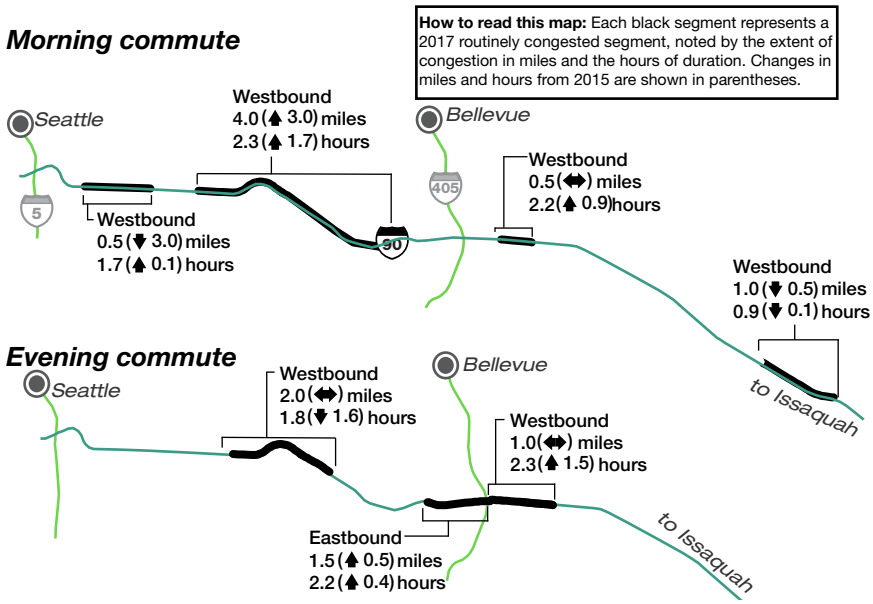
What does congestion mean for travel times on the corridor?

General purpose lane trips: Capacity constraints impacted the I-90 corridor between Seattle and Issaquah heavily in the westbound direction near Mercer Island and the Eastgate area. However, the new HOV lanes between Seattle and Bellevue had a stabilizing effect on general purpose (GP) lane travel times. Between 2015 and 2017, GP lane travel times on I-90 saw moderate increases ranging from one minute (for the average travel time on the morning commute from Bellevue to Seattle) to five minutes (for the reliable travel time for the evening commute from Seattle to Bellevue).

The Bellevue to Seattle evening commute has the highest maximum throughput travel time index (MT3I) of the 12 commutes tracked on I-90 between Seattle, Bellevue and Issaquah. The route's MT3I of 2.07 means that the commute takes more than twice as long as it would if traffic were moving at maximum throughput speed (50 mph). WSDOT uses this index to compare the severity of congestion across commutes.

HOV lane trips: The completion of the I-90 Two-Way Transit & HOV Operations project provided an all-day HOV lane in each direction between Seattle and Bellevue beginning on June 1, 2017. This project resulted in small improvements in average HOV lane travel times, and large improvements in reliable HOV lane travel times. For example, the average HOV lane travel time on the morning commute from Issaquah to Seattle decreased by one minute (6%) between 2015 and 2017, while the corresponding reliable travel time decreased by nine minutes (29%).

Routinely congested segments of I-90 Routinely Congested Segments
2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (change from 2015)



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Note: See pp. 7-8 in the Appendix for all central Puget Sound region routinely congested segment data.

All five park and ride lots along I-90 at capacity

Transit trip travel times: On I-90, transit and HOV lanes allow people to bypass highway capacity constraints in the corridor's GP lanes. As of June 1, 2017, the I-90 corridor has an all-day HOV lane in both directions between Seattle and Bellevue, which has substantially improved transit travel times on the corridor.

For example, in 2017 the average and reliable transit travel times for the I-90 commute from Bellevue to Seattle in the morning were 12 and 16 minutes, respectively. These times are seventeen minutes faster than the average (29 minutes) and reliable (34 minutes) transit travel times in 2015. Additionally, 2017 average and reliable transit travel times on the morning Bellevue to Seattle commute were faster than corresponding GP travel times by nine and 14 minutes, respectively. These differences are large enough that they cannot be entirely attributed to the fact that the transit commute is 1.4 miles shorter than the GP commute. See p. 23 for a comparison of transit trips to GP and HOV trips.

Why did I-90 transit travel times drop in 2017?

The I-90 corridor map on p. 23 shows decreases in transit travel times between Seatte and Bellevue on both the morning and evening commutes, and between Seattle and Issaquah in the morning. These drops are primarily attributable to the improvements in HOV travel times. While the endpoints of some transit commutes changed between 2015 and 2017, all four of the transit trip distances in the corridor map on p. 30 got slightly longer between the two years.

Transit ridership and GHG emissions avoided: Transit moved roughly 14,891 riders on the I-90 corridor during the morning and evening peak periods on an average weekday in 2017, a 9% decrease from 2015 (about 16,328 riders). Daily transit passenger miles traveled decreased by approximately 5% from 2015 (150,142 miles) to 2017 (141,986 miles).

Peak period transit ridership on the I-90 corridor in the central Puget Sound region was equal to 1.3 extra general purpose lanes of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement).

Approximately 86% of available seats on transit on I-90 commutes were occupied during the morning and evening peak periods in 2017, a decrease from 92% in 2015. Of the 310 daily transit trips during the peak periods in 2017, 144 were over 90% of seating capacity on a typical weekday. Transit use during peak periods avoided roughly 70,000 pounds of GHG emissions per day on the I-90 central Puget Sound corridor in 2017, an 8% decrease from 2015 (76,063 pounds).

Park and ride: Along the I-90 corridor in the central Puget Sound region in 2017, park and ride (P&R) utilization rates ranged between 96% and 104%. Any P&R lot that has 85% or more utilization is identified as operating at capacity, meaning that all five P&R lots are operating at or above their current capacity. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders and carpoolers. To be considered effective, P&R lots must also have high utilization rates. Targeted outreach efforts from transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the central Puget Sound region.

How much is congestion costing you?

Commuters making round trips on I-90 in the central Puget Sound region experienced significant costs due to congestion in 2017. The average commuter who made a daily round trip between Seattle and Bellevue using I-90 (the non-tolled, cross-lake alternative to SR 520) in a single-occupancy vehice paid more than $650 annually in 2017 due to congestion (measured in wasted time and gas for travel below maximum throughput speed).

Visit bit.ly/agolCCR18CentralSoundmap for this article's interactive map.

State Route 167 Corridor Capacity Analysis

Annual GP person miles traveled
2015 vs. 2017
311.7 vs. 314.5
in millions of miles
▲ 0.9%

Annual GP vehicle delay[1]
2015 vs. 2017
288.5 vs. 367.6
in thousands of hours
▲ 27%

Annual GP GHG emissions
2015 vs. 2017
261.7 vs. 254.2
in millions of pounds of CO_2 equivalents
▼ 2.9%

Annual passenger miles traveled on transit
2015 vs. 2017
14.3 vs. 20.9
in millions of miles
▲ 46%

Capacity savings due to transit
2015 vs. 2017
0.5 vs. 0.7
in number of lanes
▲ 40%

Percent transit seats occupied
2015 vs. 2017
56% vs. 74%
on average during peak periods
▲ 18%

Percent park and ride spaces occupied
2015 vs. 2017
80% vs. 78%
on average during peak periods
▼ 2%

Commute travel times

2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[2] travel times for general purpose (GP), high occupancy vehicle (HOT) and transit[3] trips.

Average GP | Average HOT | Average transit
Reliable GP | Reliable HOT | Reliable transit

Auburn to Renton

Morning; 6:45 a.m.; Trip length 10 miles

GP	2015	21	30
	2017	22	30
HOT	2015	14	20
	2017	15	20
Transit[3]	2015	34	41
	2017	48	57

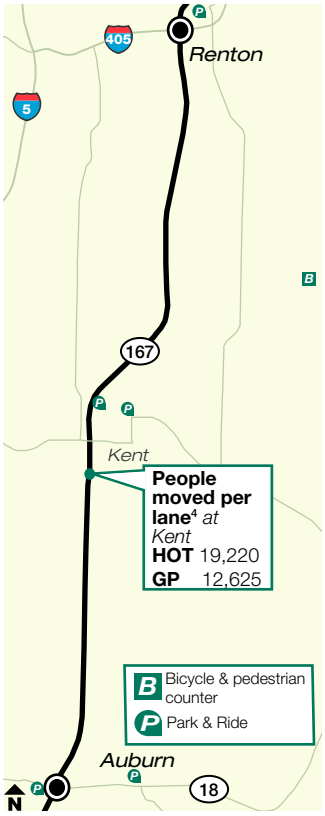
Transit trip length 15.6 miles

Renton to Auburn

Evening; 3:25 p.m.; Trip length 10 miles

GP	2015	20	36
	2017	20	32
HOT	2015	13	18
	2017	13	17
Transit[3]	2015	41	49
	2017	46	54

Transit trip length 15.6 miles



Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[3] peak periods; Ridership and percent of available seats occupied on select commutes

By commute

	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	2015	2017	2015	2017
Auburn to Renton	2,892	3,684	52%	68%
Evening (3-6 p.m.)				
Renton to Auburn	2,945	4,138	61%	81%

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations)

Auburn-Renton commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Auburn Station (633)	100%	100%
South Renton (373)	100%	98%
Kent area (996)	98%	98%
Renton (150)	97%	79%
Peasley Canyon (54)	95%	83%
Renton Municipal (150)	76%	77%
Auburn (244)	69%	55%
Kent/James Street (713)	28%	26%

Data sources and analysis: WSDOT Multimodal Planning Division, Sound Transit, Pierce Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for GP trips only on the SR 167 corridor between Auburn and Renton. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **3** Transit travel times by bus may not be directly comparable to GP/HOT trips due to different start and end points or off-highway travel. WSDOT attempts to match transit trips as closely as is practical to GP/HOT. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **4** Person throughput values include morning (6-9 a.m.) and evening (3-7 p.m.) traffic.

State Route 167 (SR 167) is a key commute and economic corridor in the central Puget Sound region that functions as an extension of Interstate 405 (I-405) south of the Tukwila/Renton area. Nearly 315 million person miles were traveled on SR 167 between Renton and Auburn in 2017, a 0.9% increase over 2015. Greenhouse gas (GHG) emissions decreased 2.9% from 2015 to 2017.

Highway capacity constraints vary based on the presence of managed lanes and multimodal travel options; the SR 167 corridor is served by Sounder commuter rail, transit buses, and high occupancy toll (HOT) lanes. The HOT lane (a high occupancy vehicle lane open to solo drivers who choose to pay a toll) at Kent on this corridor moved 52% more people in 2017 than each adjacent general purpose (GP) lane. Carpools of two or more, vanpools and buses use the HOT lanes toll-free. Toll rates adjust to ensure traffic in the HOT lane is as close to free flowing as possible even when the regular lanes are congested.

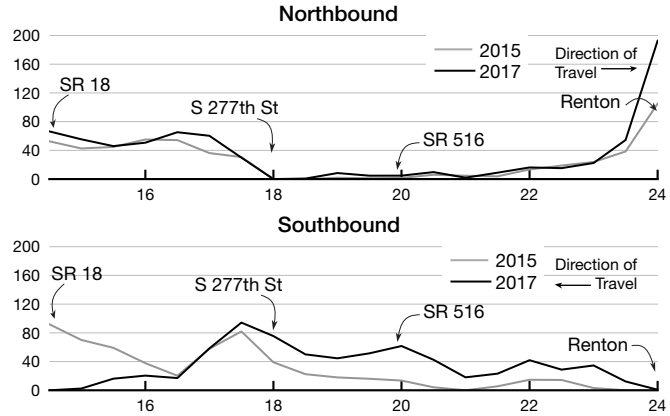
SR 167 sees increases in delay during peak periods in 2017

Corridor delay: Overall delay on SR 167 between Auburn and Renton increased by 27% from 2015 to 2017. Because person miles traveled increased by only 0.9% over the same period, this increase in delay suggests that capacity constraints are impacting traffic on the corridor during peak periods. In addition to delaying commuters, this congestion directly impacted the movement of goods in Washington as trucks accounted for 8% of the total daily traffic volume on the corridor in 2017.

The worst delay, as well as the greatest increase in hours of delay, occurred on northbound SR 167 in Renton (see graph below). This delay may have been influenced by construction at the interchange. The heatmap graph at the bottom of the page shows the intensity of delay in 2017 by the time of day and location.

Delay along the SR 167 corridor

2015 and 2017; Average daily vehicle hours of delay by milepost



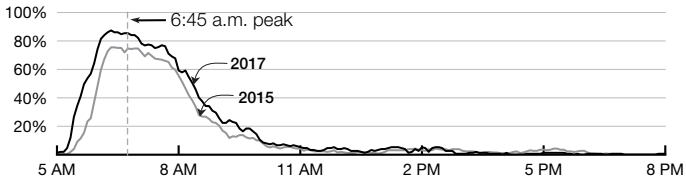
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Most locations on the SR 167 corridor between Auburn and Renton saw increases in vehicle delay in both directions between 2015 and 2017. The exception to this was the southbound stretch of highway between the SR 18 interchange and milepost 16, where the extension of the southbound HOT lane to Pacific in December 2016 likely decreased delay (see graph at left).

A focus on hot spots: SR 167 commuters drove in severely congested conditions (36 mph or less) more often in 2017 than in 2015. For example, at around 6:45 a.m. during the morning commute from Auburn to Renton, speeds were below 36 mph on 85% of weekdays in 2017—up from 75% in 2015 (see chart below).

Severe congestion on the Auburn to Renton commute

2015 and 2017; Northbound; Percent of days the average speed was slower than 36 mph



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on SR 167 in the central Puget Sound region, WSDOT analyzed vehicle throughput at 84th Avenue South in Kent. There were larger losses in throughput productivity at this location in 2017 than in 2015, indicating an increase in the impact of capacity constraints on the corridor. For example, on southbound SR 167, the period during

SR 167 delay between Auburn and Renton

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 on southbound SR 167, delay extended along the entire corridor, with the most intense delay occurring from 2-4:30 p.m.. On northbound SR 167, delay lasted for the entire morning commute, with the most intense delay occurring between South 277th Street and SR 18.

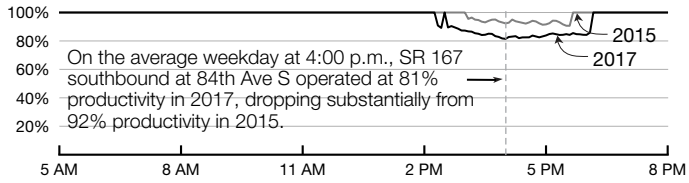
Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Duration and extent of routine congestion increases

which throughput productivity dropped below 100% both began earlier and ended later in 2017 than in 2015. Throughput productivity loss in 2017 was also consistently greater than in 2015 (see throughput graph below).

Throughput productivity on southbound SR 167 at 84th Avenue South in Kent

2015 and 2017; Based on the highest observed 5-minute flow rate of 1,860 vehicles per hour per lane = 100%

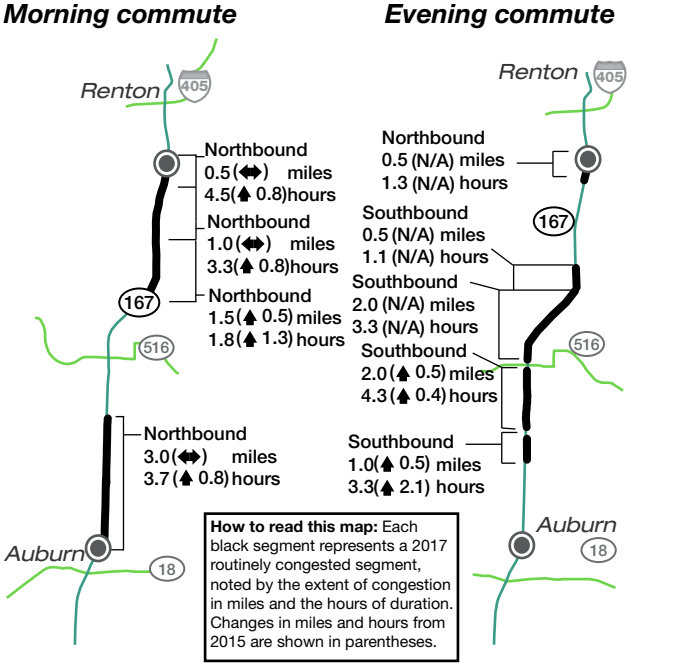


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Routinely congested segments: The segments of the SR 167 corridor between Auburn and Renton that saw the most routine congestion in 2017 were between SR 516 and SR 18 in both directions, and northbound approaching the SR 167/I-405 interchange. Overall, the locations where routine congestion occurred increased by two miles between 2015 and 2017 (see map below left).

Routinely congested segments of SR 167

2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles;Daily duration of congestion in hours (change from 2015).



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Note: See pp. 7-8 in the Appendix for all central Puget Sound region routinely congested segment data.

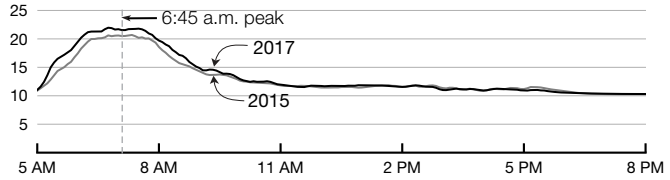
What does congestion mean for travel times on the corridor?

General purpose lane trips: Between 2015 and 2017, the average travel time for the Auburn to Renton morning commute worsened by one minute (5%), while the travel time for the return commute in the evening did not change. The reliable travel time for the Auburn to Renton morning commute did not change between 2017 and 2015, while the Renton to Auburn evening reliable commute time improved by four minutes to 32 minutes. The relative stability of travel times on this corridor indicates that the increased delay on this corridor results from small increases throughout the morning, rather than from a large spike at the peak travel time. The graph below shows that from 5 a.m. to 11 a.m., travel times on the Auburn-to-Renton commute were slightly longer in 2017 than they were in 2015.

The Auburn to Renton morning commute has the highest maximum throughput travel time index (MT3I) of the four commutes tracked on SR 167. The route's MT3I of 1.78 means that the commute takes more than one-and-three-quarters times as long as it would if traffic were moving at maximum throughput speed (50 mph). The Renton to Auburn evening commute has an MT3I of 1.63, meaning that it takes nearly one-and-two thirds times as long as it would if traffic were moving at maximum throughput speed. WSDOT uses this index to compare the severity of congestion across commutes.

Travel time on the Auburn to Renton commute

2015 and 2017; Northbound; Average travel time in minutes



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

HOT lane trips: Between 2015 and 2017, the average HOT-lane travel time for the morning Auburn to Renton commute increased by one minute, while the average HOT-lane travel time for the evening Renton to Auburn commute did not change at all. The reliable travel time for the Renton to Auburn evening commute improved by one minute between 2015 and 2017, while the reliable travel time for the morning Auburn to Renton commute held steady. Both average and reliable travel times were

Transit ridership on SR 167 increases by 34% in 2017

substantially lower for HOT lanes than for GP lanes in both 2015 and 2017, with differences ranging from seven to 10 minutes. In general, travel times indicate that the HOT lanes on the SR 167 corridor are functioning as intended.

Transit trip travel times: On SR 167, Sounder commuter rail, transit buses and HOT lanes allow people to bypass highway capacity constraints in the corridor's GP lanes. HOT lanes reduce travel times for carpoolers, transit riders, and solo drivers who pay a toll to use the lanes. However, it is difficult for transit travel times to get close to GP travel times on this corridor due to the frequent stops made by buses (see box at right). For example, in 2017 the average and reliable transit travel times for the SR 167 commute from Auburn to Renton in the morning were 48 and 57 minutes, respectively. This is 14 minutes slower than the average (34 minutes) and 16 minutes slower than the reliable (41 minutes) transit travel times in 2015. Additionally, in 2017 average transit travel times were slower than the corresponding GP average by 26 minutes, and reliable transit travel times were slower by 27 minutes. See p. 27 for a comparison of transit trips to GP and HOT trips.

Transit ridership and GHG emissions avoided: Transit moved approximately 7,822 riders during the morning and evening peak periods on an average weekday in 2017, a 34% increase over 2015 (5,837 riders). Daily transit passenger miles traveled (PMT) increased by roughly 46% from 54,837 miles in 2015 to 79,928 miles in 2017. Unlike on other corridors in the central Puget Sound region, these increases in ridership and PMT appear to be due not to growth in the number of trips, but to higher ridership on existing trips. Approximately 74% of available seats on transit on SR 167 commutes were occupied during the morning and evening peak periods in 2017—a substantial increase from 56% in 2015.

Transit use during peak periods avoided about 45,965 pounds of GHG emissions per day on the SR 167 central Puget Sound corridor in 2017, 50% more than in 2015 (30,702 pounds). This increase parallels the growth in transit passenger miles traveled.

Peak period transit ridership on the SR 167 corridor in the central Puget Sound region was equal to approximately 70 percent of a lane of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement).

Park and ride: Along the SR 167 corridor in the central Puget Sound region in 2017, park and ride (P&R) utilization rates ranged from 26% to 100%, with three out of eight having utilization rates at or above 95%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders. To be considered effective, P&R lots must also have high utilization rates. Targeted outreach efforts by transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the central Puget Sound region.

How much is congestion costing you?

Commuters making round trips between Auburn and Renton on SR 167 in the general purpose lanes in 2017 experienced costs due to congestion (measured in wasted time and gas for travel below maximum throughput speed) of over $1,600 per passenger vehicle annually.

Why are some transit travel times slower than HOT?

On the SR 167 corridor map on p. 27, the two commutes have average transit travel times which are both 33 minutes slower than the corresponding HOT lane travel times. Off-highway travel to stops increases transit travel times. For example, on the Renton to Auburn evening commute, the Sound Transit 566 exits the highway at Kent and makes three stops before re-entering the highway, resulting in a transit trip more than five miles longer than the corresponding HOT and GP trips.

Additionally, there are no direct-access HOT ramps on this corridor, which means that buses must use the GP lanes to exit the highway to reach stops along their routes.

High Occupancy Vehicle Trip Analysis

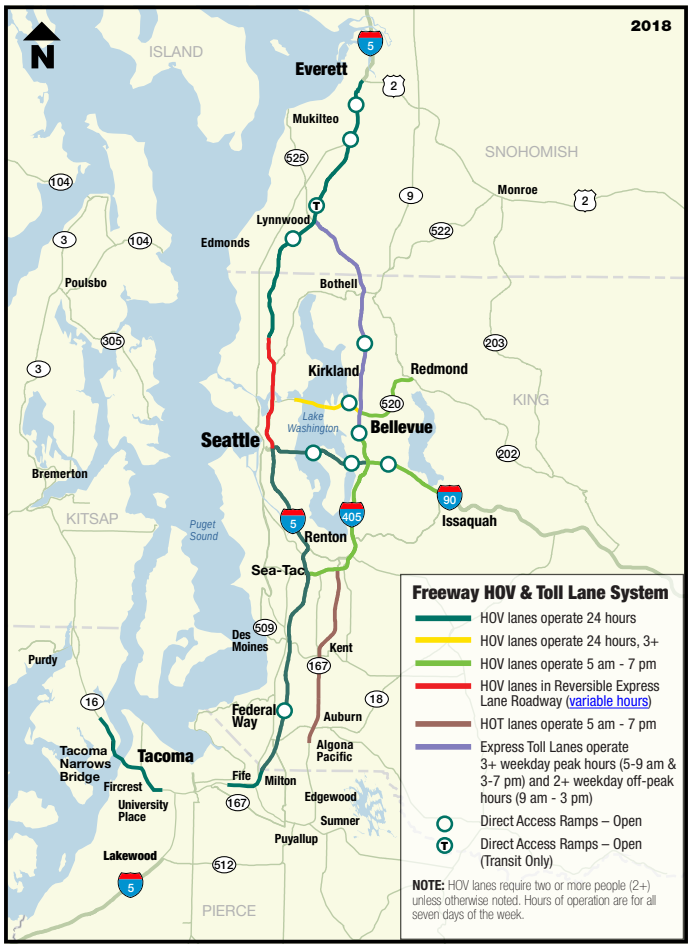
High occupancy vehicle (HOV) lanes are reserved for carpools, vanpools, buses, motorcycles or any vehicle carrying a minimum number of people (either two or three, depending on the location and time of day), in addition to certain other vehicles granted access by the Legislature. The central Puget Sound region freeway network includes a system of HOV lanes designed to provide faster and more reliable options for travelers. This system also enhances the efficient operation of the freeway network by moving more people in fewer vehicles than adjacent general purpose (GP) lanes. About 250 lane-miles of the planned 369-mile Puget Sound region HOV network have been completed. These figures reflect the HOV freeway system and exclude ramps and arterials; the planned freeway lane-miles have been updated based on new projects funded through Connecting Washington and additional HOV options such as high occupancy toll lanes and express toll lanes. More information about the HOV lane network can be found at http://www.wsdot.wa.gov/hov/.

WSDOT monitors three aspects of Puget Sound region HOV lane performance: 1) the person-carrying performance of HOV lanes as compared to the adjacent GP lanes, 2) travel time performance for HOV lane users, and 3) overall travel performance and reliability on freeway HOV corridors.

HOV lanes outperform GP lanes for person throughput

One of the key metrics for HOV lane performance is the ability of the HOV network to efficiently move more travelers. WSDOT estimates the number of vehicles and travelers at 10 locations on the major freeway corridors in the central Puget Sound region to evaluate HOV network performance.

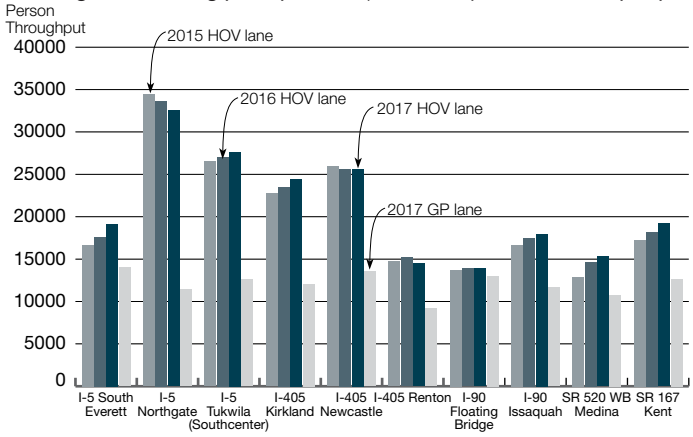
In 2017, changes in person volume varied by location, with seven of the 10 monitored locations showing higher person throughput compared to 2015. The magnitude of HOV person volume in 2017 across the entire central Puget Sound HOV network increased by about 23% when compared to 2015, while general purpose lane (adjacent to HOV network) person volume increased by about 10%. The significant increase in HOV person volume can be attributed to the introduction of the I-405 Express Toll Lanes in 2015. The person volume estimates are based on point locations and do not reflect the vehicle miles traveled on the central Puget Sound region freeway network as a whole.



Since 1970, WSDOT has built approximately 250 lane-miles of a planned 369 lane-mile freeway system in the Puget Sound region that features managed lanes (HOV, HOT, ETL). Approximately 58 additional HOV lane-miles serve as direct access transit lanes/ramps, HOV ramps or other HOV lanes on state highway arterials and freeway ramps; previous editions of the Corridor Capacity Report incorrectly reported this figure as 75 miles. Image from www.wsdot.wa.gov/hov.

Person throughput[1] higher in HOV than GP lanes

2015 through 2017; Average daily person throughput volumes for morning and evening peak periods (combined) in number of people



Data source: WSDOT Multimodal Planning Division.

Notes: **1** Person volume estimates are based on the most recent 2015-2017 transit ridership and other data. The GP lane volumes are the estimated person volumes for the average GP lane at each location.

Puget Sound HOV lanes account for 38% of miles traveled

Across all the monitored locations, an average of 40% of the people using the freeway during the peak periods at these locations are traveling in an HOV lane. These values have been generally consistent from year to year.

The number of people using HOV lanes varies by location and time of day. The most successful examples of HOV system use occur when using an HOV lane offers a clear person throughput and travel time benefit for users combined with strong transit service. GP lanes at six of the 10 monitored locations saw a decrease in person throughput volumes between 2015 and 2017 while most of the adjacent HOV lanes showed an increase. This indicates persistent demand for HOV lanes in the central Puget Sound region.

Puget Sound region HOV network reaches 7.8 million person miles traveled daily

2015 and 2017; Average daily person miles traveled in thousands

Highway	2015	2017	% change
Interstate 5	3,744	4,029	7.6%
Interstate 405	1,815	2,184	20.3%
State Route 520	489	532	8.8%
Interstate 90	416	508	22.1%
State Route 167	444	511	15.1%
Total	**6,908**	**7,764**	**12.4%**

Data source: WSDOT Multimodal Planning Division.

The Northgate area on I-5 north of downtown Seattle is a good example of a freeway segment with high person throughput, as it is in a heavily traveled freeway corridor served by a number of transit routes. In previous years, this location has consistently shown HOV lane travel time benefits and significant usage. In 2017, during the average morning peak period, the southbound I-5 HOV lane at Northgate carried more than 47% (14,303) of all travelers toward downtown Seattle in 23% (4,198) of the vehicles. The HOV lane at this location carried an average of 3.4 persons per vehicle, which is calculated by dividing the HOV person throughput by the number of vehicles in the HOV lane. The average number of people carried in an HOV lane is about 2.9 times the number of people carried in each of the adjacent GP lanes. Ridesharing travelers and high levels of transit service and ridership are major contributing factors to the person throughput on I-5 and the HOV system overall.

Roughly 7.8 million person miles were traveled on the central Puget Sound region freeway HOV network on an average weekday in 2017, 12.4% more than in 2015. Approximately 38% of all freeway person miles traveled in the central Puget Sound region were on the HOV network in 2017. HOV lanes comprise approximately 27% of total lane miles on the tracked corridors (see Appendix p. 4). I-5 carried more than half of the region's HOV person miles traveled (4.0 million miles). I-90 saw the biggest two-year increase in the region (22.2%) due to the replacement of the reversible HOV lane with 24-hour HOV lanes in both directions.

Carpool, transit and vanpool critical to higher HOV person throughput

Bus riders make up a significant portion of HOV network users. In the central Puget Sound region, King County Metro (KCM), Sound Transit (ST) and Community Transit all showed steady annual ridership growth since 2015, continuing the trend from recent years.

KCM's 2017 transit boardings were up by over a quarter million (0.2%) from 2015, with ridership reaching 121 million. KCM experienced significant ridership growth on routes that benefited from new investments funded by the voter-approved Seattle Proposition 1, which provides additional funding for bus routes that primarily serve the city of Seattle. KCM added metro service in certain high-demand areas to meet growing commuter needs.

The ST Express regional bus service reported an increase in boardings of over 62,000 (0.3%) from 2015 to 2017 (18.4 million boardings total). About 66,000 riders rode ST Express regional bus service everyday on weekdays.

Community Transit fixed-route bus ridership grew by 2% (57,740) between 2015 and 2017. WSDOT will continue to track bus ridership trends and levels of transit service as part of its ongoing HOV performance monitoring efforts.

According to the National Transit Database, the Puget Sound region is considered the vanpool capital of the nation, with vanpool boardings per capita almost double those of the next closest region (Los Angeles). Puget Sound region vanpools logged nearly 38 million miles in 2017, and made up 80% of the vanpools statewide (3,031 of 3,783).

HOV speed and reliability performance

HOV lanes continue to provide speed and reliability benefits for travelers

WSDOT monitors the benefits for HOV lane users by tracking the travel times and reliability of HOV trips that parallel each of WSDOT's 40 high-demand commute corridors. On I-5, alternate HOV routes are provided in the reversible lanes.

Of the 38 HOV trips analyzed for 2017, 29 had average travel times more than two minutes faster than the associated GP trip (during times of peak congestion). The other 9 trips showed no significant average travel time difference between the GP and HOV route options. Overall, the 2017 HOV travel time results are similar to those seen in previous years.

In 2017, 35 of the 38 HOV trips had reliable travel times that were more than two minutes faster than those of their GP counterparts, indicating that HOV lanes were the more dependable option. The other three trips showed little or no difference between HOV and GP reliable travel times.

For average and reliable travel times for all HOV lanes, see Appendix pp. 22-23.

I-405 ETL/SR 167 HOT Performance

I-405 ETL commutes between Lynnwood and Bellevue are not reported in this section, as they have separate legislatively mandated speed and reliability performance measures and reporting requirements (per RCW 47.56.880). For consistency, WSDOT follows the same reporting guidelines for the SR 167 HOT lanes.

For the most up-to-date performance information on the I-405 ETLs and the SR 167 HOT lanes, see WSDOT"s Toll Division Annual Reports at http://www.wsdot.wa.gov/tolling/publications.htm.

HOV performance declines at all ten monitored locations

The performance and reliability standard for freeway HOV lanes that was adopted by WSDOT and the Puget Sound Regional Council in 1991 states that travelers in the HOV lane should be able to maintain an average speed of at least 45 mph 90% of the time during the peak hour of travel.

One of the 12 monitored HOV peak-direction corridors (the evening I-90 eastbound commute between Seattle and Issaquah) met the state performance standard in 2017; three corridors met the standard in 2015. The degree of compliance with the performance standard held steady or worsened for all 12 monitored locations in 2017 compared to 2015.

Even when performance is reduced during congested periods, HOV lanes still generally provide speed and reliability benefits over adjacent GP lanes. During the off-peak times of day, all HOV corridors generally meet the standard.

See the table below for a summary of the degree to which each HOV corridor met the state performance standards in recent years in the peak direction of travel.

High occupancy vehicle lane speed and reliability performance on major central Puget Sound corridors
2013 through 2017; Goal is to maintain 45 mph for 90% of peak hour; Percent of peak hour goal was met

Commute routes	2013	2014	2015	2016	2017	Commute routes	2013	2014	2015	2016	2017
Morning commutes						**Evening commutes**					
I-5, Everett to Seattle SB	42%	28%	26%	19%	**18%**	I-5, Seattle to Everett NB	66%	46%	36%	21%	**12%**
I-5, Federal Way to Seattle NB	43%	30%	18%	18%	**15%**	I-5, Seattle to Federal Way SB	53%	40%	32%	21%	**19%**
I-405, Tukwila to Bellevue NB	65%	35%	26%	24%	**22%**	I-405, Bellevue to Tukwila SB	41%	26%	21%	18%	**14%**
I-90, Issaquah to Seattle WB[1]	100%	98%	98%	97%	**89%**	I-90, Seattle to Issaquah EB[1]	99%	100%	99%	97%	**94%**
SR 520, Redmond to Bellevue WB	50%	44%	63%	61%	**50%**	SR 520, Bellevue to Redmond EB	52%	52%	73%	71%	**65%**

Data source: WSDOT Multimodal Planning Division.
Notes: The above HOV reliability performance standards are based on the peak hour, when average travel time is slowest. To meet the standard, a speed of 45 mph must be maintained for 90% of the peak hour. Numbers represent the percentage of the peak hour when speeds are faster than 45 mph. The WSDOT Multimodal Planning Division analyzes performance data for all complete segments of HOV lanes that have a loop detector. In some cases, data cannot be analyzed for the very beginning and ends of the lanes because there are no detectors at these locations. **1** The I-90 reversible HOV lane between I-5 and Mercer Island was replaced by 24-hour HOV lanes in both directions on June 4, 2017.

South Puget Sound I-5 Corridor Capacity Analysis

Visit bit.ly/agolCCR18SouthSoundmap for this article's interactive map.

Annual GP person miles traveled
2015 vs. 2017
1,627 vs. 1,601
in millions of miles
1.6% ↓

Annual vehicle delay[1]
2015 vs. 2017
1,641 vs. 1,903
in thousands of hours
16% ↑

Annual GHG emissions
2015 vs. 2017
1,358 vs. 1,325
in millions of pounds of CO_2 equivalents
2.4% ↓

Annual passenger miles traveled on transit
2015 vs. 2017
30.5 vs. 30.0
in millions of miles
1.6% ↓

Capacity savings due to transit
2015 vs. 2017
0.9 vs. 0.9
in number of lanes
0% ↔

Percent transit seats occupied
2015 vs. 2017
49% vs. 44%
on average during peak periods
5% ↓

Percent park and ride spaces occupied
2015 vs. 2017
85% vs. 86%
on average during peak periods
1% ↑

Commute travel times

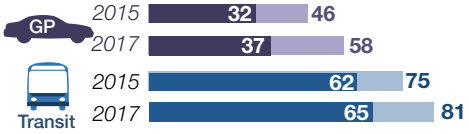
2015 and 2017 during the morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[2] travel times for general purpose lane (GP) and transit[3] trips.

Average GP | Average transit
Reliable GP | Reliable transit

See Appendix pp. 30-36 for more commute routes

Olympia to Tacoma

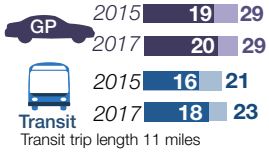
Morning; 7:25 a.m.;Trip length 26 miles



Transit trip length 33 miles

Tacoma to Federal Way

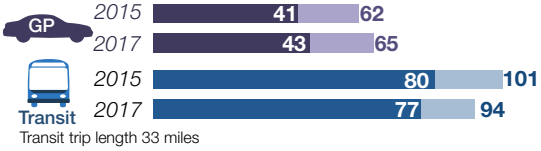
Morning; 5:25 a.m.; Trip length 12 miles



Transit trip length 11 miles

Tacoma to Olympia

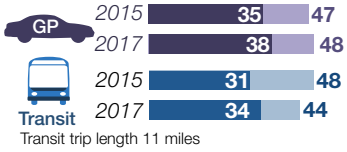
Evening; 4:40 p.m.; Trip length 26 miles



Transit trip length 33 miles

Federal Way to Tacoma

Evening; 4:50 p.m.; Trip length 12 miles



Transit trip length 11 miles

Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[3] peak periods; Ridership and percent of available seats occupied on select commutes

By commute

	Daily peak period riders		Percent of seats occupied	
Morning (6-9 a.m.)	**2015**	**2017**	**2015**	**2017**
Olympia to Tacoma	260	241	22%	17%
Tacoma to Federal Way[4]	3,684	3,920	67%	63%
Evening (3-6 p.m.)				
Tacoma to Olympia[5]	425	392	35%	27%
Federal Way to Tacoma[4]	3,356	3,328	61%	57%

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations)

Olympia-Federal Way commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
SR 512 Lakewood (493)	99%	99%
Tacoma Dome (2,337)	98%	99%
Lakewood Station (541)	79%	82%
DuPont (109)	72%	74%
Martin Way (318)	42%	45%
Hawks Prairie (332)	28%	22%

Data sources and analysis: WSDOT Multimodal Planning Division, Sound Transit, Pierce Transit, Intercity Transit, WSDOT Olympic Region and WSDOT Office of Strategic Assessment and Performance Analysis.
Notes: Measures at the top of the page are for general purpose (GP) trips only on the I-5 corridor between Olympia and Federal Way. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **3** Transit travel times by bus may not be directly comparable to GP/HOV trips due to different start and end points or off-highway travel. WSDOT attempts to match transit trips as closely as is practical to GP/HOV. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak. **4** Includes transit trips between Olympia/Tacoma and Seattle.

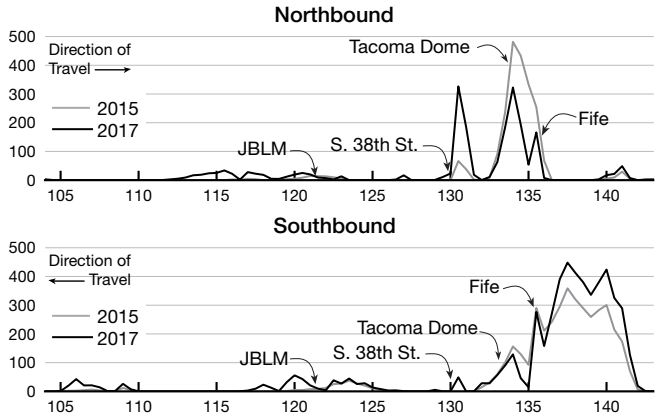
South Sound I-5 corridor sees increased delay in 2017

Interstate 5 (I-5) is the primary commute and economic corridor connecting the south and central Puget Sound regions. More than 1.6 billion person miles were traveled between Olympia and Federal Way during weekday peak periods in 2017, a 1.6% decrease from 2015. Greenhouse gas (GHG) emissions declined by 2.4% between 2015 and 2017.

Overall delay on the corridor increased by 16%, with the largest increases in delay occurring northbound just south of the Tacoma Dome, and southbound near the end of the HOV lanes just north of Fife. In addition to delaying commuters, this congestion directly impacted the movement of goods in Washington, as trucks accounted for 9% of the total daily traffic volume on the corridor in 2017.

Delay along the I-5 corridor

2015 and 2017; Average daily vehicle hours of delay by milepost



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Corridor delay: Delay worsened at some locations on the I-5 corridor between 2015 and 2017, but improved at others. Morning and evening weekday commutes experienced moderate to heavy congestion on a daily basis in both years.

Northbound delay was impacted by lane changes that occurred during the construction of new ramps and lanes between SR 16 and I-5, and near the Tacoma Dome. As a result, the majority of northbound delay on I-5 occurred between South 38th Street (Tacoma Mall) and Fife. From 2015 to 2017, delay on northbound I-5 increased significantly in the Tacoma Mall area, but decreased between the Tacoma Dome and Fife (see graph at right).

In the southbound direction, most of the delay occurred between the King County line and Fife in both years. This area of delay, which worsened between 2015 and 2017, appears to have been caused by the lane reduction near the end of the southbound HOV lane, which terminates at Fife (see graph above). Continued construction in the Tacoma Dome area (which was in progress in both 2015 and 2017) likely also impacted southbound delay.

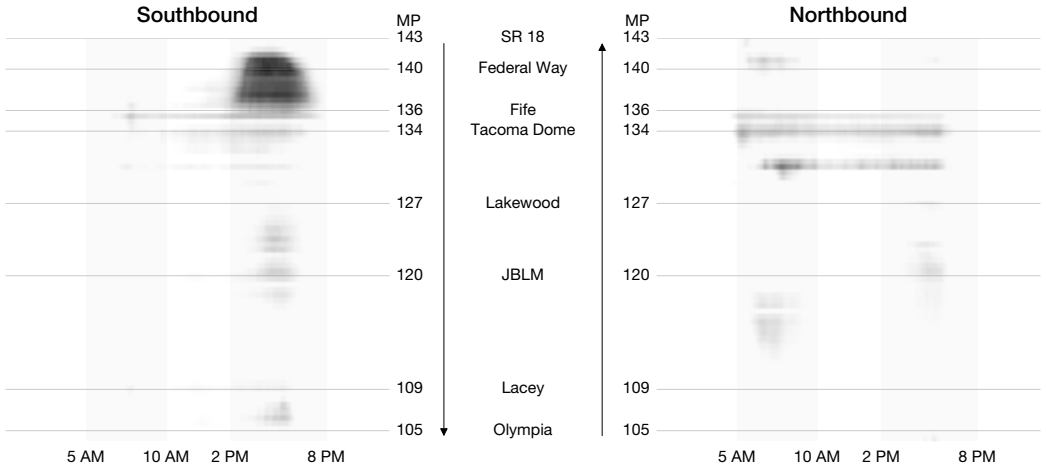
Delay was also influenced by increases in population and employment in the region. Both Pierce and Thurston counties saw their populations grow by 3.5% from 2015 to 2017. Employment in the Tacoma-Lakewood metropolitan area also increased significantly (by 5.5%) between 2015 and 2017. The heatmap graph at the bottom of the page shows 2017 delay by milepost and time of day.

A focus on hot spots: In 2017, commuters driving from Federal Way to Tacoma on I-5 experienced severely congested conditions (36 mph or below) more often than they did in 2015, regardless of the time of day. The graph at the top of the next page shows that in

I-5 delay between Olympia and Federal Way

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 on northbound I-5, delay lasted from 5 a.m. to 7 p.m. around the Tacoma Dome, with the most intense delay occurring during the morning commute. On southbound I-5, delay was most intense during the evening commute, extending from SR 18 past the Tacoma Dome and lasting from 2 p.m. to 8 p.m.

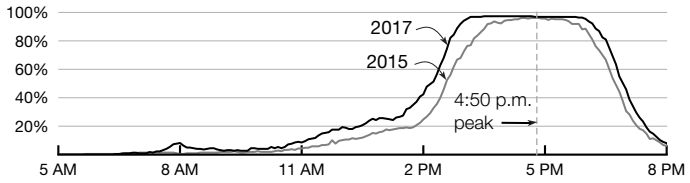


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Tacoma Dome, Fife experience increased congestion

Severe congestion on the Federal Way to Tacoma commute

2015 and 2017; Southbound; Percent of days the average speed was slower than 36 mph

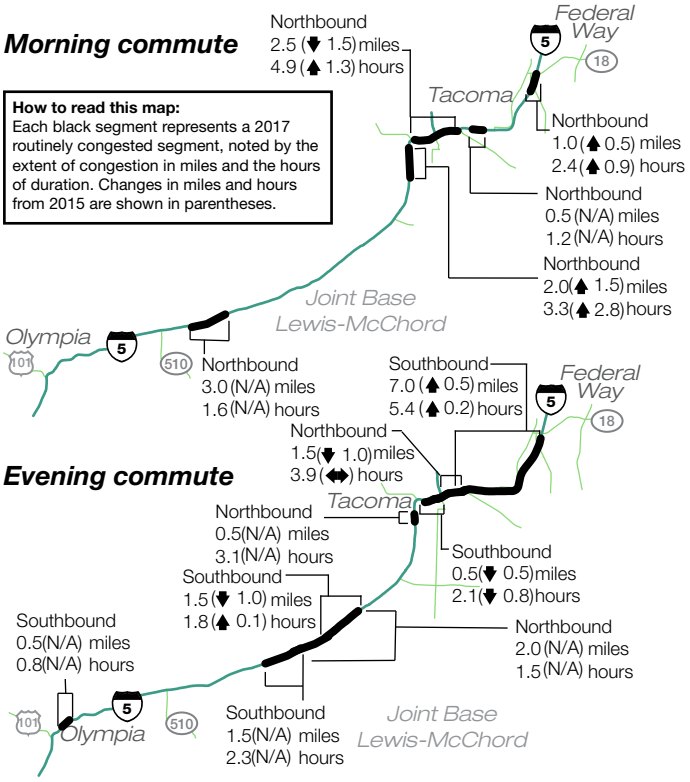


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

2017, commuters making this trip experienced speeds below 36 mph on more than 80% of weekdays between 2:40 p.m. and 6:30 p.m.. This indicates a significant worsening of severe congestion from 2015, when speeds on this commute were below 36 mph on more than 80% of days from 3:15 p.m. to 6:10 p.m.. At the most congested time, 4:50 p.m., 97% of days experienced severe congestion in 2017, compared to 96% in 2015.

Routinely congested segments of I-5

2017; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (change from 2015)

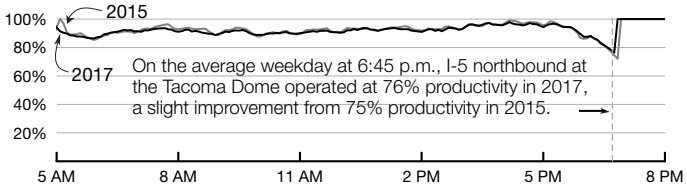


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: See p. 33 in the Appendix for all south Puget Sound region routinely congested segment data. **1** Routinely congested segments that dropped below 50 minutes in duration in 2017 from 2015 are noted with text on the map, but are not shown with the bold segment lines.

Throughput productivity on northbound I-5 at the Tacoma Dome

2015 and 2017; Based on the highest observed 5-minute flow rate of 1,580 vehicles per hour per lane = 100%



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on I-5 in the south Puget Sound region, WSDOT analyzed vehicle throughput at five locations: near 14th Avenue in Olympia, near Joint Base Lewis-McChord (JBLM), near the Tacoma Dome, at Fife and near SR 18. In 2015 and 2017, productivity at these locations ranged from 64% to 100% at their most congested.

Throughput productivity loss in the northbound direction near the Tacoma Dome remained relatively stable from 2015 to 2017. The graph above shows how productivity on northbound I-5 at the Tacoma Dome varies by time of day. For example, 24% of the freeway's capacity was unavailable due to congestion at 6:45 p.m. on the average day in 2017—slightly less than the 25% that was unavailable in 2015.

Routinely congested segments: The most routinely congested segments of the I-5 corridor between Olympia and Federal Way in 2017 were located between SR 18 and Tacoma, and near JBLM. The locations where routine congestion occurred were similar in 2015 and 2017, but many of them experienced increases in the duration of congestion between the two years (see map at left).

What does congestion mean for travel times on the corridor?

General purpose (GP) lane trips: Travel times on the I-5 corridor in the south Puget Sound region either held steady or increased between 2015 and 2017. For example, on the morning northbound I-5 commute between Olympia and Tacoma, average travel times increased from 32 minutes to 37 minutes (16%) and reliable travel times increased from 46 minutes to 58 minutes (26%) over this period. These increases in travel times are largely attributable to the construction around Joint Base Lewis-McChord that began in 2016 and continued into 2017.

Transit ridership saves most of a lane of capacity on I-5

Not all commutes in the region saw such drastic increases; the Federal Way to Tacoma southbound evening commute saw average travel times increase from 35 minutes to 38 minutes (9%), and reliable travel times increase from 47 minutes to 48 minutes (2%) between 2015 and 2017. The impact of congestion on this commute was similar—and high—in both years. Nearly all of the 12-mile evening commute from Federal Way to Tacoma is routinely congested (see graph at bottom of p. 36). In 2017, this commute also had a maximum throughput travel time index (MT3I) of 2.56, which indicates that it takes more than two-and-a-half times as long to make the trip than it would at maximum throughput speed. WSDOT uses the MT3I to compare severity of congestion across commutes; the evening commute from Federal Way to Tacoma has the highest MT3I of the 20 commutes analyzed in the south Puget Sound region.

Transit trip travel times: Transit travel times on I-5 in the south Puget Sound region clearly show the impact of HOV lanes. On the morning commute from Tacoma to Federal Way, where HOV lanes allow transit vehicles to bypass traffic in the GP lanes for most of the trip, average and reliable transit travel times (18 and 23 minutes) were shorter than GP travel times by two and six minutes, respectively.

In contrast, the average and reliable morning transit travel times between Olympia and Tacoma (where there are no HOV lanes), were longer than the corresponding GP travel times by 28 and 23 minutes, respectively. They also increased between 2015 and 2017, with the average transit travel time going from 62 to 65 minutes, and the reliable transit travel time increasing from 75 to 81 minutes.

Transit ridership and GHG emissions avoided: On an average weekday in 2017, transit moved approximately 9,226 people on I-5 between Olympia and Federal Way during the morning and evening peak periods—a decrease of 0.5% from 2015 (9,277 riders). Daily transit passenger miles traveled dropped by 1.6% over the same period. Ridership from Olympia to Tacoma during the morning peak period and from Tacoma to Olympia during the evening peak period decreased by 7% and 8%, respectively, from 2015 to 2017.

Peak period transit ridership on the I-5 corridor in the south Puget Sound region was equal to 85% of an extra GP lane of capacity in 2017 (when compared to the peak efficiency of the GP lanes, which is a conservative approach to this measurement). Additionally, transit use on the south Puget Sound I-5 corridor during peak periods avoided approximately 53,353 pounds of GHG emissions per day in 2017, a 5.2% decrease from 2015 (56,289 pounds).

In 2017, 44% of available transit seats on south Puget Sound I-5 commutes were occupied during the morning and evening peak periods, and five of the 334 daily transit trips during the peak periods were over 90% of seating capacity on a typical weekday. These figures indicate that transit use in the south Puget Sound region is not constrained by capacity.

Park and ride: Along the I-5 corridor in the south Puget Sound region in 2017, park and ride (P&R) utilization rates ranged from 22% to 99%. The SR 512 Lakewood P&R and the Tacoma Dome Station both saw utilization rates of 99%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. Lakewood Station and the DuPont P&R have utilization rates of 82% and 74%, respectively, which are considered to be nearing capacity. All of the P&R lots except for Hawks Prairie saw increases in utilization from 2015 to 2017.

P&R locations are essential parts of the transit service network. To be considered effective, P&R lots must also have high utilization rates. Targeted outreach efforts from transit agencies as well as employer Commute Trip Reduction initiatives help address highway capacity needs in the south Puget Sound region.

How much is congestion costing you?

Commuters driving on I-5 in the south Puget Sound region experienced significant costs due to congestion (measured in wasted time and gas for travel below maximum throughput speed), with the highest costs being borne by those making daily round trips between Federal Way and Tacoma. In 2017, congestion cost the average commuter making this 24-mile round trip each weekday in a single-occupancy vehicle about $1,500.

Spokane Region I-90 Corridor Capacity Analysis

Visit bit.ly/agolCCR18Spokanemap for this article's interactive map.

Annual person miles traveled
2015 245.8 vs. 2017 250.2 in millions of miles — ↑ 1.8%

Annual vehicle delay[1,2]
2015 15.9 vs. 2017 32.6 in thousands of hours — ↑ 105%

Annual GHG emissions
2015 190.1 vs. 2017 190.0 in millions of pounds of CO_2 equivalents — ↔ 0%

Annual passenger miles traveled on transit[3]
2015 1.5 vs. 2017 1.2 in millions of miles — ↓ 20%

Capacity savings due to transit
2015 0.08 vs. 2017 0.07 in number of lanes — ↓ 13%

Percent transit seats occupied
2015 57% vs. 2017 48% on average during peak periods — ↓ 9%

Percent park and ride spaces occupied
2015 65% vs. 2017 75% on average during peak periods — ↑ 9%

Commute travel times

2015 and 2017 during the morning (7-10 a.m.) and evening (3-6 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[4] travel times for single occupant vehicle (GP) and planned, average and reliable transit[5] travel times.

Average GP · Reliable GP · Average transit · Reliable transit

Argonne Rd. to Division St.

Morning; 7:45 a.m.; Trip length 7.5 miles

		Average	Reliable
GP	2015	10	12
	2017	11	16
Transit	2015	N/A	
	2017	10	14

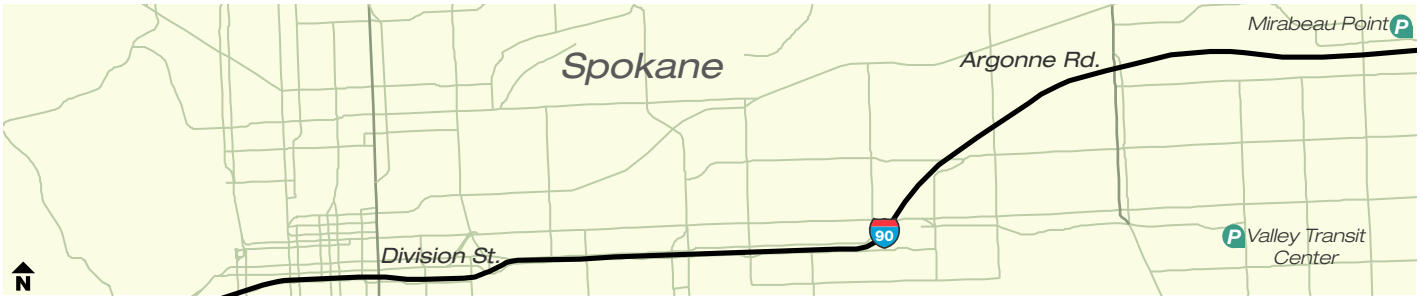
Transit trip length 5.8 miles[4]

Division St. to Argonne Rd.

Evening; 5:20 p.m.; Trip length 7.5 miles

		Average	Reliable
GP	2015	10	15
	2017	10	14
Transit	2015	N/A	
	2017	12	25

Transit trip length 6.1 miles[4]



Transit system use

2015 and 2017; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) transit[5] peak periods; Ridership and percent of available seats occupied on select commutes

By commute

	Daily peak period riders		Percent of seats occupied	
	2015	2017	2015	2017
Morning (6-9 a.m.)				
Argonne to Division	573	466	57%	49%
Evening (3-6 p.m.)				
Division to Argonne	400	332	56%	47%

Park and ride capacity

2015 and 2017; Peak percentage occupied for select park and rides (see map for locations)[6]

Argonne-Division commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Mirabeau Point (198)	75%	76%
Liberty Lake (204)[7]	74%	63%
Valley Transit Center (236)	56%	84%

See Appendix pp. 37-39 for more commute routes

Data sources and analysis: WSDOT Eastern Region Traffic Office, Spokane Transit Authority and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for general purpose (GP) trips only on the I-90 corridor in the Spokane area. **1** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **2** Annual vehicle delay numbers were recalculated due to the change in the data source. **3** The 2015 value for passenger miles traveled on transit was recalculated due to the change in methodology noted in footnote 5. The measure now more accurately reflects the passenger miles traveled on I-90, while the previously published value included some off-highway travel. **4** Reliable travel time will get a commuter to their destination on time or early 19 out of 20 weekdays (95% of the time). **5** In 2017, Spokane Transit Authority made improvements to their data collection so that transit travel times accurately reflect the travel time on I-90. Travel times collected in 2017 are not comparable to previously published travel times, which included off-highway travel. Transit travel times are calculated using a representative trip that occurs as close as possible to the 5-minute peak**6** Spokane region P&R occupancy figures represent the day with peak occupancy. Other regions report average P&R occupancy. **6**. Liberty Lake park and ride not shown in map extent.

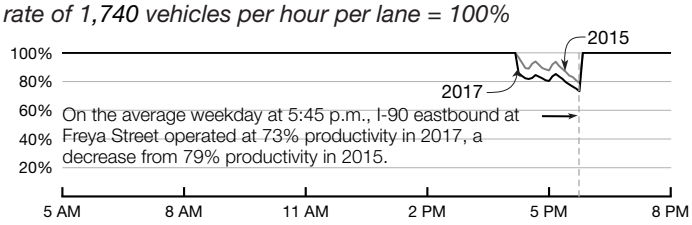
Interstate 90 (I-90) in the Spokane area is one of the region's key commute and economic corridors. Over 250 million person miles were traveled on I-90 between Division Street and Argonne Road in 2017, an increase of 1.8% since 2015. Traffic at specific locations on the corridor worsened from 2015 to 2017, with morning and evening commutes experiencing moderate congestion on a daily basis. Delay increased 105% on the corridor between 2015 and 2017 due to increased traffic volumes on a corridor that is reaching capacity during the peak

I-90 experiences increased routine congestion

periods. Closely spaced on- and off-ramps also impact congestion on this corridor. In an effort to preserve and maximize existing capacity, while reducing collisions, ramp meters will be constructed on the eastbound on-ramps from US 195 to Hamilton. The first ramp meter is being constructed in the fall of 2018 on the US 195 on-ramp, and the remaining will be constructed in 2019.

Throughput productivity on eastbound I-90 at Freya Street

2015 and 2017; Based on the highest observed 5-minute flow rate of 1,740 vehicles per hour per lane = 100%

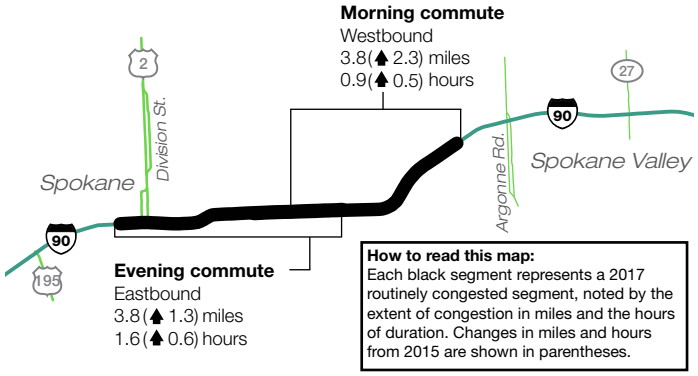


Data sources and analysis: WSDOT Eastern Region Traffic Office and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on I-90 in the Spokane region, WSDOT analyzed vehicle throughput at several locations between Division Street and Argonne Road. In 2015 and 2017, productivity at these locations was as low as 70% at their most congested. The graph above shows how productivity varies by time of day near Freya Street. For example, at 5:45 p.m., 27% of the corridor's capacity was unavailable due to congestion on eastbound I-90 near Freya Street.

Routinely congested segments of I-90

2017; For weekday morning (7-10 a.m.) and evening (3-6 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (change from 2015)



Data sources and analysis: WSDOT Eastern Region Traffic Office and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: See p. 39 in the Appendix for all Spokane region routinely congested segment data. The westbound evening congestion mentioned in the report is not included in this map because its duration was less than 50 minutes.

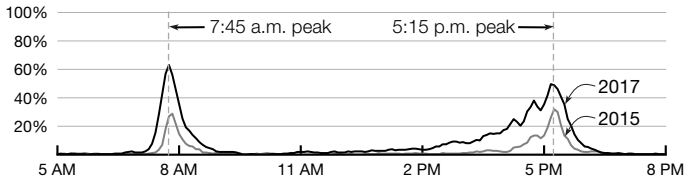
Why does WSDOT install ramp meters?

WSDOT uses ramp meters to reduce collisions and decrease travel times for commuters. Most ramp meters allow only one vehicle through each green light, creating a 4 to 15 second delay between cars entering the highway. This delay helps reduce disruptions to freeway traffic and reduces accidents that occur when vehicles merge onto the highway.

Routinely congested segments: In 2017, the eastbound evening commute experienced nearly four miles of congestion lasting over an hour-and-a-half between Monroe/Walnut and Custer Road. This is an increase in length of 1.3 miles (to 3.8 miles) and an increase in duration of 35 minutes (to 1 hour 35 minutes) over 2015. Notably, the westbound I-90 evening commute is now experiencing 15 minutes of congestion over a length of 1.2 miles—measurable evening westbound congestion did not exist in 2015. For westbound morning commuters, the duration of congestion increased from 25 minutes to 55 minutes and the length increased by 2.3 miles.

Congestion on the Argonne to Division commute

2015 and 2017; Westbound; Percent of days the average speed was slower than 45 mph



Data sources and analysis: WSDOT Eastern Region Traffic Office and WSDOT Office of Strategic Assessment and Performance Analysis.

A focus on hot spots: Those traveling on I-90 between Division Street and Argonne Road experienced increasing congestion in 2017. Westbound travelers had a 63% chance of experiencing congestion during the morning peak period and a 50% chance during the evening peak period. These are increases of 34 and 18 percentage points, respectively, over 2015. Eastbound travelers had a 53% chance of experiencing congestion during the evening peak period, which is an increase of 15 percentage points over 2015. This same route experiences severe congestion (speeds less than 36 mph) as well. The westbound commute had a 24% chance of severe congestion in the morning and an 18% chance in the evening peak period, while eastbound evening travelers experienced severe congestion 10% of the time.

Park and ride use increases while transit ridership drops

What does congestion mean for travel times on the corridor?

Between 2015 and 2017, average and reliable travel times for westbound morning commuters increased by one minute (10%) and four minutes (33%), respectively. The average travel time on the eastbound evening commute remained constant while the reliable travel time improved by one minute (down 7%).

In 2017, average and reliable transit travel times were 10 and 14 minutes, respectively, for the highway portion of the morning westbound commute. The average and reliable transit travel times were 12 and 25 minutes, respectively, for the eastbound evening commute. The 2015 transit travel times that were previously published included off-highway travel and are not reported here due to the change in data collection methodology.

Transit ridership and GHG emissions avoided: Transit moved nearly 800 people on the corridor during the morning and evening peak periods on an average weekday in 2017. Peak period transit ridership on the Spokane region I-90 corridor was equal to about 7% of an extra lane of capacity in 2017 (when compared to the peak efficiency of the roadway, which is a conservative approach to this measurement).

Transit routes on the I-90 corridor operated at 49% of their seating capacity during the morning and 47% during evening peak periods in 2017. Combined morning and evening ridership declined by approximately 18% in 2017 compared to 2015. Similarly, the amount of greenhouse gas emissions avoided declined by approximately 24%. Transit use during peak periods avoided roughly 1,900 pounds of GHG emissions per day on the I-90 Spokane region corridor in 2017.

Park and ride: Along the I-90 corridor in the Spokane region in 2017, P&R utilization rates ranged from 63% to 84% depending on location. The Valley Transit Center P&R saw an average utilization rate of 84%. Any P&R lot that has 85% or more utilization is identified as operating at capacity. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders. To be considered effective, P&R lots must also have high utilization rates.

STA receives grant funding to improve service

Spokane Transit Authority has received grant funding to coordinate with WSDOT and regional partners to begin designing improved connections with routes outside of the corridor, upgrade passenger amenities, enhance operations, improve reliability and expand park and ride (P&R) facilities. These improvements are expected to encourage additional ridership and accommodate growth in demand for P&R spaces.

Visit bit.ly/agolCCR18Vancouvermap for this article's interactive map.

Vancouver Region I-5, I-205 & SR 14 Corridor Capacity Analysis

Annual person miles traveled[1]

2015 693.8 vs. 2017 694.6 — ▲ 0.1%

in millions of miles

Annual vehicle delay[2]

2015 219.5 vs. 2017 242.7 — ▲ 11%

in thousands of hours

Annual GHG emissions

2015 575.1 vs. 2017 564.6 — ▼ 1.8%

in millions of pounds of CO_2 equivalents

Commute travel times

2015 and 2017 during the morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Weekday travel times in minutes at the 5-minute peak including average and reliable[3] travel times for general purpose (GP) travel times.

Average GP | Reliable GP

Interstate 5 commutes

I-205 to I-5 bridge

Morning; 6:35 a.m.; Trip length 8 miles

GP: 2015 18 25; 2017 15 22

I-5 bridge to I-205

Evening; 5:10 p.m.; Trip length 8 miles

GP: 2015 8 10; 2017 8 9

Interstate 205 commutes

I-5 to I-205 bridge

Morning; 6:35 a.m.; Trip length 10 miles

GP: 2015 13 22; 2017 16 24

I-205 bridge to I-5

Evening; 5:20 p.m.; Trip length 10 miles

GP: 2015 11 14; 2017 12 15

State Route 14 commutes

Camas to I-205

Morning; 7:15 a.m.; Trip length 8 miles

GP: 2015 15 26; 2017 11 17

I-205 to Camas

Evening; 5:15 p.m.; Trip length 8 miles

GP: 2015 9 10; 2017 9 11

See Appendix pp. 41-47 for more commute routes

Percent park and ride spaces occupied[3]

2015 65% vs. 2017 57% — ▼ 7%

on average during peak periods

Park and ride capacity

2015 and 2017; Average percent occupied for select park and rides (see map for locations)

Interstate 5 commute route

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Andresen (100)	94%	99%
99th Street Transit Ctr. (609)	65%	60%
Salmon Creek (472)	57%	53%

Interstate 205 commute route

Park and ride (spaces)	2015 percent occupied	2017 percent occupied[4]
Fisher's Landing Transit Ctr. (563; 761)[4]	90%[4]	66%[4]
Evergreen Transit Ctr. (267)	13%	16%
Columbia House P&R (34)	N/A	88%

Data sources and analysis: WSDOT Southwest Region Planning Office, C-TRAN, WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-5, I-205 and SR 14 corridors in the Vancouver area. **1** Due to limited data availability, measurements for annual person miles traveled (PMT) are not comparable to previous editions of the *Corridor Capacity Report*. WSDOT recommends that the percent change in PMT be used as an indicator of a general trend for the region. **2** WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. **3** Reliable travel time will get a commuter to their destination on time or early 19 out of 20 weekdays (95% of the time). **4** The total number of available P&R spaces increased from 2,011 in 2015 to 2,243 in 2017 due to an expansion of the Fisher's Landing P&R and the expansion of transit service to the Columbia House lot.

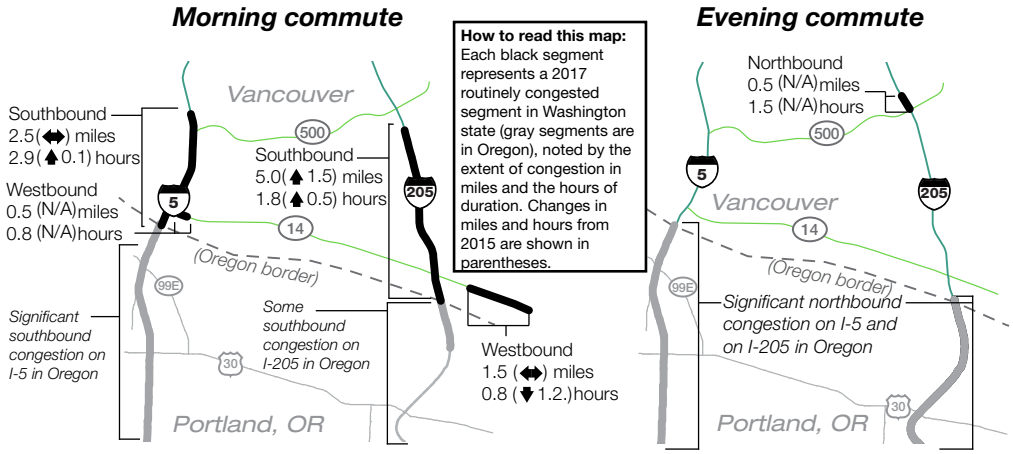
Interstate 5 (I-5), I-205 and State Route 14 (SR 14) in the Vancouver area are three of the region's key commute and economic corridors. General trends for these corridors combined indicate a 0.1% increase in annual person miles traveled between 2015 and 2017. The I-5 and I-205 corridors are analyzed for the Vancouver urban area from the I-5/I-205 split to the respective bridges that cross the Washington/Oregon border.

Delay increases on I-5 and I-205 heading into Oregon

Traffic at some locations on the corridors improved from 2015 to 2017, while other locations worsened. The combined delay on these corridors increased 11% between 2015 and 2017. (See heatmap graphs for I-5 and I-205 on p. 44). In addition to delaying commuters, this congestion directly impacted the movement of goods in Washington. In 2017, trucks accounted for 8% of the total daily traffic volume on I-5, 6% on I-205 and 5% on SR 14.

Routinely congested segments of I-5 and I-205 in the Vancouver area

2017; For weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours (compared to 2015)

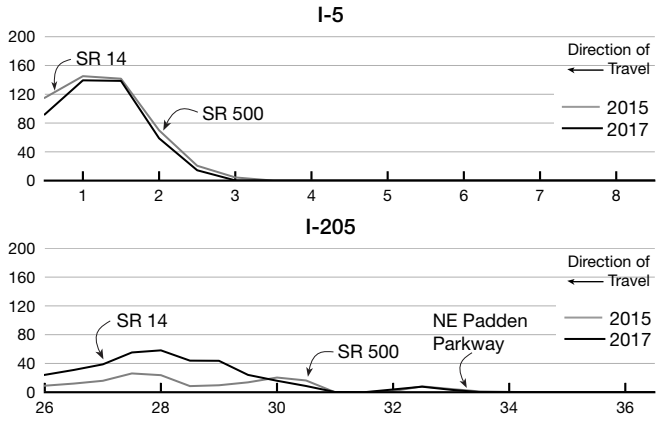


Data sources and analysis: WSDOT Multimodal Planning Division, WSDOT Southwest Region Planning Office, WSDOT Office of Strategic Assessment and Performance Analysis, and endorsed by Oregon Department of Transportation.

Note: See pp. 48-49 in the Appendix for all Vancouver and Portland region routinely congested segment data. Generalized Portland routinely congested segments are shown in the map above in light gray.

Southbound delay along the I-5 and I-205 corridors

2015 and 2017; Average daily vehicle hours of delay by milepost

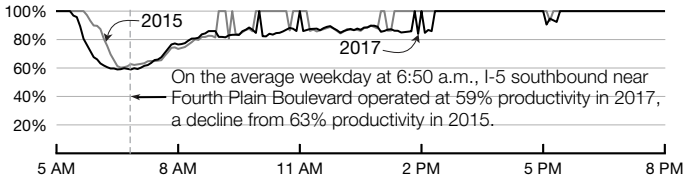


Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Highway productivity: As traffic increases and speeds drop below maximum throughput speed, congested roads carry fewer vehicles, resulting in a drop in throughput productivity. In order to gauge the lost productivity on I-5, I-205 and SR 14 in the Vancouver region, WSDOT analyzed vehicle throughput at three locations: near Fourth Plain Boulevard on I-5, near 10th Street on I-205, and near South Lieser Road on SR 14. In 2017, productivity at these locations ranged from 59% to 100%. Throughput productivity varies by direction of travel, location and time of day. For example, in 2017, 41% of the corridor's capacity on southbound I-5 near Fourth Plain Boulevard was unavailable due to congestion during the morning peak 5-minute period. The graph below shows that productivity loss started earlier in the morning peak and extended later into the afternoon in 2017 than in 2015.

Throughput productivity on southbound I-5 near Fourth Plain Boulevard

2015 and 2017; Based on the highest observed 5-minute flow rate of 1,330 vehicles per hour per lane = 100%



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

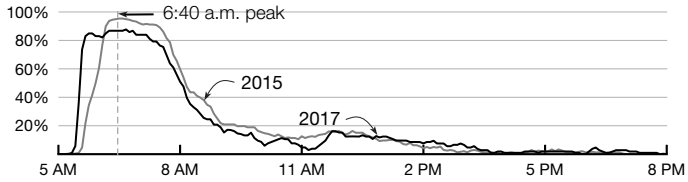
Routinely congested segments: The segments of the analyzed corridors in the Vancouver area that experienced the most routine congestion in 2017 were on southbound I-5 and southbound I-205 between SR 500 and the state line, primarily during the morning commute. Combined routine congestion on the I-5, I-205, and SR 14 corridors in the Vancouver area increased in length from 9.0 miles in 2015 to 9.5 miles in 2017. As shown in the map at the top of this page, significant congestion also occurred in the Portland area on the I-5 and I-205 corridors heading into Washington during the evening commute. Refer to Appendix p. 49 for more details on Portland-area congestion.

Congestion on I-205 commutes worsens in 2017

A focus on hot spots: Commuters driving on I-5 between SR 500 and the I-5 bridge at the state line traveled in severely congested conditions (36 mph or less) on fewer days in 2017 than in 2015 for all but the earliest part of the morning peak period. For example, at 6:40 a.m. the southbound I-5 commute was severely congested on 88% of weekdays in 2017 compared to 95% in 2015 (see graph below). The southbound commute on I-205 from SR 500 to the I-205 bridge experienced severe congestion more often in 2017 than 2015 (see graph below). For example, at 6:40 a.m. speeds were below 36 mph on 80% of weekdays in 2017 and on 35% of weekdays in 2015.

Severe congestion on the I-5 Vancouver to Portland commute (SR 500 to I-5 bridge)

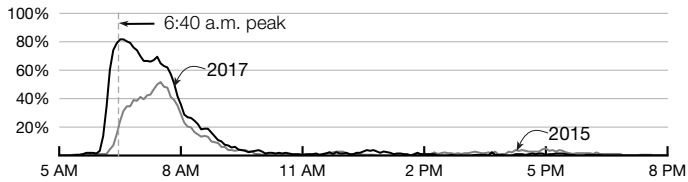
2015 and 2017; Southbound; Percent of days the average speed was slower than 36 mph



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Severe congestion on the I-205 Vancouver to Portland commute (SR 500 to I-205 bridge)

2015 and 2017; Southbound; Percent of days the average speed was slower than 36 mph



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

What does congestion mean for travel times on the corridor?

General purpose lane trips: Between 2015 and 2017, average and reliable peak travel times for I-5 morning commutes in the Vancouver region decreased by as much as three minutes. Part of this improvement may be attributable to more active management of I-5 southbound traffic, including the use of electronic signs encouraging motorists to move left during periods of heavy merging from SR 14 and dynamic adjustment of the SR 14/Washington Street ramp meter to improve mainline I-5 flow. Average and reliable travel times for the I-5 evening commute remained relatively steady between 2015 and 2017. On I-205 average travel times increased by three minutes, while the reliable travel time increased by up to six minutes. For the westbound morning peak commute from Camas to the I-205 interchange, the average travel time improved by four minutes while the reliable travel time improved by nine minutes. The eastbound evening commutes on SR 14 saw increases in average travel time of one minute or less.

In 2017, 10 of the 12 Vancouver-area commutes analyzed had a maximum throughput travel time index (MT3I) greater than one. The southbound I-5 morning commute from SR 500 to the I-5 bridge exhibited the highest MT3I (4.17), which means the trip took over four times longer than it would at maximum throughput speed. Speeds on this commute were 12 mph on average during the peak 5-minute period. This two-mile segment of stop-and-go traffic approaching the bridge has the highest MT3I in the state, making it the most congested commute in Washington by that measure.

Park and ride: In the Vancouver region in 2017, park and ride (P&R) utilization rates ranged from 16% to 99%. The Andresen P&R had the highest average utilization rate (99%). The Fisher's Landing Transit Center P&R was expanded in September 2016 from 563 spaces to 761 spaces, causing a lower utilization rate in 2017 (66%) compared to 2015 (90%) despite having the same number of spaces occupied.

P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders and carpoolers. To be considered effective, P&R lots must also have high utilization rates. Any P&R lot that has 85% or more utilization is identified as operating at capacity.

Targeted outreach efforts from transit agencies as well as employer Commute Trip Reduction initiatives help address regional highway capacity issues.

Additional congestion in the Vancouver region

Vancouver area commuters regularly experience delays on other major arterials including SR 500 and Padden Parkway. Because data collection infrastructure is not in place to reliably quantify this congestion, information for these corridors is not provided in this report. For additional information on Clark County traffic trends, refer to Southwest Washington Regional Transportation Council's 2017 Congestion Management Process Summary Report at http://rtc.wa.gov/reports/cmp/CMsum17.pdf.

Congestion costs I-205 commuters $400 annually

Transit: Vancouver area commuters on I-5, I-205, and SR 14 have the option of taking buses operated by C-TRAN. Ridership figures for C-TRAN buses that cross the Columbia River are listed below. On SR 14, C-TRAN is currently operating a bus-on-shoulder pilot program that allows buses to bypass congestion. For more information, see https://www.c-tran.com/bus-on-shoulder.

Daily transit ridership across the Columbia River
2015 and 2017

	2015	2017
AM	1,624	1,308
PM	1,686	1,550

Data sources: C-TRAN, Southwest Washington Regional Transportation Council
Note: Figures are for transit ridership on C-TRAN-operated buses that cross the Columbia River on I-5 and I-205.

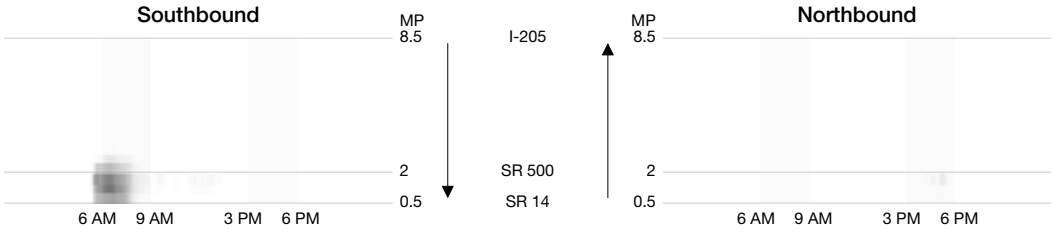
How much is congestion costing you?

In 2017, drivers on the 8.4-mile southbound morning commute on I-205 from the I-5 interchange to the Columbia River experienced the region's highest costs due to congestion (measured in wasted time and gas for travel below maximum throughput speed)—about $400 per vehicle annually. The corresponding figure for the I-5 commute between the interchange and the bridge is $293 per vehicle annually. Congestion on the return trips is mostly on the Oregon side of the river, and only the cost of congestion within Washington is accounted for in this report's cost calculations.

I-5 delay between the I-5 bridge and the I-205 interchange

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

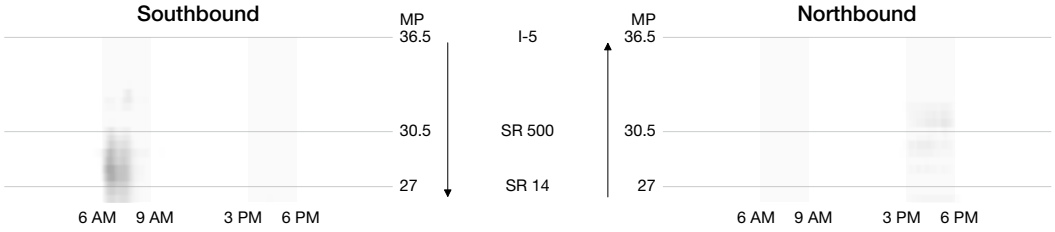
In 2017 on southbound I-5, morning delay extended from before State Route 500 to the I-5 bridge. Delay near the I-5 bridge lasted from 5:25 a.m. to 2:15 p.m. On northbound I-5, there was minor delay from 4:00 to 5:30 p.m. between SR 14 and SR 500.



I-205 delay between Glenn Jackson Bridge and the I-5 interchange

2017; Vehicle hours of delay; Weekdays only; By milepost (MP); Shading represents intensity of delay; Highlighted sections represent peak periods

In 2017 on I-205 southbound, delay lasted from 5:30 to 9:00 a.m., and extended from before NE Padden Parkway to the Glenn Jackson Bridge. On northbound I-205, delay occurred during the evening peak period, with pockets of delay from the Glenn Jackson Bridge to NE Padden Parkway.



Data sources and analysis: WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis.

Tri-Cities US 395 & SR 240 Corridor Capacity Analysis

Annual person miles traveled

2015	vs.	2017	
112.3		117.4	4.5%

in millions of miles

Annual vehicle delay[1,2]

2015	2017 [1]
290.1	*430.9*

in thousands of hours

Annual GHG emissions[1]

2015	2017 [1]
97.3	*102.6*

in millions of pounds of CO_2 equivalents

Vehicle delay and GHG emissions are not comparable between 2015 and 2017 due to a change in data source. See Note 1 for details.

Commute travel times[1]

2015 and 2017 during the morning (6-8 a.m.) and evening (3-6 p.m.) peak periods; Weekday travel times in minutes during peak periods including average and reliable[3] travel times for general purpose (GP) trips.

Average GP Reliable GP

US 395 commutes

Kennewick to Pasco

Morning; 7:45 a.m.; Trip length 6.9 miles

	Average	Reliable
GP 2015	13	19
GP 2017	12	15

Pasco to Kennewick

Evening; 5:20 p.m.; Trip length 7.3 miles

	Average	Reliable
GP 2015	15	23
GP 2017	15	20

SR 240 commutes

I-182 to Stevens Drive

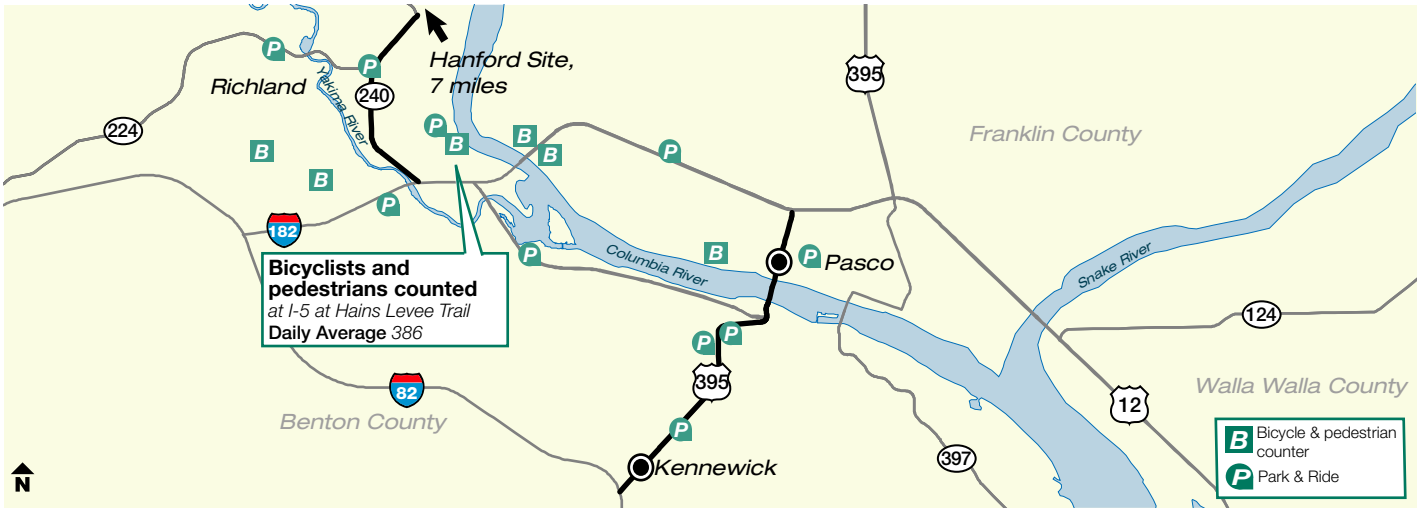
Morning; 7:50 a.m.; Trip length 3.9 miles

	Average	Reliable
GP 2015	7	8
GP 2017	7	8

Stevens Drive to I-182

Evening; 5:10 p.m.; Trip length 3.9 miles

	Average	Reliable
GP 2015	8	16
GP 2017	11	21



Park and ride capacity

2017; Average percent occupied for select park and rides (see map for locations)

Kennewick-Pasco commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
Union Street & 27th Avenue (50)	58%	60%
Ed Frost (Huntington) Transit Center (135, 96)[4]	41%	50%
US 395 & Yelm Street (39)	39%	46%
Pasco - North 22nd Avenue Transit (50)	39%	30%

Stevens Drive - I-182 commute

Park and ride (spaces)	2015 percent occupied	2017 percent occupied
SR 240 & SR 224 (89, 80)[4]	36%	50%
SR 224 - Flattop Park (154)	46%	38%
Stevens Drive & Spengler Road (686, 350)[4]	14%	33%
Columbia Park Trail & Tulip Lane (139)	2%	21%

Data sources and analysis: WSDOT South Central Region Planning Office, National Performance Management Research Data Set, WSDOT Multimodal Planning Division and WSDOT Office of Strategic Assessment and Performance Analysis

Notes: Measures at the top of the page are for the US 395 and SR 240 corridors in the Tri-Cities area.

1 The data provider for the National Performance Management Research Data Set (NPMRDS) changed in February 2017. Differences between performance measures for 2015 and 2017 may reflect the change in data source rather than actual traffic trends. **2** US 395 and SR 240 are signalized corridors and have inherent delay due to signal operations. To account for this inherent delay, the posted speed limit was not used as the basis for delay for these corridors. Instead, the 85th-percentile non-peak daytime speed was used as the basis for free-flow speed. Also, since the maximum throughput speed on signalized corridors is more complicated than on freeways, the delay on these corridors was defined as when speeds are below free-flow speed instead of the typical WSDOT definition of delay as when speeds are below 85% of the posted speed limit. **3** Reliable travel time will get commuters to their destination on time 19 out of 20 weekdays (95% of the time). **4** The number of spaces at the Ed Frost (Huntington) Transit Center, SR 240 & SR 224, and Stevens Drive & Spengler Road Park & Ride lots were reduced between 2015 and 2017.

US 395 and SR 240 experience delay

National Performance Management Research Data Set (NPMRDS) source changes in 2017

From July 2013 to December 2016, the data for the NPMRDS was provided by HERE (a private-sector mapping company). In February 2017, the data provider changed to Inrix (also a private-sector company). The two data providers have slightly different methods of collecting and processing the data, so differences between 2015 and 2017 may reflect changes in the data source rather than actual traffic trends. Due to these differences, WSDOT does not recommend comparing the 2015 and 2017 performance measures that are calculated using this data, including travel time, delay and GHG emissions.

The NPMRDS is an archive of average travel times, reported every five minutes when data is available, on the National Highway System. The Federal Highway Administration (FHWA) provides access to state and local agencies for performance management activities.

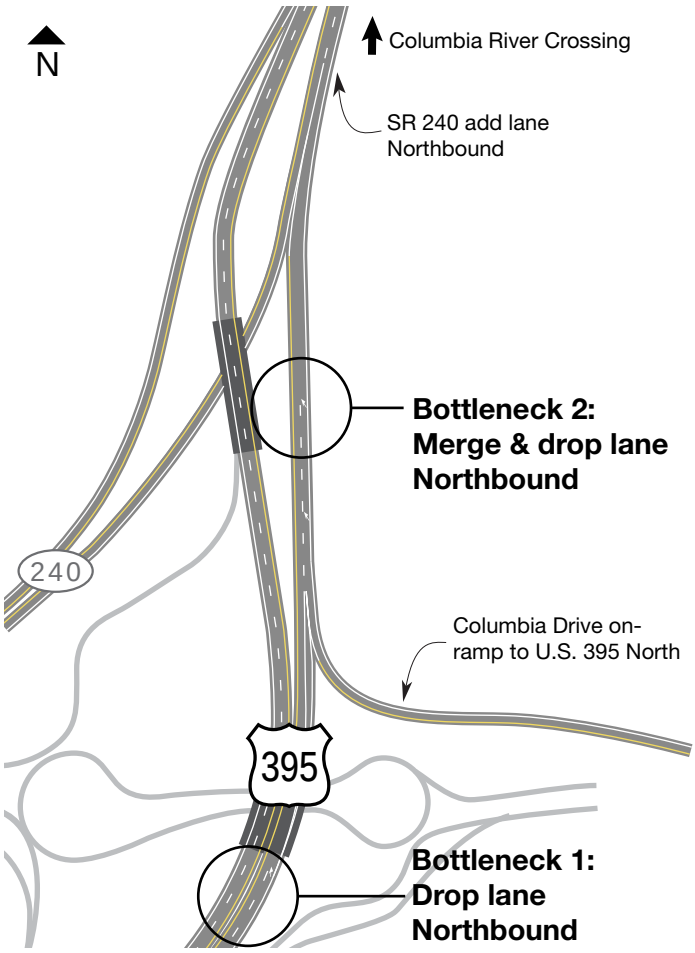
US 395 and State Route 240 (SR 240) are two of the key commute and economic corridors in the Tri-Cities region. The segment of US 395 between Interstate 82 (I-82) and I-182 includes a five-mile section in Kennewick with eight traffic signals, a two-mile freeway segment mostly in Pasco and a small freeway segment in Kennewick. More than 73 million weekday person miles were traveled on this corridor in 2017, a 5.5% increase over 2015.

The segment of SR 240 that extends from Stevens Drive/Jadwin Avenue to the I-182 interchange is known as the Bypass Highway. The Bypass Highway experiences frequent and persistent delay during peak commute periods, primarily due to heavy commuter traffic to and from the US Department of Energy Hanford Site north of Richland. In 2017, there were 44.1 million weekday person miles traveled on this corridor, a 3.0% increase over 2015.

Corridor delay: There was significant delay along the signalized section of US 395 and the entire Bypass Highway, with morning and evening weekday commutes experiencing moderate to severe congestion on a daily basis. In 2017, the US 395 corridor had 271,600 hours of delay and the SR 240 corridor had 159,300 hours of delay. In addition to delaying commuters, this congestion directly impacts the movement of goods in Washington; in 2017, trucks accounted for 11% of the total daily traffic volume on US 395 and 7% of the total daily traffic volume on SR 240.

A focus on hot spots: The US 395/SR 240 interchange at the south end of the Columbia River Bridge is a key chokepoint on US 395. There are two bottlenecks created by a complicated series of merges, weaves and lane reductions (see graphic below). In the northbound direction, two lanes of traffic are restricted to one lane (bottleneck 1), followed by traffic merging from the Columbia Drive on-ramp into one lane (bottleneck 2). Shortly after, traffic from SR 240 merges onto US 395. These capacity issues cause significant congestion as the corridor crosses the Columbia River.

The most congested segment of the US 395 corridor is the roughly three-quarter mile segment between the SR 240 junction and the intersection with Clearwater Avenue, which saw 29% of the delay on the corridor in 2017 despite only accounting for 11% of the length of the corridor. The segment between Clearwater Avenue and 10th Avenue was also moderately congested; despite only accounting for 13% of the length of the corridor, it had 20% of the corridor's delay.



Park and ride utilization increases in Tri-Cities region

Compare and contrast: Columbia River crossings
I-182 and US 395, both major Columbia River crossings in the Tri-Cities, have very similar traffic volumes—71,000 and 69,000 vehicles per weekday in 2017, respectively. However, I-182 experiences much less delay than US 395. Unlike on US 395, there are no bottlenecks or complicated traffic patterns in close proximity to the I-182 bridge. I-182 also has an additional lane in each direction.

Traffic volumes on SR 240 peak at the Aaron Drive/ westbound I-182 on-ramp intersection, causing delay that creates queues that sometimes extend past intersections upstream. The southbound section of SR 240 between this intersection and the intersection with Swift Boulevard accounted for 26% of the delay on the corridor in 2017 despite only accounting for 20% of the length of the corridor. The SR 224/Van Giesen Street intersection is another hot spot with the junction of two state highways. The intersection experiences significant delay.

What does congestion mean for travel times on the corridor?

The average peak travel time for the US 395 morning commute from Kennewick to Pasco was 12 minutes and the reliable travel time was 15 minutes in 2017. The average peak travel time for the evening commute from Pasco to Kennewick was 15 minutes and the reliable travel time was 20 minutes.

The average and reliable travel times for the SR 240 morning commute from I-182 to Stevens Drive were seven minutes and eight minutes, respectively, in 2017. The evening commute from Stevens Drive to I-182 was 11 minutes and the reliable travel time was 21 minutes. Although the travel time data for 2015 and 2017 were collected using different methods, the large increase in travel time for the evening commute from Stevens Drive to I-182 indicates that conditions worsened between 2015 and 2017.

Park and ride: In 2017, park and ride (P&R) utilization rates ranged from 21% to 60% along the US 395 and SR 240 corridors. Six of the eight P&R lots had higher utilization rates in 2017 than in 2015, and the overall utilization rate increased by 13% over the same period. The largest P&R on the corridor—Ed Frost (Huntington) Transit Center—had a drop in the average number of spaces used, but the utilization rate rose because the total number of spaces available decreased. P&R locations are essential parts of the transit service network and need to consistently have enough available spaces for transit riders, carpoolers, and vanpoolers.

Transit measures will be discussed in future Tri-Cities region analyses depending on data availability.

Signalized arterial analysis methodology updated

In previous editions of the Corridor Capacity Report, WSDOT used the same methodology to calculate delay on US 395 and SR 240 as it uses for the freeway corridors throughout the state. This methodology uses maximum throughput speed (85% of posted speed limit) as the threshold in order to measure delay relative to a highway's most efficient operating condition. For the travel delay methodology, see the 2nd edition of the Handbook for Corridor Capacity Evaluation (p. 8) at www.wsdot.wa.gov/publications/fulltext/graynotebook/CCR_methodology_2nd_edition.pdf.

Signalized corridors (including SR 240 and parts of US 395) have certain characteristics that make the methodology used for freeways less applicable. First, these corridors have inherent delay due to signal operations because most vehicles traveling through a signalized corridor are unable to travel at the speed limit for the entire corridor even during periods of low traffic volumes. To account for this inherent delay, the new methodology does not use the posted speed limit as the basis for free-flow speed on these corridors—instead, the free-flow speed is defined as the 85th-percentile non-peak daytime speed (between the hours of 8 a.m. and 3 p.m. and between the hours of 6 p.m. and 10 p.m.). Additionally, due to the complexity of traffic flow on signalized corridors, a methodology for calculating maximum throughput speed on signalized corridors has not been developed. Therefore, the threshold for delay on these corridors is defined as when speeds are below free-flow speed.

Washington State Ferries Corridor Capacity Analysis

Annual ridership[1]

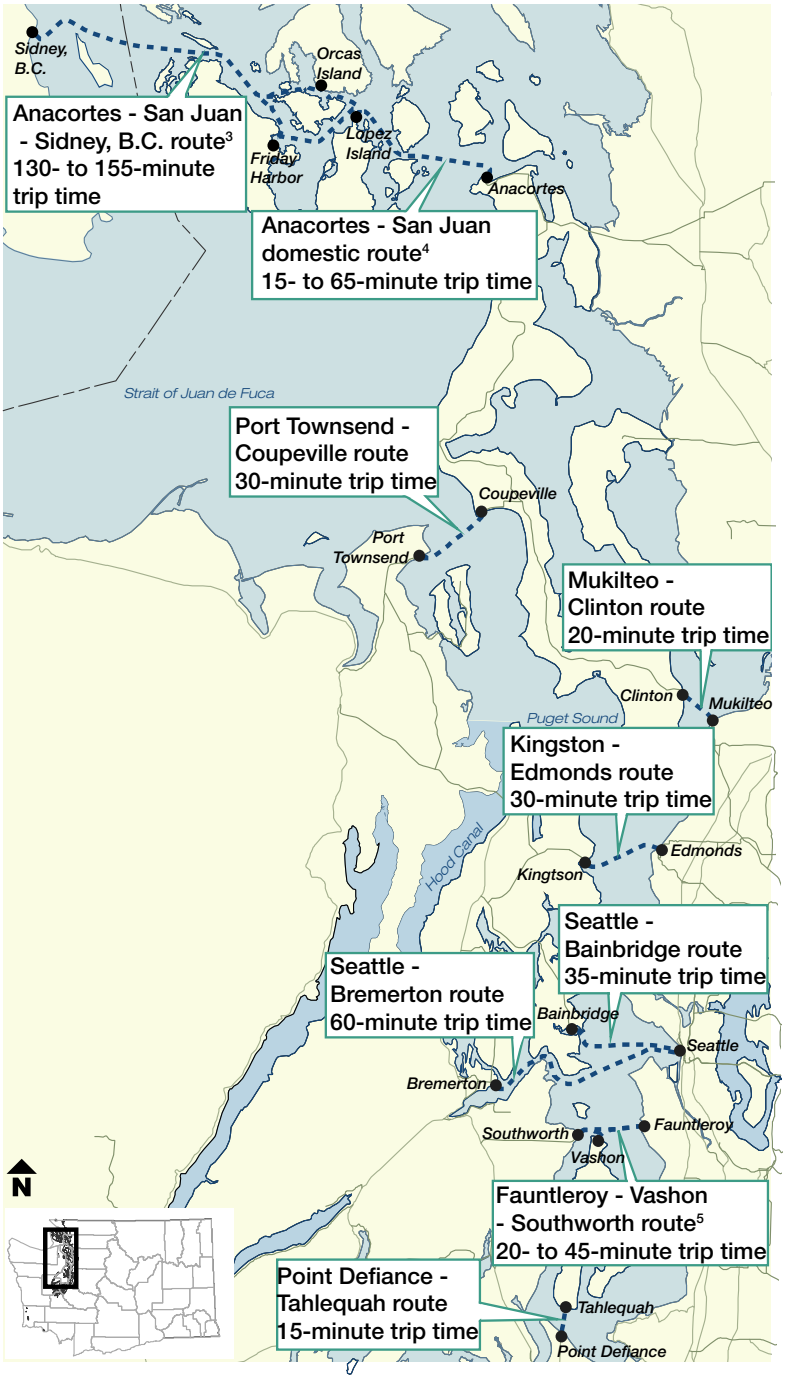
2015	vs.	2017	
23.88		24.46	▲ 2.4%
in millions of passengers			

Annual trip reliability[2]

2015	vs.	2017	
99.5%		99.0%	▼ 0.5%
of scheduled trips sailed			

Annual total fuel usage & usage per service mile

2015	vs.	2017		2015	vs.	2017	
17.34		18.91	▲ 9.1%	19.09		20.98	▲ 9.9%
in millions of gallons				in gallons per mile			



Ferry capacity utilization

2015 and 2017; Vehicle utilization (driver + passenger utilization)

Ferry Route	2015	2017	Change (Δ)
Anacortes - San Juan domestic	57% (11%)	57% (11%)	0% (0%)
Anacortes - San Juan - Sidney, B.C.	51% (17%)	41% (17%)	-10% (0%)
Edmonds - Kingston	69% (12%)	68% (11%)	-1% (-1%)
Fauntleroy - Vashon - Southworth	57% (9%)	55% (9%)	-2% (0%)
Mukilteo - Clinton	67% (12%)	67% (12%)	0% (0%)
Point Defiance - Tahlequah	54% (7%)	55% (8%)	1% (1%)
Port Townsend - Coupeville	70% (12%)	78% (13%)	8% (1%)
Seattle - Bainbridge	61% (16%)	60% (16%)	-1% (0%)
Seattle - Bremerton	49% (15%)	46% (14%)	-3% (-1%)
System-wide	**62% (12%)**	**61% (12%)**	**-1% (0%)[6]**

Notes: Utilization data is based on the cumulative capacity (in terms of the number of vehicle spaces and room for passengers) on all vessels serving that route, and is measured for all sailings in a calendar year. Utilization for the San Juan domestic route is measured at Anacortes, and for the Fauntleroy - Vashon - Southworth "triangle route" at Fauntleroy. See Appendix p. 48 for number of trips data.

On-time performance by route

2015 and 2017; Annual percentage of trips that departed on time

Ferry Route	2015	2017	Change (Δ)
Anacortes - San Juan domestic	91.3%	84.4%	-6.9%
Anacortes - San Juan - Sidney, B.C.	93.3%	86.7%	-6.6%
Edmonds - Kingston	98.3%	95.7%	-2.6%
Fauntleroy - Vashon - Southworth	92.0%	91.8%	-0.2%
Mukilteo - Clinton	94.6%	96.1%	1.5%
Point Defiance - Tahlequah	97.1%	98.9%	1.8%
Port Townsend - Coupeville	99.3%	92.7%	-6.6%
Seattle - Bainbridge	91.0%	91.2%	-0.2%
Seattle - Bremerton	97.6%	94.4%	-3.2%
System-wide	**94.4%**	**92.5%**	**-1.9%**

Notes: A vessel is considered on time if it departs within 10 minutes of its scheduled departure. WSDOT's annual goal is for 95% of trips to depart on time.

Ridership by route

2015 and 2017; Annual ridership in thousands

Ferry Route	2015	2017	%Change (Δ)
Anacortes - San Juan domestic	1,974	2,018	2.2%
Anacortes - San Juan - Sidney, B.C.	139	131	-5.4%
Edmonds - Kingston	4,103	4,136	0.8%
Fauntleroy - Vashon - Southworth	2,975	3,111	4.6%
Mukilteo - Clinton	4,113	4,105	-0.2%
Point Defiance - Tahlequah	769	844	9.8%
Port Townsend - Coupeville	787	807	2.5%
Seattle - Bainbridge	6,362	6,529	2.6%
Seattle - Bremerton	2,660	2,779	4.5%
System-wide	**23,882**	**24,460**	**2.4%[6]**

See Appendix p. 48 for more information

Data source and analysis: WSDOT Ferries Division.
Notes: **1** Passenger ridership includes vehicle drivers and passengers, as well as walk-on passengers and bicyclists. **2** Trip reliability is the ratio of actual sailings compared to the number of scheduled sailings. **3** The international route takes 130 minutes non-stop between Anacortes and Sidney, B.C., and 155 minutes if the trip stops at Friday Harbor. **4** Data for the San Juan inter-island route is combined with the San Juan domestic route. The 65-minute trip time is specifically for Anacortes to Friday Harbor with no stops, and the inter-island trips have shorter trip times. **5** Some trips are direct between two locations (with shorter trip times) and others serve all three locations. **6** Capacity increased between 2015 and 2017 due to the addition of three new Olympic class vessels; because capacity increased more than ridership, capacity utilization declined while ridership increased.

Ferries ridership over 24 million with 99% reliability

Annual ridership on Washington State Ferries (WSF) increased 2.4% from 2015 to 2017, with approximately 416,000 more passengers and 162,000 more vehicles traveling by ferry. Annual trip reliability decreased slightly over the same period (going from 99.5% to 99.0% of scheduled sailings completed), but continued to meet the annual system-wide goal of at least 99% reliability. Between 2015 and 2017, total ferry vessel fuel use increased 9.1%, and fuel use per mile increased 9.9%. These increases are primarily due to the addition of WSF's third new Olympic-class vessel (the Motor/Vessel Chimacum) to the fleet in 2017, which replaced a smaller vessel that used less fuel.

WSF's nine ferry service routes function as marine highway corridors, with stops at 19 ferry terminals in Washington and one stop in Sidney, British Columbia. Washington State Ferries are integral links across Puget Sound, connecting island and peninsula communities with major employment centers in addition to facilitating leisure trips. Seven of the nine ferry routes are served by multiple vessels operating simultaneously in order to keep terminal wait times low. Route capacity is defined as the cumulative passenger and vehicle capacities for all sailings of each vessel serving a particular route, and may fluctuate depending on vessel size or crew availability for each trip.

Ferry route analysis:

Ridership by route: Between 2015 and 2017, ridership changes ranged from a 5.4% decrease (on the Anacortes — San Juan — Sidney, B.C route, which also saw a 2.4% drop in the number of sailings) to a 9.8% increase on the Point Defiance – Tahlequah route, which may have been due to construction on the piers on Vashon Island, and congestion on the Fauntleroy-Vashon-Southworth route.

Capacity utilization: In 2017, the utilization of vehicle spaces on all ferry trips averaged 61%, one percentage point lower than in 2015. Vehicle space utilization on individual ferry routes ranged between 41% (Anacortes — San Juan — Sidney, B.C) and 78% (Port Townsend – Coupeville) in 2017. The Port Townsend – Coupeville route saw the greatest increase in vehicle utilization, with an 8 percentage point change from 70% in 2015 to 78% in 2017, which can be attributed to higher use by commercial trucks.

Ferry route utilization based on ridership and vessel capacity reflects utilization for all sailings over the entire day, not for peak periods as used to track capacity for most other transportation modes. Because ferry vessels can carry many more passengers than vehicles, the passenger utilization rates are lower, ranging from 8% (Point Defiance – Tahlequah) to 17% (Anacortes — San Juan — Sidney, B.C) of the available capacity in 2017.

Passenger capacity utilization on ferries, which includes drivers of the onboard vehicles, fluctuated for some routes (increasing or decreasing by no more than 1%) between 2015 and 2017, but did not significantly change system-wide.

On-time performance: There were more than 161,000 sailings in 2017, an average of 441 sailings every day of the year (see Appendix p. 48). In 2017, 92.5% of sailings departed within 10 minutes of their scheduled departure time, below WSDOT's annual system-wide goal of 95%. On-time performance declined on seven of the nine routes between 2015 and 2017, with drops ranging from -0.2% to -6.9%. The routes with the largest drops were Anacortes — San Juan domestic (-6.9%), Anacortes — San Juan — Sidney, B.C (-6.6%) and Port Townsend — Coupeville (-6.6%).

System-wide on-time performance declined by 1.9% between 2015 and 2017. The decline in on-time performance is mostly due to increased ridership, which increases the time vessels need to be at the dock for loading and unloading. The addition of three new Olympic class vessels between 2015 and 2017 increased both capacity and ridership, contributing to increased loading and unloading times. Finally, unplanned maintenance required some vessels to be assigned to routes they do not normally serve, which also negatively impacted on-time performance in 2017.

Trip reliability: Six of the nine routes met the annual system-wide goal of completing at least 99% of scheduled sailings in 2017. System-wide, Ferries made 99.0% of its 162,736 scheduled trips in 2017, and had 1,664 net missed trips. The Port Townsend – Coupeville (91.5%), Anacortes — San Juan — Sidney, B.C (96.8%) and Seattle — Bremerton (98.8%) routes did not meet the annual goal in 2017.

Amtrak CASCADES®

Corridor Capacity Analysis

Passenger miles traveled

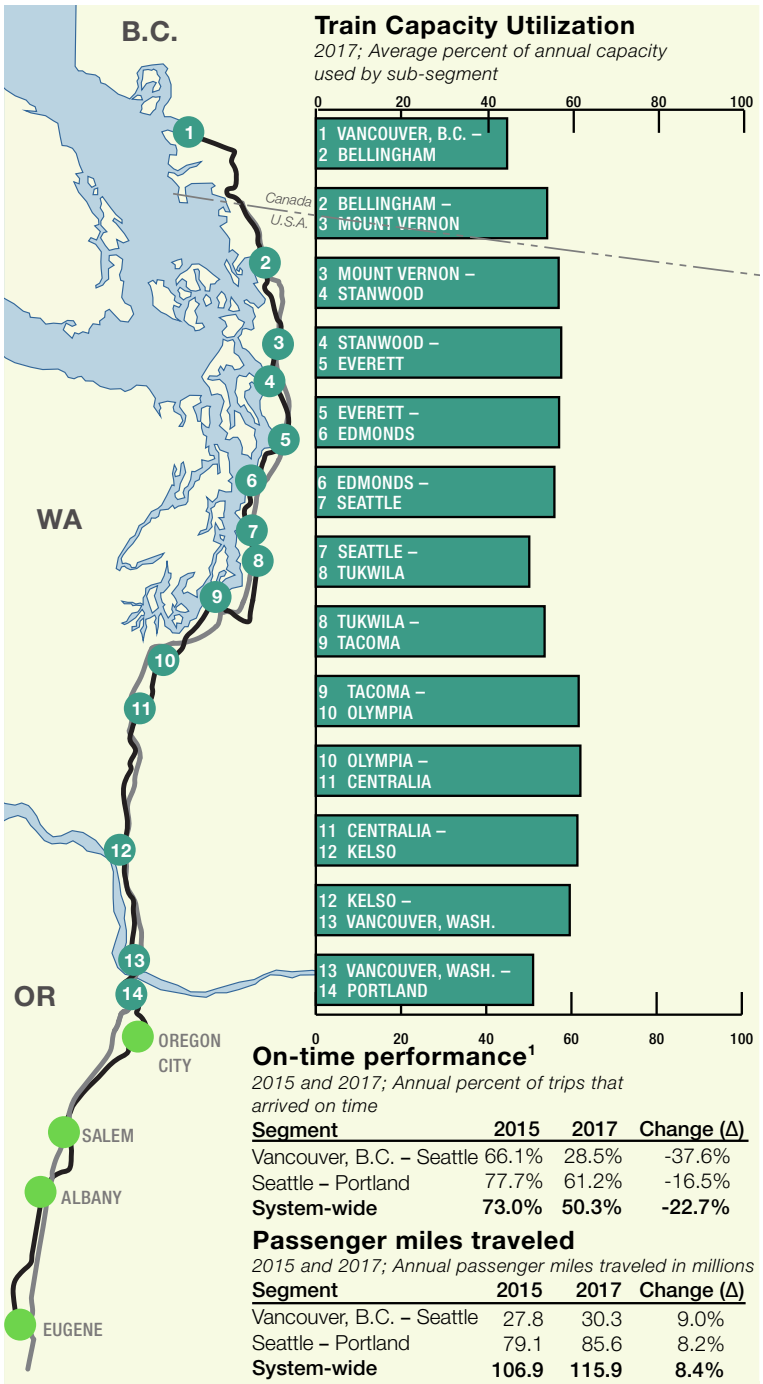
2015	vs.	2017	
106.9		115.9	8.4% ▲
in millions of miles			

Annual on-time performance

2015	vs.	2017	
73.0%		50.3%	22.7% ▼
of scheduled trips			

Annual capacity utilization + annual ridership

2015	vs.	2017		2015	vs.	2017
56.8%		62.1%	5.3% ▲	672		728
for the peak sub-segment				in thousands of passengers		



Train Capacity Utilization

2017; Average percent of annual capacity used by sub-segment

On-time performance[1]

2015 and 2017; Annual percent of trips that arrived on time

Segment	2015	2017	Change (Δ)
Vancouver, B.C. – Seattle	66.1%	28.5%	-37.6%
Seattle – Portland	77.7%	61.2%	-16.5%
System-wide	**73.0%**	**50.3%**	**-22.7%**

Passenger miles traveled

2015 and 2017; Annual passenger miles traveled in millions

Segment	2015	2017	Change (Δ)
Vancouver, B.C. – Seattle	27.8	30.3	9.0%
Seattle – Portland	79.1	85.6	8.2%
System-wide	**106.9**	**115.9**	**8.4%**

Bicycles onboard

2015 and 2017; Annual number of bicycle reservations

Segment	2015	2017	Change (Δ)
System-wide	8800	7700	-12.5%

Amtrak Cascades operates 16 passenger trains each day between Vancouver, British Columbia and Eugene, Oregon, providing a viable transportation option for travelers on the I-5 corridor and supporting the state's long-term goal of providing a sustainable multimodal transportation system.

Passenger miles traveled: In 2017, Amtrak Cascades passengers rode 115.9 million passenger miles in Washington, an increase of 8.4% from 2015. Ridership increased by 8.3% over the same period, from approximately 672,000 in 2015 to about 728,000 in 2017.

Fuel efficiency: In 2017, Washington trains used an estimated 1.2 gallons of fuel per mile traveled, resulting in an average of 125 passenger miles traveled per gallon of fuel used.

Capacity utilization: Riders used an average of 62.1% of Amtrak Cascades train capacity on Washington's peak sub-segment (Olympia – Centralia), increasing from 56.8% in 2015. Utilization rates for the peak sub-segment can limit available capacity for the entire corridor. For example, if the Olympia – Centralia sub-segment was sold out, someone in Seattle could not buy a ticket to Portland. Average train capacity utilization fluctuates throughout the year, with trains selling out during weekends, holidays and the summer.

On-time performance: Trains in Washington achieved 50.3% on-time performance in 2017, down from 73.0% in 2015. While the on-time performance goal is 80%, several factors caused delays in 2017, including speed restrictions due to track conditions, landslides, and train interference. The Seattle—Portland segment had the highest on-time performance, at 61.2%.

Bicycle riders: Train passengers can bring their bikes along for the ride, further enhancing multi-modal connectivity for their trips. In 2015, more than 8,800 passengers booked their bikes on the Cascades trains serving Washington state, and 7,700 did so in 2017. The 2017 drop in bike riders was particularly evident during the first six months of the year, when record-breaking rainfall deterred many outdoor activities.

Data source and analysis: WSDOT Rail, Freight and Ports Division.

Notes: All "Washington" data is for trains between Portland, Oregon, and Vancouver, B.C. regardless of funding entity. See wsdot.wa.gov/Rail/PerformanceReports.htm for more information. **1** A train is considered on time if it is within 10 minutes of scheduled arrival times for trains operating the Vancouver, B.C.—Seattle and Seattle – Portland segments; or 15 minutes of scheduled arrival times for trains operating the entire Vancouver, B.C.—Portland segment.

Incident Response Annual Report

WSDOT helps keep traffic moving at 61,913 incidents

Incident Response (IR), WSDOT's traffic incident management program, responded to 61,913 incidents in 2017 (23.5% more than in 2015), clearing scenes to keep traffic moving in an average of 12 minutes and 30 seconds after incident notification. WSDOT's assistance resulted in approximately $96.6 million in estimated economic benefit to travelers and businesses in Washington by reducing congestion caused by traffic incidents and helping prevent secondary incidents. WSDOT's annual IR budget was $6 million in 2017, meaning WSDOT provided an estimated $16.10 benefit for every dollar spent on traffic incident management.

Incident clearance times improve slightly in 2017

WSDOT's IR teams cleared incidents in an average of 12 minutes and 30 seconds in 2017. This was about 15 seconds faster per incident than in 2015. The IR program's average incident clearance time hovered between 12 and 13 minutes from 2013 through 2017. In general, faster clearance times mean less incident-induced congestion and fewer secondary incidents.

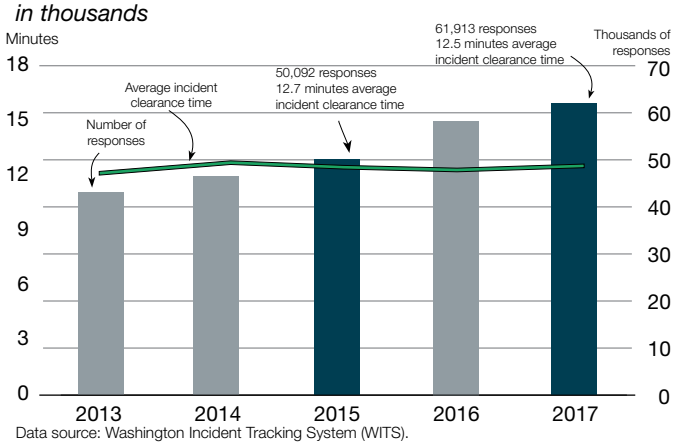
Traffic incident management is a key strategy for maximizing highway system performance

Traffic incidents such as collisions are responsible for nearly half of non-recurrent congestion (traffic congestion caused by one-time events). Non-recurrent congestion can also be caused by severe weather or large events. These events temporarily reduce the transportation system's ability to move people and goods. Traffic incident management is nationally recognized as a best practice for reducing or preventing non-recurrent congestion.

The WSDOT Incident Response program's mission is to clear traffic incidents safely and quickly, minimizing congestion and the risk of secondary collisions. The program is active statewide, with roughly 59 full-time equivalent positions and 69 dedicated vehicles. Teams patrol 1,300 centerline miles of state highway on major corridors during peak traffic hours and assist the Washington State Patrol in traffic emergencies at all hours.

Clearance times remain below 13 minutes, while responses increase by 23.5% from 2015

2013 through 2017; Clearance time in minutes; Responses in thousands



Data source: Washington Incident Tracking System (WITS).

Note: Data is only for incidents to which a WSDOT Incident Response team responded.

WSDOT prevents $96.6 million in delay and secondary collisions

WSDOT estimates that IR crews' proactive management of incident scenes provided an economic benefit of $96.6 million to travelers and businesses using Washington highways in 2017. These benefits were provided in two ways. First, by clearing incidents as quickly as possible, WSDOT crews reduced the time and fuel motorists wasted in incident-induced congestion. In 2017, WSDOT estimates that IR crews prevented about $54.6 million in incident-related congestion costs. Second, by proactively managing traffic at incident scenes, IR crews reduced the risk of secondary incidents caused by distracted driving or sudden changes in traffic conditions. WSDOT crews prevented an estimated 11,702 secondary incidents in 2017, resulting in $42 million of economic benefit. See WSDOT's Handbook for Corridor Capacity Evaluation pp. 45-47 for delay-reduction benefit calculations as well as all other IR related metrics.

A WSDOT Incident Response team at an incident on I-5 near Tacoma.

WSDOT teams provide $96.6 million in benefit in 2017

WSDOT teams' 2017 performance at incidents resulted in savings of $96.6 million in incident-related costs
2017; Incidents by duration; Time in minutes; Cost and economic benefit in dollars

		Blocking incidents		All incidents	Economic impacts	
Incident duration	**Number of incidents[1]**	**Percent blocking[2,6]**	**Average roadway clearance time[3,6]**	**Average incident clearance time[4,6]**	**Cost of incident-induced delay[6]**	**Economic benefits from IR program[5,6]**
Less than 15 min.	47,309	15.0%	2.8	4.7	$55,865,270	$26,035,918
Between 15 and 90 min.	13,879	55.0%	16.2	30.7	$121,049,998	$53,019,005
Over 90 min.	725	86.4%	140.3	172.4	$41,632,742	$17,569,626
Total	**61,913**	**24.7%**	**15.3**	**12.5**	**$218,548,010**	**$96,624,548**
Percent change from 2015	**↑ 23.6%**	**↓ -1.5%**	**↓ -28.8%**	**↓ -1.6%**	**↑ 20.4%**	**↑ 20.5%**

Data sources: Washington Incident Tracking System. Notes: Some numbers do not add to 100% due to rounding.
1 Teams were unable to locate (UTL) 3,405 of the 61,913 incidents. Because an IR team attempted to respond, these incidents are included in the total incident count, but are not factored into other performance measures. **2** An incident is considered blocking when it shuts down one or more lanes of travel. **3** Roadway clearance time is the time between the IR team's first awareness of an incident (when a call comes in or the incident is spotted by a patrolling IR unit) and when all lanes are available for traffic flow. **4** Incident clearance time is the time between an IR team's first awareness of an incident and when the last responder has left the scene. Incident clearance time is usually longer than roadway clearance time (for blocking incidents). **5** Estimated economic benefits include benefits from delay reduction and prevented secondary incidents. See WSDOT's Handbook for Corridor Capacity Evaluation, 2nd edition, pp. 45-47, for WSDOT's methods to calculate IR benefits. **6** Excludes incidents IR team was unable to locate.

Incidents resulted in $218.5 million in congestion-related costs in 2017

Traffic delay at the 61,913 incidents that WSDOT teams responded to in 2017 cost travelers on Washington highways an estimated $218.5 million. This is 20.4% more than the $181.5 million in costs that were incurred in 2015. Without the work of WSDOT's IR crews, the 2017 cost would have been $315.2 million ($96.6 million in prevented delay and estimated secondary collisions costs plus $218.5 million in actual delay costs).

Blocking incidents a quarter of all incidents, but over half of all delay

About 24.7% of the incidents that WSDOT's IR teams responded to in 2017 blocked at least one lane of traffic. Blocking incidents caused 61.6% of the incident-related congestion costs for 2017.

Blocking incidents cause more congestion per minute than non-blocking incidents. Also, blocking incidents tend to last longer (compare the roadway clearance columns for blocking versus all incidents in the table above) as they are more complicated to clear.

Commercial vehicles involved in 7.1% of all incidents

Commercial vehicles, such as semi-trucks, were involved in 4,157 incidents or about 7.1% of all incidents IR teams responded to in 2017 (not including unable to locate incidents; see notes in table above). On average these incidents took 18 minutes and 13 seconds to clear, about 5 minutes and 43 seconds longer than the overall average clearance time.

Commercial vehicles involved in 23.3% of extraordinary incidents

Commercial vehicles were involved in a larger proportion of incidents lasting over 90 minutes, accounting for 23.3% of these incidents (169 out of 725). Furthermore, over-90-minute incidents involving a commercial vehicle took an average of 3 hours and 23 minutes to clear. This is roughly 31 minutes longer than all over-90-minute incidents, including extraordinary incidents (those lasting longer than six hours).

Incidents involving commercial vehicles can be more complex to clear due to factors such as the size of the vehicle or any freight spilled due to the incident. These incidents can also require special towing equipment. Just like with other incidents, WSDOT's goal is quicker clearance times for less impact to the system.

Customer feedback: Incident Response program keeps traffic safe and moving

WSDOT drivers give comment cards to motorists who receive assistance. Below are some of the comments the program received in 2017.

- "Heather was a ROCK STAR! She did everything she could do to make us safer. Heather got us back on the road."
- "Ted was fast, efficient and friendly. This is all amazing service. Thank you, Ted!"
- "Jan saved me as I had run out of gas in the snow, the program is excellent. Thank you!"

Corridor Capacity Report Credits

The *Corridor Capacity Report* is developed and produced by a small team of data analysts at the WSDOT Office of Strategic Assessment and Performance Analysis each year, with the help of dozens of individuals both at WSDOT and across the state's transportation community. WSDOT gratefully acknowledges their contributions.

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Behind the scenes of the *Corridor Capacity Report*

Beginning with the 2014 Corridor Capacity Report WSDOT published detailed performance measure information as part of a data appendix along with a Handbook for Corridor Capacity Evaluation, which serves as a one-stop shop to help readers navigate the annual Corridor Capacity Report's multimodal analysis of transportation system performance. The handbook is a tool for technical professionals working to implement system performance measurement and reporting as part of their agency's accountability initiatives and/or the federal Moving Ahead for Progress in the 21st Century (MAP-21) requirements. WSDOT published a second edition of the document in 2016, which can be found at: wsdot.wa.gov/publications/fulltext/graynotebook/CCR_methodology_2nd_edition.pdf.

Americans with Disabilities Act information for the public

Accommodation requests for people with disabilities can be made by contacting the WSDOT Diversity/ADA Affairs team at wsdotada@wsdot.wa.gov or by calling toll-free, 855-362-4ADA (4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Civil Rights Act of 1964, Title VI Statement to the Public

It is the Washington State Department of Transportation's policy to assure that no person shall, on the grounds of race, color, national origin, or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated may file a complaint with WSDOT's Office of Equal Opportunity. For additional information regarding Title VI complaint procedures and/or information regarding our non-discrimination obligations, contact OEO's Title VI Coordinator at (360) 705-7090.

WSDOT's 2018 *Corridor Capacity Report* is prepared by the
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