

STORM-RELATED CLOSURES OF I-5 AND I-90: *FREIGHT TRANSPORTATION ECONOMIC IMPACT ASSESSMENT REPORT*

Winter 2007-2008

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**Washington State
Department of Transportation**

Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report

Winter 2007-2008

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Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report

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Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report

EXECUTIVE SUMMARY

Introduction and Project Purpose

This report documents the freight-related economic impact analysis undertaken by the Washington State Department of Transportation (WSDOT) in response to the storm-related closures of I-5 and I-90 in the winter of 2007-2008. The analysis will help make informed decisions about economic and infrastructure investments for the state's transportation system. The closures were the result of severe weather that overwhelmed the roadways and disrupted freight and passenger movements across the state and West Coast. In all, the highways were closed for eight days—four days for I-5 and four days for I-90. A chronology of events for both the I-5 and I-90 closures is shown to the right.

A New Methodology and Approach.

To obtain a more complete picture of the statewide economic impacts of the highway closures than is typically available through traditional economic impact assessment methods, WSDOT contracted with Washington State University's Social and Economic Sciences Research Center (SESRC) to conduct survey research and economic analysis of the two storm-related events. WSDOT staff and SESRC researchers worked together to design and develop a new economic assessment methodology that would provide the state's citizens and decision-makers with a reality-based, comprehensive analysis of the effects of the closures on the state's freight-dependent industries and the economy as a whole.

<i>Chronology of Events</i>	
I-5 Closure: December 2007	
Dec. 3	20-mile section of I-5 closed due to floodwaters. Governor Gregoire declares State of Emergency.
Dec. 4	SR 7 & US 12 detours opened to trucks with emergency supplies and perishable loads on a case-by-case basis.
Dec. 6	One lane opened in each direction to commercial freight vehicles. 11-mile section opened to all traffic.
Dec. 7	I-5 completely reopened to all traffic.
I-90 Closure: Jan. - Feb. 2008	
Jan. 29	I-90 at Snoqualmie Pass closed for avalanche control.
Jan. 30	I-90 reopened for 4 hours. I-90 closes again due to second avalanche.
Jan. 31	Governor Gregoire declares State of Emergency.
Feb. 2	I-90 reopened to all traffic.

Economic Impact Analysis: Methods and Data Sources

To effectively estimate the economic impact of the delay of freight movement during the I-5 and I-90 winter closures, WSDOT and SESRC developed a multi-phased analytic approach, involving:



Flooded community in Lewis County

- Direct survey of the trucking industry and freight-dependent sectors. A total of 2,758 surveys were received and analyzed, which represents 58 percent of all freight-dependent and trucking industry businesses in the sector.
- Estimation of business losses suffered by the trucking industry and freight-dependent sectors.
- Estimation of direct impacts on the economic output of the trucking industry and freight-dependent sectors.
- Estimation of the total economic impacts on the state, including indirect and induced impacts, as well as impacts on output, employment, personal income, and state sales tax receipts as a result of freight delay. WSDOT used the survey results to inform the state's input-output economic model, IMPLAN, which estimated the ripple effects of the closures as they spread throughout the economy.

This study does not include local business economic impacts, costs to passenger vehicle delays, or road maintenance and repair.

Economic Impact Analysis Findings

Key Analytic Findings. As shown in the exhibit below, the total loss from freight delay identified, due to the two corridor closures, was almost \$75 million. More than \$47 million of the total loss is attributable to the I-5 closure, with almost \$28 million attributable to the I-90 closure. Employment loss, defined as estimated job loss for one year following the economically disruptive event, was 460 jobs. Sales tax revenues lost are estimated at \$3.81 million, and reduction in personal income is estimated at \$23.15 million.

The study also examined the distributional impacts of the closures by region, finding that businesses in all regions of the state were affected by the highway

Exhibit ES-1: Summary of Statewide Freight-Related Economic Impacts from the 2007-2008 Closures of I-5 and I-90 (in \$ Millions)

Type of Economic Impact	I-5 Closure	I-90 Closure	Total Impacts Due to Closures
Total Lost Economic Output (\$ Million)	\$47.07	\$27.89	\$74.96
Employment Loss (Estimated Job Loss for One Year Following the Closures)	290	170	460
State Tax Revenue Loss (\$ Million)	\$2.39	\$1.42	\$3.81
Reduction in Personal Income (\$ Million)	\$14.55	\$8.60	\$23.15

Source: WSDOT Freight Systems Division IMPLAN Modeling, 2008

closures to a similar degree of severity. The coastal counties experienced relatively more severe impacts to businesses and the economy during the I-5 closure, including the effects of the closures of 65 other roadways in the area.

Qualitative Data and Findings. In addition to the quantitative analysis of economic impacts of the two highway closures, the report also presents qualitative information on the impacts to businesses and communities. Four case studies and comments received from businesses and local government representatives convey a snapshot of what organizations were dealing with as they worked to maintain business operations during the closures.

Lessons Learned and Recommendations Going Forward

WSDOT is using the study findings to develop additional strategies to respond quickly during future disruptions. The following recommendations are included in this report:

Provide More State Support and Investment for Maintenance Activities. The December 2007 flood caused approximately \$18 million in damage to state highways. During the I-90 closure, WSDOT crews worked around the clock to clear the highway of snow and avalanche danger. Rising costs for deicer materials, coupled with the increased usage and the exceptional labor hours required for the I-90 response, resulted in a \$9.1 million overage in actual expenditures versus planned expenditures for winter 2007-2008.

Develop a Parking Plan. When truck drivers can't find designated parking, they park on freeway ramps, along the road shoulder, and at weigh stations. Improving truck parking would improve roadway safety by decreasing the number of trucks parked illegally and by providing truck drivers a safe and legal place to park, when they become fatigued or must meet the federally-required 10-hour rest periods after 11 hours of driving.

**Mitigating Chehalis River Flooding:
Chehalis River Basin Flood Program.**

The state of Washington has made a commitment to reducing flood damages in the Chehalis River Basin. The 2008 Washington State Legislature provided \$50 million to begin addressing flooding issues and conduct flood hazard mitigation projects throughout the basin. The newly formed Chehalis River Basin Flood Control Authority is conducting a study to examine options for flood mitigation in the larger Chehalis River Basin, including rural areas of Lewis, Grays Harbor, and Thurston Counties.

With the flooding experienced last winter, the Washington State Legislature and Governor Gregoire provided \$50 million to begin addressing flooding issues and implementing flood hazard mitigation projects throughout the basin. The Chehalis River Basin Flood Control Authority is conducting a basin-wide study and the US Army Corps of Engineers is working on a flood-control project at Centralia and Chehalis. Collaborative efforts will focus on basin-wide solutions that provide flood protection and prevent economic loss for all the basin communities as well as I-5.

Determine Use of Detour Routes to I-5. When I-5 was closed in December 2007 because of the flooding, WSDOT established a primary truck detour along I-84 in Oregon and over I-82 and I-90 in Washington. This route added 440 miles to a 200-mile trip from Portland to Seattle. The SR 7 and US 12 routes were made available for trucks carrying emergency supplies and perishable items, but implementing the distinction between "emergency" and "non-emergency" shipments proved problematic on the ground. To enable use of these routes in the future, the state will need to take several actions, including working with local communities and developing plans on when, how, and where to provide detours on local roads; conducting a highway capacity assessment; and developing written protocols for which classifications of freight will be allowed to use the route and with what priority.



A pedestrian signal nearly submerged by the Lewis County floodwaters

Build a Safer Mountain Pass: The I-90 Snoqualmie Pass East Project.

The identified Preferred Alternative for the I-90 Snoqualmie Pass East Project provides for extensive reengineering of the snowshed, culverts, and bridges to decrease avalanche and rock slide danger and mitigate the road closures caused by such events. This project will add an additional lane in each direction,

for a total of six lanes along the 15-mile stretch from Hyak to Easton. Along with the lane expansion, areas for vehicles to chain up will also be lengthened and the sharp curves around Lake Keechelus will be reduced to increase sight-distance.

The first phase of construction will begin in 2009, with heavy construction commencing in fall 2010. The second phase of the project addressing the remaining ten miles from Keechelus Dam to Easton is still awaiting funding.

Continue to Improve Communication with the Truck and Freight Industry. WSDOT communicated with affected businesses and communities during and after the closures. This was done to provide timely and accurate information to the freight industry through a variety of traditional and innovative methods. To target information specifically to freight shippers and carriers, WSDOT developed a freight email list and sent several messages, called truck stops with updates on road conditions, provided information to trucking channels on Satellite radio, distributed flyers and detour maps directly to truck drivers, and kept the WSDOT Web site updated with alternative truck routes. Recommendations for improving communications include:

- Upgrading WSDOT’s information technology system to better communicate road conditions and truck detour routes.
- Providing more timely and predictive information.
- Providing more cameras to provide real-time information.
- Continue using innovative communication strategies and social media tools.



Trucks on I-90 during the winter storm before the closure

Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report

1.0 INTRODUCTION AND PROJECT PURPOSE

1.1 Project Overview and Background

The purpose of this report is to document the freight-related economic impact analysis that Washington State Department of Transportation (WSDOT) undertook in response to the storm-related closures of I-5 and I-90 in the winter 2007-2008. The closures came as a result of severe weather that overwhelmed the roadways and disrupted freight and passenger movements across the state and West Coast. The closures were remarkable in many respects—for the sheer volume of rain, wind, and snow that covered the roads; for the impacts on travelers who were stranded on the highways; for the tenacity and hours worked by WSDOT crews as they rerouted traffic and worked to reopen the highways; and for the significant business and other losses experienced by the firms and communities across the state.



**Traffic waiting for I-5 to
reopen on Dec. 7**

The I-5 closure was also noteworthy in that it was similar to the storms and resulting events that transpired in 1990 and 1996, when major storms flooded I-5 near Chehalis, forcing closures of the highway for up to four days.

Press Inquiries About Economic Impacts. The genesis of this study came during the I-5 closure, when members of the media—seeing hundreds of trucks sitting idle for miles and miles—asked WSDOT how much the disruption was costing the state. In response, the agency provided a preliminary estimate of \$4 million per day in additional costs to trucking companies. This figure was based on the traditional approach to economic impact assessment, which multiplies the average number of trucks using the affected portion of I-5 (10,000 per day) by an estimated \$400 additional cost to take the detours. To many observers, as well as WSDOT staff, this figure seemed unreasonably low.

Designing a New Approach. WSDOT wanted to obtain a more complete picture of the economic impacts of the winter 2007-2008 I-5 and I-90 closures on the state's freight sector. WSDOT contracted with Washington

State University's Social and Economic Sciences Research Center (SESRC) to conduct survey research and economic analysis of the two storm-related events. WSDOT staff and SESRC researchers worked together to design and develop a new economic assessment methodology that would provide the state's citizens and decision-makers with a reality-based, comprehensive analysis of the effects of the freight system disruptions on the state's freight industry and the economy as a whole.



Traffic waiting for I-90 to reopen on Jan. 30

The methodology developed for this project represents a broader approach than is often used in traditional economic impact analysis. It allowed findings to be made about the inter-relationships and cascading economic impacts of even a brief road closure to freight movement. The survey protocol used also provides an opportunity for the freight community to share information and feedback with WSDOT. This feedback includes perspectives on what road condition and routing information the firms used in their decision-making during the closures. Firms also gave feedback on what worked well operationally and what could be improved by WSDOT during closures.

1.2 Overview of this Report

This report contains six sections. In addition to this introductory section, the report encompasses:

- **Section 2:** A summary of the specific events associated with each highway closure.
- **Section 3:** The economic impact analysis methodology and data sources used in the study.
- **Section 4:** Findings of the economic impact analysis.
- **Section 5:** A qualitative perspective on the highway closures, including four case studies and direct comments from affected businesses and local governments.
- **Section 6:** Summary and conclusion.

2.0 WEATHER-RELATED CLOSURES OF I-5 AND I-90: WHAT HAPPENED

2.1 The December 2007 Storm and Closure of I-5

Rain, Snow, Wind, and Heavy Flooding. Beginning on December 1, 2007, a severe storm generated extremely high winds, more than three feet of snow in the Cascade Mountains, and rain and flooding across the state. During the height of the storm, there were sustained winds of 40 to 50 mph, with hurricane-force winds of 80 to 130 mph in coastal areas. One-day rainfall totals reached 11 inches in Bremerton, in the Puget Sound Region and 8.6 inches near Montesano, along the Olympic Peninsula. Communities experienced fallen trees, landslides, and downed power lines blocking roads. Several communities had their highway access blocked by trees and flooding and thus were isolated. In many urban areas, rainwater overwhelmed drainage systems and water pooled on roadways.

<i>Chronology of Events</i>	
I-5 Closure: December 2007	
Dec. 3	20-mile section of I-5 closed due to floodwaters. Governor Gregoire declares State of Emergency.
Dec. 4	SR 7 & US 12 detours opened to trucks with emergency supplies and perishable loads on a case-by-case basis.
Dec. 6	One lane opened in each direction to commercial freight vehicles. 11-mile section opened to all traffic.
Dec. 7	I-5 completely reopened to all traffic.

Four-Day Closure of I-5 Near Chehalis. Rain combined with melting snow from the mountains created extremely high floodwaters on I-5 in the Chehalis area. With 12 feet of flowing water on the highway in some places, a 20-mile section of I-5 was closed on December 3, 2007. In all, the highway was closed for four days, with approximately 10,000 trucks per day needing to find alternate



Flooding on I-5 in Lewis County

routes to navigate around the affected segment. This closure mirrored the 1996 storm, which similarly resulted in closure of I-5 near Chehalis for four days. I-5 is the principal north-south commerce corridor on the West Coast linking Canada to Mexico and connecting mega regions such as Seattle, Washington and Los Angeles, California.

State of Emergency Declared. The flooding affected the road network across the state. In addition to I-5, WSDOT needed to close 65 other state highways due to flooding, landslides, and thousands of fallen trees. In recognition of these challenges, Governor Christine Gregoire declared a State of Emergency on December 3. Estimated highway damage from the storm was \$23 million for state routes and another \$39 million for city and county roads.



Governor Gregoire, Transportation Secretary Hammond, and Washington State Patrol Chief Batiste inspect flood damage in Chehalis

Detour Routes Established. WSDOT responded to the closure by providing email updates to freight companies on the agency’s listserv and by frequently updating WSDOT’s Web site with the most current information on detour routes and road conditions. These updates provided companies and truckers with the best information available, enabling them to plan and strategize as much as possible. WSDOT also established several detour routes through southern Washington and Oregon, and worked with the Washington State Patrol and the National Guard to enforce limited use restrictions on the detour along SR 7.

In February 1996, a similar event closed I-5 near Chehalis for four days. During the closure, WSDOT detoured freight vehicles along SR 7 and US 12 through various rural communities. Community members and officials became concerned about the noise, safety hazards, and road damage resulting from the excessive traffic. WSDOT was notified of their concerns and these previous complaints, along with the primary issues of lack of capacity and safety, contributed to WSDOT’s initial decision not to use this detour during the 2007 Chehalis flood.

The detour along SR 7 and US 12 is the shortest—adding just 85 miles to the trip—but was not made available to freight on the first day of the I-5 closure for reasons explained above. The need for a shorter route quickly became clear as trucks with crucial supplies for the flooded communities were delayed, and by December 4, trucks carrying perishable goods and fuel, and trucks with supplies for local communities were allowed to use this detour on a case-by-case basis.

Detour Triples 200-Mile Trip to More Than 600 Miles. As a practical matter, there are no substitute routes to effectively transit I-5. The interstate is the West Coast’s major north-south corridor for both freight and auto traffic, so establishing detours during the closure was a challenge. As shown in the map in Exhibit 1, WSDOT established a primary truck detour along I-84 in Oregon and over I-82 and I-90 in Washington. This route added 440 miles to an approximately 200-mile trip from Portland to Seattle. Because following this primary detour route along the interstate system was the longest detour, many trucks instead took US 97, which still added approximately 344 miles to the trip.

Exhibit 1: I-5 Truck Detour Routes



Source WSDOT, 2008

The longest detour—the primary route along the interstates—took an additional 8.5 hours of driving time from Seattle to Portland. By the third day of the closure, trucking companies were at risk of losing drivers due to federally mandated Hours of Service regulations which require truck drivers to take a 10-hour rest period after 11 hours of driving. Many drivers were close to timing out of their allowable drive time, which would pull them out of service when they were most needed.

Costs to Trucking Firms and Communities. Trucking companies reported that the I-5 detours took a substantial toll on their businesses, requiring double the resources—including drivers, power units, and trailers—to make the longer trips. According to members of the Washington Trucking Association, the additional fuel and overtime labor costs of taking one truckload around the primary detour was \$800 to \$850. Taking the shorter detour on I-84 to US 97 to I-90 cost them over \$500 more per truckload.

Trucking companies tried to meet customers' needs and schedules by assigning double the number of trips and drivers to transit the long detours. However, even with these additional resources, the detours were so long that truckers could only make half of their normal deliveries. Critical deliveries of food, medicine, fuel, perishable goods, and disaster relief supplies were missed or delayed. The closure also disrupted delivery of freight to the Port of Tacoma, bound for southeastern Alaskan communities. Many of these communities are dependent on Washington freight services for groceries and other essential supplies.

State and Federal Emergency Funding Made Available. While the storm and flooding was detrimental to the statewide economy, it had a devastating impact on communities in the Chehalis-Centralia area. Many families lost their homes and livelihoods due to flood damage. In response, on December 24 Governor Gregoire announced \$300,000 in emergency assistance from the Governor's emergency funds to those affected by the flooding. President Bush also issued a federal declaration naming Washington's flood a major disaster, which made federal disaster aid available to supplement state and local recovery efforts.

I-5 Opens for Semi-Trucks Only.

Receding floodwaters and action by WSDOT maintenance crews to breach a dike on state right-of-way land enabled first partial and then full reopening of the highway. By Thursday evening, December 6, WSDOT crews were able to open one lane in each direction to commercial vehicles over 10,000 gross vehicle weight. Later that evening, crews opened an 11-mile portion of southbound I-5 to all traffic. Finally, late Friday morning December 7, 2007, I-5 was completely reopened to all traffic.



Freight vehicles were allowed to use the newly opened lane of I-5 before all other vehicles

2.2 The January 2008 Snowstorm and Closure of I-90

I-90 is the longest Interstate highway in the United States stretching from Seattle to Boston. It is the main highway route for east-west commerce in the state linking Puget Sound to Spokane in eastern Washington. The route connects eastern Washington agriculture businesses and other industries with urban markets in northwest Washington and Puget Sound, along with global markets via the Ports of Seattle and Tacoma. On a typical weekday, approximately 6,500 trucks travel over I-90 at Snoqualmie Pass. It's a strategic freight corridor because of the international and domestic trade it carries.

Snow and Avalanche Threats Require Closure of Snoqualmie Pass. The winter of 2007-2008 brought extremely heavy snows and avalanche danger to Snoqualmie Pass. For the last two weeks of December, chains were required for all vehicles traveling across the pass, and at one point, WSDOT crews worked around the clock for six days to reduce the avalanche danger.

<i>Chronology of Events</i>	
I-90 Closure: Jan. - Feb. 2008	
Jan. 29	I-90 at Snoqualmie Pass closed for avalanche control.
Jan. 30	I-90 reopened for 4 hours. I-90 closes again due to second avalanche.
Jan. 31	Governor Gregoire declares State of Emergency.
Feb. 2	I-90 reopened to all traffic.

Beginning in late January, less than two months after the Chehalis area flooding closed I-5, the state experienced another major freight system disruption. This time, record snowfall and warm temperatures in the mountain passes closed I-90 at Snoqualmie Pass from January 29 through February 2, 2008. WSDOT crews worked non-stop to clear the roadways of snow, but avalanches continued to be a threat and Snoqualmie Pass remained closed for almost four days. As with the closure of I-5 the previous month, Governor Gregoire issued a declared a State of Emergency for the area.

Storm and Closure Chronology. The storm began with near-record snowfalls and high winds hammering the eastern part of the state. On Monday, January 28, steady snow fell in the Cascade Mountains, putting closures into motion on all mountain passes:

- On Tuesday, January 29, I-90 was closed for avalanche control for 28 hours.
- WSDOT reopened the I-90 pass, but after only four hours, an avalanche trapped two motorists and forced WSDOT to close I-90 again.
- Snoqualmie Pass on I-90 remained closed for another 61 hours, finally reopening at 4:00 a.m. on Saturday, February 2.
- The total time of closure for I-90 during the 4-day period was 89 hours.

Heavy Snowfall and Closure of Stevens and White Passes. Heavy snow, coupled with extreme avalanche danger, also resulted in the closures of Highway 2 at Stevens Pass, totaling 82 hours, and Highway 12 over White Pass several times in January and February 2008. Both passes experienced extreme weather conditions and associated risks to travelers. Stevens Pass saw winds over 100 mph and near-record snowfall, with a season-ending total of 605 inches. At White Pass, 267 inches of snow fell during the 16-day period between January 26 and February 10, including 78 inches within a 48-hour period.

By the end of the season, total snowfall for White Pass was recorded at 679 inches. There were also multiple avalanches at White Pass, including one that covered the highway with 20 feet of snow and destroyed many trees in its path. As a result, White Pass was closed for a total of 59 hours from February 7 to 10, 2008.

Limited East-West Detour Options. While under normal conditions most commercial truckers prefer and are often instructed to use I-90 rather than secondary routes, with most of the state’s east-west routes closed, trucks were left with very few options. WSDOT’s recommended detour routes, shown in Exhibit 2 below, called for trucks to detour southward along I-82 to I-84 in Oregon. But severe weather also caused a closure of I-84 between Pendleton and La Grande for a time, cutting off all east-west detour routes.

Exhibit 2: Pass Closures and I-90 Truck Detour Routes



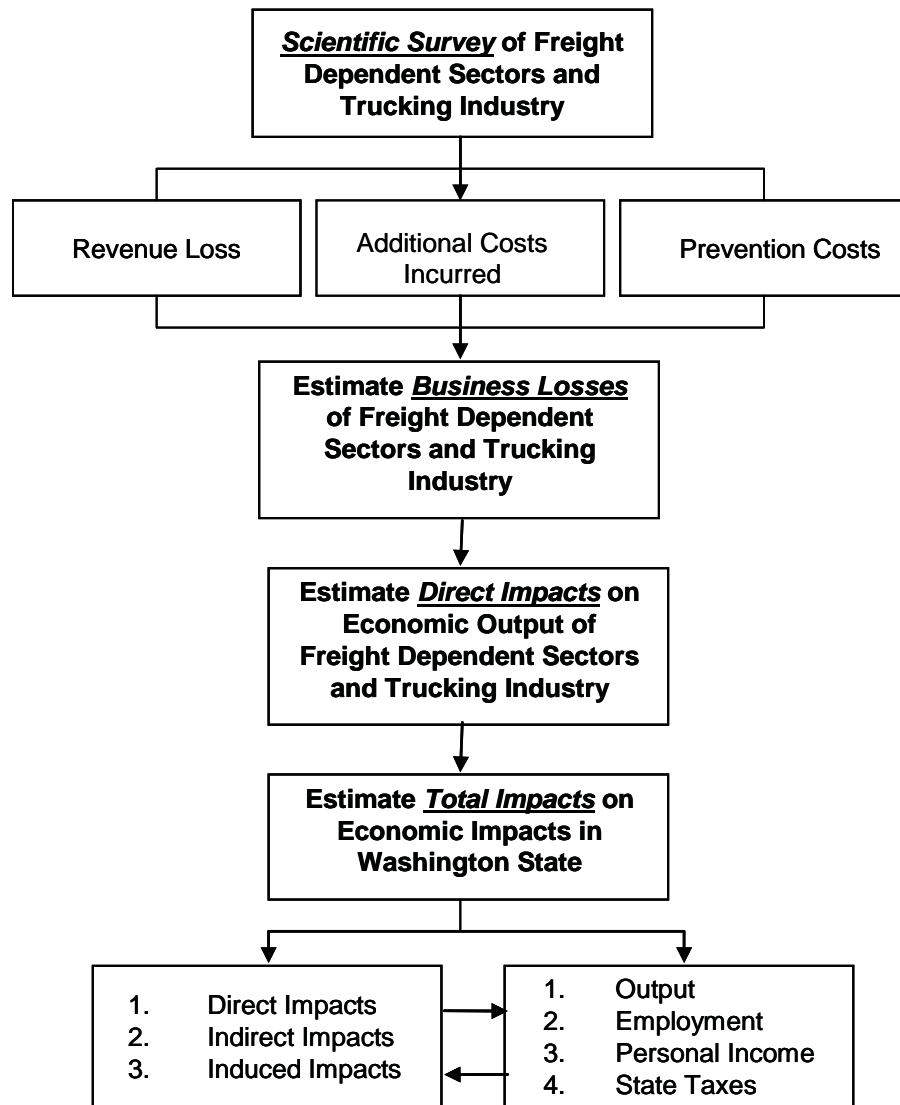
Source: WSDOT, 2008

3.0 ECONOMIC IMPACT ANALYSIS: METHODS AND DATA SOURCES

3.1 Overview of Methodology

To effectively estimate the economic impact of the I-5 and I-90 winter closures, WSDOT and SESRC developed a multi-phased analytic approach, as shown in Exhibit 3 below.

Exhibit 3: Economic Impact Assessment Methodology Used to Estimate the Freight-Related Impacts of I-5 and I-90 Winter Storms Closure



Source: WSDOT and SESRC, 2008

This approach was based on four major tasks:

- Direct survey of the trucking industry and freight-dependent sectors, including queries about revenue losses, additional costs incurred, and prevention costs.
- Estimation of business losses suffered by the trucking industry and freight-dependent sectors.
- Estimation of direct impacts on the economic output of the trucking industry and freight-dependent sectors.
- Estimates of the total economic impacts for Washington State, including indirect and induced impacts, as well as impacts on output, employment, personal income, and state tax receipts.

Defining and Assessing Direct Economic Impacts. Direct impacts are defined as the additional costs and lost sales revenues incurred by freight-dependent industries during and immediately after the highway closures. Direct impacts also include the investments firms reported needing to make to lessen the impacts of future disruptions on I-5 and I-90 in the affected areas. Three types of direct losses were assessed in this study:

- **Loss of Sales or Revenue.** These estimates focus on losses incurred by firms who could not deliver products for their customers in time, including losses associated with perishable goods. Losses could also be incurred because firms did not receive the orders their customers had placed.
- **Total Additional Costs During Closure.** These business losses relate to actions taken by firms as a result of the road closures. Examples include costs associated with delay, detour, use of alternative modes of delivery, and other actions, which caused additional costs. Such costs encompass increased fuel charges, increased wages and overtime pay for drivers, additional communication costs, higher costs of using alternative methods for delivery of goods, and other operational costs.
- **Total Additional Costs After Closure.** The third type of loss is the additional spending firms plan to undertake after the closures, in order to prevent future loss and retain customers.

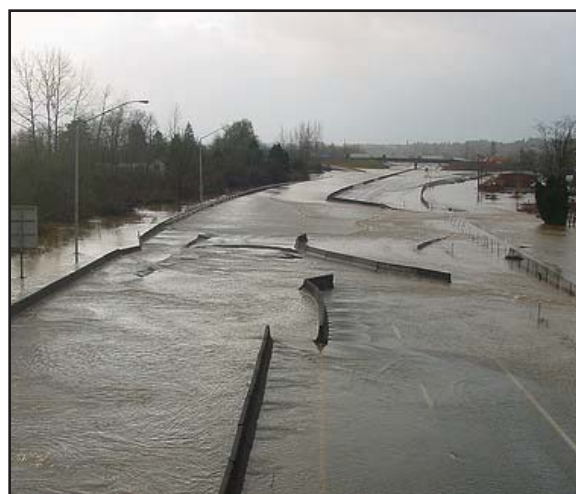
3.2 Key Analytic Methods: Direct Survey, IMPLAN Analysis, and Distribution Effects Analysis

Direct Survey of Trucking Firms and Companies with Private Fleets. SESRC surveyed firms statewide in February and March 2008. The Research Center randomly sampled owners and operators of trucking firms registered in the state, including for-hire trucking companies as well as companies that operate private fleets whose primary business is in one of the state's freight-dependent industry sectors. A total of 2,758 surveys were received and analyzed.

IMPLAN Analysis: Using the Washington State Input-Output Model. WSDOT used the Washington State input-output economic model, developed using IMPLAN, to estimate the ripple effects of the closures as they spread throughout the economy. The IMPLAN model was used to estimate the total economic impacts of the I-5 and I-90 closures, including the cascading effects of the closures (direct, indirect, and induced impacts). Since the input-output model requires inputs in terms of revenue or employment, the additional costs incurred both during and after the road closures were converted into revenue changes based on the price elasticity of truck transportation. These data assumed that additional costs of truck freight transportation were built into the price of service and passed along to consumers.

Understanding the Distribution of Economic Impacts.

A distributional impact analysis was also conducted to describe who was impacted by the closures, where the impacts were, and what the intensities of the impacts were. This analysis helped generate additional understanding of the economic impacts of the closure. In assessing the impacts of the highway closures on the state as a whole, the study found that the closures had far-reaching effects, which were experienced fairly equally statewide. For example, companies in Spokane suffered similar losses from the closures as those incurred by firms in the Puget Sound Region.



I-5 damage resulting from the severe flooding

3.3 Comparing and Contrasting the Approach with Traditional Economic Impact Analysis Methods

The traditional approach to estimating freight-related economic impacts involves multiplying the number of trucks delayed on the road by a predetermined value-of-time factor, to establish an economic value of the delay incurred. In contrast, the approach used in this project began with SESRC conducting a statistically valid survey of affected companies to quantify the actual costs incurred by freight-dependent firms as a result of the highway closures.

This unique methodology was developed to provide a more comprehensive, on-the-ground estimate of the actual losses incurred by businesses as a result of the highway closures. Thus, while more typical economic impact methods are based on high-level assumptions, including use of vehicle delay as a proxy for true economic impacts, the approach used in this study identifies revenue losses, including the direct, indirect, and induced impacts of losses incurred. This is important, since revenue losses account for about 60 percent of total business losses from road closures.

The findings of this study demonstrate the interconnectedness of business activity in the state, and suggest that analysts can do a better job of understanding the economic impacts of disruptions to transportation infrastructure by including revenue loss estimates in their calculations.

3.4 Conservative Estimates of the Economic Impacts

The economic impacts reported in this study are higher than estimates produced by traditional analytic methods. This is because the study not only captured the actual direct costs and lost sales incurred by trucking firms during the highway disruptions; it also documented similar losses in freight-dependent industries such as manufacturing, agribusiness, construction, timber and wood products, retail and wholesale goods, and the trade and logistics sectors. The study then accounted for the total effect of these impacts throughout the state's economy.

Although the study's economic impact findings are higher than those likely to be generated using traditional impact assessment methods, they should be considered conservative estimates. This is due to the following factors:

- The survey was conducted in February and March 2008, and at that time some survey respondents had not completed documenting their storm-related costs. Consequently, the full incremental costs of closure may not be encompassed by the reported numbers.
- The study was originally planned to include all in-state and out-of-state commercial truck registrants doing business in Washington. However, the study's researchers were not able to correlate databases for out-of-state truck owners with in-state databases without significant reprogramming.

Such reprogramming was not feasible given the time and budget constraints of the study. Therefore, the business losses of Washington firms associated with out-of-state commercial truck registrants are understated, and losses accruing to out-of-state companies doing business in Washington are not included in the findings.

- This study likewise does not include local business economic impacts related to the closures, unless they were caused by disruption of the freight systems.
- Automobile delays and the costs associated with such delays were not included in this study.



Traffic waiting for avalanche control crews

4.0 ECONOMIC IMPACT ANALYSIS FINDINGS

4.1 Total State Economic Losses

As shown in Exhibit 4 below, the total loss in economic output to Washington State's economy due to the two freight system disruptions was \$75 million. More than \$47 million of the total loss is attributable to the I-5 closure in December 2007, and almost \$28 million is attributable to the I-90 closure in January-February 2008.

Exhibit 4: Summary of Statewide Freight-Related Economic Impacts from the 2007-2008 Closures of I-5 and I-90 (in \$ Millions)

Type of Economic Impact	I-5 Closure	I-90 Closure	Total Impacts Due to Closures
Total Lost Economic Output (\$ Million)	\$47.07	\$27.89	\$74.96
Employment Loss (Estimated Job Loss for One Year Following the Closures)	290	170	460
State Tax Revenue Loss (\$ Million)	\$2.39	\$1.42	\$3.81
Reduction in Personal Income (\$ Million)	\$14.55	\$8.60	\$23.15

Source: WSDOT Freight Systems Division IMPLAN Modeling, 2008

This total loss encompasses direct, indirect, and induced economic impacts, as further described in Sections 4.2 and 4.3 below.

The breakdown in losses by category is as follows:

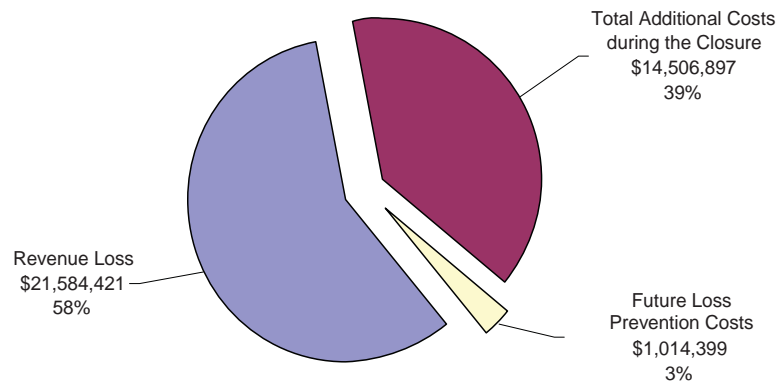
- **Employment Losses.** Employment loss is defined as estimated job loss for one year following the economically disruptive event. The analysis shows that, due to the two highway closures, Washington State didn't reach its economic potential for the year. The economy was smaller than it would have been and the state lost jobs. The analysis concludes that approximately 460 more people would have been working in the state during the year following the events if the closures had not taken place.

- **Sales Tax Revenue Losses.** The state also lost tax revenues due to the reduction in economic activity caused by the closures. Freight-dependent industries lost sales and produced lower taxable revenue, with the state losing close to \$4 million in tax revenues.
- **Reduction in Personal Income.** Workers and families throughout Washington State lost over \$23 million in personal income from the two freight system disruptions. The I-5 closure is responsible for \$14.5 million in lost personal income and the I-90 closures for \$8.6 million.

4.2 Total Direct Business Losses

As shown in Exhibit 5, an estimated \$37.1 million in direct business losses were incurred during the two highway closures. Averaging both incidents, 58 percent of these losses are directly attributed to loss of business sales, 39 percent is attributed to additional costs such as fuel and overtime pay for drivers, and about three percent of loss is attributed to future loss prevention costs.

Exhibit 5: Direct Freight-Related Business Losses Due to the 2007-2008 Closures of I-5 and I-90



Source: WSU/WSDOT Economic Impact Survey of I-5 and I-90 Winter Storm Closures, 2008

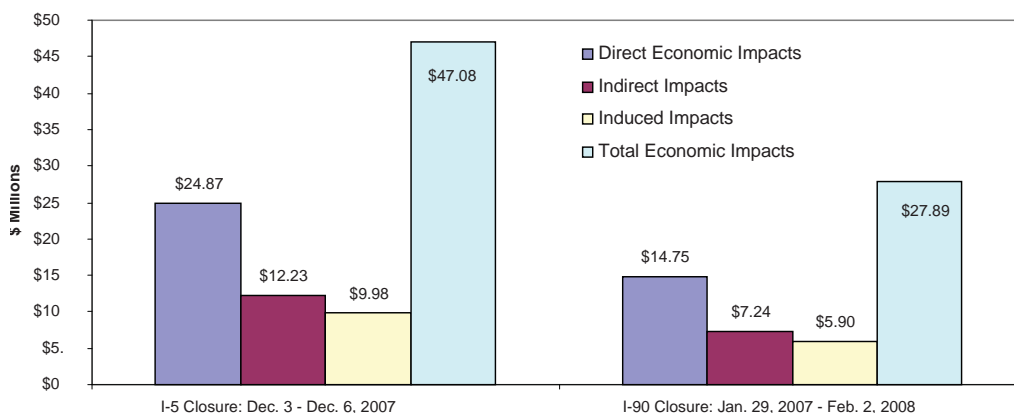
4.3 Direct, Indirect, and Induced Business Losses by Event

The direct impacts to freight-dependent industries caused indirect damage to suppliers and customers. These indirect impacts create additional impacts as decreased spending and lower efficiency cascades through the state’s economy. These economic impacts affect employment, personal income, government revenues, such as taxes, and other economic activities across the state. As previously noted, the sum of the direct, indirect, and induced impacts equals the total economic impact of the two disruptions to the state’s freight systems, estimated at almost \$75 million.

Exhibit 6 presents the breakdown of the direct, indirect, and induced costs from both closure events. As the exhibit shows:

- The \$47.08 million in total economic loss from the closure of I-5 is comprised of: \$24.87 million in direct economic impacts; \$12.23 million in indirect impacts; and \$9.98 million in induced impacts.
- The \$27.89 million in total economic loss from the closure of I-90 is comprised of: \$14.75 million in direct economic impacts; \$7.24 million in indirect impacts; and \$5.90 million in induced impacts.

Exhibit 6: Direct, Indirect, Induced, and Total Freight-Related Impacts on Economic Output due to the I-5 and I-90 Winter Storm Closures (in \$ Millions)



Source: WSU/WSDOT Economic Impact Survey of I-5 and I-90 Winter Storm Closures, 2008

4.4 Economic Impact by Region: Trucking Industry and Freight-Dependent Sectors

The analysis identified economic impacts for the trucking industry and freight-dependent sectors within each of the state's seven major geographical regions. As shown in Exhibit 7 below, businesses in all regions of the state were affected by the highway closures to a similar degree



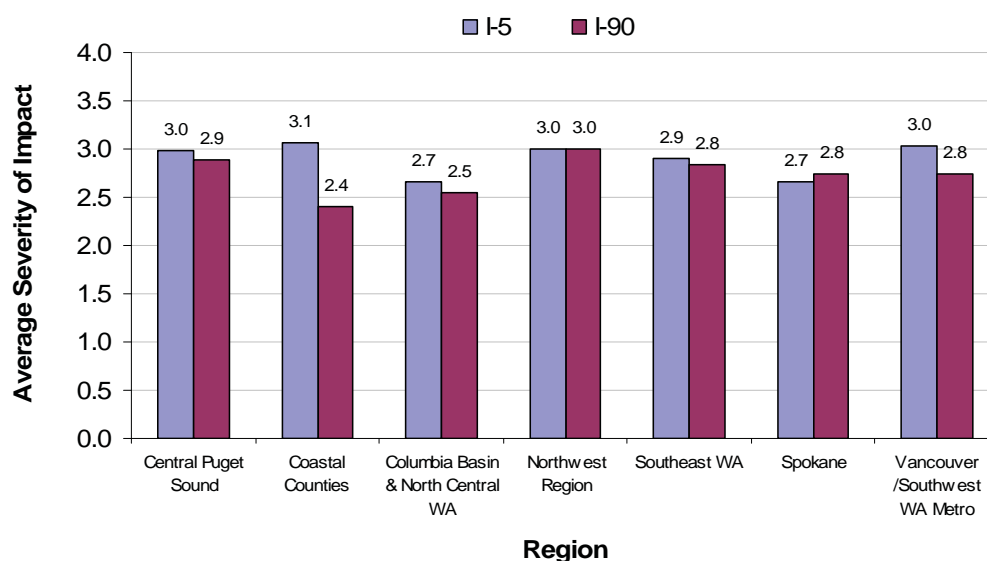
Flooded I-5 Exit 79 in Chehalis

of severity, except for the coastal counties. In those counties, the I-5 closure caused relatively more severe impacts to businesses and the economy.

It should be noted that quantification of these impacts is limited to the trucking and freight dependent industries; local business impacts associated with the closures are likely not captured in these numbers. Going forward, future studies could be broadened to include this information, which could potentially be obtained by incorporating a local business survey in the study design.

Exhibit 7: Freight-Related Impact by Region of the 2007-2008 I-5 and I-90 Closures

(1=No Impact; 4=Severe Impact)



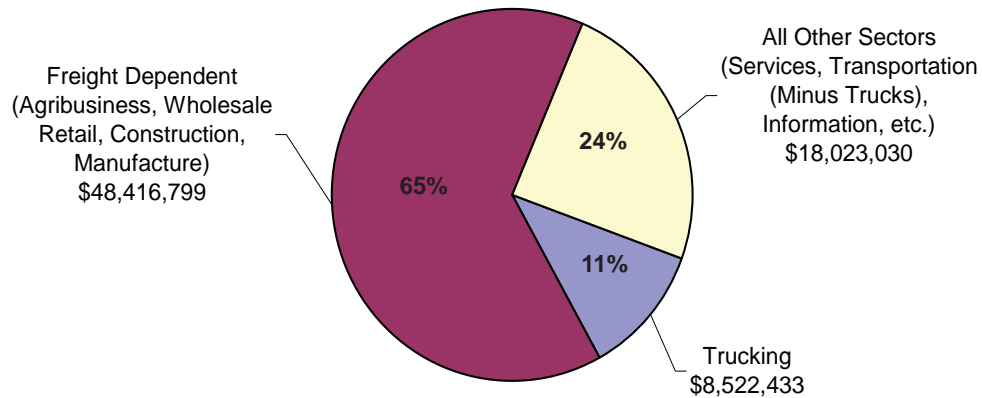
Source: WSU/WSDOT Economic Impact Survey of I-5 and I-90 Winter Storm Closures, 2008

4.5 Impact by Business Nature

Exhibit 8 shows the distribution of total lost economic output due to the two freight corridor closures on three groups of business sectors:

- The trucking industry, which accounted for 11 percent of loss of economic output.
- Freight-dependent industry sectors, including agribusiness, forest and wood products, construction, manufacturing, wholesale, and retail sectors, accounted for 65 percent of the impact.
- All other economic sectors, which were affected indirectly by the closure accounted for 24 percent of the total.

Exhibit 8: Total Freight-Related Economic Impacts from I-5 and I-90 Winter Storm Closures on Different Industry Sectors

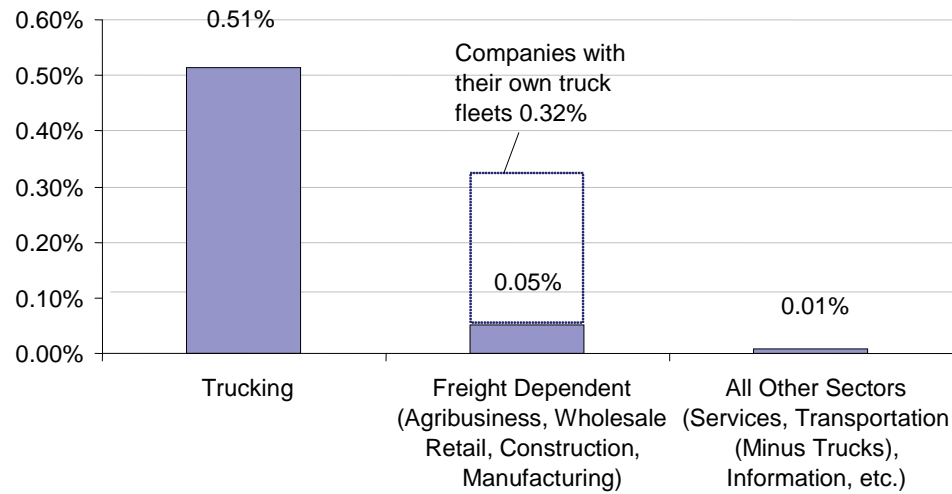


Source: IMPLAN modeling based on data from WSU/WSDOT Economic Impact Survey of I-5 and I-90 Winter Storm Closures, 2008.

4.6 Lost Revenues and Sales

The study documented the amount of revenue lost by the state's companies during the closures relative to their total annual revenue, as shown in Exhibit 9. The state's trucking industry, which depends on the state's primary freight corridors for their daily businesses, suffered the highest percentage of lost revenues. Trucking companies reported losing 0.51 percent of their total annual revenue because of the two highway closures. For a small trucking company with \$2 million in annual revenue this would represent \$10,200 in lost revenue—not including additional costs from the closures. For a larger trucking company with \$50 million in annual revenue, lost revenue from the combined eight days of closures would average \$255,000.

Exhibit 9: Percentage of Companies' Total Freight-Related Annual Revenues Lost Due to the I-5 and I-90 Closures



Source: WSDOT Freight Systems Division, 2008

On average, Washington State’s freight-dependent sectors lost 0.05 percent of their total annual sales revenue. Freight-dependent companies that operate their own truck fleets lost 0.32 percent of their total revenues. All other sectors lost approximately 0.01 of one percent of the year’s sales revenues; representing \$5,000 for a company with \$50 million in sales. Although these non-freight-dependent sectors reported a lower percentage of lost sales, they comprise a large share of the state’s economy.

4.7 Impacts by Type of Commodity Shipped and Frequency of Shipments

The study found a difference in the severity of impacts between types of commodities shipped. Perishable commodity shippers generally experienced higher business losses than non-perishable goods carriers.

Similarly, losses were higher for firms with 50 or more shipments per week (0.16 percent loss of annual sales), compared with firms with fewer than 50 weekly shipments (0.01 percent loss of annual sales).

5.0 QUALITATIVE IMPACTS OF THE HIGHWAY CLOSURES: CASE STUDIES AND STORIES FROM THE FIELD

This section presents case studies of four very different companies affected by the highway closures. The case studies provide useful qualitative information on the impacts and effects of the closures on the firms' business operations and ability to meet customer needs. Also included in this section are direct quotes from firms and local governments regarding on-the-ground impacts of the closures, and WSDOT's response to the situation.

5.1 Business Case Studies: Impacts on Agricultural, Food Distribution, and Aerospace Firms

These case studies demonstrate the role and importance of the state's transportation system to businesses and the state's economy. The four freight-dependent companies highlighted represent the food processing, grocery, agriculture, and manufacturing industries. As the case studies show, a company's product, industry, location, supply chain system, and emergency preparedness all were key factors in the impacts the firms experienced and their ability to respond to the closures.

Case Study #1: Draper Valley Farms – Mount Vernon, Washington

Draper Valley Farms raises and processes chicken sold fresh in Washington and Oregon. The company operates close to 30 trucks on I-5, including 17 live chicken trucks, four feed trucks, one hatchery truck, and eight finished-good trucks. The company's operations are dependent on I-5, with trucks driving feed, live chickens, eggs for hatching, and product along the I-5 corridor. Each week, Draper Valley Farms ships more than 200 truckloads of "locally-grown, all natural fresh chicken" in Washington and Oregon.



Chicken farms near Chehalis rely on I-5 for transporting feed

A Dangerous Situation for Livestock. The I-5 closure posed a life and death situation for live chickens from Draper Valley Farms. During the closure, the primary alternative truck routes was a 440-mile detour over the mountains on I-90 Snoqualmie Pass. Draper Valley Farms needed to truck birds between its chicken farms south of Chehalis and the Seattle area but was concerned about the welfare of the birds. The chickens would be in danger of freezing, if they were trucked over the mountain pass on the recommended alternate route. With ideal temperatures for transporting live poultry between 42 and 86 degrees, transporting birds through the snow-covered mountains during the cold of winter was a hazardous option.

“Travel distances, cold weather, wind, and other factors can affect the birds’ well being. Animal welfare is our number one priority. We have strict policies in place for keeping our birds comfortable,” said Bob Wolfe, Vice President and General Manager. “We called WSDOT and explained that we had live chickens that we couldn’t bring over the mountains because of the cold temperatures. WSDOT’s understanding and assistance was fantastic—they found a way to get our trucks through back roads and get the birds where they needed to go.”

The live chickens made it safely, but Draper Valley Farms tripled or quadrupled their logistics costs moving other products and supplies during the I-5 closure. Two trucks flooded at the Chehalis warehouse facility and had to be drained and repaired. The company had to reroute trucks and cancel or delay close to 65 shipments. The 440-mile detour added truck driver expenses such as lodging, meals, and overtime, and fuel and shipping costs increased significantly.

“Fortunately, the flood did not damage any live chickens,” said Wolfe. “But we had birds on the ground in ranches and needed to get them fed. The I-5 closure cut us off from the feed mills. We had to detour our trucks over Snoqualmie Pass, adding six hours to a 3-hour drive.”

Lost Product and Revenue. Draper Valley Farms had to shut down their processing plant for a day and a half during the I-5 closure. The company typically processes 80,000 chickens per day getting about five pounds of meat per chicken. That week, they lost production of approximately 600,000 pounds of chicken.



Draper Valley Farms lost sales during the flood

Draper Valley Farms also lost about \$50,000 in sales, because they could not get their delivery trucks with their perishable product to several customers. The company sells their chickens fresh, not frozen. If the trucks couldn’t deliver, the product would be damaged and dumped. Instead of throwing it away, Draper Valley Farms gave away a truckload of chicken, valued at \$30,000, to families displaced during the flooding in the Chehalis area.

Emergency Plan Improvements. Many of the company employees live and work at the mill and on ranches in the Chehalis area. Draper Valley Farms had good internal communications with staff and a good crisis plan in place. The company reported that, due to this emergency and the practical experience gained, they are more prepared for future disruptions. They enhanced their plan, defined alternate routes, and developed a faster response system.

Case Study #2: Walla Walla Gardener's Association – Walla Walla, Washington

On behalf of its 33 member farms, the Walla Walla Gardeners' Association brokers, markets, and sells fresh asparagus and Walla Walla sweet onions under the Gloria brand. The Association's business model is a low overhead operation that delivers produce directly "farm to market."

The Association is the oldest sweet onion house in the country. It employs 150 people at the firm's distribution center in Walla Walla where the Association stores, markets, and distributes produce year-round. The Association typically delivers about six truckloads of fresh produce to Seattle markets each week, including the sale of storage onions during the off-season.

Unable to Make Crucial Deliveries. Due to last winter's storms and the closure of I-90, the Walla Walla Gardeners' Association was unable to deliver fresh produce to the Seattle market for a week. The closure meant six truckloads—or \$70,000 to \$150,000—in lost sales to family-owned farms.

"Every delivery is critical to the bottom line," said Thayne Stone, National Sales and Marketing Manager for the Association. "We are dedicated to protecting our farmers. They live and die by the sales and depend on the profits to put meals on their tables."

Seattle area grocery stores and restaurants supplied by the Association depend on the shipments of fresh produce. Nearly every supermarket and food service supplier in Seattle carries the Association's Walla Walla sweet onions and asparagus.

"Supermarkets hold small inventories of fresh produce and ran out of onions after just a few days," said Stone.

"It's amazing how reliant we are on the trucking industry to get people the goods they need daily."

Increased Expenses. During the winter storms, two company-owned semi-tractor trucks were making deliveries when I-90 was closed. One empty truck was stuck on the west side of I-90. The truck driver was anxious to get home, but was unable to cross the closed mountain pass. The Association paid the truck driver's overtime and expenses while he waited for the highway to reopen. The other truck was re-routed, but with the additional mileage and expenses, the company had to sell the product at a loss. Other scheduled deliveries were canceled or delayed.

The Importance of Reputation. The Walla Walla Gardener's Association has delivered produce to the Seattle and Portland markets since the 1940s and is well established. Although their customers were upset about running out of product, they understood and continued buying from the Association once the roads reopened.



Stores and restaurants ran out of produce items

Case Study #3: Safeway, Inc. – Chehalis, Washington

During the December 2007 flood on I-5, floodwaters and mud inundated the Chehalis Wal-Mart Super Center, K-Mart, and Home Depot. With I-5 closed, most nearby retailers closed their businesses.

A Vital Link in Supplying the Community.

One lone Safeway store, located on dry ground just south of downtown Chehalis, was the only major grocery store that remained operational. While other stores had to dump truckloads of perishable, frozen, and refrigerated food, Safeway kept its doors open and served the Chehalis community.



“We were the only big store still open. We were able to help people move their prescriptions from flooded stores to the Safeway Pharmacy so they could get their critical pharmaceutical needs met,” said Jason Moulton, Safeway’s Loss Prevention Director and Emergency Planning Coordinator for Montana, Idaho, Washington, and Alaska. “If we weren’t open, I don’t know where residents

would have gotten food, water, medicine, and emergency supplies.”



Flooded Chelais Wal-Mart parking lot

Residents flocked to the Safeway store to purchase fresh food and necessary supplies for their families. Because of the emergency, some people panicked and loaded up on staple items such as bread, milk, bottled water, perishables, and canned goods. They also purchased candles and other

non-food items. The shelves were empty within a day or two because of the huge demand for food and supplies.

“We were not able to get normal deliveries into the Chehalis store because of the flooding and road closures,” said Joel Leisy of Safeway Trucking. “The store was wiped out. We needed to restock the shelves and keep them stocked. The community also needed huge amounts of drinking water.”

Previous Arrangements Ensured Delivery. As a result of prior established relationships with Washington State Emergency Management, Safeway was able to obtain special clearance from the Washington State Patrol to get trucks access through restricted roads to deliver loads of groceries to the Chehalis store. Instead of the usual couple of pallets of bottled water, Safeway brought in an entire truckload of water. Employees and shoppers cheered when the store manager announced that a semi-truck full of bottled water had pulled into the parking lot.

Regional Effects. Restocking the stores in the hard-hit areas of Chehalis and Centralia was simple compared to the challenges of getting product from south of the flooded area to Safeway's main distribution facility in Auburn, Washington. The distribution center provides goods for 200 stores in Safeway's Seattle Division, including Alaska. Much of the food sold in Washington is produced in California and trucked north on I-5 to Auburn. On a typical day, 120 to 130 trucks deliver product to Safeway's Auburn distribution center. However, during the I-5 closure, many of Safeway's suppliers could not make their scheduled deliveries. Others experienced delay or had to reroute shipments over the mountain passes.

The Auburn distribution center holds a 10-day supply of basic food items. Safeway had to re-route trucks through Oregon and over the mountain passes to re-stock the distribution center and stores. The long detour increased fuel costs, doubled driver expenses, and reduced on-hand supplies in the distribution center to a 3- to 5-day supply.

Taking Care of the Community. Safeway strives to take care of its customers and neighbors and makes giving back to the community a priority. During the flood and road closures, Safeway donated food and emergency supplies to displaced families through organizations such as the Red Cross.

Case Study #4: The Boeing Company – Seattle, Washington

The I-5 closure presented a huge challenge to Boeing’s Puget Sound Licensed Transportation Service Group. One of the team’s core services is the movement of high-value production parts to support Puget Sound production systems. The group is responsible for making sure that the right parts are delivered—at the right time—to support their internal business partners’ strategies.

The Transportation Service Group provides an internal transportation fleet to haul freight to areas on Boeing sites where the trucking industry does not have access. Truck drivers haul products and parts with a fleet of semi-trucks, two-ton trucks, and one-ton pickups.

Internal Freight Essential to Success. Boeing maintains a global supply base, and the firm’s lean approach to airplane manufacturing requires minimal inventory. Mechanics use roll-on and roll-off supply carts delivered at the point of use.

“Depending on how critical a resource is and how soon it’s needed, we step in. Vendors don’t guarantee deliveries in less than 72 hours, and we may need a part line-side in an hour,” said Robert Sullivan, the group’s senior operations manager. “We pick up the product and deliver it straight to mechanics working on the airplanes.”



Freight transportation is critical for delivering airplane parts to Boeing’s production line

Finding a Way. When I-5 closed, Boeing had to find another way to make its four daily trips from the Seattle area to the factory in Portland, Oregon. The group solved the problem by taking alternate routes over the mountain passes. Because of the additional mileage, and to stay within the federal required driving hour limits, Boeing doubled the number of truck drivers from four to eight. Trucks were sent back and forth over the mountain passes four times a day. Drivers swapped trailers in Yakima where they stayed overnight. This approach involved increased transportation costs due to driver overtime and travel expenses, and the additional fuel costs.

“This was the worst road closure I can remember,” said Sullivan. “One of Boeing’s leadership principles is to ‘find a way’ through a problem toward

a solution and that's exactly what we did. It's critical to keep the Boeing production system moving smoothly.”

Boeing was able to react quickly using its private fleet and the resources at its disposal. The company was nimble and found ways to move resources and keep their production line moving. In recognition of this problem-solving approach, the Washington Trucking Association has recognized The Boeing Company with a “private fleet award” two years in a row.

Contributing to the Community. The Boeing Company also made a large corporate donation to help rebuild flood-damaged areas in Washington and Oregon. Boeing Corporate contributed \$250,000 toward Northwest flood relief, and Boeing employees likewise contributed \$124,101.

5.2 Businesses and Local Governments Speak: Comments from the Field

During the highway closures, WSDOT made a significant effort to keep businesses, shippers, dispatchers, and other freight systems users informed about the highway conditions and route options. In addition to the public information outreach, WSDOT sent more than ten email updates to the 900+ contacts on the freight email distribution list. WSDOT also created daily “Trucker Information” flyers with detour maps that the Incident Response Team staff and State Patrol distributed door-to-door to truckers waiting in line. Variable message signs were driven throughout truck stops to notify drivers that the closures were long-term and the 511 hotline was kept up to date.

During the I-5 closure in particular, WSDOT was praised for its effective communication. Specifically, the email updates were identified as the most helpful tool for the freight companies, followed by information on the WSDOT Web site and the Webcam reports. The information provided was lauded as detailed and timely. Companies that were able to use the SR 7 and US 12 detour were also grateful for the recognition that emergency supplies and perishable goods needed to be given priority. Many companies also commented that they appreciated I-5 being opened only to commercial trucks initially to enable the trucks to reach their destinations more quickly.



Traffic waiting for I-5 to reopen

The following comments are excerpts from a much longer compendium of questions, feedback, and information requests conveyed to WSDOT during the I-5 and I-90 closures. Taken together, the comments reflect the importance of opening the freight corridors, and the urgency firms and local agencies experienced during the closure periods.

Freight Feedback From the Field:

I would like to personally thank you for the timely updates, throughout this ordeal. I have been forwarding your updates as needed to area truck lines and other business interested groups, and they were very appreciative of the updates.

-Kathleen A. Johnson, Chairman
Cowlitz County Board of Commissioners

Thanks for all the help. Your communications have kept us rolling and getting our needed parts to the prime locations for all our airplane programs...Thanks for everything and please keep in touch.

-Scott A. Garl, Passenger Service Manager,
Site Services—Licensed Transportation
Boeing

WSDOT is to be commended for its swift, and professional reaction during a very difficult situation. Thanks again for being our voice.

-Larry Pursley,
Washington Trucking Association

We really appreciate getting these bulletins. My brother lives and works in Chehalis. He said it is an enormous mess.

-John Ryan,
Toysmith

Thanks very much for developing an e-mail update. You folks have done a great job during this disaster. Keep up the good work.

-Mark Mochel, Business Development Manager,
Yakima County Development Assoc.

I just wanted to pass along my appreciation that the resiliency plan not only indicates recovery of freight movement is priority number #1, but that in a real crisis, we are living the plan. Thank you for your influence to get the freight moving.

-Rick Bingle,
REI

I wanted to know if Sysco can get into Centralia and Chehalis to make food deliveries. We have health care accounts in the area. I don't know if restaurants need food to support the community. We will also be making the Red Cross deliveries some time today. Please let me know. Thank you for all your help.

-Kenneth C. Christie, VP of Operations,
Sysco Seattle

I received the email you sent me on Monday regarding the I-5 closure. Thank you. I am the transportation manager for Rite Aid for the West Coast and we have a distribution center in Wilsonville, Oregon that services Oregon, Washington, Idaho and Utah Rite Aid stores. I had heard that certain truck loads were being allowed to take the detour on Highway 12 and was wondering if we would be able to use this detour to get to our stores. We are pulling extra supplies for our stores due to the flooding such as water, propane fuel, candles, etc. and running out of transportation resources to get these needed supplies to our customers because of the extra time it is taking us to go around the I-5 closure. Please contact me if it is possible for us to run up I-5 to make these deliveries happen. If it would help we could return on the detour east. Thanks and good luck with the problems you are facing due to the storm.

*-Craig Southard,
Rite Aid*

Thanks for the updates. I have heard just recently that there may be one lane open tonight, have they issued a time? I will have about 8 trucks headed north around 11 pm tonight, it would be nice for them not to have to take the bypass. Thanks again.

*-Joe Van Domelen, On Site Manager,
Rite Aid Distribution Center*

I wish to recognize the extraordinary efforts of the Washington State Department of Transportation's Freight Systems Group. [The] team, through constant and accurate information, feedback, and actions minimized our company's, owners', and our milk hauler LTI Milky Way's financial losses during the current Chehalis flooding and wind storm damage in Southwest Washington.

Resiliency, communication and working with commerce to provide food and dairy products to stores, schools, and hospitals and pickup on farms was addressed quickly and minimized the disruption to the impacted citizens and farms in the area. Without their preplanning and the quick work of the team the impact to Darigold, our customers and dairy farmer owners could have been significantly greater. Thanks for the recognition and emphasis that you and your staff have demonstrated toward freight and commerce. We at Darigold appreciate it very much.

*-Mike Bevers, Director of Logistics,
Darigold, Inc.*

6.0 SUMMARY AND CONCLUSIONS

6.1 Summary of Approach and Key Findings

In response to the winter storm-related closures of I-5 (December 2007) and I-90 (January-February 2008), WSDOT's Freight Systems Division undertook a comprehensive economic impact analysis of the closure's effects on the state's freight transportation industry. WSDOT commissioned WSU's Social and Economic Sciences Research Center (SESRC) to undertake a new and more comprehensive approach to the economic impact analysis, involving direct survey of affected trucking firms and freight-dependent businesses statewide. In all, 2,758 surveys were completed, creating a rich data source for this analysis.

Economic Impact Findings. The direct business losses identified due to the two corridor closures was almost \$75 million. More than \$47 million of the total loss is attributable to the I-5 closure, with almost \$28 million attributable to the I-90 closure. Employment loss, defined as estimated job loss for one year following the economically disruptive event, was 460 jobs. Sales tax revenues lost are estimated at \$3.81 million, and reduction in personal income is estimated at \$23.15 million. The study also examined the distributional impacts of the closures by region, finding that businesses in all regions of the state were affected by the highway closures to a similar degree of severity, except for the coastal counties, which experienced relatively more severe impacts to businesses and the economy.



Alternative transportation down Louisiana Avenue near the airport in Chehalis

The study's findings should be considered conservative, due to the following factors:

- When the survey was conducted in February-March 2008, some survey respondents had not completed documenting their storm-related costs. Consequently, the full incremental costs of closure may not be encompassed by the reported numbers.
- Because data was not available for out-of-state trucking firms, business losses for Washington companies that use these firms are understated.
- This study does not include local business economic impacts related to the closures, unless they were caused by disruption of the freight systems.
- Automobile delays and the costs associated with such delays were not included in the study.

6.2 Lessons Learned and Recommendations

WSDOT is using the study findings and lessons learned to develop additional strategies to respond quickly during future disruptions. Operational and policy recommendations for the agency to consider include:

State Support and Investment for Maintenance Activities.

The December 2007 flood caused approximately \$18 million in damage to state highways. During the I-90 closure, WSDOT crews worked around the clock to clear the highway of snow and avalanche danger. More snow and ice requires more labor, equipment, and materials to provide safer road conditions. Rising costs

for deicer materials, coupled with the increased usage and the exceptional labor hours required for the I-90 response, resulted in a \$9.1 million overage in actual expenditures versus planned expenditures for winter 2007-2008. A supplemental snow and ice budget amount of \$3.25 million was granted by the legislature and signed into law by the Governor. Additional investment in the state's snow and ice program is needed.



Crews working to clear an avalanche on I-90

Develop a Parking Plan. A parking plan for trucks stranded on the pass and along the highways is needed. Truck drivers need parking for federally-required 10-hour rest periods after 11 hours of driving. When truck drivers can't find designated parking, they park on freeway ramps, along the road shoulder, and at weigh stations creating safety hazards. Improving truck parking would improve roadway safety by decreasing the number of trucks parked illegally and by providing truck drivers a safe and legal place to park when they become fatigued.

Chehalis River Basin Flood Program. There is a long history of past efforts related to flooding of the Chehalis River and its tributaries. The most recent work is a federal study that



Crews repairing I-5 damage caused by the floods

was initiated in 1998 by the US Army Corps of Engineers (“Corps”). The study resulted in a recommendation to build a flood-control project at Centralia and Chehalis. The project received federal authorization in 2007 and is currently being re-evaluated using the most recent flood data.



I-5 Southbound completely submerged

With the flooding experienced last winter, the Washington State Legislature and Governor Gregoire provided \$50 million to begin addressing flooding issues and implementing flood hazard mitigation projects throughout the basin. The funding includes \$2.5 million for the newly formed Chehalis River Basin Flood Control Authority to conduct a basin-wide study, with the remainder intended to provide the non-federal match for the Corps project.

For the future, collaborative efforts between the Flood Authority, state, and Corps of Engineers will focus on basin-wide solutions that provide flood protection and prevent economic loss for all basin communities as well as I-5.

Detour Routes for I-5. When I-5 was closed because of the February 1996 storm, WSDOT detoured trucks along SR 7 and US 12. However, these routes run through several rural communities, and concerns were expressed by some in those communities about the noise, safety hazards, and road damage resulting from the additional traffic. WSDOT learned of these concerns and complaints, and as a result of this past experience combined with the route’s lack of capacity and safety issues, WSDOT decided not to make these routes available as primary detours during the 2007 I-5 closure. The SR 7 and US 12 routes were considered secondary and only made available for trucks carrying emergency supplies and perishable items. Implementing the distinction between “emergency” and non-emergency shipments proved problematic on the ground.



WSDOT Notification Vehicle

While SR 7 and US 12—two-lane roads with some winding curves—are not ideal routes for truck traffic, a shipper or trucker will always prefer the shorter,

more efficient route than the much longer detours that are otherwise required. To enable use of SR 7 and US 12 in the future, the state will need to work with local communities to develop plans on when, how, and where to provide detours on local roads. This will provide clarity and help prevent the confusion regarding access that occurred in the early days of the I-5 closure.

To prevent over-use of these detour routes, which can result in damage to the roadway and the creation of hazards, a highway capacity assessment should be performed to define more exact capacity estimates than currently are available for these roadways. Once the roadway capacities are established, WSDOT can define parameters for which freight will be allowed to use the route and with what priority. Defining priorities about how best to allocate available capacity, and communicating those priorities will help mitigate the need to make ad hoc, on-the-ground decisions about which vehicles are allowed to use the route. Instead, priority freight classifications should be defined and a permit system developed, with information made available to freight carriers well in advance of closures. This information will enable freight operators to plan their routes and resource needs more effectively.

Roles and Responsibilities. Another need identified post-event is clarification of responsibilities for enforcing detour use, and clear roles and responsibilities across agencies. During the I-5 closure, while WSDOT was responsible for identifying the classification of freight allowed to use the SR 7 and US 12 detours, the State Patrol and National Guard were on the ground enforcing the classifications. This resulted in some confusion and miscommunication on site. For example, there was one reported incident involving a truck allowed onto the detour route by the State Patrol, which was then stopped midway enroute by the National Guard. Establishing clear, written protocols for use, along with chain-of-command and communication procedures, would help mitigate these situations in the future.

The I-90 Snoqualmie Pass East Project.

The need to address the frequency of avalanche closures and overall road capacity on I-90 has long been a priority for WSDOT. This winter's closures further demonstrated how large the economic impacts are when this crucial link is severed. In 1996 WSDOT conducted the Hyak to Ellensburg Corridor Study, to identify problems and conceptualize solutions



Crews worked around the clock to clear Snoqualmie Pass

for I-90 on the eastern side of Snoqualmie Pass. Historically, the roadway from Hyak to Easton is closed an average of 80 hours a year due to avalanches, and has double the number of accidents than other rural sections of I-90.

To address these issues and improve the capacity of the roadway, the identified Preferred Alternative for the I-90 Snoqualmie Pass East Project was initiated. The identified Preferred Alternative for the I-90 Snoqualmie Pass East Project will add an additional lane in each direction, for a total of six lanes along the 15-mile stretch from Hyak to Easton. Along with the lane expansion, areas for vehicles to chain up will also be lengthened and the sharp curves around Lake Keechelus will be reduced to increase sight-distance. The project also provides for extensive reengineering of the snowshed and roadside slopes to decrease avalanche and rock slide danger and mitigate the road closures caused by such events. New culverts and bridges will also provide more safe crossings for wildlife, resulting in safer driving conditions.

Funding for the initial 5-mile phase of the project from Hyak to Keechelus Dam has been approved, with funding coming partly from the 2005 Transportation Partnership Funding Package. The project's Final Environmental Impact Statement was completed in August 2008, and outlined the effects of the new lanes and other elements on travel and the surrounding habitats. The first phase of construction will begin in 2009, with heavy construction commencing fall 2010. The second phase of the project, which addresses the remaining ten miles from Keechelus Dam to Easton, is still awaiting funding.

The successful completion of both phases of the I-90 Snoqualmie Pass East Project is a crucial step in mitigating the economic impacts caused by delays on Snoqualmie Pass. With the proposed improvements, the likelihood of closing the pass due to avalanches and rockslides would be greatly reduced, allowing for the more consistent passage of freight across the state.



Crews worked all night to clear a snow slide 30 feet deep



Tanker truck trapped by an avalanche on Snoqualmie Pass

Improving Communication with the Truck and Freight Industry.

WSDOT devoted considerable time and energy to communicating with affected businesses and communities during and after the closures, including a new approach to target information specifically to freight shippers and carriers. The following recommendations will improve communications with the freight industry:

Information and communication system upgrades are needed to communicate the road conditions. During the I-5 closure, WSDOT instituted the email alert system, which reached 900 contacts. By the time of the I-90 closure, nearly 3,000 contacts were included on the distribution list. With the addition of the Washington and American Trucking Associations, an estimated 10,000 contacts can be reached through the freight notification system. Freight messages were sent several times each day to provide maps, updates on road conditions, and information on safe and legal detours for trucks. Information technology systems that provide reliable, robust, real-time information are a critical part of the state's ability to communicate with the freight industry during extraordinary events, and investment in these systems is needed to ensure they are fully functional during weather emergencies and other crises.

More timely information. During the highway closures, the freight companies heavily used WSDOT's Web site, and relied upon that site more than general information provided by the media. While the information placed on WSDOT's Web site was accurate and detailed, companies need more timely and predictive information on road conditions, closures, and truck detours.

More cameras to provide real-time information. "A picture says a thousand words" and WSDOT's ability to obtain robust, real-time information and convey it out to the freight industry was aided by the cameras on I-90 and the temporary cameras placed on I-5. This on-site information was especially helpful to freight dispatchers, who were able to monitor ongoing progress.

Continue innovative communication strategies and use of social media tools. WSDOT used the agency's social media tools such as Flickr to publish photos, YouTube to publish video, and Blogger to help tell the story of how bad the winter storms were. WSDOT also provided information via trucker satellite radio stations. To communicate directly with truck drivers, WSDOT crews and the State Patrol hand delivered truck detour fliers along the routes. WSDOT also called truck stops with updates and drove variable message signs throughout area truck stops to let truck drivers know that the closure would be lengthy. Making extra efforts to reach truck drivers and freight companies through these new tools was helpful and should be continued for future disruptions.

WSDOT understands the role and importance of the transportation system for freight-dependent businesses and is working proactively to make improvements to the state's transportation system. This research validates the data we had and captures data we've never had before. We are using the information to develop additional strategies to respond quickly during future disruptions.