
Yelm Highway Widening Traffic Analysis

Prepared for

Thurston County

Department of Roads and Transportation Services
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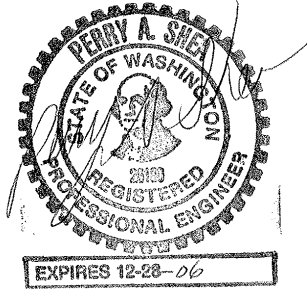
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KEY TERMS

ADT	Average Daily Traffic
FHWA	Federal Highway Administration
TWLTL	Two-way left-turn lane
VE	Value Engineering

1. INTRODUCTION

1.1 PURPOSE OF REPORT

A Draft Design Report was prepared in October 2000 for the Yelm Highway Widening Phase 5 project. The Draft Design Report provided a comprehensive description of the design considerations and analysis taken into account in the design of the proposed improvements to Yelm Highway. After completing that document, additional analysis, including a Value Engineering (VE) Study in 2003, has resulted in changes to elements of the design. The VE Study recommended several changes to the original design, some of which could impact traffic operations. The following analysis summarizes additional analysis resulting from the VE recommendations and provides a description of the current design of the roadway and intersections and a summary of the traffic capacity analysis prepared in support of the recommended design. The descriptions in this report are specific to the vehicular capacity improvements and do not focus on urban improvements such as sidewalks or planter strips.

1.2 BACKGROUND

Yelm Highway is classified by Thurston County as an arterial highway. The highway begins at the intersection with Cleveland Avenue in the City of Tumwater and ends at the intersection with State Route 510 east of Lacey. The portion of the roadway between Henderson Boulevard and Boulevard Road is currently a two-lane roadway with a two-way left-turn lane. From Boulevard Road to Rich Road, it has two lanes westbound and one lane eastbound, and a two-way left-turn lane throughout. A portion of the project lies within the City of Olympia and the remainder lies in Thurston County, but within Olympia's growth management area.

The decision to widen the segment of Yelm Highway to five lanes is the result of the *East-West Corridor Study* in 1998. This study was a multi-jurisdictional effort with the objective "...to evaluate ways to increase East-West Transportation capacity and circulation for the south URBAN area." The preferred alternative from the study was to widen Yelm Highway to four/five lanes. The design includes construction of added lanes, curb, gutter and sidewalk, planter strips, bicycle lanes, drainage and stormwater treatment, intersection control, intersection realignment, illumination, construction of noise walls and signing on approximately 1.2 miles of Yelm Highway.

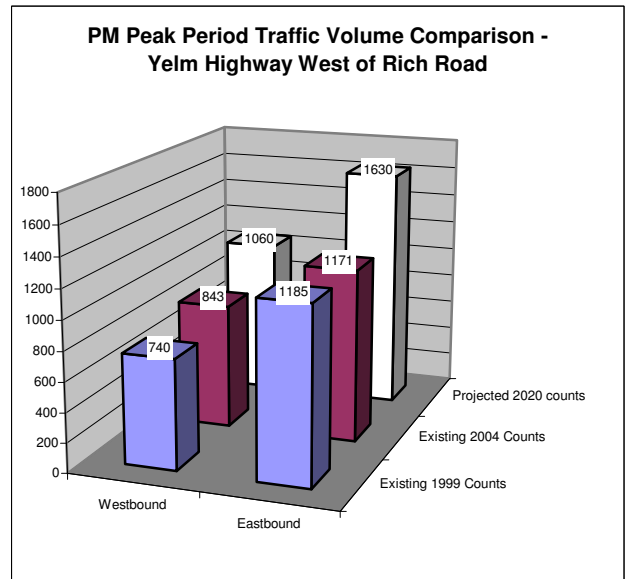
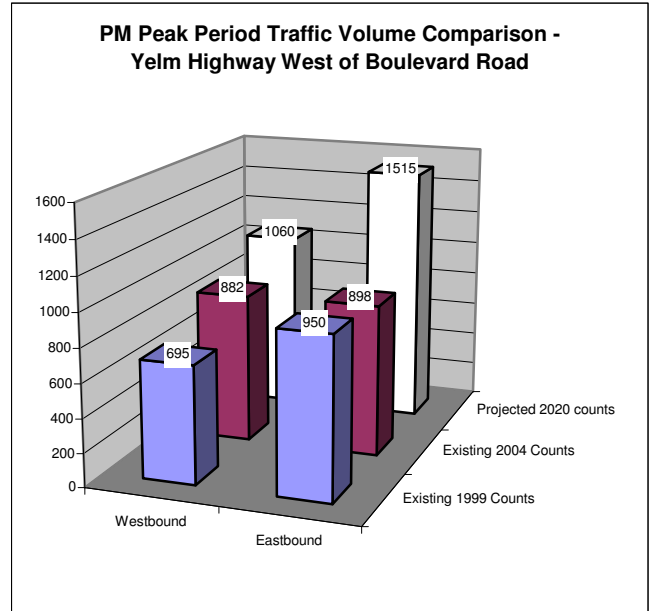
2. TRAFFIC ANALYSIS

This section documents additional traffic analysis performed for the Yelm Highway corridor and development of the recommendations for final design of the improvements.

2.1 TRAFFIC VOLUME PROJECTIONS

The year 2020 was established as the analysis horizon year for this study. Horizon year traffic volume estimates were prepared using Thurston Regional Planning Council TModel2 output for the years 1998 and 2020 model scenarios. The growth rates calculated from the model data were applied to the base year (1999) turning movement counts. The resulting values were then balanced through the Yelm Highway corridor study area. The proposed access restrictions and use of U-turns along portions of the corridor result in a slight shift in traffic volumes at the affected intersections. The traffic volumes were adjusted to reflect an estimate of the U-turning traffic.

2020 PM peak hour volumes were estimated for the entire network. 2020 AM peak hour volumes were also estimated for the Rich Road and Boulevard Road intersections. The projected 2020 AM and PM peak period (two-hour average) traffic volumes used in this study are shown on **Figure 1**. As noted, the initial count program that was used as the basis for calculating the 2020 projections were collected in 1999. After the initial count program more recent counts have been collected in the area. We have prepared a comparison of the original 1999 counts, counts collected in 2004 and the 2020 projections.



2.2 2020 OPERATIONAL ANALYSIS

2.2.1 Analysis of Corridor between Henderson Boulevard and Boulevard Road

In 1999, Parametrix performed an analysis to determine design treatments required to provide access to the minor streets and driveways between Henderson Boulevard and Boulevard Road. Through previous analysis it was determined that the existing two-way left-turn lane (TWLTL) should be maintained between Henderson Boulevard and Village Drive. Due to right-of-way limitations an alternative was sought to providing a TWLTL on Yelm Highway between Brassfield Road and Boulevard Road.

An outcome of the Value Engineering study was the recommendation to construct a modern roundabout at Boulevard Road and an unsignalized U-turn at Brassfield Road which would allow construction of a narrower raised median between Brassfield Road and Boulevard Road. Access to the minor streets would be available through U-turns at Boulevard Road and Brassfield Road. The analysis of the intersections is described later in this report.

Conclusions and Recommendations: With the implementation of U-turns at Henderson Boulevard, Brassfield Road, and Boulevard Road the existing two-way left-turn lane can be removed from east of Brassfield Road to Boulevard Road. Implementation of a raised median would allow a narrower roadway section. An uncontrolled U-turn movement is not recommended at the Brassfield Road location due to safety concerns. A roundabout is recommended to facilitate U-turns.

2.2.2 Analysis of Corridor between Boulevard Road and Rich Road

The proposed Boulevard Road roundabout in conjunction with a U-turn at Rich Road would provide the ability to construct a raised median on Yelm Highway to the east of Boulevard Road. Based on the traffic projections of the minor streets and curvature of the Yelm Highway it was determined that construction of a raised median between Boulevard Road and Boulevard Extension could improve the safety and operation of Yelm Highway.

Conclusions and Recommendation: With the implementation of U-turns at Boulevard Road and Rich Road the existing two-way left-turn lane can be removed from Boulevard Road to east of Boulevard Extension.

2.2.3 Yelm Highway/Henderson Boulevard Intersection

The Yelm Highway/Henderson Boulevard intersection was analyzed under two configurations: as a roundabout and as a traditional signalized intersection. Table 2-1 summarizes the results of the analyses.

Table 2-1. Year 2020 PM Peak Hour LOS Summary for Yelm Highway/Henderson Boulevard Intersection

	No Build	Signal w/o U-turns ¹	Signal w/ U-turns ²	Roundabout
	LOS	LOS	LOS	LOS
Yelm Highway/ Henderson Boulevard	F	C	D	C

¹ East-west protected left turns and northbound right-turn overlap phasing

² No east-west permitted left turns and no northbound right-turn overlap phasing

Source: SCA Engineering Memorandum (Scenario 1) to Dave Hilderbrant, P.E. on May 8, 2000

NOTE: LOS Calculation revised for signal w/U-turn scenario based on recent design changes

It was concluded that a roundabout did not offer any significant benefits over a traditional signalized intersection and would require significant right-of-way acquisitions. Right-of-way acquisitions would have impacted a historic property and YMCA access (off the Henderson Boulevard north leg). While a roundabout may have provided a better level of service for some approaches throughout the design period, eastbound traffic on Yelm Highway (the critical approach during the PM peak period) would not have been improved with a roundabout design. A roundabout would have been in conflict with proposed area development and the City of Tumwater’s design of the Cleveland Avenue/Yelm Highway improvements, west of Henderson Boulevard.

The final design for the Yelm Highway/Henderson Boulevard intersection will be signalized with the following lane configuration:

- Eastbound on Yelm Highway: 1 left-turn lane, 1 through-lane, and 1 through/right lane
- Westbound on Yelm Highway: 1 left-turn/U-turn lane, 1 through-lane, and 1 through/right lane
- Northbound on Henderson Boulevard: 1 left-turn lane, 1 through-lane, 1 right-turn lane
- Southbound on Henderson Boulevard: 1 left-turn lane, 1 through-lane, and 1 through/right lane

The proposed intersection configuration at Yelm Highway and Henderson Boulevard is expected to operate at LOS D during the PM peak hour in year 2020. Maintaining the 2-way, left-turn lane on Yelm Highway will maintain access to adjacent land uses and minimize the demand for westbound to eastbound U-turn maneuvers at the intersection.

2.2.4 Brassfield Road/Yelm Highway Intersection

In response to the Value Engineering recommendation, this intersection was evaluated for implementation of an uncontrolled U-turn operation. It was determined that an uncontrolled U-turn operation at this location could be a difficult maneuver to make and could result in a degradation of safety. As an alternative, construction of a modern roundabout was considered for this location.

Roundabout operations are analyzed through a computer program called aaSIDRA. This program was developed in Australia and provides operational analysis for single and multiple circulating lane roundabouts. The aaSIDRA analysis worksheets are provided as an attachment. The analysis results are summarized below:

Under the proposed roundabout control this intersection would operate as a tee intersection with two approach and departure lanes on the east-west legs of Yelm Highway. The south leg (Brassfield Road) would have single approach and departure lanes. The center island would have a diameter of approximately 90 feet (including the truck apron). The roundabout would have two circulating lanes. With these geometrics the intersection would operate at an overall LOS A during the PM peak hour for the 2020 horizon. Table 2-2 provides a summary of the anticipated intersection operation.

Table 2-2. Brassfield Road/Yelm Highway Projected 2020 PM Peak Hour Traffic Volumes Roundabout Operational Summary

Approach	LOS	Average Delay (in seconds)	95th Percentile Queue
Yelm Highway (EB)	A	2.7	95 feet
Brassfield Road (NB)	B	12.4	Less than 20 feet
Yelm Highway (WB)	A	2.8	45 feet
Intersection Average	A	2.8	

Conclusions and Recommendations: A roundabout should be constructed at this intersection. The analysis indicates a roundabout would operate at LOS A during the PM Peak Hour.

2.2.5 Boulevard Road/Yelm Highway Intersection

As described previously, a recommendation of the Value Engineering study was to construct a modern roundabout at this intersection. Based on the VE team recommendation the intersection would operate as a four-leg intersection with a two circulating lane roundabout. The east and west legs of Yelm Highway would each have two approach and departure lanes. The southbound approach would have two approach and departure lanes and the northbound driveway approach would have single approach and departure lanes. Based on the VE team design the intersection would operate at a LOS A condition.

Boulevard Road would require significant widening beyond the extents of this project to accommodate two approach and departure lanes at this intersection. To minimize the impact to Boulevard Road we have provided an additional analysis of the intersection with single approach and departure lanes on Boulevard Road. Under this configuration the intersection would operate at an overall LOS B during the 2020 PM peak period and LOS A during the 2020 AM peak period. Based on the results of this analysis we recommend the southbound approach of Boulevard Road be designed with single approach and departure lanes.

Tables 2-3 and 2-4 provide a summary of the anticipated intersection operation with the recommended lane geometrics for projected AM and PM peak hour conditions.

Table 2-3. Boulevard Road/Yelm Highway Projected 2020 AM Peak Hour Traffic Volumes Roundabout Operational Summary

Approach	LOS	Average Delay (in seconds)	95th Percentile Queue
Yelm Highway (EB)	A	5.9	46 feet
Service Station (NB)	B	10.5	Less than 20 feet
Yelm Highway (WB)	A	5.3	163 feet
Boulevard Road (SB)	C	26.2	191 feet
Intersection Average	A	8.1	

Table 2-4. Boulevard Road/Yelm Highway Projected 2020 PM Peak Hour Traffic Volumes Roundabout Operational Summary

Approach	LOS	Average Delay (in seconds)	95th Percentile Queue
Yelm Highway (EB)	B	14.1	330 feet
Service Station (NB)	C	27.9	33 feet
Yelm Highway (WB)	A	5.4	77 feet
Boulevard Road (SB)	C	32.2	449 feet
Intersection Average	B	15.3	

Conclusions and Recommendations: A two-circulating-lane roundabout should be constructed at this intersection. The east-west approaches should provide two approach and departure lanes and the north-south approaches should provide single approach and departure lanes. The analysis indicates with this geometric configuration a roundabout would operate at LOS A and LOS B by the 2020 horizon during the AM and PM Peak Hours, respectively.

2.2.6 Yelm Highway/Rich Road Intersection

This intersection currently operates under traffic signal control. The east-west approaches on Yelm Highway each have exclusive left-turn lanes and two through lanes with right turns made from the curbside through-lane. The northbound approach has an exclusive right-turn lane and a shared through-left lane. The southbound approach has a single shared lane. No additional lanes are planned at this intersection as part of the roadway improvements; however, an eastbound to westbound U-turn operation will be implemented as a shared movement from the eastbound left-turn lane. Additional lane width will be added on the north side of Yelm Highway, west of the intersection, to facilitate the U-turn movement. It is also recommended that the signal phasing for the east-west left-turn movements operate under protected (green arrow) phasing only.

We have evaluated the intersection for morning and evening peak hour projected traffic flows with the proposed lane usage and signal phasing. Based on the analysis the intersection will operate at LOS D during the morning peak hour and LOS C in the evening peak hour. The results of the analyses are shown below in Table 2-4.

Table 2-5. Rich Road – Year 2020 Intersection Operation and Average Intersection Delay

	AM		PM	
	LOS	Delay (seconds/vehicle)	LOS	Delay (seconds/vehicle)
Yelm Highway/Rich Road	D	39	C	31

2.3 MINOR INTERSECTIONS

There are currently 10 minor unsignalized or private intersections serving 10 or more residences in the corridor. One of the unsignalized intersections (Brassfield Road) will be converted to a modern roundabout and is described previously in this report. All intersections will be improved to standard design geometry as a result of this project. Improvements to the intersections are a result of and incidental to the widening of Yelm Highway.

Requests for signals at minor intersections were voiced by the public at the open house meetings conducted for the project, particularly for the intersections of Village Drive and Stratford Drive. An analysis of signal warrants for these locations indicates that none of the minor intersections would meet the minimum requirements. In all cases, the intersection side volumes are too low to meet the 75 vehicles-per-peak-hour criteria.

2.3.1 Orvas Court

The intersection of Orvas Court/Yelm Highway is a Tee intersection to the south of Yelm Highway serving a small subdivision with no other entrance or exit to the development. The project will maintain the existing turn lanes at this intersection and add bike lanes, sidewalk, and planter strip to the west of Orvas Court. No other improvements are anticipated. Minimum intersection sight distances will be maintained as a result of the sidewalk and bike lane widths.

2.3.2 Village Drive

The intersection of Village Drive/Yelm Highway is a Tee intersection to the north of Yelm Highway serving a small subdivision with no other entrance or exit to the development. The project will maintain the existing turn lanes at this intersection and add bike lanes and sidewalk. No other improvements are anticipated. Minimum intersection sight distances will be maintained as a result of the sidewalk and bike lane widths.

A suggestion from the public meetings to connect Brassfield Road with a relocated Village Drive was evaluated for signal warrants. Future side volumes failed to justify the need for a signal even under a combined intersection.

2.3.3 Clar Mar Lane

The intersection of Clar Mar Lane/Yelm Highway is a Tee intersection to the north of Yelm Highway serving a private subdivision with no other entrance or exit to the area. The project will modify access to be right-in and right-out only with a median separation between the westbound and eastbound lanes on Yelm Highway. Opportunities for motorists to make left turns to and from Yelm Highway will be accommodated via U-turns at the Brassfield Road and Boulevard Road roundabouts. Minimum intersection sight distances will be maintained as a result of the sidewalk, planter strips, and bike lane widths.

2.3.4 Juli Court

The intersection of Juli Court/Yelm Highway is a Tee intersection to the north of Yelm Highway serving a small subdivision with no other entrance or exit to the area. The project will restrict Juli Court to “right-in/right-out” movements only. Opportunities for motorists to make left turns to and from Yelm Highway will be accommodated via U-turns at the Brassfield Road and Boulevard Road roundabouts. Minimum intersection sight distances will be maintained as a result of the sidewalk and bike lane widths.

2.3.5 Laura Street

The intersection of Laura Street/Yelm Highway is a Tee intersection to the south of Yelm Highway serving residential areas on the east side of Hewitt Lake. Laura Street is approximately 160 feet west of the intersection of Yelm Highway/Boulevard Road. As a result, the intersection falls within the left-turn channelization for the Boulevard Road intersection. This project proposes to restrict Laura Street to “right-in/right-out” movements only. Opportunities for motorists to make left turns to and from Yelm Highway will be accommodated via U-turns at the Brassfield Road and Boulevard Road roundabouts.

A realignment option of Boulevard Road was investigated to align Boulevard Road with Laura Street and install a traffic signal. This option would have improved the operation of Laura Street but resulted in significant impacts to the gas station and the vacant property north of Yelm Highway. Property owners in the area did not support the realignment option and believed that additional traffic would be routed down Laura Street as a result. The existing intersection sight distance to the right at Laura Street is limited. There is a privately owned wall obstructing the view further to the west. The sight distance will be improved due to the reconstruction of the intersection. In addition, the speed of the vehicular traffic on Yelm Highway will be significantly lower than the posted speed, as the vehicles will be decelerating as they approach the roundabout at Boulevard Road. Because of these factors, the sight distance is within desired standards.

2.3.6 Boulevard Extension Road and Stratford Lane

The existing intersection of Yelm Highway/Boulevard Extension is a Tee intersection on the south side of Yelm Highway with an additional leg on the west. Boulevard Extension serves a residential area of 100 to 150 homes south of Yelm Highway and connects to Laura Street via a side street. Access to Yelm Highway via Glenmore Street is also possible through a circuitous street system.

The intersection of Stratford Lane/Yelm Highway is a Tee intersection to the north of Yelm Highway serving a residential area.

Sight distance for Boulevard Extension to the west is substandard and the approach angle of Boulevard Extension is severe. The project proposes to realign the intersection of Boulevard Extension

approximately 140 feet to the east. The new intersection will approach Yelm Highway at a 90-degree angle and improve the intersection sight distance to meet desired standards. The new intersection will be nearly opposite Stratford Lane, a private entrance to a small subdivision. However, with the addition of the center median in this area, traffic using Stratford Lane and Boulevard Extension Road should not affect one another. Both streets will be restricted to “right-in/right-out” movements only. Opportunities for motorists to make left turns to and from Yelm Highway will be accommodated via U-turns at the Boulevard Road roundabout, and a signalized eastbound U-turn at Rich Road.

At the public meetings, it was suggested that the intersection be signalized. There are no volume warrants for signals at the new intersection based on traffic projections from Boulevard Extension and Stratford Lane. In addition, this intersection will be restricted to “right-in/right-out” movements only.

2.3.7 Glenmore Drive

The intersection of Glenmore Drive/Yelm Highway is a Tee intersection to the south of Yelm Highway serving a local residential area. The project will maintain the existing turn lanes at this intersection and add bike lanes and sidewalk. No other improvements are anticipated. Minimum intersection sight distances will be maintained as a result of the sidewalk and bike lane widths.

2.3.8 Donovan Drive

The intersection of Donovan Drive/Yelm Highway is a Tee intersection to the north of Yelm Highway serving a local residential area. The project will maintain the existing turn lanes at this intersection and add bike lanes and sidewalk. No other improvements are anticipated. Minimum intersection sight distances will be maintained as a result of the sidewalk and bike lane widths.

3. PEDESTRIAN CIRCULATION

The proposed Yelm Highway improvements will include providing continuous sidewalks on both sides of Yelm Highway between Henderson Boulevard and Rich Road. Crosswalks will be provided at Henderson Boulevard, Brassfield Road, Boulevard Road and Rich Road. Each of the crosswalk locations is at a controlled intersection. The possibility of implementing crosswalks at mid-block, uncontrolled locations was evaluated for the Yelm Highway corridor within the study area.

The Federal Highway Administration (FHWA) report *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines, February 2002* contains information regarding appropriate usage of uncontrolled marked crosswalks. The report indicates that marked crosswalks generally will improve pedestrian safety on roads with low speeds and low traffic volumes. However, on roadways with four or more lanes and higher traffic volumes, pedestrian safety decreases with marked crosswalks.

The report states that marked crosswalks are insufficient (without additional design treatments) and should not be used on roadways with four or more lanes with a raised median and an Average Daily Traffic (ADT) volume of 15,000 or greater. Yelm Highway currently has an ADT of approximately 18,000 and is expected to increase to approximately 25,000 by the 2020 horizon.

Other types of pedestrian crossing design treatments available for crossing a high traffic volume arterial include pedestrian crossing signals or a pedestrian bridge. However, based on existing pedestrian usage, a large pedestrian demand is not expected across Yelm Highway between the controlled intersections.

4. SUMMARY OF IMPROVEMENTS

The following is a summary of the roadway capacity improvements planned for the Yelm Highway Corridor.

Yelm Highway – Henderson Boulevard to Village Drive: The roadway will be widened to provide two lanes in each direction with a center two-way left-turn lane. The westernmost 450 feet of the center lane will be striped as an exclusive westbound U-turn/left-turn lane at Henderson Boulevard. Public Streets and driveways will retain full access along this segment of roadway.

Yelm Highway – Village Drive to approximately 100 feet east of Stratford Lane: The roadway will be widened to provide two lanes in each direction. The center lane will transition from a TWLTL to a raised median from approximately 100 feet east of Village Drive to 200 feet east of Boulevard Extension. Along this section minor streets and driveways will be limited to right-turn movements inbound and outbound. Modern roundabouts will be constructed at the intersections of Brassfield Road and Boulevard Road. In addition to providing intersection control, the roundabouts will be utilized to perform U-turns to access minor streets and driveways. The Rich Road intersection will also be designed to accommodate U-turns for vehicles accessing minor roadways between Boulevard Road and the east end of the raised median.

Yelm Highway – 100 feet east of Stratford Lane to Rich Road: The roadway will be widened to provide two lanes in each direction. A center TWLTL will be provided for the entire segment except for a 100 foot long raised median positioned approximately 75 feet east of Donovan Drive.

Brassfield Road/Yelm Highway Intersection: This intersection will be constructed as a three-leg modern roundabout with two circulating lanes. The eastbound and westbound approaches of Yelm Highway will each have two approach and departure lanes. The northbound approach of Brassfield Road will have single approach and departure lanes.

Boulevard Road/Yelm Highway: This intersection will be constructed as a four-leg modern roundabout with two circulating lanes. The eastbound and westbound approaches of Yelm Highway will each have two approach and departure lanes. The northbound and southbound approaches will each provide single approach and departure.

Rich Road/Yelm Highway: This is an existing four-leg intersection under traffic signal control. No new lanes are proposed at this location, but the intersection will require modifications to accommodate eastbound to westbound U-turns from the eastbound left-turn lane. To allow adequate turning radius for the U-turn movement, Yelm Highway will be widened slightly on the north side of the roadway, just west of the intersection. It is also recommended that the signal phasing for the east-west left-turn movements operate under protected (green arrow) phasing only.