2 Traffic and Congestion

2A Traffic and Congestion

2B Case Study: I-5 Closure

2C Case Study: Transit Tunnel Closure

2D Complete Streets

Fact Sheet

Traffic and Congestion

What is traffic congestion and why does it happen?

In economic terms, traffic congestion is to automobile travel what bread lines are to bread: an example of demand exceeding supply. In the case of traffic congestion, the number of motorists wanting to drive somewhere simply exceeds the roadway capacity to accommodate them. While motorists may find congestion annoying, many still make a choice to sit in congestion rather than avoid the trip, use another travel mode, take a different route or change their trip pattern altogether. Just as it is difficult to live without bread, it is challenging for many families to match affordable housing, a decent job and an easy commute.

The science of fluid dynamics is often used to help describe traffic patterns and congestion – much like the plumbing system in your house or the blood in your veins. Traffic congestion tends to form in places where you get a lot of turbulence in a liquid system, like where a small pipe connects to a big pipe, or where pipes meet at odd angles.

Traffic itself results largely from a strong, dynamic economy – commerce is humming, workers are going to work, developers are building, and people are spending discretionary income on things they enjoy. For some planners, traffic congestion is merely a sign of economic "success." Indeed, the only major city in U.S. history that has ever eliminated its congestion problem was Detroit, where congestion was eliminated by the collapse of the urban downtown as a multi-use center.

Traffic congestion is a concern largely for four reasons:

- It is annoying and reduces quality of life for everyone stuck in it.
- It acts as a limit on future economic expansion. Major transportation capital projects tend to be followed by new building and economic expansion that in turn results in congestion.
- Cars stuck in congestion produce significantly more CO_2 per mile than free-flowing traffic.

- As congestion reaches certain levels, the person capacity of the overall transportation network declines sharply, resulting in economic contraction until the system re-balances. That is, congestion gets so bad that people and companies simply move to other regions.

This last point is especially important. As traffic volumes increase, the vehicle throughput on a given street increases steadily until the street starts to reach capacity. At that point, throughput begins to decline rapidly to the point where there are so many cars that none can move. When I-5 is heavily congested at peak times, it may be moving fewer cars than it does in the middle of the night. To keep people, cars and buses moving, it is important that the street system be managed to avoid instances of severe congestion.

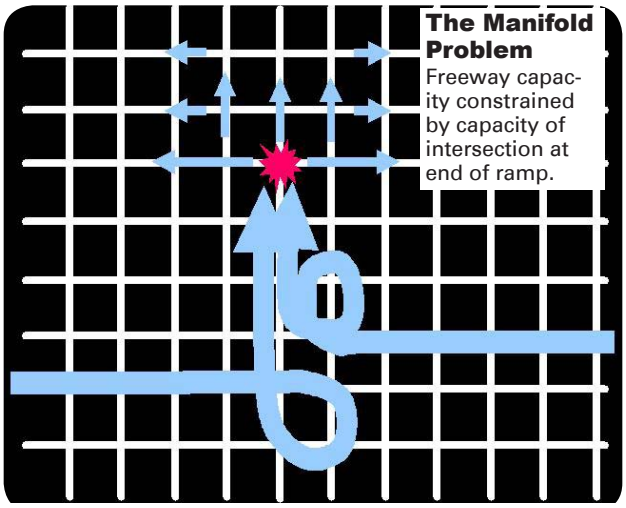
Where does congestion happen on Center City Streets?

In Seattle, the congestion chokepoints are determined largely by the city's unique geography. They include:

- **Freeway ramps.** Congestion accumulates at all of Seattle's freeway on- and off-ramps for two main reasons:
  - ✧ As the one large pipe of a freeway ramp meets the many small pipes of city streets, motorists are making many turning movements and sorting themselves out into the grid.
  - ✧ When the freeway is congested, cars heading onto the freeway back up onto

city streets, reducing the ability of those streets to serve local trips.

- **Colliding grids.** Congestion accumulates where Center City's three main street grids meet at Denny Way, Yesler Way, between Olive and Stewart and along Broadway. This happens in part because of the awkward geometries where these grids meet – like 6th Avenue/Denny/Vine and in part because some streets don't continue or are severely misaligned – like Boren/Denny.
- **Broken grids.** Over half of Center City's surface street capacity is lost because so many streets are discontinuous. Of the nine street corridors south of downtown (Alaskan Way through 8th Avenue S), only four are continuous: Alaskan Way, 1st Avenue S, 4th Avenue South and 5th Ave S/Airport Way; the others are disrupted by the stadiums, I-90 and I-5. Among the 33 east-west streets from Royal Brougham to Mercer, only 12 continue outside Center City – and none leaves the city – largely because of I-5. The 28 north-south street corridors that meet Mercer get cut to four local bridges across the ship canal. Altogether, about 70% of Center City's streets dead end, limiting their usefulness for traffic capacity.
- **Colman Dock.** The third busiest ferry terminal in the world, Colman Dock is a mixed blessing for Seattle. On the one hand, it delivers over 20,000 walk-on passengers a day, many of whom would otherwise be congesting local roadways. On the other hand, each morning peak boat pushes a surge of over 200 vehicles into a highly constrained link in the Center City street grid, limiting north-south green time for vehicles and pedestrians using Alaskan Way and Western Avenue. More importantly, cars queuing to reach ferries in the evening peak back up onto city streets, resulting in a major loss of throughput for all vehicles in downtown. Of the 1,650 vehicles that disembark at Colman Dock during a weekday morning peak period, 17% drive to a nearby destination within downtown and another 43% to destinations in other nearby neighborhoods such as SODO, Uptown, University District and First Hill/Capitol Hill. These passengers bring their cars in part because of lack of parking and access alternatives at their home end, and partly



because of poor transit connections from Colman Dock to most destinations.

Outside these predictable congested locations, Center City Seattle has relatively little congestion on its major arterial system. Outside this "ring of bottlenecks," most streets have more capacity than the vehicles they carry, even at peak. Exceptions include special events, such as those at Seattle Center, the stadiums or Pike Place Market.

Moving People

How many cars can a traffic lane move?

A free-flowing freeway lane can move around 2,000 vehicles per hour, while an urban street can move only about 700 vehicles per hour, largely because of the need to move traffic on cross-streets through at-grade intersections. A fine network of many urban streets, however, can move far more vehicles than a single, limited-access freeway. Where freeways interrupt the local street grid, the result can be a net loss of capacity. The major advantage of freeways is not capacity but speed – they are particularly useful moving people long distances quickly.

How many people can a lane move?

Cars take up a lot of space. A single light rail vehicle can move 33 times as many people per unit of road space than one person in a car. A full bus moves 25 times as many people as a single occupant car. Were transit use to decline in Seattle, the transportation system would move fewer people.

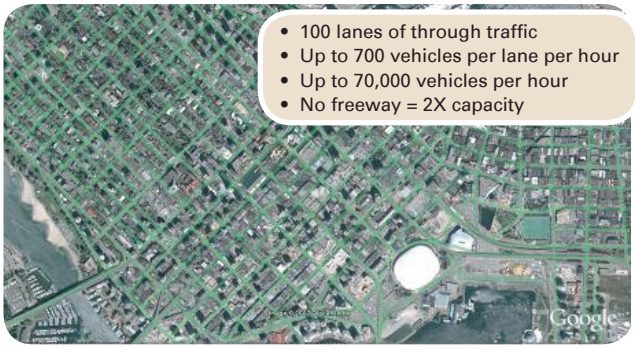
Today, buses represent only 2% of the total vehicles, yet carry 40% of all the people on Center City streets.

The 2003 Center City Circulation Report identified the "Ring of Bottlenecks" where congestion forms along the colliding grids and freeway ramps.

How can we "solve" the congestion problem?

Short of major demand management techniques – particularly parking pricing and roadway pricing – no city has ever "solved" their congestion problem. All successful cities have traffic congestion. The most successful cities simply locate their inevitable congestion in places where it has

Freeway vs. Grid System Capacity Comparison



the least impact on local economic development, quality of life and other goals.

San Francisco, for example, intentionally places its freeway congestion in the middle of its CBD, where the Bay Bridge meets US 101. This has the effect of making it relatively easy to drive to the downtown, but rather difficult to drive through the downtown. By using congestion to discourage through trips, San Francisco ironically increases the capacity of the roads to accommodate traffic into its downtown, thereby taking the most economic advantage of its freeway.

Vancouver takes a different approach. It places traffic bottlenecks in a ring around the city. Traffic heading into the city from the Lion's Gate Bridge, for example, may queue for over a mile in a retained cut through Stanley Park as it is metered into the downtown grid. The result is relatively little congestion in the city center because of the metering effect of the bottleneck at Georgia and Denman.

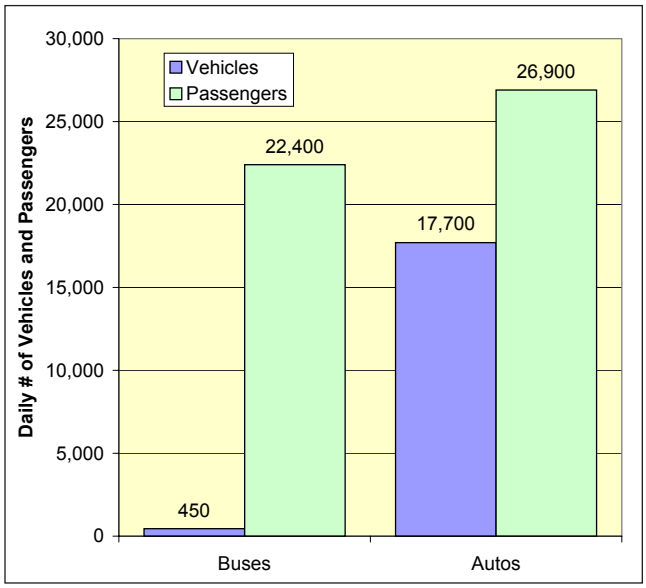
Seattle currently takes a hybrid approach, but without the advantages of either San Francisco or Vancouver. Like San Francisco, it places a bottleneck for regional traffic on I-5 in Center City, but does not provide an effective regional traffic bypass, nor does it provide good alternative routes for traffic to leave the I-5 congestion and reach their Center City destinations. The Alaskan Way Viaduct offers a good bypass of downtown, but is used primarily for local, intra-Seattle traffic. On local streets, the ring of bottlenecks is close to the heart of the city, where it has far greater negative economic and quality of life impacts than Vancouver's ring.

How can the city grow if it already has traffic congestion?

If there are already too many cars on the road, how can we allow more growth? Won't the city just strangle itself on more traffic?

In order to allow more people to live, work, shop and visit in Seattle, we have no choice but to move them in more efficient ways. This is not a matter of ideology, but of geometry. People in cars simply take up at least 10 times as much road space as people in any other form of transportation.

Vehicles and Person Movement in Seattle's Center City



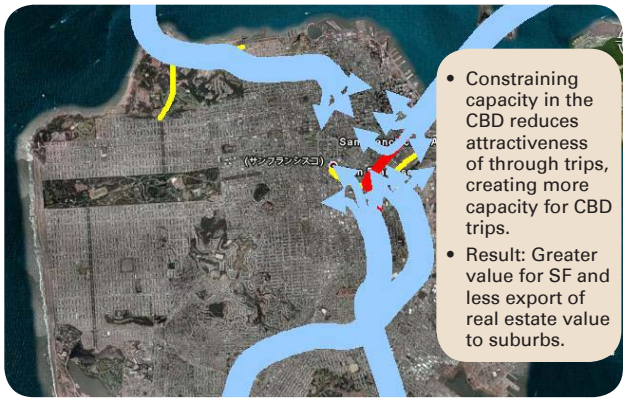
Buses = 2% of the total vehicles, but carry 40% of the total passengers.

For significant numbers of people to choose more efficient travel modes, three factors merit special attention:

- **Time.** Most people, especially working people and those with children, place a high value on their time, regardless of their income. If one way is faster than another, people will adjust their travel to use it. This is especially true for all forms of public transit – if the bus, train, ferry or streetcar is faster than driving, most people will choose transit over driving. This is why subways, busways and dedicated right-of-way rail attract vastly higher ridership than mixed traffic transit.

  People also value different types of time in different ways. Some people will choose transit over driving even if transit takes longer if they can make productive use of their time on board. Awkward transfers and unreliable service, however, are maddening for most travelers – time spent waiting can have a perceived "cost" tenfold higher than time spent in a vehicle.

- **Quality.** People will avoid travel choices that do not offer a decent level of human dignity. This is often an obstacle against bicycling mixed with heavy traffic or riding a bus de-



signed only to serve those for whom transit is a choice of last resort. Similarly, people may perceive their time spent walking as a positive part of their day if the walk is pleasant or an alternative to the gym; but if the walk is dangerous or unpleasant the perceived time cost escalates.

- **Cost.** The impact of cost on travel choices varies with income and is typically charted as a curved line. That is, as cost increases, travel choices are not much affected until prices get rather high, then the impact of price rapidly escalates. So a daily parking rate of $10 may have little impact on travel choices if driving is faster than other modes, since people value their saved time as worth more than the $10 parking fee. But if parking prices rise to $30, suddenly a significant share of travelers would find other ways of getting downtown. Very few would park at $60 a day.

An alternative to shifting people into more efficient travel modes is to help them avoid making the trip altogether. This means focusing on accessibility rather than mobility. Mobility is about adding travel lanes, bike lanes or new bus routes in order to allow people to travel freely wherever they want to go. Accessibility is about bringing goods and services closer together so people can get what they want without needing to travel.

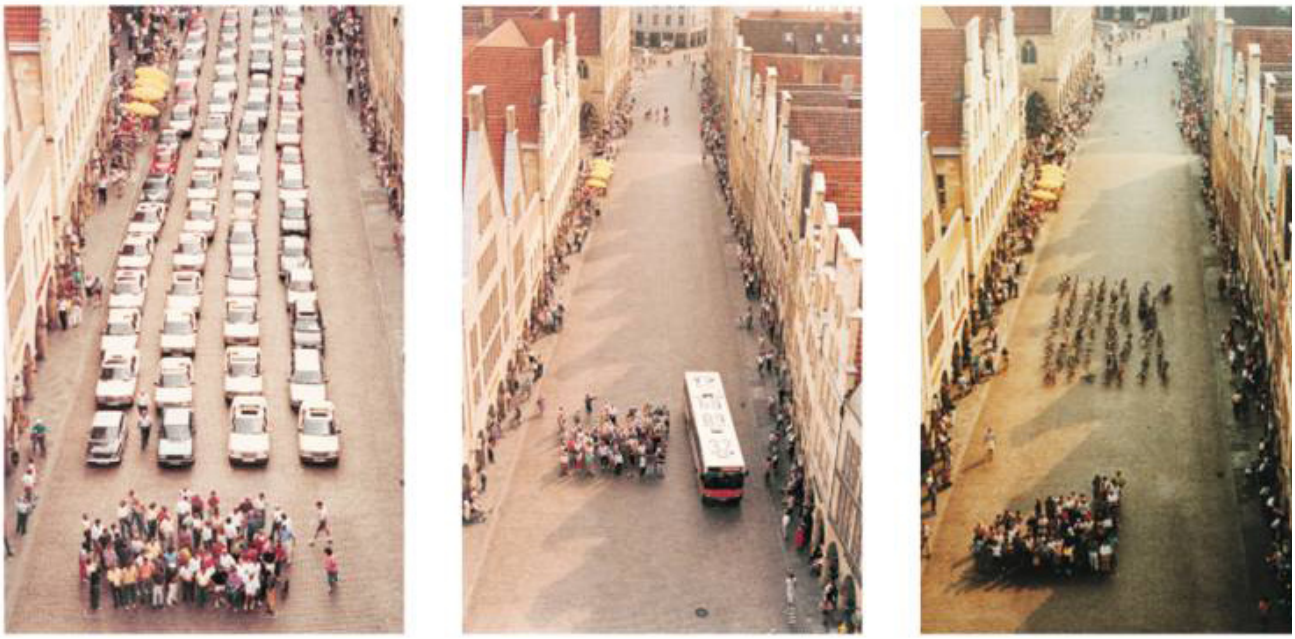
Seattle can significantly reduce traffic by creating more complete neighborhoods, as outlined in the Comprehensive Plan, bringing a fuller array of jobs, services and retail into each neighborhood center and reducing the need for people to drive across town to conduct routine business and take care of basic needs.

Sources:

SDOT Center City Circulation Report, 2003.

Vukan Vuchic, Transportation for Livable Cities, CUPR Press, 2000.

Washington State Ferries Origin-Destination Studies (1999 and 2006).



Amount of space required to transport the same number of passengers by car, bus or bicycle. (Poster in city of Muenster Planning Office, August 2001) Credit: Press Office City of Muenster, Germany.

Fact Sheet

Case Study: I-5 Closure

How did the August I-5 closure impact travel?

In August 2007, Seattle-area residents showed just how adaptable travel behavior can be when a major route disappears. Bombarded by news stories predicting massive traffic delays, but bolstered by information on construction details and transportation alternatives, travelers demonstrated their willingness and ability to adapt to changing conditions. Regular commuters and general I-5 traffic shifted to alternate routes, transit, and carpools – or postponed or eliminated trips – in numbers sufficient to prevent the predicted gridlock.

What prompted the I-5 closures?

Nearly a year in advance, the Washington State Department of Transportation (WSDOT) announced planned construction on I-5 that would entail unprecedented, 24-hour lane closures. Over 19 days in August 2007, I-5 would be reduced to three and then two northbound travel lanes into downtown Seattle while crews completed resurfacing and expansion joint work on 1.13 miles of interstate. Because rain would preclude the necessary concrete repaving, WSDOT planned continuous 24-hour closures between Spokane Street and I-90 so that work could be finished as rapidly as possible during a single summer construction session, even anticipating possible weather delays (WSDOT, 2007).

I-5 approaching downtown Seattle
Source: istockphoto

How many vehicles drove on this stretch of I-5 before the project?

Pre-construction traffic counts showed 126,000 vehicles passing through this northbound route every weekday. Traffic models predicted backups stretching up to 50 miles unless 55% of the usual trips shifted to some other mode or route.

What happened to traffic during the lane closures?

During the first week of construction, northbound I-5 was reduced to three lanes, and traffic volume dropped to 87,000 vehicles per weekday. Even more vehicles disappeared during the additional lane closure through the final week of the project, allaying fears that many drivers would return to I-5 after the first week's conditions proved passable. According to WSDOT's final report on the closure, "Over the course of the project, daily volumes on I-5 through the construction zone dropped by between 33,000 and 58,000 [vehicles] as travelers adjusted to the different phases of construction" (WSDOT, 2007).

Daily traffic volume compared to pre-construction volumes

Dates	Condition	Backups	Daily traffic volume
Aug 10-16	3 lanes open	Rarely over 10 minutes	30% fewer vehicles
Aug 17-24	2 lanes open	15-55 minutes	50% fewer vehicles

Data source: Leth, Mark. "I-5 / Spokane Street to I-90 Bridge Repair." [PowerPoint] WSDOT presentation to PSRC Policy Board, October 11, 2007.

Where did these travelers go?

Considering daily totals as a whole, the greatest proportion of travelers switched to other arterials throughout the grid, including additional trips measured on SR-99, E. Marginal Way, 1st and 4th Avenues, Airport Way, MLK Way, and Beacon and Rainier Avenues. However, focusing on the morning peak period only (6 AM – 10 AM), the greatest proportion of diverted trips went to transit during the first week, and then to arterials during week two. I-405, already regularly displaying heavy daily congestion, absorbed 5,000 more peak hour travelers. On transit routes throughout the city, approximately 7,000 additional daily riders took transit during week one, and 5,000 during week two of construction (King County Department of Transportation, 2007). These transit rider counts include King County Metro buses and Sound Transit buses operated by Metro, the Vashon Island Passenger Only Ferry, Elliott Bay Water Taxi, Sounder commuter rail, and County vanpools and vanshares. The figure below documents WSDOT's calculated trip diversions from I-5 onto arterials, I-405, and transit.

Daily trips shifted from I-5 to another route or mode

		Additional daily trips measured on:			
Dates	Condition	Arterials	I-405	Transit	Unknown
Aug 13-16	3 lanes open	13,000	5,000	5,300	11,000
Aug 17-24	2 lanes open	27,000	7,000	4,300	20,000

Data source: Washington State Department of Transportation. Final report on I-5 construction. Provided by Matt Beaulieu, WSDOT, November 20, 2007.

A substantial number of the usual 126,000 daily northbound I-5 trips that disappeared could not be assigned to a specific alternate route or mode (Leth 2007). Among these "Unknown," it is likely that many discretionary trips were postponed, diverted to a different destination for the same purpose, or eliminated altogether through chaining or not making the trip at all. Further, one of the main recommendations sent to employers and employees included going on vacation or teleworking during construction. It is unknown how many commuters responded by staying home.

What happened on the Sounder commuter train during construction?

The Sounder commuter train route from Tacoma to downtown Seattle added a fifth run and the option of standing-room only in anticipation of construction. Through the week before closures began, this Sounder route brought a little over 3,600 people into Seattle each morning; on August 13, the AM trains served a record high of 6,719 riders (Sound Transit, 2007a). During the two week construction period, trains continuously carried 40% more daily riders than earlier in 2007 (WSDOT, 2007). Further, compared to the same two weeks in August 2006, ridership was up between 72% and 85% during the weeks of August 13 and 20, 2007.

Sounder Rail, Tacoma to Seattle: Average Total Daily Riders

Dates	Riders
Pre-construction:	
May and July 2007	7,000
During construction:	
Week of August 13	10,000
Week of August 20	8,929

Data sources: Sound Transit. Data provided by Benjamin Smith, Sound Transit, November 5, 2007 and November 13, 2007.

Through the week of August 27, Sounder still carried 10% more passengers compared to pre-construction levels. These trains continued to serve 660 more riders each day on September 10 & 11 than the daily average for Mondays and Tuesdays in July, about a 9% increase (Sound Transit, 2007a).

How did bus ridership change during construction?

Sound Transit buses from Tacoma arriving in downtown Seattle via I-5 actually saw a slight decline in total daily riders on the first day of construction, but numbers returned to expected non-construction levels after Wednesday, August 15. It is possible that some of these riders tried the Sounder train and then returned to the bus after the first few days showed no major bus delay (Sound Transit, 2007b). The Pierce Transit-operated Sound Transit route also saw a small decline in ridership, but the decrease was slight. In addition, Pierce Transit passenger count data are difficult to extrapolate to individual weeks; numbers specific to the construction period can only be estimated from ridership for the entire month.

Over 130 morning King County Metro buses shifted from usual I-5 routing to avoid construction, including using the transit, carpool, and truck-only lane on Airport Way. All told, these Metro routes saw a 10-12% increase in ridership each weekday morning, or about 615 additional riders each day, compared to usual August counts (King County Department of Transportation, 2007). Metro routes inbound to downtown from the south saw even greater rider count increases.

Additional Metro bus riders during construction on inbound routes from the south

Routes	Additional daily riders
Routes through Beacon Hill	895
Routes through White Center, Delridge, and Burien	1,653
Routes from West Seattle	835
Total increase on all routes from the south	3,993

Data sources: King County Department of Transportation (2007). Draft 2007 I-5 Closure Traffic Impact Analysis Report.

Did travelers adopt other modes?

Sounder trains from Tacoma to Seattle arrive at King Street Station
Source: Nelson\Nygaard

The Vashon Island Passenger Ferry added an extra run and carried more than 50 additional passengers during the first week of construction, though this dropped off to normal levels in the second week. During the two-week construction period, the Elliott Bay Water Taxi carried on average of 300 extra riders each day compared to typical loads (WSDOT, 2007).

King County Metro created increased incentives for ridesharing during construction, including leasing extra parking for park-and-ride lots, waiving VanPool and VanShare startup fees, and reducing van startup requirements. King County Rideshare Operations successfully started 48 new vanpools and vanshare groups in August, "more than double the number for an average month" (King County Department of Transportation, August 24, 2007). Twenty-one of the new vanpools and 7 of the new vanshares formed directly as a result of the closures. Even after construction ended, 16 of the 21 King County Metro vanpools formed in response to the I-5 incentives are still vanpooling as of November 2007; 2 of the 7 vanshare groups continue to vanshare (King County Metro, 2007).

Washington State Ferry
Source: istockphoto

Source: istockphoto

What approaches did governments take to prepare?

Coordinating communications

WSDOT partnered early with King County Metro, Sound Transit, and private employers to coordinate information campaigns. Daily news announcements through radio, newspapers, project websites, and email carried warnings about possible delays before and during construction and offered suggestions especially for commuters. WSDOT utilized existing communication contacts to reach private companies and disseminate information directly to employees on construction closures and alternatives ranging from telework and flextime to transit and carpooling (WSDOT, 2007).

Monitoring conditions

WSDOT and the City of Seattle established roving incident response teams to quickly clear any collisions from both the I-5 construction zone and city arterials. WSDOT's Emergency Operations Center and extended-hours Traffic Management Center monitored travel and construction conditions to ensure prompt assistance and accurate public information. A project hotline provided an extra resource for those seeking information, and the project website carried up-to-the-minute traffic conditions in addition to construction details.

Creatively utilizing existing infrastructure

The City of Seattle restricted one lane of northbound Airport Way to transit, carpool and freight traffic only, to support these modes and maintain flow. The city also adjusted signal timing to prioritize travel along north-south detour routes. WSDOT directed traffic that remained on I-5 through narrower 11 feet travel lanes, reduced speeds to 45 mph, and installed extra wayfinding signs to assist those still routing through the construction zone (Leth, 2007).

Bolstering transit alternatives

King County Metro detoured all bus routes that normally run on I-5 to parallel streets, issued service change announcements to alert customers, and readied standby coaches in case passenger volumes warranted additional buses. Sounder Commuter Rail, Washington State Ferries, and the Elliott Bay Water Taxi all offered additional daily runs for commuters.

What can we learn from I-5?

The experience on I-5 should not be overestimated, because it is much easier to get people to change habits for two weeks during the summer vacation season than it is to generate permanent change. However, this experience demonstrates that Seattle residents can change their travel habits and that travelers will adapt in a number of ways best suited to their own needs. Some former I-5 drivers made a permanent shift to another mode or route after trying something new in August. This is especially reflected in the increased Sounder train ridership and vanpool retention rates. Though many other travelers switched back to I-5 driving after construction ended, this case study shows that people can adopt a new travel habit if they have alternatives, know what the choices are, and see an incentive to make a change.

The data account for only 40% of the usual daily trips that were removed from northbound I-5 during construction. We do not know how many of the other travelers stayed home, took non-arterial streets that were not monitored, or traveled by carpool, bicycle, or on foot. It is certain that many commuters chose this as an opportune time to take a summer vacation, and that a number of discretionary trips would have been postponed or cancelled. We do know that highway closures offer an opportunity for transit systems to draw new riders, that the remaining Seattle street grid can efficiently absorb additional trips, and that closures prompt individuals to adapt their behavior in countless and sometimes unpredictable ways. Governments have many tools available to bolster transportation alternatives and communicate these options to the public.

Sources:

King County Department of Transportation (2007). Draft 2007 I-5 Closure Traffic Impact Analysis Report.

King County Department of Transportation, August 24, 2007, "Metro posts double-digit ridership increases during I-5 construction," http://www.metrokc.gov/kcdot/news/2007/nr070824_I-5metro.htm (accessed November 12, 2007)

King County Metro (2007). Data provided by Wendy Scholtz, Rideshare Operations, November 14, 2007.

Leth, Mark. (2007). "I-5 / Spokane Street to I-90 Bridge Repair." [PowerPoint] WSDOT presentation to PSRC Policy Board, October 11, 2007.

Sound Transit (2007a). Data provided by Benjamin Smith, November 5, 2007.

Sound Transit (2007b). Data provided by Benjamin Smith from Jim Moore, Sound Transit, November 13, 2007.

WSDOT (2007). Final report on I-5 construction. Provided by Matt Beaulieu, WSDOT, November 20, 2007.

Fact Sheet

Case Study: Transit Tunnel Closure

The 1.3 mile Downtown Seattle Transit Tunnel closed between September 2005 and September 2007. According to King County Department of Transportation, bus route changes affected 60% of transit riders to the Seattle Central Business District (CBD), with 140 additional buses in the peak hour operating on surface streets. To accommodate the additional bus volumes on north-south surface streets in downtown, general purpose traffic on Third Avenue was restricted during the morning and evening rush hours. Overall, bus and general purpose travel times through the CBD remained virtually unchanged and, in many cases, improved. Several of the street and operational changes initiated to mitigate construction impacts are being retained after the tunnel reopened. This section summarizes what happened, and how lessons learned on this project may help Seattle plan its future.

Why did the tunnel close?

Built in the 1980s, the tunnel was retrofit during closure to serve both buses and trains for Sound Transit's Link light rail opening in 2009. Crews completed 95% of the construction underground, including laying new tracks and adjusting loading heights for new low-floor trains and buses, installing signals and overhead wires, and installing fire safety and accessibility improvements. The retrofitted tunnel also has better lighting, wayfinding, and public announcement systems for passenger security and usability. The dedicated, subsurface right-of-way simplifies transit operations, increases travel reliability, and accommodates lower-emissions hybrid buses, as well as electric light rail service beginning in 2009.

Sound Transit, King County Metro Transit, Community Transit, and the City of Seattle worked together to minimize the impact on surface streets during tunnel closure. These partners established a Monitor & Maintain Committee to conduct baseline and follow-up measurements for transit riders, general purpose traffic, and pedestrians.

Link light rail will begin using the tunnel with buses in 2009.

What happened to transit travel times on the surface streets?

After some initial backups and confusion, travel times have improved in many cases compared with pre-closure conditions. This is true for both transit and private vehicles on surface streets.

Bus trip times measured by the Monitor & Maintain Committee in January 2006, four months after the tunnel closed, were 11% slower through the study area after closure in September 2005. Travel times had improved drastically by March, as road users became used to changing travel patterns, transit schedules, and street restrictions. The average trip times documented in the following table include bus layovers. These trip times can be divided by two in order to roughly estimate the amount of time a bus rider spent traveling, for example, on Third Avenue between Yesler and Stewart.

Figure 1 Average Bus Trip Time Within Downtown Study Area

	Time (minutes)	% Travel Time Change from Baseline
Sept-05 (before closure)	21:59	(baseline)
Jan-06	24:30	+11
Mar-06	17:09	(-22%)
Aug-06	16:55	(-23%)
Jan-07	19:46	(-10%
Jul-07	16:21	(-21%)

Note: Travel time between entering and exiting the CBD, measured between 4 PM-6PM.
Data source: King County Department of Transportation, "Performance Report on Surface Streets in the Seattle Central Business District," Volumes 1-6.

Over the months, speed improved the most for buses routed along Third Avenue, where non-transit traffic was restricted during peak periods. When the tunnel reopened in September 2007, a study done by SDOT found buses on Third Avenue were traveling 20% faster than pre-closure.

Travel times became more variable for surface bus routes that formerly traveled through the dedicated underground tunnel. The most recent "Monitor & Maintain" report prepared by King County Department of Transportation observes, "Bus travel times on surface streets are still generally improved over pre-tunnel closure conditions, but riders of the routes that previously operated in the tunnel continue to experience longer trip times." Still, reliability on monitored corridors improved greatly between the initial closure and the July 2007 report.

What happened to transit ridership?

Sound Transit's Route 550 bus that previously routed through the tunnel experienced a slow but steady decline in ridership between 1999 and December 2006. Since December, Route 550 ridership numbers show a steady increase according to data collected by Sound Transit.

King County Metro bus ridership through the downtown core continued a rising trend through closure after a small dip in spring 2006.

Figure 2 King County Metro Bus Riders Crossing University Street

Fall 2004	95,000
Spring 2005	106,700
Fall 2005	106,400
Spring 2006	103,000
Fall 2006	106,200
Spring 2007	109,400

Data source: King County Department of Transportation, "Performance Report on Surface Streets in the Seattle Central Business District," Volumes 1-6. http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

By other measures, Metro ridership increased even more within the CBD overall. Buses entering the CBD gained almost 12,000 riders between spring 2005 and fall 2006. (Source: King County DOT) The Monitor & Maintain Committee also measured pedestrian wait times at bus stops before and after tunnel closure. At first, crowding increased. By the second report update in March 2006, however, improved bus reliability and customer knowledge of route changes brought wait times and queuing back down.

Metro bus on Third Avenue.
From istockphoto.com

What happened to general purpose surface traffic?

Tunnel closure partners also monitored general traffic flow along downtown corridors. By August 2006, King County reported travel times were within one minute of pre-closure conditions for morning and midday traffic. Evening rush hour travel times had become slower on certain streets, especially Stewart and 5th Avenues, but even these were within one to two and a half minutes of pre-closure travel times.

Due to Third Avenue travel restrictions, traffic volumes increased on parallel downtown streets. The Monitor & Maintain Committee notes that with less available excess street capacity, any incidents – traffic collisions, weather, or event traffic – cause more severe backups that take longer to clear. Nevertheless, surveys of CBD customers, including bus riders and drivers, concluded that, "While [users] have noticed some changes in how smoothly traffic flows in, through, and out of downtown Seattle…for the most part respondents have remained positive about their overall experiences, demonstrating the resiliency of the population to deal with construction impacts in order to effect transportation improvements." (Source: King County DOT 2007)

Were there any significant traffic disruptions?

Project partners collaborated on a Contingency Planning/Quick Response team to monitor conditions. Staff observed conditions on the ground

during peak commute times. During the initial adjustment period in September 2005, the greatest increased congestion and delay occurred on Stewart and Virginia Streets. A number of former tunnel routes began operating on these east-west corridors, and the evening peak delays were as high as 10- and 25-minutes on some days.

The Response team immediately responded with operational, scheduling, and other mitigation measures. Transit agencies removed some buses from Stewart, altered schedules, and reduced stops along these streets. The City of Seattle implemented advance pedestrian crossing signals and more parking restrictions during peak hours to reduce conflicts. Hotel charter bus and public transit zones on intersecting streets were relocated, closed, or otherwise altered to ease bus congestion. As a result, by March 2006, travel times improved by five to seven minutes, bus routes were more reliable, and travel through the Stewart corridor became faster than before tunnel closure. (Source: King County DOT)

What did governments do to prepare and react to such challenges?

The Contingency Planning/Quick Response team that identified and addressed the Stewart and Virginia challenges was only one of a number of mitigation efforts. Partners from King County, the City of Seattle, Sound Transit, and Community Transit devoted $16 million to complete pre-construction mitigation measures. Before the tunnel closed, these agencies:

Transit operations:

- Designated Third Avenue as a transit priority route by restricting through traffic and business access during peak commute times
- Added transit priority improvements and contra flow lanes on Olive Way, 9th Avenue, and 5th Avenue
- Planned the tunnel's closure and reopening to coincide with regularly-scheduled transit service changes
- Added shelters, benches, and lighting to 50 bus stops

The tunnel reopens, September 2007.

Street operations and signals:

- Improved traffic signs
- Completed street work at north and south entry points to downtown
- Installed a dynamic signal priority system for emergency vehicles
- Engaged police to enforce Third Avenue restrictions, intersection clearing during red lights, and pedestrian and cycling laws, as part of ongoing traffic control and enforcement activities

Communications:

- Coordinated public communication campaigns to alert transit riders, drivers, and downtown businesses to service and street changes
- Held community meetings and maintained website and email updates
- Worked directly with property owners and employers to address concerns before and during closure
- Created street teams to conduct in-person transit rider assistance

Business relations:

- Collaborated with the Downtown Seattle Association to plan police presence and improve trash collection and streetscape at storefronts
- Adjusted loading zones for businesses
- Expanded Transportation Demand Management programming, including offering Home Free Guarantee for individuals to purchase, free Plan Your Commute sessions and bus tickets, telecommute and bicycling workshops, and shopping guides to downtown businesses

- Increased marketing for Flexcar, Flexpass, and RideshareOnline.com

What can we learn from the tunnel closure?

This major change to surface street vehicle loads resulted in minor transportation problems, and even led to several improvements. The successful efforts of governments, employers, and individuals during the tunnel closure showcase diverse tools that help make traffic work even with increased load on the street grid. Agency partners planned early, carefully coordinated their resources, and fostered relationships with a wide variety of stakeholders. Perhaps most importantly, this was a multi-year closure that occurred during a time of significant growth and construction in downtown Seattle.

Many of the measures taken to mitigate construction effects will continue now that the tunnel has reopened. Signal improvements, transit-only and contra-flow lanes, and new transit and pedestrian infrastructure remain. As some bus routes return to the tunnel, 20 more will move to the ongoing transit-priority Third Avenue and reduce bus congestion on surrounding streets. Partners also implemented additional mitigation measures before the tunnel reopened, such as installing new electronic displays regarding peak-hour restrictions on Third Avenue, and creating better wayfinding signs, repainting crosswalks, and installing countdown crossing signals for people on foot.

All of these measures combine to support improved traffic flow on surface streets and better movement of people across all modes downtown. This case study is important in light of ever-increasing transportation demand in Seattle. Further, at some point during light rail operations, buses will again be excluded from the transit tunnel. Due to expanding bus service and demand, Seattle will again have as many buses on surface streets as during tunnel closure. Seattle residents, transit agencies, and government partners can now be confident that downtown streets can handle buses in these volumes.

Sources

City of Seattle, "Downtown Seattle Transit Tunnel Closure," City of Seattle, http://www9.seattle.gov/transportation/tunnelclosure.htm (accessed November 15, 2007)

Downtown Seattle Transit Tunnel, www.seattletunnel.org (accessed November 15, 2007)

Downtown Seattle Transit Tunnel, "How Are Impacts to Downtown Seattle Being Minimized?", http://www.seattletunnel.org/project.asp (accessed November 15, 2007)

King County, "Keeping Downtown Seattle Moving: Partners mark on-time completion of Downtown Seattle Transit Tunnel retrofit," King County Executive Office, http://www.metrokc.gov/exec/news/2007/0918tunnel.aspx (accessed November 15, 2007)

King County, "Transit Tunnel Conversion Project," King County, http://transit.metrokc.gov/up/projects/tunnel-project.html (accessed November 16, 2007)

King County Department of Transportation, 2005. "Performance Report on Surface Streets

in the Seattle Central Business District: Volume 1: Baseline Conditions." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

King County Department of Transportation, 2006. "Performance Report on Surface Streets in the Seattle Central Business District: Volume 2: First Update – Post Tunnel Closure." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

King County Department of Transportation, 2006. "Performance Report on Surface Streets in the Seattle Central Business District: Volume 3: Second Update – Post Tunnel Closure." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

King County Department of Transportation, 2006. "Performance Report on Surface Streets in the Seattle Central Business District: Volume 4: Third Update – Post Tunnel Closure." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

King County Department of Transportation, 2007. "Performance Report on Surface Streets in the Seattle Central Business District: Volume 5: Fourth Update – Post Tunnel Closure." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

King County Department of Transportation, 2007. "Performance Report on Surface Streets in the Seattle Central Business District: Volume 6: Fifth Update – Post Tunnel Closure." http://transit.metrokc.gov/up/projects/tunnel-perfrpt.html (accessed November 12, 2007)

Sound Transit, Route 550 ridership data provided by Benjamin Smith, November 5, 2007.

Fact Sheet

Complete Streets

Issue #1. What is the Complete Streets movement?

Complete Streets is a national movement focused on promoting safe and convenient access and mobility for all users, including pedestrians, bicyclists, and transit riders, as well as freight and motor vehicle drivers. A complete street supports easy movement and crossing opportunities for multiple modes and for people of all ages and abilities.

The Complete Streets movement grew out of a desire to restructure transportation policies and practices to include all modes rather than focusing on auto level of service. Roads designed primarily for vehicle access may lack safe places to walk or bike, feel uncomfortable to people on foot or bicycle, or make reaching public transit difficult or dangerous. Streets that present barriers for any user group - pedestrians or transit riders, seniors or children – offer only incomplete access. The focus on moving cars has led to labeling non-motorized and transit travel as "alternative" modes rather than being recognized as significant mobility choices.

Complete streets policies strive to extend transportation goals beyond vehicle throughput and integrate routine consideration for all road users into every street project. Many jurisdictions have adopted policies and codes that promote investment in and design for complete streets, including Seattle, Portland, San Francisco, and Boulder.

Issue #2. What policies affect complete streets in Seattle?

In April 2007, Seattle adopted its Complete Streets ordinance. The ordinance is intended to shape roadway systems through "stating guiding principles and practices so that transportation improvements are planned, designed and constructed to encourage walking, bicycling and transit use while promoting safe operations for all users." The legislation guides investments for transporta-

Residential Complete Streets in Seattle: Holly Park and High Point

Recent residential complete streets improvements in Seattle include Holly Park and High Point residential construction. These mixed-rate housing developments replace former public housing projects that sat on cul-de-sacs and offered few amenities for non-motorized travel. The new streets are a narrow 28' wide, with short blocks providing multiple routes and on-street parking on both sides to naturally slow speeds. Sidewalks, curb ramps, street trees, tight curb returns, and houses close to the street further protect pedestrian safety and accessibility and create a well-defined walking environment.

Credit: Dan Burden

Credit: Dan Burden

Complete Streets in Seattle: Stone Way at North 45th Street

In 2007, a repaving project on Stone Way stimulated a simultaneous road diet and improved pedestrian, bicycle, and ADA facilities. Prior to the repaving, Stone Way at North 45th Street was a four-lane roadway with difficult pedestrian crossings often at unsignalized intersections. Today, this segment consists of two vehicle travel lanes, a center turn lane, and bike lanes. Crosswalks were repainted using a ladder style and vehicle stop bars.

In addition to these improvements, bus shelters and street signage were refurbished for better wayfinding and transit rider experience. New curb ramps were installed at each corner of the intersection, street trees were added, and sidewalks were repaired to improve pedestrian safety, comfort, and accessibility. The two travel lanes plus a center turn lane design allows for the potential addition of a crossing island in the future. A pedestrian overlay zone here now requires any new buildings to be brought up to the street to support the walking environment. The photo below pictures a new street-fronting building that follows this overlay zoning. This mixed-use building replaces a former fast food restaurant surrounded by a parking lot and vehicle drive-through.

Source: Peter Lagerwey, Seattle Bicycle and Pedestrian Program

tion projects and street improvements, specifically including those funded by the city's Bridging the Gap transportation package. Further, the Seattle Department of Transportation (SDOT) is required to incorporate complete streets principles into manuals, plans and policies, including the Transportation Strategic Plan, Seattle Transit Plan, and the Bicycle and Pedestrian Master Plans. Building complete streets supports the goals of Seattle's Climate Action Plan by improving high-capacity and non-motorized transportation options.

Seattle's existing street classification system and *Right-of-Way Improvements Manual* combine to provide design criteria that consider safety, service, environmental concerns, and multiple modes. Importantly, the April 2007 legislation recognizes that every street serves a different purpose and operates within a unique context. Acknowledging the diversity of street types, complete streets principles will apply and be realized differently on all roads in order to appropriately balance user needs. Seattle's Complete Streets ordinance directs SDOT to implement the desired policies in a manner consistent with street characteristics and the surrounding community. Certain improvements and streets – including ordinary maintenance and Major Truck Streets - are exempt from the complete streets requirements, to allow for flexibility in minimizing costs, protecting public safety, and ensuring designs appropriate to street use and context.

Issue #3. Why are complete streets important for livable communities?

A comprehensive approach to transportation provides people with choices about how to get around. Research has shown that more people walk, bike and take transit when facilities are available. This translates into improved health, minimized congestion and vehicle emissions, and enhanced opportunities for social interaction.

The not-for-profit organization Complete the Streets outlines several community benefits, summarized below:

1. **Safety improvement** – Complete streets can reduce crashes. Studies have shown that as the number and proportion of people bicycling and walking increases, deaths and injuries related to vehicle crashes decline.

2. **Community health** – Complete streets encourage more walking and biking.
3. **Mitigation for vehicle traffic congestion** – Complete streets provide travel choices and increase the overall capacity of the transportation network.
4. **Children's health and safety** – Complete streets allow children to gain independence and engage in physical activity through walking and cycling to explore their community.
5. **Climate change** – Complete streets provide alternatives to single-occupant vehicles. Shifting trips from driving alone to high-capacity transit and non-motorized transportation reduces greenhouse gas emissions.

Issue #4. What elements does a complete street include?

Complete streets are always unique to the community, context, and purpose served. Still, all complete streets policies and projects share a focus on accommodating the full range of mobility options and consider the entire right-of-way. Specific complete street elements may include, but are not limited to: design and operation of general travel lanes, sidewalks, pathways, trails, bicycle lanes, street and sidewalk lighting, pedestrian and bicycle safety improvements (including appropriate crossings), freight access improvements, access improvements consistent with the Americans with Disabilities Act, public transit facilities (including pedestrian access to transit stops and stations), street trees, landscaping, street amenities, dedicated transit lanes, buffer/stormwater facilities, or signal improvements to accommodate all modes and users.

Issue #5. When right of way is limited, how are decisions made regarding what modes are incorporated into a street?

Right-of-way width is often highly constrained, making it impossible to accommodate all modes equally well on every street. Seattle's Right-of-Way Improvements Manual and street classification system already provide basic structure and guidance on street design and decisions. Streets in Seattle are therefore not necessarily designed on a case by case basis. Decisions regarding limited right-of-way depend on the context or environment of a street or the design and function of adjacent streets in the network. Although perhaps not every street will be able to accommodate the most land-intensive version of each transportation mode, it is critical that a system exist for seamless mobility of all modes.

Seattle's Complete Streets ordinance differs from similar ordinances around the country in that it specifically identifies freight as an important street function. According to the ordinance, ". . . freight will be the major priority on streets classified as Major Truck Streets. Complete Street improvements that are consistent with freight mobility but also support other modes may be considered on these streets." Seattle designates Major Truck Streets to ensure that a complete road network is available to accommodate the unique needs of freight. This supports the complete streets goal of providing continuous, safe travel networks for all modes.

Sources:

City of Seattle, April 9, 2007. Ordinance 122386. "An ORDINANCE relating to Seattle's Complete Streets policy." Legislative Information Service. http://clerk.ci.seattle.wa.us/ (accessed December 26, 2007)

City of Seattle, April 30, 2007 (press release). "Council Passes 'Complete Streets' Law."

http://www.seattle.gov/council/newsdetail.asp?ID=7278&Dept=28 (accessed December 26, 2007)

Complete the Streets. www.completestreets.org (accessed December 26, 2007)

Extensive data is available on factors that affect mode choice, much of it summarized by Todd Litman at Victoria Transportation Policy Institute at www.vtpi.org/tdm/tdm20.htm (accessed December 26, 2007).

Photo Sources:

Peter Lagerwey, Seattle Bicycle and Pedestrian Program. Permission granted 12/24/2007

Dan Burden photos provided by Peter Lagerwey, Seattle Bicycle and Pedestrian Program. Permission granted 12/24/2007