APPENDIX E

Highways 18 and 22 Safety Report

The Highway 18 and 22 Safety Report was initiated to address the increasing concerns over the safety problems evident on ORE 18 and ORE 22.

The study examined 12 specific locations along ORE 18 and ORE 22 including the ORE 22/ORE 99W intersection (Site 11).

This study is the precursor to the facility plan process described in this report.

HIGHWAYS 18 AND 22 SAFETY REPORT

Prepared for

OREGON DEPARTMENT OF TRANSPORTATION

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Executive Summary

The Highways 18/22 Safety Solutions Report was initiated to address the increasing concerns over the safety problems evident on State Highways 18 and 22. Recommendations in this report are based on an accident analysis report completed on May 6, 1999. These recommendations were developed in cooperation with a steering team of ODOT, local government, law enforcement, and consultant staff. Both short-term and long-term enhancement alternatives are identified for the safety problems on Highways 18 and 22. The short-term measures are intended to be items that could be implemented quickly and with limited resources. Long-term measures are those that typically require consideration at the program level for inclusion in future budgets or in the Statewide Transportation Improvement Plan (STIP). Wherever possible a *benefit/cost* (B/C) analysis was performed to provide a benchmark comparison of the cost of the alternatives versus the benefits derived.

Over the last 10 years, Highways 18 and 22 have experienced a 75 percent increase in traffic volumes. In the past 4 years alone the traffic volumes have increased 60 percent on these roads. The most notable increase was during the 1995 to 1997 period with the opening or upgrading of several major tourist attractions and retail centers. These include: the Spirit Mountain Casino in Grande Ronde, Chinook Winds Casino in Lincoln City, the Oregon Coast Aquarium in Newport, and the Factory Outlet malls in Lincoln City and McMinnville. Highways 18 and 22 are the primary routes for traffic from Portland and Salem to these attractions and the Oregon Coast.

Along with the increase in traffic volumes, there has been a corresponding increase in traffic accidents and fatal crashes. The increase in number of accidents has been at or a little below the statewide average for similar types of roads. Of concern is the disproportionate rise in fatal crashes. The total number of fatal crashes per million vehicle miles is higher than several comparable routes statewide. One reason for these statistics could be the types of accidents that occur as a highway reaches, or in some sections exceeds, its design capacity. Most of the 12 significant accident locations identified in this report are intersections. As traffic volumes increase there are fewer gaps in traffic to allow safe turning movements or crossings. Another possible factor could be "destination fever". A common theme that surfaced during interviews with law enforcement officers in this area was the "destination fever" that many drivers seem to exhibit. They stated that drivers become so obsessed with getting to their destination that they exhibit unsafe driving practices such as speeding, tailgating, and unsafe passing. This behavior places themselves and others at risk for severe accidents.

Enhancement Alternatives

A broad spectrum of alternatives was considered to address the safety problems identified in this report. These alternatives fall into three basic categories: engineering options, enforcement options, and education options. Within these categories is a variety of short- and long-term methods that are available. In many cases, a short-term solution is called for to gain a level of safety until a more complex or expensive long-term solution can be programmed.

Engineering alternatives include techniques such as new traffic control devices, intersection and road reconstructions, and access management. Many of the traffic control solutions are short-term measures that in some cases can be implemented by maintenance forces. Such things as signing, striping, and traffic signals can be done to provide added capacity or increased safety to the highways until longer-term solutions can be programmed and funded.

Enforcement solutions can be very effective on problems such as the ones that occur on these highways. Increased presence by local and state police forces in the problem areas would be desirable to discourage high-risk behaviors such as aggressive driving. In some areas improvements are needed for this option to work. Pullout areas, launch pads, and median crossovers would need to be built to allow the police presence to be effective.

The project team and ODOT identified many opportunities for public education. These include the use of radio, brochures, outdoor advertising, and theatre screen advertising. Public information could be circulated in partnership with radio stations, newspapers, and private travel publications.

The table on the following page shows which sites were identified as problems during the study and what the proposed solutions are for each site.

Funding

Many different types of improvements will need to be pursued in order to make significant, cost-effective progress toward improving the safety of these highways. Consequently, the number and variety of funding sources to be pursued will also be quite broad. Some of the solutions can be funded and performed by maintenance forces. Other improvements will need to be funded and programmed as safety improvements or modernization in the STIP. Some of the larger and more costly improvements may be fundable under the bonding capacity ODOT received this year from the Oregon Legislature. Local jurisdictions should look for opportunities to make improvements as conditions of development along the highway.

Table 1 – Summary

LOCATION	PROBLEM	SOLUTION	NOTES
OR 18			
Fruit stand – MP 52.6	Approaching traffic not aware of vehicles waiting to make left turn into business	Left turn refuge	This is not a high accident location. Region 2 Traffic and District 3 will identify when left-turn warrants are met. Property owner is conditioned to install the left-turn lane when warranted.
Lafayette Hwy – MP 49.91 (Site 1)	Cross street traffic running stop sign or not yielding to mainline traffic.	Interchange, reconstructing intersection to "T" with offset approaches, or traffic signal.	ODOT and County addressed running stop sign problem.
Norton Lane – MP 46.69 (Site 2)	Excessive speed of cars approaching traffic signal causes rear-end accidents	Eliminating traffic signal, constructing frontage roads, and building interchange ½ mile to the east.	Long-term solutions from corridor plans.
Various locations (Site 3)	Vehicles crossing centerline in unsafe passing areas, highway is over capacity and is losing its ability to absorb driver errors.	Review the entire corridor for areas to add or extend "No Passing" striping, construct four-lane divided highway for passing lanes.	Rumble strips, durable striping, increased law enforcement, and public education are additional short-term solutions. ODOT Maintenance implementing striping review.
Durham Lane – MP 43.02	Approaching traffic not aware of vehicles waiting to make left turn onto Durham Lane	Left turn refuge	Region 2 Traffic is looking into adding pavement at this intersection to allow for restriping or passing on the right.
MP 39-41	Deceptive "hump" in roadway decreases passing sight distance.	Stripe area for no-passing. Long-term consider passing lane in this area.	Region 2 Traffic is considering this area for a future passing lane.
Christensen Rd – MP 35.62	Westbound vehicles waiting to turn onto Christensen Rd hinder mainline traffic	Widen westbound shoulder on the highway. Enlarge "Intersection ahead" sign and add street names.	ODOT Maintenance implementing shoulder widening.
Red Prairie Rd – MP 31.66 (Site 4)	Cross street traffic running stop sign or not yieling to mainline traffic.	Close north approach, reconstruct approaches, reconstruct intersection to "T" with offset approaches.	Proposed STIP project.
MP 28	Four lane divided highway is difficult area for law enforcement to patrol	Add emergency vehicle median crossing	ORS restricts the ability to add new median crossings at a spacing of less than 3 miles apart.
Wallace Bridge – MP 27.17 (Site 5)	Confusing interchange configuration.	Long term: look at reconfiguring the interchange.	1996 paving project implemented short term improvements which addressed sigh distance problems.
Three lane section – MP 24-27 (Site 6)	Passing allowed for westbound traffic, undivided highway.	Short term: Modify the no-pass striping. Long-term: Make a divided four-lane section.	Proposed STIP project. ODOT Maintenance restriped for no–passing in April, 1999.
MP 24	End of westbound passing lane combined with speed reduction and intersection create merge problem.	Additional merge signing and speed study to evaluate location of 45 mph signing	Region 2 Traffic and District 3 will re-evaluate and coordinate with proposed STIP project and Refinement Plan.
Fort Hill area – MP 23.85 (Site 7)	High traffic volumes and badly located accesses.	Access management such as improving, combining, closing, or relocating residential, commercial, or public accesses to the highway.	Proposed STIP project.
Valley Junction MP 23.1 (Site 8)	Substandard geometry creates sight distance problem, and high traffic volumes create gap problems.	Long-term solution is interchange or relocation of this intersection.	Proposed STIP project.

OR 99W			
MP 24-29	No detour route in this area when accidents cause the highway to be closed down.	Identify detour routes.	ODOT is working with Yamhill County ot identify detour routes
MP 25.5	Southbound vehicles use bike lane to pass on right.	Add traffic control devices to discourage this movement.	Recent changes will be evaluated for their effectiveness.
City of Dundee – MP 25.52 to 26.46	Capacity of highway exceeded, absence of access control allows many traffic conflicts.	Construct by-pass, create couplet, implement access control.	Newberg–Dundee By-pass EIS is proposed STIP project. Dundee TSP or refinement study recommended.
MP 27.13	Northbound vehicles commonly don't perceive end of passing lane.	Re-stripe striping and arrows, merge passing lane sooner.	Recent changes will be evaluated for their effectiveness.
MP 27.6	Northbound direction has less than desirable sight distance around curve.	Excavate slope adjacent to roadway, add traffic control device to warn	New blinking flasher was installed in March 1999. The new device will be evaluated for its effectiveness.
Dundee to McDougal Junction – MP 26.46 to 29.79	Excessive speed and rear end accidents.	Increased police enforcement, access control measures, construct four-lane divided highway.	
OR 22			
Perrydale Rd – MP 11.79 (Site 9)	Substandard geometry of north approach.	Reconstruct north approach.	ODOT is evaluating intersection.
Kings Valley Hwy – MP 12.83 (Site 10)	Overcapacity intersection due to turning movements.	Construct channelized intersection including left turn and right turn lanes.	Proposed STIP project.
Hwy 99W – MP 16.12 (Site 11)	High accident rate for signalized intersection, including rear-end and turning accidents.	Interchange	
Greenwood Rd to Rosewood Drive – MP 18.61 to 24 (Site 12)	Undivided highway and absence of access control allows many traffic conflicts	Moving, combining, or closing accesses, constructing frontage roads, installing median curb or barrier.	Refinement study recommended.
Corridor-wide Solutions			
Various locations	Unsafe passing areas.	Review the entire corridor for areas to add or extend "No passing" striping, construct four-lane divided highway for passing lanes.	ODOT Maintenance is implementing.
Various locations	Exce3ssive speed.	Construct police pull-outs/launch pads.	ODOT Maintenance is implementing.
Hwy 18	Drivers not aware of hazards in corridor.	Public education program with a range of messages would increase driver awareness.	ODOT Traffic Safety is working with local communities to develop an education program.
Various intersections	Unclear intersection.	Improving delineation through installing white reflector posts at intersections. Improve signing by adding street signs to intersection ahead signs.	ODOT Maintenance is implementing.

Introduction

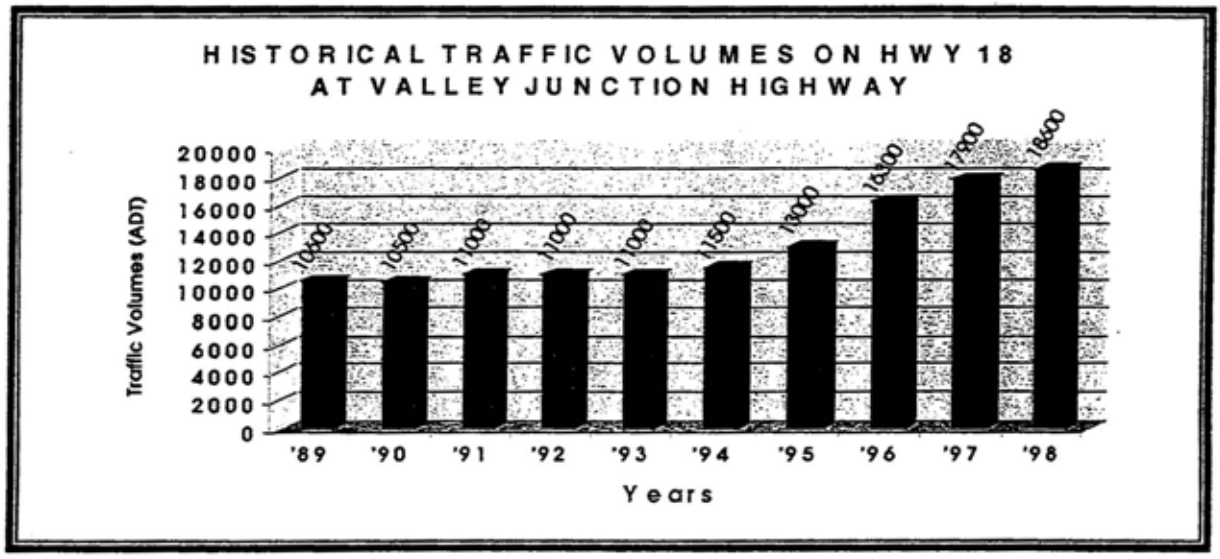
1

Introduction

The Highways 18 and 22 Safety Report was initiated to address concerns over safety problems on Highways 18 and 22. As shown in *Figure* 1, Highway 18 passes through McMinnville and Grande Ronde and proceeds to Pacific Coast Highway 101. Highway 22 connects Salem to Grande Ronde and Pacific Coast Highway 101.

As illustrated in *Figure* 2, Highways 18 and 22 have experienced a 75 percent increase in traffic volumes over the last 10 years. In the past four years alone the traffic volumes have increased 60 percent on these roads. The most notable increase was during the 1995 to 1997 period with the opening or upgrading of several major tourist attractions and retail centers. These include: the Spirit Mountain Casino in Grande Ronde, Chinook Winds Casino in Lincoln City, the Oregon Coast Aquarium in Newport, and the Factory Outlet malls in Lincoln City and McMinnville. Highways 18 and 22 are the primary routes for traffic from Portland and Salem to these attractions and the Oregon Coast.

Figure 2
1989 – 1998 Traffic Volumes



**Volumes obtained from ODOT ATR Station 27-001 at MP 23.76*

Along with the increase in traffic volumes there has been a corresponding increase in traffic accidents and fatal crashes. The increase in number of accidents has been at or a little below the statewide average for similar types of roads. Of concern is the disproportionate rise in fatal crashes. The total number of fatal crashes per million vehicle miles is higher than several

comparable routes statewide. One reason for these statistics could be the types of accidents that occur as a highway reaches, or in some sections exceeds, its design capacity. Most of the significant accident locations identified in this report are intersections. As traffic volumes increase there are fewer gaps in traffic to allow safe turning movements or crossings. Local law enforcement officers revealed another common theme in the accidents in the study area. They stated that drivers become so obsessed with getting to their destination ("destination fever") that they exhibit unsafe driving practices such as speeding, tailgating, and unsafe passing. This behavior places themselves and others at risk for severe accidents. Other unsafe behavior related to the increase in accidents involves drivers attempting to enter or cross the highway through gaps in traffic that are too small for them to do so safely.

Figure 3
Comparison of Fatal Accident Rates on Selected Highways

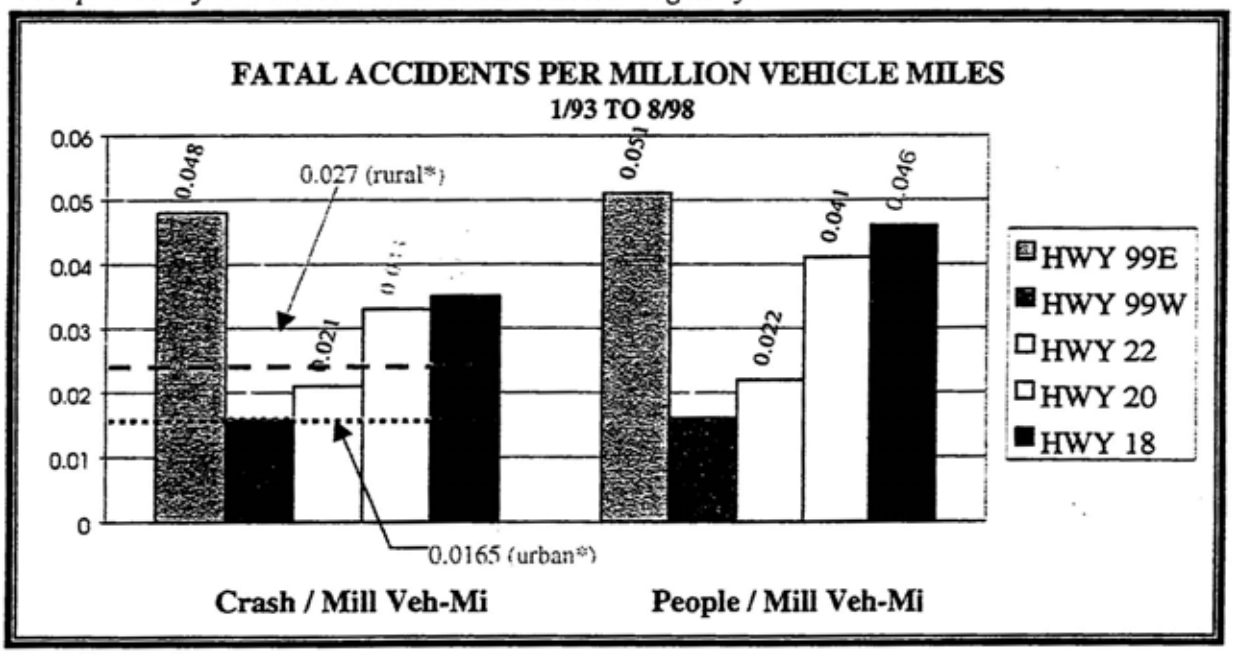
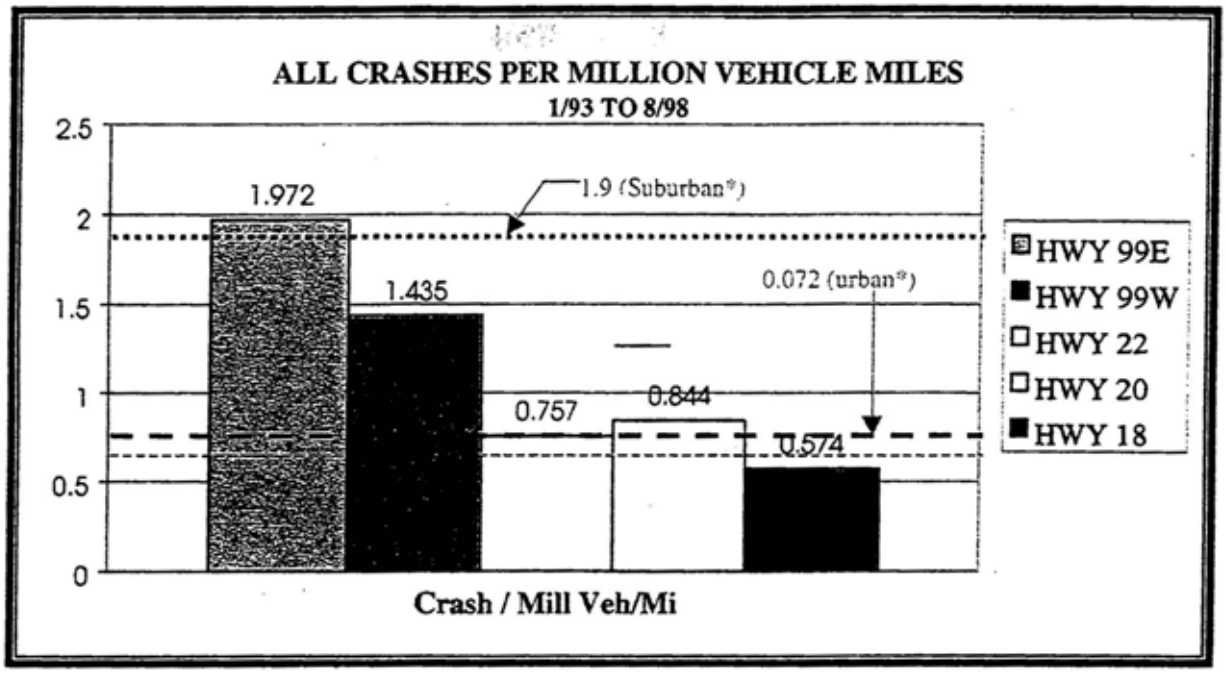


Figure 4



* *Statewide average for 1997*

Process

This analysis was started with a tour of the two routes with commissioners and law enforcement officers of Polk and Yamhill Counties, Oregon State Police, and ODOT traffic and design engineers and planners. Notes were taken along the routes regarding hazardous locations and possible solutions.

This field report was followed up by an in-depth look at accident reports and diagrams of individual collisions.

Twelve locations were selected for more detailed analysis within the scope of this study. Each of these locations was visited and analyzed.

The short-term improvements are intended to be items that could be implemented immediately, dependent upon funding availability. This category also includes any project or activity that would not otherwise be eligible for inclusion in the STIP. Long-term improvements are therefore any projects that would be eligible for inclusion in the STIP.

The types of projects that are proposed for this highway include engineering, enforcement, and education. The engineering projects address the physical characteristics of the facility such as constructing turning lanes or interchanges. The enforcement improvements are those that would assist local police with enforcing the speed limit and other laws regarding vehicle safety on public roads. They include increasing the police presence in the area or constructing launch pads or pullouts for police patrols. Education provides information to the traveling public about the

need for safety *specifically on these highways.* The goal would be to educate drivers so they would change their driving habits to reflect a higher degree of safety.

Possible improvements for the 12 locations were evaluated using an objective method of benefit/cost (B/C) analysis. The benefit/cost method is an engineering economy term. The method attaches a value to the benefits of a particular improvement and compares that to the cost of the improvement. The comparison is achieved by dividing the benefit by the cost and calculating the B/C ratio. This approach is one way to evaluate different improvements to see if they have enough benefit to be cost-effective. The B/C ratios can also be used to compare projects. The B/C ratios were used on this project to establish a ranking of projects for inclusion in the STIP.

Enhancement Alternatives

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Engineering Options

The standards implemented on these highways typically reflect the date of the original construction or the most recent pavement overlay. As traffic volumes increase and exceed the capacity of the existing highways, many engineering-based improvements can be implemented to extend the safety and efficiency of the existing roadway.

The existing roadways must have the appropriate traffic control devices. This includes signing, striping, and traffic signals. In many cases maintenance crews have added or replaced devices as need has arisen. It appears that existing devices are providing the direction and/or traffic control that was originally expected. There is interest in adding new devices to Highway 18, such as durable striping and rumble strips. Durable striping and rumble strips are effective in alerting drivers that their vehicle has strayed across the striping line and on highways where there is through traffic similar to the recreational traffic on Highway 18. These devices and the advantages and disadvantages of each are discussed in more detail for Site 3 in the next section.

Upgrading intersections is a commonly used improvement on a highway. Adding left or right turn lanes and improving the geometry of the approach roads are typical improvements. Large-scale improvements include constructing interchanges. Each of the following options is intended to increase the safety and operational capacity of the intersections. Such improvements are necessary because higher volumes of traffic are causing conflicting movements to be less safe.

Most of the significant accident locations identified by the study are intersections. In some cases, the recommended options are as simple as adding reflectors and improving striping, or can be as complicated as constructing a major interchange at Site 11 (Highway 22 at Highway 99W intersection). Each of these solutions is addressed in the next section.

Access management measures can also increase the safety and capacity of a roadway. The goal of access management is to reduce conflicts between through traffic and vehicles entering or leaving a highway from an intersecting road or driveway. Such measures include reducing the number of intersecting roads and driveways (especially near an intersection), channelizing the approaches to the highway to more clearly direct traffic, and improving merge lanes. Site 12 (Highway 22 from Greenwood Road to Rosewood Drive) is an excellent example of a five-lane highway where safety and capacity could be improved with aggressive access management measures.

Major reconstruction projects are long-term improvements to address safety and capacity problems. Reconstruction of the highway can allow a higher design speed and greater sight distance for traffic. Widening shoulders and constructing slopes that allow the driver to recover control of their vehicle can increase both safety and capacity. Finally, adding travel lanes to

carry the expected traffic volumes increases safety and efficient traffic movement in a highway system.

Enforcement Options

The presence of enforcement is an effective tool in increasing compliance with traffic laws and, therefore, in reducing traffic crashes.

State and local law enforcement agencies patrol routes 18 and 22. The Oregon State Police, Yamhill and Polk County sheriffs offices have jurisdiction over various portions of these two roadways. All three agencies recognize the need for increased enforcement to encourage compliance with traffic laws. All three include Highways 18 and 22 in their strategic plans. In addition, they all receive grants for overtime enforcement from ODOT.

Other enforcement-related enhancements suggested in discussions for safety improvements include pull-outs, and "launch pads". Pull-outs are similar to slow vehicle turn-outs that allow police safer areas to contact motorists. Typical cost is $28,000. "Launch pads" are small, paved areas for safer traffic surveillance. A typical cost is $5,000. Current safety and operational guidelines for cross-over installation would probably prohibit installations on these corridors.

Aggressive behaviors are typical traffic offenses in these two corridors, and are noted in many of the accident reports. They include unsafe passing, following too closely and speeding. Another aggressive behavior noted in a number of accident reports involves drivers attempting to cross or enter the highway through gaps too small to allow them to do so safely.

Education Options

Education is one of the keys to behavior modification. Several ideas regarding education have surfaced during the solutions discussion process. Typical forums for increasing driver awareness include radio and TV public service announcements (PSAs), billboards, brochures, theater ads, transit ads, press releases, editorials, newspaper feature articles and media events.

Logical partners in the distribution of educational materials include motels, restaurants, casinos and other travel-related business.

The results of education in behavior modification are harder to assess that enforcement and engineering efforts. Repeating the message and displaying it often and in various media are the two most important components to an effective awareness campaign.

Study Location Recommendations

3

Introduction

The basis of this study was the accident reports written by police officers who responded to the accident scenes. The reports are compiled into a database at ODOT. The study looked at a standard period of five years of accident data. The latest data available was used, which included 1994 through 1998. ODOT staff from the Traffic Safety section converted the data from reports to graphical accident diagrams. Text and graphical form allowed a more thorough analysis of the data. Review of the data and diagrams identified locations of multiple accidents. Further review of the data determined if there were similar types or patterns in the accidents that were occurring.

This section discusses 12 sites that were determined to have a large number of accidents and/or trends of specific kinds of collisions, such as rear-end. Accidents were grouped by type, location, and severity to determine significance with respect to the safe operation of the highway. Further analysis was necessary at certain locations to understand the operation of the site. This includes reviewing traffic turning movements where traffic count data were available, and performing capacity analyses to determine the level-of-service (LOS) of the intersection.

The selection of sites to be analyzed in this report was based on traffic volume and type of accident, based on conditions in the highway system as a whole. Other sites with accident histories exist in these and other corridors and may be considered in other documents.

Site 1 - Highway 18 at Lafayette Highway Intersection

Existing Situation, Problems, and Issues

Between 1994 and 1998, there were 19 accidents at this intersection, including two fatal accidents and four Injury "A" accidents. Almost half of the accidents involved traffic on Lafayette Highway either running the stop sign or failing to properly yield the right-of-way to traffic on Highway 18. At this location, Highway 18 has one through lane in each direction with a left-turn lane while Lafayette Highway has a single-lane approach.

1999 traffic counts at this intersection yielded level-of-service (LOS) "E" during the weekday p.m. peak hour. Level-of-service is a concept developed by the transportation engineering profession to quantify the degree of comfort afforded to drivers as they travel through an intersection or roadway segment. Level-of-service designations range from "A", indicating that motorists will experience little delay, to "F", indicating that they will experience significant traffic congestion and delay. For signalized intersections, LOS "D" is typically considered to be the minimum acceptable level-of-service. For unsignalized intersections, LOS "E" is considered to be the minimum acceptable level-of-service. All LOS analyses described in this report were

conducted in accordance with the procedures stated in the 1994 Highway Capacity Manual (Transportation Research Board, 1994).

Possible Improvement Alternatives and Opportunities

The possible solutions to this intersection are somewhat limited. One way to reduce the number of crossing accidents is to convert the existing intersection into two "T" intersections. Vehicles wanting to travel across Highway 18 would be required to turn onto the highway and then turn off the highway at a second intersection. While this would remove the crossing accidents, it would likely increase the turning movement accidents, which are less severe. The benefit/cost ratio of this improvement was calculated based on a construction cost of $1.0 million. It was assumed that the number of accidents would have been cut in half as some at-grade conflicts would still be present. These assumptions yielded a benefit/cost ratio (B/C) of 2.64 for this alternative.

A second solution would be to install a traffic signal. While the traffic signal may be warranted, it may not be a good solution for this intersection; a traffic signal has not been evaluated for inconsistency with the highway plan. Since only a few of the accidents involved turning movement conflicts, this option would not address the primary accident problem. In addition, traffic signals in rural settings such as this can cause a sharp increase in the number of rear-end accidents. Since the benefits of installing a traffic signal are difficult to quantify, a benefit/cost ratio was not calculated for this alternative.

A longer-term but more costly solution would be the construction of a grade-separated crossing over Highway 18. This would safely separate the major conflicting movements at this intersection. The Oregon Highway 18 Corridor Refinement Plan, (ODOT, 1996), which analyzed the section of Highway 18 west of Lafayette Highway, estimates the construction costs for a grade-separated crossing with a ramp to be $2.5 million. Since a benefit/cost ratio was not listed for this project in the plan, one was calculated. A benefit/cost ratio of 1.51 was calculated based on the construction of a $3.0 million interchange that would theoretically eliminate all accidents.

Due to the low benefit/cost ratios of the alternatives, a feasible short-term solution may include purchasing the right-of-way for a future interchange while periodically monitoring the intersection to gauge the threshold that would warrant its construction.

Site 2 - Highway 18 at Norton Lane Intersection

Existing Situation, Problems and Issues

Between 1994 and 1998 there were 17 accidents at this intersection with the majority involving excess speed and/or rear-end accidents. The accident pattern reflects the typical problem with traffic signal installations along rural stretches of the highway. While this area is on the outskirts of McMinnville, the majority of drivers are travelling through the area and are not anticipating a need to reduce speed. This location of Highway 18 has two through lanes in each direction with

a continuous left-turn lane, while Norton Lane has a three-lane approach. This intersection provides access to the Tanger Outlet Mall and a hospital. 1999 traffic counts at this intersection yielded LOS "B" during both the p.m. peak and Saturday mid-day peak hours.

Possible Improvement Alternatives and Opportunities

The Oregon Highway 18 Corridor Refinement Plan includes a more detailed analysis of this intersection and the surrounding area. The traffic signal is expected to reach LOS "D" by the year 2001. The short-term recommendations, which include upgrading the signal and adding additional capacity to Norton Lane, will delay the expected change to LOS "D" to the year 2007. The long-term recommendation includes the closure of this intersection with traffic rerouted along frontage roads to either the existing East McMinnville Interchange or a new interchange approximately Y:z mile east of Norton Lane.

Site 3 - Highway 18, various passing locations between McMinnville and Sheridan

Existing Situation, Problems and Issues

Site 3 includes several locations from milepost (MP) 45 to 33. There have been 23 accidents caused by vehicles crossing the centerline throughout this stretch of highway. The highway has two-way, two-lane traffic in these areas. The Highway 18/22 Accident Analysis Report dated May 6, 1999 identified several items that contribute to the high number of accidents. They include items such as unfavorable highway configurations for passing, the location and width of bridges, and the heavy volumes of recreational traffic. The traffic volumes range from to 8,500 to 15,300 in this section. There are both short-term and long-term measures that could address the passing problem for the two-lane facility.

Possible Improvement Alternatives and Opportunities

Most of the accidents in this area are related to vehicles crossing the centerline of the highway. These drivers may be passing aggressively; they may be sleepy, distracted, or drivers under the influence of intoxicants; or drivers with impaired visibility due to inclement weather, worn striping, or other factors. The variety of factors in these accidents is addressed by the different methods described below.

Short-term engineering measures to reduce the passing accidents in this area include reevaluating the areas where passing is allowed. The accident data have been used to identify several locations where passing is unsafe even though the roadway is still within acceptable engineering standards. These are locations in which the double-yellow striping should be extended to enlarge the no-passing zones. They are summarized in Table 1.

An innovative idea to improve the delineation of the travel lanes includes using rumble strips. These strips are created by grinding the pavement near the striping to create a series of bumps.

When a vehicle drives across the bumps, a vibration results that immediately alerts drivers that they are straying across the striping. Rumble strips have recently been installed on 1-5 on the shoulders. Rumble strips would also be effective on the shoulders of Highway 18. To directly address the passing problem, we propose using durable striping with profile (bumps). Rumble strips could be considered in conjunction with the double yellow striping to delineate no passing zones, but this would be a new use in Oregon. Perhaps this solution would be best initiated by including it in a research project. Different designs could be evaluated for effectiveness. Table 2 lists the cost of typical rumble strips.

A similar method is the use of durable striping. This consists of an epoxy or thermoplastic material that can be placed in variable thicknesses to create bumps in the striping line. The bumps have a similar effect to the rumble strips by alerting a driver who has strayed from their lane. The use of durable striping on recently paved roadways has become more common in the last several years; however, it is used only on selected projects due to cost. The cost of durable striping is shown in Table 2; in contrast, conventional striping.

One of the most effective aids in controlling traffic is the presence of law enforcement. There are several specific efforts to increase the presence of law enforcement on Highway 18, including the Multi-Agency Team. Based on input from state and local police officers, there are several locations that are difficult to enforce. One of difficulties is the lack of wide shoulders for pulling over vehicles and for observing traffic. A prime example is the section from Gopher Valley Road to Oldsville Road (MP 35-40), where the two-lane highway has four-foot shoulders. A pull-out area or launch pads for the use of police patrols at coordinated locations within this section would expand the areas in which law enforcement patrols can operate safely. Launch pads are similar to a driveway except they are used only by police cars to observe traffic and perform speed checks. The scope and cost ofthese pull-outs and launch pads are relatively minor and could be constructed by the maintenance crews. The cost for a typical pull-out and launch pad can be found in *Table* 2.

Table 1

RECOMMENDED LOCATIONS FOR ADDITIONAL "NO PASSING" STRIPING ON HIGHWAY 18*

FROM MP	TO MP	DIRECTION OF TRAFFIC
45.39	45.63	Eastbound
45.87	45.59	Westbound
33.40	33.84	Eastbound
34.08	33.60	Westbound

NOTE: Locations determined by field visits and review of video log.

Table 2

ESTIMATED COSTS FOR MISCELLANEOUS IMPROVEMENTS	
ITEM	**REC. UNIT PRICE FOR COST ESTIMATES***
Rumble Strips	$2,000 / mile
Durable Striping (2-Lane Highway)	$62,000 / mile
Launch Pad (3.6 m x 30 m)	$5,000 each
Pull-out (5.0 m x 150 m)	$28,000 each
* *Prices include mobilization, TP/DT (traffic control), and 30% engineering and contingencies. Launch pad and pull-out estimates do not include right of way or environmental considerations.*	

The fundamental problem is that the highway is over capacity. Traffic volumes have dramatically increased, especially during recreational periods. To address capacity, the basic number of travel lanes would need to be increased from two lanes to four. Constructing a four-lane section of highway would require a significant amount of funding and several years to implement. This is a long-term solution that would be broken down into projects that would be proposed in future updates of the ODOT STIP. One recommended improvement of this nature is the Oldsville Road Section. The improvement consists of constructing a four-lane divided highway for about a mile. This would provide a passing lane in the middle of a 13-mile section of a two-lane highway. The passing lane would provide significant benefits to traffic traveling to and from the Oregon coast. This project was proposed as a Safety Project for the 2001-2003 STIP. It was considered by MW ACT but was not selected based on the benefit/cost ratio and the overall cost of the project (see Appendix). It is uncommon for a four-lane project to be funded exclusively by safety funding because a project that improves capacity rarely mitigates enough accidents to compete for the funding. However, the fact that the project was competitive in the Safety category illustrates the need for the project. At this location, highway capacity and accident rates are directly related.

Site 4 - Highway 18 at Red Prairie Road intersection

Existing Situation, Problems and Issues

There were 17 accidents at this intersection between 1994 and 1998, most of which involved vehicles on Red Prairie Road failing to stop prior to crossing the highway. Weather, the time of day, and alcohol do not appear to be significant contributing factors to the reasons for the collisions. 1999 traffic counts at this intersection yielded LOS "C" during the weekday p.m. peak hour.

A field visit highlighted some of the elements that may be contributing to the accidents. The highway grade is lower than the existing terrain. To drivers on Red Prairie Road, especially those in the southbound direction, the highway is practically invisible. Many accidents appear to be related to drivers not recognizing the intersection in time to safely stop before crossing into the highway. Oversized signs warning drivers of the intersection were installed within the past several years. They do not appear to have reduced the rate of accidents at this intersection.

Possible Improvement Alternatives and Opportunities

One possible solution is to regrade approximately 150 m (500 feet) of Red Prairie Road on either side of the intersection. The new vertical alignment would increase sight distance from the highway and should reduce the number of accidents on Prairie Road. With a construction cost of $250,000, the benefit/cost ratio for this improvement is over 13.

Another solution is to close off the north leg of the intersection entirely. This leg is approximately one-half mile long with several residential driveways along it. Those drivers would be rerouted to Mill Street, which parallels Highway 18. They could then access the highway either at the Ballston Road interchange to the north or the Harmony Road intersection to the south. This inexpensive solution would create a safer "T" intersection with Highway 18. Negative aspects of this improvement include logistics and safety for movement of farm equipment across Highway 18.

Site 5 - Highway 18/22 at Wallace Bridge (Willamina Interchange)

Existing Situation, Problems and Issues

Site 5 is a complex intersection of three state highways (Willamina-Salem Highway (OSH 22), Salmon River Highway (OSH 18) and Willamina-Sheridan Highway), adjacent to a major drainage (South Yamhill River). The complexity of providing connections between three highways in a setting constrained by the close proximity of the South Yamhill River has produced an unusual interchange configuration with one significant at-grade intersection, where the Willamina-Salem Highway crosses the Willamina-Sheridan Highway. This intersection has been the site of the majority of accidents within the interchange itself.

Prior to a 1996-1997 project that reconstructed the Willamina-Salem Highway/Willamina-Sheridan Highway intersection, the predominate type of accident at this intersection involved right -angle accidents where vehicles crossing Highway 22 were struck by westbound vehicles on Highway 22. Westbound rear-end accidents were also among the most frequent. The right-angle accidents were attributed in part to poor sight distance for vehicles stopped at the intersection looking to the east over Wallace Bridge. A 1996-1997 project that reconstructed this intersection appears to have reduced all types of accidents at this intersection, but some collisions still occur.

Possible Improvement Alternatives and Opportunities

The existing interchange configuration remains substandard. The northbound on-ramp onto Highway 18 is relatively close to the off-ramp from Highway 18 to Highway 22, creating some potential for congestion and weaving movement problems during peak traffic periods. This problem is somewhat mitigated by the continuous auxiliary lane between the on-ramp and off-ramp. The route that the Willamina-Sheridan Highway takes through the interchange, which creates two at-grade intersections, is not ideal for accommodating the heavier volumes of traffic anticipated in the future. Some traffic movements through the interchange require more than normal out-of-direction travel.

In short, the entire interchange is probably a candidate for major reconstruction sometime in the future. However, it is extremely unlikely that the very high cost of reconstruction could be justified in terms of benefit/cost ratios determined by anticipated accident reductions. It is also unlikely that reduction of out-of-direction travel would significantly increase the benefit/cost ratio to an acceptable level, since relatively few vehicles are required to make out-of-direction movements.

The recommendation of this report is to monitor the overall performance of the interchange through periodic traffic counts, traffic speed studies and annual review of the accident history, especially at the Willamina-SalemlWillamina-Sheridan Highway intersection. Since the cost of complete reconstruction of the interchange is probably difficult to justify, it seems more likely that additional minor improvements will be identified that can be done at a reasonable cost.

Site 6 - Highway 18/22 three-lane section west of Wallace Bridge

Existing Situation, Problems and Issues

The three-lane section is a significant accident site due to vehicles crossing the centerline and causing head-on crashes. Currently, there are two westbound lanes and one eastbound lane. There is no median separating the opposing traffic, and passing was allowed in the eastbound direction until recently. In April 1999, ODOT implemented a short-term solution by modifying the centerline striping to deny passing by eastbound traffic.

Possible Improvement Alternatives and Opportunities

The long-term solution at this location is to widen the existing facility to a four-lane divided highway. This would be accomplished by building the second travel lane in the eastbound direction and installing a concrete barrier to provide separation between opposing traffic lanes. The Willamina to Grande Ronde Corridor Refinement Plan (currently in progress) supports this option. This project is also included in the draft 2000-2003 STIP as a combined modernization and safety project. The construction cost has been estimated $5.7M. A B/C ratio was not available for this project.

Site 7 - Highway 18/22 at the Fort Hill area

Existing Situation, Problems and Issues

This area experiences accidents for several reasons. The highway has substandard sight distance near a narrow bridge located on a curve. Fort Hill Road, Yamhill River Road, and several commercial driveways access the highway just east of the bridge. There are also a number of residential driveways in this area. The two-lane highway allows passing in this half-mile section, which is on a slight curve, but the east end of the section is bounded by a narrow bridge that allows no room for error in passing. Finally, the high traffic volumes exacerbate the problems. The milepost limits are listed in Table 1.

Possible Improvement Alternatives and Opportunities

The short-term improvements at this location could include a variety of access management techniques, a speed study to evaluate current posted speed of 45 mph, striping modifications, and increased signing on the roadway. Applicable access management techniques include improving, combining, or closing commercial and residential accesses to the highway. Yamhill River Road would be a likely road approach to close since it also accesses the highway one-half mile to the east. The striping modification would extend changing the striping between the two bridges over the Yamhill River.

Long-term solutions for this area are being considered in the Willamina to Grande Ronde Corridor Refinement Plan. The preferred alternative appears to be relocating Fort Hill Road to the east of Fort Hill area and constructing frontage roads to serve the residential and commercial accesses. This would involve several thousand feet of county road re-alignment and constructing a channelized intersection on the highway. The existing county road approaches would be closed. The solution is currently being considered as a safety project in the draft 2000-2003 STIP. The construction cost is currently estimated at $1.8M and the B/C ratio is 2.25.

Site 8 - Highway 18/22 at Three Rivers Highway intersection (Valley Junction)

Existing Situation, Problems and Issues

This intersection suffers from a substandard configuration and high traffic volumes. Most accidents are conflicts between through traffic and vehicles on Three Rivers Highway turning to the east on Highway 22. The sight distance to the east is substandard due to the alignment of roadway east of the intersection. There are no short-term solutions at this intersection.

Possible Improvement Alternatives and Opportunities

The Willamina to Grande Ronde Corridor Refinement Plan considers the long-term solution at this location to be a grade-separated interchange with frontage roads to the north and south, west of the intersection. The estimate construction cost is $4.0M.

Site 9 - Highway 22 at Perrydale Road intersection

Existing Situation, Problems and Issues

The accidents at this intersection appear to be related to inadequate sight distance for northbound traffic on Perrydale Road. The sight distance is restricted due to a dip in Perrydale Road north of the intersection. A second contributing factor is the increase in traffic on Highway 22. This increase appears to have reduced the number of gaps in traffic that enable vehicles on Perrydale Road to safely cross Highway 22 or join westbound traffic on Highway 22.

The five-year accident history from January 1, 1994 to December 31, 1998 lists 12 accidents that occurred at the intersection of Highway 22 and Perrydale Road. Seven accidents involved northbound vehicles on Perrydale Road attempting to cross Highway 22. One accident involved a vehicle attempting to cross Highway 22 from the north to the south. Three accidents involved vehicles attempting to make a left turn from the south leg of Perrydale Road onto westbound Highway 22. The only single-vehicle accident was attributed to excessive speed.

All of the accidents listed above occurred during the day, between the hours of 8 am and 5 p.m., and none appear to be related to darkness or icy road conditions.

The horizontal and vertical alignment of Highway 22 in this area is straight and fairly flat, with two travel lanes (one in each direction), wide paved shoulders and a center turn lane at Perrydale Road. There is no obvious sight distance problem on Highway 22.

Perrydale Road intersects Highway 22 at a slightly skewed angle on the south side of the intersection. Perrydale Road also dips abruptly below the grade of Highway 22 north of the intersection, with a horizontal curve just beyond. Based on the accident data and field visits, drivers may be hesitating in the intersection due to the limited sight distance. This hesitation, coupled with the increased traffic volumes on Highway 22, appears to be a common element in most of the accidents at this location.

1997 traffic volumes on Highway 22 were about 5,700 vehicles per day west of Perrydale Road and 5,600 vehicles per day east of Perrydale Road. While no traffic count data was available fOJ Perry dale Road itself at the time this report, it is very likely that a contributing factor in the accident history at this intersection is a lack of adequate gaps in traffic on Highway 22 fOJ vehicles on Perrydale Road to cross or turn left onto Highway 22. Drivers that are frustrated from waiting at the stop sign are probably trying to cross or turn left onto Highway 22 in gaps that are too short to make these movements safely.

Possible Improvement Alternatives and Opportunities

There is no obvious solution to the problem oftoo few gaps in traffic on Highway 22 for vehicles to cross or turn onto Highway 22. A traffic signal would provide safer gaps in through traffic on Highway 22; however, it would also increase the rate of rear-end collisions (see the accident history for the intersection of Highway 22 at Highway 99W at Rickreall). A traffic signal would also be inconsistent with the Highway Plan.

Realigning the north leg of Perrydale Road to improve sight distance would address some of the accident problems, assuming that the contributing factor in these accidents is the alignment of Perrydale Road. Benefit/cost analysis shows that a B/C ratio of 2.0 could be achieved at a project cost of up to $1,090,000 (see benefit/cost ratio worksheet in the appendix). It is likely, however, that other factors, such as the lack of gaps in traffic on Highway 22, were also factors in the seven south to north crossing accidents. This type of realignment would probably not eliminate the potential for future collisions.

A field survey, detailed analysis of the actual sight distances at this intersection, and more detailed engineering design are required to verify whether the option of realigning the north leg of Perrydale Road would reduce the future risk of accidents at this location.

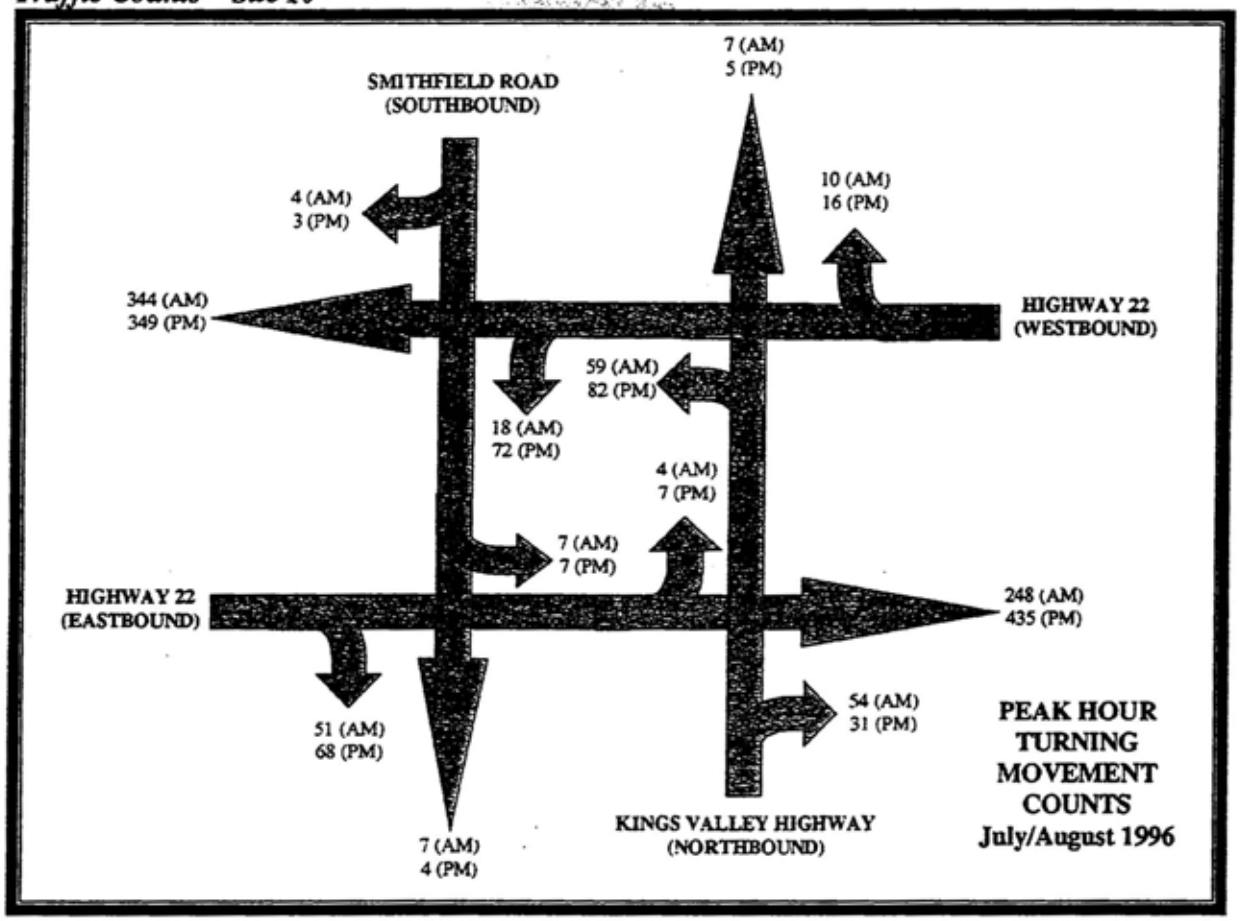
Site 10 - Willamina-Salem Highway (Highway 22) at Kings Valley Highway (OR 223) / Smithfield Road intersection

Existing Situation, Problems and Issues

The 1994-1998 accident history lists eight accidents that occurred at or near this intersection. Of the eight incidences, two involved collisions with vehicles attempting to cross Highway 22 from south-to-north (one ran the stop sign and one stopped in the intersection). Two involved collisions with vehicles attempting to turn left onto Highway 22 from the south. Two involved vehicles attempting to turn left from westbound Highway 22 to the south. Two involved westbound vehicles on Highway 22 that may have been attempting to avoid vehicles that were slowing at the intersection.

The mix of various accident types listed above does not immediately point to a specific problem, but traffic turning movement counts taken in 1996 reveal more about the problems as shown in *Figure* 5.

Figure 5
Traffic Counts – Site 10



The data suggest that gaps in eastbound Highway 22 traffic are insufficient to allow the westbound Highway 22 traffic to turn safely onto southbound Kings Valley Highway in the p.m. peak hour. Drivers appear to be turning through gaps that are too small.

Rear-end and sideswipe accidents between westbound vehicles on Highway 22 are also documented at this intersection. There is no center left turn lane or refuge allowing turning traffic to decelerate safely out of the through traffic.

There is also a high volume of vehicles making left turns from the Kings Valley Highway onto westbound Highway 22. Again, accidents appear to result from traffic turning into inadequate gaps in Highway 22 traffic. Although the volume of northbound vehicles crossing Highway 22 smaller than in the other directions, the lack of adequate gaps in traffic on Highway 22 probably also contributed to the two collisions recorded in the five-year accident history.

Possible Improvement Alternatives and Opportunities

A westbound left turn refuge on Highway 22 appears to be the best solution to the problem of providing a safe place for westbound vehicles on Highway 22 to decelerate and wait for an adequate gap in traffic to turn left. ODOT has a project in the STIP to construct a new left turn refuge at this intersection. disappear

Another STIP project was to install a flashing beacon was recommended as a possible solution to help address the problem of vehicles on the Kings Valley Highway failing to observe stop signs at Highway 22. Also, oversize (48"x 48") "Stop Ahead" and "Stop" signs may be a partial solution to this problem. Jiggle bars (similar to rumble strips, but placed *across* a lane) across the Kings V alley Highway several hundred feet before the intersection could also be a partial solution to this problem. Two collisions in the five-year period appear to be related to this type of problem.

There is no obvious solution to the problem of how to reduce or eliminate collisions that involve vehicles making left turns from the Kings V alley Highway onto westbound Highway 22. Turning movement volumes at this intersection do not warrant construction of a full-directional, grade-separated interchange, which would allow this left turn movement to be made much more safely. This option may be considered in the future as turning volumes and through traffic volumes increase.

Most of the accidents at this location appear to be related to lack of a westbound turn refuge on Highway 22 and/or lack of sufficient intersection-ahead advance-warning devices on Kings Valley Highway. If this is the case, it may be reasonable to spend up to about $587,000 for improvements to this intersection, based upon a benefit/cost ratio of2.0 (see the benefit/cost ratio worksheet in the appendix).

Site 11 - Highway 22 at Highway 99W intersection

Existing Situation, Problems and Issues

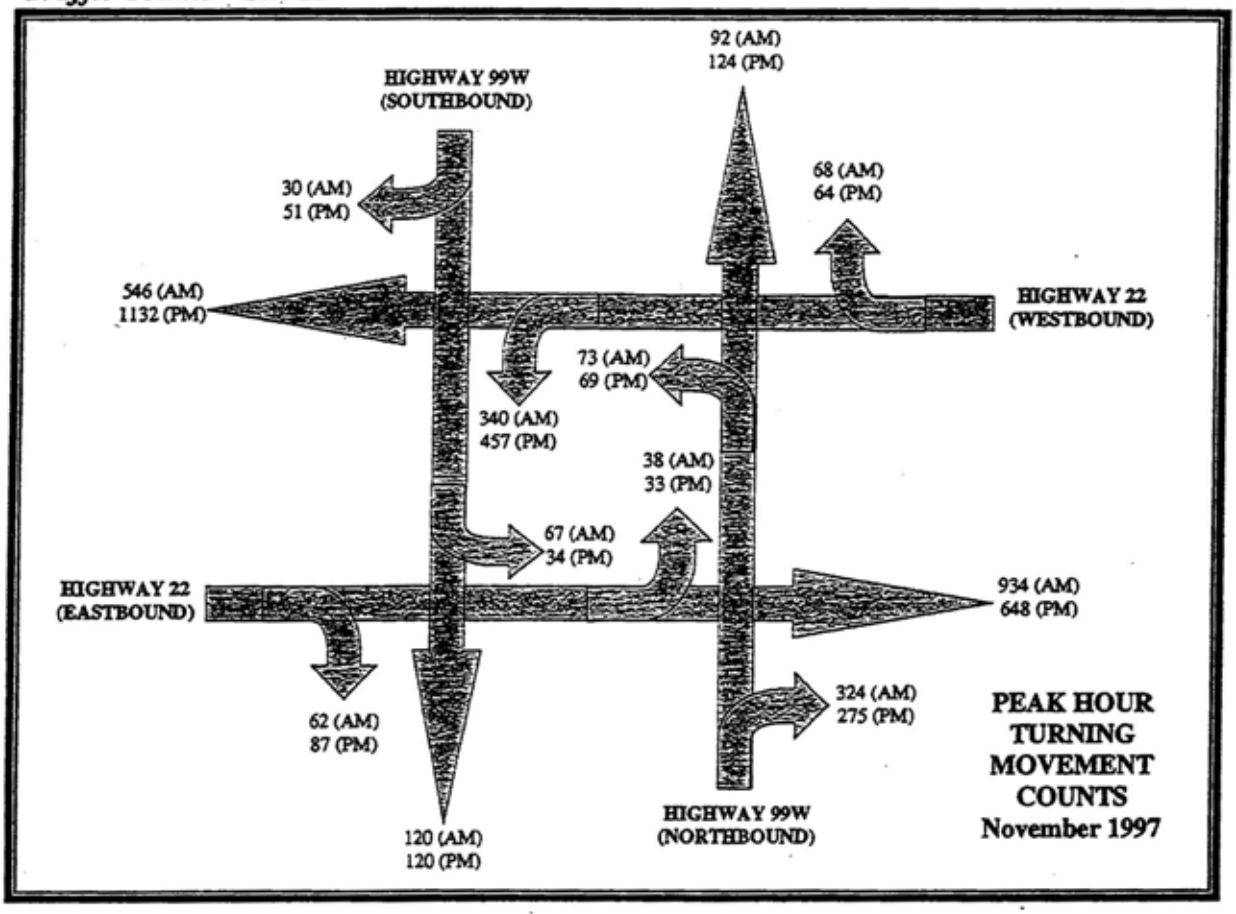
This intersection is signalized and accidents are primarily those that are commonly associated with a traffic signal on a high-speed, rural highway. During the 5-year study period from January 1, 1994 to December 31, 1998, approximately 55 potentially preventable accidents occurred at or near this intersection. Nearly half were rear-end accidents between two vehicles (where one vehicle was stopped or slowing for the signal) and about half involved vehicles making turning movements. Of these collisions, 25 accidents resulted in injuries, 29 were property-damage-only accidents and one accident resulted in a fatality.

See *Figure* 6 for 1997 Average Daily Traffic (ADT) totals for Highway 22 (Willamina-Salem Highway), 99W (Pacific Highway West) and for Highway 223 (Dallas-Rickreall Highway). It is clear from the 1997 traffic volume data that a considerable number of vehicles enter and exit Highway 22 to and from Highway 223, more even than at Highway 99W. Highway 223

intersects Highway 22 at a skewed angle, about 0.30 mile to the west of the Highway 22/99W intersection. To resolve the accident potential at the Highway 22/99W intersection, the Hjghway 22/223 intersection must be considered as well.

Sight distance at all of the approaches to the Highway 22/99W intersection appears to meet or exceed standards, and the existing signal appears to be operating properly.

Figure 6
Traffic Counts – Site 11

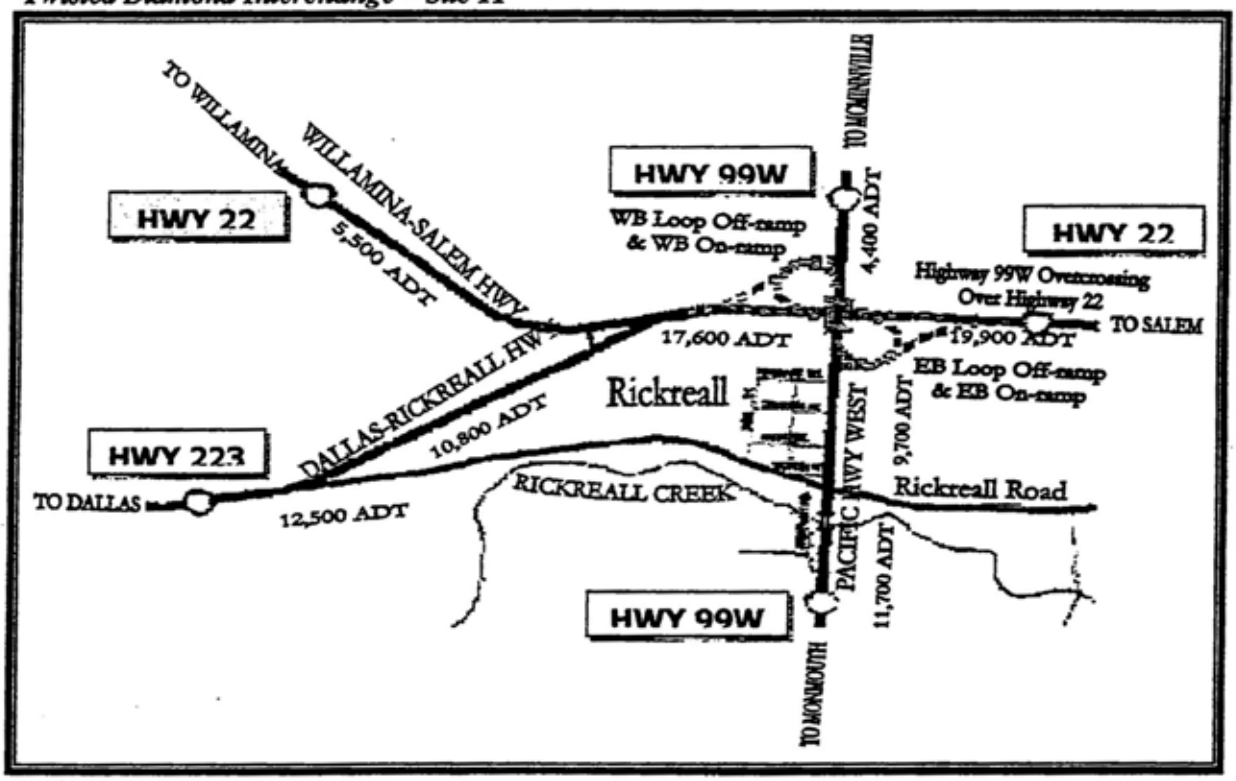


Possible Improvement Alternatives and Opportunities

The data suggest that a fully-directional, grade-separated interchange is the only alternative solution that is likely to significantly reduce accidents at this location. A partial "jug-handle" at grade intersection improvement has been suggested as a possible way to reduce left turn movements at the Highway 22/99W intersection (and thus reduce the number of accidents involving left turns), but is unlikely to sufficiently reduce the risk of collisions by itself. This could be one phase of a full grade-separated interchange.

A benefit/cost ratio calculation was performed for several potential intersection improvements using data from the five year 1994-1998 accident history (see Appendix for Benefit/C_st Ratio Worksheets). Additional study will be necessary to select a preferred alternative improvement at this location due to the variety of possible improvements. *Figure* 9 illustrates a "twisted diamond" configuration with two loop off-ramps, which may be a potential preferred alternative for this location.

Figure 7
Twisted Diamond Interchange – Site 11



Site 12 - Highway 22 from Greenwood Road to Rosewood Drive

The accident history in this four-to-five lane section of Highway 22 can probably be attributed to a number of factors, as follows:

- Relatively high traffic volumes - 24,000 to 36,500 vehicles per day (1997 Average Daily Traffic (ADT)).
- Relatively high posted speed limit for an urban, non-accessed-controlled highway - 50 to 55 mph.
- No physical barrier between eastbound and westbound traffic, which allows left-turns out of driveways (involved in 14 accidents), V-turns (2 accidents) and head-on and side-swipe

meeting accidents (9 accidents) (based on 5 year accident history from January 1, 1994 to December 31, 1998).

- Sections with numerous uncontrolled, closely-spaced access points, including many public street, road and highway intersections and many private residential and commercial driveways. This allows unpredictable left and right turns at many locations within the section.
- Animals crossing the highway.
- Inclement weather.

It is very likely that traffic volumes in this section will increase in the future. It is also possible that additional roadside development could occur, adding more turning movements on and off of the highway from driveways and local roads. Therefore, it may be expected that the accident rate will increase in the future, unless some action is taken to address these factors.

Possible Improvement Alternatives and Opportunities

Since there are no other suitable highway routes parallel to Highway 22, it is extremely unlikely that any significant amount of through traffic can be re-routed to another corridor. One possibility is to make improvements to the local street system and construct new frontage roads with connections to the existing local street system parallel to Highway 22. By collecting and redirecting turning movements from Highway 22 onto a system of low-volume, low-speed frontage roads and streets, the incidence of accidents on Highway 22 would likely be reduced. This type of improvement may face a variety of engineering, environmental, and political challenges.

An access management alternative is moving, closing and/or combining some driveways to reduce the total number of direct accesses to the highway and space them further apart. Based on field observation, it is unlikely that many of the existing driveways, roads and streets can be closed, given the lack of alternatives for access to land along the corridor. As a minimum, driveways that are located very close to public road intersections should be considered for relocation or removal, to reduce conflicting turning movements within the intersection influence area.

Another option that could reduce accidents associated with left turn movements onto and off of the highway is to install a raised center median with left turn pockets at specific intersections to limit crossing opportunities to the safest locations. This would involve redirecting left turn and crossing movements to intersections where these movements can be accommodated more safely, through provisions such as turnarounds for V-turns and possibly signalization, where warranted. An alternative to a raised, curb-height median would be to install a concrete median barrier with openings and impact attenuators at specific intersections.

The existing highway configuration would allow turning movements for cars, small delivery vans and other vehicles of similar size to make V-turns from the center turn lane. Trucks, RVs and other larger vehicles must have a much larger area to make a V-turn, which may require

constructing a turnaround, such as a 'jug-handle", to allow vehicles to turn left from the center turn lane into a protected turning area to complete the V-turn (such as the turnarounds at the "Lincoln Beach to Fogarty Creek" section on VS 101). Locating such turnarounds in this section may be difficult and expensive, due to steep terrain and close proximity of existing buildings and other features.

As detailed in the benefit/cost ratio worksheets in the appendix, the B/C ratios listed in the table below were calculated for purposes of evaluating the potential value of installing a non-traversible concrete median barrier in this section and in the specific sub-sections listed below. For the purposes of this exercise, it was assumed that concrete median barrier would be installed between Greenwood Road and Rosewood Drive, with median openings for left turns and V-turns at the Independence Highway, ODOT's weigh station, Doaks Ferry Road and College Drive. It was assumed that such a median barrier would effectively prevent 100 percent of accidents involving left turn movements from driveways and minor streets onto Highway 22, as well as accidents where vehicles crossed over the centerline or made illegal U-turns.

Table 3
Site 12 – Benefit/Cost Ratio Summary

BENEFIT/COST RATIO SUMMARY				
SECTION	**ESTIMATED PROJECT COST**	**PDO (x 2)**	**INJURY & FATALITY ACCIDENTS**	**B/C RATIO**
Greenwood Rd. to Rosewood Dr. *	$ 1,530,000	26	26	5.88
Greenwood Rd. to Independence Hwy. *	$ 400,000	6	4	3.83
Independence Hwy. to Doaks Ferry Rd.	$ 600,000	6	15	9.10
Doaks Ferry Rd. to College Dr.	$ 400,000	6	3	2.94
College Dr. to Rosewood Dr.	$ 130,000	8	4	6.31

NOTE: PDO is Property Damage Only accidents. For the purpose of B/C ratio calculations, the number of preventable PDO accidents that are reported and recorded in the accident history is multiplied by 2 to account for an assumed number of preventable unreported PDO accidents.

** NOTE 2: The cost of constructing turnarounds may significantly increase depending on the type of solution..*

Construction of a raised, non-traversible median or median barrier would require providing appropriate, safe ways for vehicles to make V-turns. V-turn opportunities should be located at reasonable intervals so that out-of-direction travel is kept to a minimum.

Any proposal that involves the installation of a raised, non-traversible median or concrete median barrier will require extensive education of drivers in the corridor. This must be taken

into account in the planning stages and should be a factor in programming the project into the STIP, to allow sufficient time for working through the issues and alternatives before implementation.

It is possible that a reduction in the posted speed limit could reduce accidents, if a speed zone study shows that motorists would obey a reduction in the posted speed. A speed zone reduction study may have already been completed in the recent past, but it may be valuable to perform such a study again, to determine if the current posted speed limits of 50 and 55 mph are still appropriate for this section. It is unlikely that such a study would result in a recommendation or determination to reduce the posted speed limit, but it could reveal whether drivers are obeying the existing posted speed limit and whether additional enforcement may be helpful. It may also be helpful to learn what the actual average speeds are, to determine if sight distance and other geometric features of the existing roadway are adequate for the current travel speeds.

Installing new traffic signals on this high-volume, high-speed highway may provide a safer location to make turning movements than at uncontrolled intersections. However, research shows that additional accidents occur at signals, in some cases negating the value of the signal. The public may request that ODOT perform traffic signal warrant analysis for the major intersections where median openings would be likely.

To resolve these issues, it is recommended that ODOT consider initiating a Refinement Study for this section, to further explore alternatives and engage the local stakeholders in a discussion of the problems and potential improvement options.

Appendix

Appendix materials have been transferred to the project binder, under the Appendix tab.