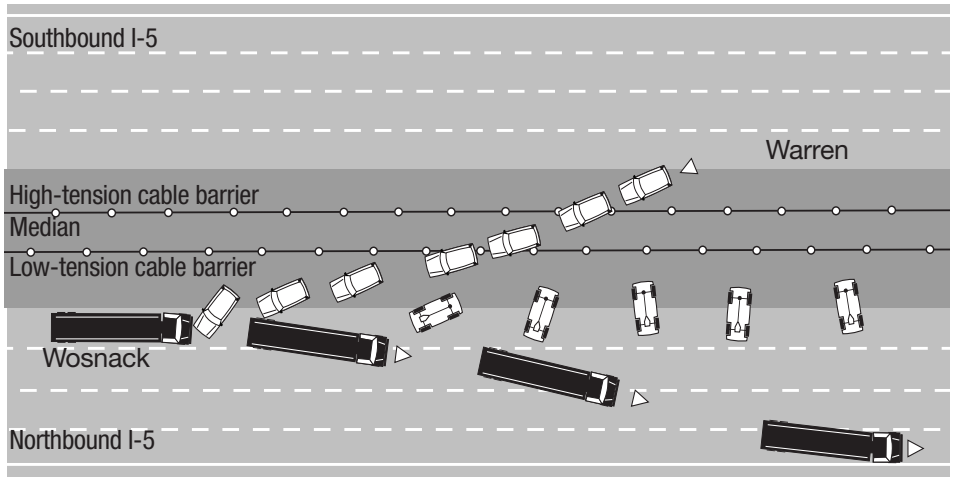
The fatal collision on I-5 in Marysville on Feb. 13, 2007

A fatal cross-median collision occurred on Feb. 13, 2007 on I-5 in Marysville. WSP's Major Accident Investigation Team examined the collision. The following information is summarized from their report, which can be found in Appendix D.

On Feb. 13, 2007, at 3:08 p.m., a fatal two-vehicle collision occurred on I-5 approximately 0.36 miles south of 88th Street Northeast in Marysville. Events leading to the collision began when a 2001 Infiniti QX4, driven by Clifford Warren of Everett, entered the southbound lanes of the freeway from the 88th Street Northeast on-ramp and suddenly veered left. A number of witnesses in the southbound lanes of I-5 observed the Infiniti as it veered sharply to the left from the right lane of the freeway and entered the median. Witnesses said the Infiniti did not appear to slow, and the brake lights were not activated prior to entering the median. Several witnesses said they saw the SUV's left turn signal activated as the vehicle began crossing the southbound lanes diagonally from right to left. The vehicle entered the median where it struck the high-tension cable barrier adjacent to the southbound lanes at an approximate 22 to 25-degree angle and drove over the barrier, bending one post over and dislodging a second. The vehicle continued to travel southeast and struck the low-tension cable barrier adjacent to the northbound lanes. The SUV hit the top two cables, carrying the top cable into the northbound left lane, where the SUV struck a Prevost charter bus head-on.

Figure 5.1



The force of the crash killed Warren instantly, according to the Snohomish County Medical Examiner. Sigrid Wosnack, the bus driver, suffered a broken femur and shattered knee.

The Medical Examiner did not find any other medical conditions that would have caused Warren's death. Investigators were unable to determine a specific reason why Warren drove his 2001 Infiniti QX4 from the 88th Street on-ramp across all three southbound lanes, leading to the collision with the bus. However, a likely contributing factor was the alcohol he had consumed prior to driving. Studies show that driving skills are significantly affected at a 0.07 blood alcohol content. According to the Washington State Liquor Control Board brochure "How Drinking Impairs Driving," even at a lesser blood alcohol

content of 0.05, one's thoughts, judgment and restraints are more lax, steering errors increase and vision is impaired. This condition significantly increases the potential for driving errors and the likelihood of a crash. At a minimum, Warren drove his vehicle in a negligent manner, unable to control his Infiniti as he entered the highway. RCW 46.61.5249 (1)(a) states in part: "A person is guilty of negligent driving in the first degree if he or she operates a motor vehicle in a manner that is both negligent and endangers or is likely to endanger any person or property, and exhibits the effects of having consumed liquor or an illegal drug." As a result of his own negligence, Warren crossed his entire intended direction of the freeway, crashed through the median barriers and collided with the bus driving in the opposite direction, clearly endangering all drivers in the immediate area.

How did the Infinity SUV override one cable median barrier and continue through a second cable median barrier?

WSDOT and independent experts from Safety Quest Inc., McKnight Laboratories, WSP's Major Accident Investigation Team and WSDOT's Materials Testing Laboratory investigated the collision to determine how the SUV got past two runs of cable median barrier. Related reports are in Appendix D.

What specific types of cable median barrier were involved in this incident?

The cable median barrier adjacent to the southbound lanes was a high-tension proprietary barrier known as a Cable Safety System, manufactured by Trinity Industries. In 2003, the Texas Transportation Institute crash tested this barrier in accordance with National Cooperative Highway Research Program Report 350 Test Level 3 criteria. The Federal Highway Administration accepted this barrier for use on the National Highway System in an acceptance letter dated May 13, 2003. The barrier was installed by Petersen Brothers Inc. under a contract executed by WSDOT on June 8, 2006. The barrier was installed approximately 12-feet from the edge of the southbound travel lane on a slope up to 6:1, which is consistent with national guidelines and manufacturer's recommendations. The design height of the Cable Safety System system is 29.8 inches. The measured height of the top cable of the high-tension system at the scene of the collision, as determined by independent engineering company Safety Quest Inc., was 28.8 inches. According to the report prepared by Safety Quest: "[T]his height is considered within construction tolerances and should not have affected the performance of the system," (See Appendix D, Safety Quest report, page 13). Furthermore, other three-cable barrier systems have been successfully tested with a 27-inch top cable height.

The cable median barrier adjacent to the northbound lanes was a low-tension system, referred to in the American Association of State Highway and Transportation Officials, et al., "A Guide to Standardized Highway Barrier Hardware" as Weak Steel Post Cable Guardrail SGRO1a-b. The Texas Transportation Institute crash tested this barrier in accordance with National Cooperative Highway Research Program 350 Test Level 3 criteria. The Federal Highway Administration accepted this barrier for use on the National Highway System in an acceptance letter dated Feb. 14, 2000.

Portions of the barrier were installed by Petersen Brothers under a contract executed by WSDOT on June 8, 2006. The barrier was installed approximately 17 feet from the edge of the northbound travel lane on a 6:1 slope. The design height of the top cable of the low-tension cable barrier is 30 inches. The measured height of the top cable of the low-tension system, as determined by Safety Quest was 29.8 inches.

Why did the SUV override the high-tension cable median barrier adjacent to the southbound lanes?

The analysis conducted for this report found that three factors may have been involved in allowing the Infinity SUV to override the high-tension cable median barrier adjacent to the southbound lanes:

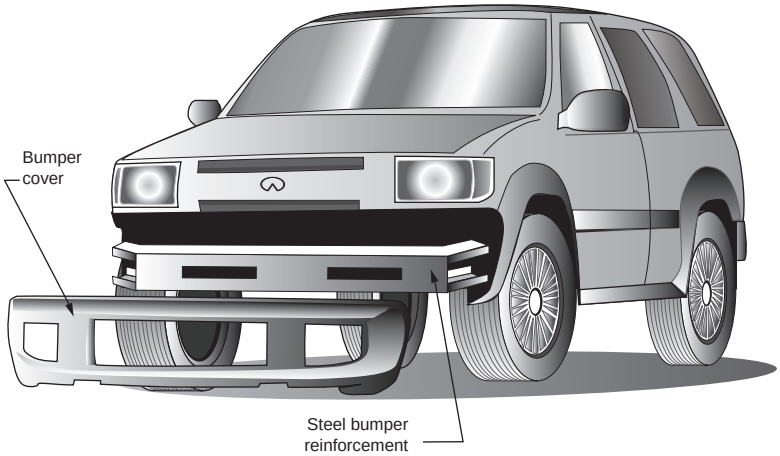
- the SUV's steel bumper reinforcement was higher than the cable median barrier.
- the placement of the barrier on a slope and the trajectory of the SUV may have allowed the SUV to hit the barrier in a fashion that compromised its ability to arrest the vehicle.
- the impact of the SUV at the top of a cable barrier post may have crimped the top of the cable barrier post.

Height of the bumper in relation to height of the cable median barrier

The Infinity QXR bumper has a large bumper cover. Both the bumper and cover are designed to withstand at least a 5 mph collision. A steel bumper reinforcement is located behind the bumper cover. The steel bumper reinforcement behind the bumper cover is a critical component in any high speed collision with cable median barrier. When a vehicle such as the Infinity SUV hits cable median barrier at high speeds, the bumper cover typically will be crushed or break away, and the steel cable should engage the steel bumper and vehicle frame. The cable should stop the vehicle within the median. At WSDOT's request, Safety Quest researched the height of the steel front bumper of a 2001 Infinity QXR and found it to be 27 inches. To place this bumper height in relation to other important dimensions:

- specified height of the top cable of Cable Safety System high-tension proprietary cable barrier is 29.8 inches.
- measured height of the top cable as determined from the Safety Quest crash investigation was 28.8 inches.
- bumper height of the vehicle used in crash tests to obtain Federal Highway Administration acceptance for Cable Safety System high-tension proprietary cable barrier was 23.4 inches.

Figure 5.2



Placement of the barrier and the trajectory of the Warren SUV

Safety Quest engineers also investigated how the vehicle's speed and the median slope affected the trajectory of the SUV and the height of its steel bumper when it encountered the cable system. In inspecting the slope of the median at the collision site, they found that the slope transitions from approximately a 10:1 slope at the shoulder to a 6:1 slope in the vicinity of the cable barrier. Using data from the previous crash tests to estimate the trajectory of an SUV traveling at 60 mph and a 25 degree angle, Safety Quest concluded that the tires of the SUV did not lose contact with the ground, but that the vehicle momentum may have lifted the chassis and caused the suspension to relax. This could effectively add additional height to the vehicle in relation to the ground and the cable. As a result, the height of the SUV's steel bumper may well have been above the cable median barrier at the time of impact, defeating the system's ability to arrest the vehicle.

Crimping the top of the cable median post

Some part of the SUV bumper hit the top of the cable median barrier post and bent it. The post pulled the cables down enough that the cables didn't grab the SUV, and instead slipped under the vehicle.

Why did the SUV go through the low-tension cable median barrier adjacent to the northbound lanes?

From their examination of the crash scene, engineers determined that cables making up the low-tension system had been pulled from their anchor housing assembly as the SUV apparently traveled through the barrier. This led to a focus on the anchor housing assembly, though other possibilities also were considered.

To rule out a manufacturing defect in the materials used in cable barrier installation, WSDOT hired Mayes Testing Laboratories to perform an independent examination of three low-tension cable barrier anchor housing assemblies from random locations for strength and manufacturing defects. A new low-tension cable anchor housing assembly also was provided to Mayes Testing Laboratories to serve as a control for its experiments. Mayes Testing Laboratories hired sub-consultant Dwight Company Inc. to perform the tests.

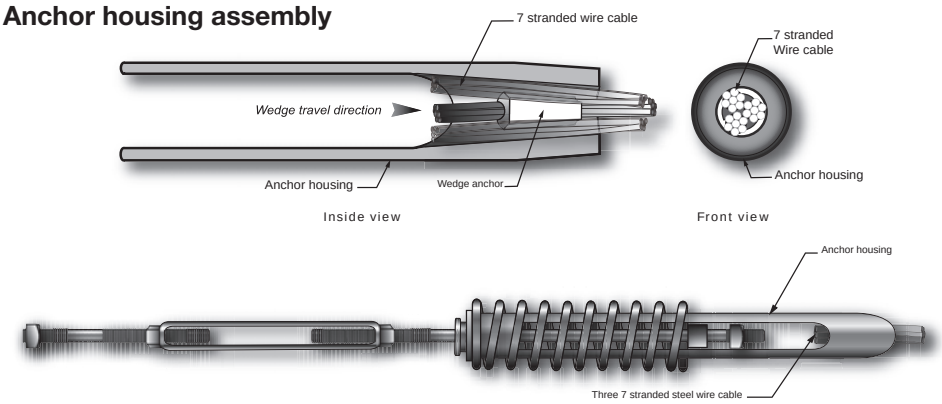
Dwight Co. modified equipment to measure the maximum weight each anchor housing assembly could support, and the maximum distance the wire cable could move. The machine applied weight to each of the anchor housing assemblies in 5,000-lb. increments until failure. When the testing concluded, engineers found that the anchor housing assemblies passed the test: Free from manufacturer defects, they were capable of supporting a load of 25,000 lbs. without failing.

Examining the possibility that an installation defect caused the failure of the anchor housing assemblies

During the Feb. 13 collision, the top and middle steel cables were pulled from their anchor housing assemblies. The anchor housing assembly employs a wedge to secure the three steel cables. Observers at the collision scene noted that the low-tension cables pulled free of their anchor housing assemblies. They formed the hypothesis, tested by McKnight Laboratories, that the wedges did not properly secure the cables. When installing the wedge into the anchor housing assembly, crews place the wedge between the three steel cables and insert the wedge until they feel the cable is secure. They then bend strands to prevent any backward movement.

Figure 5.3

Anchor housing assembly



Examination by McKnight Laboratories

McKnight Laboratories conducted an independent engineering investigation at WSDOT's request to examine the damaged components of the low-tension cable median barrier system and to make a random inspection of undamaged sections of the system on I-5 in Marysville. The following procedures and tests were carried out:

- **Field investigation:** Determine the depth of the wedges in the anchor housing assemblies
- **Tensile testing:** Test cable barrier components for strength and defects
- **Dynamic pendulum testing:** Recreate the force of a collision using a one-ton pendulum
- **Metallurgical testing:** Conduct a forensic investigation

One part of their investigation involved tests conducted at the Texas Transportation Institute (TTI) at Texas A&M University. Researchers performed weighted pendulum testing on anchor housing assemblies similar to those found on I-5 in Marysville. All of the cable barrier components used in this test were obtained from a cable barrier system manufacturer, not from existing stockpiles or installations. In these tests, an anchor housing assembly was attached to a weighted anchor and a 2,085-lb. pendulum. The pendulum swung away from the anchor at approximately 22 mph and applied force to the anchor housing assembly. The test measured the strength of the anchor housing assembly and simulated its reaction during a collision. Tests were performed to consider various cable-securing wedge depths, methods of driving the cable-securing wedge into the cable anchor assembly, cable alignments, pendulum velocities, and pendulum heights.

When this testing was complete, TTI submitted the results, photographs, videotape and anchor housing assemblies to McKnight Laboratories. McKnight Laboratories then examined the anchor housing assemblies collected from the Feb. 13, 2007 collision site and from the weighted pendulum tests conducted by TTI.

During the examination, McKnight Laboratories noted that the wedge was made of a softer metal than the rest of the anchor housing assembly. The cables left marks on the wedge when force was applied to the anchor housing assembly. These marks indicated that the wedge had not been seated deep enough to prevent the cables from pulling free.

McKnight Laboratories concluded that: "Based on comparisons between the condition of the wedge, cable and markings on the inside of the spring compensating end castings, the results indicate that the wedge on the three cable assemblies that pulled out of the housings at the accident site were

caused by the wedge not having been properly and completely seated in the cast housing assemblies at the time of installation. If the wedge had been seated to a depth of approximately 14 mm or more, one would have expected that the wedge and cable would not have pulled out of the spring anchor assemblies."

The McKnight Laboratories report can be found in Appendix D.

Follow-up investigation of other anchor housing assemblies in Marysville

Learning that test results suggested that the wedge may not have been seated properly, WSDOT moved quickly to examine similar anchor housing assemblies in the Marysville area and elsewhere.

WSDOT first hired KBA Construction Management to investigate a sample of the low-tension cable median barrier in Marysville that was not involved in the collision on Feb. 13. Their task was to examine:

- initial wedge depth.
- wedge depth after crews seated it deeper inside the anchor housing assembly.
- total wedge movement.

As KBA Construction Management examined the wedges they noted:

- the majority of wedges could be seated one tenth of an inch deeper.
- in some cases, crews had not bent strands of wire over the wedges.
- two wedges were protruding out of the anchor housing assembly.
- some assemblies were over- or under-tightened.

In addition to this work, WSDOT maintenance crews immediately began checking low-tension cable barrier systems around the state to search for the inconsistencies found on I-5 in Marysville. Crews checked over 1,800 anchor housing assemblies. They found that the vast majority of them were installed properly. Approximately 2 percent of low-tension cable barrier statewide displayed some inconsistencies similar to the low-tension cable barrier on I-5 in Marysville.

What does WSDOT recommend to improve cable barrier performance?

Make routine inspections of in-service cable median barrier systems: Field investigations should be completed regularly to determine that all wedges in the low-tension cable median barrier system are sound. Inspections should be completed periodically and whenever barrier is hit and repaired. A representative sample of high-tension system installations also should be checked regularly.

Urge adoption of revised crash test criteria that use higher bumper heights: Questions about whether the bumper height or the trajectory of the Infinity SUV in the Feb. 13 crash have drawn attention to the changing fleet mix in favor of larger and higher vehicles. The criteria currently used to evaluate the crashworthiness of a system are being rewritten, and proposed criteria include using a larger truck in crash tests. As systems are tested using larger vehicles, modifications to existing barrier systems may be identified that will improve their performance. Ideally, the new testing should be performed by a national testing program supported by cooperative research funds with participation from the Federal Highway Administration. If a national approach cannot be established, WSDOT should consider funding and administering its own tests to help better understand the problem. The Midwest Roadside Safety Facility at the University of Nebraska is developing a new four-cable median barrier

system that may provide some insight into the interaction of newer pickups and SUVs and cable median barriers.

Crash test criteria that currently are used to evaluate median barrier systems are being rewritten to include larger trucks. As systems are tested in accordance with this new criteria, modifications to existing barrier systems may be identified that will improve their performance.

Ideally, the new testing should be performed by a national testing program supported by cooperative research funds or Federal Highway Administration grants. If a national approach cannot be established, WSDOT should consider funding and administering its own tests to help better understand the problem.

Urge additional testing of cable median barrier on slopes. The performance of the Infinity SUV in riding over the high-tension barrier also has raised questions about the adequacy of crashworthiness testing of cable median barriers installed on flat surfaces. Testing should be considered with the barrier placed on typical medians, many of which have slopes. This will help support decisions about which type and configuration of cable barrier and hardware to use, based on established performance when barriers are installed on the variety of cross sections encountered in real life. Ideally, the new testing should be performed by a national testing program supported by cooperative research funds with FHWA participation. If a national approach cannot be established, WSDOT should consider funding and administering its own tests to help better understand the problem.

According to Ray, research on the proper placement of cable median barriers in relation to median slopes is needed, and guidance in this area is either outdated or never was completed. Some crash tests of high-tension cable median barriers have been performed on 4:1 slopes, but a comprehensive study of vehicle behavior when traversing typical depressed medians is needed to determine exactly where barriers should and should not be located. A new National Cooperative Highway Research Program project is underway that will look at the issue of guardrail and median barrier placement on slopes. National Cooperative Highway Research Program 22-22, “Placement of Traffic Barriers on Roadside and Median Slopes,” will examine a variety of types of guardrails and median barriers placed on slopes. WSDOT will encourage the project team to examine cable barrier placement. National Cooperative Highway Research Program 22-17, “Identification of Vehicular Impact Conditions Associated with Serious Ran-Off-Road Crashes,” is examining real-world impact conditions to try and re-examine the most relevant crash test conditions. This project has been active since 2001 and recently has been expanded.

Improve WSDOT’s tracking procedures: Drivers who hit cable median barrier do not always report the collision to the WSP. As a result, collision data is incomplete and may, for example, omit incidents where drivers drive away uninjured from a cable median barrier hit. Also, it is important that collision records capture information engineers need to evaluate barrier systems and installations. WSDOT should continue to make use of cable median barrier repair records to gather information that may not be captured in collision records. WSDOT should continue to track barrier repairs and, if necessary, improve them to ensure that information is collected in ways that make it easier to track trends and issues.

Continue to monitor the performance of all cable median barrier: WSDOT will continue to monitor the performance of all cable median barriers on Washington state highways, and will report on the barriers’ performance annually for the next two years.

Create procedures to install the wedge in low-tension cable barrier systems: WSDOT procedures for installing the wedges are not adequate to

Figure 5.4

Vicinity map

ensure consistent seating of the wedges within the anchor housing assembly. WSDOT engineers will develop written instructions to help both construction and maintenance crews install the wedge correctly.

Provide dimensions of fabricated parts and materials specifications for low-tension cable barrier systems to design engineers: If WSDOT decides to install low-tension cable barrier systems in the future, engineers will modify standard plans and special provisions to add dimensions and materials specification for low-tension cable barrier components to ensure compatibility of components from multiple manufacturers. Currently, WSDOT is installing only high-tension cable median barrier systems.

Improve the design of the cable-securing wedge in low-tension cable barrier systems: If WSDOT decides to install low-tension cable barrier systems in the future, engineers will investigate designs to improve the wedge.

Sponsor research to examine placement of high-tension cable barrier on slopes and crash tests with larger vehicles: WSDOT will request funding to sponsor research for new crash tests examining high-tension cable median barrier placement on slopes and its effectiveness with vehicles that have higher bumpers.

The facts of cable median barrier on I-5 in Marysville

In addition to investigating the Feb. 13, 2007 collision, independent expert Malcom Ray, P.E., Ph.D., and WSDOT engineers examined collisions on a 10-mile stretch of I-5 through Marysville. Twenty-two cross-median incidents, four of which were fatal, have occurred on I-5 through Marysville since WSDOT installed cable median barrier in 1995. Ray and WSDOT engineers compared collision rates on I-5 in Marysville before and after cable median barrier was installed. They found mixed results.

The rate of fatal cross-median collisions increased 4 percent. Before cable median barrier was installed there were 0.27 fatal median collisions per million vehicle miles traveled; there were 0.28 after it was installed. This differs dramatically from every other location with cable median barrier in the state, where no fatal crossmedian collisions have occurred.

The rate of cross-median collisions decreased 63 percent. Before cable median barrier was installed there were 2.32 cross-median collisions per million vehicle miles traveled; after, there were 0.84.

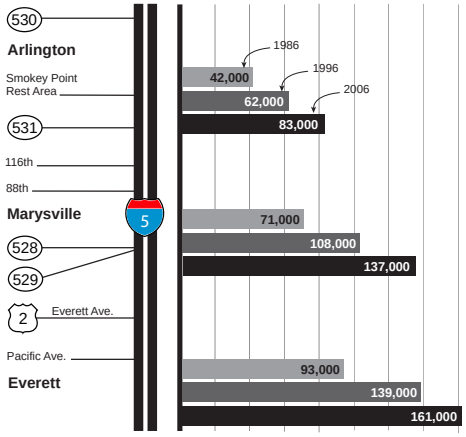
The rate of disabling cross-median collisions decreased 63 percent. Before cable median barrier was installed there were 0.54 disabling median collisions per million vehicle miles traveled; after, there were 0.2.

The rate of rollover collisions decreased 55 percent. Before cable median barrier was installed there were 2.32 rollover collisions per million vehicle miles traveled; after, there was 1.

While the cable median barrier enhanced safety by many of these measures, the increase in fatal cross-median collisions is unique. There have been no fatal cross-median collisions in any other location in the state where cable median barrier has been installed. What's unique about I-5 in Marysville?

Figure 5.5

I-5 average daily traffic



Why are these collisions occurring on I-5 in Marysville?

Ray and WSDOT engineers reassessed I-5 traffic and safety data for Marysville. They determined that there is no single reason why there is a unique crash history in Marysville. Collisions overall in Marysville are less than the statewide average. Some factors that need additional study are:

Speeds: Posted speeds in this stretch of I-5 transition between 70 mph and 60 mph. In addition, a significant number of drivers exceed speed limits in this area. One out of every 2,000 drivers, more than 1,000 every month, are traveling at more than 90 mph in this area. This ranks fourth highest in the state of the 47 locations where WSDOT has permanent traffic recorders. In this location, faster drivers meet slower moving traffic. This mix of speeds can lead to weaving, tailgating and other aggressive driving behaviors, and force other drivers into erratic, reactive driving.

Interchanges and ramps: North of Arlington, interchanges and ramps are relatively few and far between. Traffic on I-5 in Marysville enters and exits the freeway at many ramps: Smokey Point rest area, State Route (SR) 528, 88th Street Northeast, 116th Street Northeast, SR 531 and SR 530. Many of these ramps carry a high volume of traffic, and the traffic volumes have dramatically increased during the past several years. This increases merging and many related maneuvers by drivers.

Traffic volumes: Mirroring nearby residential and commercial growth, this more-than-10-mile section of I-5 has experienced dramatic traffic growth during the past 20 years. Traffic has roughly doubled.

Urban meets rural: This 10-mile stretch of I-5 is often the northern boundary between free-flowing rural traffic and congested urban traffic in the greater-Seattle area. Not all drivers anticipate the change in traffic conditions as they enter this area. Nineteen of the 22 cross-median collisions, and all of the fatal collisions in this area involved southbound vehicles crossing into northbound traffic. Nearly all of the most severe crashes occurred in the afternoon, which coincides with peak southbound traffic congestion.

What does WSDOT recommend to enhance safety on I-5 in Marysville?

WSDOT engineers recommend installing concrete barrier instead of the existing cable median barrier on the northbound side of I-5. The concrete barrier should nearly eliminate cross-median collisions. The recommendation has been made by Malcolm Ray, the independent expert, and endorsed by the WSP and WSDOT. The recommendation reflects that this section of southbound I-5 has a high number of cross-median crashes. This new barrier installation should be placed at least 10 feet away from northbound highway lanes to allow room for emergency vehicles and a refuge area for disabled vehicles. The estimated cost of this improvement is $27 million.

WSDOT engineers recommend keeping the cable median barrier adjacent to the southbound side of I-5. Maintaining two barriers provides redundant protection from cross-median collisions. In addition, southbound drivers who run off the freeway will hit cable median barrier, which will absorb more of the force of impact, reduce the risk of rollovers, and reduce the risk of rebound collisions that involve other vehicles.

The decision to install concrete barrier is not without risk and cost. Concrete barrier is expected to reduce, but not eliminate, the risk of cross-median collisions. Concrete barrier will increase the risk that drivers who run off the freeway will rebound off of the barrier into other vehicles. Drivers who hit the concrete barrier also will experience a significantly higher force of impact than those who hit cable median barrier.

Fatal median crashes on I-5 in Marysville

Four fatal cross-median crashes have occurred since WSDOT installed the cable barrier:

Oct. 31, 2003, milepost 205.5: a southbound Subaru Legacy crossed the median, went under the cable median barrier and hit a northbound vehicle. Both drivers were killed.

Dec. 15, 2004, milepost 205.4: a southbound Ford Explorer crossed the southbound lanes and median, went through the cable median barrier and hit a northbound vehicle. A passenger in the northbound vehicle was killed.

May 30, 2005, milepost 202.97: a southbound Ford F350 pickup towing a 37-foot fifth-wheel trailer ran off the freeway, entered the median, hit the cable barrier and overturned onto the northbound lanes. A northbound vehicle hit the pickup and trailer. Three people in the northbound vehicle were killed.

Feb. 13, 2007, milepost 200: an Infinity QXR sport utility vehicle entered I-5 southbound at 88th Street and traveled across three traffic lanes, drove over one cable median barrier, crossed the median, through a second cable median barrier, and hit a northbound bus. The Infinity driver was killed. Detailed information about this crash can be found in Chapter 6.

Four other fatal crashes occurred in the median during this time:

May 20, 2000, milepost 205.23: a northbound Acura Integra entered the median, hit the cable barrier, and was redirected back into traffic, where it hit a northbound Toyota pickup. The pickup lost control, rolled over and struck the cable barrier. Two passengers who were riding in the bed of the pickup were ejected and killed.

Oct. 10, 2000, milepost 206.6: a southbound Ford Escort entered the median, rolled over and hit the cable barrier. A passenger who was partially ejected was killed.

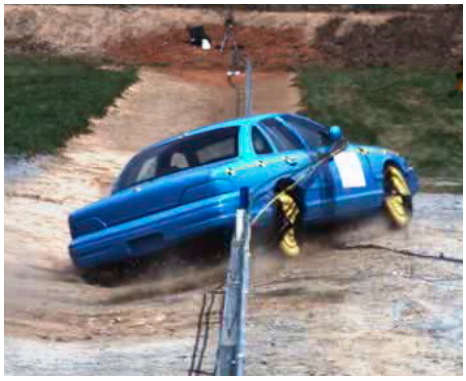
March 4, 2004, milepost 203.05: a vehicle went northbound in the southbound lanes and hit a southbound vehicle. The two vehicles then hit three additional vehicles, one of which left the freeway, hit the cable median barrier and stopped. The driver of the northbound vehicle was killed.

Nov. 26, 2004, milepost 202.52: the driver of a northbound vehicle lost control, the vehicle entered the median and hit the bridge pier at 116th Street. It then entered the southbound lanes and a southbound vehicle hit it. Cable median barrier was not involved. The driver of the northbound vehicle was killed.

Figure 5.6

Sedan nosing under cable median barrier

This photo, from a 2004 Federal Highway Administration crash test, shows how the front tires of a sedan compress after hitting the bottom of a ditch. This allows the bumper of the car to nudge under the lowest barrier cable.



As the vehicle continues forward, it lifts the cable median barrier and continues up the slope, while the cables pass over the top of the vehicle.

WSDOT/WSP

I-5 Marysville cable barrier history

Today, cable median barrier exists for more than nine miles of I-5 in Marysville. Guardrail, bridge rail, earth berms and precast concrete Jersey barrier exists for more than a mile of I-5 in Marysville and overlap cable median barrier in some locations. These other barriers typically are used in locations where there isn't enough room for cable median barrier to deflect, for example, on bridges or near bridge piers.

WSDOT first installed cable median barrier in this area in 1995

Crews installed more than two miles of median cable barrier in the I-5 median in Marysville. This was the first installation of modern cable median barrier in Washington state. The site was selected because of its high traffic counts, high rate of traffic growth and high number of collisions. The cable median barrier was located near the 116th Street interchange.

2000: more cable median barrier installed on I-5 in Marysville

After noting the success of the first miles of cable median barrier, WSDOT installed approximately seven miles of new cable median barrier between SR 528 and the Stillaguamish River. In addition, WSDOT removed the existing cable median barrier and reinstalled it closer to the bottom of the median ditch.

This was done to move the barrier farther away from traffic and provide more space to stop vehicles driven off the road before they hit the barrier. Moving the barrier also balanced the amount of room for barrier deflection between northbound and southbound traffic.

2003 to 2007 crossover collision mystery; WSDOT engineers add a second run of cable barrier

Between Oct. 2003, and May 2005, three fatal crossover collisions occurred on I-5 in Marysville. These collisions raised concerns about whether the cable median barrier was effective. In 2005, WSDOT conducted an extensive review and found the cable median barrier was catching 92.4 percent of vehicles that hit the barrier, which is somewhat lower than the 95 percent average for cable barrier performance on highways elsewhere in the state.

The engineers found that the majority (but not all) of the Marysville crossover collisions involved southbound sedans that ran into the median and bottomed out in the ditch. This compressed the cars' front suspension, which left their front bumpers low enough to nudge beneath the lowest cable on the barrier. Then as momentum carried the cars up the slope, they lifted the cable median barrier and continued across the median as the cables passed over the top of the vehicles.

In July 2005 WSDOT reduced speed limits from 70 mph to 60 mph on I-5 through Marysville to reduce the risk of drivers running off the road. Since then, the Washington State Patrol has emphasized law enforcement in the area. In addition, WSDOT hired a contractor to relocate some of the existing cable median barrier, flatten some slopes in medians, and install a new run of cable median barrier near the southbound lanes. This work was completed in Jan. 2007.

WSDOT engineers considered installing concrete barrier or guardrail, but determined that these more rigid barriers likely would increase the number and severity of crashes.